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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.

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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. $1\frac{3}{4}$ 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 I-I½ 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 I 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 that this condition will obtain in Ceylon too ; and at most only about 75% of the 25,000 acres converted into fish-farms will consist of productive ponds ; namely, only 18,750 acres[31]. And the probable production of bait from them by 1975 will be :

Without fertilisation (at 100 lbs/acre/year)	...	837 tons/year
With fertilisation (at 300 lbs/acre/year)	...	2,511 tons/year

In other words the production of bait from the proposed brackish-water fishery is likely to be only 1/15th of the 12,500 tons expected by Silva *et al.* ; or at best 1/5th of it.

Taking only the more favourable of these two figures into consideration and assuming that all this available bait will be given to the more efficient units, the large distant-water long-liners, and none to the 20/80-tonners and the 11-tonners, then it follows that at 20 tons per ton of bait, approximately 50,000 tons of tuna may be produced. Export of all this together with the 12,420 tons that may be produced from other sources (see Note 18), will bring Ceylon only about 71¾ million rupees a year in foreign exchange[33], less than a third of the 226½ millions expected (Table E9, PLAN).

Assuming as the Plan does, that the prawn-production from these brackish-water ponds will be 1/5th of the milk-fish production, then at best about 500 tons of prawns might be harvested from them annually by 1975, instead of the 2,500 tons expected (Table A7, PLAN). Export of this at 5,000/- per ton (Table E9) will bring 2½ million rupees ; and with the shrimp-trawler catch of about 1,450 tons[32] bringing a further 7¼ millions, the total foreign exchange earnings from export of tunas, skipjack, etc. and of prawns will at best amount to about 81½ million rupees annually by 1975 — less than a third of the 253½ millions expected under the Plan (Table E9, PLAN) ; and will impose a shortfall of 172½ million rupees,[34] or fully 54%, on the total foreign exchange earnings of 315 million rupees a year which Silva *et al.* assure us the fishing industry as developed by them will bring Ceylon by 1975 (p. 83 and Table E9, PLAN).

One should not fail to note that to achieve this production of 2,500 tons of milk-fish and 500 tons of prawns a year from the brackish-water fish-farms the Corporation would be required by this Plan to invest a sum of 133½ million rupees by 1975, 32⅓ millions being in foreign exchange (Tables C1, C2, PLAN). This is an enormous investment for so small a return ; it is an enormous investment even if the entire planned production of 15,000 tons/year of fish and prawns were achievable. By way of contrast, the 3,005 new fishing boats which are expected to produce 36 times as much fish (543,400 tons/year) will cost 632½ million rupees, or less than 5 times as much (Tables, A2, A4, C1, C8, PLAN).

Before closing this section I must draw attention to 2 curious features concerning these fish-farms : *First.* Except in the first 2 years of the Plan-period — when bait is to be imported — and in the last year, Silva *et al.* have planned to produce more bait fish from these farms than they claim they require (Table B3, PLAN). That this is not due to any realisation that types of craft other than the 3 named in Table B3 will need bait, nor to any attempt to meet some of those requirements, is clear from (i) the fact that there is no such excess at all in the last year of the Plan-period and thereafter (presumably) though the unsatisfied requirements remain; and from (ii) the way in which this excess varies erratically during the period—from 440 tons in 1968 to 520, 800, 650, 150, 1625, and 375 tons in each of the succeeding years (Table B3, PLAN). It is difficult to avoid the suspicion that Silva *et al*. have allowed a preconceived spacing of investment to decide the acreage of fish-ponds to be constructed each year, so that discrepancies have arisen between requirements and production of bait-fish as set out in their Plan. I have examined another instance of this sort of thing earlier — see p.109, Section 2 of this Report.

Second. Another curious feature concerning these fish-ponds is the way their production rate varies from 0.45 tons/acre/year during the first 2 years, 1967 and 1968, to 0.36 ton/acre/year during the next 4 years, 1969-72, and up again to 0.50 ton/acre/year during the last 3 years, 1973-75. It is of course true that, for any particular newly constructed fish-pond, production does fall off for a few years from an initial value, before returning to it and then rising beyond it. Hickling (1962), for example, mentions this phenomenon. But in fixing the production rates of their ponds in Table A7 (PLAN), Silva *et al*. have misapplied this fact about the behaviour of an *individual* pond to a *complex* of ponds of different ages ; and this has led them to making rather amusing mistakes, which emerge when Table A7 is studied in conjunction with Table A6. For example, one discovers that the production rate (in ton/acre/year) of a fish-pond in its 2nd year of functioning will be 0.45 if it began in 1967, but only 0.36 if it began in any of the years 1968—1971, and yet as much as 0.50 if it began in 1972. Another example : one discovers that, notwithstanding the phenomenon referred to earlier in this paragraph, *all* these fish-ponds, be they in their 1st., 2nd., 3rd., 4th., 5th., 6th., or 7th. year of functioning, produce at one and the same rate of 0.36 ton/acre/year in the year 1972, but of 0.50 in the year 1973. Apparently the productivity of a fish-pond built under this Plan will depend not on its age but on the particular year it was built !

6b. My criticism in this Section has so far been directed mainly at the production rate and production totals claimed for the proposed brackish-water fishery by Silva *et al*. Let us now suppose that these are in fact attainable. What of the fry needed ?

The fish to be grown in these ponds, *Chanos chanos* (Forskal), do not breed in them. They are marine fish which breed somewhere off-shore, their fry drifting inshore for the rich feeding in the shallows, particularly in the lagoons and estuaries, where they spend much of their juvenile lives before moving off-shore again. Nowhere in the world have their actual breeding sites in the sea been located ; nor has it anywhere been possible artificially to induce these fish to spawn in ponds. All fry for fish-ponds have to be collected from suitable beaches, the vast milkfish-farming industries of Indonesia, Philippines, Taiwan and indeed that of any country, depending on such collections. The fry have to be collected, sorted from the young of predatory and other undesirable species, counted, acclimatised to brackish-water, transported, stored in fry-holding ponds, grown to fingerling size in nurseries, and finally stocked into the growing-ponds from which they will ultimately be harvested. And there is a considerable mortality between collection and harvest despite the greatest care. How many fry will have to be collected for the 25,000 acre fish-farming industry which Silva *et al.* propose to build, supposing, as they do, that the entire extent will consist of growing-ponds and that each acre of pond will produce 1,120 lbs. of milkfish a year?

For use as tuna long-line bait these fish have to be about 4 ozs. or 20 cms. in size[35]; that is, 4 fish to the pound, approximately. Hence the postulated harvest of 1,120 lbs/acre/year must contain about 4 × 1,120 fish, and the harvest from the entire extent of growing ponds will contain as many as 4 × 1,120 × 25,000 = 112 million fish. Mortality between collection and harvest has already been mentioned. In Indonesia despite great experience and care mortalities are so high that 14-17 fry have to be collected for each fish finally harvested[36]. Even at the lower figure of 14 fry per harvested fish this means that Ceylon's proposed milkfish-farms will need 14 × 112 = 1,568 million fry each year. Are such enormous numbers of fry available off our Ceylon beaches that 1,568 million of them can be collected each year?

In the absence of any proper study of this problem a definite answer cannot be given to this question. Indications are that fry will not be available on our beaches in sufficient numbers. Indonesia which is in need of fry badly enough to be willing to import them, manages to collect only 380-400 million fry from her own beaches (Hickling, 1962). De Fonseka, a former Director of Fisheries, Ceylon, had issued instructions to his department in 1958 that the possibility be examined and an attempt made to export fry by air to Indonesia as a commercial undertaking (De Fonseka, *personal communication*). That such a foreign exchange earning business has not yet been started could, of course, have several reasons, but one reason might well be the lack of sufficient fry. In the absence, however, of anything definite I shall assume that fry are available in vast enough numbers on suitable beaches to permit an annual collection of 1,568 millions of them. What will this collection entail?

The collecting season in Ceylon extends over about 5 months, March-April and October-December, which means that it lasts about 150 days. But fry are not present on every day of the fry seasons; sometimes *Chanos* fingerlings take their place, sometimes neither fry nor fingerlings of this fish are present. And even when fry are present weather conditions may make collecting difficult or even impossible. Taking everything into consideration it is likely that not more than 50% of the season will offer abundant enough fry *and* good enough weather for collecting them. However, to be generous to the Plan I shall take 2/3rds. as the proportion of suitable collecting days. This means that 1,568 million fry will have to be collected within 100 days, a rate of 15.68 million fry per day. To collect, sort, count, acclimatise and bag for transport more than $15\frac{1}{2}$ million delicate fry each day, fry measuring 10-20 mm. each, is a truly enormous undertaking and one that can be achieved, if achieved at all, only by having a host of collecting units on the beaches working every day of the season.

Hora and Pillay (1962, p. 69) state that in Taiwan a single scoop-net (operated by one man?) can collect 30-100 fry per day. This seems rather low, and Hora and Pillay do themselves admit that the scoop-net is not a very efficient device, though they do not indicate how many fry per day can be collected by the various other collecting devices used in the Indo-Pacific region. In Ceylon last year 47,000 fry were collected in 2 months by the single collecting unit operated by the Fisheries Department (Silva, 1965, p. L84). This unit had to travel from Pitipane in Negombo to the collecting beaches — between Manaar and Silavaturai usually, but occasionally on the Batticaloa coast as well — and back again by lorry, covering distances of 375-400 miles on each trip. And it is therefore not likely that more than 1 trip per week was achieved ; which would mean at least 8 days of collecting on the beach during the 2 months when these 47,000 fry were gathered, giving a collecting rate of 6,000 fry per day per unit[37]. This rate too is rather low ; and may have been due to a lack of urgency about the work and to other limiting factors like a shortage of plastic bags, of oxygen cylinders, and an absence of incentives for a higher rate, all of which can be remedied. In which case it is possible that, a sorter could sort, count and acclimatise fry at a rate of about 1 fry per second, or 3,600 fry per hour. A single collecting unit of 2 men to handle the net, 1 man to receive the fry from the net and to carry them to the sorters farther up the beach, and 3 sorters (total : 6 men [38]) should be able to collect, sort, etc., and prepare for transport in polythene bags topped with oxygen, $8 \times 3 \times 3{,}600 = 86{,}400$ fry per day of 8 working hours. To be generous once more to this Plan, I shall suppose that these men will work 25% faster than this and will, in fact, attend to about 100,000 fry per day. At this rate the 15.68 million fry which have to be collected each day will need 156.8 collecting units, consisting of 940 men. Adding 10% to replace absentees we get a total collecting staff of 1,034 men of whom half (517) will be specially skilled, the sorters.

For transporting these fry a lorry could carry 50 large plastic bags (capacity : 8-10 gallons) each holding about 2 gallons of water and about 2,000 fry per gallon,[39] the rest of the space in each bag being filled with oxygen. Each lorry would therefore transport about 200,000 fry at a time, and the day's collection of 15.68 million fry would need 78 lorries for their transport. Assuming that transport from collecting beaches to fry-holding ponds will be by night, and will be completed within the night, then a total of 234 lorries[40] will be needed each day, distributed as follows :

On beach for loading up (driver and mate working also as part of collecting unit[38].)	78 lorries
Discharging at fry-ponds ; and resting between alternate nightly trips.	78 ,,
Returning by night to collecting beach	78 ,,
Total	234 ,,

Adding 10% to the above figure to account for lorries that will be off the road for maintenance and repair, one gets 257 as the size of the fleet of lorries needed. A crew of 1 driver and 1 mate for each of the 234 lorries on the road at any one time, and 10% extra to take care of absentees, will make a total transport staff of 514 men. Together with the collecting staff of 1,034 this makes a total staff of 1,548 men needed for the collection and transport of 1,568 million *Chanos* fry each year for the fish-farms. Have Silva *et al.* provided for this in their Plan ?

Even at a mere 20 thousand rupees each, the fleet of lorries will cost something over 5 million rupees. Table C10 (PLAN) indicates, however, that only Rs. 0.980 million has been provided for the purchase of vehicles for the development of the proposed brackish-water fish-farming industry. Even if one assumes that the whole of this amount will be spent on lorries for transport of fry, there isn't enough for more than 1/5th. of those needed. In fact, however, one cannot make that assumption : the allocation of Rs. 0.980 million will have also to be used for the purchase of mechanical earth-moving equipment for the construction of the 25,000 acres of fish-farms. The use of manual labour for this purpose is so uneconomical that in Indonesia, where convict-labour, which had been used decades ago for constructing most of the present pond area, is no longer available, the pond area is not expanding at any significant rate today despite the great demand for these pond-cultivated fish (Hickling, 1962, pp. 187, 197-200; Hora and Pillay, 1962, p. 4). It is unlikely that manual labour for pond construction will be any less un-economical in Ceylon; and when the necessary earth-moving equipment has been purchased there will be little money left for fry-transport lorries.

What of the staff ? Table D9 of the Plan which sets out the distribution of total employment that it will give, indicates that 7,500 persons will be employed in connection with the brackish-water fishery. But a comparison of the annual increase in number of persons thus employed (Table D9, PLAN) with the increase in extent of brackish-water farms (Table A6, PLAN) soon makes it clear that these 7,500 men are the fish-farmers themselves and do not include the 1,548 men needed for the collection and transport of fry. The only other group that might include these men is that named 'Ancillary Production and Services', (Table D9). But since for the entire fishing industry Silva *et al.* have assigned only 4,446 persons for such ancillary services, it is not likely that they have included amongst them the 1,548 persons needed to collect and transport *Chanos* fry. This is confirmed by the fact that they have not provided for the wages of these persons, Table D5 (PLAN) which sets out incomes derived from the brackish-water fish-farming industry including a mere Rs. 0.671 million in the item "Service incomes" whereas at least about Rs. 2.786 millions, or more than 4 times as much, is needed. For, of these 1,548 men 517 will be sorters and 257 will be drivers, specially skilled men. At an all-inclusive wage of even Rs. 200 p.m. for each skilled worker and Rs. 100 p.m. for each of the other workers, the annual wage income earned by the 774 skilled and 774 other workers, will be Rs. 1,857,600 and Rs. 928,800 respectively, or Rs. 2,786,400 in all[41].

6c. Finally there is the question of the cost of this bait to the local tuna long-line fisherman to be considered. Calculating from Tables D5, E9 and A7 (PLAN), one finds that Silva *et al.* expect that the bait-fish produced by the fish-farms will be sold at 64.7 cts/lb., at least. The 2,500 tons of prawns they hope to harvest each year from these ponds by 1975 (Table A7) are priced at Rs. 5,000 per ton (Table E9) and will therefore fetch a total income of Rs. 12.500 million. But the total income earned by sale of both fish and prawns harvested from these ponds has been fixed at Rs. 30.625 million (Table D5). Hence the sale of the 12,500 tons of bait-fish which Silva *et al.* expect from these ponds must account for the difference — Rs. 18.125 millions. This is equivalent to 64.7 cts/lb.

This price includes, amongst other components, the cost of services and Table D5 sets aside a sum of Rs. 0.671 million for services in producing the 15,000 tons of fish and prawns in these farms ; or just under 2 cts/lb. But it has just been shown (Section 6b above) that the wages of the staff needed just for collecting and transporting the fry will amount to about Rs. 2.786 millions, and the whole of this sum will enter the value of the 112 million fish harvested each year. It works out at 2.5 cts per fish or 10 cts/lb since 4 fish will weigh a pound — instead of the 2 cts/lb allowed for in the PLAN. Hence the cost of bait-fish from these ponds will not be 64.7 cts/lb but about 73 cts/lb (64.7 — 2 + 10 = 72.7) ; or even 81 cts/lb[42].

Imported bait costs Ceylonese tuna long-line fishermen today about 66.4 cts/lb[43]. This, as pointed out by Sivasubramaniam (1964a) and by Kvaran (1964), is twice as much as it costs his Japanese counterpart fishing in the Indian Ocean and is one of the reasons why he cannot produce tuna from it as cheaply as the Japanese does. With his bait costing 73-81 cts/lb after the Plan has been implemented he will find it even more impossible to compete with the Japanese. And one of Ceylon's new 250 G.T. long-liners using this bait will produce tuna at a cost of rather more than 84 cts/lb.; and export of this at Rs. 1,150 per ton or 51.3 cts/lb, as postulated in Table E9 (PLAN), will be impossible unless heavily subsidised (see Sections 3c, p. 115 ; and 4d (i), p. 118).

6d. One final aspect of the proposed brackish-water fish-farming industry needs mentioning : Pillai (1964, p. 289) claims that milkfish sells easily for human consumption at Rs. 1 per lb. If this is so one wonders how Silva *et al.* propose to ensure that the fish-farmers sell their harvest of milkfish to the Corporation cheaply enough for the latter to issue it to the tuna long-line fishermen for use as bait at 64.7 cts/lb, or even at 73-81 cts/lb. This will prove a particularly difficult task when, according to the Plan, the average retail price of fresh fish consumed in Ceylon in 1975 will be Rs. 1.15 per lb,[44] For, the fish-farmers will naturally wish to sell their fish at the best prices and not necessarily to the Corporation. And should lease conditions be imposed to compel sale to the Corporation at its price it is likely that stocks of fish in the ponds will begin to dwindle and may even disappear "from sudden and accidental mortalities", "from heavy and persistent attack by birds and other predators like otters, tarpon and giant perch" and for other such "natural causes beyond the fish-farmer's control". The Corporation may have its suspicions but will be able to do very little effectively about them. The farmer, after all, will be his own watchman.

7. Fish in the Local Diet.

Silva *et al.* state that although the highest priority has been given in their Plan to the export of all exportable varieties of fish in order to earn the foreign exchange needed to finance the Plan, nevertheless domestic consumption of fish as food will also be increased from the present 189,000 tons/year to 353,000 tons/year in 1975, that is from the present 38 lbs/person/year to 53 lbs/person/year in 1975 (p 25, PLAN). However, my examination of their Plan in the preceeding sections of this report has shown that many of their production targets are completely beyond realisation for a variety of reasons ; and it is therefore necessary now to inquire what effect this will have on their promise of this very considerable increase[4] in the amount of fish to be eaten in Ceylon by 1975 if their Plan is implemented.

Of a total planned production in 1975 of 678,400 tons, a quantity of 15,000 tons was to have come from the fish-farms (Table A8, PLAN), 125,900 tons from distant seas (Table A4, omitting catch of the 11ton and the 20/80 ton boats), and 537,500 tons from coastal waters (Tables A4, A8, PLAN). Whatever is harvested from the fish-farms will be used as bait or for export. And, as has been shown in Section 2 of this report, the harvest from our coastal waters will not exceed about 266,000 tons/year. Hence the maximum possible production under this Plan from the sea will be no more than about 391,900 tons/year (266,000 + 125,900).

The shortage of bait discussed in Section 4 of this report means that 173,870 tons/year of this cannot be caught ; and that leaves a possible harvest of only 218,030 tons/year (391,900 — 173,870). Of this amount 62,420 tons will be tuna, skipjack and similar scombroid fish (Section 4 and Note 18 of this report) and 1,450 tons will be prawns (Note 32a) ; all of which will have to be exported to earn whatever fraction can still be earned of the foreign exchange expected under the Plan. This will leave just 154,160 tons/year for consumption locally as food. This is about 3/7ths. of the 353,000 tons/year promised under the Plan and will mean an average consumption in 1975 of 23 lbs/person/year instead of the promised 53 lbs. In other words, an attempt to implement this Plan will not bring any increase in the local consumption of fish as food, but will instead lead to a decrease from the present 38 lbs/person/year to a future 23 lbs/person/year by 1975.

8. Summary and Conclusions.

An examination of certain fishery aspects of the 10-year Plan proposed by Silva *et al.* (1965) for the development of Ceylon's fishing industry has been made.

i. It shows that the production target for the coastal fishery has been fixed at a figure (537,500 tons/year by 1975) more than twice as high as the potential catch from our coastal sea (266,000 tons/year). As a result production from the sea, both coastal and distant, cannot be more than 391,900 tons/year though the Plan expects 663,400 tons/year.

ii. And although for the implementation of this Plan about 15,566 tons of bait will be needed annually by 1975, Silva *et al.* have provided in it for the production and use of only 12,500 tons of fish as bait (all of it dead-bait).

iii. This 12,500 tons of bait is to come from a new 25,000 acre brackish-water milkfish-farming industry which is to be set up. But the production rate of these fish-ponds has been greatly over-estimated at 1,120 lbs/acre/year, whereas it is more likely to be between 100 and 300 lbs./acre/year ; and therefore, at best, only about 2,500 tons of bait-fish will be produced from these farms annually by 1975.

iv. This makes a total bait shortage of 13,066 tons/year, which represents a further reduction of 173,870 tons/year in the fish harvest. The maximum possible catch from the sea will therefore be a mere 218,030 tons/year instead of the 663,400 tons/year expected under this Plan.

v. Most of the fishing fleet will be affected by this shortage of bait, but in particular (a) the 20 pole-and-line boats, costing 20 million rupees, which will need about 720 tons of live-bait to achieve their target of 20,000 tons/year of skipjack and similar scombroid fish, but will get no bait at all ; and (b) the 100 large long-line boats, costing 175 million rupees, which will need 4,000 tons/year of dead-bait to achieve their target of 80,000 tons of tuna and similar scombroid fish, but will receive 2,500 tons — and that too only if the entire milk-fish production of the ponds is given them — and will therefore be able to catch only 50,000 tons/year.

vi. Though the Plan requires about 221,100 tons of tuna, skipjack and similar scombroid fish to dispose of by 1975 (197,100 tons in exports to earn much needed foreign exchange with which to finance the Plan) yet the bait shortage means that no more than 62,420 tons of them can be caught. Even if all this is caught and exported at price envisaged (51.3 cts/lb) only about 71¾ million rupees will be earned in foreign exchange instead of the 226½ million rupees expected from this source.

vii. In fact, sale of this fish at 51.3 cts/lb will not be possible on the world market unless subsidised, especially in the case of the 50,000 tons of tunas from the large long-line fishing boats which will have cost at least 60-84 cts/lb to produce even with bait costing about 66.4 cts/lb as at present when it is imported. With bait costing 73-81 cts/lb, as it is likely to when produced by the new fish-farms, this subsidy will have to be much larger.

viii. And when all the 62,420 tons of scombroid fish produced annually by 1975 have been exported to earn 71¾ million rupees of foreign exchange, there will be none left for canning nor for curing into Maldive fish. The elimination of imports of canned and of Maldive fish promised in the Plan will be impossible ; and these items will account for a foreign exchange drain by 1975 of about 18½ million rupees annually.

ix. There will also be no tunas, skipjack and similar fish left for domestic consumption in Ceylon, the demand for which today accounts for about 4,000 tons/year and is not likely to be any less by 1975.

x. Besides this, the impossibility of achieving its production targets in general will mean that any attempt to implement this Plan in its present form will actually result in a decrease in domestic consumption of fish from 38 lbs/person/year as at present to about 23 lbs/person/year by 1975 ; instead of increasing it to the 53 lbs/person/year promised in the Plan.

xi. Changes in the fishing fleet are vitally important in any plan for the development of a fishing industry, yet this whole matter has been unsatisfactorily dealt with by the authors of this Plan. For example : Nowhere have they stated the sizes of any of the larger fishing boats which they propose to introduce at a total cost of 257½ million rupees, all of it in foreign exchange. Yet on size will depend range and probable fishing-grounds, catch-rate and cost of fish-production, and many other matters so important for a satisfactory assessment of each proposed introduction.

xii. And in the hopes of fishing our coastal waters in the teeth of bad monsoonal weather and of preventing the coast-to-coast migration that occurs at present with each change of monsoon, Silva *et al.* propose to introduce 2,500 units of a new and as-yet untried type of boat, 11 tons or a little larger in size, as the backbone of the future coastal fishing fleet — eliminating in the process (a) our traditional beach-landing craft, so important to a country like Ceylon with few natural harbours or shelters, and (b) the tried and successful 3½ ton modern craft which has been so largely responsible for the spectacular increases in the island's fish-production over the past decade. Experience of fishing boats even 22 tons in size shows that the 11-tonners will not be able to fish in bad monsoonal weather and will be compelled to migrate if fishing is to be year-round. And this will completely disorganise harbour facilities, transport and distribution schemes, etc., established under the Plan.

xiii. Another example that deserves mention in this summary : Over 42½ million rupees, all of it in foreign exchange, is to be spent on introducing 35 large fishing boats of 5 different specialised types, in order to investigate the fishery potential of the Indian Ocean beyond our coastal sea. Yet this investigation could be carried out much more efficiently by 1 or 2 research vessels each suitably equipped for several different methods of fishing, and each costing only 1-1½ million rupees. Furthermore, each of the 35 fishing boats has been assigned a very high fish-production target, and this will ensure that it will have little freedom, if any, for investigation.

xiv. One cannot help but conclude that the shortcomings of this Plan, are so fundamental as to ensure both complete failure to achieve all its major production targets and also much damage to the local fishing industry in the attempt to achieve them.

9. Acknowledgement.

I am grateful to Dr. P. L. D. Waidyasekera for the Sinhala translation of the above Summary and Conclusion which appears at the end of this paper.

NOTES

1. The author was in charge of the Fisheries Research Station, Colombo, from November 1961 until he resigned from that position in May, 1965. The report now published is substantially that which he sent to the Minister of Fisheries in June 1965.

2. They had been officially appointed the first Directors of the newly established Ceylon Fisheries Corporation in October 1964, but had actually been nominated earlier and had been at work since August 1964.

3. This publication by Silva, Withana, De Silva, Wickramaratna, and Kadirgamar (1965) will hereinafter be referred to by the abbreviation PLAN.

4. Per capita consumption of all kinds of fish (fresh, cured and canned) is planned to increase from 38 lbs (wet-fish equivalent) in 1965 to 53 lbs in 1975. It is interesting, therefore, to note that in 1958 Japan with 48.4 lbs had the highest per capita consumption in the world, Sweden with 39.6 lbs taking fifth place, and Britain with 22.0 lbs taking tenth place after her ; and that Silva *et al.* (p. 33, PLAN) believe that Ceylon's present per capita consumption of 38 lbs/year is low.

5. The Pedro Bank is a relatively shallow area of sea-bed continuous with and extending Ceylon's continental shelf to the north-east of the Island. Starting near Mullaitivu, it stretches across to and is continuous with the south-eastern part of the Indian continental shelf around Cape Calimere. As in a classical continental shelf the sea-bed of the Pedro Bank slopes gradually to the 100 fathom contour before falling away sharply to abyssal depths. That part of the Bank within the 50-fathom contour and outside India's territorial waters must be assumed to have been included by Silva *et al.* within the first 3 depth-zones in the Table on p. 3 of the PLAN. The remaining part, between the 50 and 100 fathom contours, amounts to about 500 sq. mls.

Incidentally, it is interesting to note that having included the Pedro Bank within Ceylon's coastal fishing area (Table, p. 3, PLAN), Silva *et al.* also count it as one of the areas available for exploitation in a distant-water fishery of the Indian Ocean (para 1, p. 7, PLAN).

6. It is clear from the context that what is meant is a distant-water fishery, though the words "deep-sea fishery" are used.

7. It is interesting to note that whilst Silva *et al.* propose to work these grounds — at least on a semi-exploratory basis (para 3, p. 4, and para 1, p. 7, PLAN) — they are not introducing any such large hand-line fishing boats (Table A1, PLAN). This must mean that they actually hope to use bottom long-liners or bottom-trawlers on these Banks despite Wheeler's experience and advice.

8. The shark catch has been left out of account in these calculations. If this is brought back the fish-hold could, of course, be filled about twice as quickly. But the value of the total catch would fall very markedly since shark fetches in Ceylon only 1/3rd. to 1/5th. the price commanded by these " mullets ". As already mentioned little shark if at all is brought back from the Wadge Bank.

9. Baleya forms almost 40% of all the scombroid fish taken in our coastal fisheries. Atavalla or Mackerel Tuna, *Euthynnus affinis* Cantor, and Alagoduwa or Frigate Mackerel, *Auxis thazard* (Lacapede), form about 25 and 15% respectively, and are taken mainly by trolling (55%) and only secondarily by pole-and-line (30%). The Kelavalla or Yellow-fin Tuna, *Thunnus albacares* Bonnaterre, forms about 20% of the scombroid catch and is taken mainly with the long-line (c. 40%) and troll-line (c. 30%), the pole-and-line accounting for a little less than 20%. The As-gedi Kelavalla or Big-eye Tuna, *Thunnus obesus* Lowe, and the little Thora Baleya or Bonito, *Sarda orientalis* Temminck and Schlegel, form less than 1% each of our coastal catch of scombroids (Sivasubramaniam, *personal communication*[11]).

Our scombroid catch by the existing types of small coastal fishing craft has shown a small but steady increase from about 2,000 tons/year in 1950 to about 4,000 tons/year in 1964, and is likely to reach 10,000 tons/year by 1975 (Sivasubramaniam, *personal communication*). If I assume that the proportions contributed by the different fishing methods remain the same in 1975 as at present, then these 10,000 tons will be made up as follows :

		Catch by Method of Capture (tons/year)			
	Total Catch	*pole-line*	*long-line*	*troll*	*other*
Kind of Fish	*(tons/year)*	*(live-bait)*	*(dead-bait)*	*(bait-less)*	
Skipjack (Baleya)	4,000	2,800	—	800	400
Mackerel Tuna (Atavalla)	2,500	750	—	1,375	375
Frigate Mackerel (Alagoduwa)	1,500	450	—	825	225
Yellow-fin Tuna (Kelavalla)	2,000	400	800	600	200
Various Scombroids	10,000	4,400	800	3,600	1,200

I am aware that the assumption of proportionate increase is open to objection but use it for want of a better method of forecasting. In fact, if more live bait is available the pole-and-line catch would be considerably higher that shown above — see Section 4c main report, p. 117.

10. These existing types of small coastal fishing craft include both the traditional craft, like the outrigger-canoes, and the modern planked and motorised 3½-tonners, commonly called " mechanised boats ". I shall refer to them collectively as the E.T.S.C. hereafter. The new types of coastal craft which the Plan proposes to introduce, the 11-ton and the 20/80 - ton boats, I shall refer to collectively as the N.T.S.C.

11. Subsequently published ; see Sivasubramaniam, 1965.

12. This is exclusive of the relatively small harvest from our fresh-waters, which amounted to about 4,300 tons/year by 1963 (Balasuriya, 1964). As the whole of this harvest is used for human consumption it makes no difference to the arguments in this Section on the allocation of bait. Incidentally, Silva *et al.* (para 1, p. 5, PLAN) have quite incorrectly decided that planning the development of fresh-water fish-production is not now possible. This is unfortunate as it has been shown (Weerekoon, 1964) that there has been, in the seven years since 1957, an eleven-fold increase in production in return for a relatively negligible expenditure.

13. On Canadian and other good fishing grounds 1 lb. of dead-bait brings in about 15-20 lbs. of catch. Medcof (1963) has reported that in Ceylon's coastal waters 1 lb of bait brings in only about 10 lbs of catch, perhaps because of the smaller size of the fish caught. In estimating missing bait (of the 3 bottom long-liners) I have used the highest of these ratios (20 catch : 1 bait) ; in estimating missing catch due to non-provision of bait (for the E.T.S.C. and the N.T.S.C.) I have used the lowest (10 catch : 1 bait) — in each case so as to be as generous as possible to the authors of this Plan.

14. There is, of course, little likelihood of all the components of the catch increasing in proportion. Sivasubramaniam (*personal communication*) feels that it would be safer to try to assess individual trends in the different components of the coastal fish-catch over the past several years, however incomplete the statistics may be. On this basis he estimates that about 5 times as much bait will be needed by 1975 as is used annually now. That is to say, the bait requirements of the E.T.S.C. will be about 5,000 tons in 1975. I agree that this is a safer estimate ; but since it is about 3 times larger than that obtained on the assumption of proportional increases I have used the latter in this assessment of the effects of non-provision of bait on Plan targets, so as to be as generous to the authors of the Plan as possible.

15. The 11-tonner is being introduced to replace the present 3½-tonner and must, presumably, operate at least those fishing methods used by the latter, one of which is pole-and-line fishing. The 20/80-tonners have been specifically named by Silva *et al.* (para 4, p. 6, PLAN) as using pole-and-line among other fishing methods.

16. This shortfall of 115,000 tons/year will be made up as follows :

No. and Kind of Boats	*Bait Quota (tons) acc. to PLAN*	*Catch (tons) acc. to PLAN*	*Missing bait (tons)*	*Missing catch (tons)*
100 Tuna Long-liners	4,000	80,000	1,500	30,000
350 20/80-tonners	3,500	105,000	3,500	35,000[13]
2,500 11-tonners	5,000	312,500	5,000	50,000[13]
Total	12,500	497,500	10,000	115,000

In other words failure of the brackish-water fish-farms has rendered more than 1/6th of the planned production imaginary.

Of this total shortfall of 115,000 tons/year by 1975, a quantity of 30,000 tons represents tunas that might have been brought in by the long-liners. Some of the shortfall in the case of the N.T.S.C. will also represent tuna. Silva *et al.* do not anywhere in their Plan state what they expect this quantity to be ; but it is possible to arrive at some sort of estimate. Note 17, below, shows that at least 8,350 tons of the 41,750 tons of scombroid fish that should, according to the Plan, be taken by the N.T.S.C. would have been tunas. Assuming proportional contributions to the catch by different fishing-methods remain the same as indicated in Note 9, then 40% of this 8,350 tons would have been taken with dead-bait and the long-line, that is 3,340 tons.

17. Table B1 (PLAN) which states that 197,100 tons of tuna, skipjack and similar scombroid fish are to be exported by 1975, also implies that Silva *et al.* expect to have *at least* 221,100 tons of these fish to dispose of annually by then, thus :

197,100	tons/year		for export
10,000	,,	,,	for canning[19].
10,000	,,	,,	for curing into Maldive fish[20].
4,000	,,	,,	for domestic consumption in fresh state[21].
221,100	,,	,,	

But though they have planned to dispose of about 221,100 tons of scombroid fish annually by 1975, their production plans indicate a much smaller catch, thus :

No. and Type of Boats		*Quantity (tons) and Nature* of Catch*	*Authority for statement*
100 Tuna Long-liners		80,000 Tuna	Table A4, PLAN.
20 Pole-and-liners		20,000 Skipjack	,,
12,250 E.T.S.C.		10,000 Tuna 2,000 Skipjack 8,000	Note 9 of this report.
2,500 11-tonners	N.T.S.C.	31,250 Tuna 6,250 Skipjack 25,000	Note 9 and Section 46 of this report
350 20/80-tonners	N.T.S.C.	10,500 Tuna 2,100 Skipjack 8,400	,,
all boats		151,750 Tuna and Skipjack†	

Planned production therefore is about 70,000 tons/year short of planned disposal. And one wonders whether Silva *et al.* missed noticing this because they had assumed that all the dead-bait they assigned to the 20/80 - tonners would be used in tuna long-lining, and none for any other types of line-fishing. If such an assumption had been made these 350 boats would be expected to produce 70,000 tons of tuna with the 3,500 tons of dead-bait assigned them ; instead of the mere 2,100 tons indicated in the Table above. But this assumption cannot legitimately be made. In the first place it contradicts their own statement (para 4, p. 6, PLAN) that these 20/80-tonners will be used for other types of fishing as well, including bottom long-lining. In the second place it requires that the narrow strip of our coastal sea which these boats will fish, extending only a little beyond the edge of our continental shelf (para. 4, p. 6, PLAN ; Section 2 of this report), will contain such large stocks of tuna as to be able to yield a catch of 70,000 tons of them a year. These large tunas are oceanic fish, and it is only the fringes of their populations that enter coastal seas. The Japanese today range over almost the whole Indian Ocean (area : c. 32 million sq. mls.) to gather their present catch of about 100,000 tons of tuna a year from it. Even Silva *et al.* themselves propose to send their 100 large tuna long-liners over the whole Indian Ocean for their catch of 80,000 tons of tuna a year. It would be quite wrong to suppose that our narrow coastal sea can yield anything like 70,000 tons of tuna a year.

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*Only the main type of scombroid fish caught is named.

†Besides these 151,750 tons/year, there will also be about 80 tons of Frigate Mackerel taken in the beach-seines, but this is too small a contribution to make any difference to the conclusions. The 5 trawler-seiners (Tables A1, A2, PLAN) may also catch some skipjack, but I have omitted them from consideration since these boats are to be experimental—see Section 5d of this report.

18. Of the planned production of 151,750 tons of scombroid fish (see Note 17) the shortage of bait discussed in Section 4 (*a* to *c*) of this report will mean a maximum possible production of 74,840 tons contributed by the different types of boats as follows :

No. and type of boats	*Target in PLAN (tons)*	*Shortfall from lack of bait. (tons)*	*Balance (tons)*
100 Tuna Long-liners	80,000	30,000	50,000
20 Pole-and-liners	20,000	20,000	—
12,250 E.T.S.C.	10,000	5,200	4,800
2,500 11-tonners	31,250	16,250	15,000
350 20/80-tonners	10,500	5,460	5,040
All fishing craft	151,750	76,910	74,840

These figures are based on the assumption that the coastal sea can yield 537,500 tons of fish a year as claimed by Silva *et al.* in their Plan. But as shown in Section 2 of this report its potential yield is only about 266,000 tons/year — that is, about half the quantity claimed. Hence the E.T.S.C. and the N.T.S.C. which will be exploiting this coastal sea are more likely to land just half the catch of 24,840 tons indicated in the Table above. This 12,420 tons of scombroids from the coastal sea together with the 50,000 tons brought in from distant-waters by the large long-liners makes a maximum probable scombroid catch of only 62,420 tons/year instead of the 221,100[17], required by the PLAN.

19. Though Silva et *al.* have omitted to state the kind of fish to be canned, it seems fairly certain, from what Kvaran (1964, p. 302) reports, that tunas are expected to form the main raw material for the canneries referred to in Table C9 (PLAN) as costing about 31½ million rupees.

20. Though Silva *et al.* do not state anywhere in their Plan the quantity of fish they propose to convert into Maldive fish by 1975, they do state on p. 26 of the PLAN that "there would be some increase in the per capita consumption of Maldive fish". Imports in 1964 were about 8,100 tons (wet-weight equivalent) as reported by Silva (1965, p. L60). Therefore by 1975 about 10,000 tons (w.w.e.) is likely to be needed if one is to provide the increase contemplated in the Plan.

21. Some of the 214,000 tons of fresh fish to be consumed locally each year by 1975 (Table B1, PLAN) must be skipjack, tunas and similar scombroids. At present (1964) about 4,000 tons of these fish are caught[9] and all this is consumed locally in the fresh state. Silva *et al.* propose to double the local consumption of fresh fish (pp. 25-6, PLAN), and it is not unreasonable to expect that the local consumption of these fish by 1975 will not be less than it is at present, even though a proportional increase to 8,000 tons may not have been envisaged by them.

22. I have included the 20 trawlers referred to in Tables A1 and A2 (PLAN) with the other existing type of non-traditional craft, the 3½-tonner, 500 more of which are to be introduced (Table A3, PLAN).

23. The Government and private sector investment of 17¼ million rupees is to be concerned with the programme of mechanising traditional craft (8¼ million rupees) and with the introduction of the additional 500 units of 3½ ton boats during 1965/6 and 1967 (9 million rupees) — see Tables C8, C4, A3 and p. 34, PLAN.

24. As a matter of fact, the catch-rates of 2 kinds of these boats, the pole-and-liners and the bottom long-liners, are the highest fixed for any type of boat in this Plan, namely 1,000 tons/boat/year.

25. It must be noted that in the case of the 11-tonner, figures of both catch and costs are speculative since we have no experience worth mentioning of any of these boats in operation, as Kvaran himself admits when pointing out that at the time of his report (November, 1964) only one such boat had been put into operation (Kvaran, 1964, p. 305). In the case of the 3½-tonner we have the statistics and experience of more than half a dozen years and many hundreds of boats.

26. Of course, fishing on the relatively calm days that occur within an unfavourable monsoon period will always be possible — not only for these 11-ton boats but also for the 3½-tonners *and* for the even smaller traditional craft, as indeed happens today.

27. See however Section 4b on p. 116.

28. About 153,300 tons/year produced as follows from :

100 Tuna long-liners	...	80,000 tons	(at 20 tons/ton bait)
350 20/80-tonners	...	70,000 ,,	(,, but see Note 17)
2,500 11-tonners	...	2,500 ,,	(See Notes 9 & 17)
12,250 E.T.S.C.	...	800 ,,	(,,)
		153,300 tons	

29. Besides milkfish, Hickling reports that the Indonesian ponds produce another 46 lbs of prawns and 23 lbs of wild fish per acre per year on an average, making a total of 209 lbs/acre/year.

30. Supplementary feeding can easily double or treble a crop (Hickling, 1962, p. 125). In case Silva *et al.* hope to achieve their postulated rate of 0.5 ton/acre/year by heavy supplementary feeding, it is necessary to note that a conversion rate of food into fish of 5 : 1 will apply (op cit., pp. 142, 164, 166, 179). So that for the 0.5 ton of fish to be harvested 2.5 tons of supplementary food will have to be added per acre per year ; or if pond fertilisation and management is skilful enough to provide the blue-green algae needed for half this weight of fish, then 1.25 tons/acre/year will have to be added. For 25,000 acres of ponds this will amount to 62,500 tons (high) or 31,250 tons (low) of supplementary food annually.

Even if rice-bran at 10 cts/lb is used the cost will amount to about 7-14 million rupees per year. Table D5 (PLAN) shows that the cost of *all* materials (stores, fertilisers, food, etc.) consumed in running these fish-ponds has been estimated at 6½ million rupees, and indicates that provision has not been made for all this supplementary feeding ; and that intensive supplementary feeding is not the explanation for the belief of the authors of the Plan that it will be possible to harvest 0.5 ton/acre/year of milkfish from the proposed fish-ponds. In any case such supplementary feeding is uneconomical in brackish-water fish-culture (Hora and Pillay, 1962, p. 175).

31. Even if it is argued that the figure of 25,000 acres quoted in the Plan is exclusive of bunds, channels, etc. it must be conceded to include fry-storage ponds. It cannot be claimed that these are to be built *in addition* to 25,000 acres of growing ponds, for there is clearly no financial provision in the Plan for building them. Since 1,568 million fry per year (p. 127) have to be collected and stored till they are needed for the growing-ponds, a holding-rate as high as 100 fry/sq. metre, or about 400,000 fry/acre, which is twice as high as the rate in the fry-ponds of the Philippines, will still mean that about 3-4,000 acres of fry-ponds will be required. And these alone will form 12-16% of the 25,000 acres.

32. (*a*) With a maximum of 500 tons of prawns likely from the brackish-water farms and of 1,450 tons from the shrimp fleet (see Section 5(d) of this report), the maximum possible foreign exchange earnings from prawn exports will be 9¾ million rupees (1,950 × 5,000/-) instead of 27 millions.

(*b*) Incidentally, the shrimp mother-boat with its attendant catchers is a strange introduction (Table A4, PLAN). This unit will be catching only 25% more than a shrimp trawler but will cost almost 90% more (Table C8, PLAN). Perhaps Silva *et al.* have reason to believe that it will catch these prawns more cheaply ; but if they do, they do not say so anywhere in their PLAN.

33. Since as shown by Kvaran (1964, p. 301), the foreign exchange component — due to cost of ship, spares, fuel, gear, etc., — in the cost of production of tuna by a 250 G.T. long-liner is itself about 40-50 cts/lb., it follows that sale, for 57½ million rupees at 51.3 cts/lb., of these 50,000 tons of tuna caught by them will bring Ceylon a relatively negligible nett earning of foreign exchange of between 1½ and 11½ millions only. For the entire 62,420 tons of scombroid fish exported this nett earning of foreign exchange is likely to be about 20-30 million rupees.

34. It should not be forgotten that this shortfall of 54% is on the basis of the most favourable production figures for the proposed fish-ponds ; that is, 1/5th. of the estimate by Silva *et al.* As has been shown earlier it is at least as likely that production will be only about 1/15th. of this estimate.

35. This size is reached in 5-6 months, so that if the fish are not to grow too large for use as tuna long-line bait there will have to be 2 harvests a year, each yielding 0.25 ton/acre ; but this will make no difference to the calculations that follow.

36. In Indonesia 142,944 acres of productive ponds produce at an average rate of 160-180 fish/acre/year. The entire harvest would therefore number about 22.8 - 25.4 million fish. For this harvest between 380 and 400 million fry are collected annually from the beaches. This works out at a rate of 14-17 fry collected per fish harvested (Hickling, 1962, pn. 190, 197-200). Hora and Pillay (1962) confirm that mortalities are very high. For example, they quote the figure of 70% as mortality in the nursery-pond stage alone in Indonesia.

In Ceylon no proper study has been made of this problem, but the most recent (April, 1965) harvest of the 2.68 acre fish-pond at the Pitipane fish-farm revealed a mortality of about 50% in the growing-pond stage alone. The corresponding figure for Indonesia is 10-20% (Hickling, 1962, p. 197). Admittedly the fish remained nearly twice as long in this case as is usual in Indonesia ; but that is not likely to have accounted for all the difference, since fish mortalities are generally higher during the earlier than during the later stages of their growth. In any case this very high mortality of 50% in this experimental harvest confirms that the overall mortality in Ceylon's proposed fish-farms will certainly not be less than that in Indonesia, and that *at least* 14-17 fry will have to be collected from our beaches for every fish it is hoped to harvest from the ponds.

37. If there had in fact been more trips than one per week, then the number of days of collecting would have been higher and the number of fry collected per day would have been lower.

38. More sorters per unit would require an increase in the number of " bucket-men ". The two " net-men " in the unit use the net to catch the fry ; the " bucket-man " carries after them the bucket of water into which the fry are gathered from the net and in which they are taken to the 3 sorters stationed farther up the beach. Bagging the fry after they have been dealt with by the sorters is done by the driver of the lorry and his mate who, I have assumed, will assist the collecting unit in this matter.

39. According to Pillai (1962, p. 21) approximately 500 fry can be carried in a litre of water. Hora and Pillay (1962, pp. 103-4) in a much more complete account give the figure 400-500 fry/litre, which is equivalent to 1,800-2,250 fry/gallon. Of course the larger the fry the fewer of them that can be transported per gallon ; and Hora and Pillay's figure refers specifically to the 10-20 mm fry we are considering.

40. (*a*) Assuming transport across 185-200 miles. The construction of fry-holding ponds at or near the collecting beaches will not materially reduce the number of lorries that will be needed ; for the fry will still have to be transported to the nursery-ponds on the farms. Nor will the construction of these nursery-ponds for the growing of fry to fingerling size near the collecting beaches before transporting them help. For though there will be much fewer fish to transport much fewer can be transported per litre of water because of their greater size and activity. For example: whereas at 10-20 mm. 400-500 fry can be transported per litre, at 30 mm. only 150-200, and at 40 mm. only 80-120 fry can be transported (Hora and Pillay, 1962, p. 104). Indeed these authors specifically state that the transport of fry longer than 50 mm., that is fingerling-sized fish, is considered uneconomical.

Reduction in the number of lorries needed would be possible if the growing-ponds themselves were sited near the collecting beaches ; that is, in and around Manaar. This would mean that the fish-farms would have to be there ; and people would have to be settled there as colonist fish-farmers in special land-utilisation schemes. If the administrative problems and delays that would inevitably be involved in any such colonisation schemes are to be avoided, it means that the growing-ponds must be situated around lagoon and estuarine marshes scattered along a stretch of relatively well inhabited coast-line quite distant from the collecting beaches.

(*b*) It should be noted that in calculating the number of lorries needed I have not taken into consideration the delivery of fry to the growing ponds of the fish-farmers. It can be safely assumed that since the fry collecting seasons last only about 5 months a year, the same lorries used for the transport of fry from beach to fry-holding pond can also be used for this purpose. In the alternative, fry-holding ponds can be sited near enough to all concentrations of fish-farms to reduce the problem to relatively negligible proportions.

41. It is not likely that this wages bill can be significantly reduced by paying the men for just 5 months instead of the whole year ; that is, by paying them during the fry-collecting seasons only. As already mentioned (Note 40b) the transport staff will have to work outside the fry-collecting season as well. As for the collecting staff, these men, particularly the sorters, will have special skills. If they are to be employed and paid for 2 short spells of 2 and 3 months each in a year (March/April and October/December) and discharged from service during the remaining 7 months of the year, it is certain that the consequent rise in pay-rates demanded will cancel out any anticipated savings from such a move.

42. Throughout the calculations in Section 6 of this report I have used, of any pair of alternative figures, that which was more favourable to the Plan even when it was the less likely. Had this not been done the position would have been as follows : 1,904 million fry to be collected in 75 days, 25.38 millions/day, would need 294 collecting units and hence 1,940 men as collecting staff ; and 419 lorries with a transport staff of 838 men. This totals 2,778 men of whom 1,389 would be specially skilled and, at Rs. 200 p.m., would need Rs. 3.333 millions in wages a year ; the rest at Rs. 100 p.m. would need Rs. 1.667 million a year.

Wage-component on this account in the value of the bait-fish produced would be 5 million rupees for 112 million fish, or 4.5 cts/fish or 18 cts/lb. And the cost of this bait to local fishermen would be 80.7 cts/lb. (64.7 — 2 + 18).

43. Rs. 20 per case of 120 fish = 16.6 cts/fish = 4 × 16.6 or 66.4 cts/lb.

44. This follows from Table B1 (PLAN), which states that 214,000 tons of fish will be consumed in 1975 in the fresh or frozen state, that is as wet fish ; and from Table D8 (PLAN), which indicates that its value will be 551¼ million rupees.

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සම්පිණ්ඩනය සහ නිගමනය

සිල්වා සහ අනිකුත් අය (සංවර්ධන සැලැස්ම, 1965) ලංකාවේ ධීවර කර්මාන්තය දියුණු කිරීම සඳහා යෝජනා කරන ලද 10 අවුරුදු සැලැස්මේ සමහර ධීවර කොටස් ගැන කරන ලද විභාගයකි මේ.

(1) මුහුදු බඩ ධීවර කර්මාන්තයේ නිපදවීමේ ඉලක්කය සඳහා නියම කර ඇති ගණන (1957 වර්ෂය වනවිට ටොන් 537,500) අපේ මුහුදු කරයේ අල්ලනු ලබන සිද්ධවිය හැකි ඇල්ලීමට (වර්ෂයකට ටොන් 266,000) වඩා දෙගුණයකටත් වැඩි බව පෙන්වයි. සැලැස්ම අනුව අවුරුද්දකට ටොන් 663,400 බලාපොරොත්තු වුවත් මුහුදෙන් ලබන නිපදවීමේ ප්‍රතිඵලය අනුව (මුහුදු බඩ සහ ගැඹුරු මුහුදේ) එය අවුරුද්දකට ටොන් 391,900 ට වඩා වැඩි නොවිය හැක.

(2) මේ සැලැස්ම ක්‍රියාවේ යෙදීමට 1957 සිට වර්ෂයකට ටොන් 15,566 පමණ ඇම් උවමනා වුවත් සිල්වා සහ අනිකුත් අය නිපදවා පාවිච්චි කිරීම සඳහා වෙන් කර ඇති මාලු ඇම් ප්‍රමාණය ටොන් 12,500 කි. මෙයද මැරී ඇති ඇම්ය.

(3) මෙම ඇම් ටොන් 12,500 ලබා ගැනීමට යොද ඇත්තේ දෙදිය මුසු පොකුණු අක්කර 25,000 ක ඇති කිරීමට යන වෙක්පැටවුන් කර්මාන්තයෙන් ය. මේ මාලු පොකුණු වල නිපදවීම නියමයට වඩා ගණන් බලා අවුරුද්දකට අක්කරයකින් රාත්තල් 1,120 ක් යයි සඳහන් කර ඇතත් නියම විදියට බලන කල අවුරුද්දකට අක්කරයකට ටොන් 100 ටත් 300 ටත් අතර වේ. එනයින් 1975 වන විට මේ මසුන් වගාවෙන් ගත හැකි ඇම් මාලු ප්‍රමාණය වැඩි වශයෙන් වර්ෂයකට ටොන් 2,500 යක් ය.

(4) මේ නිසා අවුරුද්දකට ටොන් 13,066 ක ඇම් හිඟයක් ඇතිවීමෙන් මසුන් ලබා ගැනීමට බලාපොරොත්තු වූ ගණනින් වර්ෂයකට තවත් ටොන් 173,870 අඩු වේ. මුහුදෙන් අල්ලා ගත හැකි වැඩිම ප්‍රමාණය (සැලැස්ම අනුව බලා–පොරොත්තු වන) වර්ෂයකට ටොන් 218,030 ක් ය.

(5) මෙම ඇම්වල හිඟය ධීවර යාත්‍රා කණ්ඩායමේ වැඩි කොටසකටම බලපායි. (ඒ) රුපියල් දශලක්ෂ විස්සක් (කෝටි **2** ක්) පමණ වැය වූ "පෝල් සහ ලයින්" යාත්‍රා විස්සට බලයන් කෙලවල්ලන් වැනි මසුන් වර්ෂයකට ටොන් 20,000 ක් ඇල්ලීමේ ඉලක්කය සඳහා පන ඇති ඇම් ටොන් 720 අවශ්‍ය වුවත් එය නොලැබීම සහ (බී) රුපියල් දශලක්ෂ 175 ක් (කෝටි 17½) පමණ වැය වී ඇති විශාල "ලෝන් ලයින්" යාත්‍රා 100 ට කෙලවල්ලන් වැනි මසුන් ටොන් 80,000 ක් ඇල්ලීම සඳහා වර්ෂයකට මළ ඇම් ටොන් 4,000 අවශ්‍ය වුවත් සම්පූර්ණ වේක් පැටවු නිපදවීමේ පොකුණුවල වගාව ලැබී යෙදවුවත් ලබාගත හැක්කේ ටොන් 2,500 කි. මේ නිසා ඇල්ලීමට හැකිවන්නේ වර්ෂයකට මසුන් ටොන් 50,000 ක් පමණි.

(6) සැලැස්ම අනුව කෙලවල්ලන් බලයන් වැනි මසුන් ටොන් 221,100 **1975** වර්ෂය වනවිට උවමනාවේ. (මෙයින් ටොන් 197,100 ක් පිටරට පටවා සැලැස්ම ක්‍රියාවේ යෙදවීමට උවමනා විදේශ විනිමය ලබා ගැනීමට ය). නමුත් ඇම්වල හිඟය නිසා ටොන් 62,420 ට වඩා ඇල්ලීමට නොහැකිය. මේ සියල්ලමත් අල්ලා ලබාගැනීමට බලාපොරොත්තු වන මිළ (රාත්තලට ශත 51.3 බැගින්) පිටරට පැටවුවත් විදේශ විනිමය ලබා ගත හැක්කේ රුපියල් දශලක්ෂ 71¾ පමණි. නමුත් රුපියල් දශලක්ෂ 226½ මේ ක්‍රමයෙන් බලාපොරොත්තු වෙයි.

(7) ලෝක වෙළඳ පොලෙහි මෙම මසුන් රාත්තල ශත 51.3 කට විකිණිය නොහැකිය. එසේ කළ හැක්කේ උපකාර මුදල් ක්‍රමයකින් පමණි. විශේෂ–යෙන්ම විශාල (ලෝන් ලයින්) යාත්‍රා වලින් ලැබෙන කෙලවල්ලන් වැනි මසුන් ටොන් 50,000 ට රාත්තලකට ශත 60–84 දක්වා වියදම් විය හැක. මෙයද දූනට පිට රටින් ඇම් ගෙන්වන අයුරු රාත්තල ශත 66.4 බැගින් ඇම්වලට වැයවූවොත් පමණි. නමුත් අලුත් මාලු පොකුණු වලින් ලැබෙන ඇම් වල මිල රාත්තල ශත 73–81 දක්වා වුවහොත් උපකාර මුදල් ප්‍රමාණය තවත් වැඩි වන්නට පුළුවන.

(8) 1975 වන විට වර්ෂයකට ඇල්ලීමට හැකි බලයන් කෙලවල්ලන් වැනි මසුන් සියල්ලම විදේශ විනිමය දශලක්ෂ 71¾ ලබා ගැනීමට පිටරට යැවු–වොත් ටින් වල ඇහිරීමටත් උම්බලකඩ තැනීමටත් කිසිවක් ඉතිරි නොවේ. මේ නිසා සැලැස්මේ පොරොන්දු වී ඇති ටින් මාලු සහ උම්බලකඩ පිටරටින් ගෙන්වීම නැවැත්වීම කළ නොහැකි ය. මෙම වර්ගවලට 1975 වන විට වර්ෂයකට රුපියල් දශලක්ෂ 18½ විදේශ විනිමය පිට රටට පිටවී යනවා ඇත.

(9) තවද අඩුවක් නොමැති වී දූනට වර්ෂයකට ටොන් 4,000 ක් පමණ ලංකාවේ ජනයා ආහාරයට ගන්නා බලයන් කෙලවල්ලන්, වැනි මසුන් 1975 වන විට දේශීය ආහාරයට නොලැබී යනවා ඇත.

(10) මෙපමණක් නොව නියමිත නිපදවීමේ ඉලක්කය, ලබා ගැනීමට නො–හැකිව මේ සැලැස්ම ක්‍රියාවේ යෙදවුවොත් 1975 වන විට දේශීය පරිභරණය සඳහා දූනට වර්ෂයකට මිනිසෙකුට මසුන් රාත්තල් 38 ක් වුවමනාවුවත් වර්ෂයට මිනිසෙකුට රාත්තල් 23 දක්වා පහත බැසීමක් සිදුවනවා මිස සැලැස්ම පොරොන්දු වී ඇති ප්‍රකාර වර්ෂයකට මිනිසෙකුට රාත්තල් 53 දක්වා ඉහල නැගීමක් සිදු නොවනවා ඇත.

(11) ධීවර කර්මාන්තයක් දියුණු කිරීම සඳහා ඕනෑම සැලැස්මක ධීවර යාත්‍රා වෙනස්වීම ඉතාමත් වටිනා දෙයකි. නමුත් මෙම සැලැස්මේ කතෘන් විසින් මෙම කාරණය සම්පූර්ණයෙන්ම අසතුටුදායකව සකස්කර ඇත. ඔවුන් විදේශ විනිමය දශලක්ෂ $257\frac{1}{2}$ වැය කොට එකතු කිරීමට යන විශාල ධීවර යාත්‍රාවල ප්‍රමාණය කිසිම තැනක සඳහන් කර නැත. නමුත් මසුන් ඇති ස්ථාන, ඇල්ලීමේ ප්‍රමාණය සහ මසුන් ඇල්ලීමට යන වියදම සහ අනිකුත් යෝජනා කරණ ලද සතුටුදායක සෑම තක්සේරුවක් ම රඳී පවතින්නේ යාත්‍රාවේ ප්‍රමාණය අනුවය.

(12) අපේ මුහුදුබඩ ධීවරය සඳහා වාරකන් කාලවල ඇතිවන අසතුටුදායක කාල ගුණයේ බලපෑම වැලැක්වීමටත් ඒ කාලවලදී වෙරලින් වෙරලට මාරුවීම වැලැක්වීම සඳහාත් සිල්වා සහ අනිකුත් අය දැනට අත්හද බලා නැති අළුත් වර්ගයේ (ටොන් 11 ක් හෝ ඊට වඩා තරමක් ප්‍රමාණයෙන් විශාල) යාත්‍රා 2,500 ක් අපේ මුහුදු බඩ යාත්‍රා කාණ්ඩායමේ කොඳු ඇටය වශයෙන් යෙදීමට යයි. මේ අයුරු ඔවුන් (අ) ස්වභාවික වරායවල් හෝ ආවරණ ඉතාමත් අඩු ලංකාව වැනි රටකට වටිනා අපේ සම්ප්‍රදයික වෙරළට ගොඩ කරන යාත්‍රාත් (ආ) පසුගිය කාලය තුල අපේ රටේ ධීවරයේ මසුන් නිපදවීම වැඩි කිරීමට උපකාරී වූ අත්හද බලා සාර්ථක වූ ටොන් $3\frac{1}{2}$ නවීන යාත්‍රාත් මේ ක්‍රමයේ දී සම්පූර්ණයෙන්ම ඈත්කර තිබේ.

ටොන් 22 යාත්‍රා වලින් ලත් පලපුරුද්ද අනුව පෙන්වන අයුරු ටොන් 11 යාත්‍රා තද වාරකන් කාලවලට අනිකුත් ප්‍රදේශ කරා ගෙන යාමට සිදුවේ. සම්පූර්ණ වර්ෂයේ ම මසුන් ඇල්ලීම සඳහා මේ නිසා වරායවල පහසුකම්, බෙදා හැරීමේ ක්‍රම යනාදි (සැලැස්ම අනුව ඇති) පිළිවෙළවල් වෙනස් වේ.

(13) මෙම සම්පිණ්ඩනයේ සඳහන් කළ යුතු තවත් උදහරණයක් ඇත. අපේ මුහුදු බඩ හෝ ඈත ඉන්දියන් සාගරයේ ධීවර විභවය සොයා බැලීම සඳහා විශේෂ වෙනස් ක්‍රම පහකට සකස් වූ විශාල ධීවර යාත්‍රා 35 ක් සඳහා විදේශ විනිමය රුපියල් දශලක්ෂ $42\frac{1}{2}$ ක් වියදම් කිරීමට යයි. නමුත් මෙයට වඩා ඉතාමත් සාර්ථක අන්දමට මේ පරීක්ෂණය කළ හැක්කේ එකක් රුපියල් දශලක්ෂ $1 - 1\frac{1}{2}$ දක්වා වටිනා නියම අයුරු උපකරණ සහිත වෙනස් ධීවර ක්‍රම අත්හද බැලිය හැකි ධීවර පර්යේෂණ යාත්‍රා 2 ක් යෙදවීමෙනි. තවද මේ ධීවර යාත්‍රා 35 ට වැඩි මසුන් ඇල්ලීමේ ඉල්ලක්කයකුත් යොදා ඇති නිසා එයට පරීක්ෂණ පැවැත්වීමට නිදහස ඇතොත් එය ඉතා අල්පය.

(14) මේ සැලැස්මේ ඇති අඩුපාඩු නිසා යමකුට බැසිය හැකි එකම නිගමනය නම් උසස් නිපදවීමේ ඉල්ලක්කය ලබා ගැනීමට සම්පූර්ණයෙන්ම අසමර්ථ වූ බව සහ එය ලබාගැනීමට කරණ ලද ප්‍රයත්නය නිසා දේශීය ධීවර කර්මාන්තයට විශාල අලාභානි ද සිදුවීමය.