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An Examination of the 10 — Year Plan for the Development of Ceylon's Fisheries, 1965-1975

by

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I. Introduction

SILVA, Withana, de Silva, Wickramaratna and Kadirgamar (1965) published their Plan for the development of Ceylon's fisheries in April 1965[2]. It is certainly a very ambitious and, at first sight, a very attractive plan. Silva *et al.* propose so to develop the industry that in 10 years' time production of fish, for example, will have increased 7½ fold (p. 8, Silva *et al.*, 1965[3]) ; per capita consumption of fresh fish will have doubled[4] (p. 25-6, PLAN) ; jobs will have been created for 60,000 more persons in the industry, a 75% increase (p. 59, PLAN) ; total income earned in the industry will have increased about 3-fold (p. 57, PLAN) ; the total income of the fishermen themselves will have increased by 100% and their per capita income by 88% (p. 57, PLAN) ; and Ceylon will have a fleet of 100 large ships ranging the Indian Ocean after tuna (pp. 5, 7, and 9, PLAN), as well as a vast and brand-new fish-farming industry, covering 25,000 acres and yielding 12,500 tons of fish and 2,500 tons of prawns annually (pp. 5, 19-21, PLAN). In Chapter 5 of their Plan, Silva *et al.* go on to explain that this tremendous development will be self-financed "......on the basis of its (the Corporation's) own resources, and finance available from local banks and industrial, commercial and banking organisations abroad" (p. 81-2, PLAN), so that the Corporation will not be a burden on the Government. And they also tell us that at the end of this planned development "......the Corporation, the Government and the country would have an asset which is annually earning a profit of 184 million rupees and bringing in every year foreign exchange to the value of 315 million rupees" (p. 83, PLAN).

The fishing industry is concerned with the exploitation of a living natural resource ; and the value of any plan for its development must finally depend *not* on the adroitness of its method of financing, or the vastness of the investment involved, or the attractiveness of the capital/labour ratios of such investment, et cetera, *but* on the soundness of its proposals from the point of view of fisheries biology and fisheries technology. Yet, an examination of the Plan from this point of view shows that despite the attractive promises it holds out, this Plan is, in fact, very unsatisfactory and fraught with danger for the fishing industry of this country.

1. For this first note and all subsequent notes see p. 134 et seq.

2. The Coastal Area and its Fishing Potential.

One of its gravest defects is that the production target for the coastal fishery has been fixed at a figure twice as high as the highest reasonably safe estimate of the potential catch of the coastal sea, Silva *et al.* expecting to harvest 537,500 tons of fish annually by 1975 from an area with a potential catch of only about 266,000 tons/year (p.8 and Tables A4, A5, A8, PLAN). This is the result of (i) their rejection of the method of estimation used by the very scientists, Prasad and Nair (1960, 1963), on whose researches they claim to have based their estimates ; and their adoption instead of a different method, involving the application of a productivity rate per sq. ml. to the shallow-water fishing area around Ceylon ; and (ii) their making out that this area is about 55% larger than it actually is.

The Continental Shelf around Ceylon, except in the north-east, extends out to a depth of 50-60 fathoms and then plunges sharply as a steep Continental Slope down to depths of 1,000 to 2,000 fathoms and more. For Ceylon the continental shelf does not extend out to the 100-fathom contour, that conventionally accepted outer limit of a typical shelf — again except in the north-east, off Mullaitivu-Pt. Pedro (Sivalingam, 1960). Nevertheless, Silva *et al.* have drawn up their Plan on the basis that it does so extend, and they have thereby increased its area — see Table on p. 3 of PLAN. It is only the first 3 of the depth zones indicated in that Table that may legitimately be included within Ceylon's continental shelf. These total 9,370 sq. mls. ; to which may perhaps be added another 500 sq. mls. approximately, on account of those parts of the Pedro Bank[5] which have not already been included in the 3 areas referred to above. This gives 9,870 sq. mls. as the maximum area of Ceylon's continental shelf. If a productivity rate per sq. ml. derived from Prasad and Nair's work is applicable *at all* and in *any* reduced form (see, however, p. 109 below), then it is to this area of 9,870 sq. mls. only that it is applicable ; and not to an area of 15,820 sq. mls. as Silva *et al.* would have it, an area almost 55% larger.

That region of the sea lying beyond the edge of our continental shelf and up to 5 miles farther out than the 100-fathom contour — that is, the region comprising the 4th and 5th depth-zones of the Table on p. 3 of the PLAN — is so close to our shores that it certainly may be considered as lying within our coastal fishing area. Nevertheless, this region is a deep-sea area, much of it being 1 — 2 miles deep. And it is impermissible, when estimating its potential productivity, to apply to it a rate per sq. ml. which has been derived from researches (Prasad and Nair's) aimed at discovering the productivity of an entirely different kind of fishing area, an area of shallow waters of an average depth of 7½ fathoms, lying well within a typical continental shelf. It is impermissible even if one were arbitrarily to reduce that rate to as little as 1/7th. of its original value before using it, as has been done by Silva *et al.* . And if it were not impermissible, there would be no reason why one should stop at just 5 miles beyond the 100-fathom contour, for here the sea is already as deep as it is in most of the open Indian Ocean ; there would be no reason why one should not apply the same arbitrarily reduced rate of 10 tons/sq. ml./yr. to a zone extending 25 miles beyond the 100-fathom line (this would still be close enough to lie within the coastal fishing area), or even to the rest of the 32 million sq. mls. of the Indian Ocean, and arrive at the conclusion that the potential productivity of the Indian Ocean is 320 million tons of fish a year. It is absurd to apply a productivity rate per sq. ml. in this way, ignoring the great and fundamental differences between the neritic and the pelagic environments as fishing grounds. Besides, a rigid application of a productivity rate per sq. ml. to every square mile of coastal sea also treats each such square mile as though it were a closed pond with a self-perpetuating fish population ; whereas in fact, it is open, and its fish population dependant to a large extent on recruitment from outside its boundaries.

Prasad and Nair (1960, 1963) did not use this method in making their estimates. The productivity rate of " about 75 to 110 tons of fish per square mile per year " used in the PLAN is one that Silva *et al.* have *themselves* derived from Prasad and Nair's *estimate* of potential catch in certain Indian waters ; it is not one calculated by Prasad and Nair, despite the contrary impression conveyed in the PLAN. Having shown that the actual fish catch in those coastal waters which they were studying, a narrow strip about 6½ miles wide and about 7½ fathoms deep on an average, was only 0.03% of the total Carbon fixed in those waters by photosynthesis, whereas in the coastal waters of the North Sea where fishing was highly mechanised the catch was as much as 0.2 — 0.3% of the Carbon fixed in them, Prasad and Nair concluded that the potential Indian coastal catch for that area (the Indian coast of the Gulf of Manaar) was 7-10 times the actual catch at the time of their studies, a time when there was hardly any mechanisation of the local fishing industry.

And if one really wished to base one's estimates on the work of these Indian scientists, theirs is the method that one should follow : Ceylon's potential coastal catch, from an area roughly 6½ miles wide around the island, should be 7-10 times the actual catch before mechanisation set in. The catch of about 38,000 tons in 1956 (Weerekoon, 1964) was the best in the decade before mechanisation brought about the spectacular increases of the years 1958-1963 ; and using this, we get the range 266,000 - 380,000 tons/yr. as potential catch. But since an area 6½ miles wide around the coast of Ceylon is, much of it, much deeper than 7½ fathoms, and because of the many possible sources of error in any experimental determination of carbon-fixation in the sea, it would be most unwise to use any figure other than the lowest in this range as an estimate of the potential catch from Ceylon's coastal fishing area. And one's target should be based on this (Weerekoon, 1964).

Instead, Silva *et al.* estimate the potential annual productivity of Ceylon's coastal sea at 584,000 tons (low) to 875,000 tons (high), and propose to harvest 537,500 tons of this each year by 1975 (pp. 6, 8, PLAN). This target is itself more than twice the safe estimate of potential catch indicated in the paragraph above. It is unrealisable.

Why did Silva *et al.* not follow the method adopted by the very scientists on whose findings they claim to have based their views ? We are given a clue to the answer in this sentence from p. 33, Chapter 3 of the PLAN : " One of the main questions that had to be settled *prior to the drawing up of this Plan* related to the scale of the proposed investment." From the words I have emphasised in this sentence it seems very likely that the target was decided after the scale of investment had been settled, and that it was made to depend on that scale. And a reading of the rest of Chapter 3 confirms that this indeed is what happened. The scale of investment itself was decided on on the basis that since Ceylon's National Product was required to increase at a rate of 5-6%, a total investment of about 14 thousand million rupees would have to be made over the 10-year period 1965-75. Of this sum the authors of this Plan decided arbitrarily that the fishing industry, which had hitherto been neglected, should absorb between 10 and 12% — or Rs. 1,575 million, to be precise (p. 34, PLAN).

We therefore have the curious situation where a scale of investment is decided on first, and decided on quite arbitrarily, and then the target for fish-production is based on this. Since the target in the case of a natural resource like fish must be a function of the size and reproductive capacity of that resource, this procedure is tantamount to one's deciding what the size and nature of the resource is, on the basis of how much money one wishes to invest in exploiting it. This reduces planning to an absurdity.

3. Distant-Water Fishery Prospects.

3a. The Mauritius-Seychelles and Chagos Banks.

On p. 4 of the PLAN, Silva *et al.* quote a Report entitled " On the possible ways of development of the fishing industry in Ceylon ", submitted to them by a team of Russian experts who had paid this island a brief visit, a report which Silva *et al.* state makes " the prospects of a deep-sea fishery[6] seem most promising indeed ". This is a rather surprising conclusion for most of the Report quoted consists of very general statements of which the following is a typical example : " Very promising for the development of fisheries are the waters of the eastern part of the Indian Ocean, which are rich in organic matter ". The only part of the Report quoted which contains a statement regarding fishing potential sufficiently specific to be subjected to scrutiny is the following : " The Mauritius-Seychelles group of islands should be considered as the most promising area for the development of the fishing industry. According to Wheeler's estimates the potential total annual catch from these areas may exceed 1 million tons of fish and 800,000 tons of shark. The same author states that the area of the Chagos Archipelago is of rich potentialities where an annual catch of over 250,000 tons may be expected."

The areas referred to lie at a considerable distance from Ceylon, the Mauritius-Seychelles Arc being about 1,500 — 2,200 miles away, the Chagos Archipelago about 1,000 miles away. At 8 knots a fishing boat would take 8-9 days to reach the fishing grounds within the former area, and 5-6 days those within the latter.

An extensive fisheries survey lasting 2 years was made of these areas by Wheeler for the British Colonial Office and published in 1953. It is this work to which the Russian Experts' Report refers. Wheeler states that the edges of the Banks fall away so precipitously that the only fishable grounds are on the tops of the Banks themselves, and rarely exceed 60 fathoms. The most productive depths were between 10 and 18 fathoms, on sandy bottom with patches of coral and rocky outcrops, the largest fish being found on the roughest ground. Of the many types of gear tried out — including 40-ft. otter-trawls, seines, 150-hook longlines, trolling lines, fish-traps, etc. — the hand-line, with 1 or more hooks, " proved far and away the most efficient " and was the main gear used in the survey. Wheeler concluded that exploitation of these grounds would have to be by hand-lining, and recommended a boat about 120-140 ft. long[7], with especially low freeboard and superstructure, and manned by a crew of about 24 of whom 16 would be seamen-fishermen to keep 14 hand-lines fishing simultaneously. (Wheeler, 1953, pp. 19, 126-7).

In a total fishable area of 15,982 sq. mls. Wheeler found many large Banks " where fishing with the simple method of hand-lining is productive on a scale equalling the best efforts of trawlers and drifters on some of the richest grounds in the world (p. 121, *op. cit.*). Some of the catch rates he has reported are shown in Table I below in which I have included only those Banks with an area of 500 sq. mls. and more.

Table I.

Catch rates of the main fishable grounds in the Mauritius-Seychelles and Chagos Areas (*after Wheeler, 1953*).

Name of Bank	*Area (in sq. mls.)*	*Catch Rate (in tons/man/yr.)*		
		Fish	*Shark*	*Total*
St. Brandon Island	900	8½	7	15½
Chagos Archipelago	2,500	27½	33½	61
Seychelles Islands	3,000	13½	16	29½
Amirante Islands	640	24	21	45
Nazareth Bank	3,100	22	9	31
Saya de Malha (corpus)	4,450	26	18	44
Saya de Malha (cervix)	700	40	55	95

Granting these grounds are very rich, one has still to decide how valuable they are for the development of Ceylon's fishing industry. Let us compare Wheeler's figures of production with those of an area more familiar to Ceylon, the Wadge Bank. According to Wheeler (p. 42, *op. cit*) the overall fishing rate for these Mauritius-Seychelles-Chagos fishing grounds is 18 tons of fish (and 21½ tons of shark) per man per year of 240 fishing days. According to Medcof (1963) the trawler " Maple Leaf " during 1953-54 had an average catch on the Wadge Bank of 8,578 lbs per day at sea (almost the entire catch landed consisted of fish, hardly any appreciable quantity of the shark caught being retained and brought back to port). Since the " Maple Leaf " spent about 90% of her days at sea on the fishing grounds, this catch is equivalent to one of 9,551 lbs of fish per day on the grounds. Assuming that of her total crew of 28 men, as many as 20 were seamen actually engaged in handling the gear, this is equivalent to a catch of 476½ lbs. of fish per man per day on the grounds. In a year of 240 days' fishing on the grounds this daily rate works out at 51 tons of fish per man per year for the Wadge Bank, a rate which compares very favourably indeed with the 18 tons/man/year overall for the Mauritius-Seychelles-Chagos areas. In fact, even if one were to add the shark catch of 21½ tons/man/year the total of 39½ tons/man/year for those areas would still be fully 20% smaller than the Wadge Bank rate for fish alone.

But the " Maple Leaf " was over-crewed when working off Ceylon, since off Scotland she had operated with a crew of just 15 men. This was probably the result of the " wages system " of payment for crew which was adopted in Ceylon instead of the more usual " lay system " (Medcof, 1963). But whatever the cause the fact remains that she was over-crewed here ; and it is reasonable therefore to assume that with that cause eliminated the " Maple Leaf " could have brought in the same catches with a crew of 15 men. Allowing her a Captain, a Mate, two Engineers and a Cook, that would leave 10 seamen for actual handling of the fishing gear — as against 20 previously. As a result the fishing rate for the Wadge Bank would work out at 102 tons of fish per man per year on an average. This is very much more than the average rate of 18 tons of fish or 39½ tons of fish and shark for the Mauritius-Seychelles-Chagos areas ; more even than their maximum rates of 40 tons of fish or 95 tons of fish and shark per man per year (Table I).

One can also look at the matter in another way. The area of fishable ground in the Mauritius-Seychelles Arc is 13,500 sq. mls. So that the postulated potential catch of 1.8 million tons of fish and shark per year is equivalent to a rate of about 133 tons/sq. ml./year. Similarly the Chagos Archipelago with a potential of 250,000 tons a year and a fishable area of 2,500 sq. mls. has a rate of about 100 tons/sq. ml./year. These are, of course, high rates and indicate rich fishing grounds — but not grounds very much richer than our own shallow coastal waters. And whereas these shallow coastal waters lie within about 5 miles from our shores, the Mauritius-Seychelles grounds are about 1,500-2,200 miles, and the Chagos grounds about 1,000 miles away from Ceylon's ports.

Or one can look at it in yet another way : what will the catch per boat per year be for a boat based on a Ceylon port and working these Mauritius-Seychelles-Chagos grounds ? Wheeler in recommending a 120-140 ft. hand-liner (see p.111, above) had in view a fishery based on Mahé in the Seychelles or on Mauritius, and exploiting grounds 600-750 miles away at most from the home-ports. But we shall probably be correct in assuming that a similar 140-foot handliner could be designed and built for exploiting these grounds from Ceylonese ports. Such a boat could have a fish-hold capacity of 40-60 tons. Wheeler (p. 127, *op. cit.*) has estimated that such a fishing vessel should be able to catch from the Nazareth Bank (Table I, p. 111) about 300 tons of gutted fish (330 tons ungutted) per year of 240 fishing days. The fish would mainly be various Lethrinids and Lutianids, two of the families of so-called " mullets " (really Breams, Bass and Snappers) which form the bulk of our Wadge Bank catch as well. Wheeler's estimate means a catch of 1.3 tons per day on the grounds. At this daily rate it would take the Ceylon-based boat with a 40 ton fish-hold capacity about 30 days of fishing to fill up. With the turn-around in port taking 4 days (in 1954-55, according to Medcof, 1963; it is probably longer now) and travelling to the fishing grounds and back taking 9 days each way, a single fishing trip will take about 7½ weeks. (Even the nearer Chagos banks will mean a fishing trip of about 6½ weeks). Allowing for annual slipping and repairs, it is not likely that more than 5 trips can be made a year. From which it follows that the catch per boat per year will be about 200 tons of fish, of the same sort as are caught on the Wadge Bank [8]. In other words boats of about the same size and worked by about the same number of crew, will bring back about 575 tons of fish per boat per year from the Wadge Bank (Weerekoon, 1964 ; Mendis, 1964. But Silva *et al.*, 1965, estimate it at 800 tons), but only about 200 tons per boat per year from the Mauritius-Seychelles-Chagos grounds, which we were told (p. 110 above) was the " most promising area for the development of the fishing industry " of Ceylon. A 10-day fishing trip to the Wadge Bank would suffice to bring us 40 tons of fish, for which a 52-day trip to the Mauritius-Seychelles-Chagos grounds would be needed.

It should be clear now that rich as they undoubtedly are these distant fishing grounds are not richer than the Wadge Bank which Ceylon has been fishing for about 3 decades and which is so much closer to her (a mere 150 miles away) ; and that whilst they might be fished with profit from bases in the Seychelles or in Mauritius which are 600-750 miles away, it is fairly certain that they are not economically fishable at present from bases in Ceylon which is about 1,000-2,200 miles away. As Wheeler (p. 120, *op cit.*) himself reminds us " Every unfished mile of water traversed to reach them (the fishing grounds) reduces the value of the ultimate catch so that the nearer the Bank is to the base or market the greater its value, for the overhead costs of a ship remain approximately constant whether she is fishing or moving to and from her fishing grounds."

3b. Skipjack

The Skipjack or Baleya, *Katsuwonus pelamis* (Linné) is found in our coastal waters where it is exploited up to 15 miles off-shore. It is taken mainly with pole-and-line, a fishing method which uses an unbaited barb-less hook which the fish snap at in a feeding-frenzy induced in them by the release (chumming) into their midst of live bait-fish. This method accounts for almost 70% of all the skipjack caught in our coastal fishery by the existing types of small fishing craft[10].; trolling being responsible for another 20% and drift-netting for the balance (Sivasubramaniam, *personal communication*[11]). The skipjack is also found farther out, even up to 100 miles off-shore; and also in the coastal waters of the Maldive and Laccadive Islands. The fish is migratory and seasonal, so that the fishery is also seasonal, lasting from November to March generally in Ceylon's south-western waters and from July to September in her eastern waters.

Sivasubramaniam (1964a) has pointed out that the skipjack fishery[9] should be expanded by exploiting the fish of the 15-100 mile zone of our waters which is untouched today. And he has recommended that the region up to 50 miles out be fished by a 40-ft. class of boat equipped not only for pole-and-line but also for other methods of fishing, like trolling, trawling, bottom long-lining, drift-netting, etc., which would be used when skipjacks were out of season ; and that the 50-100 mile region be fished from a 50-60 ft. class of boat equipped for pole-and-line fishing for skipjack and for long-line fishing for tuna during the skipjack off-season. These boats would probably cost 80-100 thousand and 200-300 thousand rupees each, respectively, the smaller being within the present capacity of our own ship-yards to build.

Whilst saying nothing at all about this recommended expansion of our off-shore fishery for skipjack, Silva *et al.* propose to introduce a fleet of 20 large pole-and-line ships, each costing 1 million rupees and expected to catch 1,000 tons of skipjack per year (Tables A1, A4, C8, PLAN). They have omitted to specify the size of these ships, but from the price they expect to have to pay for them in relation to present costs it would appear that each of them will be about 100 ft. long and about 150 G.T. in tonnage. Obviously Silva *et al.* mean to establish a distant-water pole-and-line fishery for this fish — probably in the waters around the Maldive and Laccadive Islands, about 400-600 miles away. But Sivasubramaniam (1964a) has pointed out that skipjack are smaller there than in Ceylonese waters, and that this has already led to Japanese rejection of a proposal for a joint Maldivian-Japanese pole-and-line fishery in Maldivian waters. Besides, with 2 fishing seasons totalling at best only 8 months each year the expected catch of 1,000 tons/boat/year (Table A4, PLAN) means a catch of 4-5 tons/day, which is much higher than that normally achieved by such boats. Finally, as if to ensure the failure of their proposed distant-water pole-and-line fishery, Silva *et al.* have set aside no live-bait for these boats (Tables B1, B3, PLAN). And yet on the basis of a fairly widely accepted rate of 80 lbs. live-bait per ton of skipjack caught, each of these 20 pole-and-line fishing boats will need about 36 tons of live-bait a year. None is provided in the PLAN ; an omission that is difficult to understand unless it is assumed that Silva *et al.* being unfamiliar with fisheries were misled by the fact that pole-and-line fishing uses *unbaited hooks* into believing that *no bait* at all was used. Whatever the explanation the fact is that this omission to provide bait will mean that this fleet of 20 ships costing 20 million rupees (all in foreign exchange) will have to remain idle and will throw the whole Plan out of gear by not bringing in the expected catch of 20,000 tons of skipjack a year. Or fish meant for other purposes — e.g., a part of the anchovy (hal-massa) catch meant for human consumption — will have to be assigned to them as live bait ; and this too will throw the Plan out of gear. Incidentally, it must be pointed out that our existing skipjack fishery is itself gravely hampered by a shortage of bait and will certainly have none to spare for the proposed new one.

3c Tuna.

Silva *et al.* propose to establish a large-scale distant-water tuna fishery in the Indian Ocean with a fleet of 100 large tuna long-liners costing 175 million rupees (pp. 6-7, Tables A1, C8, PLAN). In this case too they have omitted to specify the size of boat to be introduced. However, on the bases of the price to be paid for, of the bait assigned to, and of the catch expected of, each of these boats (Rs. 1¾ million, 40 ton/year, 800 tons/year — see Tables A1,C8, B3, A4, PLAN), and in view of the recommendations made to Silva *et al.* by Sivasubramaniam (1964a) and by Kvaran (1964), it seems fairly certain that these boats are to be of the 250 G.T. class.

There are already 80 Japanese tuna long-liners in the Indian Ocean, of which about 50 are fishing on any one day. The Japanese catch of tuna from this ocean has risen since the fishery began in 1952, and is now (1965) about 100,000 tons/year. But the average catch per boat per day's fishing has fallen from about 6 tons in 1952 to about 2 tons in 1963, and the catch-rate from 7 fish per 100 hooks in 1952 to about 2 per 100 in 1963 (cf. Sivasubramaniam, 1964b). In this situation the introduction, within a relatively short period of just 7 years (Table A1, PLAN), of another 100 tuna long-liners into the Indian Ocean may well damage the resource and depress the catch rate so drastically as to make *all* distant-water tuna long-lining in this ocean uneconomic, not only for the Japanese but for ourselves as well. The Japanese tuna-fishery, well established and ranging widely over the oceans of the world, would probably absorb the shock of this failure and soon recover ; the infant Ceylonese tuna-fishery is almost certain to be crippled beyond all chances of recovery.

It cannot be argued that there is no need for misgiving since the introduction of these 100 boats is to be gradual, and can be called off immediately at the first signs of danger and before any great damage is done. An introduction at the rate of 5 boats in the 1st year and 8, 10, 16, 20, 20, 20 in each of the succeeding 6 years *is not gradual* however one looks at it. By the time any ill-effects became certain enough to warrant action a few years, at least, will have passed ; and Ceylon might well find herself with 24 or even 40 of these boats on her hands, boats that would have cost her 40 to 70 million rupees in foreign exchange, boats specially designed and equipped for a fishery that was no longer economically feasible. Even if the ill-effects became sufficiently apparent before the end of the very first year, a most unlikely event, Ceylon would already have 6 of these boats for which she would have paid 10½ million rupees, boats which would have to run at increasingly heavy losses or to idle. A truly gradual introduction on the other hand of tuna long-liners for a safe entry by Ceylon into the Indian Ocean tuna fishery would be 1 or 2 such boats per year for the first several years at least, as suggested, for example, by Iyama (1958).

Even if there were no ill-effects on the tuna resource, failure of the proposed brackish-water fish-farms to produce more than about 1/5th. (= 2,500 tons year) of the bait that Silva *et al.* claim they will (see Section 6a, below) means that at best there will be sufficient bait by 1975 for only 62 of this fleet of 100 long-liners — and that too *provided all* the bait-fish produced is assigned to these large long-liners and *none at all* of it to the 2-tonners and the 20/80-tonners for which it was also meant according to the Plan (Table B3, PLAN)....If these latter are also given their share, proportionately, of what bait is produced then there will be only 800 tons of bait for the large long-liners and only 20 of them will be able to operate. The attempt to enter the Indian Ocean tuna fishery in this way will fail.

Silva *et al.* have fixed 80,000 tons of tuna as target for this fishery by 1975 (Table A4, PLAN). In fact the maximum possible target, with just 62 ships operating, will be only 50,000 tons/year. Even with bait fish costing about 66.4 cts. lb. [43] as at present this tuna will cost 60-84 cts./lb to produce (Kvaran, 1964, pp. 301-2, & Fig. 30). But as shown in Section 6c below (p. 129) bait from the new fish-farms will in fact cost 73-81 cts./lb., and the tuna caught with it will cost rather more than 84 cts./lb. to produce. Sale at 51.3 cts./lb. as proposed by Silva *et al.* (Table E9, PLAN) will be impossible — unless heavily subsidised for the sake of the foreign exchange earned. There is no indication in the Plan that such subsidisation is contemplated ; certainly there is no provision for it. If nevertheless the sale is subsidised, the entire catch of the new distant water fishery will bring Ceylon only 57½ million rupees in foreign exchange[33] instead of the 92 millions expected of it. (See also Sections 4d (i) and 6a, on pages 118 and 125 respectively).

4. Allocation of Bait Under the Plan & its Effect on Fish-Production

4a. Without bait almost all line-fishing (even pole-and-line fishing which uses unbaited hooks) is impossible. In Ceylon there is already a grave shortage of bait, which is restricting fish production, as has been pointed out by Sivasubramaniam (1964), Medcof, (1963), Iyama (1958) and others. Yet the proposals of Silva *et al.* in their 10-year Plan show no understanding of this, and are so defective that they will add to the present shortage.

Table B1 of their PLAN sets out the disposal of the entire fish catch each year[12]. In it Silva *et al.* tell us that by 1975, when the planned development will be complete, 12,500 tons of fish of a total production of 678,400 tons will be used as bait. And by comparing this Table with Tables A7 and B3 we see clearly that this entire quantity of bait is to come from the proposed brackish-water fish farms ; and also that it is to be used by the 100 tuna long-liners (4,000 tons of it), the 350 coastal boats of the 20/80 ton class (3,500 tons of it), and the 2,500 coastal boats of the 11-ton class (5,000 tons of it) — *but not by any of the other fishing boats.* And since the entire catch will have been disposed of according to this Table B1, *there will be no other fish available to these other boats for use as bait.* The other boats which will need bait are the 20 pole-and-line boats and the 3 bottom long-liners (Table A2, PLAN), and the 12,250 small coastal craft of the existing types[10], both the mechanised and non-mechanised traditional craft and the 3½ ton modern craft popularly referred to as " mechanised boats " (Table A3, PLAN). Silva *et al.* have provided no bait at all for them. How much will they need ? How will lack of this bait affect their catch ?

4b. Bait requirements not met by the Plan

On the basis of a fairly widely accepted rate (see p. 114), a pole-and-line fishing boat with an annual catch of 1,000 tons will need about 36 tons of live bait a year ; and a bottom long-liner with an annual catch of 1,000 tons will need about 50 tons of dead-bait a year[13]. Therefore the 20 pole-and-line boats and the 3 bottom long-liners of the proposed fleet will need about 720 tons of live-bait and 150 tons of dead-bait each year, respectively.

The bait requirements of the fleet of E.T.S.C.[10] are somewhat less easy to assess because these boats can and do operate nets as well as lines, and because insufficient statistics are available of their actual bait consumption in the past. Sivasubramaniam, who has during the last 2 years (1963-65) been studying several aspects of the coastal small-boat fisheries, estimates that they use about 850 tons of dead-bait and another 150 tons of live-bait a year at present, making a total of about 1,000 tons (*personal communication*). The E.T.S.C. now (1964) bring in about 71,000 tons of fish a year and are expected, according to the Plan to increase this catch by 1975 to about 110,000 tons a year, that is by about 54% (Table A5, PLAN). Assuming proportionate increases in the different components of the catch[14], it follows that there will be a 54% increase in the amount of bait needed and instead of the 1,000 tons a year now used at least 1,540 tons a year will be needed by the 12,500 boats of the E.T.S.C. operating in 1975 — 1,310 tons of dead-bait and 230 tons of live-bait.

Next come the 2,850 units of 11-ton and 20/80-ton boats, the new types of small coastal fishing craft, hereafter referred to as N.T.S.C., which are to be introduced under the Plan. These have indeed been allotted dead-bait, but some of their catch will be skipjack (and similar scombroid fish, even young tuna) taken with pole-and-line[15]; and for this live-bait will be needed. These boats of the N.T.S.C. will be operating in our coastal waters, going only a little farther out than our 3½ ton boats do at present (para. 4, p. 6, PLAN). Of the catch of almost 110,000 tons brought in annually by 1975 by the E.T.S.C. fishing this same area 10,000 tons[9], or nearly 10%, will be scombroids ; and we shall not be unfair to this Plan if we assume that *at least* 10% of the catch of the N.T.S.C. (Table A4, PLAN) will also be scombroids. In the case of the 11-tonners this works out at 31,250 tons, and in the case of the 20/80 tonners at 10,500 tons. Of these catches of scombroids at least 44%[9] would have been taken with pole-and-line and live bait — which is 13,750 and 4,620 tons respectively. At a rate of 28 tons of scombroid fish per ton of live bait the N.T.S.C. will need 656 tons of live bait if they are to produce these quotas. None of this bait has been provided for them in the Plan.

The missing bait so far amounts to 3,066 tons a year by 1975, of which 1,460 tons is dead-bait and 1,606 tons is live-bait. But this is not all. For, although on paper (Tables B3, A7, PLAN) a quantity of 12,500 tons of bait-fish will be produced by the new brackish-water fish-farming industry, in fact — as shown in Section 6a below — almost certainly no more than a fifth of this amount will be produced, namely 2,500 tons. This makes the total bait shortage in 1975 about 13,066 tons a year of which 11,460 tons will be dead-bait and 1,606 tons will be live-bait ; a shortage of over 83%.

4c. Shortfall in Production Targets Resulting from Lack of Bait.

In the first place the entire catch of the 20 pole-and-line boats and the 3 bottom long-liners will not be there — 20,000 tons of skipjack and similar scombroids and 3,000 tons of demersal fish ; and these ships costing Rs. 27 millions in foreign exchange would be idling (Tables A4, C8, PLAN). Next come the E.T.S.C. On the basis that each ton of dead-bait they use brings in 10 tons of fish[13] (including some tuna) and every ton of live-bait about 28 tons of scombroids (mainly skipjack but also other genera including young tuna), then their quota of 1,310 tons of dead-bait and 230 tons of live-bait would have produced 13,000 and 6,440 tons of fish respectively. But another estimate of the scombroids that might have been brought in by the E.T.S.C. in 1975 with live bait is 4,400 tons (Note 9, p. 135), and I shall adopt this instead of 6,440 tons since it is more favourable to the authors of this Plan. Finally, failure to provide live-bait for the 2,850 units of the N.T.S.C. will mean that none of the 18,370 tons of scombroid fish that they might have produced with pole-and-line fishing will, in fact, be produced.

Therefore, the shortfall in production that must result from the failure of Silva *et al.* to include any provision for certain of the bait requirements of the fishing fleet will be about 58,870 tons/year — of which at least 42,770 tons represent scombroids that might have been taken in pole-and-line fishing (mainly skipjack), and about 800 tons[9] represent scombroids that might have been taken in long-line fishing (mainly tuna). To this must be added the shortfall in catch of those boats whose bait requirements have not been completely forgotten by the authors of this Plan, but which will be met only partially because of failure of the fish-farms to produce as expected. Instead of 12,500 there will be only 2,500 tons of dead-bait and this will mean an additional shortfall of 115,000 tons in the planned targets[16]. This brings the total shortfall to 173,870 tons/year, of which 76,910 will be tunas, skipjack and similar scombroids[18]. Overestimation of the potential productivity of the coastal sea by Silva *et. al* had led to their planning a catch from the sea of 633,400 tons/year by 1975, when it could have been no more than 391,900 tons, namely, 266,000 from coastal sea and 125,900 from distant waters (Tables A4, A5, A8, PLAN and Section 2 of this Report). Now, lack of bait and the resulting fall in catch reduces this further to 218,030 tons/year — a mere third of what is expected in the Plan.

4d. Other Consequences of the Lack of Bait.

Besides this crippling shortfall in total fish-production some of the more important of the other consequences will be the following :

i. The shortfall of 76,910 tons of scombroid fish will mean that little more than 62,420 tons of these fish will be produced a year[18]; and even if all this is exported and sold at Rs. 1,150/- per ton as proposed (Table E9, PLAN) the maximum gross foreign exchange earnings from this source will be a mere Rs. 71.783 millions[33] instead of Rs. 226.665 millions anticipated by Silva *et al.* ; and since they are counting on exports of tuna " to provide a fair part of the foreign exchange needed to finance the Plan " (last para. p. 4, PLAN) the importance of this loss need hardly be emphasised.

ii. If all the 62,420 tons of scombroids produced are exported there will be none left for canning, though the PLAN (Table B1) requires 10,000 tons for this purpose[19]. The canning factories will have to remain idle for the most part and imports of canned fish which it was hoped to eliminate will have to continue ; and will by 1975 drain away 8½ million rupees annually from the country (Table E7, PLAN).

iii. Similarly there will be no skipjack or other scombroid fish left for conversion into Maldive fish ; and imports of this commodity will have also to continue. About 10,000 tons (wet weight equivalent) will have to be imported by 1975[20], and will cost the country about 10 million rupees annually in foreign exchange.

iv. There will for the same reason be no skipjack and tuna for local domestic consumption in the fresh state. At present this consumption amounts to about 4,000 tons, and there is no reason to suppose that the demand will have got any smaller by 1975[21].

v. Even if all the bait produced by the fish-farms is assigned to the tuna long-liners there will be enough for only 62 of these large ships, which cost Rs. 1.75 millions each. The remaining 38 of them will have to idle, or to have their bait, amounting to 1,500 tons a year, imported for them with a further drain of about 2-3 million rupees in foreign exchange.

5. The Fishing Fleet

Boats must form a very important part of any plan for the development of fisheries ; particularly so of this Plan by which the harvest from boats is to be increased in the course of 10 years from 74,000 tons to 653,400 tons annually, almost 9-fold (Tables A4, A5, A8, PLAN). Besides pressing on vigorously with the mechanisation of our traditional craft Silva *et al.* propose to introduce 2,985 craft of new types and 520 craft[22] of the traditional types already in use in Ceylon's fisheries (Tables A1 - A4, PLAN). This programme requires an investment by the Fisheries Corporation of 632½ million rupees and by Government and private investors of another 17¼ million rupees,[23] 557½ million and 11½ million being in foreign exchange (Tables C1, C2, C4, C5 and C8, PLAN). Thus the programme involves a very large sum of money indeed, and one is therefore surprised to find so many defects in it. Some examples are briefly dealt with below :

(*a*) The 2 trawlers referred to in Tables A3 and A5 (PLAN) as landing 800 tons of fish per boat a year for the next 4-5 years must be the old trawlers "Maple Leaf" and "Braconglen" owned by the Fisheries Department. Yet, as Silva is aware, the "Braconglen" has been unable to go out fishing since early 1964 and has been condemned by a competent official ship-survey as unfit for repair and further use as a trawler (Mendis, 1964, pp. 268-9 ; Silva, 1965, p. L87).

(*b*) The Plan does not provide for replacements of our traditional craft, all 13,750 of which must as a result eventually disappear (Table A3, PLAN). Yet Silva *et al.* have not suggested a substitute for these small beach-landing craft, so important for a country subjected to the full force of 2 monsoons and so ill-provided by nature with shelters and small harbours as Ceylon is. This omission is all the more strange since a possible substitute, in the shape of an 18-ft. fibre-glass boat with out-board motor, had already appeared and was gaining favour amongst fishermen.

(*c*) Except in the case of the 11-ton and 20/80-ton boats Silva *et al.* do not tell us in their Plan what the sizes are of the many types of boats they propose to introduce (Tables A1, A2, PLAN). And yet on size of boat will depend so many factors influencing the operation of the Plan, will depend its range and fishing grounds, its catch-rate and cost of production of fish, its bait and fuel needs, etc. For example : a 100/150 G.T. tuna long-liner would need a smaller crew than a 250 G.T. one, would cost less to maintain, but would be limited more or less to operating within a 1,500 mile radius of Colombo, so that many of the richer tuna grounds would be beyond her reach and her probable catch would therefore be about 2 tons/day and would cost 80-120 cts./lb. to produce. A 250 G.T. long-liner would be able to fish up to 3,000 miles from Colombo and would have all the richest tuna grounds within her range so that her probable catch would be about 3½-4 tons/day and would cost 60-80 cts/lb. to produce (Sivasubramaniam, 1964*a* ; Kvaran, 1964). But though Silva *et al.* had apparently debated the relative merits of these 2 sizes of long-liner for their proposed distant-water tuna fishery (Sivasubramaniam, 1964*a*, p. 286-7 ; Kvaran, 1964 p. 301-2) they do not tell us which of these boats or what other they have decided to introduce.

This omission by Silva *et al.* to state boat sizes obstructs assessment of their Plan ; and leaves room, on the one hand, for misunderstanding and, on the other, for the reply to be made to criticism, that it is inapplicable since a different size of boat is in fact contemplated. Certainly " flexibility is an all important consideration in a Plan of this nature " (p. 7, PLAN) but I need hardly emphasise that this is not the sort of flexibility that is needed in any plan.

(*d*) Silva *et al.* state that though the prospects of a distant-water fishery[6] seem most promising to judge by a certain expert-report which they quote (see, however, Section 3a above),nevertheless " a considerable amount of exploratory work has yet to be done......the only proved methods in (the distant-waters of) the Indian Ocean (being) bottom trawling and tuna (long-line) fishing'. Therefore, whilst "the primary objective of this Plan is to exploit the resources of our coastal fishery to the maximum during the Plan period 1965/66 to 1975......a secondary objective of the Plan is to investigate the fishing potential beyond the Continental Shelf and in the deep sea, with a view to its intensive exploitation in the course of the next Plan period." (pp. 4, 7, PLAN). And to carry out this investigation they propose to introduce 35 large distant-water fishing boats of 5 different and specialised types — 5 trawler-cum-purse-seiners, 20 pole-and-line boats, I shrimp mother-boat 32b and attendant catchers, 6 shrimp-trawlers and 3 bottom long-liners (pp. 6, 7, PLAN).

These experimental boats are to cost 42½ million rupees, all in foreign exchange, so that it will be a very expensive investigation indeed ; and one that cannot be justified since any fishery information gathered by these boats can be gathered more efficiently by one or two properly equipped fishery research vessels each fitted out for several different methods of fishing, and each vessel costing about 1-1½ million rupees. Indeed plans and specifications for such a research vessel to suit Ceylon's special needs are already in existence. They were completed in 1963 (Balasuriya 1964, p. L76) by 2 F.A.O. experts, a naval architect and a naval engineer, working in the Ceylon Fisheries Department in consultation with its Research Station. The vessel will be equipped to carry out the following types of fishing : bottom and mid-water trawling, purse-seining, drift-netting, bottom-set gill-netting, long-lining and pole-and-line fishing ; and will have a range of 3,000 nautical miles and an endurance of 3 weeks. Silva, the senior author of the Plan, was also the Director of the Fisheries Department and was aware of this proposed research vessel ; (Silva, 1965, p. L92) and what he should have done was to have included provision for 1 or 2 such research vessels in his development Plan instead of 35 specialised fishing-boats for this exploratory work.

Incidentally, the fixing of production targets for boats on exploratory fishing trips and the inclusion of these targets into a production plan, as has been done in this case (Tables A4, A8, E9, etc., PLAN) is quite impermissible. Either the target will be sacrificed to meet the needs of exploration, or the exploration will be sacrificed to achieve the production targets. Either way the Plan suffers. This incompatibility is the more marked the higher the assigned catch-rate — and in the case of all these 35 exploratory boats catch-rates have been fixed especially high[24]. A thousand tons a year, for example, from each bottom long-liner, which on the basis of generally accepted performance in other seas, is more likely to bring in 200 tons ; 1,000 tons/year from each pole-and-liner which is not likely to exceed 750 tons ; and 400 tons/year from the shrimp-trawlers which are not likely to catch more than 200 tons a year.

The truth, of course, is that these 35 boats are not for exploratory investigations at all ; they will be engaged in commercial venturing into the unknown. I do not suggest that there is anything improper about incorporating commercial venturing into a development plan — by no means. But to claim, as Silva *et al.* do, that such commercial venturing is investigation or research is consciously to invite such a degree of indulgence in, or even exemption from, the scrutiny of its economics as commercial ventures are not entitled to. And whilst referring to these fishing boats as exploratory may permit one conveniently to counter criticism of the catch-rates proposed for them, it does not entitle one to build these same tentative figures of experimental yields into proposed targets in a vast and elaborate Plan.

(e) Another serious defect in the Plan is the proposal to replace the tried and successful 3½ ton boat with an as-yet untried 11-ton boat. These small 3½-tonners, whose introduction has been largely responsible for the very noteworthy increase in Ceylon's fish-production by about 10,000 tons/year since 1958 (Weerekoon, 1964), are to be eliminated, no more of them being introduced after 1967 (Table A3, PLAN). Instead, a larger boat, the 11-tonner or one a little larger, will be introduced and will be made "the backbone of the future coastal fishing fleet of Ceylon" (p. 5, PLAN) 2,500 of them, costing 200 million rupees, being added to the fleet in 8 years (Tables A1, C8, PLAN).

According to Kvaran (1964, pp. 304-6, Figs. 32, 33) the cost of production of fish by a 12-ton boat will probably be about 30-35 cts/lb, of which about 4-12 cts will be in foreign exchange ; by a 3½-tonner about 59 cts/lb of which 18 cts. will be in foreign exchange. So that besides being expected to catch more fish than the 3½-tonner — 125 *vs.* 25 tons/year (Table A4, PLAN), or 80 *vs.* 20 tons/year (Kvaran, 1964) — the 11-tonner is expected to catch it more cheaply and with a smaller drain in foreign exchange than the 3½-tonner[25]. This would, indeed, be a good reason for deciding to encourage the larger boat, but I cannot agree that it justifies the complete discontinuance of issues of the smaller, particularly as (i) these 3½-tonners are owned by fishermen through hire-purchase, whereas the 11-tonner will be owned and maintained by the Corporation, and merely worked by fishermen on a share basis (para 1, p. 6, PLAN). Besides (ii) the 3½-tonner provides at least twice as much employment of fishermen per rupee invested (Kvaran, 1964, p. 306 ; de Silva 1964, p. 260) ; (iii) the stoppage of issues of the 3½-tonners will mean the closure of many small boat-yards (Weerekoon, 1964) ; and (iv) the 3½-tonner has become the basis of an important method of trolling for skipjack and similar scombroid fish which has been perfected by our local fishermen to such an extent that catch-rates surpass those of American and even Japanese fishermen (Sivasubramaniam, *personal communication*[11]).

Kvaran himself was against discontinuance of the 3½-tonner. Pointing out that it had fallen into disrepute mainly because "of massive defaulting in loan repayments by hirers and because of difficulty in keeping them operating at capacity", he showed that Government policy regarding loan recovery administration, engine maintenance and repair facilities, had been responsible for both these shortcomings ; and he indicated how the drawbacks in the present scheme could be overcome instead of being taken as grounds for eliminating what he calls "this very useful type of boat" (Kvaran, 1964, pp. 306, 308-10).

On the other hand, whilst the 11-tonner *may* prove capable of catching fish more cheaply than the 3½-tonner, nowhere in their Plan do Silva *et al.* advance this as a reason for introducing the former and eliminating the latter. Instead we are told (p. 5, PLAN) that :

i. the 3½-tonner lacks facilities for sleeping and for storing fish, food, fuel and ice, and is unable regularly to stay more than a day out at sea, so that "the distant waters (*sic*) of the Continental Shelf are virtually unfished today" ; and that

ii. the 3½-tonner is not large enough to fish during most of the monsoon and must seasonally migrate to the opposite coast, or idle — so that "a good proportion of the craft is unutilised for about 6 months of the year and the waters around each coast of the country are unfished also for about half the year."

The 11-tonner, we are given to understand, will not have these shortcomings and is being introduced to solve the problems referred to in (i) and (ii) above as being caused by them (p. 5, PLAN).

But, only slight alterations *within the hull* would provide room for the facilities in (i) above — at least, for as much of them as may be necessary for inshore fishing — and the supposed lack of them is certainly not reason enough for eliminating this type of boat. Besides, in practice it is not lack of these facilities that prevents the 3½-tonner from staying out longer than she does ; it is the need to rush back with the catch before the other boats come in, so as to get the best prices from the fish-merchants who control the market. It is this need to be as nearly first in with the catch that leads to the 3½-ton boat fisherman's not icing his fish immediately it is caught — this, and the fact that a sufficient supply of cheap ice is not yet readily available in most of Ceylon's fishing villages and towns. Let the Fisheries Corporation set up buying points where the fisherman will be sure of getting good fixed prices for his catch however late in the day or night he may bring it in and however much of it he may bring, and the 3½-ton boat fisherman will have no difficulty in staying out fishing longer than he now does and in icing his fish immediately it is caught (provided enough cheap ice is available on the market). If, thereafter he still does not stay out more than a day at a time, this will simply be because he has filled his boat up with fish before that — and why should any fisherman stay out longer after that ?

The second argument Silva *et al.* use — see (ii) above — involves a much more serious mistake. The 11-tonner they believe will be able to weather the unfavourable monsoon sufficiently to fish right through it and will not have to migrate seasonally in order to fish the year round. This is not correct. The Fisheries Department operates two Canadian coastal trawlers, the " Canadian " and the " North Star ". Each is a 22-tonner, 42 ft. long and powered with an 80/90 h.p. engine, and yet is quite unable to fish in bad weather during the monsoon and has to be moved from east coast to west and back again if fishing is to be done year round (e.g., Silva, 1965, p. L92). And there is not the slightest doubt that the proposed 11-tonner, or a boat even twice that tonnage, will have to migrate from coast to coast seasonally, or idle for about half the year[26].

This failure of the 11-tonner might not in itself have mattered much, since it *may*[25] catch fish more cheaply than the 3½-tonner, but for the following circumstances :

i. The 11-tonners are being introduced not in addition to but in place of the 3½-tonners, which have several advantages over them (see p. 121 of this report).

ii. The designing and construction of fishery harbours, of ice-production plants and other facilities in each harbour, the fish transport and distribution schemes, etc., will all have been done in the belief that these 2,500 boats, the 11-tonners, will not migrate seasonally from coast to coast. Since they will certainly have to, harbours and ancillary facilities will suddenly find themselves called upon during one monsoon to accommodate and cater for several times the number of boats they were designed for ; and during the next for several times less than this number or even for none at all.

iii. And if they are not permitted to migrate they will have to idle during one or other of the monsoons and the planned catch from these boats — 312,500 tons/year by 1975, nearly 60% of the total production (p. 6 and Table A4, PLAN) — will be almost halved, completely disrupting the Plan.

6. Brackish-Water Fish-Farming.

6a. Silva *et al.* propose to start a whole new section in Ceylon's fishing industry by developing 25,000 acres of brackish-water marsh into fish-farms. From these farms is to come all the bait[27] they suppose will be needed by the industry by 1975, bait that will be used to produce most[28] of the 197,100 tons of scombroid fish to be exported. From these same farms are also to come 2,500 of the 5,400 tons of prawns to be exported. And from these exports of scombroid fish and of prawns are to come Rs. 253.665 millions of the Rs. 315.135 millions of foreign exchange which the development of fisheries according to this Plan is going to earn Ceylon annually by 1975 (Tables A2, A7, B1, B3, E9 PLAN). It is obvious that the successful development of these fish-farms is more than merely an " integral part " of their Plan ; it is a vital part. Should it fail the whole Plan must fail.

Silva *et al.* propose to produce the 12,500 tons of bait in the form of milk-fish (*Chanos chanos* (Forskal) ; S. Vekka ; T. Pal-meen) from 25,000 acres of brackish-water farms at a rate of 0.5 ton/acre/year ; that is, 1,120 lbs/acre/year.

These ponds though constructed by the Fisheries Corporation are to be leased out and worked by private persons (p. 5 and Tables A6, A7, PLAN). Can they produce what is expected of them ?

According to Hickling (1962) average production rates in the 3 countries which lead the world in this form of fish-farming are :

Indonesia ...	... 140 lbs/acre/year[29]
Philippines ...	... 267 lbs/acre/year
Taiwan ...	... 712 — 1,068 lbs/acre/year.

It is true that Pillai (1964) has claimed a rate of 3,500 lbs/acre/year in experiments conducted on a ¼ acre pond at the Fisheries Department's pilot fish-farm at Pitipane in Ceylon. But he has provided no details at all of these experiments and one does not know what total weight and number of fish were introduced into that pond ; nor whether supplementary feeding of the fish was resorted to and to what extent[30]; nor what the results were of similar experiments, if any, in other ponds of the Pitipane Farm. And it is most unlikely that Ceylon's proposed brackish-water fish-farms, tended by persons with no experience of any kind of fish-farming, will from the very first year of their existence produce on an average 25% more fish per acre (at 0.45 ton/acre/year) than the ponds in Taiwan tended by highly skilled and traditionally experienced fish-farmers ; and 7 times more, on an average, than the equally well though less intensively managed ponds in Indonesia.

The Indonesian ponds are neither fertilised (except occasionally with a little green manure) nor supplied with supplementary food. This is the case also with the Philippine growing-ponds though their nursery-ponds are specially fertilised and the fry given supplementary food. In the Taiwanese ponds very heavy fertilisation with a variety of organic manures (like rice-bran, groundnut-cake, night-soil, etc.) is carried out, and some of this will doubtless also be used directly by the fish as supplementary food, though their main food as usual is *lab-lab*, the blue-green algal mat produced in the ponds themselves by manuring and skilful management (Hickling, 1962 ; Hora and Pillay, 1962). Our Ceylon ponds, without fertilisation and without supplementary feeding, are likely to produce fish at an average rate somewhat less than the Indonesian, perhaps at a rate of about 100 lbs of milk-fish/acre/year (together with about 1/3rd. of that weight in prawns). With heavy fertilisation and some supplementary feeding it is possible that an average rate of about 300 lbs./acre/year may be achieved by 1975. But it will only be with experience gained over many years that production rates may be raised any higher.

When calculating total production one must also remember that not all the 25,000 acres of the proposed brackish-water farms will be actually productive, not all of it will be used for actually growing the fish. In Indonesia, of 198,537 acres of brackish-water farms the productive area amounts to only 142,944 acres, or 71.4% of the total acreage involved. In general, only about 73% of the area of a fish-farm produces fish — fry-holding ponds, bunds, sluices, water-channels, boat-ways and watch-huts, etc. accounting for the unproductive area (Hickling, 1962, pp. 199-200 ; Hora and Pillay, 1962, p. 179). It is certain