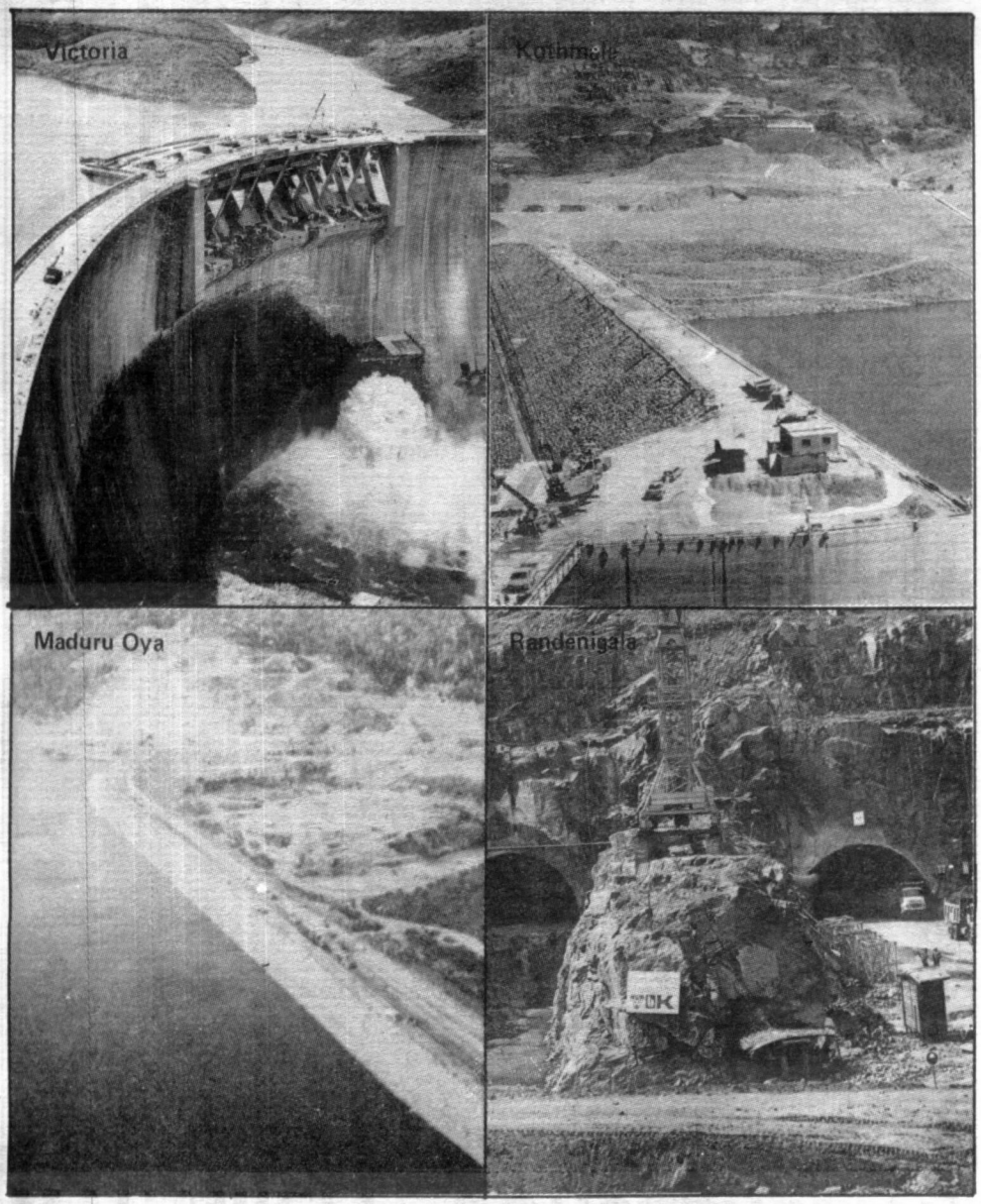


MAHAWELI CONSTRUCTION

The official commissioning of the Kotmale Project on August 24 this year marked the completion of a major part of the construction work on the Mahaweli Ganga Multi Purpose Project. The accelerated Mahaweli Programme, begun in 1978, was due for completion within a period of six years, yet several factors such as faulty rock formations, engineering difficulties on both the dams and tunnels, funding and administrative delays, and the fact that a project of this magnitude had never been attempted in Sri Lanka before held up work on more than one occassion, particularly in the early stages. Plans on some projects had to be altered and the original six year deadline may stretch over a further 3 years, though a major part of the construction has now been completed.

The accelerated Mahaweli Programme as constituted at present is made up of 3 main components: the headworks projects, at Victoria, Kotmale, Maduru Oya and Randenigala; the downstream engineering and irrigation works; and settlement and agricultural production. Construction activity is confined mainly to the first two components and it was felt at the outset that if the Accelerated Programme should falter it would do so first at the levels of construction.

The original programme, in the Master Plan formulated by an UNDP/ FAO team covering a 30 year period, was considerably amended when the Accelerated Programme was drawn up. For instance, the six year Accelerated Programme was intended to irrigate 340,000 acres as against the original plans for 900,000 acres under the 30 year programme.

The original cost estimates in the early 1970's on the larger 30 year project was around Rs. 7 billion, though later in 1970 the programme of irrigation, hydro power, agricultural and infra structural facilities of all projects was estimated to cost as much as Rs. 15 billion. In 1978, however, the somewhat more modest accelerated programme comprising six major reservoirs, five power stations and downstream development of systems A, B, C and D were estimated to cost Rs. 11 billion; although by the end of 1984 a sum of over Rs. 25 billion had already been spent on only some of these projects and a further Rs. 16.5 billion was due to be spent over the next five years. (See Table 1). The total cost of the four major headworks, namely Victoria, Maduru Oya, Kotmale and Randenigala was estimated at Rs. 23.7 billion at the end of 1984, and by that date Rs. 17.5 billion had been expended on these four projects. The other downstream engineering and irrigation works and settlement and agricultural activity alone was expected to cost as much as Rs. 12.5 billion.

The Mahaweli Development Programme thus has continued to be not merely the country's biggest investment item in recent years, consituting around 35 percent of the government's budget; it has also roused more attention than any other project attempted in this country. This project is easily the most ambitious scheme ever to be undertaken on the island and has been the keystone of the government's development programme since 1977.

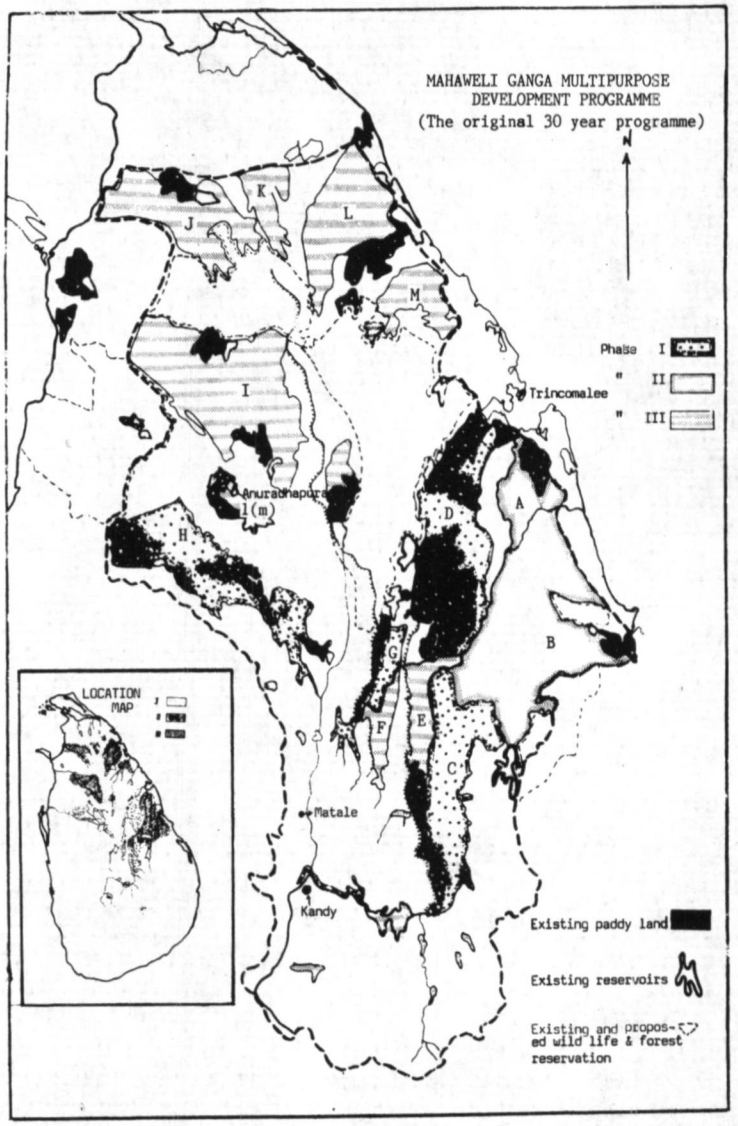
Accelerated Programme

After 1977 the pressure was heavy for speeding up implementation of this project. A step-wise implementation of the Mahaweli Development Programme would have lasted 25 years from 1975. The new government, in July 1977, decided to speed up implementation of a truncated programme and complete the project within its term of office of 6 years. A decision was taken for 'acceleration' or immediate implementation of certain key projects of the Programme based on the recommendations in the Mahaweli Master Plan that had been formulated in 1968 by the United Nations Development Programme (UNDP) and the United Nations Food and Agriculture Organisation (FAO) with the assistance of Sri Lanka's Departments of Irrigation, Survey, Agriculture and the then Department of Government Electrical Undertakings. What was meant by 'acceleration' was to undertake simultaneously a number of projects which under normal conditions would have been done sequentially.

After the decision was taken by the Government to accelerate the Mahaweli Development Programme, the responsibility for its implementation was vested in the newly established Ministry of Mahaweli Development. As an umbrella organisation for planning and implementing the Programme, the Mahaweli Authority of Sri Lanka (MASL) was established by Parliamentary Act No. 23 of 1979. The MASL, the Mahaweli Development Board (MDB), the River Valleys Development Board (RVDB) and the Central Engineering Consultancy Bureau (CECB) were placed under the aegis of the Ministry of Mahaweli Development.

The Master Plan

The Mahaweli Ganga basin covers a total area of about 4,000 sq. miles of the country's 25,000 sq. miles and has been estimated to discharge nearly 6.4 million acre-feet of water into the sea.

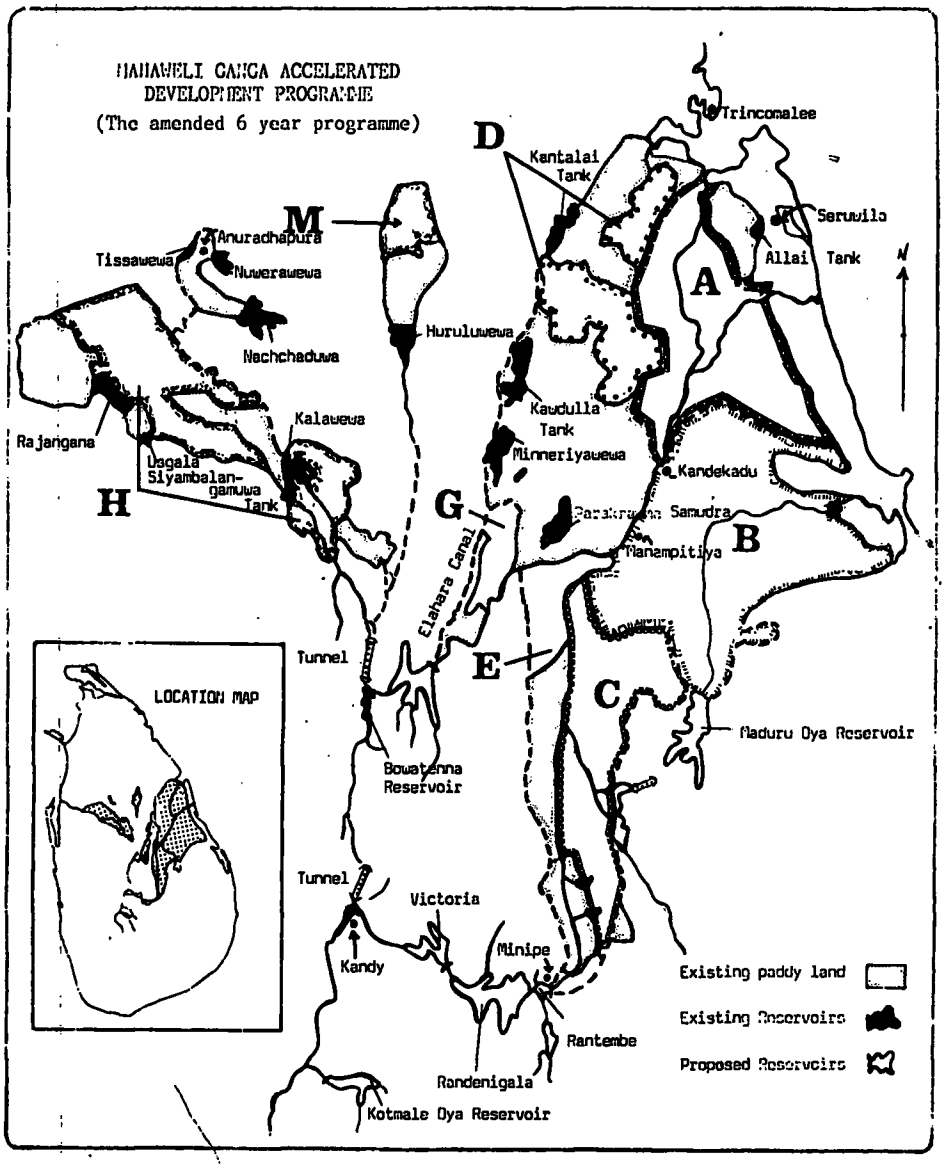


This volume of water represents approximately one fifth of the total discharge of all the Island's rivers into the sea. In order to plan the utilisation of the water resources of the Mahaweli in an effective manner, an UNDP - FAO team together with Sri Lankan engineers and scientists carried out investigations during a four year period between 1964 to 1968, and formulated the 'Master Plan' which proposed to utilise 4.3 million ac. ft. of the flow of the Mahweli Gange in an area of 900,000 acres in the dry zone of the country, while 0.9 million ac. ft of water available in these areas were also to be utilised.

It was originally intended not merely to irrigate 900,000 acres of land but also develop 15 multi-purpose projects, 4 trans-basin diversion canals and several power stations with a total capacity of 500 megawatts, and settle over half a million people who would earn their livelihood in the area – all at a cost of Rs. 27 billion (in 1977 prices).

The original Mahaweli Master Plan had envisaged the development of 365,000 ha.* (901,500 ac.)** of new land under irrigation of which 100,000 ha. (247,000 ac.) consisted of already developed land but which had been recommended for improved irrigation facilities. It planned for the construction of a series of reservoirs on the Mahaweli Ganga, its tributary the Amban Ganga, the Maduru Oya, Yan Oya, Malwatu Oya and proposed the development of irrigation projects in thirteen "systems".

*Ha = Hectares **ac = acres,



Accelerated Mahaweli Programme — Cost Estimates (Rs. Million)*

Project	Mid 1978[1] economic prices	Cumulative[2] Expenditure upto end 1984	Estimated[3] Expenditure 1985 – 89	Total (2) + (3)	Total cost Mahaweli[4] Development Ministry Estimates
1. Victoria	3,086	6,523	659	7,182	7,890
2. Kotmale	3,328	6,649	1,003	7,652	8,755
3. Randinigala	1,827	1,893	2,314	4,207	4,450
4. Maduru Oya	800	2,532	–	2,532	2,631
5. Minipe Transbasin Canal		1,165	20	1,185	1,543
6. Irrigation System 'B'		2,442	6,995	9,397	10,487
7. Irrigation System 'C'		1,838	2,588	4,426	5,529
8. Irrigation System 'G'		63	* 109	172	
9. Stage I and II		1,595	34	1,629	
10. Others		311	887	1,198	
Total		25,001	14,569	39,580	41,285
11. Operation & Maintenance			1,945	1,945	

(1) Implementation Strategy Study, NEDECO Engineering Consultants 1978.
(2) Central Bank of Ceylon, Annual Report 1984 p. 42.
(3) Public Investment 1985 – 89, National Planning Division, Ministry of Finance & Planning May, 1985 p. 179.
(4) Mahaweli Prospects and Programme, Ministry of Mahaweli Development Dec. 1984, pp 6 - 9.

*The escalation in costs over these 7 years could be accounted for partly by the inflationary trends over this period and partly as a result of additional expenses on the project, mainly due to unforeseen circumstances. An indication of the extent to which the increased expenditure was affected by inflation is given below.

As measured by the Colombo Consumer Price Index, the inflation rates for each year from 1978 to 1984 were as follows:

1978 – 12% 1981 – 18%
1979 – 11% 1982 – 11%
1980 – 26% 1983 – 14%
1981 – 18% 1984 – 17%

On this basis the total increases as a result of inflation from 1978 to 1984 was 109 percent.

The first phase consisted of the construction of the Polgolla - Bowatenne Complex, the Victoria-Minipe diversion and the Moragahakande Reservoir to benefit 135,000 ha. (333,400 ac.) of land under irrigation and installation of 200 MW*** capacity for power generation.

The second phase was for the development of 95,000 ha. (234,600 ac) using the storage of water which would be made available in Victoria and Moragahakande reservoirs, and installation of approximately 15 MW of capacity for power generation.

The third phase was for the construction of other reservoirs such as the Kotmale, Randenigala and those on the Uma Oya, Loggal Oya and certain tributaries of the Amban Ganga to irrigate parts of the North Central and Northern Provinces and installation of approximately 380 MW capacity for power generation.

Need to Accelerate

At the end of 1977 when the Government decided to telescope the implementation programme proposed in the Master Plan into a tight time frame of six years it included only the major projects of the Master Plan in its Accelerated Programme. The Government was prompted by many motivating considerations to accelerate the implementation of the Mahaweli Programme within the shortest possible time. The imperatives of keeping the nation fed, the annual drain on the foreign exchange resources of the country arising from the necessity to import staple food, the need to contain the rising prices of food, and the problem of acute unemployment were among the main considerations.

The increasing costs of fossil fuels and the increasing demand for electricity in the rapidly expanding

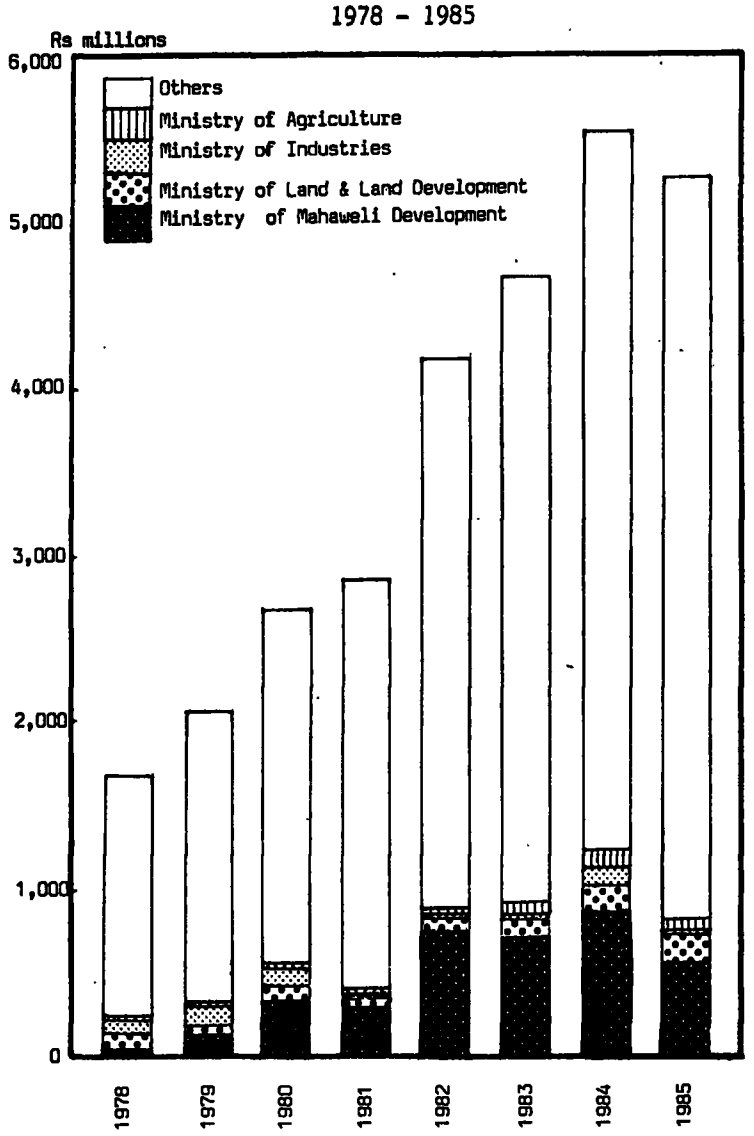
***mw = megawatts

commercial and industrial sectors and in Urban re-development areas,and the high demand for rural electrification too prompted the Government to accelerate the Mahaweli Programme, as the generation of hydro-power formed one of its essential components. In fact, hydro-power came to receive greater emphasis than irrigation after the oil price hikes of the early 1970's and this priority for power is evident in the accelerated programme.

The installed capacity in Sri Lanka even in 1982 was 455 MW and the average consumption for the country was 123 MW hours per head, which was considered one of the lowest averages in Asia. Also at the time, only about 10 percent of the rural population was provided with this facility. This situation highlighted the need for the expansion of the rural electrifiation programme.

Furthermore, the slow implementation of the Mahaweli Programme, over the originally estimated period of thirty years, it was also felt would have made the cost of construction unbearable for the country in the face of spiralling inflation, which was pushing up construction costs.

GOVERNMENT BUDGETARY ALLOCATIONS FOR MAHAWELI DEVELOPMENT,LAND AND LAND DEVELOPMENT, AGRICULTURE AND INDUSTRY
1978 - 1985



Source:Estimates of Revenue and Expenditure of the Sri Lanka Government 1982 Volume I - Annual Report Central Bank

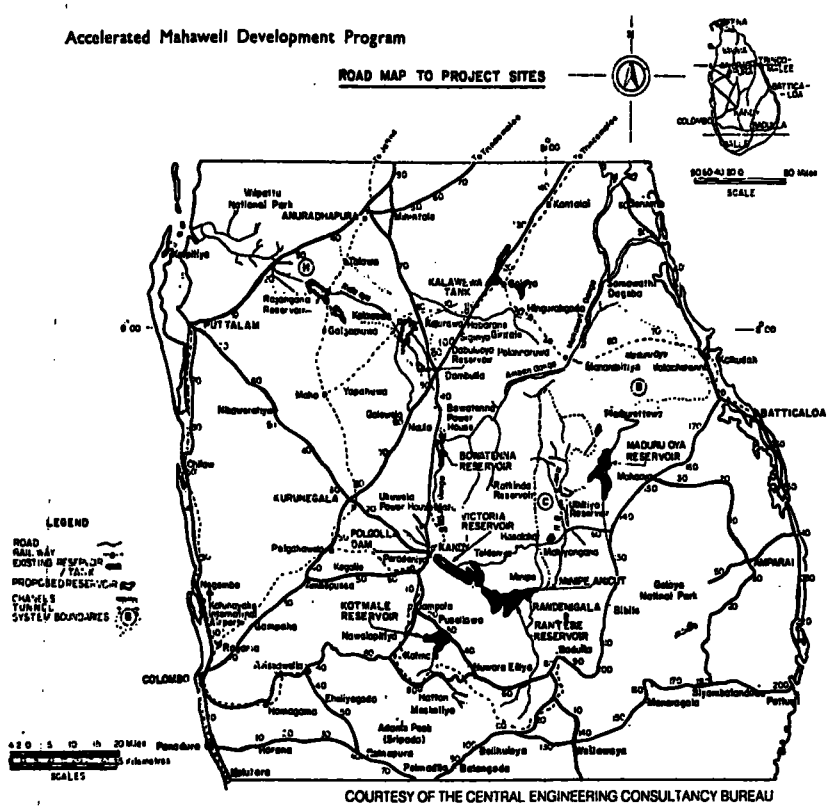
Multi-Purposes of Project

The Accelerated Mahaweli Programme envisaged the construction of a series of reservoirs with hydro-electricity plant, to develop a large extent of land in the downstream areas with irrigation facilities, for establishment of new settlements and agricultural development. This new programme envisaged the irrigation, agricultural and infrastructure development of about 320,000 acres (compared to the original 900,000 acres) and increasing the hydro-electric generating capacity of the Island by 400 megawatts by the construction of six major reservoirs and five power stations. It was hoped to complete these major works within six years from 1978 at an estimated coast of Rs. 11 billion, the major part of this investment being for equipment and materials.

The accelerated plan originally included the construction of the Kotmale, Victoria, Maduru Oya, Randenigala and Moragahakanda Projects simultaneously in a single concerted construction phase. A later review of this implementation strategy by the Netherlands-Consultancy firm pointed to a situation that with proper water management, the construction of Kotmale, Victoria and Maduru Oya reservoirs alone would be sufficient to irrigate the land area and generate hydro-power to the extent that was expected under the Accelerated Programme. However, the Government decided to take up the construction of four reservoirs, including the Randenigala reservoir, along with the three recommended by the NEDCO studies. Randenigala was justified solely on the basis of the country's energy requirements anticipated around 1986.

Basic Features

The Accelerated Mahaweli Programe was therefore brought down to three main components: (a) the four main headworks projects of Victoria, Kotmale, Maduru Oya and Randenigala; (b) the downstream engineering works dealing with



COURTESY OF THE CENTRAL ENGINEERING CONSULTANCY BUREAU

diversion works; and (c) the irrigation and the development of downstream areas, which included the systems 'B' and 'C' and later 'A' and 'D', the balance lands in system 'H' and some lands in system 'G' comprising the old Elahera colonization scheme.

The major projects of the original Accelerated Programme listed for priority attention were:

(i) Maduru Oya Dam, Irrigation and Power Tunnel, Power Station and Link tunnel:
(ii) New Minipe Anicut, Right Bank Transbasin Canal and Ulhitiya Reservoir;
(iii) Kandakadu Anicut;
(iv) Victoria Dam, Power Tunnel and Power Station;
(v) Randenigala Dam and Power Station;
(vi) Kotmale Dam, Power Tunnel and Power Station;
(vii) Moragahakanda Dam and Power Station; and
(viii) Irrigation facilities and settlement in areas A, B, C and D.

The basic features of the projects falling within this Accelerated Programme covered the following aspects of irrigation and hydro-power.

Irrigation and Drainage Systems

The Accelerated Programme was expected to supply water to an extensive region along the course of the river, mainly to the Mahaweli plain stretching from Mahiyangana to Trincomalee. This region is described in the Mahaweli Development Plan as the Systems, A, B, C and D (see amps) Initially systems B and C were to receive water.

The big irrigation engineering works comprising five major dams and related works expected to supply Mahaweli water to 320,000 acres of new land and 90,000 acres of existing paddy land coming within this region. An approximate breakdown of the extent of new land in the Accelerated Mahaweli Programme is as follows:

System A	– 36,000 ha.	(89,000 ac)
System B	– 48,000 ha	(118,000 ac)
System C	– 24,000 ha.	(59,000 ac)
System D	– 19,000 ha.	(47,000 ac)
System G	– 2,800 ha	(7,000 ac)
	126,000 ha	(312,000 ac)

Additionally, the on-going work of System H was also brought under the Accelerated Programme.

Generation of Hydro-Power

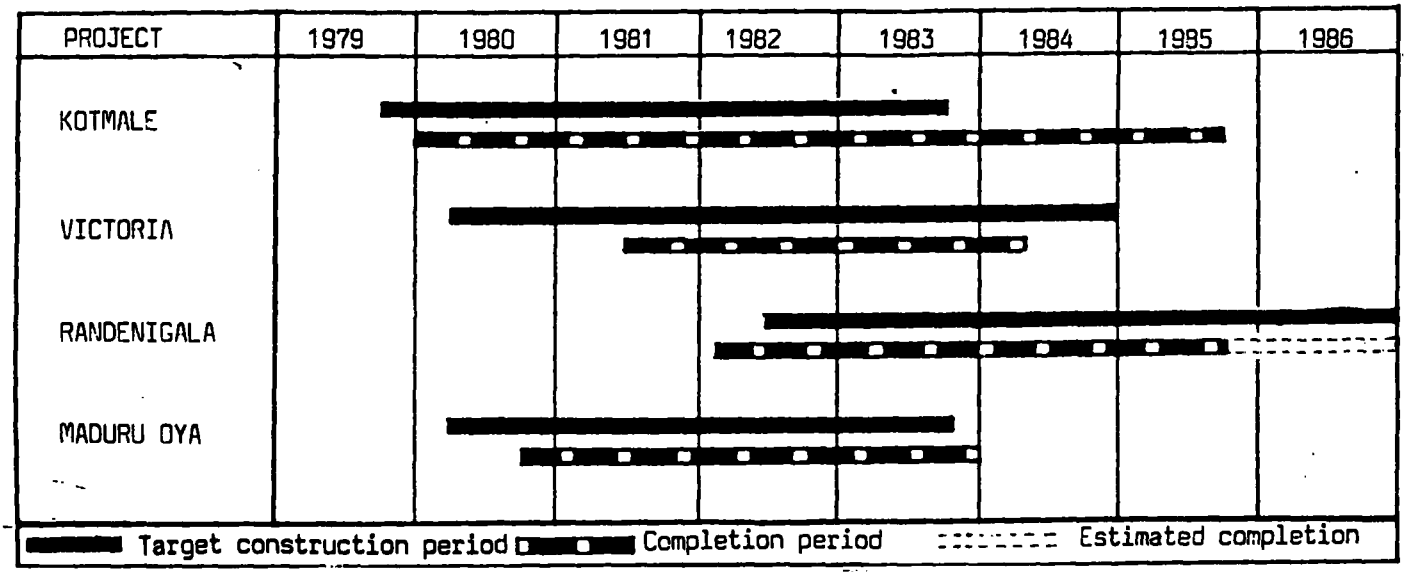
Kotmale
134 MW (an additional unit of 67 MW capacity to be installed later)
Victoria
210 MW (provision has been made to install additional units providing a further 210 MW to meet any likely demand for peaking capacity in the future thus going upto a total of 420 MW)
Randenigala
126 MW (Rantembe reservoir which will re-regulate discharges from Randenigala reservoir is due to have a total installed power capacity of 49 MW)

The Accelerated Programme by itself is a project of immense magnitude when considered in the light of the demand it makes on the country's resources; but there was also now the added factors of the tight time target set for implementaton and the necessity for many other action programmes before work actually commenced on these projects.

The decision to accelerate the Mahaweli Programme required speedy action to get the feasibility of the key projects, recommended in the Master Plan in general terms, studied and appraised in detail before acceptance for implementation and for foreign funding. In this, the services of a number of foreign agencies were obtained and studies carried out with advice from the Central Engineering Consultancy Bureau were financed by a number of donor countries. Based on those feasibility studies, a development programme and implementation strategies were prepared.

Apart from the Master Plan and the early feasibility report which was prepared by Messrs SOGREAH of Grenoble, France, in respect of System H and the feasibility reports on Polgolla; and Bowatenna Complexes

MAHAWELI HEADWORKS CONSTRUCTION PROGRAMME-TARGETS AND ACHIEVEMENT



and the Kotmale Power Project prepared before 1977, such detailed feasibility studies had not been done in respect of any other Project under the Mahaweli Development Programme.

Foreign and Local Funding

The implementation of the Programme also called for harnessing adequate resources, particularly the raising of foreign funds for the construction of the Projects and the implementation of the various downstream development programmes. In this, the country was fortunate in obtaining commitments of funds from USA, Canada, UK, the Federal Republic of Germany, Sweden, the Netherlands, Belgium, Kuwait, Saudi Arabia, Japan and from international funding agencies like the World Bank.

The international community showed a quick response and steady co-operation when it came to mobilising the financial and technical resources for the implementation of these projects. One factor responsible for this ready response was that within two years of the announcement of the Accelerated Mahaweli Programme the government had arranged for or completed detailed feasibility studies on all aspects of the Programme and linked donors with the main elements of the programme. Almost 70 percent of the funding was expected from foreign sources. Upto the end of the year 1984 about Rs. 25 billion had been spent on the projects, of which about 26 percent or Rs. 6.6 billion was spent during 1984 and only around 30 percent of this was from local funds. In the resource allocation for national development, the Accelerated Mahaweli Programme continued to receive the highest priority. The government's views on this priority were summed up in the following statement by the Minister of Finance in an address to prospective foreign investors visiting Sri Lanka in September 1980:

> "The Mahaweli will not only provide the much needed cheap power and save on expensive oil imports, but also provide the insurance to the farmer against unpredictable rains, in achieving higher agricultural output. We cannot develop agriculturally unless we get effective control over water. Contrary to popular belief, it is not a long-term project in a convetional sense. It is a conglomeration of short-term projects of dams, reservoirs, water channels, and farmer settlement — each of which can produce results within 3 to 4 years — results in the form of land, food, employment and power. Moreover, it is such an imaginative project that it is capable of generating popular appreciation of the need to contain current welfare, thereby inducing a transfer of resources from consumption to investment. It is the vision of the future that we wish to build. Thus, our whole economic strategy could flounder, without Mahaweli."

The Minister of Lands, Land Development and Mahaweli Development viewed the magnitude of the project bieng attempted in the following manner, in 1978:

> "The enormity of the tasks under the Accelerated Programme can be visualised from the fact that the development envisaged therein far excced the combined irrigation and power benefits derived from all the multi-purpose hydro power and new irrigation projects undertaken in this country since independence.

Clearly, the Accelerated Programme is a massive task. Never before has such a multi-faceted and vast undertaking been attempted in our country simultaneously, over such a

widely scattered area and scheduled for completion in such a tight time-frame".

At this stage five major dams; Victoria, Maduru Oya, Kotmale, Randenigala and Moragahakande were to be built, though the fifth project proposal came to be shelved. The first of the headworks projects to be completed was Maduru Oya, followed by Victoria and Kotmale.

MADURU OYA PROJECT

The Master Plan proposed by the UNDP/FAO Team in 1965 – 68 concluded that the water resources of the Mahaweli Ganga would be more than sufficient to develop the available land in the Mahaweli Basin and therefore they suggested a trans-basin diversion of the Mahaweli waters to the adjacent basins. It was found that since the Maduru-Oya basin was on the eastern side of the Mahaweli basin it could receive additional water from the Mahaweli Ganga through a diversion at the Minipe anicut via the Right Bank Trans-basin Canal and the Randenigala Maduru Oya Tunnel. The original proposal envisaged the irrigation of 46,750 hectares of new land and 3,750 hectares of developed paddy lands in System B lying within the Maduru Oya Basin. The reservoir

Continued on page 10

was to be formed by impounding the water of the Maduru Oya augmented by the Mahaweli water, conveyed from the Minipe anicut into this reservoir. The site selected for the dam is of much historical interest as it was found that on this very site an earthen dam had been constructed several centuries ago. (See Box)

A rockfilled dam was selected as the most economical type of dam suitable for this site, after considering other alternatives such as a concrete gravity dam and an earth filled dam. This was the first rockfilled dam to be constructed in Sri Lanka. The main features of the dam are listed in the adjoining box.

Finances

The headworks of the Maduru Oya project were financed by a soft loan from the Government of Canada. The amount of the loan was Canadian $76 million, and free of interest commitment or service charges. The loan is due to be paid in 80 semi-annual instalments commencing on March 31, 1990, and ending on September 30th 2029. This loan was for the foreign component of the project; while the local costs of the project were met by the Government of Sri Lanka.

Consultancy Services

Initial site investigation and preparation of plans, designs and tender documents were done by the Central Engineering Consultancy Bureau (CECB). Further Canadian aid was provided by the Canadian International Development Agency (CIDA) the organisation of the Canadian government responsible for monitoring the project and disbursement of the funds. CIDA made provisions for a grant and the engineering consultants, Crippen International Limited, who were responsible for development of the construction drawings and for supervision of works on site, in collaboration with the CECB.

Contract Awards

The Maduru Oya contract for the main civil works was awarded on April 7, 1980 to a Canadian Contractor FAFJ, a Joint VEnture comprising the following Canadian Firms: The Foundation Company of Canada Ltd; (Sponsor); Atlas-Gest International Ltd; Fitzpatrick Construction Ltd; and Janin Construction Ltd.

The contract for Hydro-Mechanical works, Contract No. 3A was awarded to the Hydraulic Engineering Corporation of China in September, 1981 for the supply and installation of Hydro-Mechanical Equipment. The values of contract awarded are shown in the table at right.

Finally the total costs of the Maduru Oya headworks amounted to Canadian $ 100 m. (Foreign) and Local costs Rs. 923 m. making a total of Rs. 2,631m. Canada also provided a sum of Canadian $ 26 m. towards the local costs by means of food aid during 1981/82.

In 1979 the total cost of provision of irrigation facilities, including infrastructure requirements such as roads, community centres, storage facilities etc. was estimated to amount to Rs. 2,400 million. On this basis, the total cost of headworks was expected to be about Rs. 1,150 million with about 40 percent being the cost of the dam only. Nearly two thirds of this cost was required in foreign exchange.

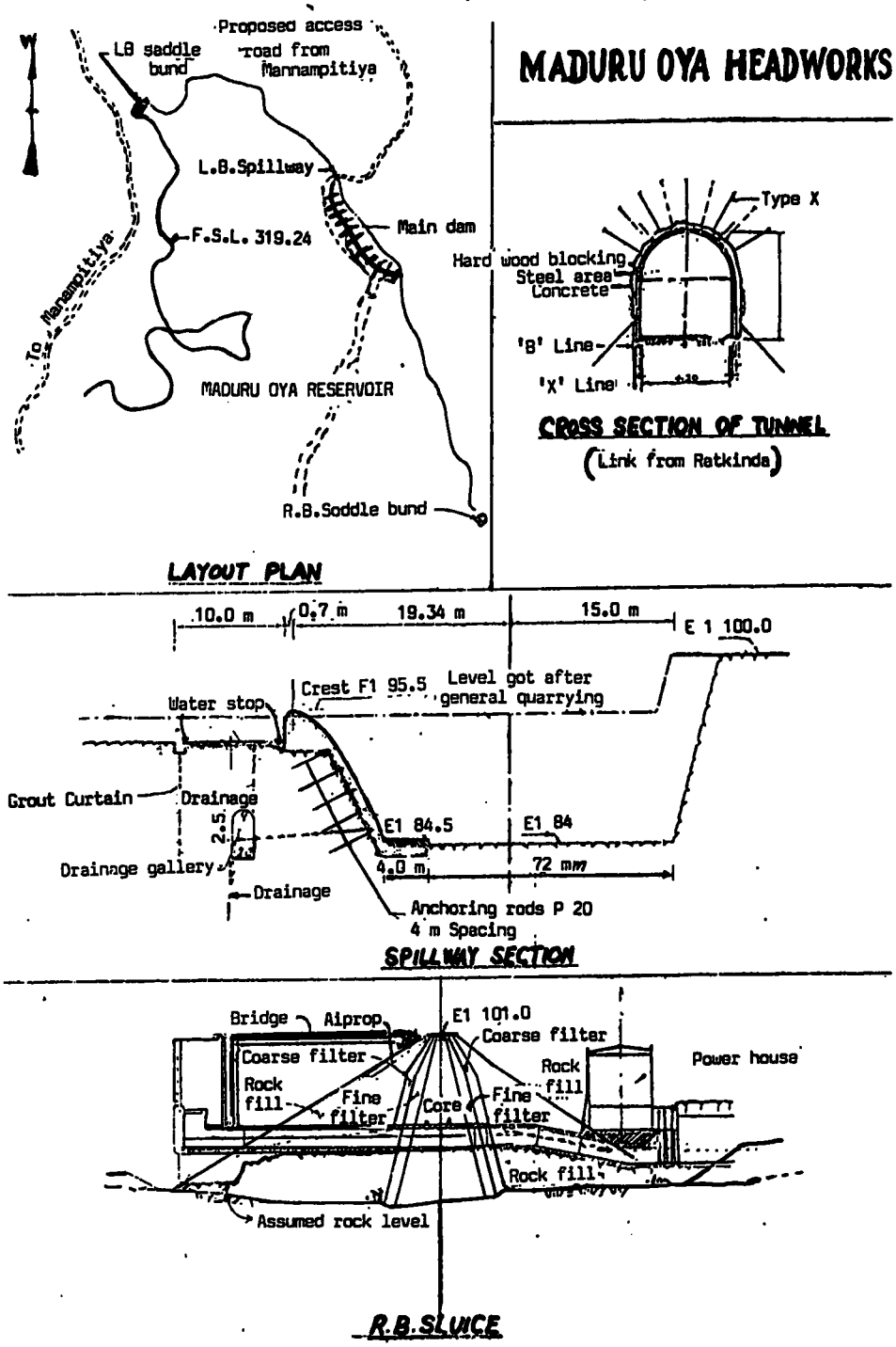
Meanwhile, according to the "Mahaweli Programme – Review of Progress 1980" the construction programme for the project was scheduled to cover a period of 3 years commencing immediately after the preliminaries were completed in 1979. Construction operations on the dam were to be concentrated in the years 1980-81 ending with the final closure works in 1982. According to this schedule the installation of electro-mechanical equipment was to be carried out during the last two years of construction and the testing of the equipment to be completed by January 1983. But there arose delays and a lag in the scheduled programme.

The contract was awarded only

Continued on page 13

	Local Rs.	Foreign Rs.	Total Rs.
Contract No. 2	235,031,981	849,369,671	1,084,401,652
Contract No. 4	53,834,927	200,141,600	253,976,527
Contract No. 3A	2,164,500	10,791,429	21,955,929
	291,031,408	1,069,302,700	1,360,334,108

(Conversion Rate Used: 1C$ = 13.25; 1 US$ = Rs. 21.00)



FOREIGN CONTRACTORS

Nearly 70 percent of the funding on the headworks was coming in through foreign sources and in terms of the conditions of the foreign assistance received on the Mahaweli Project the contractors were generally from the country which provided the funds. The level of funding and inflow of funds had never occured before on so large a scale on any other project in Sri Lanka's history. In the case of Maduru Oya Project, for instance, the consortium of four Canadian firms was awarded contracts in April 1980 to the value of Rs. 1.3 billion and inflation took this sum up further.

In the case of the Victoria Project Balfour Beatty Nuttal of UK was awarded the tender for constructing the dam in March 1980 at a value of Rs. 1.5 billon and also the contract for constructing the tunnel at a value of Rs. 645 million. The contract for building the power Station was awarded to Costain International of UK in October 1980 at a value of Rs. 250 million.

At Kotmale the construction contracts covering Initial, Underground and Reservoir Works costing about Rs. 6.2 billion were awarded in 1979 to Messrs. Skanska Cementgjuteriet; and contracts for the Electrical and Mechanical Works costing Rs. 1.2 billion were awarded in 1981 to ASEA, both of Sweden.

With such enormous sums of money being expended on these projects the issue of wastage or misuse of funds was raised in certain quarters One official view point on charges of such wastage and misuse of funds was that once the contracts were awarded utilization of funds were the responsibility of the contractor firms and if there were instances of "leakages", in accounting terms provision had been made in their budgets for a small percentage of wastage.

There were numerous contractor firms involved in projects both after the start of the Accelerated Programme as well as before, as the following lists indicate. (It is possible that the lists do not include the names of some contracting firms, which were not available).

FOREIGN CONSULTANTS AND CONTRACTORS

Firms and Function

VICTORIA

1. Sir Alexander Gibb & Partners
2. Preece Cardew & Rider
3. Hydraulics Research Station
4. Balfour Beatty Nuttal Joint (Comprising Balfour Beatty Construction Ltd. & Edmund Nuttal Ltd.)

Consulting Engineers in association with Specialised advice from Main civil contractors for Dam and Tunnel

5. Costain International Ltd.
   Power Station
6. Whessoe Boving Joint Venture (Comprising Whessoe Heavy Engineering Ltd., Boving & Co. Ltd.)
   Hydraulic Equipment
7. Balfour Kilpatrick Ltd.
   Dam Electrical Distribution System
8. Boving & Co. Ltd.
   Turbines and Associated plant
9. GEC Large Machines Ltd.
   Generators and Associated Plant
10. Hawker Siddeley Power Transformers Ltd.
    Transformers and Associated equipment.
11. NEI Reyrolle Ltd
    High Voltage Switchgear
12. BICC Supertension Cables Ltd
    High and Low Voltage Cables
13. GEC Electrical Projects Ltd
    Station Miscellaneous Plant
14. Herbert Morris Ltd
    Cranes and Lifting Equipment
15. Eve Construction Ltd
    High Voltage Transmission Lines

KOTMALE

1. The Water and Power Development Consultancy Services (WAPCOS)
   Feasibility Studies
2. Sir William Halcrow and Partners, UK
   Consultancy Services
3. Kennedy & Donkin and Westbrook Mills, UK
   Consultancy Services.
4. SKANSKA of Sweden
   Civil Engineering Works
5. ASEA of Sweden
   Electro Mechanical Equipment
6. NEY/RPIC of France
   Supplying of steel gates for the spillway.

RANDENIGALA

1. Joint-venture Randenigala M/s. Salzgitter Agrarund Electrowatt
   Feasibility Studies
2. Kreditanstalt fur Wideraufban – 'KFW'
   Dam Construction
3. Joint Venture of M/s Dyckerheff and Widman, Bilfinger and Berger and Alfred Kunz, of West Germany Joint Venture
   Randenigala Civil Contractors
4. Marchinenfabrik Augsburg-Nueraberg A.G. (M.A.N.) of west Germany
   Randenigala Hydromechanical Contractors
5. Brown Boveri and CIE Aktiengesellschaft (BBC) of West Germany
   Randenigala Electrical Equipment Contractors

MADURU-OYA

1. Crippen International Ltd
   Canadian Consultants
2. The Foundation Company of Canada Ltd., Atlas-Gest, International Ltd., Fitzpatrick Construction Ltd & Janin Construction Ltd. Joint Venture
   Dam Construction
3. ACRES
   Consultants' (Maduru Oya Dam and System B)
4. SOGREAH
   French Consultants (Maduru Oya Dam design)
5. Hydraulic Engineering Corporation of China (HECC)
   Manufacture of all hydro-mechanical works for Maduru Oya project.

DOWNSTREAM DEVELOPMENT

1. Snowy Mountains Engineering Corporation, Australia
   Construction and upgrading of 134 kilometres of raodway in Systems B & C.
2. Tippets-Abbett-McCarthy-Stration (TAMS) of USA
   Environmental assessment study and plan of action in System B & C.
3. Vianini Italy
   Contractor The R. B. Transbasin Channel, Minipe.
4. Hazama Gumi Toda & C. ITOH of Japan (Joint Venture)

Contractor – R. B. Transbasin, Channel No. 2 Ratkinda.

5. Nippon Koel Jec & Chue Koihatsu, Corporation Japan
Consultants (Moragaha Kanda Feasibility Report)

6. NEDECO – The Netherlands
Consultants – (Implementation Strategy of the Accelerated Mahaweli Programme)

7. SOIL Mechanics Ltd. of UK
Consultants (Special Geological Survey)

8. Zachry - Diltingham USA. (Construction of Left Bank Main Canal)

9. Louis Berger International Inc. USA.

in April 1980 for the construction of the three dams, namely, the main dam, one on the left Bank and one on the Right Bank. A revised implementation schedule required completion of the link tunnel by April 1983 to allow transfer of Mahaweli water to the reservoir. The impounding of the reservoir commenced on October 12, 1982 with closure of the dry-season diversion conduit; and the main dam and spillway were completed in 1983. A review by the Consultants Crippen International Ltd., indicated that the contractor attributed delays in the schedule to the late award of the contract which caused a loss of construction time during the non-monsoon season.

Expatriate personnel working in a project site

Crippen pointed out that even specific contracts such as the award of the Electrical Mechanical Contract fell behind schedule which would have had the effect of delaying power house construction. Due to such delays initially, virtually no permanent work could be undertaken at this stage and the contractor felt that as a result the full 1980 construction season was lost.

Initial Problems

In a project of this magnitude, where uneven resources had to be mobilised on so large a scale within a limited time span, delays spawned. The consultants on the Maduru Oya Project drew attention to several factors that according to them caused delays in the early stages, and it was some of these same factors that affected the other projects as well, in the initial stages. Apart from the late award of contracts, delays in establishing schedules, bonding requirements and mobilization of advance payments; there were also problems such as non-availability of local equipment, delays in arrival of construction equipment from offshore, lack of adequate spare parts, unpredictable ocean freight shipments, and lack of experienced operators despite the salary incentives offered. In the case of the Maduru Oya Project there were instances where due to lack of services or delays in providing these services, expatriate personnel had to be deployed on construction work other than site construction. But despite such initial problems the contractor succeeded in completing the project on schedule as a result of an intensive effort together with the support of a dedicated staff and good weather conditions. Though the project started late, with the relatively dry 1980/81 monsoon the contractor was able to deploy his forces very efficiently during early 1981 on cofferdam construction and recover a substantial portion of time lost in 1980.

Another problem faced by this project and some of the other headworks projects was that of delays in raising the required financial resources which was aggravated by general inflationary trends and an escalation in costs.

Thus, in 1981 although aid commitments had increased substantially in support of Sri Lanka's development strategy high inflation and a large and steady deterioration in the terms of trade had made them inadequate. The result was that large financing gaps emerged on many development projects, which in turn caused strong budgetary pressures and a heavy current account deficit in the balance of payments. Sri Lanka had even to resort to non-concessional finance on a significant scale to help to cover these budgetary and balance of payment gaps. On the Mahaweli Programme, however, the initial underestimate of costs and subsequent unexpectedly high price escalation resulted in a heavy increase in total costs. This resulted in large financing gaps on the headworks. In order to finance the increased local costs, without resorting to inflationary finance, the government had no alternative but to cut down on other public investments. The policy of not introducing new projects initiated around this time continued into mid 1980's.

The consultants reporting on the Maduru Oya project drew attention to the escalation of costs in this specific instance. The rapid rate of increase in cost escalation for the Sri Lanka rupee part of the project was of major concern during the first 18 months of the project. Between 1981/82 costs had gone up an estimated 122 percent and this made budget projections difficult. However, by the end of 1983 the rate of escalation of costs slowed down

somewhat; by then Sri Lanka's rupee portion of the project cost had increased by 155 percent and the Canadian $ portion by 25 percent relative to tendered prices. The end result was that total escalation payments to complete the work were Rs. 364 million and Canadian $ 10.5 million. When these figures were applied to the non escalated costs the total, including escalation, were Rs. 650.9 million and Canadian $ 92.9 million in a project where the total cost was Rs. 2,482 million or Canadian $ 127.3 million.

Implementation Schedule

The planned schedule for the Maduru Oya project, developed in 1979 called for the dam to be complete so as to detain the waters of the 1982 monsoon in the reservoir. Following award of the main civil contract in mid 1980 the Canadian Contractor employed a work force of about 100 expatriates and 2,500 Sri Lankans, working two shifts six days per week, and with approximately $ 25 million worth of heavy equipment to achieve this target.

The hydro-mechanical contract was awarded in October 1981. Working to a tight erection schedule, the HECC erection team, comprising 45 Chinese nationals achieved closure of the intake gates in October only 12 months after award of this contract. This critical activity allowed impounding of the reservoir to commence as scheduled.

All work was completed by July 1983.

Infra-Structure

The Maduru Oya Reservoir site is situated in a jungle far away from habitations. The nearest town is Polonnaruwa, which is about 64.4 km (40 miles) away. The remoteness of the site proved a challenge both to the Mahaweli Authority and the contractors, particularly in providing the required infra-structure to undertake the construction of this project.

The infra-structure required the provision of the following:

* Over 35 miles of access roads, most of it paved, at an approximate cost of Rs. 30 million.
* A complete town site for about 200 Canadians, including families, and some 250 Sri Lankan staff on the banks of Pimburettawa tank. Attractive staff bungalows and accommodation, a large recreation centre and school and medical facilities were set up at this townsite. Nearby was the labour camp accommodating the 2,500 workers on the project.
* The required electric power supply for construction and domestic purposes was provided by the Ceylon Electricity Board (CEB) from power lines extended from Mahiyangana and Polonnaruwa. Full standby emergency diesel generator power supply was also provided.
* The Ceylon Petroleum Corporation (CPC) constructed a special refuelling station at Welikanda to cater to the needs of this project. This depot has a storage capacity of 250,000 litres (50,000 gallons) dieseline and 22,500 litres (5,000 gallons) of petrol.
* A water supply scheme for the construction staff and workers was also constructed; the purified water for this purpose being supplied from the Pimburettewa tank.

Downstream Irrigation Development

Water from the Maduru Oya reservoir will irrigate areas in System B through its Left Bank (LB) and Right (RB). Work on the Left Bank Main Canal and its branch and distributory canals commenced after work was completed on the main dam and reservoir. The construction of the main and branch canals was divided into 2 phases: under the first phase, about 60 km. (37.3 miles) of the main and branch canals were due to be constructed. The second phase comprises about 80 km (49.7 miles) of the main and branch canals.

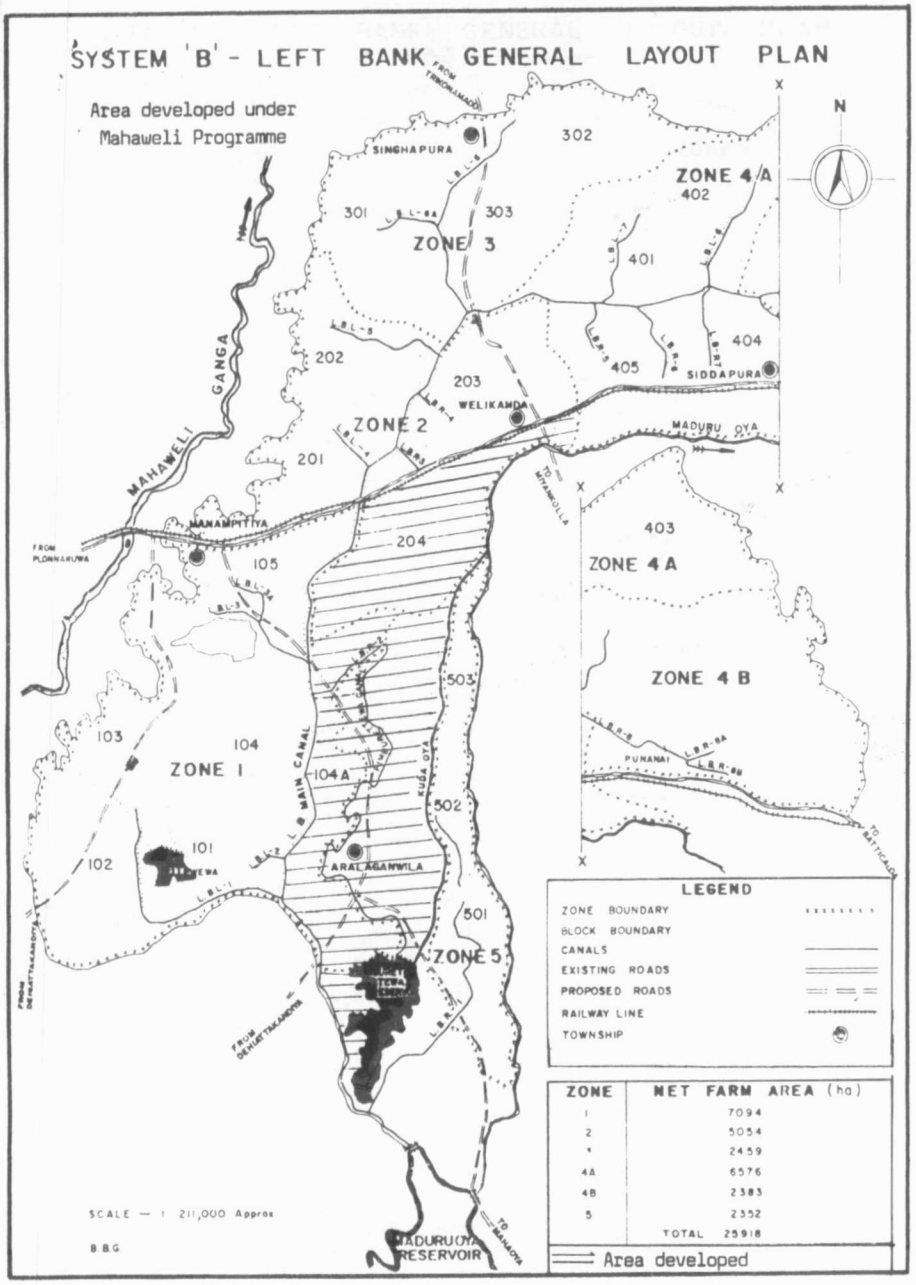
Work on this canal was given on contract to Messrs. Zachry-Dillingham, an American Joint-Venture and those portions of the Left Bank Main Canal serving blocks 501 and 502 in Zone 5, which total 1,500 ha. (3,600 acres) were completed by 1984. Construction of the main and branch canals serving blocks 101, 102 and 103 in Zone 1, totalling about 3,000 ha. (8,400 acres) were also completed. Distributory and field canals were also built to provide irrigation facilities in Blocks 501 and 502 of Zone 5, and a further 3,500 ha. (8,400 acres) in Z Zone I blocks 101, 102 and 103 were programmed for completion for Maha 1984.

All these canals in the Left Bank area will be concrete lined. Under phase 1(a), about 25 km of Main canals and about 35 km of Branch canals were constructed, this work commencing in July 1982 while under Phase 1(b) about 30 km of Main canals and about 50 km of Branch canals were being constructed. All work on this contract is expected to be completed by March 1986. The total cost of these canals would be nearly US$ 100 million.

The Right Bank Main canal and Branch canals will irrigate about 14,000 ha. (35,000 acres). A detention reservoir was created at the confluence of Nagolla, De & Kaduinne Elas at what is called the NDK Dam and the RB main canal to it from the Maduru Oya RB Sluice, 2.3 km in length was constructed. Work on the rest of the RB main canal and Branches were due to be given out on contract and work due to start in 1985.

The Main Conveyance System which has been completed to feed the Mahaweli waters into these new areas in Systems B & C comprises:

(a) The new Minipe Anicut and the Minipe RB Transbasin canal, about 31 km in length.



(b) Twin service reservoirs at Ulhitiya-Ratkinda with a combined spillway.

(c) 10.90 km Ulhitiya Left Bank Main Canal feeding Zone 2 of System C.

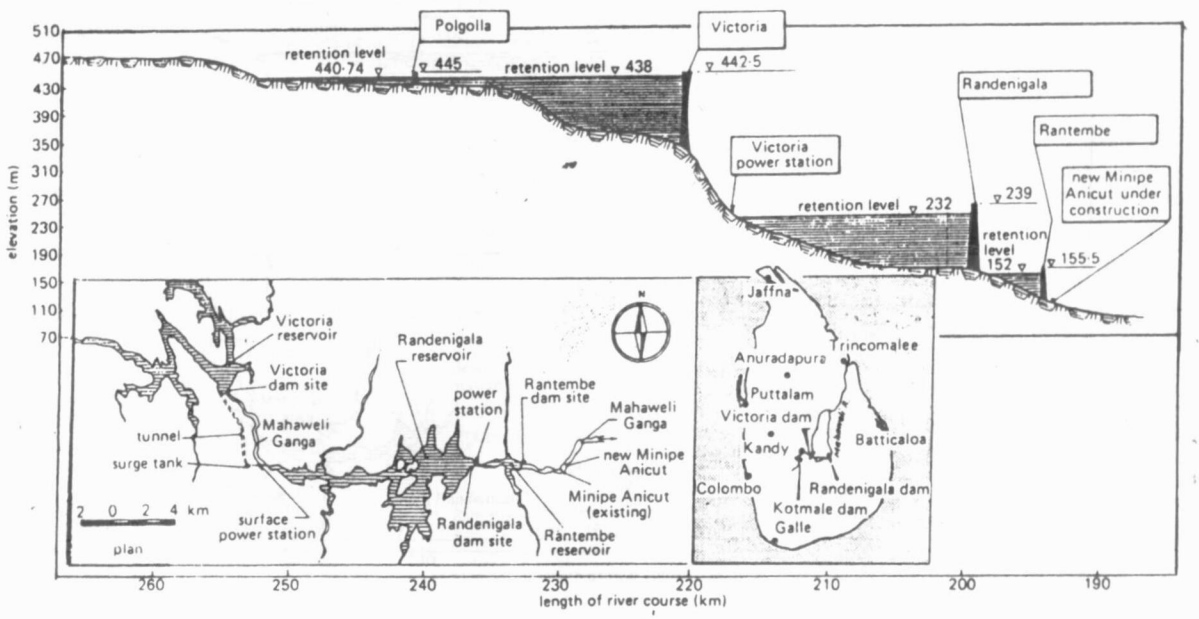
(d) 17.35 km Ratnkinda Right Bank main canal No. 2 feeding Zones 3 to 6 of System C, (under construction).

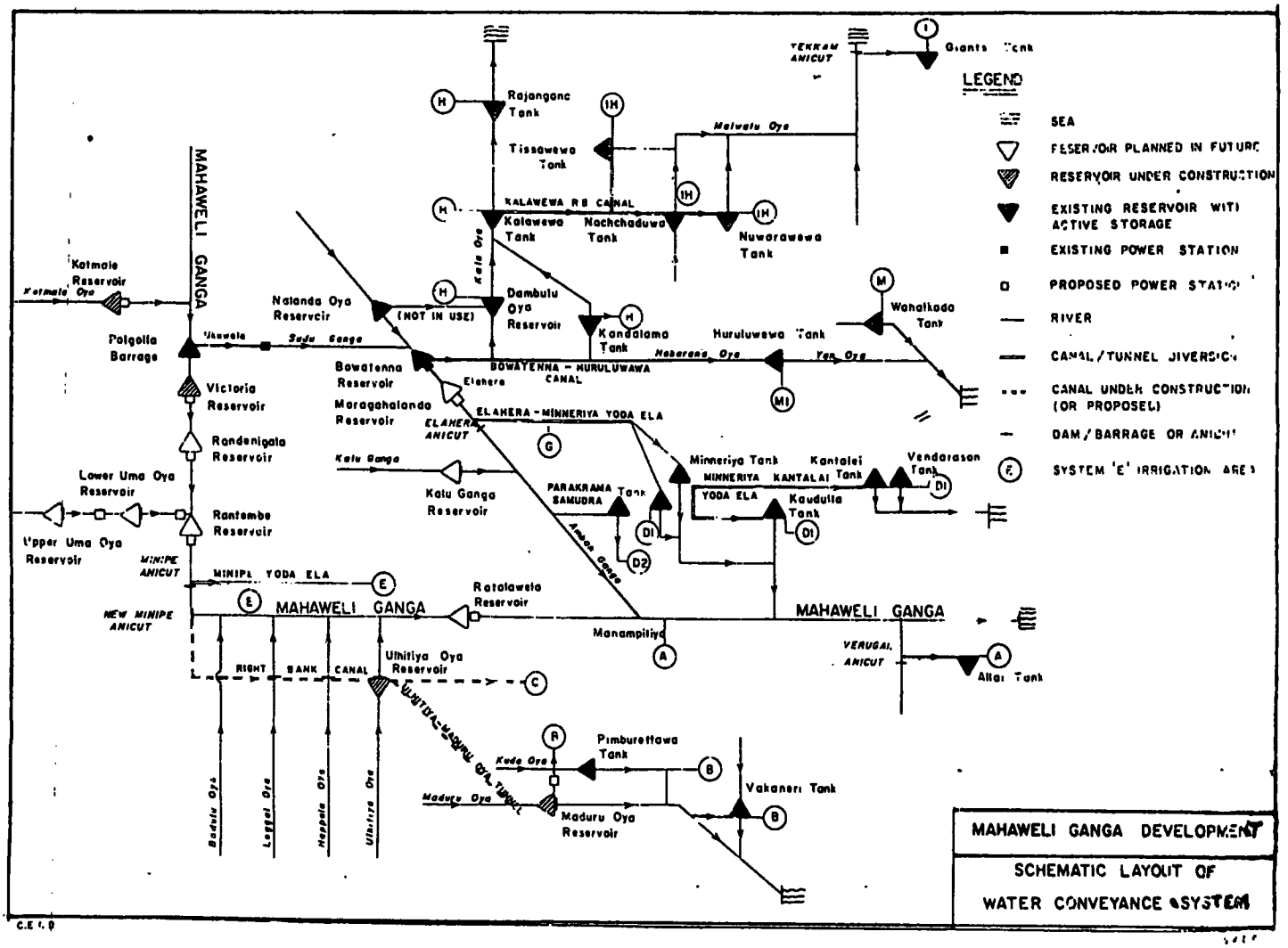
(e) 5.6 km Link Tunnel to transfer Mahaweli waters from Ratkinda to Maduru Oya Reservoir.

(f) Maduru Oya Left Bank canal about 53 km in length, of System B (construction in progress).

(g) The Maduru Oya Right Bank canal about 41 km in length, of System B (completed up to NDK dam.)

The headworks programme was able to be kept within schedule after initial problems were cleared and adjustments made and this has helped considerably in the power supply programme of the overall project. But the irrigation aspect has fallen behind expectations. It has always been accepted that downstream projects particularly irrigation, agriculture, and settlements are as important as the headworks since the major objectives of the Accelerated Programme such as the increase of food production, saving of foreign exchange





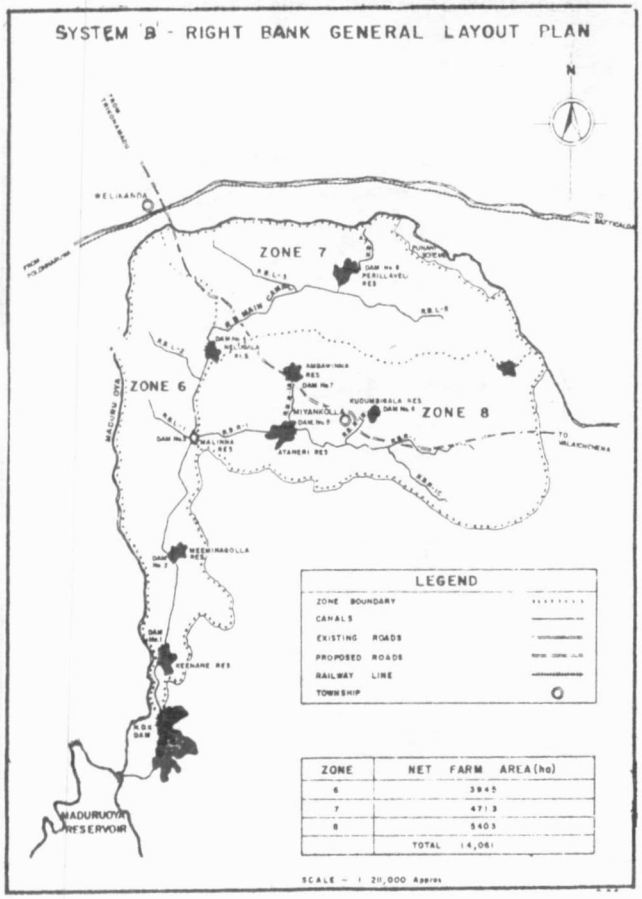
expenditure, and employment generation could not be achieved without the full development of the downstream projects. The late start and delays in construction at different stages of the project have resulted in accumulated delays in the downstream works and in the long run this could have an impact on the wellbeing of the settlers for whom the Mahaweli Project was intended.

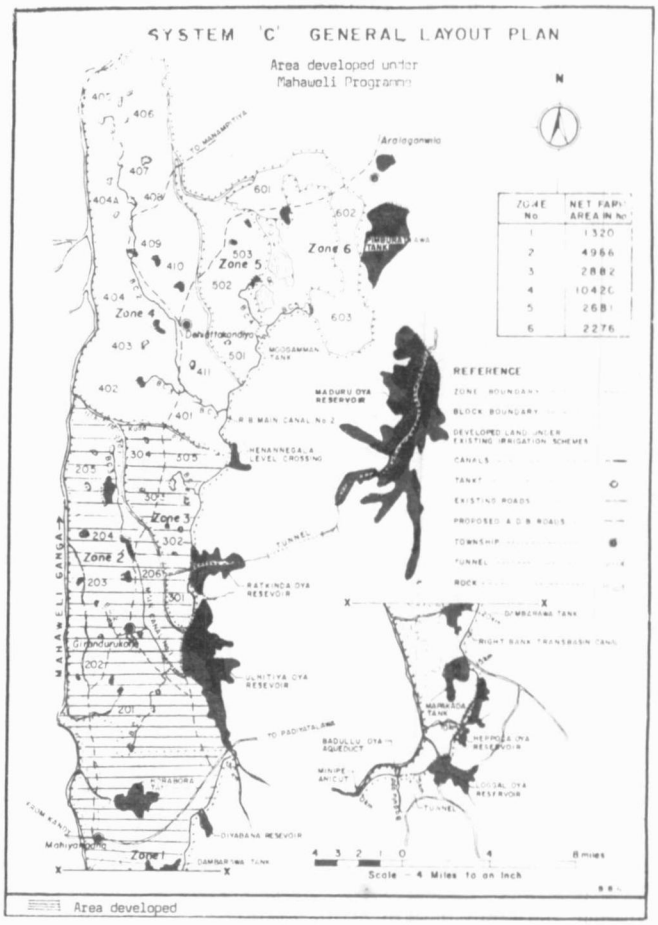
As shown in the table and maps there has been a heavy backlog in the settlement programme. The assured annual water issue under the Accelerated Programme was estimated to be capable of irrigating about 131,000 ha (330,000 acres) of land in 5 systems. Furthermore, according to the Mahaweli Programme of 1979 about 140,000 families were expected to be settled on the lands brought under irrigation in this project. If these targets were to have been achieved within the period of the accelerated programme, namely, the 6 years between 1977 and 1983, there has been a considerable shortfall in the areas of irrigation and settlement after almost 8 years. Since 1977 only 6.02 percent of land under the targetted areas could be fully developed with irrigation water and only about 13 percent of the targetted 140,000 families have been settled. System G which is covered mostly with areas already settled under Elahera — Bakamuna area is a marginal system as far as downstream development is concerned. On the other hand, System B and C are the major areas of settlement development under the Accelerated Mahaweli Programme. However, only 23.58 percent and 3.54 percent of the land could be fully developed with irrigation water in System C and B, respectively.

The Right Bank region of System B covers an area of 48,000 ha. of which about one third is to be brought under paddy. The Right Bank channel of the System was expected to take water towards the northern region but still remains untouched as a result of funding problems and no new settlement has taken place in this area.

Meanwhile, in the Left Bank area of System B, which is divided into Zones 1 to 5, development activities had begun in one of the Zones and about 1,500 hectares settled; and the total number of families brought in

BRINGING MAHAWELI WATERS TO SYSTEM "B" AND "C"



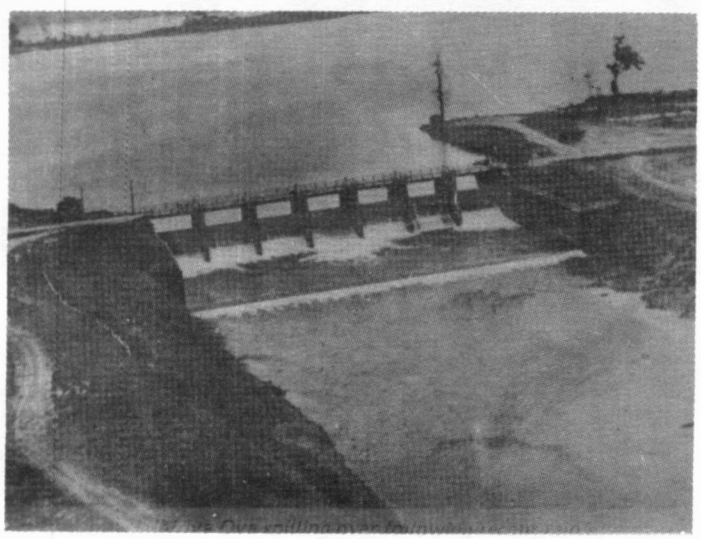


was 7,515. As seen in the map it is only part of Zone 1 in System B that has been developed while Zones 2, 3, 4, 5 and part of 1 are awaiting development.

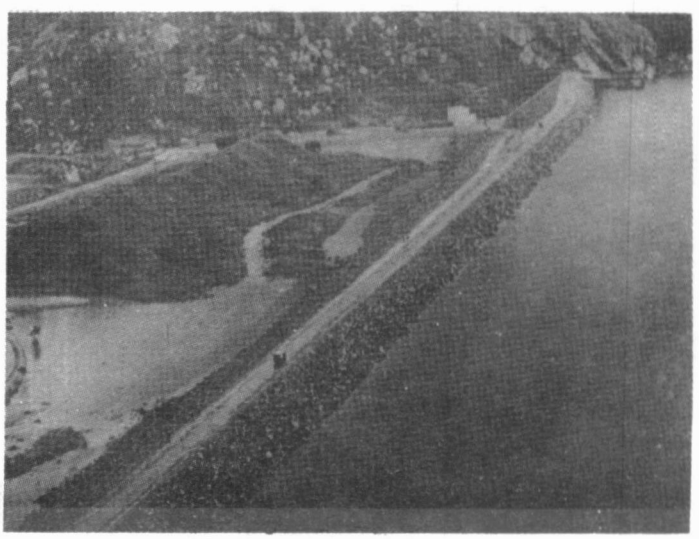
System C comprises about 66,000 hectares and here Zones 1, 2 and 3 have been developed, while Zones 4, 5 and 6 are awaiting development. With increasing incidence of terrorist activities in these areas there could be a serious threat from this quarter to further progress on downstream development and settlement within the Mahaweli Project.

By early August work at several sites in System 'B' and 'C' had come to a standstill, with construction of farmer houses and minor canals halted in the Welikanda, Sinhapura, Sevanapitiya and Katuwanwila areas. Despite the threats construction work on the canal intended to carry water from Maduru Oya to Poonani was continuing with difficulty.

(A further discussion of Downstream Development in these areas irrigated by the Mahaweli waters is contained on pages 34 – 37).



Ulhitiya Oya spilling over following recent rain's



Maduru Oya and Reservoir

TABLE 2

Some Basic Features of the Accelerated Mahaweli Programme — Headworks (Targets & Achievement)

	COST (Rs. Million)			TIMING		DAM PARAMETERS Height/ Length (Ft.)		CAPACITY (Acre. Ft.)		POWER GENERATION INSTALLED CAPACITY (M. W.)		IRRIGATION Hectares		SYSTEM	DONOR
	1977	1984	Increse %	Target	Actual Achievement	1977	1984	1977	1984	1977	1984	1977	1984		
VICTORIA	3018	7890	261.4	1984 Dec.	1984 Nov.	400/ 1663	400/ 1663	590800	500800	120	210	45000	64544	B.C	UK
MADURUOYA	1758	2631	150.0	1983	1983	130.4/ 3362	130/ 3307	378500	393000	4.5	4.5	49500	39979	B	Canada
KOTMALE	3650	8755	240.0	1985 March	1985 Aug.	350/ 1969	262.4/ 1969	331000	141000	200	140	Increased Irrigation Water available at Polgolla. (36500)			Sweden
RANDENIGALA	1043	4450	427.0	1985 Dec.	1985 Dec.*	295/ 1640	308/ 1590	648000	697000	75	126	Supplemtal Irrigation benefits (30,200)		A,B,C	West Germany

*Work in progress.

Source: Mahaweli Projects and Programme — 1979, 1983, 1984. Victoria and Hydro Electrical Scheme — 1984. Mahaweli Ganga Development Sri Lanka (Summary Report on Project) — 1977.

Table 3

Accelerated Mahaweli Programme — Targets and Achievements of Downstream Development and Settlement (Hectares)

Target of Accelerated Programme between 1977 — 1983			Achievements as at 31. 05. 1985.			
(1) Systems	(2) Irrigatable Land	(3) Number of families to be settled	(4) Total Area developed with irrigation	(5) 4 as a % of 2	(6) Total number of families settled	(7) 6 as a % of 3
A	36,000		—	—	—	
B	48,000		1,700	3.54	7,515	
C	24,000	140,000	5,658	23.58	9,781	12.96
D	19,000		—	—	—	
E	2,800		450	16.07	854	
Total	129,800	140,000*	7,808*	6.02	18,150	12.96

*Area fully developed upto level of irrigated farming.

Source: Mahaweli Projects and Programme 1979 — 1984 Progress Reports, Mahaweli Development Authority, Department of Census and Statistics Studies.

Changing emphasis in Mahaweli Programme

The Manager of the Victoria project and Deputy General Manager Central Engineering Consultancy Bureau, Mr. H. B. Jayasekera commenting on the change of emphasis in the project and economic banefits stated that the original programme was drawn up by the UNDP in the 1960's and the UNDP/FAO Master Plan of 1968 included several projects with the emphasis on irrigation and agriculture.

The oil crisis of the early 1970's and the dramatic rise in oil prices changed the whole situation. Oil prices increased almost ten fold and emphasis naturally had to be shifted from irrigation to hydropower. In the original programme power was a small component compared to irrigation, but after the oil price hike power was given priority. The decision at this stage was an economic one to tap maximum energy in the shortest possible time. This was one reason why water couldn't have been taken to the NCP. The decision was that there should be minimum of diversion and therefore only the minimum requirements at Kalawewa and Elahera were met.

The original programme was phased over a 30 year period. The NEDECO consultants were called in around 1977 and they identified as priority the 4 headworks and systems A,B, & C. All the required power, agriculture and irrigation potential was to be tapped from these projects. Thereafter the original concept of maximum diversion was changed to minimum diversion. The result was that the earlier programme of 70—80 reservoirs to irrigate 900,000 acres was considerably reduced.

Moragahakanda was being looked into by the Japanese, with a view to financing the project but it was never taken up after NEDECO submitted their report.

At Victoria the emphasis was changed to provide 210 MW and provision made to provide a further 210 MW to meet peak power demands of the future. The total cost of supplying energy was estimated at Rs. 8,000 mn of which the cost of Victoria was Rs. 3,000 m; Kotmale Rs. 3,000 mn; and Maduru Oya Rs. 2,000 mn.

In the case of Victoria, as in the other headworks, the decision to shift the emphasis to power was based on strict economic criteria. It has been estimated that the power benefits alone would help to recover the cost of construction; while the other benefits such as agriculture, fisheries and irrigation became national assets."