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MAHAWELI

PROJECTS & PROGRAMME

1987

A survey of the progress of work
on the Accelerated Programme
of Mahaweli Development
in 1986
and the development proposed
in 1987

Mahaweli
Projects & Programme
1987
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FOREWORD

The major capital works of the Accelerated Mahaweli Programme like the dams, reservoirs and canals are now completed and form an integral part of the physical relief of our country. On account of their epic scale and visibility, these structures have added a colossal dimension of engineering exactitude to the already impressive man-made environment of Sri Lanka, where the stupendous achievements of our forbears standout.

With only a residual component of work to be taken in hand at Rantambe, it is possible to assert that the large bulk of the capital works of the Accelerated Programme is behind us. But this is not to say that everything is going to be downhill from now on.

The work now in hand is the enormously more challenging task of social engineering directed towards the evolution of a well-rounded, cohesive settler society and infusing it with an awareness of its historic role as the agent of catalysis in a new environment reclaimed from jungle.

Officials ministering to settler requirements have been instructed on the need to be mindful of, and sensitive to, the hopes and aspirations of the settlers, as they will constitute the pith and core of the new Mahaweli society, which will ultimately give identity and character to the new development area.

To date, the Mahaweli balance sheet has vindicated the conceptual validity of the overall Mahaweli Project, especially the decision of the government headed by His Excellency J. R. Jayewardene to force its pace. This was perhaps the boldest decision taken in the economic history of this country and it has paid off.

ACHIEVEMENTS

The power development potential in the island has been more than doubled, with the provision of cheap hydropower development capacity of over 500 Megawatts, and the import of expensive fossil fuels has been drastically reduced. Rice imports have fallen from Rs. 884 million in 1979 to Rs. 197 million in 1984 and to even a lower figure now. Up to the end of last year, over 50,000 new farm families have been settled in the newly developed lands, thus providing employment to nearly 2 lakhs of persons in agricultural pursuits and almost that number in allied pursuits in the service sector.

New towns have sprung to life in remote areas like Galnewa, Tambuttegama, Galkiriyagama, Girandurukotte, Heengalakandiya, Dimbulagala, Welikande, Aralaganwila, etc., thus reviving the ancient hydraulic civilisation that existed in those parts. An unprecedented acreage of fertile lands has been brought under the plough, in a comparatively short period of time and new crops will be raised for the export market such as gherkins, vinca, rosea, ramie, sunflower and exotics unheard of in those areas before. Traditional crops like paddy, chillies, green gram, black gram, soya beans, maize, cowpea, groundnuts, kurakkan, sesame and onions are flooding the consumer markets and also supplying the basic needs for agro-based industries.

The contribution of the Mahaweli Programme to the national production of paddy has increased from 81,813 metric tons in 1981 to 325,714 metric tons in 1985, an increase of nearly 300%. The acreage yield of paddy per hectare in the Mahaweli areas, by far exceeds the national average by about 1000 kg (1 metric ton) per hectare. 43% of the estimated chillie demand is met from the Mahaweli areas, particularly from System 'H' which contributes 91% of the chillies, 85%

of the cowpea, 95% of black gram, 74% of red onions and 94% of Bombay onions produced in the Mahaweli areas. The newly settled Mahaweli farmers have earned a gross income of over Rs. 80 million in 1985 from subsidiary crops alone and over Rs. 100 million in 1986.

THE NEW PHASE

In order to attract private investors to promote agro-based industries in the Mahaweli areas, a new organisation has been set up within the Mahaweli Ministry, namely "Employment Generation and Investment Enterprises". Incentives such as tax exemption etc., will be offered to private investors who are prepared to venture out into these new areas.

A Mahaweli Capital Investment Fund is being launched to enable the Mahaweli Authority of Sri Lanka to promote equity investments in enterprise development in the Mahaweli Special Areas, by subscribing to a part of the share capital.

For promoting small scale ventures, the MASL has established a joint venture capital company in association with Appropriate Technology International (ATI) of the United States of America. This will undertake the processing of agricultural produce, thus promoting small scale industries in the rural sector. The projects identified are the production of vinegar, rice milling and processing, chillie grinding and processing, handloom industry, manufacturing cement blocks, fruit canning and assembling of agricultural implements.

A Household Enterprise Development Centre has taken off the ground at Girandurukotte, which will provide small scale investors with facilities such as credit, transport, storage and processing of agricultural produce. These Centres will also impart basic training in business management to enterprising farmers, who are prepared to step out into new ventures.

Apart from agricultural crops on the lands newly opened up, there is a big potential for developing fresh water fisheries and prawn farming in the vast expanses of water stored in the new reservoirs. Fresh water fish provides the much needed protein to the new population in the Mahaweli areas, where sea fish will not be available, being in the interior far removed from the sea coast. The surplus fish from reservoirs can be preserved as dry fish or canned fillets, and also used for making fertiliser and poultry food.

A very useful Draught Animal & Dairy Development Programme is progressing well in the Mahaweli areas, which will provide a good portion of the tillage power needed by the farmer. This is much cheaper than mechanised tillage, which requires valuable foreign exchange that has to be paid for imported tractors and expensive fossil fuel. The dairy development part of this programme supplements the much needed protein for the new settlers and their children,

The Mahaweli farmers will be actively participating in all these new enterprises and stepping out of the normal groove of being a "subsistence farmer" as of old, who produced just enough to make ends meet, to becoming an "enterprise development farmer", who will have no limit to his achievements. The existing area of arable land available in the island is inadequate to produce enough to feed the population on the levels of production now in vogue, (at 0.4 hectare of land per head of population). The levels of production have to be intensified like in Japan, to about ten times what we get now.

The Mahaweli Development Programme has created a break away from the 'urban trap' which was the trend prior to this programme, when the village folk used to clamour for white collar jobs in the city. Now that trend has been reversed and those in the urban areas are attracted to go back to the land, where opportunities for them are greater.

The planners of the Mahaweli Development Programme have not lost sight of the adverse impact that such a large development scheme can have on the environment. Several wild life reserves have been created, in fact covering areas larger than what have been developed, to provide habitats for the displaced wild animals. Only essential clearing is being carried out in development areas, and all reservations along streams, canals, roads and settlements are being planted up. The catchment areas of major reservoirs are being reafforested and preserved as forest reserves.

The settiers are not only provided with all the inputs and marketing necessary for agricultural development but also recreational facilities for sports activities and spiritual advancement.

To sum up, the foregoing is an impressive catalogue of achievements and proposals. But it is well to remember that the founding fathers of the Mahaweli Project did not envisage self-sufficiency in our requirements alone. Self-sufficiency per se in our rice requirements, for instance, was merely a milestone in their strategy. They looked beyond self-sufficiency towards servicing the export market.

The Mahaweli administration therefore has plans to engage in selective breeding of varieties of rice and other food commodities for the export market. Self-sufficiency per se is a hollow concept.

Therefore it is only when Mahaweli food commodities and industrial goods are loaded into ships from our ports, and only then, could we honestly acclaim that the vision of the founding fathers of the Mahaweli has been truly vindicated.

Future Potential

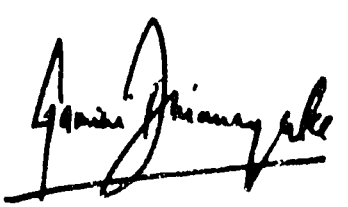
There are several more projects available for development in the Mahaweli and its tributaries. The projects selected for development

in the Accelerated Programme have been the most beneficial ones. There are several small projects available for future development, which can provide as much installed capacity for hydropower, as has been provided under the Accelerated Programme, the water releases from which can be used for further irrigation development.

The Upper Kotmale Project is one such hydropower development complex which is now being studied by Japanese Consultants under a Japanese Technical Assistance Programme.

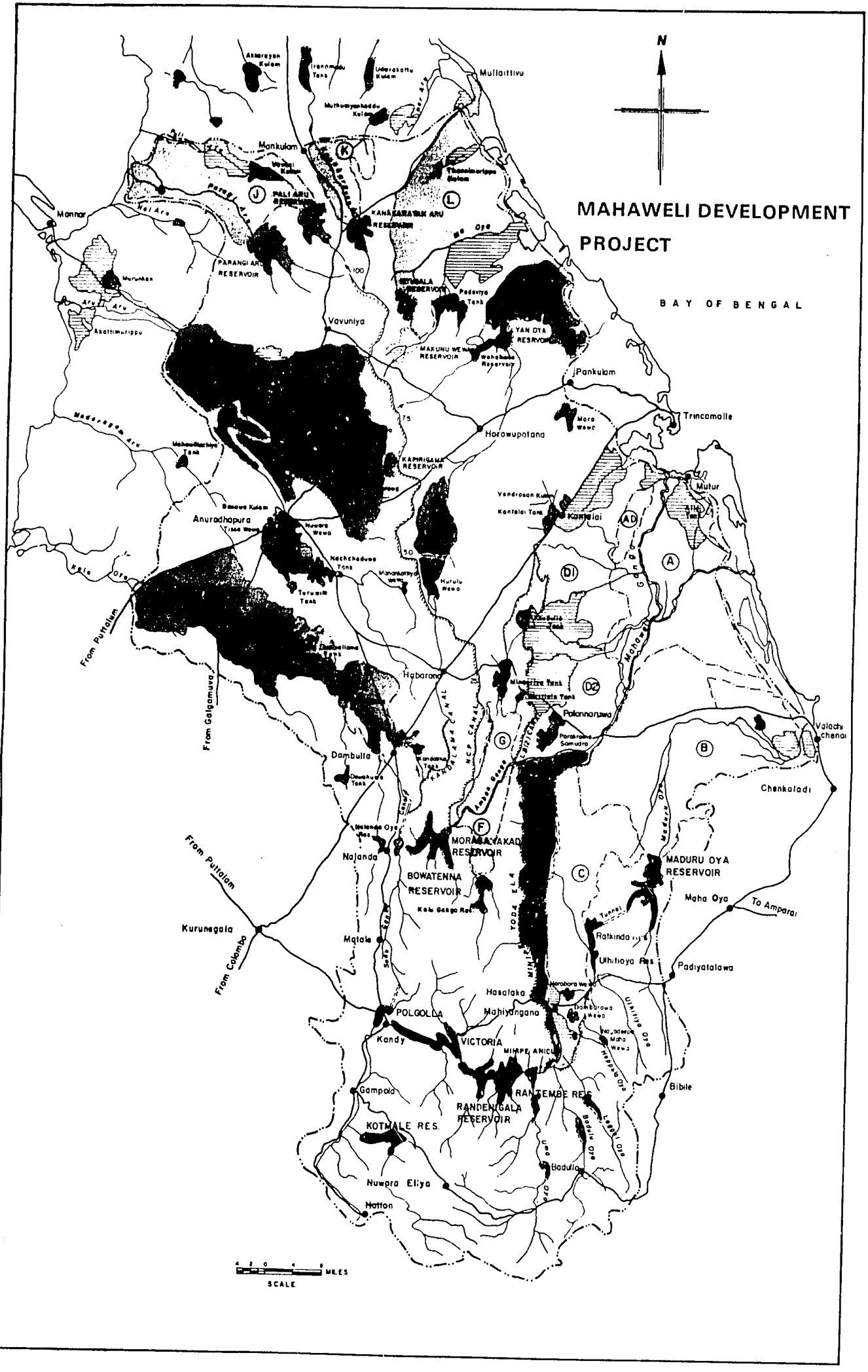
There is also System 'A' in the downstream deltaic region of the Mahaweli, which is now being studied for irrigation development by Soviet Specialists under an U.S.S.R. Technical Assistance Programme.

It was the vision and foresight of our revered leader and veteran politician, His Excellency President J. R. Jayewardene, that master-minded the launching of the Accelerated Mahaweli Programme. As envisaged by him, "We shall see it through".



GAMINI DISSANAYAKE
Minister of Lands & Land Development
and
Minister of Mahaweli Development

16, *December,*
1986.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MAHAWELI DEVELOPMENT PROJECT
BAY OF BENGAL
Mullaittivu
Mankulam
Mannar
Vavuniya
Pankulam
Trincomalee
Horowupotana
Anuradhapura
Habarana
Dambulla
Polonnaruwa
Valachchenai
Chenkaladi
Kurunegala
From Puttalam
From Colombo
From Galgamuwa
Matale
Najanda
Kandy
Gampola
Nuwara Eliya
Hatton
Bibile
Badulla
Mutur
Kantalai
Padiyatalawa
Ratkinda
Ulhitiya Res
Hasalaka
Mahiyangana
MORAGAHAKANDA RESERVOIR
BOWATENNA RESERVOIR
POLGOLLA
VICTORIA
RANDENIGALA RESERVOIR
RANTEMBE RES.
KOTMALE RES.
MADURU OYA RESERVOIR
KAHATAGASDIGILIYA RESERVOIR
PALI ARU RESERVOIR
PARANGI ARU RESERVOIR
KAPHIRIGAMA RESERVOIR
YAN OYA RESERVOIR
MAKUNU WEWA RESERVOIR
MINIPE ANICUT
TODA ELA
Maha Oya
To Amparai
SCALE
MILES

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MAHAWELI PERSPECTIVES

Earlier volumes contained articles which explained the rationale behind the Acceleration of the Mahaweli Programme. When that decision was taken the country's economy was in the doldrums. In fact to an expericenced statesman the need for such a decision would appear to have been only too transparent. Food and other essential items were critically in short supply. Jobs were not available. Imports for energy production had reached stupendously high and unacceptable levels and the country's payments position was dismal. The economy of the country was so fragile that the immediate and short-term recovery programmes required no painstaking identification or analysis. The programmes were crying out aloud for adoption. But it required maturity, courage and clarity of vision to take the decision to undertake the lead projects such as the Accelerated Mahaweli Programme – to compress a programme intended for implementation over thirty years, to a shorter time span of between six to eight years. The boldness of the undertaking is particularly underscored when what was available in 1977 was more or less a "reconnaissance report", if it could be so described, i.e. the UNDP/FAO study, with no detailed feasibility of the various projects that comprised the programme available at that point of time.

OBJECTIVES FULFILLED

In restrospect, the perspectives that underlay the decision have been proven to be right and the strategic planning to which recourse was had, has now been demonstrably justified. The doubts and concerns expressed by many sceptics and hesitants have been shown to have been ill-founded and have now been finally dispelled. But in the course of implementation, certain other perspectives were cogitatively developed and new perceptions have acquired importance. Other expectations and aspirations have been expressed and entertained, through an introspective examination of the detailed facets of the programme originally designed.

Some sub-tasks and sub-goals have been identified and after the initial complexities were unravelled, some issues have been better understood. The broad objectives were largely fulfilled with the unemployment rate being halved, the country being brought to the threshold of self-sufficiency in rice, and power production being ensured till 1991 at least, with the completion of the majority of the Accelerated Mahaweli Projects.

SETTLEMENT PHASE

It has become customary nowadays to refer to the "next phase" in the development of the Accelerated Maha-

weli Programme. In a way, it is misleading to do so. It is true that in early years the emphasis had been on the construction of the larger reservoirs and the lengthy conveyance canals, and other work connected with the massive infrastructure development that was required for purposes of settlement. But at the same time it was understood that what was envisaged as the predominant feature in the Accelerated Programme, was the establishment of human settlements for downstream development. It is therefore, not very correct to refer to that part as a different phase.

It is however, apparent and acknowledged that there are two phases in this settlement process itself, i.e. the "settlement" phase when the induction of settlers take place and their basic facilities are cared for in an intensive manner, like the provision of drinking and irrigation water, postal, health, education, transportation, commercial and other services. The next phase is the "production" phase, when the settlers produce food and other agricultural and light industrial products. In some of the Mahaweli areas, the settlers are in this phase or have reached it a few years ago. To express it differently nearly half of the allotments in Systems C, B & G – approximately 25,000 – which have been alienated, are yet in the throes of the settlement phase.

In System H (23,000 allotments) the phase of intensive production started a few years ago. In whatever phase the settlement process is, the single ultimate objective behind the programme remains fundamentally the same. In a restricted sense, the full and total well-being of the settler is the core of the programme. The focus is decidedly on the individual settler. In this connection, it is pertinent for planners and administrators to recall, that it is the smallholder settler who has been at the centre of attention and concern of successive Governments. The larger number of jobs, the more intensive form of agriculture, as visualised to be practised in the new areas and the rapidity with which production can take place, because of the activities of a host of smallholders simultaneously developing their small plots, can be provided for only on the basis of a smallholder farming concept, and in an environment where the small farmer has the freedom to take his own farming decisions, in a free enterprise market oriented economy. For the sake of his affluence and prosperity, his health, eduation, sports and cultural advancement, various programmes are designed.

INFUSION OF APPROPRIATE SKILLS

Increasingly however, it has been recognized that a community comprised of several thousand smallholders by themselves, would not be able to achieve the optimal level of attainment and that therefore, the other elements in a modern society should be brought in to provide the equilibrium that is necessary. It is expected that new technology, markets and capital will be pressed into service for the well-being of these other classes, as well as to provide the supportive thrust to the smallholder. The diversification in cropping patterns, the introduction of stock farming and pisciculture, in short, poly-culture, access to markets, the erection of proper marketing structures and mechanisms, the creation of capacities to realise sophisticated processing levels, the expansion of employment opportunities and related agricultural industrial concerns, would all be possible, only through an infusion of the appropriate skills of professionals and entrepreneurs into the Mahaweli communities.

Their activities would be compatible

with, and provide the necessary complementarity to those of smallholders.

NATIONAL AGRICULTURE, FOOD & NUTRITION STRATEGY

It is pertinent at this point to reproduce what is stated about the perspectives, in coursing through a document on National Agriculture, Food and Nutrition Strategy, which runs as follows:–

"The importance of agriculture in economic growth has prompted the Government to define a National Agriculture, Food and Nutrition Strategy (NAFNS). The formulation of this strategy is set within the objectives enunciated by the Government. These are:. .

(a) Achievement of self-sufficiency in basic foods - rice, milk, sugar, fish and pulses.

(b) Expansion of export capacity to increase contribution of agriculture to the balance of payments.

(c) Enhancement of incomes and creation of new employment opportunities in the rural sector.

(d) Improvement of nutritional status of the people.

In formulating the strategy, it became clear that a vast potential in agriculture to generate rural employment, still exists. These opportunities exist in basic agricultural production, in agro-industrial processing and ancillary services, supporting agriculture. These are good prospects to raise incomes and improve nutrition of smallholders, through removal of constraints to productivity, wider opportunities to produce and market their crops, and more versatile and adaptive institutional framework, to execute the required change.

Institutional and support services will be primed to assist smallholders who must be brought into the mainstream of development efforts, thereby initiating self-sustaining changes within the rural economy. Since smallholders have proved to be responsive to policy stimuli, it is proposed to foster significant changes in their production regimes and livelihood, through proper pricing incentives, research, extension, credit and other forms of support.

Government policy relies heavily on private intiatives to bring about these changes. Through clear signals and financial support, the Private Sector will be encouraged to actively participate in the marketing of crops, the production and supply of inputs and other facets of agricultural production. In realising these objectives, harmonious co-operation between Government and the Private Sector is essential, to help develop an agriculture, consistent with overall economic and social objectives.

The following subsectors constitute building blocks of this strategy: crop agriculture, smallholder tea and rubber, coconut, livestock, fisheries, land and water resources and nutrition."

FUTURE PERCEPTIONS

Through an independent exercise conducted within the circles of the Mahaweli Ministry and its associated Agencies, very much the same set of perspectives have been developed, and it is encouraging and comforting to note that there is a distinct synthesis of thinking, with concepts emerging at the National level. The Accelerated Mahaweli Programme is a lead project, multi-faceted and therefore, multi-sectoral in nature. In the determination of appropriate policy packages however, the Mahaweli Ministry cannot assume the lead role, since other Ministries responsibile for the different sectoral activities, would have to spell out their policies for extensive and uniform adoption throughout the country. That the

necessary symbiotic relationships have developed, though logical, is fortuitous and providentially satisfying.

In a manner of speaking the Mahaweli Programme was one that has been picked up in the middle. It is necessary for the purpose of strategic planning now, for the Mahaweli Authorities to fill in whatever gaps that have been left, by way of corrective or remedial action.

For instance, in respect of all the new project areas, a proper environmental impact assessment of the contemplated development, is now made before commencement. In the case of projects that have already been completed, or are in the course of being implemented, commencing with watershed conservation and management, the prevention of landslides in the montane regions, the setting aside of areas as fauna and flora reserves, the prevention of infestation of the new reservoirs and waterways with water weeds like salvinia, and the adverse effects of pollutants (nevertheless necessary for farming like fertilizer, pesticides and other agro-chemicals) on water quality etc., all environmental aspects, are being subjected to sophisticated analysis. The future project areas will be developed with greater care and concern for scientific land-use principles, in an integrated manner, having in mind the multi-faceted aspects of regional and river basin development, fundamentally considerate of the need for prevention of soil erosion, the requirement of the proper proportion of forest cover and so on.

To hark back to the document on National Agriculture, Food and Nutrition Strategy and to refer to the recommendations in its Executive Summary, we find overselves in agreement with what has been stated in it about the need for innovative research for sustained agricultural development, improved rural credit for transition from subsistance to commercial agriculture, improvements in agricultural marketing, the adoption of proper pricing policies, the establishment of agro-industries, the high investment that should be made in the livestock sector and the extension of the area to be brought under coconut and minor perennial crops. It is refreshing to observe that our streams of thought have converged with these recommendations.

ENTERPRISE DEVELOPMENT

It becomes clear therefore, that the set of objectives behind the Mahaweli Programme were not capriciously conceived and remain fundamentally the same, as when it was originally conceptualised.

Only the emphasis seems to have shifted somewhat from one objective perhaps to another. The necessary management structures for the realization of these objectives were set up at the very inception of the Programme and they have been described in extenso elsewhere in this publication. That they have stood the test of actual implementation enourages us in the belief that they have been well conceived.

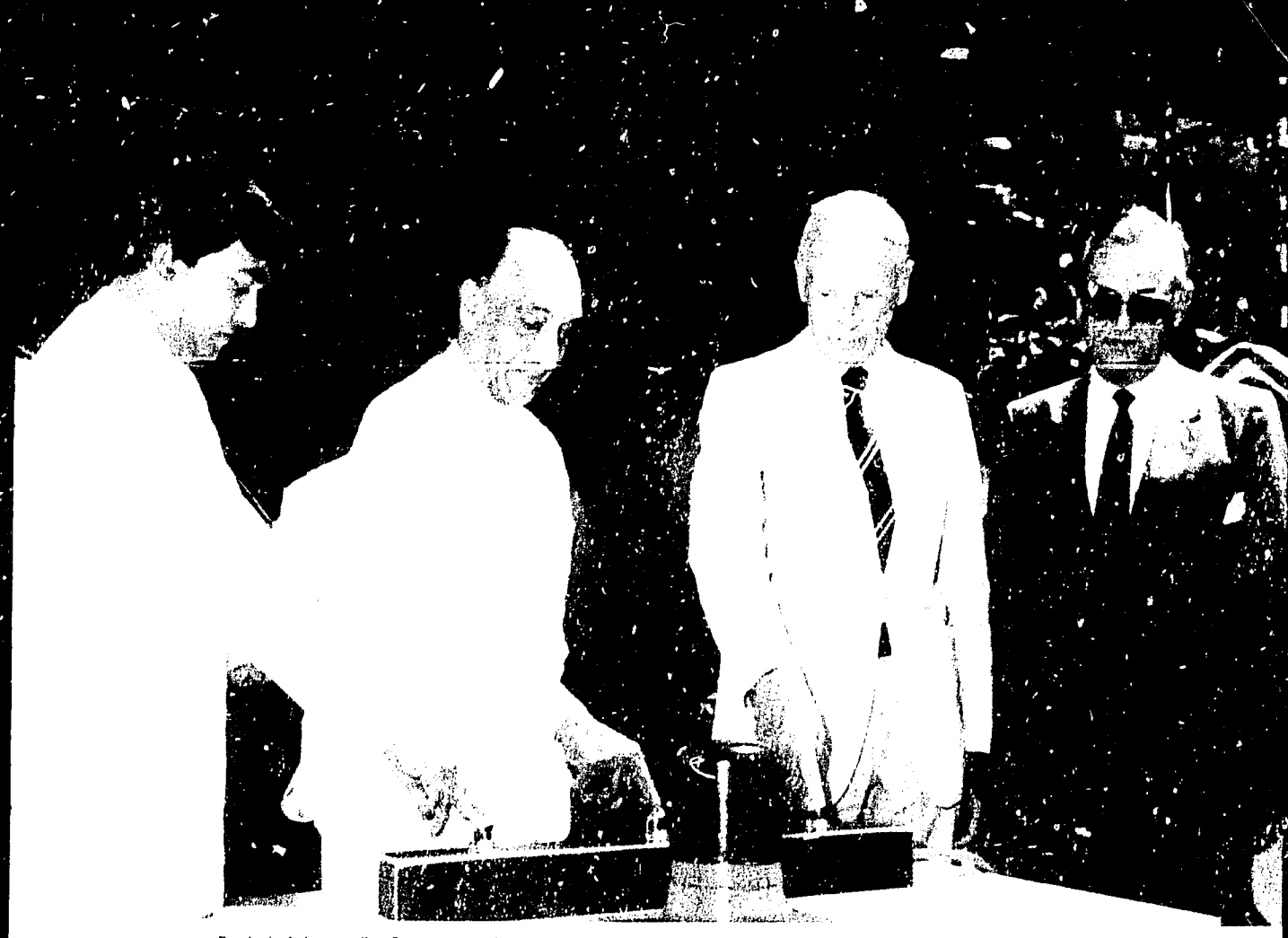
In brief, our current perceptions are that it is human settlement that will remain at the centre of the Mahaweli Programme – advancement economically, socially and culturally. Political imperatives mandate that the hardcore of the population will be smallholders, but there will have to be a proper societal milieu that will ensure the smooth and harmonious development of the project areas, through the interphasing of the different segments of the community, with professionals and entrepreneurs providing the appropriate infusion of capital and technology, market identification and promotion, and leadership in

His Excellency, President J. R. Jayewardene on April 11, 1986 ceremonially declared open Girandurukotte new town in System 'C'. Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development and MP for Mahiyangana, Luxman Seneviratne are also seen here.

the relevant fields. Development activity will be premised on the need for the total development of the area in all sectors, harnessing the diverse human resources available in the country. A middle class and an entrepreneur class will dynamise the growth process, providing the flexibility for variegation according to market demands. For instance, it would be possible for these classes to launch on the development of land extents falling outside command of gravity irrigation by recourse to other irrigation technology which may be too expensive to be afforded by smallholders, or undertake other non-irrigated upland crops or stock farming, or instal industrial, commercial and other service industries which would generate non-farm jobs, thereby alleviating the second generation employment problems of small farmers. It is also hoped that the advent of the new classes of society into these areas will lead to the generation of more savings among the rural communities, which would be retained in the same areas, without their being exported for investment in urban centres as happens now.

The necessary diversification of economic activity, would result from the mix of the population that is intended to be inducted into the new areas. Thematically, market oriented production will be resorted to, but sensitive to ecological constraints. The improved income levels and nutritional standards of the new classes it is believed, would have their spread effects throughout the entire cross-section of the population in the Mahaweli areas as a result of the intense economic activity that hopefully will take place.

Once again, it is necessary to state that these same considerations underlay the Mahaweli Programme, but perhaps were in a state of dormancy and now have been picked up for emphasis to stand out in relief, to illumine the new route to rapid and all-round multi-dimensional development without any concomitant, adverse or degrading side effects. The development thrust would continue to be primarily funded through direct government expenditure, especially in the creation of economic overheads and social infrastructures, but private sector savings will be mobilised in an increasing measure, especially in the production process per se. Direct government interventionism in produce procurement, price behaviour or output control, or through manipulation and regulation of the distribution system would be avoided, except in dire circumstances, where the regulating and corrective mechanisms of market forces fail to provide proper direction. Instead, national, fiscal and monetary policies it is hoped, will provide the necessary impulses to the growth process along a pre-planned path, to ensure the greatest good of the greatest number of Mahaweli settlers.



▲ Randenigala Impounding Ceremony was held on March 23, 1986. His Excellency, President J. R. Jayewardene together with Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development and His Excellency, Gerhard Pfeiffer, Ambassador Federal Republic of Germany participates in closing the tunnel gate to impound the Randenigala Reservoir

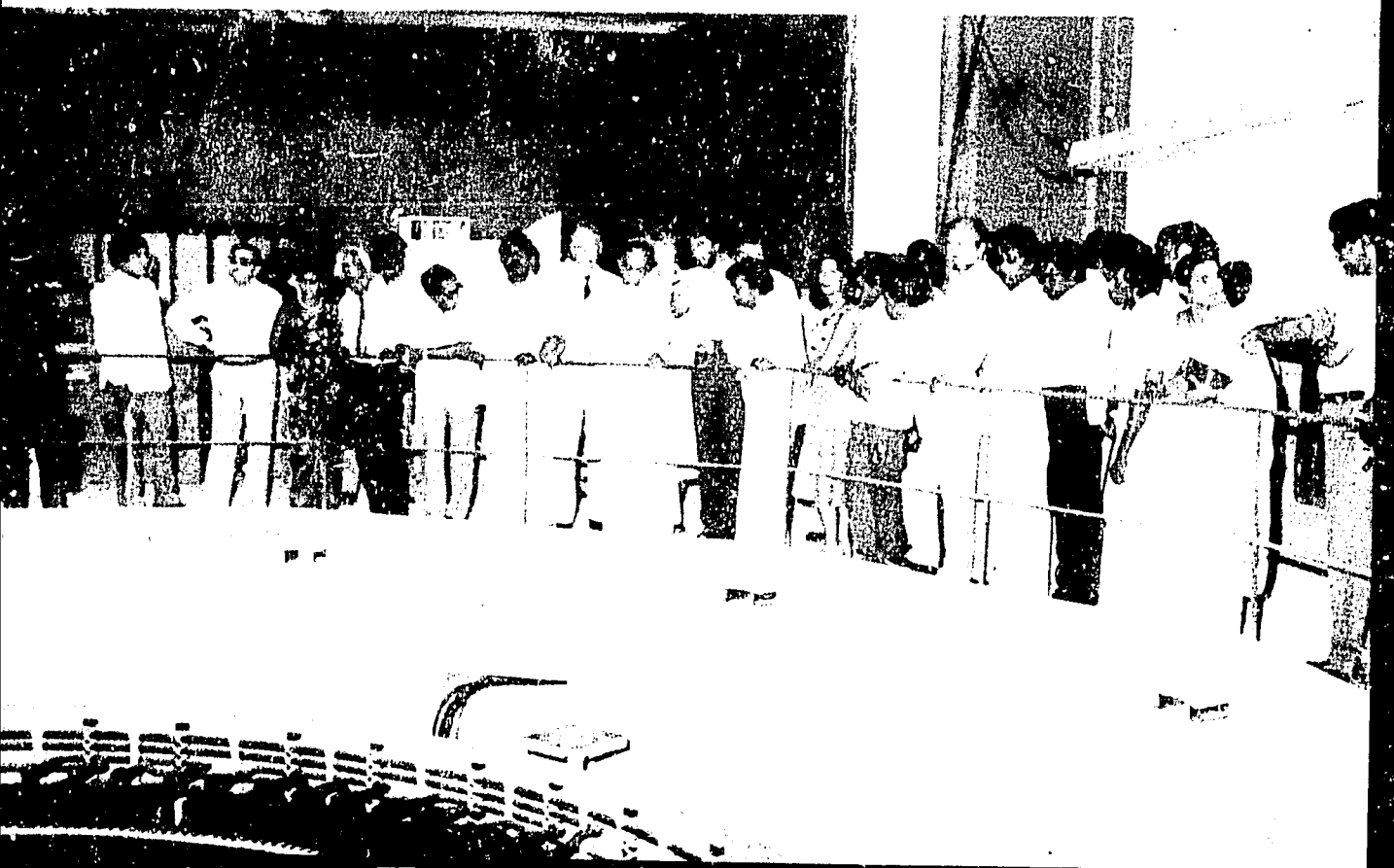
▼ The speech by His Excellency, President J. R. Jayewardene at the Girandurukotte new town opening ceremony is being simultaneously translated into English by Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development.

▲ His Excellency, President J. R. Jayewardene accompanied by Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development opens the community market at Belaganwila in System 'C'.

▼ His Excellency, President J. R. Jayewardene pays a visit to Girandurukotte Farm in the new township of Girandurukotte which was opened by him. Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development and Mr. Chris De Saram, Consultant Livestock welcomed the President.

▲ His Excellency, President J. R. Jayewardene addressing the public rally at the Randenigala Impounding Ceremony.

▼ His Excellency, President J. R. Jayewardene at the Hydropower Station after he participated in the Randenigala Impounding Ceremony



▲ Cultural and Sports Festivals have become an important feature in the Mahaweli settlement areas and the Mahaweli Sports Festival held at the Mahaweli Stadium at Galnewa was organised on a grand scale. Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake the Chief Guest, arrived at the stadium to open the Sports Festival accompanied by Deputy Minister of Lands & Land Development A. M. S. Adikari, Deputy Minister of Mahaweli Development M. L. M. Aboosally and District Minister for Vavuniya G. D. Mahindasoma.

▼ Minister of Lands & Land Development and Mahaweli Development Gamini Dissanayake and the Deputy Minister of Lands & Land Development A. M. S. Adikari presents the championship cup to the captain of the Kalawewa Sports Team.

OBJECTIVES & ACHIEVEMENTS

It will be recalled that by 1977, the economy had ground to a virtual standstill and it become extremely doubtful whether it would be possible to sustain the erstwhile social system, which was characterized by a relatively equitable distribution of income, good health and educational facilities, which was seen by many as an example to other nations. Unemployment had reached and exceeded the staggering figure of one million people in a total population of 15 million. Import of rice in 1977 amounted to 529,000 tons. A system of rolling power cuts was being imposed to tide over the shortage of power. The consumption of electrical energy was 1217 million units, which was barely met by the maximum power development capacity of 408 MW available in 1977. The country was heading towards a state of bankruptcy.

An assessment of the demand forecast indicated a requirement of 1,675,000 tons of rice and the generation of 2700 million units of electrical energy by 1985. An immediate solution had also to be found to drastically reduce the high level of unemployment. In this backdrop, the Government decided to embark on the Mahaweli Accelerated Programme, as the centre piece of an intensified development programme. The main objectives of the Accelerated Mahaweli Programme were the generation of sufficient hydropower, increased agricultural production and the provision of additional avenues of employment, the final objectives of the programme being the emergence of a self-reliant and an economically viable society.

The multi-purpose Mahaweli Accelerated Programme would strengthen the national grid adding over 500 MW of installed hydropower and irrigating an additional 130,00 ha. (320,000 ac) of new land for agricultural production. The newly opened up lands, supported by a modern social infrastructure, consisting of a network of roads, townships, power and communication lines, schools, hospitals, transport services, banks etc., would become the new environment for over a million people, who are Sri Lanka's present day pioneers.

In the implementation of a massive development programme such as the Mahaweli, for ensuring its success through the efficient use of resources and the completion of projects on schedule, accurate and systematic planning in the initial stages and regular monitoring of progress were indispensable. Considering the magnitude of the Mahaweli Development Programme and the accelerated nature of its implementation, the Programming and Progress Monitoring Unit was established in 1980 to monitor progress and enable the management

to take timely remedial action in order to avoid waste and eliminate delays.

Achievements

The dates of award of contracts for the major components of the Mahaweli Accelerated Programme are given below, together with the dates of commencement of impounding of the reservoirs and the completion of major irrigation canals and power stations:

	Award of Contracts		*Impounding of Reservoirs*		*Hydropower Production*	
Ulhitiya Reservoir . .	June	1979	July	1982		
Ratkinda Reservoir . .	September	1979	April	1983		
Minipe Anicut & Canal . .	July	1979	April	1983		
Victoria Reservoir . .	March	1980	April	1984	November	1984
Maduru Oya Reservoir . .	April	1980	October	1982		
Kotmale Reservoir . .	October	1981	November	1984	May	1985
Randenigala Reservoir . .	August	1982	March	1986	September	1986
System 'B' Right Bank Canal . .	May	1983	October	1984	Ph. I	
System 'C' Phase 1–4 . .			September	1985	Ph. 11	

and improvements. During the short period of operation, it had generated 197 million units of electrical energy.

Agricultural production in the new settlements is increasing rapidly and paddy production in the Mahaweli areas now averages about 100 bushels/acre. Cultivation of other crops has gained wide acceptances among Mahaweli farmers and crop diversification includes the growing of vegetables, fruits and exotic varieties to cater to the needs of local and foreign markets.

By the end of September this year 51,630 families have been settled in their new homes in areas which were, till recently, in wilderness. Farmer settlers are provided with extensive extention services and advice on water management and conservation. Malnutrition which was a serious threat to the new settlers at one time, was overcome by an intensive nutrition education programme and the

Benefits

Victoria power station alone generated 795 million units of electrical energy over the 12 months ending September 1986, while Randenigala, which came into commercial operation in September this year, had generated 50 million units by the end of that month. Unforeseen circumstances led to the closure of the Kotmale power house for tunnel repairs

distribution of triposha and milk through Health Care Centres. A primary Health Care Programme has been developed with emphasis on prevention, rather than curative aspects of health, and is implemented through Hospitals, Health Clinics and a Health Volunteer Programme.

In the Mahaweli Settlement Programme, particular attention has been paid to the provision of infrastructure facilities. New townships have emerged at Girandurukotte and Dehiatakandiya in System 'C', and at Welikanda, Aralaganwila and Manampitiya in System 'B'. In System 'H' Galnewa and several other villages have been upgraded to township status. A good network of roads interconnects the Mahaweli hamlets, villages, and townships. Under the Mahaweli Area Roads Development Programme, 139 km of trunk roads are being constructed in Systems 'B' and 'C'.

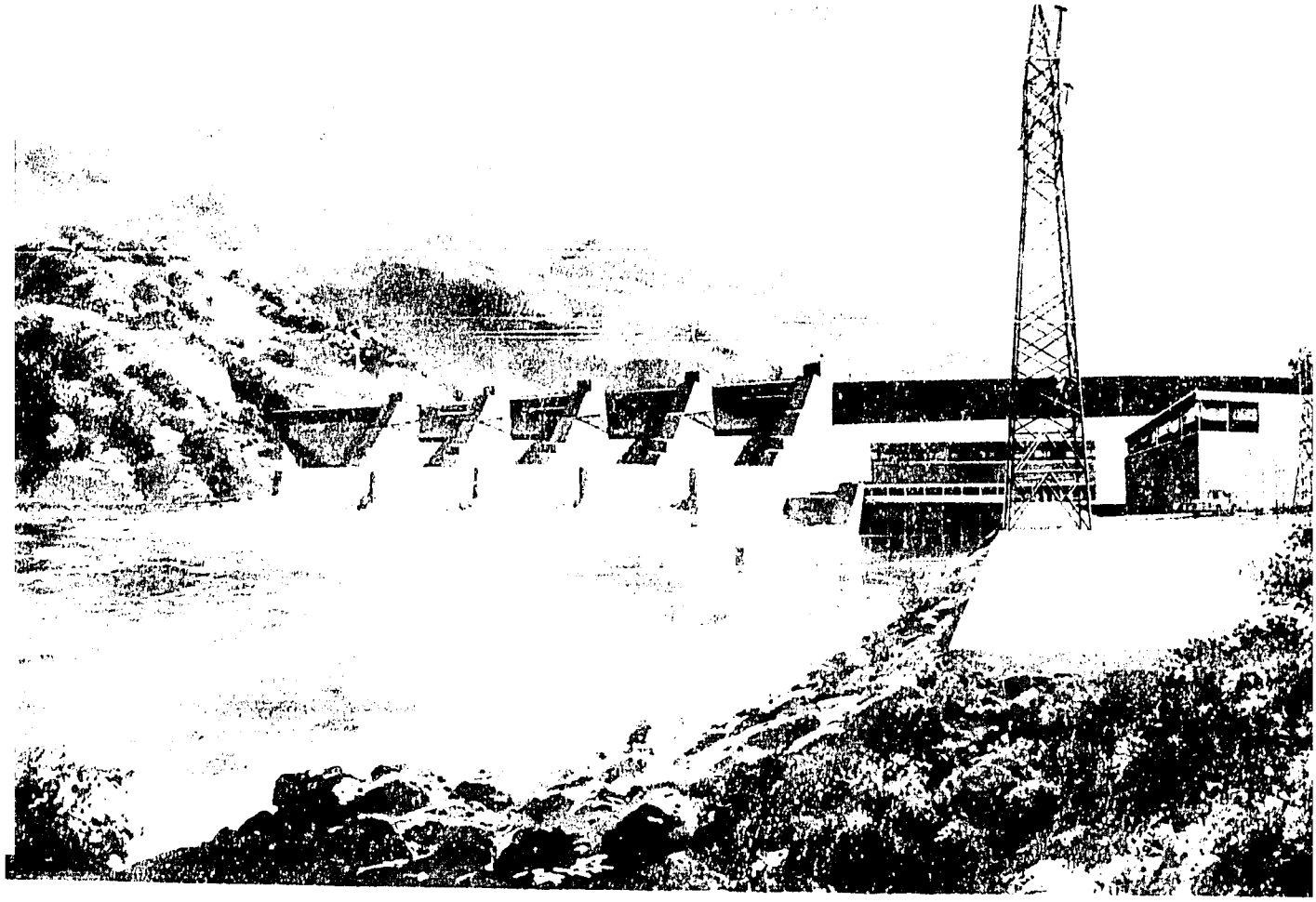
The Final Phase

The Mahaweli Accelerated Programme does not end with the building of mighty dams, nor with the provision of more hydropower for the nation, nor with the mass transfer of settlers to the new homesteads in the Mahaweli areas.

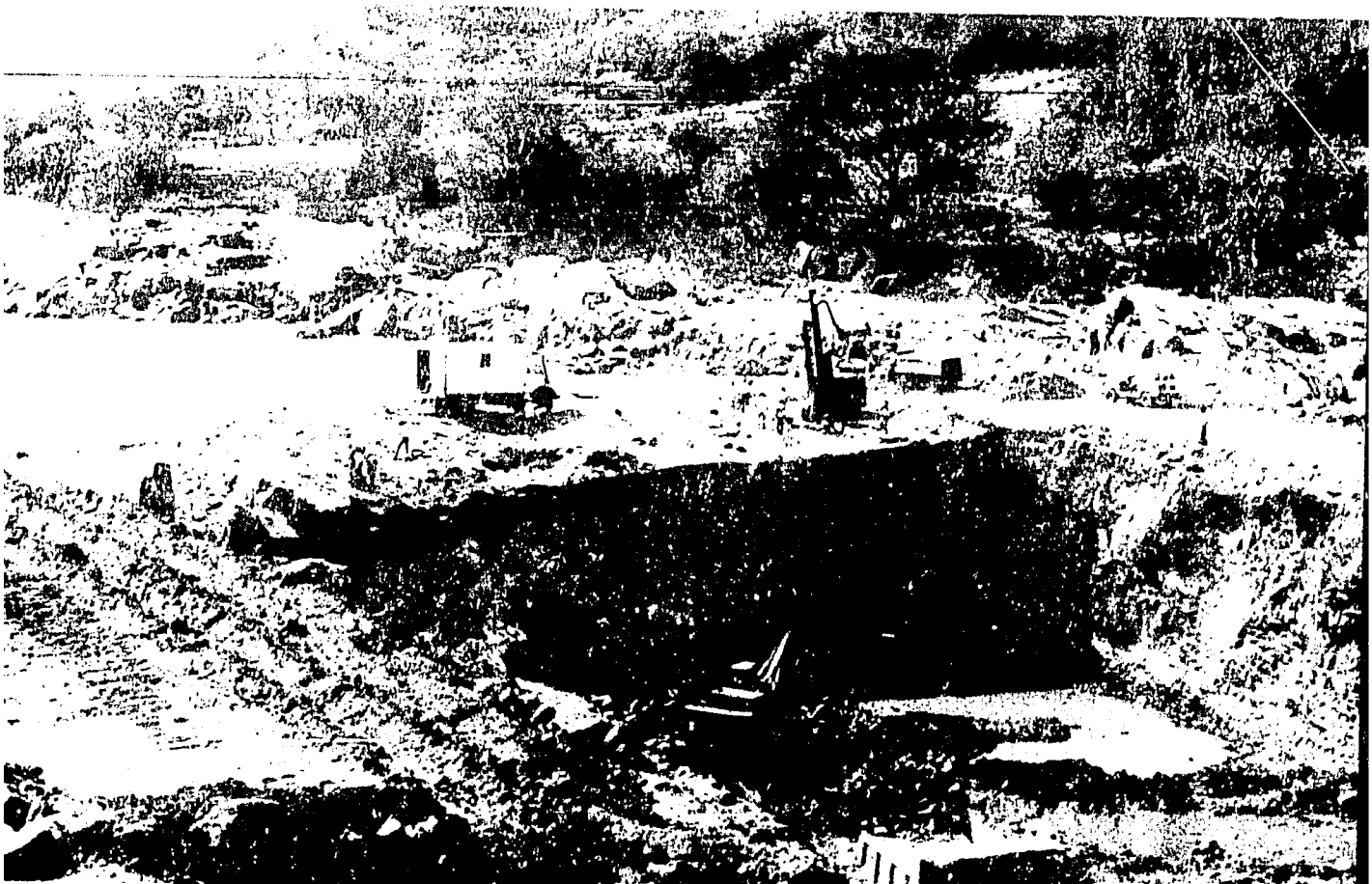
Consideration is now being given to change the patterns of development activities hitherto prevalent in the earlier settlement areas. The school curriculum in Mahaweli areas is to be changed to suit the needs of a predominantly agricultural community and the school calendar is to be changed to fall in line with the cropping calendar.

Farmer societies and the second generation of settlers are being organised to take over agriculture related pursuits such as the packaging, transport and marketing of Mahaweli products. Agro-based industries are also to be set up shortly.

The ultimate aim of the Mahaweli Programme is the creation of a self-reliant and economically viable community. Thus today, as the construction and settlement phases of the Accelerated Mahaweli Programme are being successfully concluded, the accent has shifted to what might be described as the final phase of the Accelerated Mahaweli Development Programme, namely the transformation of Mahaweli areas into major economic growth centres of Sri Lanka. Already the promotion and expansion of economic activities in the downstream areas of System 'H' & 'C' have been underway for sometime and have resulted in increasing the income of new settlers substantially. The Mahaweli Authority of Sri Lanka in an attempt to promote economic activities in all downstream areas in the future, prepared an ambitious action plan, to which end a new unit for Enterprise, Investment and Employment Development has been established to spearhead its implementation. Through this action plan the Mahaweli Authority of Sri Lanka hopes to exploit the ultimate economic potential of the Accelerated Mahaweli Development Programme. We look forward to the future with confidence and satisfaction.



An artist's impression of the Rantembe Reservoir Project. (Bottom) Construction in progress.



FUTURE PROGRAMMES & FURTHER POTENTIAL

I. ACHIEVEMENTS TO DATE

Now that most of the work on the Accelerated Programme has been completed, we have to examine the remaining projects in the Mahaweli development proposals, which can be taken up for development. Our engineers and technicians have now acquired technical skills and valuable experience, working on the completed projects and all that can be utilized to carry out similar works in future, with little or no foreign expertise. There will also be plenty of equipment available from completed works which can be utilized. It will therefore be appropriate in the national interest to examine the further potential available for future development of the Mahaweli resources.

The four multi-purpose Headworks in the Accelerated Programme, which have been completed, are Victoria, Kotmale, Randenigala & Maduru Oya, providing an additional hydropower development capacity of 537 Megawatts, which has more than doubled the energy generation in the island.

With the water releases from those headworks, irrigation facilities have been provided for existing lands for continuous cultivation and for new lands which have been settled with new farm families, namely about 24,000 ha in System 'H' and about 3,000 ha in System 'G' and parts of System 'C' and System 'B'.

Work is now in progress on providing irrigation facilities, settlement of farm families and providing the necessary infrastructure for the balance parts in System 'C' (which has a total of 24,000 ha) and System 'B' (which has a total of 36,000 ha).

II. PROJECTS TO FOLLOW

Rantembe

This is the only project headworks left to be completed in the Accelerated Programme. The contract for the construction of the Headworks Complex has been awarded and work is expected to commence shortly.

It is the last hydropower development project in the cascade formed by the dams at Polgolla, Victoria and Randenigala and serves as a forebay reservoir to re-regulate the outflow from Randenigala Power Station, which can be used for peaking purposes.

Project Features

Rantembe Dam is a concrete gravity structure on the Mahaweli just below its confluence with the Uma Oya. The maximum height of the dam is 42 m and its length 420 m. The capacity of the reservoir is 21 million m^3 (17,350 ac. ft.) at an FSL of 152 m above MSL. The Power Station, with an installed capacity of 51 MW, is on the Left Bank at the downstream toe of the dam, with two

turbines each of 25.5 MW capacity. The intake and the steel lined penstock are integrated in the dam. The control building close to the Power House has already been constructed at Randenigala.

The spillway incorporated in the Dam consists of 4 Tainter (Radial) gates, capable of discharging a flood of 10,200 m^3/sec. (360,000 cusecs) and there are two bottom irrigation outlets in the middle of the river bed, below the spillway. Downstream of the Power Station, a 40 m wide tail-race channel will be provided.

Finances

A loan of DM (Deutsche Marks) 230 million has been provided on concessionary terms by the Federal Republic of Germany to meet the foreign cost component. The Government of Sri Lanka will finance the local costs amounting to Rs. 800 million.

Consultancy Services

The Consultants are the same as for Randenigala, namely "Joint Venture Randenigala" consisting of Salzgitter Consult GMBH, Agrar Hydrotechnik and Electrowatt Engineering Services, in association with the Central Engineering Consultancy Bureau of Sri Lanka.

Construction Programme

The camps and infrastructure provided for Randenigala are available for this work. Acquisition of land for structure and the clearing of land in the reservoir bed are in progress.

The Project is scheduled for completion by the end of 1989.

Benefits

The Rantembe Power Station will generate 180 GWH of firm energy and 73 GWH of secondary energy per annum. The water releases will be used for irrigation development lower down.

Direct employment will be provided for about 1,600 Sri Lankans during construction, for a period of 36 months.

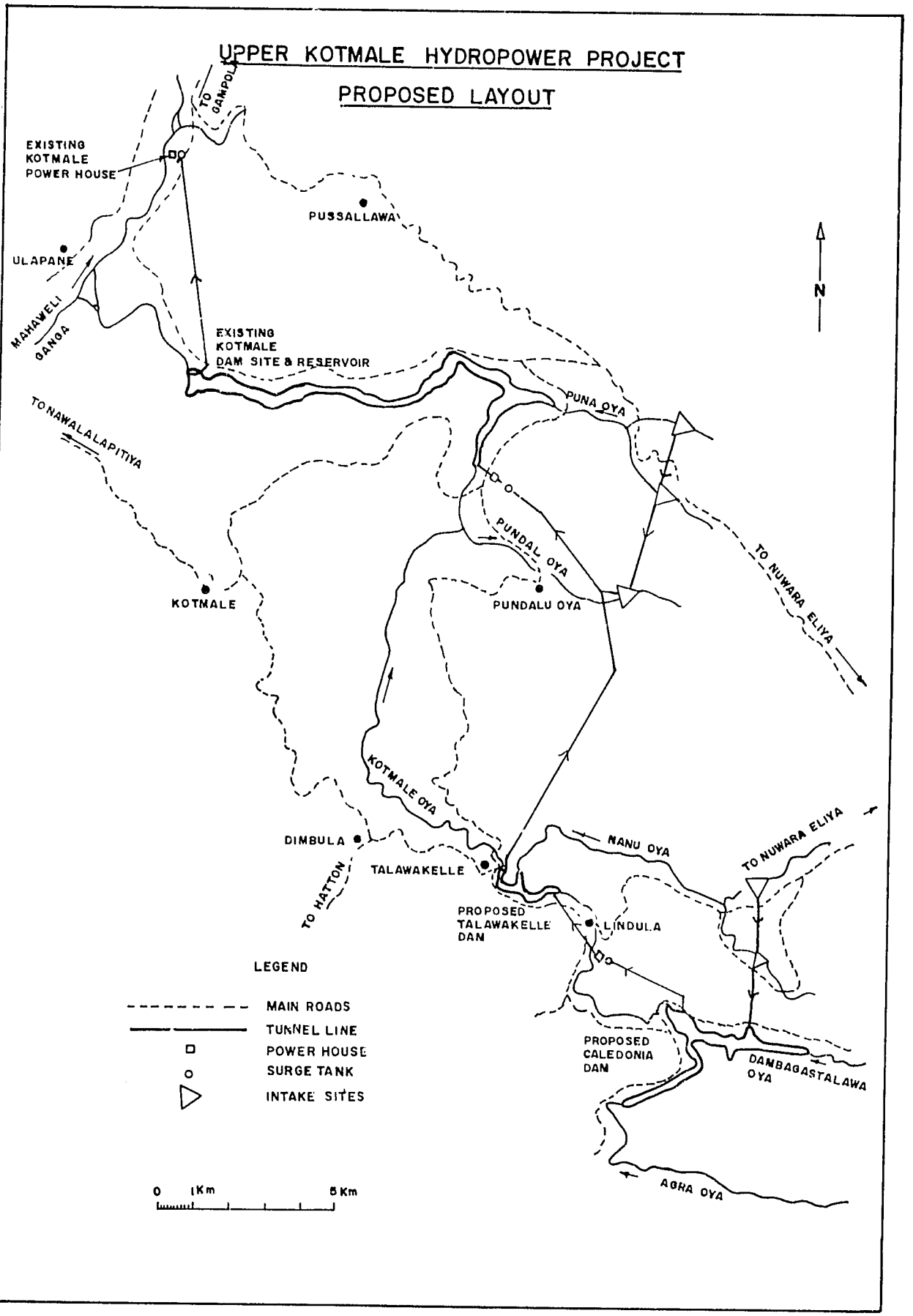
III. PROJECTS IN THE FEASIBILITY STUDY STAGE

(i) Upper Kotmale Project

Feasibility studies commenced in November 1985 by a consortium of Japanese Consultants, sponsored by the Japanese International Co-operation Agency. The Ceylon Electricity Board is responsible for this project and the Central Engineering Consultancy Bureau is providing Civil Engineering Consultancy Services for the study. An interim feasibility report has been put out in August 1986 and the final feasibility report is expected in August 1987.

The Upper Kotmale Project consists of two hydropower units of 209 MW combined capacity that can be developed in cascade in the upper reaches of the Kotmale Oya, which is a major tributary of the Mahaweli, above the newly constructed Kotmale Reservoir. There will be a network of tunnels of total length 27 km to augment the two hydropower units at Caledonia & Talawakelle.

The critical construction sequence in this project will be in tunnelling. At **CALEDONIA** there will be a concrete gravity dam across Kotmale Oya at elevation 1360 m above MSL just below the confluence of Agra Oya and Dambagastalawa Oya to impound a reservoir of capacity 30 million cubic metres active storage. An underground power house with an installed capacity of 40 MW will be activated by a head-race tunnel 2.83 km long from Caledonia Reservoir. A saddle dam will be required of height 12 m and length 95 m.


UPPER KOTMALE HYDROPOWER PROJECT
PROPOSED LAYOUT
TO GAMPOLA
EXISTING KOTMALE POWER HOUSE
PUSSALLAWA
ULAPANE
MAHAWELI GANGA
EXISTING KOTMALE DAM SITE & RESERVOIR
N
PUNA OYA
TO NAWALALAPITIYA
PUNDAL OYA
TO NUWARA ELIYA
KOTMALE
PUNDALU OYA
KOTMALE OYA
DIMBULA
NANU OYA
TO NUWARA ELIYA
TALAWAKELLE
TO HATTON
PROPOSED TALAWAKELLE DAM
LINDULA
LEGEND
MAIN ROADS
TUNNEL LINE
POWER HOUSE
SURGE TANK
INTAKE SITES
PROPOSED CALEDONIA DAM
DAMBAGASTALAWA OYA
AGRA OYA
0 1Km 5Km

Features of Caledonia Dam, Tunnel and Power House

The Concrete Dam will have a maximum height of 70 m, crest length 285 m, elevation 1360 m above MSL.

The Spillway will be a free overflow ogee section, to allow a maximum discharge of 1660 cubic m/sec.

The Catchment above this dam is 175 sq. km and it is augmented through a 4 km long tunnel of capacity 6 cubic m/sec. from Nanu Oya which has a catchment of 60 sq. km.

The Caledonia Underground Power House will have an installed capacity of 40 MW with a vertical shaft Francis Turbine activated under a effective head of 133 m with a maximum discharge of 35 m^3/sec.

The Head-race tunnel will be of 3.8 m dia. and 2.83 km long to Caledonia Reservoir with a surge shaft 13.3 m dia., and 46 m high.

At TALAWAKELLE there will be a concrete gravity dam at level 1202 m above MSL just below the confluence of the Nanu Oya with the Kotmale Oya. The catchment area above this dam is 297 sq. km, and the reservoir will be augmented through a transbasin diversion tunnel 5.25 km long from Puna Oya and Pundal Oya, having a combined catchment area of 50 sq. km.

Features of the Talawakelle Dam, Tunnel & Power House

There is a low concrete dam of maximum height 15 m and length 110 m. The reservoir capacity is 1 million cubic metres, active storage. Spillway capacity is to discharge a flood of 3000 cubic m/sec. It is equipped with 2 shell type roller gates 25m×4 m and a double roller gate 9m×5m for silt ejection. The level of this dam is kept low to avoid the inundation of Talawakelle Town.

Talawakelle Power Station is of 170 MW installed capacity. The head-race tunnel will be concrete lined horse shoe shape, 4.2 m dia., 13.1 km long. Surge shaft will be 14.7 m dia., 91.5 m high. The penstock 735 m long will be underground with average dia. 3.6 m bifurcating into two 33 m long segments. The underground power house will have 2 vertical shaft Francis Turbines with effective head of 469 m and total maximum discharge of 45 m^3/sec. with an installed capacity of 85 MW each.

For maximum utilisation of the available head for power generation the tail-race from the power house is kept just above the present Maximum Water Level of the newly constructed Kotmale Reservoir. There is provision, however, to adjust the tail-race level to allow for the future raising (up to 30 m) of Kotmale Reservoir.

Costs and Benefits

The total annual energy generation will be 759 million kilowatt hours annually, which will be required to meet the energy requirements of the country by 1996.

The total cost of the combined project will be about Rupees 9.8 billion in 1985 prices and the construction period will be around $5\frac{1}{2}$ years commencing from 1990.

(ii) System 'A' – Downstream Development

This irrigation system is situated in the DRY ZONE with a rainfall of less than 1900 mm (70 in.) in the deltaic region of the Mahaweli Ganga. It consists of a gross area of about 45,300 ha of which 22,600 ha is the commandable irrigable extent, including 6,300 ha already existing irrigated area. Most of the area is subject to annual flooding during the N.E. Monsoon. A project formulation report was prepared in June 1980 by International

Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development is presenting a plaque depicting a farming village, typical of the area to be restored in System "A", to the Soviet Technical Mission who were in Sri Lanka recently to render assistance for the development of System "A". Mr. G. T. Azadov leader of the Mission is seen receiving the plaque. Mr. Ratna S. Cooke, Special Advisor to the Ministry of Mahaweli Development and Dr. P. G. Fialkovsky who were responsible for the UNDP Mahaweli Master Plan, are also seen in the picture.

Consultants "Joint Venture Randenigala" (Saltzgitter Consult GMBH, Agrar Hydrotechnik, & Electrowatt Engineering Services) with financial assistance from the World Bank. The same consultants submitted a Final Feasibility Report in 7 Volumes and an Atlas of maps and drawings, in March 1982.

Diversion Site

The choice of diversion site, at Kandakadu Ela or at the polder bund near Vellai, is still open, pending further investigation at the final design stage.

Settlement Areas

Some 81 settlement centres will be needed including the existing 25 centres, namely 58 hamlets (15 existing), 20 villages (9 existing) and 3 towns (1 existing at Mutur). 70 km of existing major roads will be widened to 5 m and 75 km of new minor roads constructed in addition to the present 90 km existing. There will be 50 km of new access roads and also agricultural service roads along canals.

Development Area

The final feasibility report is based on decision that the project area should be limited to the Mahaweli Right Bank lands which are divided into three units namely:

Unit I covers a gross area of 21,400 ha of which 10,000 ha are to be irrigated. This is the only unit that is being developed for agriculture at present. About 6000 ha of paddy fields are existing within the Allai Scheme. The ground levels range from 12 m to 3 m above MSL. Drainage is a problem during the rainy seasons.

Unit II on the Western part of System 'A' with a gross area of 12,900 ha of which about 9700 ha are proposed to be irrigated. This area too is at present prone to floods from the Mahaweli Ganga, for which flood protection measures are necessary and the greater part is in jungle which will need clearing for development. The ground levels range from 12 m to 7 m above MSL.

Unit III in the South-Western part of System 'A' with a gross extent of 22,000 ha of which about 11,000 ha are suitable for irrigation. The topography here is somewhat rugged and the soil condition less favourable for agricultural development. Most of Unit III is in jungle and a part of it reserved for Somawathie Chaitya Sanctuary.

Soil Surveys are available in some detail, carried out from aerial surveys to a scale of 1:20,000, with test holes at 1 in 100 ha. Major soil groups are predominantly 'Alluvial' or 'old Alluvial' and there exist very little Red Brown Earth or Non Calcic Brown Earth.

Flooding The Mahaweli Ganga overflows its banks at an average discharge of about 850 m^3/sec. during the N. E. Monsoon below Manampitiya and riparian land to a width of about 10 km is regularly inundated.

A Japanese Technical Mission from ADCA Japan in May 1984 did a review of the proposals in the Feasibility Studies for the development of System 'A' done by J. V. Randenigala "Consultants" (from 1979 to 1982) and had recommended that the development of System 'A' was viable enough economically.

An U.S.S.R. Technical Mission was here in June/July 1986 with a view to render assistance for agricultural development of System 'A' with Soviet Aid.

The Soviet Team is expected to put out their proposals in the near future for the development of System 'A'.

IV. FURTHER PROJECTS AVAILABLE IN THE MASTER PLAN

(i) **Moragahakanda** multi-purpose project is situated on the Ambanganga, upstream of the Elahera Anicut. This was

originally included in the Accelerated Programme but not taken up. The dam is of total length 5070 feet, composed partly of a concrete gravity dam in the section 223 ft high & 1660 ft. long, a rock-fill dam of 167 ft. maximum height and 1350 ft. long across the Left Bank deep saddle, and an earth dam 70 ft. maximum height and 2060 ft long across the depression on the extreme Left Bank.

The spillway will be provided in the concrete dam, equipped with 3 radial gates to discharge a maximum flood of 87,000 cusecs.

The reservoir will have a capacity of 692,000 ac. ft. with an active storage of 470 thousand ac. ft. and an annual regulated flow of 1,396 thousand ac. ft. (augmented by Kotmale through Polgolla Diversion).

Hydropower generation will be with an installed capacity of 40 MW.

The geology of the dam site is of a complex nature, which requires careful investigation.

This reservoir will initially provide additional irrigation supplies to about 73,000 acres of existing lands in System D_1, G and D_2 and benefit about 37,000 acres of new lands in those systems under Minneriya, Parakrama Samudra, Kaudulla and Kantalai.

In the final phase of development, water from Moragahakanda will be taken to the North Central parts through a NCP Canal to augment Systems I, J, K, L & M. At the same time the irrigation commitments under Moragahakanda in Systems D_1, G and D_2 in Ambanganga basin will be taken over and irrigated by Randenigala water, through a new Left Bank Transbasin Canal from Minipe Diversion.

(ii) **Upper Uma Oya**: This is a multipurpose project in the upper reaches of the Uma Oya, which is an important Right Bank tributary.

The Dam is located in a narrow gorge, suitable for an arch dam, of length 1100 ft. and maximum height 280 ft with four 60'×25' radial gated spillway.

The gross storage in this reservoir is about 52,000 ac. ft. of which the active storage is 40,000 ac. ft. The average annual water releases are estimated at 205,000 ac. ft. The flood flow at the dam site is 163,000 cusecs at 0.1% frequency.

The Power Station is located $3\frac{1}{2}$ miles below the dam, which will be activated through a 3 mile long tunnel of about 7.5 ft. diameter. The installed capacity is 25.5 MW at a design discharge of 647 cusecs at a head of 548 feet. The annual energy output is around 95.5 million KWH.

(iii) **Lower Uma Oya** is also a multipurpose project situated about 13 miles below Upper Uma Oya and 5.7 miles above the Uma Oya confluence with the Mahaweli Ganga.

The headworks consists of an earthfill dam 845 feet long and maximum height of 175 feet.

The spillway proposed is a chute with 6 Radial Gates 30'×15' and a bucket. A Pressure Tunnel driven through hard monolithic rocks on the Left Bank of the Uma Oya will be 14,600 feet long of diameter 9 feet to discharge 988 cusecs. The Hydropower Station will be situated about a mile above the confluence of Uma Oya with the Mahaweli. It will have an installed capacity of 30 MW (developing 113 million KWH of firm energy) with a design head of 442 feet.

Along with Upper Uma Oya Reservoir, this project will provide a regulated flow of 317,000 ac. ft. for irrigation purpose of new lands lower down in the Mahaweli Basin.

The power capacity under these two

projects can be increased appreciably in the final designs. There are several other sites on the Uma Oya with hydropower potential, (listed under para C 3) which can be combined with Upper and Low Uma Oya projects, to form a most beneficial cascade with a high hydropower potential.

(iv) **Kalu Ganga Project** is located Kalu Ganga, a tributary of the Ambanganga, about 9.5 miles upstream of the confluence.

The reservoir will have a capacity of 208,000 ac. ft. of which 188,000 ac. ft. will be active, providing a long term mean regulation of 172,000 ac. ft. for irrigation purposes through the Hattota and Elahera Diversion Schemes.

A Power House under it is possible with a capacity of 1.9 Megawatts to produce 772 thousand KWH of energy per year.

(v) **Pallewela Multi-purpose Project** is on the Loggal Oya, which is a Right Bank tributary of the Mahaweli. It is located 7.5 miles above the mouth of the river. The Pallewela Unit will make use of the combined reservoirs of the Badulu Oya and Loggal Oya. The Headworks will consist of an earth dam having a length of 645 feet and maximum height 200 ft. There will be a chute spillway on the Left Bank with 4 radial gates 30' × 20'.

The Hydropower Station will be at the bottom of the dam with a capacity of 10 MW working under a head of 166 ft. with a discharge of 837 cusecs.

The water releases will be utilized for irrigation of new lands lower down in the Mahaweli Basin.

(vi) **Heenganga Multi-purpose Project** is on a Left Bank tributary of the Mahaweli by that name, located 5.2 miles upstream of the mouth of that river.

A Rockfill Dam is proposed, of length 1060 ft. and 285 ft. maximum height. There will be a chute spillway on the Left Bank with 3 Radial Gates of 30' × 20'.

The Power House is on the Left Bank activated through a tunnel (which can be used for river diversion during construction of the Headworks).

Its installed capacity is 7.1 MW producing an average energy output of 25.5 million KWH annually. The water releases will augment the Minipe Left Bank Transbasin Canal.

(vii) **Rotalawela Project** is the last reservoir possible on the Mahaweli (situated about 71 miles from the river mouth). An Earth Dam is proposed with a length of 6720 ft. and maximum height 80 feet to impound a reservoir of 195.6 thousand ac. ft., active storage being 184,000 ac. ft

This reservoir has an unintercepted catchment of 865 sq. miles below Minipe and it will also impound return flow of irrigation systems above it.

It will have a chute spillway on the Left Bank. It can irrigate over 100,000 acres in the lower basin.

(viii) **Left Bank Transbasin Canal** is a major canal 90 miles long taking off above Minipe Anicut on the Mahaweli Left Bank to convey water from Randenigala/Rantembe Reservoirs to irrigate System 'D' after crossing Ambanganga, to irrigate lands which were hitherto dependant on the Ambanganga, when those waters are switched over and diverted to the North Central parts through the NCP Canal, taking off from below the Moragahakande Reservoir.

The existing Minipe Left Bank Canal (which now irrigates a strip of land in extent about 15,200 acres) will be enlarged to take an additional 1600 cusecs for this purpose.

There is provision to transfer 110,000 ac. ft. annually to augment the NCP Canal by pumping from the canal water

which will be surplus to the irrigation needs of System 'D'.

(ix) **North Central Province Canal** This is a major transbasin canal 102 miles long, required to convey 2500 cusecs of the regulated flow from Moragahakande to the North Central parts of the island, after the Minipe LBT Canal from Randenigala takes over the commitments in the Ambanganga basin in System 'D' under Moragahakande.

The NCP Canal takes off below Moragahakande, from a point above Elahera, and runs parallel to the Elahera-Minneriya-Yoda Ela and crosses the water divide to enter the Yan Oya basin. At 39½ miles there is a turn-out of 144 cusecs to augment Huruluwewa (existing) and the proposed Yan Oya Reservoir. At 43½ miles it will deliver 276 cusecs to feed Nachchaduwa (existing) and the proposed Malwatu Oya Reservoir.

The Canal will continue with a discharge of 2080 cusecs with turn-outs to feed the proposed Kapirigamawewa at the 65 mile, existing Wahalkada Reservoir at the 77th mile, the proposed Kitagala Reservoir at the 83 mile and the proposed Kanagarayan Aru Reservoir at the 100th mile. The Canal ends at mile 103 with turn-outs to Parangi Aru and Pali Aru proposed Reservoirs.

A total area of 233,000 acres of new lands will be benefitted under the NCP Canal.

(V) FURTHER DEVELOPMENT POTENTIAL

Further development potential, mainly for hydropower, is available in the Mahaweli Ganga and its tributaries. The hydropower potential (shown within brackets) add up to over 400 Megawatts.

(1) On the Mahaweli Ganga the potential sites available are at: Haloluwa (17.3), Ulapane (21.0), Koladeniya (6.0), Carolina (12.5), Trafalgar (9.5) and Rozella (2.6).

(2) On the Kotmale Oya, feasibility studies are in hand for Upper Kotmale as seen under para III (i) for the development of about 200 MW.

(3) On the Uma Oya, the potential sites are at Dernatapelessa, between Upper & Lower Uma Oya Reservoir sites (21.5), Ettampitiya (22.1), Puhupola (7.3), Welimada (7.3), Bomurella (6.5), Needankanda (5.9) on Mahatotilla Oya, and Madullu Oya (6.9). (see also para III 2 and 3).

(4) On the Badulla Oya, the potential sites are at Taldena (14.5), Kalawelpota (6.1), Andeniya (14.1), Upper Yelton (1.8) and Rookatenna (2.0).

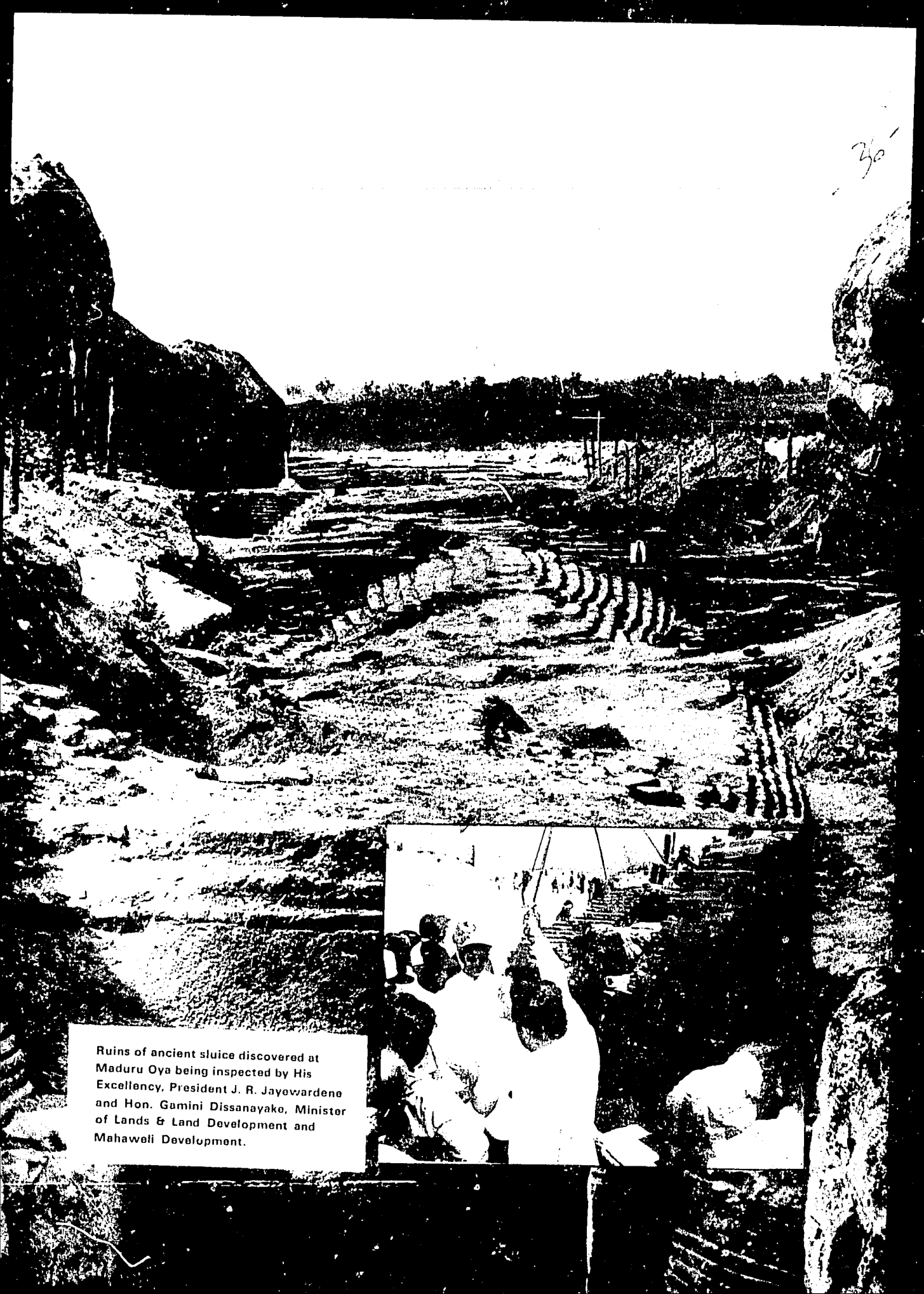
(5) On the Ambanganga the potential sites are at Bowatenne No. 2 towards Dambullu Oya (3.7), Kumbaloluwa (40.0), Makeliwela (15.9) and Kiula (22.3).

(6) On Hassalaka Oya the potential site is above Ratna Ela falls (12.4).

(7) On the Hulu Ganga the potential site is at Naranpanawa (8.6).

(8) On the Maha Oya there is a site at Tumpe (8.1).

In a comparative study made by the UNDP/FAO Specialists Team during 1964 –1968, it was found that the hydropower potential available in the Mahaweli Ganga and its tributaries, exceed the combined hydropower potential in all the other rivers in the island, including Kelani Ganga, Walawe Ganga, Gin Ganga, Nilwala Ganga and Kalu Ganga.



Ruins of ancient sluice discovered at Maduru Oya being inspected by His Excellency, President J. R. Jayewardene and Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development.

MAHAWELI IN ANCIENT TIMES

1. Sri Lanka and the Mahaweli in the International Setting

What the Nile is to Egypt or the Euphrates and the Tigris to Mesopotamia, or the Indus and the Ganges to Pakistan and India; so is the Mahaweli to Sri Lanka. It is here in these river valleys that the civilization of these countries flourished. The cultures in these river valleys did not grow in isolation but were also influenced by external forces as well. Any attempt to study them in isolation would be futile and therefore to understand them, it would necessarily involve their study in broader perspective of the context in which they developed.

Sri Lanka lies across the main sea routes from the Middle East to Indo-China and the Far-East. Sri Lanka was in fact the hub of these international Sea Routes from the most ancient times. This unique position assisted in the transfer of not only Science and Irrigation Technology, but also Religion as well, from the great civilizations to which Sri Lanka was linked by these sea routes. Thus we were exposed to the knowledge of the peoples who used these sea routes for various purposes, from trade, to migration settlement and conquest.

Heradotus (430 BC) the Greek Historian is said to have described Taprobane more accurately than anyone before him Alexander (ISKANDA), the Great Macedonian King (336 BC), after conquering the Peacock throne of Persia, in a wide sweep of conquests came to Pakistan up to Lahore and returned by sea to Babylon. His reconnoitring missions to Taprobane gave its dimensions which have been recorded by Onecicritus the Admiral of his fleet. It was the followers of Alexander the Great who gave the Western world for the first time, fairly accurate accounts of our country and its inhabitants.

Pliny (52 AD) in describing Sri Lanka makes an interesting comment that in the principal city in southern Taprobane, at Palesimundu, the King was dressed like Bacchus of old and the inhabitants clad in the habit of Arabians.

Likewise the Chinese called her Simondu, the marvel of the world and the Arabs called her Serendib which means the land of the Sinhalese.

However, the most notable works by any foreigner on Sri Lanka is that of Claudius Ptolemy (150 AD) who not only gave a description but most important of all, he gave us for the first time co-ordinates of 49 points, from which we have been able to definitely locate the positions of the places to which he referred.

If we take the essence of what the Portuguese chronicler Fernao de Queyroz relates in his "Conquest of Ceylon" (Translated by Fr. S. G. Perera) the

section that deals with the early inhabitants of Sri Lanka, says that Sri Lanka was first inhabited by Magi who were natives of the city of Ageddi in the kingdom of Parquaca which borders Persia, and who settled in Trincomalee where they cultivated the land and gave it the name "Lankava" which means distant and delightful land. Here they practiced necromancy to such an extent that they were reputed to be Demons, and for that reason they called the country Recosabuni which means land inhabited by demons. (Incidentally the Pali rendering of the Sanskrit word Raksasa is Yakkha).

Likewise when we critically examine the local chronicles in broad perspective, we note that the older chronicle the Dipawamsa, does not mention the Kuweni legend and to that extent the Vijaya myth cannot be accepted; but that it could only represent in effect the early immigrations by sea, while the Mahawamsa states that before the birth of the Buddha (543 BC), Sri Lanka was known during three eras as Ojadipa, Varadipa and Mandadipa, giving credence to the very early civilisation and habitation of Sri Lanka. We can also conclude that in essence we had two dominant or major tribes, the Yakkhas and the Nagas in the 6th century B.C. and that the Yakkha Chiefs who were in the Mahaweli plain were subjugated by Pandukabaya (307 BC); and subsequently the two Kings of the Naga dynasty, Devanampiyatissa and Maha Naga were converted to Buddhism (3rd century BC).

It is also interesting to note that from our own historical records, Ruhuna was established by Mahanaga, the brother of Devanampiyatissa and was subsequently ruled by this clan, whose decendents not only ruled Ruhuna but subsequently ruled the whole island. Mahanaga and their decendents used the totemistic symbol of the Cobra and the epithet Naga.

However, there are many indications of external influence in addition to what is already well known, which should be of interest to us in understanding the great impact of foreign influence.

We cannot but notice, primitive sun worship that was prevalent in Mesopotamia and Egypt was practised in Sri Lanka in ancient times. Civilizations of Mohenjodaro and Harappa in the Indus Valley worshipped the bull, which was also worshipped in Egypt as well as Assyria. We have the Royal symbol of the Cobra used in upper Egypt as well as other countries in the East, notably Indo-China and also used in Sri Lanka as well.

The Akkad Sumerian, as well as the Egyption civilization appear to have spread eastwards by sea along the coast, linking with the early Pakistan settlements in the Indus, while further coasting eastwards brought them to Sri Lanka as well.

We have the colossal Aukana Buddha, a true replica of the sandstone statue in the Greek Gandara style now in ruins in Afghanistan (etymologically the word Aukana is derived from the word Afghan indicating their connection). The flood irrigation civilization in Egypt, Mesopotamia and the Hadhramout in Southern Arabia, as well as the unique gravity ground water irrigation system of the Khanats of Persia and Arabia, have been adapted locally and has resulted in their synthesis in the evolution of our major tank irrigation systems.

2. Mahaweli

Ptolemy describes the Mahaweli Ganga as Phasis Fluvius or the River of the Persians and had its source in the Knuckles Massiff. It is very clear that the Galbi and Nagadiba of Ptolemy were synonymous with Rajarata and Ruhuna

of the local chronicles. According to Ptolemy there were several tribes as indicated in the tribal prefixes describing them and indicating that they have come from different parts of Asia and Africa. The same was true for prefixes given to the different rivers indicating that their banks were occupied by nationals from Persia, Arabia, Africa and the North West of the Indian subcontinent. Since what is of concern to us here is mainly those that are relevant to the Mahaweli area, I would now restrict myself to that area.

Traditionally the Mahaweli Ganga was the divide between the Rajarata and the Ruhuna. The principal port according to Ptolemy was Mudutti emporium located at Seruvila which is also known as Lankapatuna. The Right Bank of the Mahaweli was called Nagadiba which had the township of Nagadiba at Eravur as well as a secondary city or Anubinagara at Panchenkerni, while the seat of the kingdom of Nagadiba (Ruhuna) at that time was Magramum Regia, which is located on the upper reaches of the Left Bank of Gal Oya, corresponding to the vicinity of Uraniya between Nilgala and the reservoir and temple, that goes by the name Nagadiba Mahawewa. Accordingly, we conclude that the principal city of Ruhuna was not always at the same place in as much as the principal city of Rajarata was not always at Anuradhapura.

In the Mahaweli and the adjacent plains we find ruins and find it difficult if not impossible to give the exact names of Kings who constructed these great irrigation works, nor could we give their exact dates of construction. The origins of these superb engineering feats are lost in the mists of centuries time-wise. The Mahavamsa does not definitely say who constructed these and it is left for us to infer or speculate. As there are no rock inscriptions indicating their creators, it gives credence that they were constructed prior to the era of rock inscriptions.

We have the Minipe Ela (also known as Yakkha Bendi Ela) starting from Yakkundewa on the Mahaweli.

Further downstream the twin Gomali and Kalinga channels starting from Yakkure taking its waters on the left bank channel to the south of Kantale and the right bank channels as far as Triconamadu. One begins to wonder whether Yakkure is derived etymologically from Yak Pura, giving credence to its antiquity as an important ancient city of the Yakkhas. We have the construction of the engineering masterpiece of Sorabora Wewa attributed to a Yakkha Chief.

Thus it is clear that there are many questions for which, we yet do not have the answers, and that any information that is found to enlighten us further on these matters should be most welcome.

3. New Finds in the Mahaweli

It is necessary to record three of my major archaeological discoveries, for which it is difficult to obtain an explanation from existing historical records.

The first was the discovery in 1965 of the old course of the Mahaweli Ganga beyond Manampitiya, using Remote Sensing Air Survey Techniques. It is an astounding revelation that the ancient Chaityas/Dagabas were beside the old river, while in contrast there was none on the banks of the new river course. One must not forget the fact that chaityas or relic shrines, according to the Indian tradition existed prior to the Buddhist era. It is only archaeological dating of the chaityas using scientific methods, that would reveal whether in fact some of these chaityas are pre Buddhist or not. Till then it is yet an open question. (Refer: Ancient Ceylon, Journal of the

Department of Archaeology Vol. I No. 1 Page 193 of 1971).

The second was the discovery of the ancient city of Vijithapura discovered using the same technique, in 1979, which had its moats yet preserved as described in the Mahawansa. This 6th century B C city is older than Anuradhapura. The excavation of this ancient pre–6th century B C site is of prime importance if we want to study the pre-Buddhist ancient settlements of Sri Lanka.

It is clear that Vijithapura which is at Polonnaruwa pre-dates Anuradhapura as a citadel. (Refer: Ancient Hydraulic Civilization of Sri Lanka, Royal Asiatic Society Journal Special Issue, Volume XXVII of 1982).

The third important discovery was made when I accompanied Prof. B. H. Farmer of Cambridge, on a familiarising tour of the Mahaweli Project, in March, 1981. I stumbled on some brick scrapings on the ancient Maduru Oya Bund, which I identified as an ancient Sluice, for which drawings and plans were provided. The authorities were warned that the alignment of this sluice barrel was askew (at an angle) not perpendicular to the bund, and that suitable precautions should be taken when excavating. This structure was exposed in November, 1981 nine months later, and was preserved for posterity on the recommendation of the Hon. Minister of Mahaweli Development and the orders of His Excellency the President. This could be classed as one of the best archaeological finds of special interest to Engineers. This sluice is the upper sluice of Maduru Oya Dam which has been built in two stages. The ruins of yet another terracotta sluice or Mada Horowa, at a level of nearly 30 ft. below and adjacent to the upper sluice, were also detected and subsequently closed up, thus indicating that the ancient Maduru Oya bund was constructed in three stages.

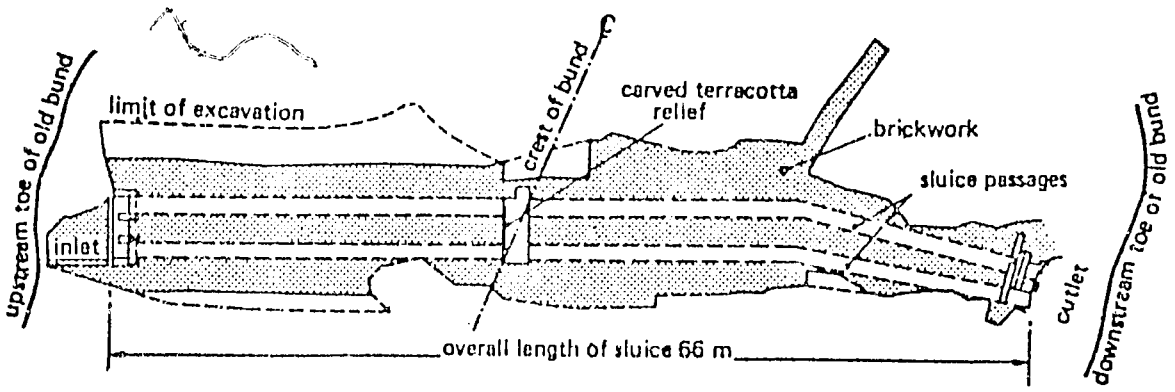
These ancient sluices of the Maduru Oya Dam were subject to a detailed study by members of the Technical Review Committee for the Maduru Oya Project, comprising of Consulting Engineers Mr. B. P. Benson, Mr. W. P. Harland and Mr. I. L. Pinkerton on the request of Hon. Gamini Dissanayake, Minister of Mahaweli Development.

This report indicated that the ancient sluiceways comprised an upper sluice and lower sluice. The upper sluice comprised two stages of construction while the lower sluice was the first to be constructed. At every stage of its construction the bund was suitably raised. The plan of the upper sluice with the top view of the Bund; the section along the centre line of the Bund; as well as the cross section of the Bund at the valley bottom, together with spill levels that have been prepared by this team, is indicated for reference. In order to obtain a scientific basis for the dating of the sluice and its different components, and the stages of construction, the author obtained the following samples for carbon 14 dating.

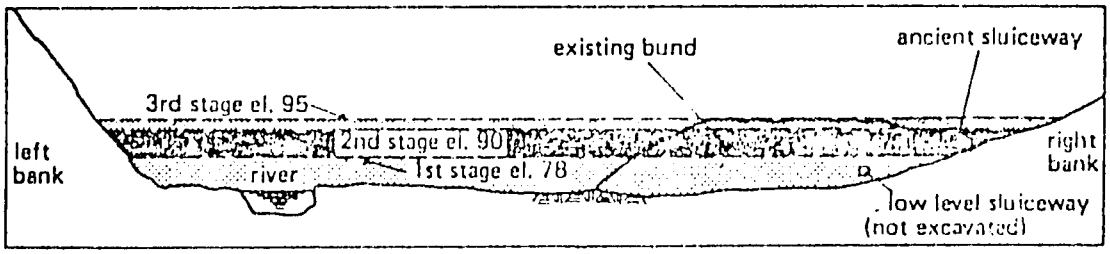
(1) Wood samples from the upper sluice barrel (to give us the date when this upper sluice ceased to function).

(2) Charcoal sample from the 3rd stage of construction below the supporting abutment of the (younger) downstream section of the upper sluice, which is distinctly of different construction (to give us a date of the construction or extension of the younger section of the upper sluice).

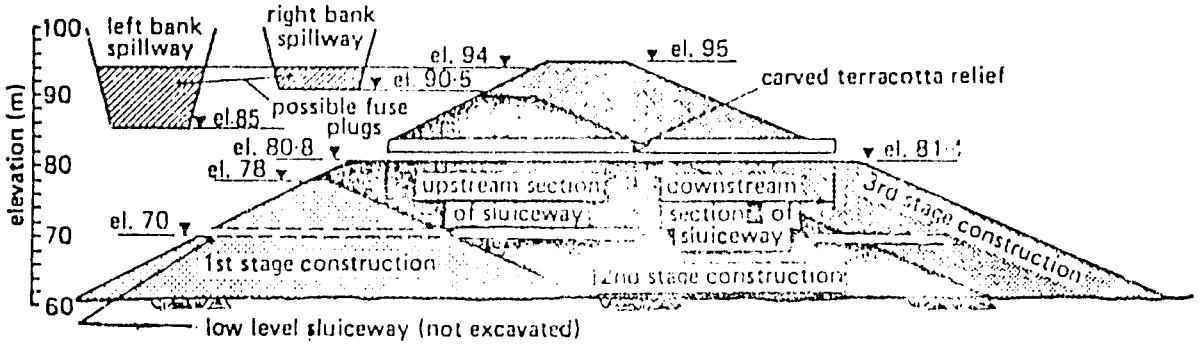
(3) Scrapings from the resin that bonded the bricks of the older sections of the upper sluice (to give us a date of the construction of this section of the sluice).



Top view of Bund and Upper-sluice



Section along centre line of Bund



Section of Bund at Valley Bottom

(4) Wood sample from among the bricks on the lower sluice which has not been fully excavated, but was closed up after exposure (to give us a date of the construction of the lower sluice).

Sample (2) and (4) were sent by the Author through Mr. A. G. Tanner, Project Director, Crippen International Ltd., Canada to the University of Washington for carbon 14 dating and facsimiles of reports are attached for reference.

Sample (1) and (3) were sent for carbon 14 dating to the Atomic Energy Authority of Sri Lanka, by the Author, through the Government Analyst. So far we have not received a report on this.

On the basis of the reports we have received so far the youngest section of the upper sluice is dated as 1520±20 BP (BP is before present, the reference date being 1950 AD) while for the lower sluice we have date 6000±20 BP. This would indicate that the youngest section of the upper sluice had been built in 430±20 AD i.e. around the period of King Mahanama (412–434 AD).

The lower sluice had been constructed in 4000 BC which is no doubt an incredible date according to present knowledge.

It immediately follows that the second stage of construction of the Bund or that section that contains the excellent resin bounded brick works, with that unique terracotta "Relief of Dancing Devatas", (which is the older section of the upper sluice) had been constructed between these two periods.

Though the date 4000 BC seems incredible according to present accepted knowledge, on this premise alone it cannot be discarded, because of the fact that we know so very little about our ancient past prior to the 6th century BC. If we recapitulate what has been said earlier, the Mahavamsa indicates three epochs or eras before the 6th century BC where Sri Lanka was known as Ojadipa, Varadipa and Mandadipa. The Mahaweli plain was occupied by the Yakkhas around up to the 6th century BC. Claudius Ptolemy calls the Mahaweli Ganga the River of the Persians, while Fernao de Queyroz says that the Raksasa (Yakkhas) came from the city of Aggedi on the borders of the kingdom of Persia and settled in the Mahaweli plain.

Taken together in the context of the other evidence of ruins in the Mahaweli plain, from ancient chaityas, channels etc., for which we do not have positive evidence of the dates of construction of these engineering feats, we have to come to one conclusion, that we indeed had a Hydraulic Civilization that pre-dates the 6th century BC of which we know very little.

If we examine the sophistication of the techniques and the finish of the ancient irrigation works, those that are closest to them in technology are those of Mesopotamia and Egypt where canal structures pre-date our canal systems. Traces of canals dating to 5000 BC have been found at Choga Mami a pre-historic site near Baghdad. The early Kings of Summer were constructing irrigation works around 3000 BC.

However, the construction of reservoirs at that early period is yet an open question. It is known and accepted that we in Sri Lanka, were the first to construct reservoirs in the world, which comprise the fusion of the two irrigation techniques, one involved in canal construction and the other used in the construction of Kanats or Falages that are found in both Persia as well as in Arabia. When the reservoirs were first constructed, is yet an open question, the Maduru Oya sluice would to my mind give us the clues, as it is of pre 6th century BC vintage.

As a scientist and technologist, I would say that the date of 4000 BC would have to be further investigated, because we are basing the dating of just one sample and moreover before confirming this date, further excavation is recommended. But the fact is, what emerges is that the preponderence of evidence not only of this sluice, but also of the other artifacts and ruins in the Mahaweli plains, indicates that this Maduru Oya Bund and sluice is of pre 6th century BC vintage, and would from all appearances and evidence be the work of the earliest settlers who came from Persia, who were known locally as Yakkhas.

More recently several solid semi-cylindrical kiln fired terracotta bricks 19 inches in height and $21\frac{1}{2}$ inches in diameter that formed part of a regular decorative structure were discovered on the right bank of the Mahaweli. This was near Henanigala between Hembarawa and Yakkura. These massive kiln fired terracotta bricks (which some have also called mouldings) of this size have been recorded in Sri Lanka for the first time. The technique of its fabrication is a question that is difficult to answer. The fact remains that the ancient people who fabricated them were fully competent in making, not only excellent kiln fired bricks, but other terracotta objects of a quality that cannot be made today with all the modern technology.

In addition to the terracotta artifacts, numerous granite pillars of different sizes having various motifs are scattered in the plain, but laid down in well ordered and regular patterns that remind us of the bygone past civilization that inhabited the Mahaweli region.

We have in this area numerous Brachmi inscriptions which go back to the 3rd century BC, on drip ledges of caves, dedicating these caves to the Sangha till the sun and the moon lasts.

These early settlers in the Mahaweli plain were subdued by the Nagas, the tribe of Mahanaga who fully established themselves first in Ruhuna and developed it, for which reason it was called Nagadiba by Ptolemy. The settlement and migration of the people are confirmed in the Dipawamsa, the Mahawamsa and Culawamsa as well, notably as in the writings of Claudius Ptolemy from the first to the 14th century.

With the fall of the Polonnaruwa kingdom due to foreign invasions, natural cataclysms and internecine wars, the cradle of our civilization was overrun by the jungle tide and became the Vanni. (Vanni is derived from the Sinhalese word Vanaya meaning forest).

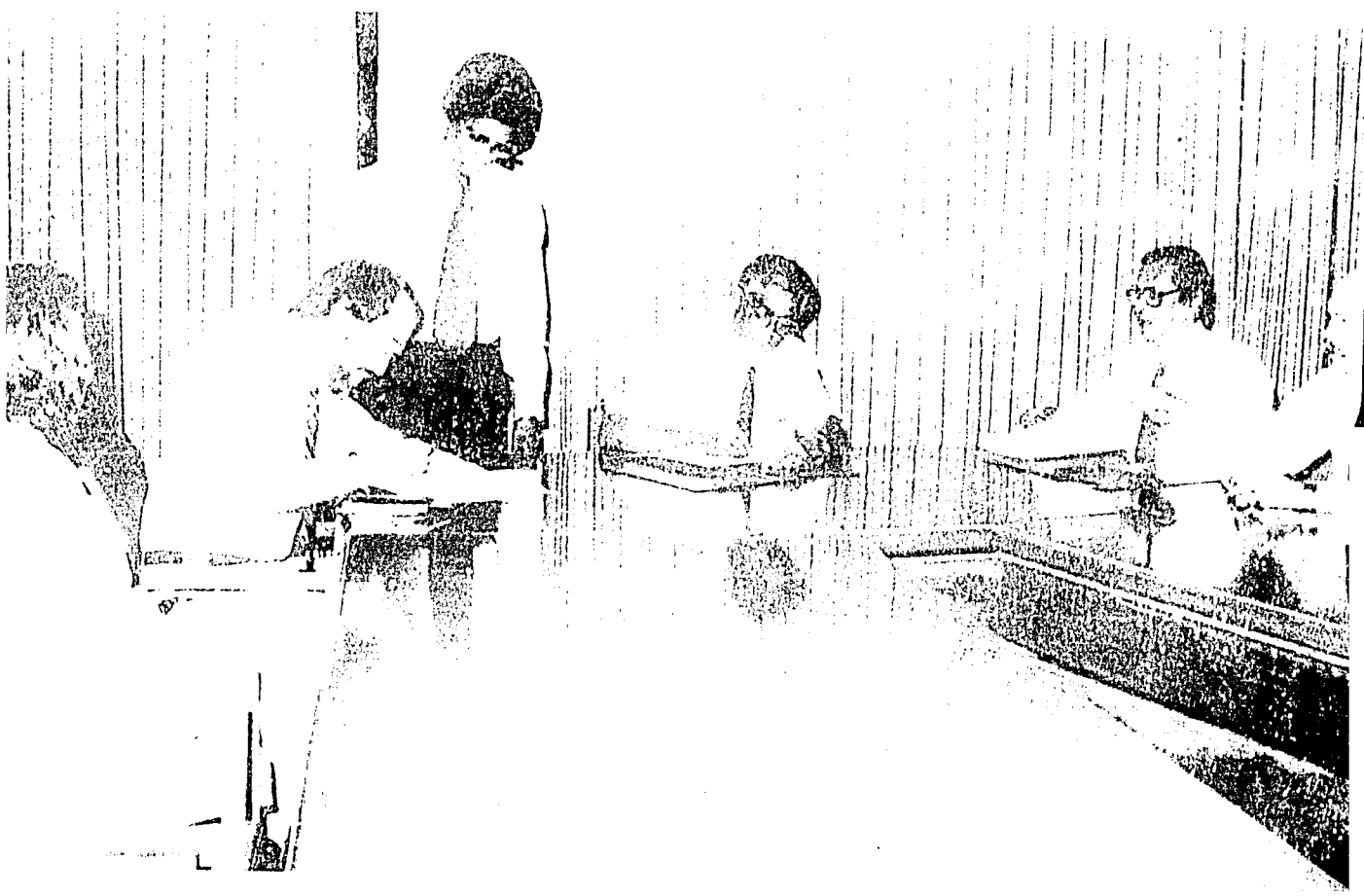
In the medieval period little is recorded in our chronicle Rajawaliya of this desolate area and we find poetic stanzas in the delightful Sandesaya style in the Maga Salakuna (Refer Royal Asiatic Society Journal No. XXXVII of 1946 page 205 for details) describing the upper reaches of the Mahaweli.

In the colonial era we note many foreigners who were Portuguese, Dutch, Danes, French, German and British, as well as Sri Lankans, describing the stupendous works of a bygone era (now in ruins) and betimes accompanied by drawing maps and plans, sketches, etchings, woodcuts and photographs to illustrate them. These descriptions have in turn emotionally stimulated our leaders to redevelop this area not only to its pristine splendour, but to improve on it as well. This has resulted in development under the present Mahaweli Programme, which has also led to the discovery of many ancient Artifacts, secrets which nature has

kept hidden from us for over thousands of years under its soil and verdant vegetation.

The Mahaweli plain that has been the cradle of our civilization which was derelict and deserted for about 3 centuries during the medieval ages to present times, is now reborn and given a new lease of life with the assistance of modern science and technology.

As an initial step towards promoting small scale ventures, the Mahaweli Authority of Sri Lanka, has established a joint venture capital company, with Appropriate Technology International (ATI) of the U.S.A. Director-General K. H. S. Gunatillake signed on behalf of the Mahaweli Authority of Sri Lanka.



INVESTMENT, EMPLOYMENT & ENTERPRISE DEVELOPMENT

The Accelerated Mahaweli Development Programme with just over half a decade of activity behind it, is well on schedule in its efforts for providing the necessary infrastructure requisites for stimulating industrial activities in the country, and especially for the promotion and development of the agro-industrial sector in the Mahaweli areas. The construction of four massive headworks and reservoir projects, and downstream irrigation works and land development, provides the required base for intensive and dynamic economic growth. The four major headworks will provide over 540 megawatts of power and storage for over 2200 million cubic metres of water, for both irrigation and hydro-electricity. The impact of this programme is already being felt, the value of rice imports having fallen from Rs. 284 million in 1979 to Rs. 197 million in 1984. An estimated 45% of this decline in imports is attributable to the Mahaweli Project. Oil imports for fueling thermal electricity have declined as well. Furthermore, over forty seven thousand farm families, in addition to those in the service sector, have been settled on irrigated lands.

Today, a new and exciting thrust is about to get underway, that will see private investors joining forces with settler families and the government, to generate even greater benefits through the industrialisation of the resources of the Special Areas of the Mahaweli Ganga Development Project. The goals of the new programme are:–

Increase per capita incomes.
Increase off-farm employment opportunities.
Introduce innovative management and business acumen.
Accelerate the rate of agro-technological change in the Mahaweli areas.

Increased and active participation of the private investor with the government is the vehicle through which these goals are expected to be achieved.

Mahaweli is an area of great economic potential. Arable land, irrigation water and an expanding network of infrastructure (notably roads and electricity for townships and settlements) are the major economic resources available to settlers and investors. Social support services in health education and in private and public institutions have been provided, and their efficacy is increasing as well. Other significant resources, include the fish habitats provided by the several reservoirs and tanks, and natural resources such as rock phosphate and clay deposits, available in several locations suitable for various types of industries. In Systems G and H and increasingly in Systems B and C, there are farm families with members in or nearing the labour force age. These young adults of the Mahaweli represent a force

to be harnessed for new business and industrial development. Their business initiatives must be stimulated.

In the towns, there are also lands set aside and available for the establishment of both agro-industrial and other industrial businesses. These lands may be leased to individual entrepreneurs by the Mahaweli Authority of Sri Lanka. Centres have been identified for industrial estates to be used by entrepreneurs.

Serving all of these Mahaweli Special Areas, is an extensive network of existing and proposed transportation links as well as the larger townships, that are in the process of being serviced with economic and social overhead facilities.

The plentitude of resources that the Mahaweli Development Programme has bestowed on the country, need to be complemented by a business environment that is conducive to investment and employment generation.

We believe that this can be achieved only through joint efforts between the Government and the private sector, in this new phase of Mahaweli development.

To meet the challenge of accelerating private sector investment and creating jobs for settler families, the Mahaweli Authority of Sri Lanka, is committed to implementing, an Enterprise Development Programme over a five-year period. The time limit will encourage investors and entrepreneurs to act now, in order to take advantage of the resources offered rather than postpone decisions.

Under this newly formulated strategy for Employment, Investment & Enterprise Development, the Mahaweli Authority of Sri Lanka, is ready to make available on a timely and attractive basis, land for commercial agriculture and agro-industry.

Financial Inducements & Infrastructure

Attracting private investments and agro-industry, in particular to the Mahaweli Special Areas, will require the development of attractive incentives to encourage investment, in one of the most ambitious pioneer regions in the world today. Thus, the Mahaweli Authority of Sri Lanka, with Foreign Investment Advisory Committee of the Ministry of Finance and Planning, is now ready to offer special financial arrangements and tax concessions, for investors willing to assume the special risks associated with the Mahaweli areas.

Among the special financial package offered by the Mahaweli Authority of Sri Lanka, is a two part equity investment venture capital programme, which has been evolved for the benefit of the investors who may require support in structuring their initial financial package. This will also benefit those who feel that joining forces with the Mahaweli Authority of Sri Lanka, in a joint venture enterprise, provides security and assures continuity of commitment. The proposed Mahaweli Capital Investment Fund when created under this programme, will enable the Mahaweli Authority of Sri Lanka, to consider equity investment in enterprises in Mahaweli Special areas, if an investor so requests. Such an equity participation will enable the Mahaweli Authority of Sri Lanka, to subscribe to part of the share capital.

As an initial step towards promoting small scale ventures, the Mahaweli Authority of Sri Lanka, has established a joint venture capital company, with Appropriate Technology International (ATI) of the USA. The principal objectives of this Venture Capital Company, will be to undertake product development, make capital investment in small scale rural

industries and ultimately pass the equity to the intended beneficiaries. A number of projects have already been identified for possible venture capital financing and include – production of vinegar, rice milling and processing, chillie grinding and processing, manufacturing of handlooms and cement blocks, fruit canning and assembly of agricultural implements and tricycles.

In addition to the Venture Capital Company through which the Mahaweli Authority of Sri Lanka, hopes to promote, participate, invest in and establish small scale and medium scale ventures, another new concept that is being actively pursued for promoting small and cottage scale enterprises are Household Enterprise Development Centres. These Centres, one of which will come into operation by the end of 1986 at Girandurukotte, in System C, are geared to provide product development, training in business development skills, venture development support and to facilitate other services, to settlers and small and intermediate scale entrepreneurs, and to assist them in gaining access to credit, transport, packaging, preserving, storing and procurement of raw materials to start their own enterprises.

The specific long-term goals of the Household Enterprise Development Centres are to create interest in entrepreneurs, provide start up assistance and finally to establish a number of enterprises throughout the area serviced by the Household Enterprise Development Centre. Household Enterprise Development Centres will be the vehicle or means, through which the small scale investor with no capital of his own, can try out his innovative ideas in business development.

Another approach for enterprise development that is under active consideration is the Nucleus Farm Concept, where an investor would be supplied land under attractive terms for a core agricultural production unit, and in addition would contract with individual farmers on an out-grower basis. This type of farming has already proved successful in Sri Lanka and other Asian countries.

The establishment of focal points for investment by business will ensure that individual enterprises, the Mahaweli region, and the nation as a whole, gain the benefits that accrue from economies of agglomeration. The programme seeks to accomplish this through the installation of necessary infrastructure facilities at key locations, throughout the Mahaweli Special Areas. Infrastructure investments will be made in close collaboration with individual investors and will take into consideration their special needs.

Institutional support, needed for the implementation of the Mahaweli Authority of Sri Lanka's new business development strategy, is provided by the newly established office: Employment, Investment and Enterprise Development. This office, backed by a professional staff, is dedicated to provide investors a full range of investor services, including assuring time-saving decisions, attending to department documentation delivering maximum support and assistance in structuring and implementing their investments.

So today, the Mahaweli Authority of Sri Lanka has entered into yet another significant phase in its development programme. Opening up a whole new range of business opportunities for the innovative investors – large and small, through its Enterprise Development Programme, the Mahaweli Authority of Sri Lanka, now stands ready to talk business and do business.

▲ Muslim folk at Welikande in System 'B' meets the Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake on his tour of the area.

▼ Mahaweli settlers have extensively cultivated green chillies beyond the requirements of local consumption for the export market. Bumper crops of red onions which were traditionally the produce of the North of the country is now being harvested in System 'H'.

HUMAN SETTLEMENTS & SOCIAL DEVELOPMENT

The concepts which guided planning and development of the Mahaweli new settlements, and how the experience that was gained in the pioneer new Mahaweli settlement in the Kala Oya valley, (System H) was being adopted in the projects which were subsequently taken up for development, were examined earlier. The reasons behind the layout of the irrigation system, based on the turn-outs and the structuring of different settlement centres in a hierarchial order too, were examined (Mahaweli Projects and Programmes 1984). These subjects which have been much discussed and written on, do not need repetition here. Therefore, this presentation is to:

(a) Review the progress made on settling people on land.

(b) Discuss some issues germane to settlement and post-settlement, social and economic development activity in the Mahaweli Projects.

Progress of Settlements

As at the end of June 1986, the number of farmer and non-farmer families, settled in the Projects which have been taken up for development, is indicated below:

Projects	*No. of Settlers as at* 31.12.85	*No. of Settlers between* 1.1.86 & 30.6.86	*Total up to* 30.6.86
Kalawewa (System H) . .	27,837	201	28,038
Maduru Oya (System B) . .	8,638	1,287	9,925
Ulhitiya – Ratkinda (System C) . .	10,007	2,103	12,110
Elahera (System G) . .	2,776	419	3,195
Total	49,258	4,010	53,268

Settlement work in the Kalawewa Project (System H) is complete.

In the Elahera Project (System G) which involves rehabilitation of the old irrigation system as well as the development of new land, the settlement programme would be complete in 1987.

In the Ulhitiya – Ratkinda Project (System C) about 50% of the settlement work is over and the interior northern part of the Project is being developed. The target for settlement in 1986 was 4652 and by June 1986, 2103 families were settled. As a result of the rescheduling

of the programme on the construction of the irrigation network, it was decided to suspend further settlements in the year. However, settlement work would resume in early 1987.

In the Maduru Oya Project (System B) Zones 1, 2 & 5 are being developed and settled. Here again, due to the same factors which influenced the settlement programme in the Ulhitiya – Ratkinda Project, 2013 familes were settled of the target 4652, in the year 1986. Settlement programme would recommence in early 1987.

The Uda Walawe Project, which is being managed by the Mahaweli Authority, was confounded by the problem of large-scale encroachments, which had occurred from its inception till about 1982, through a period of more than 10 years. According to a survey done, there existed over 20,000 encroachments and the conditions required almost a total re-establishment of the land management system. A programme is being implemented to deal with the encroachments and about 60 percent of the programme is complete.

Of the Projects which were originally intended for development under the Accelerated Mahaweli Development Programme, only System A remained to be taken up. Feasibility studies were complete in 1983. In 1986, interest was shown by USSR to contribute to the development of the Project. A team of planners did initial studies and it is expected that they would proceed with planning for the development of the Project.

Some Issues and Concepts of Development

Much of the work on the resettlement of displaced population from upstream reservoir bed areas in the Mahaweli new projects, is nearing completion. Many of them were resettled in the Kalawewa, Ulhitiya – Ratkinda Projects and to a certain extent, in the Maduru Oya Project. The present policy is to select and settle farmers from parts of distant districts in the country where the population pressure is high, and the man/land ratio low. This distance factor in conjunction with the fact, that the projects in which settlements are being established (i.e. Ulhitiya – Ratkinda and Maduru Oya) are located in the sparsely populated and undeveloped parts of the country, has thrown a challenge to the Mahaweli management, in its task of establishing a new economy and society, in a hitherto existing regional vacuum.

The task is all the more challenging, with the necessity to effect an economic and cultural transformation in certain under privileged communities, who have been resettled in the new projects. For example, the resettlement of 650 Veddha families who were used to hunting and shifting cultivation in the Bintenna area, which has eventually become a part of the Maduru Oya National Park. These settlers of different cultural and geographical background, need to be trained and geared to achieve the levels of economic and social development, the Mahaweli Development Programme aspires to. This, in turn, calls for intensive planning and management, to change the attitudes and values of these settlers and to integrate them into the Mahaweli settler community. This is an uphill, yet essential task, for the Mahaweli managers and extension cadres. These problems and situations have been taken cognizance of and special programmes are being conducted to effect the required changes.

The Mahaweli development concept encompasses Man, Habitat and his Economy. That concept is for integrated

▲ His Excellency, President J. R. Jayewardene opened the new Sanghawasa at the Girandurukotte Buddhist Centre. He was accompanied by Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake and Mrs. Srima Dissanayake.

▼ European Economic Community is aiding the development of Monaratenna village in System 'B'. Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development after opening the first house built in Monaratenna, posed for a photograph with Mr. Robert Chase, Resident Representative, USAID and the villagers.

development and for that, it has become necessary to introduce new perspectives and dimensions, into the hitherto accepted model of development.

Mahaweli policy is not to perpetuate peasant settlements as it was the concep' when the pioneer settlements were established decades ago, and followed almost without a change, up to the dawn of the implementation of the Mahaweli Scheme.

Agriculture in Mahaweli is to be changed from subsistence to commercial. The producer is to be transformed from being a peasant to a commercial and scientific farmer. Settlement schemes are to be changed from the almost singular activity of paddy cultivation to diverse crop and livestock production. Economic activity is expected to be transformed from one of primary, to secondary and tertiary levels of production and services. This involves industrial and commercial development and provision of other services. A programme is being implemented to achieve these objectives.

To commercialise agriculture, three strategies are being adopted. Firstly it is to be on the basis of small farmers who have been each allocated one hectare of irrigated farm-land. The bulk of the land in the Mahaweli Projects would be allocated on this basis in the future as well. Steps have been taken to organise the individual small farmers into producer groups, through which, input delivery system, marketing of produce would be channelled. However, it is intended to establish a few farmer organisations on a pilot basis, to develop confidence and competence for sustained management of their economy, by the farmers themselves. The ambit of activity of that organisation, would be not only the input delivery and marketing systems, but also operation and management of the irrigation system and of agricultural activity.

The second strategy is through farmers receiving larger sized farm allotments. Farm sizes ranging 10 to 20 ha were allocated in a part of the Maduru Oya Project to a limited number of selectees, who wished to invest and develop commercial farms. However, progress so far made shows that much is left to be desired. In this background, the policy is being reviewed to allocate srnaller sized farms.

Small sized farms would entail lesser amount of capital investment and therefore, it would allow the opportunity for a larger number of entrepreneurs to apply, and a better choice would be available to select the best of the required types of farmers. Those who would have the investment capacity, knowledge and the interest in developing farms, to produce seed and planting materials required in the expanding Mahaweli project, would receive priority.

Most of the applicants in the category who have requested land have identified the cultivation of such crops as chillies and pulses, etc., which are being successfully cultivated by the small farmers. Therefore, there is no compelling reason for the allocation of large sized farms for their cultivation. In allocating land to commercial agriculturists, the requirement was for them to cultivate high value crops, easily manageable in large sized farms, preferably with export potential.

The third strategy to commercialise agriculture is to establish 'core-farms' supported by small outgrowers of certain selected crops. Recently, a decision was taken to adopt this principle in the management of land in Zone 6 of Ulhitiya – Ratkinda Project, which is being planted with cashew. There would be a core plantation area which would be directly managed by the Mahaweli Authority and the surrounding area would be allocated

to farmers in small, yet viable sizes. The cashew planted land would be allocated to individuals in the fourth year of planting, so that the allottees would realise profits within a short period of their residence on the land.

Experience in the Kalawewa Project has shown, the geographical basis on which commercial agricultural activity is possible. It has shown the possibility for crop specialisation according to selected localities. It is also possible to select farmer groups according to their degree of interest and competence. To a limited extent, depending on the availability of irrigation water, specialisation is possible according to certain cultivation periods. These findings are being adopted in the other projects.

To create a condition favourable for commercial agricultural production, steps are being taken to establish contractual relationships, between agricultural producer groups and buyers, for produce supplies, buying and fixing prices. This would be arranged directly between the producers and buyers with the Mahaweli Management providing the necessary supporting services. This scheme would provide an environment for organised production and marketing, and minimise problems of uncertainty of markets and prices, and many other difficulties encountered by the farmers. In fact, as much as possible, farmers would produce for a known market.

Maduru Oya and Ratkinda Projects are being settled with people with different degrees of irrigated agricultural experience, which necessitates extra efforts to introduce some of them to systematic agriculture, and water management (e.g. resettled Veddha community). To help training them, settlers have been grouped and their elected (farmer) representatives are trained to provide leadership, and assist in water management and agriculture extension work. Training programmes for the extension workers and farmer leaders are being implemented on a regular basis.

Establishment of industrial and commercial activity is being actively promoted in the Projects. Facilities such as the allocation of land and supply of utility services, are being provided to those interested in setting up industries. So far, the industries established have been mostly of agro-processing type and that too, mainly milling rice and grinding certain produce. A concerted effort is being made to attract other industries as well. Similarly, establishment of trade and other services too, is being encouraged.

The new township at Girandurukotte, opened in April 1986, gives a cross-sectional view of the trade and other services which are normally provided for in Mahaweli townships.

A scheme is being implemented to establish industrial, trade and other services in the area, village and hamlet centres in the newly settled areas in the Maduru Oya and Ulhitiya – Ratkinda Projects.

Two old Irrigation Schemes falling within the management of the Mahaweli Economic Agency were taken up for rehabilitation in 1986. Design and the rehabilitation of the Uda Walawe Project with the assistance of the Asian Development Bank is being done and the work is expected to be complete by the end of 1989.

Pimburettawa Scheme established in 1967 and falling within the Maduru Oya Project, needed rehabilitation of its irrigation system as a result of neglect of its maintenance. A decision was taken to rehabilitate it with a high social component, by way of training water users and creating conditions for growth of water user institutions, so that they could be

Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake and Resident Representative USAID, Robert Chase meets displaced families from Kotmale who were resettled at Dimbulagala in System 'B'.

competent participants in the operation and maintenance of the irrigation system, upon completion of the rehabilitation work. Farmers would be involved even in the design stage, in the rehabilitation. This is a joint exercise by the Mahaweli Economic Agency and the Mahaweli Engineering & Construction Agency.

Management of Mahaweli Projects is receiving new orientation with the establishment of Development Centres, to cater to training and service needs of different sectors of the economy and society, in the new settlement projects. The concept is, that there should be a body with adequate resources for planning and implementation of development projects, in an integrated manner. The fundamental objective is to give a thrust to systematic and rapid development of the project. To begin with, activities of the Centre established at Girandurukotte with the assistance of the European Economic Community, has been reoriented and extended, and with the experience that would be gained there, the establishment of other such Centres as in the Maduru Oya Project could be planned.

ENGINEERING ASPECTS

The Accelerated Mahaweli Programme presents a scenario of mammoth effort on the integrated development of the water resources of Mahaweli Ganga basin for generation of hydropower and extension of irrigation facilities, within and in the adjoining basins. This programme launched in 1978 -79, essentially consists of four major storage reservoirs, appurtenant power generation systems and the downstream development for conveyance and distribution of water for irrigation in the extensible command areas. The four major dams are (i) Kotmale Dam at Kadadora across Kotmale Oya a tributory of Mahaweli Ganga (ii) Victoria Dam across main Mahaweli Ganga just upstream of Victoria Falls in Dumbara Valley (iii) Randenigala Dam downstream of Victoria, with a cascade reservoir extending up to the tail water of Victoria Power House and a subsidiary dam at Rantambe just downstream of Randenigala, to create a balancing reservoir for regular and controlled irrigation supplies to Minipe (iv) the fourth reservoir is in the adjoining basin of Maduru Oya, and is primarily for irrigation purposes with a very limited potential for power generation.

One more reservoir was originally envisaged for inclusion in the Accelerated Programme. This was to be at Moragahakande across Amban Ganga for storage of inflow from Amban and regulate the flows diverted from Mahaweli Ganga at Polgolla via Ukuwela Tunnel and Power House. However, it was deferred in preference to the utilisation of Mahaweli waters more beneficially over the Victoria, Randenigala – Rantambe cascade and only a limited diversion was provided for at Polgolla while evaluating the cascade projects. Studies are now afoot for conservation of water in Amban Ganga valley for extensive and intensive irrigation development in Central and North Central zones, and these studies would determine the stage and scope of revival of Moragahakande Reservoir Project.

Design and construction of these multipurpose storage projects were undertaken almost simultaneously.

Every project site had its own peculiarity and evolution of the most appropriate form of development of each project, was as interesting as it was professionally challenging. An account of the important engineering aspects of each of these major projects is presented here, along with a brief description of the main features of each scheme.

1. KOTMALE DAM AND POWER PROJECT

A - PROJECT FEATURES

Kotmale Project consists of a regulating reservoir of capacity 174 Million Cubic

Metres (MCM) (ultimate 375 MCM) formed by construction of a 87 metre (ultimate 116 metre) high concrete face rock-fill dam across Kotmale Oya, about 6.5 km. above its confluence with Mahaweli Ganga where it drains a catchment of 554 square km. with a mean flow of 32 cumecs and a peak flow of 5550 cumecs. Power water is conducted through a 6.4 m equivalent diameter concrete lined horse-shoe tunnel 6.6 km. long to a 15 m. diameter 144 m. high surge tank. Beyond the surge tank, the high pressure system consists of a concrete lined inclined tunnel, and a partly concrete lined and partly steel lined pressure shaft which trifurcates to feed three Francis turbines, rated at 68.2 Megawatts (MW) under a nett head of 201.5 m. corresponding to a generator output of 67 MW.

After the planned future raising of Kotmale dam, the rated generator output will be 76.5 MW at 0.85 power factor. The generating plant is housed in an underground cavern 67 m. long by 20 m. wide by 38. m. high. This is the first underground power house in Sri Lanka. The tail tunnel of the power station discharges back into Mahaweli Ganga. Total energy output from Kotmale is 455 Gwh with the present dam crest at El. 706.5 m. and will be 535 Gwh when the dam is raised to El. 735 m. Irrigation benefits from the project are presently of a limited nature arising only from the improved regulation of river flows, picked up at the Polgolla Diversion Barrage on Mahaweli Ganga downstream. However, after raising of the dam, regulated additional supplies would be available to firm up and extend irrigation to about 20,000 ha. in Amban Ganga valley and adjoining areas.

A gate controlled chute spillway with three radial gates 14 m. wide by 15 m. effective height, with automatic controls to maintain the reservoir levels, is provided at the left abutment of the dam. It has a capacity of 5550 m^3/sec. A flip bucket at the terminal of the chute throws the discharge clear of the river bank into the middle of the river bed.

A bottom outlet of capacity 90 m^3/sec. at minimum reservoir operating level of 665 m. has been provided (i) to control the reservoir filling (ii) to draw the reservoir down for any exigency maintenance and (iii) to pass irrigation supplies down in case of a long closure of the Power Plant.

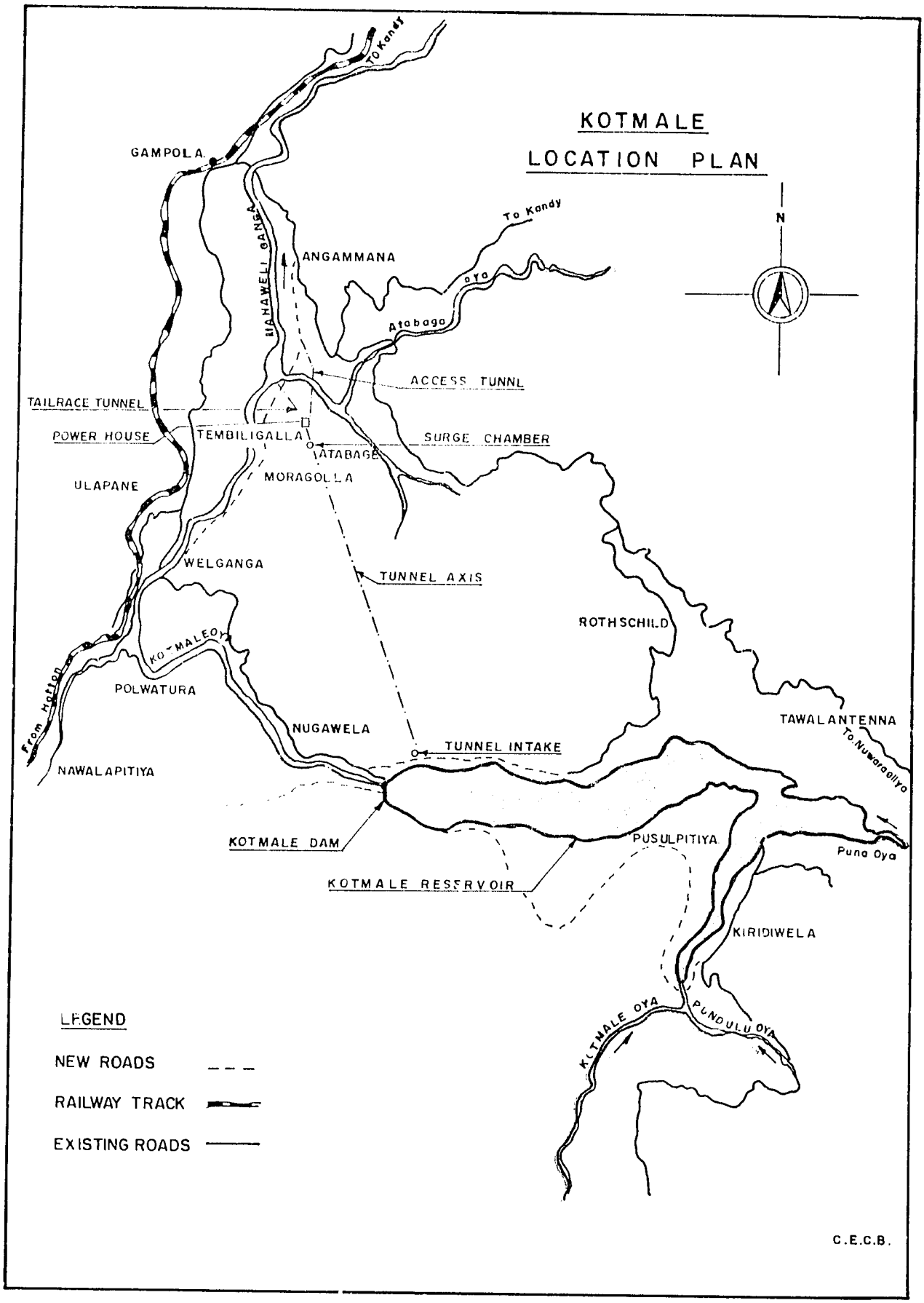
B–SPECIAL ENGINEERING ASPECTS OF KOTMALE PROJECT

1. Location of Dam axis:

At Kadadora, the wide section of Kotmale valley changes to a gorge-like section by the convergence of the charnokite cliffs. A dam site directly at the entrance to the gorge was initially selected on the basis of a seemingly favourable topography. Preparation for excavation of diversion tunnels (then proposed to be on left bank) soon brought to light the problem associated with the incipiently unstable and steep cliff on the left flank showing signs of advanced decompression and deep weathering.

This led to serious doubts about the suitability of this site. Further work on the dam appurtenances was therefore suspended and detailed investigations made, which led to shifting of the dam axis by about 250 metres downstream. The engineering considerations behind this shift and precise location and orientation of the axis, were as follows:

(i) Near the upstream toe of the dam, limestone band approaches the ground surface in the valley floor where it appears to become increasingly solutionised. Deterioration of limestone also affected the quality


KOTMALE
LOCATION PLAN
N
To Kandy
GAMPOLA
MAHAWELI GANGA
ANGAMMANA
To Kandy
oya
Atabage
ACCESS TUNNL
TAILRACE TUNNEL
POWER HOUSE
TEMBILIGALLA
SURGE CHAMBER
ATABAGE
ULAPANE
MORAGOLLA
WELGANGA
TUNNEL AXIS
ROTHSCHILD
KO-MALEOYA
From Hatton
POLWATURA
NUGAWELA
TUNNEL INTAKE
TAWALANTENNA
To Nuwaraeliya
NAWALAPITIYA
KOTMALE DAM
PUSULPITIYA
Puna Oya
KOTMALE RESERVOIR
KIRIDIWELA
KOTMALE OYA
PUNDULU OYA
LEGEND
NEW ROADS
RAILWAY TRACK
EXISTING ROADS
C.E.C.B.

of thinning mantle of charnokite. In case of shifted axis, the cover of charnokite increases to about 60 metre. This is deep enough, so as not to endanger the stability of dam foundations by collapse of cavities, but not too deep to prevent it from being sealed by curtain grouting.

(ii) Coffer dam in the initial upstream site would have been on very poor and vulnerable foundation conditions.

(iii) Bed rock quality in the upstream site is not entirely homogeneous and deep weathering and quasi-erratic variations in fracturing and permeability, were much more pronounced as compared to those at the shifted site. This feature made the upstream site rather unsuitable for a concrete face dam because founding the plinth on pronouncedly non-homogeneous rock, could lead to unequal settlement of the plinth and resultant damage to the concrete membrance.

(iv) At upstream site, geological conditions at the upstream section of the diversion tunnel, where excavation of blocky overburden and stabilising of the rock buttress would have been required, could cause design and construction complications leading to increased cost and uncertainties.

(v) Portal for the power tunnel in the initial axis layout would also have been problematic due to proximity of the block flow.

(vi) In the lower half of the left abutment and also in several places on right abutment, sound rock was exposed or proved to exist at shallow depth at the new site.

(vii) Shift of axis permitted locating the diversion tunnels on right bank with little problem of slope stability at the portal.

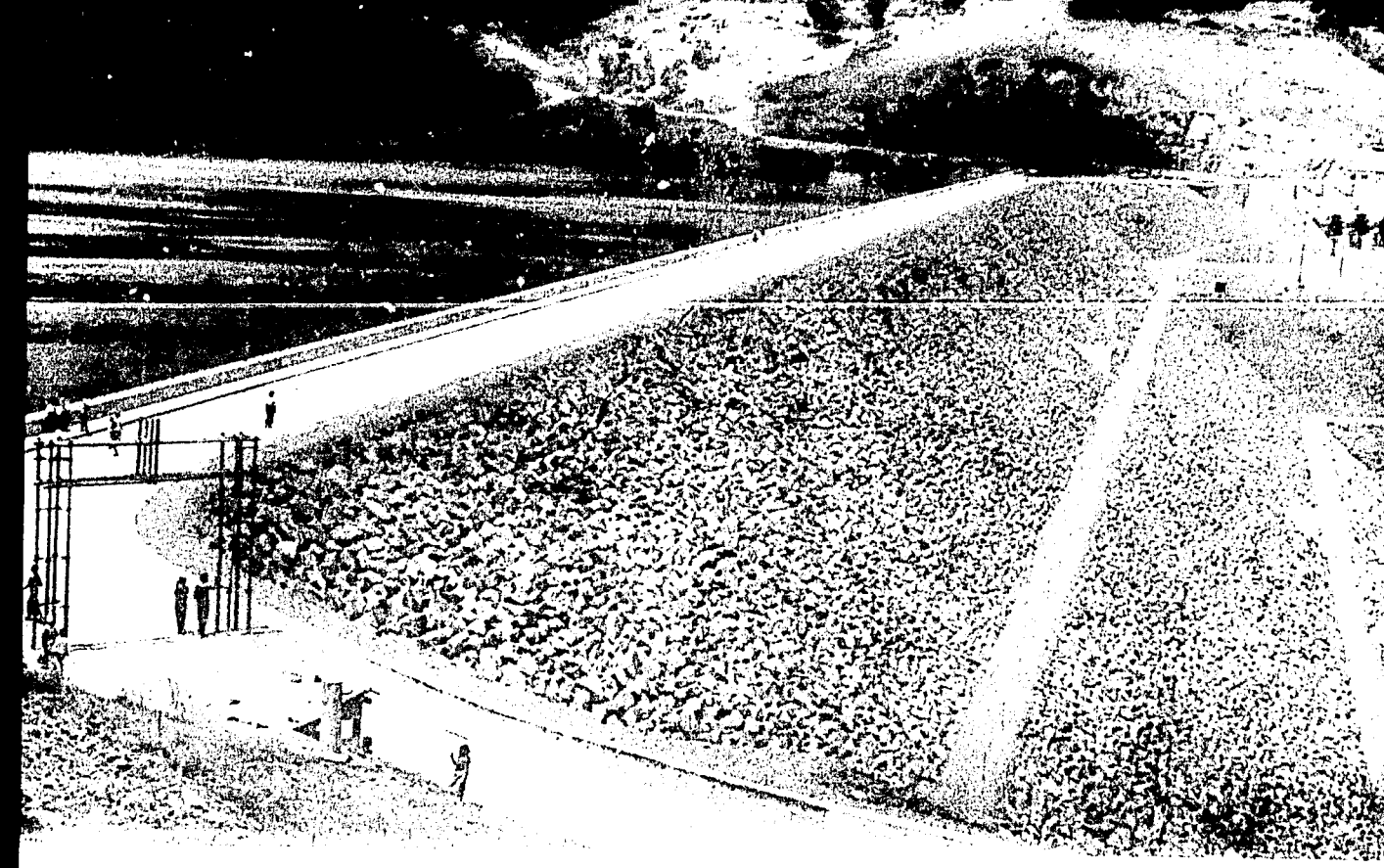
(viii) The left abutment at the shifted site formed a sort of spur between two creeks, deeply incised into the valley flanks. The geological complications of this feature to get a stable foundation and tying of the dam to the rock, were got over by siting the spillway on the left abutment, in the process of excavation of which, all the questionable formation over the spur was removed.

(ix) For a precise location and orientation of the new axis, the presence of a significant lineament on the downstream side presented some constraints. Although the lineament was not considered to be active (later siesmic observations have further strengthened this view) it was realised that it may control the hydro-geologic regime below the dam, after the formation of the reservoir and this may cause increased uplift or concentrated upwards seepage at the downstream toe of the dam. To get over this problem, a drainage system has been installed at the toe of the dam to a depth sufficient to drain foliation planes which sees daylight just upstream of the dam. Subsequent observations have shown that leakage through foundations and the dam, is insignificant and no perceptible leakage has been observed in the bed or banks of the river for some distance downstream of the dam.

2. Type of Dam:

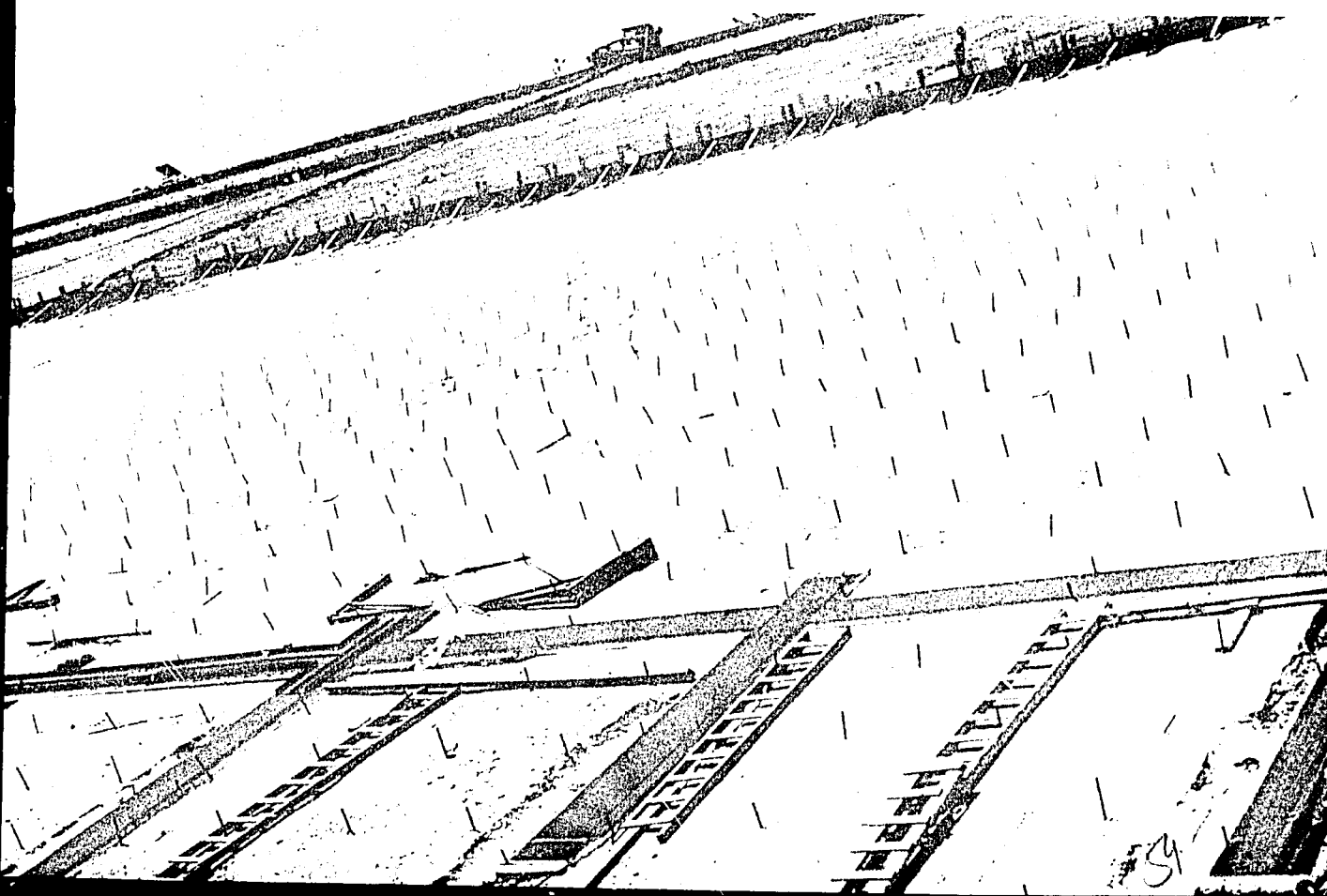
Three alternatives were considered, namely:

(i) Concrete face rock-fill dam
(ii) Clay core rock-fill dam
(iii) Hollow gravity concrete dam



Kotmale Reservoir and Dam.

Construction stage of the concrete face of the Kotmale Dam.



Concrete face rock-fill dam has certain favourable aspects at this site, in so far as the quality of available rock materials for the fill was excellent, the foundation conditions resonable competent to support the structure, time of construction were to be the least and there was cost advantage. However, for stability in sliding against the 15° downstream dipping tectonic shear seams with clay gouge of value of 10 to 12 degrees and zero cohesion, the profile of the fill was tailored to suit the low shear resistance of foundations, by addition of stablishing rock-fill against the faces of the dam, both upstream and downstream.

Clay core rock-fill dam was also considered feasible with regard to foundation conditions, availability of suitable material for core and could be regarded as more stable in earthquake conditions, due to flatter slopes as compared to concrete face rock-fill dam. However, in absence of any evidence towards existence of active faults and lineaments in the region, this factor was not considered to be of overriding significance. On the other hand, concrete face rock-fill dam was somewhat cheaper in cost, due to reduction in quantity of fill and limitation in speed of construction of core, during extended wet seasons in this area with more than 250 wet days in a year.

Hollow concrete dam had some unfavourable features with regard to local geology. Depth of excavation to achieve a suitable foundation remained uncertain, due to abrupt variations in depth of weathering, which was an inherent feature in the general geological setting of the area. Existence of tectonic clay seems dipping downstream was a rather adverse feature for a concrete dam, as it would have required considerable deepening on the downstream and, maybe, some pre-stressing cables to stabilise the stilling basin. Concrete dam was also estimated to be somewhat higher in cost as compared to rock-fill dam.

The site therefore, favoured an embankment dam rather than a concrete dam.

Although the latter type of structure could be designed for this site, with relative advantages of overtopping by floods during construction, simpler river diversion and better siting of spillway, the special treatment of foundations were to be extensive, costly and not without some residual risk of inadequacy.

A concrete face rock-fill dam was therefore finally chosen. Though not foreseen at that stage, the height of the dam was reduced by about 30 metre during initial stages of construction for reasons of financial stringency. It is however, intended to raise the dam later to full intended height. Concrete faced rock-fill dam, with a homogeneous fill in the body, offers the most convenient design for future raising of the dam. The membrane, plinth and grout curtain have been initially provided to suit the raised height. So, also the power plant, tunnel, hydro-mechanical equipment are all designed for the higher head. The only problematic structure for raising will be the spillway. In absence of any initial provision for future raising (being so for want of instant funds) it might turn out to be an economic alternative to raise the control structure and reinstall the gates at the raised crest.

3. Reservoir Tightness:

The problem of reservoir tightness is essentially linked to presence of limestone and calc-silicate rocks. A limestone horizon up to 100 m. thick exists below the dam site. The limestone is highly karsted with cavities ranging up to 5 m. in size. Possibility of under seepage across the dam and inter-basin seepage to Atabage

valley was foreseen and investigated. Reconnaissance of the region and some investigative drilling indicated that continuity of the limestone band to Atabage may not exist. While this was somewhat reassuring, it could not be called conclusive.

At the same time, some positive features like effluent characteristic of the hydro-geological regime of Kotmale Oya, and a thick soil cover over the limestone and the fact that seepage gradient towards Atabage would be less than 1%, tend towards the remoteness of significant, and if all, inter-valley seepage through limestone. No immediate measures for inter-basin seepage interruption were therefore decided upon. However, the under seepage below the dam was considered to be a realistic possibility and as a remedial measure, a grouting gallery has been provided below the dam, about 10 m. above the limestone band, with access adits on either flank which incidentally also serve as effective drainage media for the abutments. Curtain grouting from this gallery has been done across the limestone band, with a dependable degree of precision and subsequent behaviour has proved its effectiveness. The seepage across the dam foundations is insignificant and uplift pressures low

4. Land Slides in the Reservoir Area:

It was recognised from the initial investigation stage of Kotmale project that the area has been subjected to landslides of both ancient and modern age. In a detailed geomorphological survey, the existence of previously known slides as also of many previously unknown ancient landslides, plus areas of potential landslides and rockfalls, were identified. The danger of re-activation of old slides and generation of new slides as a result of impounding was evaluated. However, the risk of devastating waves overflowing the dam was greatly ameliorated, due to reduction in height of dam at the present moment. Later, a much more dependable historical data about the response of potential areas of landslides and rockfalls will be known, by the time the raising of the dam is undertaken. The same notwithstanding, the following measures have been incorporated in the design of the dam.

(i) A concrete slab has been provided at the crest and its shoulders so that any over wave wash may pass with little damage.

(ii) The downstream face of the dam has been provided with a protective cover of selected large size stones to effectively resist damage by flow of overtopping wave wash.

(iii) A higher freeboard to prevent overtopping by small and medium waves caused by sporadic slides of relatively smaller size.

5. Concrete membrane:

Design of concrete face rock-fill dam is essentially an evolutionary process. This type of construction has come increasingly in vogue only during the last 30 years, after the introduction of heavy and efficient compacting equipment. Design and construction of the Kotmale dam, takes into account the cummulative experience and practices on this type of structure and its subsequent behaviour has successfully established the adequacy of provisions made. The dam has upstream slope of 1.4 to 1 horizontal to vertical and downstream slope of 1.45 to 1. Out of 56 dams of this type, completed or under construction around the World since 1966, only 5 have slopes steeper than 1.3 or flatter than 1.5. The membrane

thickness at Kotmale follows the formula 0.3 + 0.002 H. When the dam is raised, membrane will be extended with a constant thickness of 0.3 m. Membrane is reinforced to distribute temperature and shrinkage cracks and prevent chance rupture of slab. For better effectivity of the membrane, the density, impermeability and maximum freedom from shrinkage cracks is more significant than strength of concrete. Some of the measures to be introduced in the evolutionary process of membrane design and construction are as follows:

(i) Use of fly ash as pozzolanic admixture with cement.

(ii) Application of 90 days strength criteria instead of 28 days.

(iii) Use of low shrinkage aggregate wherever possible.

(iv) Evaporative cooling of concrete aggregate.

(v) Prolonged sprinkling of curing water.

6. Bottom outlet:

A bottom outlet of 450 cumecs was envisaged for:

(i) Control of reservoir filling particularly the first filling, primarily to watch and control the activities of landslides, under seepage through limestone band and reservoir induced siesmicity effecting the stability of upstream membrane.

(ii) Emptying the reservoir in case of any exigency for special inspection and maintenance of submerged features.

(iii) Supply of irrigation requirements in case of prolonged closure of power house.

However, with the reduction in height of dam, the capacity of the bottom outlet was reviewed and reduced to 90 cumecs capacity at minimum reservoir level (El. 665).

It was proposed to have this outlet in the concrete plug of one of the two diversion tunnels to be approached by an access adit. A steel lined conduit across the plug with two slide gates in tandem was proposed because the outlets were not envisaged to regulate the flow. They were to be either fully open or fully closed. Model experiments were carried out in the Hydraulic Research Institute of the Irrigation Department of Sri Lanka and a design with generous aeration arrangement was evolved which resulted in a free falling jet with no cavitation. It was technically sound. However, with a view to ensure fast completion of works, an outlet in an independent new tunnel was adopted under expediency. Control system on this outlet consists of a Howell-Bunger valve discharging into a free flowing tunnel and a 3 m. diameter maintenance butterfly valve.

7. Concrete lining in the Power tunnels:

A view was expressed that considering the size of the tunnel and the relatively sound rock foundation with sufficient vertical and horizontal cover, lining of the tunnel may be dispensed with. However, concrete lining was adopted for reasons of getting a stable hydraulic surface and to have long range security against rock falls, activated in course of time due to lubrication of bedding and joint planes or due to chance evacuation of tunnel due to non or malfunctioning and/or lack of co-ordination in the operation of hydro and electro-mechanical equipment on the water conductor system and the power house.

8. Switch Yard at Kotmale:

Power from Victoria is transmitted to Colombo through Kotmale. This caused problems when the 220 KV Kotmale–Colombo line was delayed in construction

and endangered the initial export of Victoria power. A temporary interconnection to the existing 132 KV transmission system was hastily arranged by borrowing a 220/132 KV transformer from another site and splitting the Kotmale sub-station into two single breaker/busbar layouts, one operating at 220 KV and the other at 132 KV interconnected at the temporary transformer. The short length of the double circuit 132 KV line constructed for this intermediate phase is being retained permanently as part of the provisions associated with Unit 3 (to be installed by 1987).

9. High Pressure system at Kotmale Power Station:

There has happened a rather unfortunate incident of cracks developing in concrete lined high pressure shaft, resulting in leakage of up to 3900 litres per minute in the underground power house access adit and build up of high water pressures in the rock formation behind the power house cavern.

As a remedial measure, the entire HP system below surge tank is being steel lined, to prevent water under pressure from leaking into the surrounding rock mass, which is found to have a low level of stresses and is in a kinematic state of equilibrium.

Operation of power house will be restored towards end of 1987 after installation of steel liner from surge shaft, down to the existing liner in the lower parts of the pressure shaft.

II. VICTORIA DAM AND POWER PROJECT

A – PROJECT FEATURES

Victoria Headworks consist of 122 metre high, double curvature arch dam across Mahaweli Ganga, upstream of the Victoria falls, where the river drains a catchment of 1891 square kilo metres and has a mean flow of 105 cumecs. The reservoir has a water spread of 23.7 sq. km. and impounds 728 MCM at elevation 438 m. out of which useful storage is 698 MCM up to El 370 m. A spillway of capacity 7900 cumecs is provided over the dam in the central river section, to cater for the maximum design flood of 9510 cumecs. The spill is controlled by 8 automatically controlled counter balanced radial gates of size 12.5 m. wide by 8 m. effective height. The overspill nappe is dispersed by splitters and thrown clear of dam by a continuous lip 13 m. below the crest of the spillway.

Two low level outlets have been provided at El 355 with a maximum discharge capacity of 760 cumecs, for control of reservoir during filling or for draw-down for any exigency maintenance. Subsidiary outlets branching off from the main outlets are provided to meet downstream riparion rights of users. Arrangement has been provided for future installation of two 520 KVA turbo-generators when compensation water discharges are required or during flood discharges.

Power water from the reservoir is carried through a 6.2 metre diameter concrete lined circular tunnel 5.8 km. long to a surge tank 21 metre diameter and 187 m. high.

The high pressure system consists of three steel penstocks of 5.15 m. diameter each, feeding three Francis turbines rated at 190 m. head and 42 cumec discharge.

The rated capacity of the station is 3×70 MW = 210 MW. The discharge from the machines outfalls into Mahaweli Ganga through a short length of tail channel at EL 232, which corresponds to the Full Supply Level (FSL) of Randeni-

gala reservoir lower down. Normal energy output from Victoria will be 780 Gwh and regulated releases from the reservoir will meet the irrigation requirements of Systems B & C, where about 70,000 ha. of new land can be developed.

Arrangements have been provided to duplicate the power tunnel and the installation at the Power House at a future date, for increased peaking capacity. For this purpose, 150 metre length of the second tunnel has been presently done at the intake end, to enable future construction operations to proceed independent of the reservoir.

B SPECIAL ENGINEERING ASPECTS OF VICTORIA PROJECT

1. Height of Dam:

Planning of the Victoria Dam Project is based on an optimisation process, covering a range of alternative dam heights for Victoria and Randenigala which were analysed to select the one which was best, on economical and technical grounds. In order to develop the full hydropower potential of the system, the tail level of Victoria corresponded to retention level of Randenigala in all the alternatives considered. The limiting cases among the alternatives considered were as follows:

(a) For high Victoria, retention level 430 m, optimum combination was found to be with relatively low Randenigala, retention level 232 m; live storage provided was 500 MCM at each of the two reservoirs. Initial installation at Victoria was to be 3×60 MW which could be doubled for peaking requirements in future.

(b) For low Victoria, retention level 404 m optimum combination was found to be with higher Randenigala with retention level at 253 m. The live storage provided was to be 160 & 890 MCM respectively. Power installation at Victoria was foreseen at 2×37.5 MW initially which could be doubled later for additional peaking capacity. Since no suitable power house site was available at higher tail water level, an underground station was proposed with this alternative.

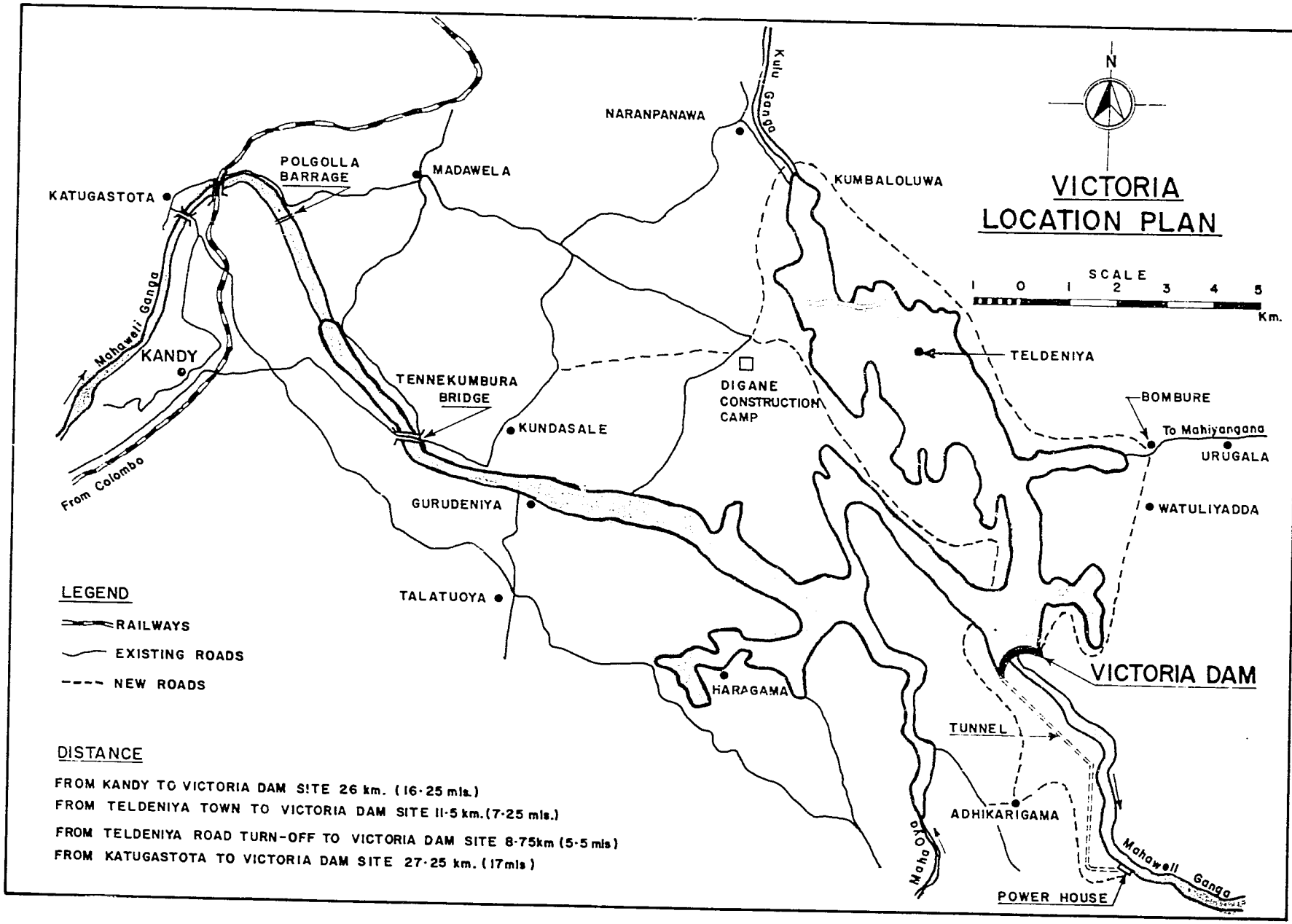
The high Victoria alternative provided considerably higher economic returns than low Victoria, the respective Internal Rate of Return (IRR) being 10.2% and 5.4%; consideration was however, further given to so called 'very high' Victoria proposition. Optimisation studies indicated that up to the studied retention level of 438 m, which was the upper limit set by the need to avoid interference with the barrage at Polgolla, it was increasingly attractive to do so. Accordingly, the Victoria Dam has been built for a retention level of 438 m. and maximum flood water level at 441.2 m, the top of dam being at El 442.5 m. The corresponding initial installed capacity is 3×70 MW. The size of machine was also limited by the constraints in transport to site.

2. Type of Dam:

Mahaweli Ganga passes through a narrow gorge upstream of Victoria Falls which offers a suitable area for construction of a high dam. Geologically, the rock conditions are better towards the upstream end of the steep sided valley, which rises to elevations considerably above the highest crest level of any dam under consideration.

Bedrock in the gorge consists of a sequence of pre-Cambrian high grade metamorphic rocks comprising gneisses with associated quartzites and metamorphosed limestone horizons.

Tropical weathering has affected the rocks and produced a well developed weathering profile, which have influenced


VICTORIA
LOCATION PLAN
N
SCALE
1 0 1 2 3 4 5
Km.
KATUGASTOTA
POLGOLLA BARRAGE
MADAWELA
NARANPANAWA
Kuln Ganga
KUMBALOLUWA
Mahaweli Ganga
KANDY
TENNEKUMBURA BRIDGE
KUNDASALE
DIGANE CONSTRUCTION CAMP
TELDENIYA
BOMBURE
To Mahiyangana
URUGALA
From Colombo
GURUDENIYA
WATULIYADDA
TALATUOYA
HARAGAMA
VICTORIA DAM
TUNNEL
ADHIKARIGAMA
Maha Oya
Mahaweli Ganga
POWER HOUSE
LEGEND
RAILWAYS
EXISTING ROADS
NEW ROADS
DISTANCE
FROM KANDY TO VICTORIA DAM SITE 26 km. (16·25 mls.)
FROM TELDENIYA TOWN TO VICTORIA DAM SITE 11·5 km.(7·25 mls.)
FROM TELDENIYA ROAD TURN-OFF TO VICTORIA DAM SITE 8·75km (5·5 mls)
FROM KATUGASTOTA TO VICTORIA DAM SITE 27·25 km. (17mls)

the extent and pattern of foundation excavation for the selected type of dam. Topographically, the site is more suitable for any type of concrete dam as compared to embankment, due to limitations imposed by the narrowness of the gorge for providing river diversion arrangements during construction and also for permanent spillway for design flood. However, rock-fill dam alternative was studied along with concrete gravity, arch gravity and arch dams. Buttress dam was not considered because the lateral stability of buttresses on the steep side slopes was problematic.

For embankment dam, clay core rock-fill was ruled out in favour of concrete face rock-fill dam because suitable core material was not available. With rock-fill dams, three diversion tunnels of 12 m. diameter each were foreseen, two on the left bank and one on the right bank. The alternative was given up in favour of the final choice of arch dam for reasons of economy and period of construction.

Among the various types of concrete dams considered, the economy and expediency of fast completion favour an arch dam, in preference to gravity or arch gravity types. This was in conformity with the fundamental general consideration that among the various types of concrete dams, the arch dam, if feasible at a given site, will be the most viable solution. Accordingly, a double curvature arch dam was adopted. This has a maximum width of only 25 metre for a maximum height of 122 m. Even this width could be reduced if it was not to limit the foundation pressures. Concrete is the material most suited for compressive stress conditions much the same way as steel is for tensile stress conditions. The double curvature arch dam puts concrete to optimal use in this respect and hence the economy which of course is partly offset by the extra cost of complicated formwork.

3. Foundation Conditions:

Geological and geotechnical investigations at the proposed site of the dam showed that modulus of deformation of the rock is high and mechanical properties are generally very good. Only in block 4 along right abutment, an isolated adverse feature was identified. Two faults and a limestone band intersect immediately below block 4 between elevations 310 and 320 (bed level 337 m). The fault gouge and micaceous seams on either side of the limestone band encountered in this block were all removed up to El 310, about 12 m. below the general foundation level. This excavation was back-filled with dam quality concrete to bring it to normal foundation level of 322 m. It was felt that the overall quality of the foundation rock is very good and the occurrence of an isolated feature of faults and limestone band beneath block 4 does not jeopardise the overall stability of the foundations.

The limestone band extends into the apron area. A remedial grouting programme was undertaken and it was believed that solution cavities, if any, in the limestone band would not be extensive or continuous and as such no risk to water tightness of foundations was foreseen.

4. Dam Design:

(a) Static loading:

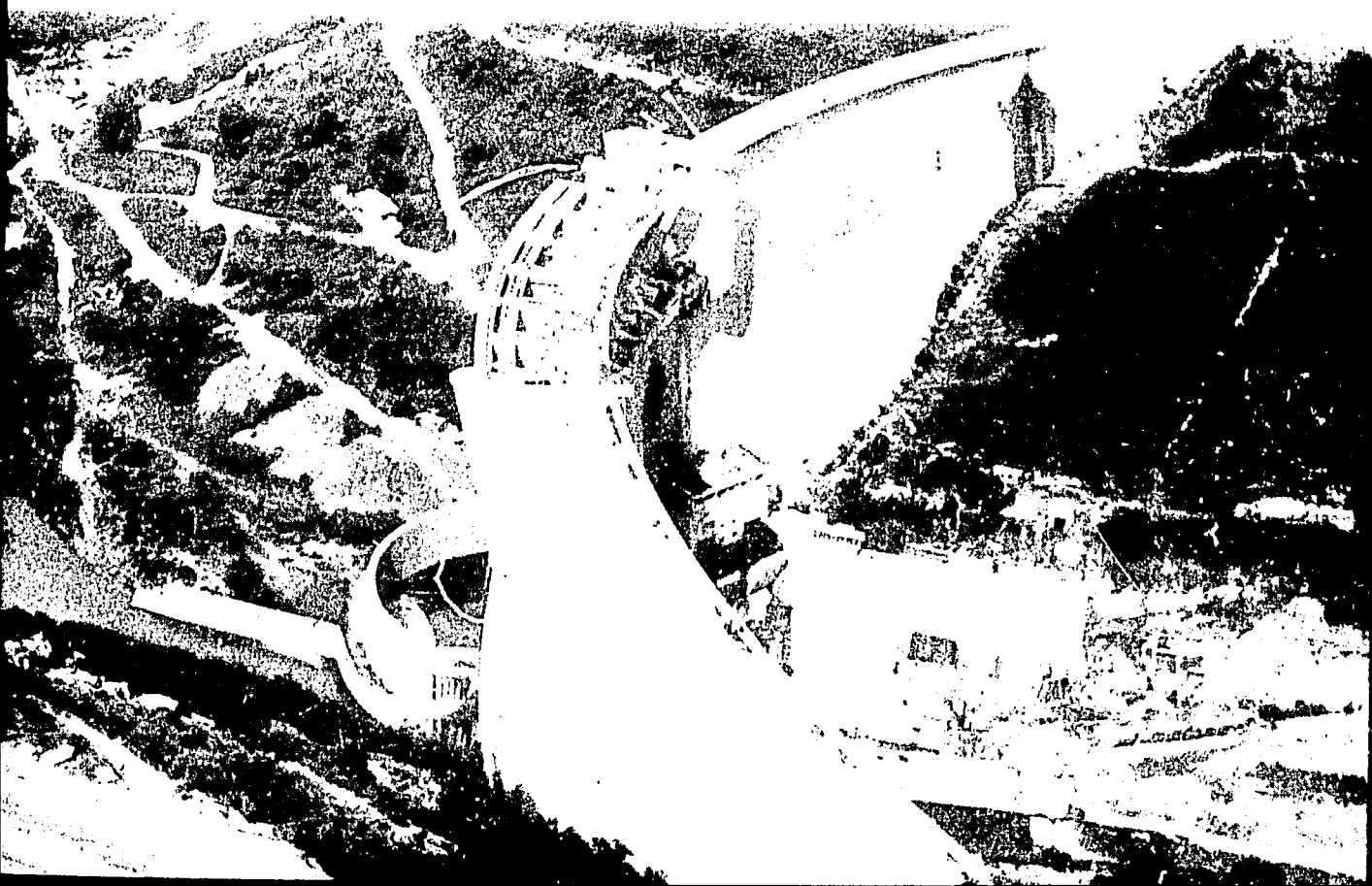
After preliminary analysis to determine the dam geometry and stress distribution, a finite element analysis was carried out to:

(i) Study the structural behaviour of dam under static loading gravity, uplift, hydrostatic and silt.

(ii) Effect of foundation deformability on the magnitude and distribution of

▲ Victoria Reservoir spilling over.

▼ Completed Victoria Dam just before impounding.



stresses in dam and establish a workable range of foundation design parameters.

(iii) Verify that compressive and tensile stresses are within acceptable limits.

(iv) Establish safety against sliding particularly at interface and near foundations.

(v) Determine optimum temperature for grouting of construction joints.

It was concluded as a result of these studies, that the stress pattern within the dam is acceptable over a wide range of foundation elastic moduli and that it would be advantageous to grout the dam at concrete temperatures below ambient, as the subsequent rise in temperature will induce compression and thus reduce tensile stresses in the dam. This would in turn help to improve shear stability conditions. Concrete temperature of 22 C was considered near optimum.

(b) Siesmic loading:

A doubt was raised that the upstream, downstream fault that occurs in the dam foundations in Victoria may be currently active. The matter in regard to siesmicity was therefore reviewed in depth and it was concluded that there is no evidence that the fault at dam site is active or potentially active. A siesmic design factor of 0.1 g used for checking the dam design was therefore considered appropriate, for the observed degree of siesmicity in the area and that this factor, would provide an adequate allowance for a possible increase in this activity following reservoir filling, which itself would be and has now been found to be at a low level.

5. Instrumentation:

In the slender and scientifically designed arch dam, monitoring of its behaviours during operation and concurrent collation of the results is essential, to be able to verify that the dam and the foundations behaviours are consistent with the design assumptions and also with the behavioural analysis.

For this purpose the following instruments have been suitably installed:

Location	Installation
Dam	48 survey targets on the downstream face.
	2 precise survey stations on dam crest.
	24 precise level studs on crest and in galleries.
	7 normal pendula
	66 groups of strain-meters
	66 thermometers.
Foundations	7 inverted pendula
	17 piezometers
	1 extensometer array (triple anchorage)
	5 groups of clinometers (2 per group).

Observations on these instruments are being continuously taken and collated. As a result it has been observed that:

(i) Trend of results are consistent.

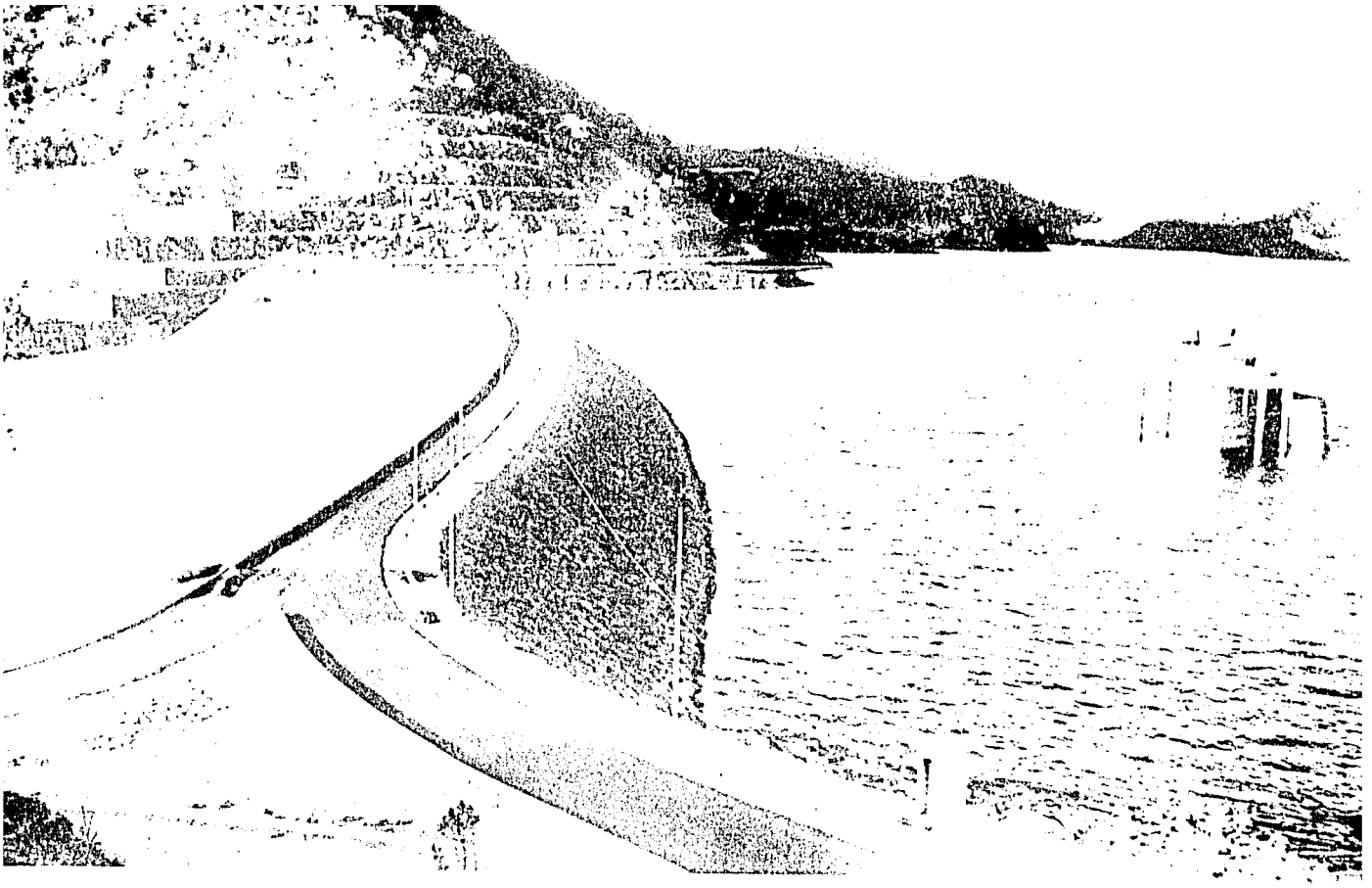
(ii) Deflections are 60% to 75% of predicted values.

(iii) Deflections on left bank are relatively higher presumably due to geotechnical asymmetry and higher deformability of the left bank due to relatively unfavourable rock structure.

(iv) Low deformability in central section may be due to rigidity of spillway cill.

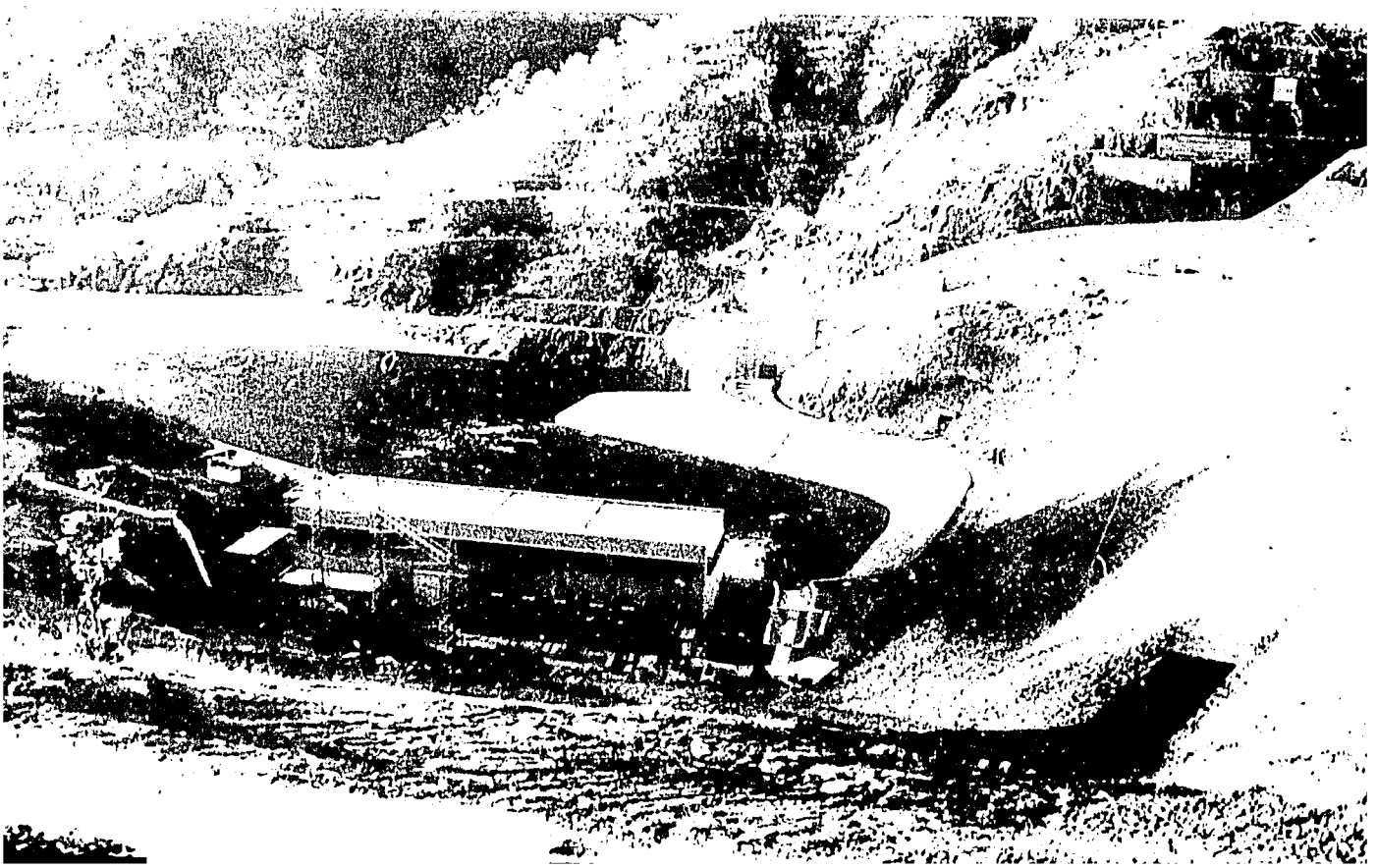
(v) Long term creep effects might bring deflections closer to predicted values.

(vi) Except for some localised under seepage, the leakages are quite contained.



▲ Randenigala the last and the largest of all the reservoirs built under the Accelerated Mahaweli Development Programme.

▼ Randenigala Hydropower Station with an installed capacity of 126 megawatts was constructed at the base of the Dam.



These conclusions are based on observations made during the first six months of reservoir filling.

6. Power Tunnel:

The tunnel is 6.2 diameter circular concrete lined with nominal concrete thickness of 500 mm.

Adoption of circular section and lining thickness have been governed by the existence of very high water-table in the area.

The tunnel was excavated through gently dipping, thickly foliated gneisses, granulites, quartzites and crystalline limestone of pre-Cambrian age. Cavity formation and rock falls took place in certain isolated locations and one major fault and several minor faults were predicted by air photographical interpretation and surface geological mapping. However, another major fault which could not be detected by the above investigations resulted in the realignment of the tunnel route.

Near the outfall end of the tunnel at chainage 5208, very difficult tunnelling conditions were encountered. Probe holes indicated substantial underground water pressures of up to 8 bars and about 245 tonnes of cement was grouted on basis of probe hole data before making the tunnel advance. Yet a major cavity occured at 5208. The tunnel section and the cavity was back-filled with concrete and a careful advance was made across the concrete plug through a pilot heading. Probes beyond the pilot heading indicated continuance of similar poor conditions of rock up to another 40 metres. Tunnelling through this strata would have been very slow and a few more months would have been lost in addition to nearly six months already lost in the above exercise. The alignment of the tunnel was therefore changed so as to skirt the fault zone keeping in view the requirement of adequate rock cover and space for the future second tunnel.

The location of surge tank was also shifted to make concurrent excavation of the surge tank possible and thus gain time on its completion, which had already become critical. As a result of this change, about 100 m. of the already constructed tunnel had to be abandoned but the new alignment reduced the overall tunnel length by approximately 200 m.

Steps to offset the delays caused by the rock flow consisted of:

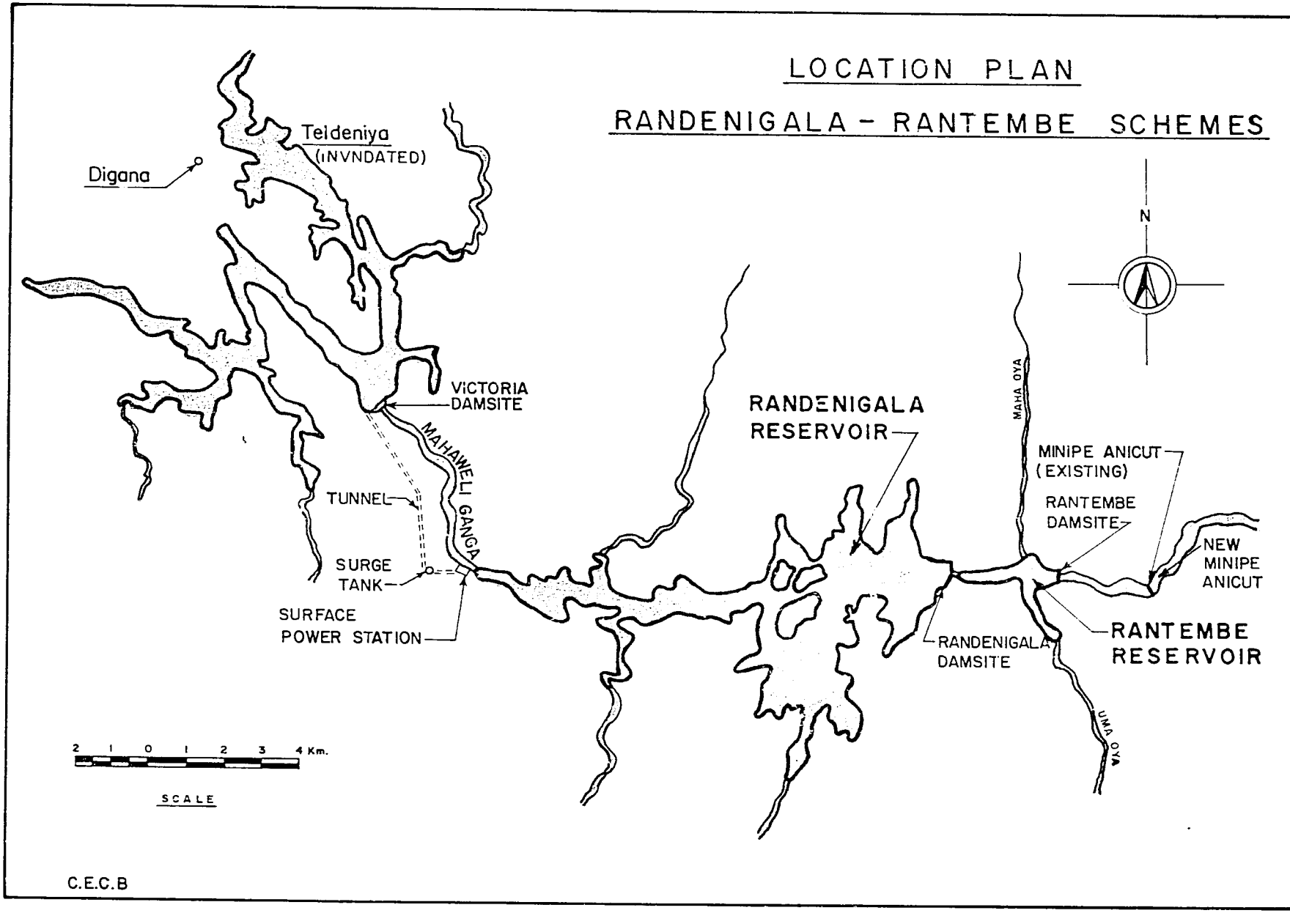
(i) Changing the pattern of blasting to improve the excavated profile.
(ii) Doing away with pattern provision of rock-bolts all over and providing them only where indicated.
(iii) Use of 90 metre long telescopic shutter for lining for continuous concreting operations.

III. RANDENIGALA - RANTAMBE COMPLEX

A - PROJECT FEATURES

Randenigala Dam across Mahaweli Ganga is located about six kilometers upstream of Minipe anicut at the boundary of the wet (1900 mm. and above rainfall) and the dry (below 1900 mm. rainfall) zones. The entire catchment is thus located in wet zone while the project and irrigation areas are in dry zone.

At the dam site, Mahaweli Ganga drains a catchment of 2330 sq. km. with a mean annual run off of 3895 MCM without Polgolla diversion and 3020 MCM with Polgolla diversion. Mean annual discharge with and without Polgolla diversion are respectively 95.8 and 123.5 cumecs. Estimated peak flood is 9750 cumecs and the routed outflow after creation of Randenigala reservoir is estimated to be 8085 cumecs for which the spillway has been designed.


LOCATION PLAN
RANDENIGALA - RANTEMBE SCHEMES
Teldeniya
(INVNDATED)
Digana
N
VICTORIA
DAMSITE
MAHAWELI GANGA
TUNNEL
SURGE
TANK
SURFACE
POWER STATION
RANDENIGALA
RESERVOIR
MAHA OYA
MINIPE ANICUT
(EXISTING)
RANTEMBE
DAMSITE
NEW
MINIPE
ANICUT
RANTEMBE
RESERVOIR
RANDENIGALA
DAMSITE
UMA OYA
2 1 0 1 2 3 4 Km.
SCALE
C.E.C.B

Randenigala is a 94 m. high 485 m. long rock-fill dam with a vertical central clay core; volume of fill in the dam is 3.17 MCM. The reservoir created by the dam has a total storage of 860 MCM with live storage being 800 MCM. The FSL of the reservoir at 232 m. corresponds with the normal tail water level of Victoria about 23 km upstream of the dam.

A gated spillway on the right flank of the dam has a maximum discharge capacity of 8085 cumecs with 3 radial gates of size 16.7 m. wide by 15 m. high. The outflow from the gates is carried in a 62.1 m. wide chute 220 m. long with a flip bucket at the downstream end to throw the discharge away from the permanent works.

A bottom and irrigation outlet of capacity 200 cumecs at retention level of 232 m. is provided in one of the two diversion tunnels.

The power house is located on the left flank and is fed by a steel lined pressure tunnel of 5.80 m. diameter and 330 m. long taking off from a tower intake close to the upstream toe of the dam. The power house has an installed capacity of 2×63 MW (126 MW).

B – SPECIFIC ENGINEERING ASPECTS OF THE PROJECT

1. Height of Dam:

Optimisation studies for Randenigala Dam were done in conjunction with Victoria Dam to determine the most beneficial disposition of Victoria – Randenigala cascade. Several combinations ranging between the so called high Victoria – low Randenigala and low Victoria – high Randenigala were studied, with the FSL of Randenigala corresponding to tail of Victoria in all these studies. Randenigala with FSL at 232 m. in conjunction with high Victoria was found to be the most attractive proposition and has been adopted accordingly. This led to a 94 m. high dam at Randenigala where a dam site suitable topographically and geologically is available on Mahaweli Ganga.

2. Type of Dam:

The project area is built-up from rocks of the pre-Cambrian highland series, represented by two major groups of rocks namely khondalite (metamorphosed sediments) and charnokites (magmatic and volcanic rocks). At the dam site, hard and dominantly massive series of gneisses and granulites strike across the valley with steeply downstream inclined dip. Modestly inclined slopes along the flanks have talus cover of 8 to 12 m. Beneath the talus, weathered rock zone of a few metres changes gradually into zone of slight weathered rock on to fresh rock. Water loss in weathered zones is modest to small and fresh rock below is impervious.

The site is suitable both for embankment and concrete dams. Hollow concrete and rock-fill dams were considered. The latter was found to be 26% cheaper than the concrete dam. This was so because dense core material, which could be used without any processing, was available within 2 km. of the dam on downstream site and excellent rock could be quarried within a few hundred metres of the site.

Rock-fill with concrete membrane was not considered primarily because of the availability of excellent core material nearby and due to the fact that being in a dry zone, the progress of fill was not expected to be perceptibly effected by rains. Moreover, due to difficult transport problems, avoidance of use of cement was considered to be a beneficial and desirable aspect.

3. Schedule of Construction:

The commissioning of Randenigala was foreseen to be in the third quarter of 1986 with a time gap of six weeks between spinning and commissioning. The filling of the reservoir was planned from April 1986. With this schedule, it was later estimated that the reservoir will not fill up to the minimum draw down level by the time spinning was scheduled to start. In the wettest year, the reservoir could just reach MDDL while in average and dry year, it would be 12 & 18 metre below the MDDL (minimum draw down level). With impounding to commence in February 1986 instead of April 1986, there was a reasonable possibility to attain MDDL for the scheduled spinning of the first turbo-generator. To achieve this the construction sequence for bottom and irrigation outlet works was revised and one of the diversion tunnels was allowed to be closed, at the stage when fill of the dam had reached an elevation higher than that required to pass a 100 year frequency flood through one tunnel only. With Victoria already completed and impounded, a close co-ordination and certain operational restrictions on Victoria were temporarily enforced to prevent any unusual man-made flood to pass down to Randenigala during the intervening period.

With this advancement, it was possible to complete the outlet works and close the other tunnel thereafter in February 1986 to commence impounding of Randenigala reservoir.

4. Some features of Engineering interest

(i) The dam axis has been given a convex curve upstream (Radius=4000 m). Of late, this feature has been adopted on a number of embankment dams under the belief that such a configuration will improve stress distribution within the body of dam and result in better interface along abutments. There is no prototype data to establish this postulation. However, if at all, such a feature could be a technical advantage with respect to performance of the dam so it is being adopted though the contractor and the field engineer do not always like it for reasons of problems associated with layout and control of fill contours.

(ii) Coretrench excavated to fresh rock has been subjected to foundation treatment, such as dental concrete and guniting. In addition, the base layer of core material is mixed with 5% bentonite to increase the plasticity of the core material which consists of clayey sand.

(iii) Consolidation grouting of rock below core has been done from an inspection and grouting gallery provided 20 m. below the foundations level. 60 metre deep curtain grouting in a single row of grout holes has also been done from this gallery. The interference of grouting operations with the construction of fill in the dam has thus been totally avoided. Drainage galleries parallel to the flow of river have also been provided in the abutment rock for relief of any pressures if and as they build up.

(iv) A special study was made for ungated spillway in comparison with gated spillway. Since the difference in cost was found to be considerable, gated spillway has been adopted. Spillway has been designed to pass 1000 year flood (4550 cumecs) at FSL with all three gates open and at 2.25 m. above FSL (i.e. at 234.25 m) with one

gate closed. In case of Probable Maximum Flood (PMF) (8085 cumecs) the reservoir level will rise to 236.20 m, with top of dam being at El 239 m. Wave and run up at a wind velocity of 130 km/hr has been estimated to be 1.6 m. This will leave a dry margin of 1.2 metres to crest of dam under PMF condition.

(v) The two outlets in the plug of diversion tunnel No. 2 are each equipped with a radial gate as service gate and a slide gate for emergency use. Radial gate measures 2.4 m.×1.8 m. each and the slide gate 2.6 m.×1.8 m. each. Somewhat larger section at the upstream gate would help suppress cavitation at these installations. The outlet conduit is steel lined along with 50 m. length of downstream channel.

A free flow downstream channel has been formed in continuation of the bottom outlets within the diversion tunnel by partly back-filling the tunnel with rock and concrete lining the surface. A small flip bucket at the end of this free flowing high velocity channel throws the water far enough in the river bed to avoid scour in the vicinity of the outfall structure.

(vi) Since the dam is located at the boundary of wet and dry zones, the catchment being in wet zone, the river diversion works are governed by SW monsoon while the design, planning and construction of works is mainly influenced by dry zone monsoon conditions governed by NE monsoons.

(vii) Rantambe Dam is an essential link of Randenigala complex for balancing the outflow of Randenigala and assuring a uniform regulated flow to Minipe for irrigation purposes. It will be 43 m high dam with a central spillway having four radial gates of size 16 m. wide by 16.4 m. high and 49 MW power station at toe of the dam. Construction of this dam and power house is being taken up now.

IV. MADURU OYA DAM PROJECT

A – PROJECT FEATURES

Maduru Oya Dam has been built across Maduru Oya which drains a catchment of 453 sq. km. at the dam site. This catchment is in dry zone with annual rainfall of less than 1700 mm. The reservoir behind the dam has a gross storage of 597 MCM and live storage of 485 MCM. Natural flow from Maduru Oya is augmented by Mahaweli water, conveyed from Minipe anicut through a transbasin canal to Ulhitiya – Ratkinda reservoirs and then through a 5.4 km. long link tunnel to Maduru Oya reservoir. 50% of the utilisable outflow from Maduru Oya reservoir is from Mahaweli diversion. The reservoir will provide assured irrigation to 46,750 ha of virgin land and 3,750 ha of developed land in System B.

The dam is 43 m. high rock-fill with central clay core with crest at El 103 m. The spillway is ungated and partially lined, with crest at El 96 m. There are two outlet works each of capacity 65 cumecs on either flank for irrigation supplies. The right bank outlet works, discharge from the stilling basin into a 150 m. long bypass tunnel skirting the ancient sluice and remains of a dam, and thence to the right bank canal system. The left bank outlet discharges into a stilling basin and on to the left bank canal system.

Construction involving the two proposed power plants 4.8 MW on left and 2.4 MW on right flank raising the crest of spillway ogee to El. 98 m. and raising the wings of the saddle dams have been deferred for the time being.

B – SPECIAL ENGINEERING ASPECTS

1. The Dam Axis:

Topographically most suitable, the initial axis was located at the same location as an ancient dam whose remains along the right flank still exist. However, considering the importance of preserving these remains, the axis was shifted upstream and aligned in a manner that a major shear zone (under seepage through which may have been the cause of failure of the ancient dam) near the left flank is not daylighted on the upstream of dam into the reservoir.

2. Type of Dam:

Foundation conditions are suitable both for an earth-fill or a rock-fill dam. Rock-fill embankment with clay core was preferred firstly because the earth for fill was available in shallow depths of 1 to 2 metres over a wide expanse of area, making quarrying slow and expensive, and secondly the construction of earthen embankment will be affected much more by rains as compared to rock-fill.

3. Other design features of the Dam:

The dam is 1000 m. long and has a total fill volume of 2.5 MCM. Foundation treatment for the dam consisted of (i) single line grout curtain on centreline of the dam to a nominal depth of 25 m. (ii) Excavation to expose sound rock within the limits of core and filters with surface treatment of joints, cavities and shear zones by dental concrete. (iii) Excavation to acceptable weathered rock under the shells with filter material over the joints and shear zones in the downstream shell only.

Rock-fill in the dam was done in lifts of 1 metre instead of 2 metre originally specified to improve compaction with the available equipment.

Dam crest was raised by 2 metre to accommodate possible future raising of FSL by 2 metres. Raising was achieved by steepening the exterior slopes above El. 93.5 and by reducing the crest width to 8 metres from 10 metres.

The slopes of the dam faces as initially provided were 1:1:8 on upstream and 1:1:5 on the downstream with a 10 m. wide berm at El. 188. In the revised section this berm was eliminated and the downstream face slope flattened to 1:1:6. With this change, the quantity of fill with increased height of dam did not exceed the quantities originally envisaged. Check on stability analysis with revised height and profile showed adequate factors of safety, meeting or exceeding the minimum values recommended by U S Corps of Engineers.

The dam being of moderate height, extensive instrumentation was not indicated. 12 surface monuments, 5 foundation piezometers all installed in the major shear zone near left abutment, 3 embankment piezometers and two seepage weirs were all the measuring devices installed.

4. Right Bank outlet works:

During overburden excavation for the stilling basin and the discharge canal, an ancient Maduru Oya sluiceway was discovered. Alternative proposal to allow this ancient structure of archaeological value to remain undamaged and undisturbed, were made by providing a tunnel in the adjoining hill conducting water from stilling basin to the right bank canal

downstream of the ancient dam and sluiceway.

Since the right bank sluice was also foreseen as a dewatering sluice, its capacity was initially kept as 150 cumecs while the irrigation requirement was only 30 cumecs or so. This would have required a 10 m. diameter tunnel which it was difficult and expensive to make in the low rock cover zone of the adjoining hill. The capacity requirements of the sluice were therefore carefully reviewed and it was considered that an outflow of 65 cumecs could satisfactorily meet the evacuation requirements. Accordingly, a m. metre diameter D – shape tunnel – same as the section of link tunnel – was adopted for expediency of construction.

5. Spillway:

An ungated spillway on left flank with a crest length of 150 metre has been provided. Its location and orientation were modified during construction so as to have the crest, ogee and the collecting basin as much into sound rock as possible. This realigment included incorporating a bend in the spillway crest to ensure sound rock contact at the left end of the spillway. Energy from the flow is dissipated in a 54 m wide by 56 m. long stilling basin from which it flows along a 50 m. wide discharge channel back to Maduru Oya.

6. Quarry:

Initially quarrying the rock from left flank to provide space for spillway was envisaged. However, at the start of excavation, it started getting apparent that the ratio of waste to usable rock in spillway quarry area will be too high due to deeper weathering than expected. This quarry was abandoned and a new quarry in reservoir area was established. This had the twofold advantage of allowing only minimum necessary excavation to be done for spillway and of having quarry operations independently in an area away from the dam construction thus avoiding mutual interference.

7. Scheduling of works for completion:

Due to various modifications and variations in the scope of work, the contractor wanted extension of time for completion. However, a careful review of his construction schedule indicated a recess period allowed by him during monsoon. It was insisted upon the contractor to work through the monsoon and attempt to meet the original schedule of impounding to commence prior to 1982–83 monsoon in October 1982. In turn, it was agreed that should rain induced delays total more than 30 days during any one monsoon period, the contractor would be allowed extension corresponding to such excess delays. The objective of impounding in 1982–83 monsoon run off was thus achieved.

DOWNSTREAM INFRASTRUCTURE DEVELOPMENT

The fundamental objectives of the Accelerated Mahaweli Development Programme (besides the provision of hydro-electric power) are to increase agricultural production, to create employment and to settle as many farmers as possible as is compatible, with the effective use of the available land and water, and with the assurance of a good life for the settlers and their families. The planning, design and execution of the numerous activities involved in the processes necessary to achieve these objectives is commonly referred to as 'Downstream Development'. This development (in selected areas or "Systems") together with the construction of the main reservoirs of Kotmale, Victoria, Maduru Oya, Randenigala and Rantambe, are the main components of the Accelerated Mahaweli Project.

Whilst the construction of the main reservoirs referred to earlier is being done by foreign contractors and consultants, (with the Central Engineering Consultancy Bureau as counterpart local consultants), the execution of all downstream development activities is being handled by the Mahaweli Engineering & Construction Agency (MECA) with funds provided through the Mahaweli Authority of Sri Lanka. The MECA is managed entirely by Sri Lankan engineers, with the employment of foreign consultants only for specific projects, where the relevant funding agencies require the engagement of such consultants as a condition of funding.

2. The MECA

The MECA, with its Head Offices in Colombo, administers the organisation through Resident Project Directors – one for each "System". The present Resident Project Directors are located at Thambuttegama (System H), Dehiattakandiya (System C) and Welikanda (System B). The Head Office comprises, besides the Chairman and Deputy Chairman, separate Directors in charge of Finance, Personnel, Administration, and in charge of the various Projects managed by the organization.

In the development areas the management is decentralised to Divisional Resident Engineers and Resident Engineers. The total regular cadre of the MECA is about 3000 employees both in the Head Office and in the work sites. The MECA also administers the Mahaweli Architectural Unit (MAU) located at Digana near Kandy, which handles all the architectural work involved in the planning of the new Mahaweli Townships and in the development of social infrastructure buildings under the Mahaweli Programme.

3. Outline of Activities

The main activities in downstream development can be outlined as follows:–

(i) planning the development areas in relation to the availability of water in the System, as well as other relevant data such as soil types and topography;
(ii) planning the requirements of social and irrigation infrastructure in the development areas;
(iii) design and construction of all buildings, roads and irrigation infrastructure required for the new settlements.

4. Irrigation Development

Development of the newly irrigated lands is based mainly on the settlement of farmers, transferred from over-populated regions of the country. The main contingent of the relocated population will be farmers on small holdings (1 ha irrigated land). A smaller number of settlers are proposed for medium sized farms on which specialised cultivation of high value crops is envisaged. Larger plantations are also proposed for highly mechanised production of crops like cotton and sugar-cane.

The area to be irrigated under the Project will be issued with water by means of:

(a) Transbasin diversions and conveyance canals from the Headworks to major reservoirs in the development areas, and
(b) Irrigation networks consisting of main, distributary and field canals.

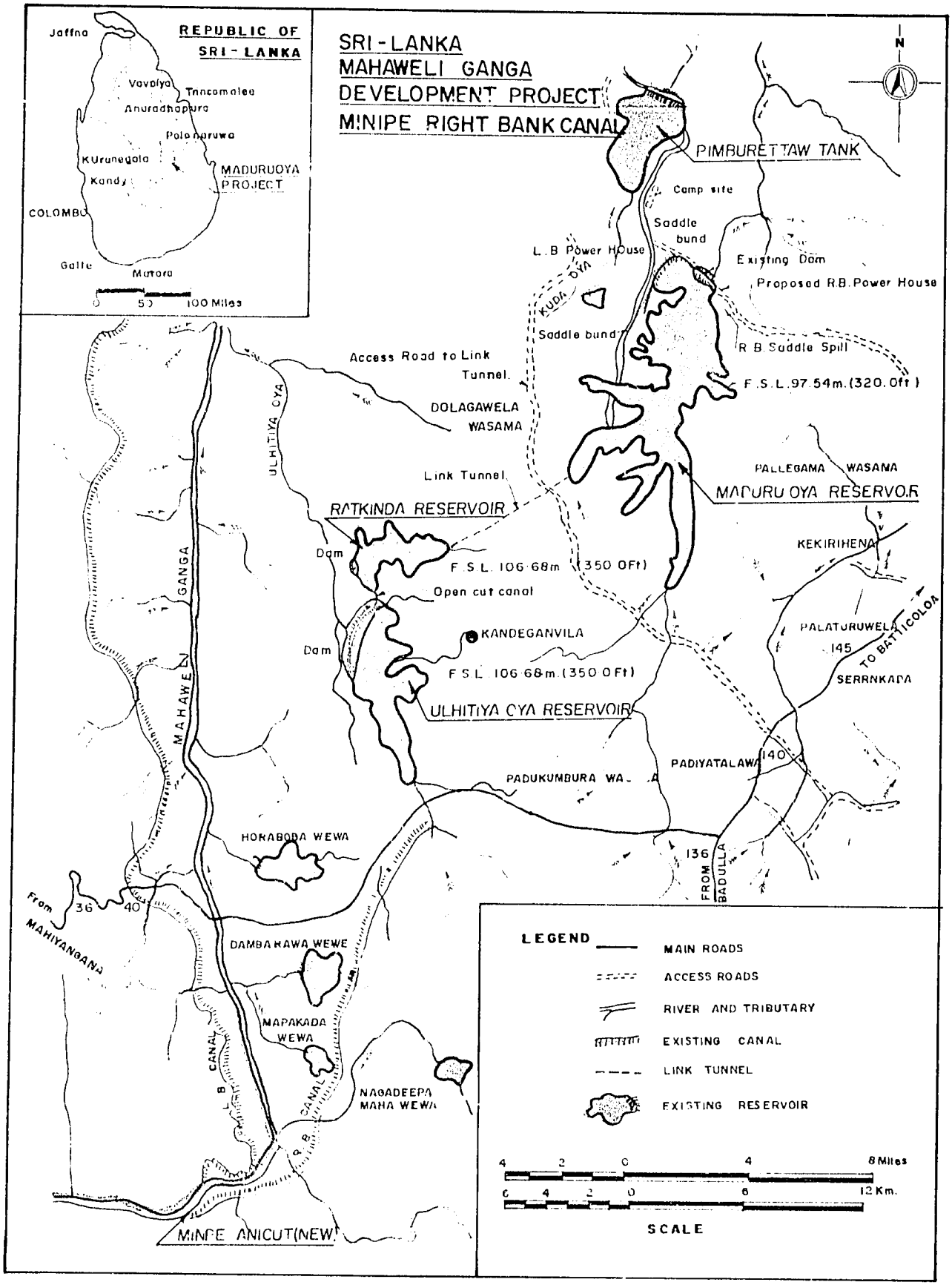
The transbasin diversions under the Project are at Polgolla and at Minipe. At Polgolla, the Mahaweli waters are diverted to the Ambanganga and from there to Kala Oya, to the Anuradhapura city tanks, to Huruluwewa, Elahera and Angamedilla. A total of about 53,500 ha. (132,000 acres) of existing paddy lands were benefitted by this diversion and enabled the farmers in these areas to have two assured crops per year.

In addition to these existing areas, 28,800 ha. (71,000 acres) of new paddy lands were opened up under Kandalama and Kalawewa Reservoirs. To cultivate these new acres, about 25,000 families were settled. The total area covered by the diversion to Kala Oya is known as "System H".

At Minipe, the Mahaweli is diverted along the 31 km long Transbasin Canal, to feed about 6070 ha (15,000 acres) of existing paddy land on the Left Bank and to transfer water to the recently constructed Ulhitiya–Ratkinda and Maduru Oya Reservoirs on the Right Bank, to feed an estimated 50,000 ha (120,000 acres) of new paddy lands in Systems B & C. The irrigable area under Maduru Oya Reservoir, known as System B, is partly in the Polonnaruwa District and partly in the Batticaloa District. System C is the area on the Right Bank of Mahaweli, north of Mahiyangana.

The irrigation canal network to feed individual land holdings could be broadly categorised into three levels: Main, Secondary, and Tertiary.

Main and Branch Canals, falling within the first category, form the main supply source for the area. These generally run along contours fixed by the command level of the reservoir outlets. Distributary Canals form the secondary level and take off from the Main and Branch Canals. They are designed to run along ridges of smaller catchments or contours, as determined by the topography. Field Canals form the tertiary level and generally run down the main slope of the catchment. The area irrigated by the field canal is about 20 hectares and is called a "turn-out area". The boundaries of the turn-out area are either natural valleys or artificial drains and are fixed so as to limit the extent irrigated to about 20 hectares. The capacity of the field canal is designed to


REPUBLIC OF SRI - LANKA
Jaffna
Vavuiya
Trincomalee
Anuradhapura
Polonnaruwa
Kurunegala
Kandy
MADURUOYA PROJECT
COLOMBO
Galle
Matara
0 50 100 Miles
SRI - LANKA
MAHAWELI GANGA
DEVELOPMENT PROJECT
MINIPE RIGHT BANK CANAL
N
PIMBURETTAW TANK
Camp site
Saddle bund
L.B Power House
KUDA OYA
Existing Dam
Proposed R.B.Power House
Saddle bund
R.B Saddle Spill
F.S.L.97.54m.(320.0ft)
Access Road to Link Tunnel.
DOLAGAWELA WASAMA
ULHITIYA OYA
Link Tunnel
PALLEGAMA WASAMA
MADURU OYA RESERVOIR
RATKINDA RESERVOIR
Dam
F.S.L. 106.68m (350 OFt)
KEKIRIHENA
Open cut canal
KANDEGANVILA
Dam
F.S.L. 106.68m.(350.0 Ft)
PALATURUWELA
145
TO BATTICOLOA
SERRNKADA
ULHITIYA OYA RESERVOIR
PADIYATALAWA
140
PADUKUMBURA WA
HORABODA WEWA
136
FROM BADULLA
From MAHIYANGANA
36
40
DAMBAHAWA WEWE
MAHAWELI GANGA
MAPAKADA WEWA
L.B CANAL
R.B CANAL
NAGADEEPA MAHA WEWA
MINIPE ANICUT(NEW)
LEGEND
MAIN ROADS
ACCESS ROADS
RIVER AND TRIBUTARY
EXISTING CANAL
LINK TUNNEL
EXISTING RESERVOIR
4 2 0 4 8 Miles
6 4 2 0 6 12 Km.
SCALE

be 30 litres/second (l/s) (l cusec), which is the peak irrigation requirements.

The provision of irrigation facilities necessitates the corresponding provision for proper drainage of irrigated lands. In each irrigation system, therefore, farm drainage ditches are led into tertiary drains which form boundaries of the turn-out areas. These are connected to secondary drainage lines, which in turn, will discharge into the existing (natural) main drainage in the area.

5. Social Infrastructure

The new development activities are located mainly in jungle areas which are being cleared for the new settlements. Thus, the opening up of new lands for irrigated agriculture, means the corresponding development of a series of new hamlets, villages and towns, as well as the planning and construction of a network of new roads, connecting up the numerous new settlement centres with each other, as well as to the main national highway system.

The new settlements require thousands of new buildings to provide facilities for the functioning of schools, hospitals, post offices, police stations, co-operatives, service centres, commercial centres and other public buildings.

Besides, the housing of a large army of officers and employees of the Mahaweli Authority, and of the various Government Departments and Corporations that would necessarily have to service the new settlements is a formidable task.

6. System H

In addition to the provision of supplementary irrigation water to the 132,000 acres of existing paddy lands, benefitted by the transbasin diversion at Polgolla, the irrigation infrastructure development in the entire 60,000 acres of new paddy lands in System H has been completed. In addition, a total length of about 81 km (50 miles) of main roads has been metalled and tarred. For the provision of social infrastructure, over 2000 new buildings have been constructed.

7. System C

(a) Provision of irrigation facilities

System C comprises about one half of the downstream development area to be served by the Victoria Dam Project, a principal component of the Accelerated Mahaweli Programme. The water diverted from the Mahaweli river through the Minipe Transbasin Canal, to the Ulhitiya-Ratkinda twin reservoir complex, will be utilised to irrigate the area under System C, comprising an irrigable area of about 23,000 ha in six "Zones". The Ratkinda main canal with a capacity of 50 m^3/sec. feeds zones 3 to 6 (about 17,800 ha in extent) whilst the Ulhitiya main canal with a capacity of 11 m^3/sec. feeds the area under Zone 2 (about 4,200 ha in extent).

Zone 1 consists of about 1300 ha of developed land fed by existing irrigation systems, outside the Accelerated Mahaweli Programme. These existing systems, however, have now been augmented with water from the new Minipe Transbasin Canal.

The Table on next page shows the position regarding provision of irrigation facilities up to October 1986:

System 'C'

The Ratkinda Canal complex feeding Zones 3 to 6 comprises a Main Canal (14.5 km) a number of Branch Canals (totally about 100 km) and about 14 minor reservoirs. This complex would cost nearly Rs. 1000 million at completion. The construction is being done by a Japanese Joint Venture, Hazama-Toda-C Itoh. The work is supervised by the MECA with the assistance of Japanese Consul-

▲ Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development and Mr. Robert Chase, Resident Representative of USAID participated at the opening ceremony of the new Canal carrying water to Dimbulagala area in System 'B' District Minister Trincomalee, H. G. P. Nelson and District Minister Polonnaruwa, A. D. B. Ekanayake are also present.

▼ The new Field Canal from the Maduru Oya Left Bank Main Canal to irrigate lands in Dimbulagala area was ceremonially opened by the Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake by pouring of milk into the waters of the canal.

System 'C'

Zone	Irrigable area (ha)	Irrigation facilities provided (up to 1986)	Remarks
1	1320	1320	Completed
2	4200	4200	Completed
3	2800	2800	Completed
4	10000	4000	Balance acreage scheduled for delivery by end 1987
5	2700	–	Scheduled for delivery by end 1988.
6	2300	–	
	23320	12320	

tants, Nippon Koei Co. Ltd. Phase I of the works, consisting of the Main Canal (0.5 to 3.2 km) Branch Canal No. 1 and Minor Branch Canal No. 1/304, has been completed and water was issued to Zone 3 for the 1984/85 Maha cultivation. Construction works for Phase II and Phase III which covers water issue to Block 401, 402, 403 & 411 were completed in May 1986. The completed sections of this canal complex has now issued water for about 7000 ha of new lands in Zones 3 & 4. The remaining canals in this System are scheduled for completion by September 1988.

(b) Japanese pilot demonstration farm

The farm is located within Zone 3 and is 673 ha. in extent. The irrigation infrastructure development was done out of funds provided as a Grant by the Government of Japan, and completed in 1984.

The main purpose of the project was to provide a pilot demonstration farm, having adequate irrigation and drainage facilities to demonstrate:

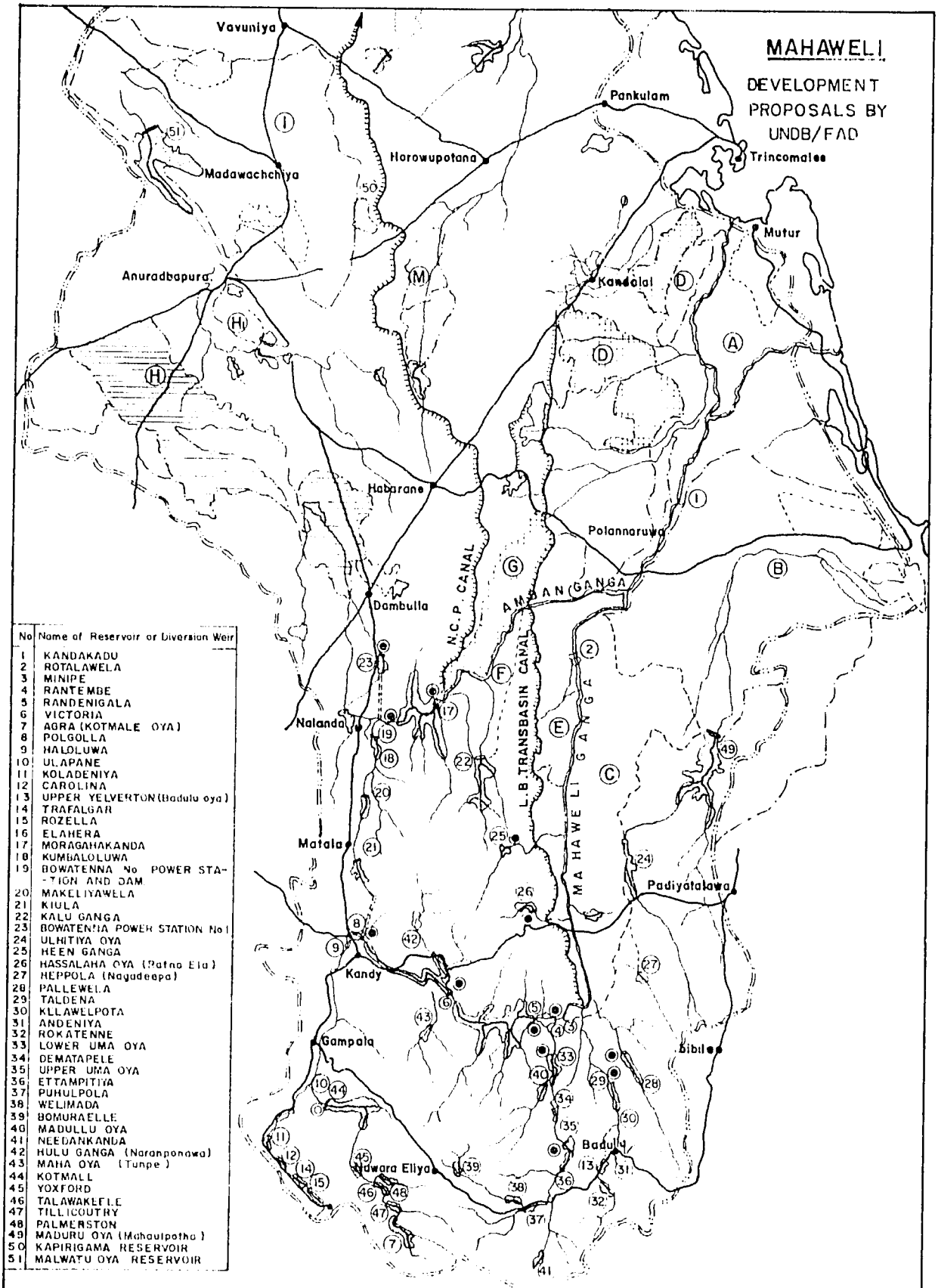
(i) New techniques of land development for maximising water use.
(ii) Minimising water losses,
(iii) Crop diversification.

The construction work on the irrigation and drainage systems was done by a Japanese Contracting Firm, at a cost of about 900,000,000 Japanese Yen. The construction work was supervised by another Japanese Consultancy Firm, Nippon Koei Co. Ltd, in association with MECA.

(c) Buildings

The new settlements in System C will require over 2500 new buildings as there does not exist any facilities in this area. These buildings are required for the 2 new townships at Girandurukotte and Dehiattakandiya, and for the 9 area centres, 26 village centres and 65 hamlet centres that have been planned.

In the new town at Girandurukotte (in Zone 2) a 50 bed Hospital, a modern Police Station, a well equipped Development Centre, a Senior Secondary School, Banks and many other public buildings have been built and are already in use. In addition, a modern Shopping Complex and a Water Supply Scheme have just been completed. A modern Sports Complex with all facilities is being planned and construction work is due to commence shortly.



No	Name of Reservoir or Diversion Weir
1	KANDAKADU
2	ROTALAWELA
3	MINIPE
4	RANTEMBE
5	RANDENIGALA
6	VICTORIA
7	AGRA (KOTMALE OYA)
8	POLGOLLA
9	HALOLUWA
10	ULAPANE
11	KOLADENIYA
12	CAROLINA
13	UPPER YELVERTON (Badulu oya)
14	TRAFALGAR
15	ROZELLA
16	ELAHERA
17	MORAGAHAKANDA
18	KUMBALOLUWA
19	BOWATENNA No POWER STA-TION AND DAM
20	MAKELIYAWELA
21	KIULA
22	KALU GANGA
23	BOWATENNA POWER STATION No1
24	ULHITIYA OYA
25	HEEN GANGA
26	HASSALAHA OYA (Ratna Ela)
27	HEPPOLA (Nagadeepa)
28	PALLEWELA
29	TALDENA
30	KELLAWELPOTA
31	ANDENIYA
32	ROKATENNE
33	LOWER UMA OYA
34	DEMATAPELE
35	UPPER UMA OYA
36	ETTAMPITIYA
37	PUHULPOLA
38	WELIMADA
39	BOMURAELLE
40	MADULLU OYA
41	NEEDANKANDA
42	HULU GANGA (Naranponawa)
43	MAHA OYA (Tunpe)
44	KOTMALL
45	YOXFORD
46	TALAWAKELLE
47	TILLICOUTRY
48	PALMERSTON
49	MADURU OYA (Mahaulpotha)
50	KAPIRIGAMA RESERVOIR
51	MALWATU OYA RESERVOIR

The other big town in System C, at Dehiattakandiya (in Zone 4) is under construction and work is progressing rapidly. All the facilities available in any modern town – and more – will be provided at Dehiattakandiya. The buildings are being planned to have a distinctive and modern architectural look, in keeping with the environment. Already, more than 200 buildings for the new town have been constructed. The entire building programme is scheduled for completion by the end of 1988.

As regards the building programme for the Area Centres, Village Centres and Hamlet Centres, all the buildings in Zones 2 & 3 have been completed. In Zone 4, the largest in the System, about 600 buildings have already been completed out of a total of an estimated 1000 buildings. In Zone 2, 3 & 4, a total of 44 schools have been built already and most of them are now in operation.

(d) Roads

Besides the new Trunk Roads that are being built with assistance from the Asian Development Bank (described separately below) about 200 km of new roads have been planned. Of this, nearly 150 km of new roads have already been completed.

8. System B

(a) Provision of irrigation facilities

Irrigation facilities under System B will be provided for a net area of about 45,000 ha. Of this extent, about 30,000 ha are on the Left Bank of the Maduru Oya and the remaining area is on the Right Bank. Water issues to System B are from the newly constructed Maduru Oya Reservoir. This reservoir is augmented by the Mahaweli waters diverted at Minipe, and delivered via the Minipe Transbasin Canal and the Ratkinda – Maduru Oya Link Tunnel, taking off from the Ratkinda Reservoir.

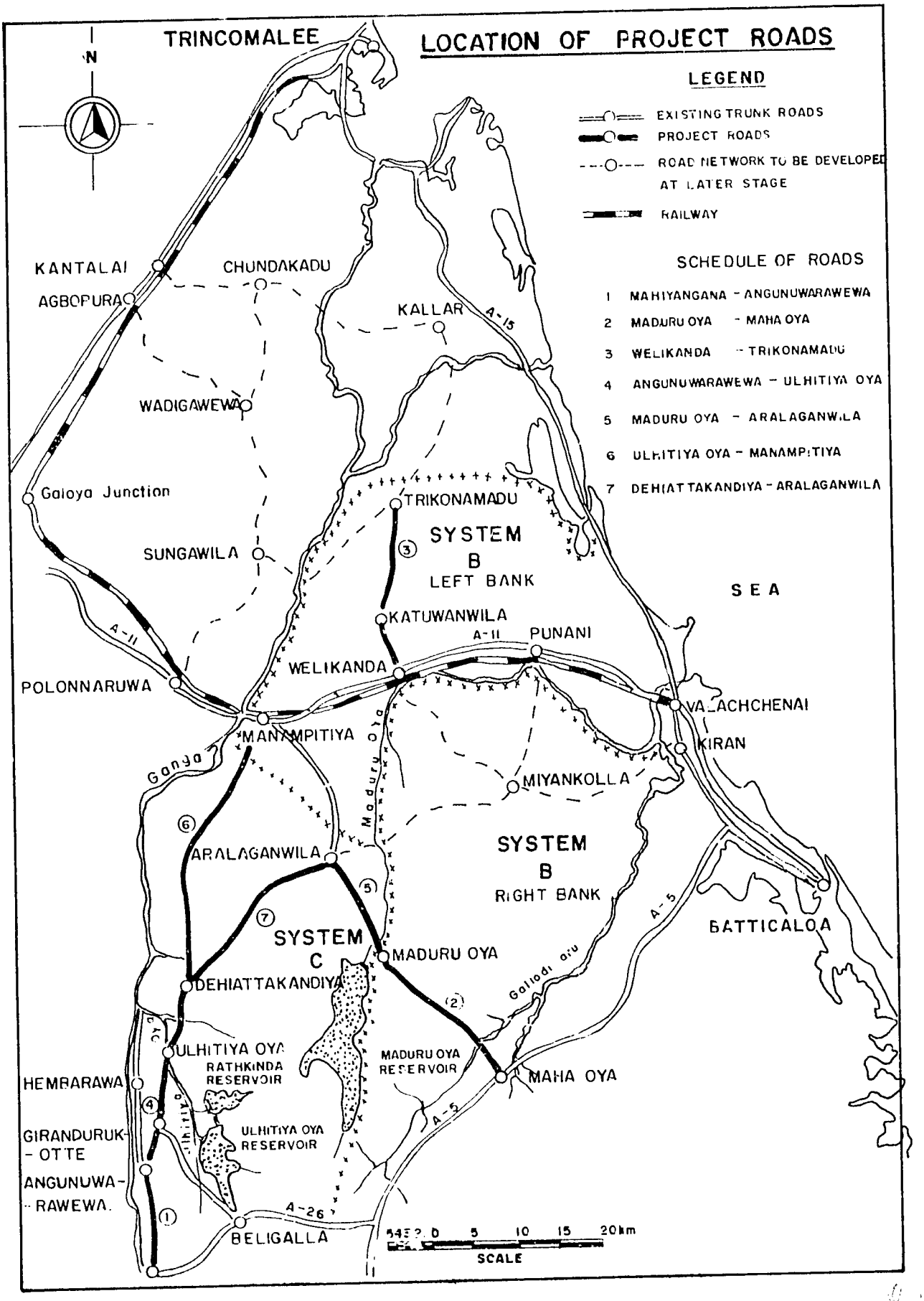
Left Bank Area

The Left Bank area of about 30,000 ha made up of 6 Zones, is fed through a concrete-lined Main Canal about 53 km long, together with concrete-lined Branch Canals of a total length of about 85 km.

This package of Main and Branch Canals, with the appurtenant structures like bridges, syphons, canal outlets, and drainage crossings, is being constructed by the American Joint Venture of Zachry–Dillingham. Another American Joint Venture Consulting Firm, BERGER/IECO in association with Resources Development

System 'B'

Zone	*Approximately irrigable area (ha)*	*Irrigation facilities provided (up to 1986)*	*Remarks*
1	6100	3600	(Balance area will receive water in Yala 1987)
2	6100	—	Scheduled for completion by October 1988.
3	2900	—	
4A	7300	—	Design work in hand.
4B	2100	—	
5	5500	4000	Balance area will receive water by October 1987.
	30,000	7600	


LOCATION OF PROJECT ROADS
N
TRINCOMALEE
LEGEND
EXISTING TRUNK ROADS
PROJECT ROADS
ROAD NETWORK TO BE DEVELOPED AT LATER STAGE
RAILWAY
SCHEDULE OF ROADS
1 MAHIYANGANA - ANGUNUWARAWEWA
2 MADURU OYA - MAHA OYA
3 WELIKANDA - TRIKONAMADU
4 ANGUNUWARAWEWA - ULHITIYA OYA
5 MADURU OYA - ARALAGANWILA
6 ULHITIYA OYA - MANAMPITIYA
7 DEHIATTAKANDIYA - ARALAGANWILA
KANTALAI
CHUNDAKADU
AGBOPURA
KALLAR
A-15
WADIGAWEWA
Galoya Junction
TRIKONAMADU
SYSTEM B LEFT BANK
SUNGAWILA
SEA
KATUWANWILA
A-11
PUNANI
POLONNARUWA
WELIKANDA
VALACHCHENAI
MANAMPITIYA
KIRAN
Ganga
Maduru Oya
MIYANKOLLA
ARALAGANWILA
SYSTEM B RIGHT BANK
SYSTEM C
MADURU OYA
BATTICALOA
A-5
DEHIATTAKANDIYA
Galoda oya
ULHITIYA OYA
RATHKINDA RESERVOIR
MADURU OYA RESERVOIR
HEMBARAWA
MAHA OYA
GIRANDURUK-OTTE
ULHITIYA OYA RESERVOIR
ANGUNUWA-RAWEWA
A-26
BELIGALLA
SCALE
0 5 10 15 20km

Consultants Ltd. of Sri Lanka, are engaged in the supervision of this contract under the direction of the MECA. This contract about US Dollars ($) 92 million in value, was awarded in 1982. Work is now nearly complete.

The tertiary irrigation systems consisting of over 600 km of Distributary Canals and over 1500 km of Field Canals. has been almost completed in Zones 5 & 1. Work in Zones 2 & 3 are about to commence. Work in Zone 4 is due to commence in 1987. A total of about 7600 ha will have been delivered with water at the end of 1986. The following Table gives the position regarding provision of irrigation facilities to new lands up to October, 1986:

Right Bank Area

The Right Bank Project would enable the development of about 15,000 ha for irrigated agriculture. The Right Bank Main Canal has already been constructed up to a distance of 1.7 km and the NDK Dam, 2.5 km in length, is also completed.

Balance work on the Main Canal (47 km in length) and approximately 100 km of Branch Canals are expected to be given out on contract in 1987. Approximately 333 km of Distributary Canals and 800 km of Field Canals will comprise the irrigation tertiary network serving the 3 zones (6. 7 & 8) on the Right Bank.

(b) Buildings

The Settlement Programme for System B will require about 5000 new buildings. These buildings will be scattered in the 4 new townships of Welikanda, Siddhapura, Manampitiya and Randiyanuwara and in the 17 area centres, 14 village centres and 130 hamlet centres to be built on both banks of the Maduru Oya. Upgrading the existing town centre at Aralaganwila has also been included.

In the new town at **Welikanda** all facilities will be provided to enable it to serve as the principal town in System B. Amongst these will be, modern water supply and sewerage disposal schemes on which work will commence at the beginning of 1987. A new road is also being built to connect Welikanda to Randiyanuwara, on the right bank, with a bridge across the Maduru Oya.

New buildings planned for System B include hospitals, schools and other public buildings, as well as housing for the employees of the Mahaweli Authority, and the large number of Government Departments and Corporations that would be servicing the settlers. Of this building programme about 1500 buildings have already been completed and a large number are presently under construction.

(c) Roads

Over 400 km of new roads have been planned for the System B area, on both banks. Of this, 113 km have already been completed and 105 km are under construction.

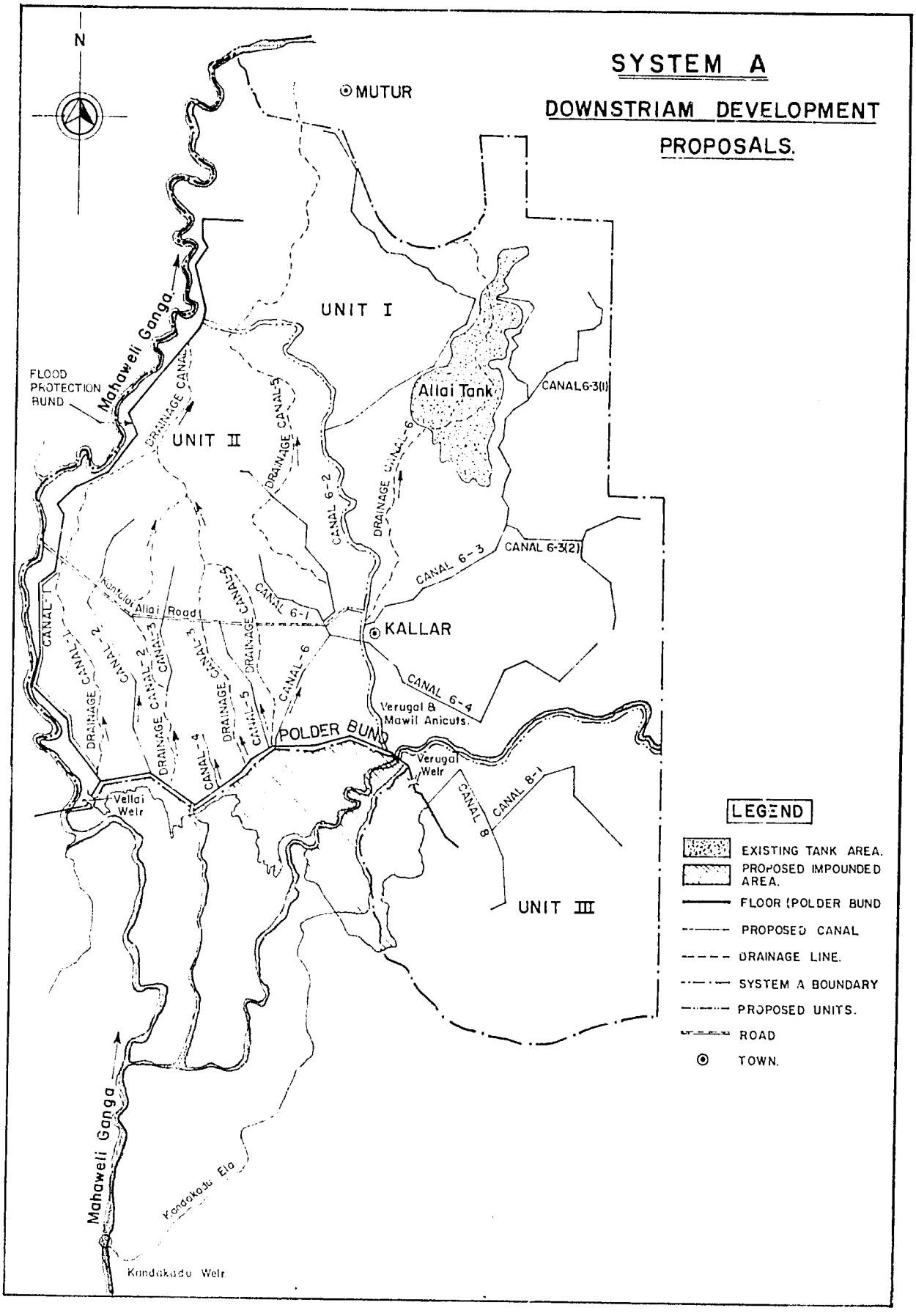
9. System G

This area covers a gross area of about 8500 ha and lies in the Polonnaruwa District.

It includes the old Elahera colony for an irrigable area of about 2200 ha settled in 1947. The new area to be developed lies between the old colony and the Amban Ganga, and covers a nett irrigable area of about 3000 ha. The Department of Irrigation, functions as the implementing agency for this project and is engaged in the design and construction supervision for the civil works.

The development work being done in this System can be broadly classified as follows:

(a) improving the existing irrigation scheme at Elahera;


SYSTEM A
DOWNSTRIAM DEVELOPMENT PROPOSALS.
N
MUTUR
UNIT I
UNIT II
UNIT III
Mahaweli Ganga
FLOOD PROTECTION BUND
DRAINAGE CANAL
Allai Tank
CANAL 6-3(1)
CANAL 6-2
CANAL 6-3
CANAL 6-3(2)
CANAL 6-4
CANAL 6-1
KALLAR
Kantalai Allai Road
CANAL 1
CANAL 2
CANAL 3
CANAL 4
CANAL 5
CANAL 6
POLDER BUND
Verugal & Mawil Anicuts.
Verugal Weir
Vellai Weir
CANAL 8
CANAL 8-1
Kondakadu Ela
Kondakadu Weir
LEGEND
EXISTING TANK AREA.
PROPOSED IMPOUNDED AREA.
FLOOR (POLDER BUND
PROPOSED CANAL
DRAINAGE LINE.
SYSTEM A BOUNDARY
PROPOSED UNITS.
ROAD
TOWN.

(b) development of the new area to be opened up for irrigated agriculture;
(c) providing social infrastructure facilities for the new settlements.

Provision of a new Head Sluice Gate for the Elahera intake was completed in 1985 under the supervision of the MECA. The Irrigation Department is providing improved irrigation facilities to the existing area, making necessary modifications to the old irrigation canal network. A new trunk road will be constructed through the development area, which will shorten the distance from Elahera to Diyabeduma by about half.

10. System A

System A is situated on the lowest reach of the Mahaweli River, extending some 70 km from Kandekadu to the river mouth in Koddiyar Bay. It lies within the administrative districts of Trincomalee, Batticaloa and Polonnaruwa. The southern boundary of this area adjoins System B and the western boundary adjoins System D. The area to be developed lies on both banks of the Mahaweli and the potential irrigable area may be nearly 30,000 ha. The CECB has prepared engineering designs for the Headworks at Kandakadu, and some other studies have already been done on this Project. However, no final proposals have been formulated so far.

The Government of the U.S.S.R. recently sent a high-powered mission to Sri Lanka to study this project, with a view to undertaking the development of this System. All indications are that the Soviet Government will be financing this Project and will commence detailed investigations shortly, with a view to finalising firm proposals.

11. Trunk Roads in Systems B & C

In addition to the large number of internal roads that are being constructed in Systems B & C, a total length of 154 km of new trunk roads are being built to provide fast access through the entire project area, and will facilitate the efficient movement of goods and people to and from the region. This programme is being financed by the Asian Development Bank and is scheduled for completion by end of 1987.

The roads coming under this programme are as follows:

Mahiyangana – Ulhitiya Road	– 24 km
Ulhitiya – Manampitiya Road	– 50 km
Maha Oya – Maduru Oya Road	– 24 km
Welikanda – Trikonamadu Road	– 22 km
Aralaganwila – Maduru Oya Road	– 15 km
Dehiattakandiya – Aralaganwila Road	– 19 km

These roads will have a bituminised surface of 5.5 m and will be constructed to Grade A standards. Construction work is being carried out by two Contractors, the State Development and Construction Corporation (S.D. & C.C.) and Keangnam Enterprises Ltd. The supervision of construction is by the MECA with the assistance of a Consultant from the Snowy Mountains Engineering Corporation, Australia.

CONSERVATION OF ENVIRONMENT

Most Third World countries are now actively pursuing the construction of large dams and associated irrigation systems as part of their socio-economic development. The Accelerated Mahaweli Development Programme, is the focus of the island's present strategy towards finding a large-scale technological solution, to Sri Lanka's increasing food, employment and energy requirements. It involves the development of intensive, year-round irrigated agriculture, transbasin diversion of water and the resettlement of people in presently forested areas, in the dry zone of the country.

Unfortunately, water resource development projects are usually associated with wide ranging ecological and environmental problems. Although some of this damage could be easily avoided or at least adequately compensated by proper planning, in the past narrowly focussed planning, bent on supplying irrigation water and energy alone, largely ignored the environmental concerns of water related development projects in the country. Such a prospect therefore underscores the need for environmental analysis and planning in the Mahaweli Development Programme.

Environmental Assessments

In view of the importance of the Mahaweli Development Programme towards socio-economic development in Sri Lanka, such environmental changes had to be reduced to acceptable limits, in order to retain the economic stability that was desired. The Government sponsored a series of studies to address the environmental concerns of the programme. Initial environmental assessments of the impacts were made as part of feasibility studies, conducted for each of the individual, irrigation and reservoir projects under the Accelerated Programme.

However, these studies were of a very preliminary nature and served only to highlight, major environmental issues relevant to the individual projects.

Subsequently, the Government commissioned a more comprehensive Environmental Impact Assessment (EIA) of the entire Accelerated Development Programme. Unlike the previous studies, this assessment was conducted with the entire river basin being considered as a single environmental unit, and all environmental issues were addressed to the river basin itself, and not isolated on a project by project basis. It also enabled an evaluation of cumulative environmental impacts common to all irrigation systems. Similarly, project impacts which could be relevant to surrounding areas, as well as those involving the upstream Mahaweli watershed was also addressed. This study provided a valuable tool for the planning and management of the natural systems

within the Accelerated Programme. It consisted of a detailed analysis of the development programme, on the terrestrial, aquatic and human environments pertinent to the project, and provided useful guidelines and recommendations for minimizing adverse impacts and enhancing beneficial aspects of the proposed development.

Subsequently, the Government negotiated an action plan for management of the Mahaweli environment. The objective was to devise an implementation plan for specific mitigation, protection and enhancement measures of the environment, in the Mahaweli areas. This Plan presents in detail how these measures should be designed and operated, the resources required and the schedule of implementation.

At present, components of this Plan are in various stages of implementation, each being pursued by the relevant Government Agencies. Progress has been notable in relation to wildlife conservation, fuel wood plantation and forest conservation, and fish farming.

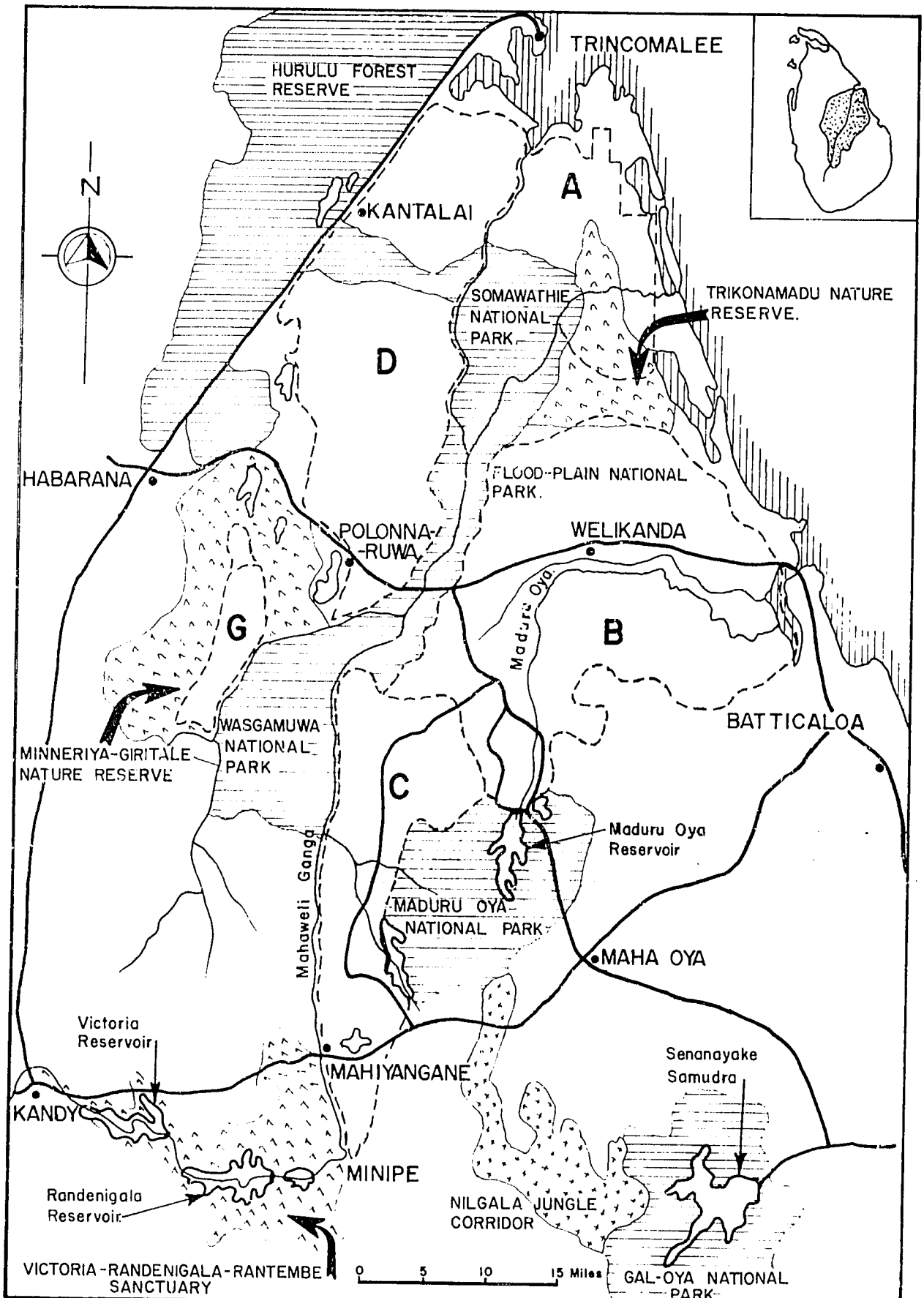
Wildlife Conservation

The forested area in the lower Mahaweli basin represents one of the richest and most diverse wildlife habitats in the dry zone of the country. The most exceptional feature of this habitat is the existence of large herds of elephants, particularly in the flood plains of the Mahaweli Ganga. The implementation of the Accelerated Mahaweli Programme, is therefore expected to have a significant impact on the wildlife population in the area, when an estimated 125,000 to 175,000 hectares of existing forest land and wildlife habitat will be cleared within the next few years, to settle 125,000 farmer families and provide 125,000 hectares of irrigable land.

However, the long and strong religious and cultural commitment to the conservation of nature in Sri Lanka, has resulted in the evolution of a need to balance development goals, with wildlife conservation. A substantial part (45 percent) of the land area around the Accelerated Mahaweli Project, has been demarcated as a series of protected areas. The objective is to provide as much contiguous natural habitat as possible, around the Mahaweli Project areas and to manage these areas, so as to maximize benefits to agriculture and settlements, and at the same time conserve the rich and varied wildlife in the area. It is on this basis that in 1983, the Mahaweli Environment Project – a five year programme of work for the creation of six protected areas, was designed and initiated. The emphasis on wildlife conservation at present is focussed on the expansion and legal protection, of two existing wildlife reserves and the establishment of four new protected reserves. In addition, the project is expected to enhance and modernize the capabilities of the Department of Wildlife Conservation.

In selection of areas for wildlife reserves under the project, very high priority has been placed on the upgrading and establishment of protected areas, in the regions identified as 'high quality wildlife habitat'; in the catchments of reservoirs, and along the major river banks and flood plains of the protect area.

The reserves being created under the project, are the Maduru Oya National Park, Wasgomuwa National Park, Somawathiya National Park, Flood Plains National Park, Tirikonamadu Nature Reserve and the Minneriya – Giritale Nature Reserve. This "Reserve" system is being linked with the extensive Hurulu forest complex in the North-West and with the Gal Oya National Park in the South, through the


TRINCOMALEE
HURULU FOREST RESERVE
N
A
KANTALAI
SOMAWATHIE NATIONAL PARK
TRIKONAMADU NATURE RESERVE.
D
HABARANA
FLOOD-PLAIN NATIONAL PARK.
POLONNA-RUWA
WELIKANDA
Maduru Oya
G
B
BATTICALOA
MINNERIYA-GIRITALE NATURE RESERVE
WASGAMUWA NATIONAL PARK
C
Maduru Oya Reservoir
Mahaweli Ganga
MADURU OYA NATIONAL PARK
MAHA OYA
Victoria Reservoir
MAHIYANGANE
Senanayake Samudra
KANDY
MINIPE
Randenigala Reservoir
NILGALA JUNGLE CORRIDOR
VICTORIA-RANDENIGALA-RANTEMBE SANCTUARY
0 5 10 15 Miles
GAL-OYA NATIONAL PARK

proposed Nilgala jungle corridor, n order to provide for the migratory needs of the large elephant population in the area. The Accelerated Mahaweli Programme, represents the first opportunity in Sri Lanka and perhaps even in the developing world, where the establishment of protected areas has been incorporated in an overall socio-economic development plan.

Although a large extent of land has been set aside as wildlife reserves in the Accelerated Programme, present development works will almost double the normal density of the elephant in the project area. This will be accompanied by a fragmentation of home ranges of the elephant and a loss of certain quality wildlife habitats. The inevitable result is an increasing conflict between the elephants which were there before and the livelihood of the new settlers. Therefore, an urgent need would be to evolve an active long-term elephant management policy that aims at preserving the elephant population, by solving their adverse impacts on neighbouring settler communities. Such an approach would consolidate the action already taken in developing the system of protected areas, under the Mahaweli Project.

The Mahaweli Environment Project is supported by a financial grant of 5 million US Dollars from the United States Agency for International Development and a commitment of a 1.9 million Dollar allocation in Rupees from the Government of Sri Lanka. The Agreement was signed in September, 1982 for the project spanning 5 years which commenced in January, 1983. Though the Mahaweli Environment Project is a programme of the Mahaweli Authority of Sri Lanka, it is being implemented under the directions of a representative Steering Committee headed by the Secretary of the Ministry of State, with representatives from the Department of Wildlife Conservation and the Mahaweli Authority of Sri Lanka.

The Steering Committee is responsible for determining project policies and priorities, approving project plans and programmes, and budgets, co-ordinating overall activities, monitoring and evaluating performances and exercising financial supervision.

As a corollary to the creation of the reserves, the project has made provision for the better management of these areas, through activities such as survey and establishment of reserve boundaries, development of buffer zones, rehabilitation of degraded wildlife habitats, development of park roads and the construction of houses for personnel and administrative buildings. In addition, the capabilities of the Department of Wildlife Conservation are to be enhanced by increasing the cadre of the Park Administration. It is also proposed to strengthen the management structure by establishing a Regional Headquarters for Park Administration and creating a Wildlife Conservation Unit. The project also proposes a National Public Awareness Campaign, designed to help generate public support for national parks and related conservation activities.

Status of Mahaweli Environment Project

Of the six protected areas totalling 210,000 hectares to be set up under the Mahaweli Environment Project, the Maduru Oya National Park (51,468 hectares), Flood Plains National Park (17,364 hectares), Wasgomuwa National Park (33,791 hectares) and Somawathiya National Park (21,048 hectares) have already been demarcated and legally declared under the Fauna and Flora Protection Ordinance of 1938. The Tirikonamadu Nature Reserve (25,027 hectares) has been demarcated and is expected to be legally defined

within the current year. The Giritale–Minneriya Nature Reserve (42,000 hectares) and the Nilgala Jungle Corridor (28,000 hectares) are presently being demarcated and are expected to be declared shortly. In addition programmes for the development of buffer zones and enrichment of degraded habitats, have already been initiated in the Maduru Oya and Wasgomuwa National Parks.

Reasonable progress has been made during the past two years in enchancing the managerial capabilities of the Project Administration. A total of 75 new staff have been recruited and posted to the Mahaweli reserves. The United States National Parks Service has been commissioned to provide the necessary Technical Assistance and Training requirements of the project. The training components are being delivered in the form of a series of short workshops where guidelines for park policy, park administration and management, law enforcement, park interpretation and education are being established. Vital staff needed for proper execution of the programme such as Ecologists, Park Planner, Training Officer, Education Officer, Rural Sociologist and Veterinarian have been recruited.

In addition a Systems Plan, which is designed to place the protected areas in the context of the regional developmental activities has been produced in the draft stage. The final Systems Plan will define broad objectives for each of the protected areas, and thereby provide the basis for subsequent area and specific management plans. It will also identify likely elephant conflict areas, locate park boundaries and suggest where buffer zones can be established, and what activities would be appropriate for each buffer zone. The Systems Plan would contribute to the overall land use plan for the Mahaweli basin.

As a prelude to monitoring the changes in the environment, a programme of baseline research will commence in the National Parks, during the course of the current year. The objective is to draw up inventories of fauna and flora within the reserve. This will form the base for future monitoring and research activities, upon which future management decisions could be based.

Forestry Planning and Management

In an era of diminishing supply and rapidly escalating prices of fossil fuels, one of the most significant benefits which Sri Lanka will derive from the Mahaweli programme, is the additional installed electrical capacity from hydropower generation.

Although, this would provide the energy requirements of the urban and industrial sectors, the needs of the rural sector will have to continue to be met from the forests. In a situation, therefore, where over 90 percent of the Mahaweli settlers use fuel wood for domestic purposes, it would be necessary to evolve long-term programmes for the establishment of fuel wood forests in the project areas.

Conscious of this urgency, the Mahaweli Authority of Sri Lanka is seeking to accelerate the rate of reafforestation, while maintaining as much of the existing forest cover as possible, so as to provide sufficient fuel wood and timber supplies to the settlers. Various steps have been taken to restrict unnecessary elimination of forests and forestry resources. Certain areas such as riverine reservation, reservoir catch-

ments and other critical conservation areas have been reserved in perpetuity for forestry. Future settlement areas such as Systems 'A' and 'D' will remain in forest until such time as they are needed for development. Other measures taken to protect the forestry resource is the elimination of clear felling in all areas, not needed for lowland paddy cultivation. Homesteads and non irrigable tracts are maintained in forest cover, so as to provide at least part of the fuel wood needs of the settlers.

Since it is expected that part of the fuel wood needs of the settlers would be met from their homestead allotments and that supplies from clearance of the forested irrigable land, would be exhausted after a few years, the establishment of fuel wood plantations becomes imperative. In other words, in order to prevent settlers from destroying protective forest areas, another source of fuel wood supply must be provided. The only way in which such a supply can be assured in the long-term is by the establishment of plantations. The Mahaweli planners have become aware of this and set aside out of command areas within the newer projects, provision for fuel wood plantations and village wood lots.

The reafforestation programmes in most downstream Mahaweli areas are being implemented by Forestry Units of the Mahaweli Authority of Sri Lanka. In other areas, these activities are carried out by State and non-governmental Agencies on behalf of the Mahaweli Authority of Sri Lanka. The reafforestation activities in the Mahaweli areas consists of programmes for establishment of fuel wood and timber plantations, and conservation forestry. Progress in reafforestation has so far been fairly satisfactory, with a total of 780 hectares in System 'C', 450 hectares in System 'B', 110 hectares in System 'G' and 1,160 hectares in System 'H' being already established. In addition, a further 760 hectares have been planted as conservation forests, in the immediate vicinity of the Minipe Right Bank Canal area, with the intent of preventing erosion of the channel banks.

In the period under review, it is proposed to undertake further forestry programmes in the Mahaweli areas. These include the reafforestation of 400 hectares in System 'C', 300 hectares in System 'B', 400 hectares in System 'H', 50 hectares in System 'G', 50 hectares in the Uda Walawe Project area and a further 400 hectares around the Minipe Right Bank canal area. The involvement of the community in forestry work is to be given further consideration. In System 'C' it is proposed to replant 200 hectares with utility timber species, with the participation of the settlers.

In addition to these activities, other programmes such as avenue planting, establishment of medicinal herb gardens and parks, enrichment and protection of natural forests, bamboo, reafforestation, awareness programmes, tree planting campaigns and landscaping programmes, form part of the forestry activities in the Mahaweli areas.

Reservoir Environs

The construction of large reservoirs under the Mahaweli Programmes, have resulted in the loss of a large extent of land in the valleys due to inundation.

In order to allay fears among some, that the creation of reservoirs on the Mahaweli Ganga, would result in the loss of some rare and endangered

▲ The afforestation programme in the Mahaweli upper catchment has been successfully implemented.

▼ Kundasale new town built in place of the Kundasale Bazaar which was submerged by the waters of the Victoria Reservoir is now complete with all facilities.

plant and animal species, the Mahaweli Authority of Sri Lanka, commissioned University personnel to undertake investigations in the proposed reservoir bed areas. These studies have indicated that virtually all the land to be inundated, particularly by the Victoria and Kotmale Reservoirs, constituted already developed land, and the conservation of wildlife in terms of protecting an existing population of rare and endangered species, does not arise. Yet, action was necessary in order to save animals that could have been drowned with the rising waters of the newly impounded reservoirs. The National Zoological Gardens assisted the Mahaweli Authority of Sri Lanka, in launching rescue operations in the Victoria and Randenigala Reservoirs.

Studies in the reservoir areas have also resulted in special measures being suggested for the protection of reservoir catchments. The Mahaweli Authority of Sri Lanka, in collaboration with the Department of Wildlife Conservation, is working on a proposal to create a wildlife reserve in the immediate catchment of the Randenigala and Rantambe Reservoirs. This Victoria – Randenigala – Rantambe Sanctuary is constituted, so as to protect these reservoirs from activities in the catchments that would otherwise contribute towards siltation and sedimentation of the reservoirs. The reserve is of particular importance to the Randenigala Reservoir project, as its catchment area is prone to landslides and severe soil erosion. This reserve will encompass the water spread of the Victoria, Randenigala and proposed Rantembe and lower Uma Oya Reservoirs. Similarly it is also proposed to declare other Reservoirs such as Kotmale, Kalawewa – Balaluwewa, Chandrika wewa, Kiribban wewa and their forested catchments, as Wildlife Sanctuaries.

Further measures to protect the reservoir environs programme of reafforestation of the immediate catchments, bamboo reafforestation along the river banks, landscaping and prevention of encroachments are being actively pursued.

However, various activities which are in conflict with the objectives of catchment conservation, such as the uncontrolled and haphazard clearing of land on steep slopes for rain fed agriculture, goes on unabated. If there is no considerable improvement in the standard of land management, the situation in the catchments is likely to deteriorate rapidly.

The Mahaweli Authority of Sri Lanka, is concerned about the rapid deterioration of the catchments and is seeking the assistance of other institutions and agencies concerned with land use, in order to bring about an improvement in the situation. As a prelude to determining conservation measures for the catchments, the Mahaweli Authority of Sri Lanka, has commissioned the Land Use Division of the Department of Irrigation, to undertake "land suitability evaluation" of the immediate catchments of the three major upstream reservoirs. It is hoped that these studies would form the basis for future conservation activities in the reservoir catchments.

Aquatic Resources

The creation of many large new reservoirs and the augmentation or restoration of many seasonal tanks under the Mahaweli project, have provided much scope for the development of inland fisheries. It provides the most efficient and desirable means of meeting

the challenge for low-cost animal protein for the settlers in the Mahaweli areas.

The Ministry of Fisheries is responsible for inland fisheries activities in the Mahaweli areas and various programmes have been initiated. A Fish Breeding and Demonstration Centre with a capacity to produce around a million fish fingerlings has been established at Dambullu Oya. A similar fisheries complex is envisioned for Maduru Oya as well.

As part of its activities, the Ministry of Fisheries has already commenced stocking fingerlings for programmes in the larger reservoirs and in the seasonal tanks, and providing subsidies for purchase of boats and fishing gear. In System 'H' a number of Fisheries Societies have been established in the seasonal tanks. These Societies which usually consist of unemployed dependants of the settlers are responsible for the management of tanks and harvesting of the fish. This provides an income to the members of the newly settled Society.

During the past year, farmers in System 'H' have been encouraged to start fish farming programmes in their homestead allotments. The Ministry of Fisheries provides technical guidance, subsidies and also fish fingerlings for these programmes. So far around 20 settler families have taken to fish farming and the results have been encouraging. It is hoped to expand the scope and dimensions of this programmes in the Mahaweli areas.

In the meantime the Ministry of Fisheries continues to stock reservoirs in Systems 'C' and 'B' with fingerlings. Around 150 fisher families are presently involved in fisheries activities in the newly created Maduru Oya, Ulhitiya Oya and Ratkinda Oya Reservoirs. The Mahaweli Authority of Sri Lanka intends providing these families with subsidies and assistance for the construction of houses, schools, welfare facilities and roads. However, the rapid spread of salvinia seems to have an adverse impact on fisheries activities in the reservoirs and seasonal tanks. Although physical eradication measures have been tried out, it has only offered temporary relief. It is hoped that the present biological control measures being tested by the University of Kelaniya would offer a lasting solution towards salvinia eradication in Sri Lanka.

An area of concern is the possible loss of important flood plain habitats due to reservoir construction on the Mahaweli. The impounding and controlled release of water to meet irrigation needs, is expected to substantially reduce the magnitude and duration of flooding of the flood plain, and thereby transform some extents of existing villu grassland into low quality grazing lands. However, this impact is to a certain extent negated by the creation of the Flood Plains National Park, in an effort to prevent over grazing and degradation of the villu grasslands and to ensure that existing migratory routes of the elephant, between the Somawathiya and Wasgomuwa National Parks are protected. However, various activities such as brick making, tobacco cultivation and cattle grazing presently taking place within the flood plains are in strong conflict to the objectives of protecting the environment. Unless such activities are curtailed, it is unlikely that the biologically important features of the flood plains could be preserved intact.

A further concern is that intensive irrigation and agricultural practices using artificial chemicals, fertilisers and insecticides in the Mahaweli areas, could result in pollution of downstream water courses. Monitoring in many instances is often the only means whereby soil and water quality problems may be adequately identified, in order to permit the formation of measures for the prevention of potential pollution impacts. Monitoring helps to locate improper use sources, so that timely corrective measures could be taken.

The ongoing water quality monitoring programme being undertaken in the Mahaweli areas by the University of Colombo analyses such parameters as temperature, pH, dissolved oxygen, major anions and cations, conductivity, nutrient salts, heavy metals, pesticide and pathogenic coliform bacteria. As part of the background, monitoring surveys have been made in existing irrigation systems, villus, wells, tanks and downstream estuarine locations in Systems 'B' and 'H'.

In the already operational areas within Systems 'C' and 'H', monitoring is made of irrigation supplies and return flows to identify potential salinity, sodium or toxicity problems. Specific attention is given to iron and floride analysis, since iron and floride values may occasionally be very high.

Today, conservation of the environment, forms an integral and essential part of the present development strategy of the Accelerated Mahaweli Programme. The objective is to evolve integrated systems of total land use where the cultivation of paddy and other field crops would be supported by programmes for establishment of fuel wood and plantation forests, wildlife reserves and programmes for the development of livestock, fisheries and home gardens.

AGRICULTURAL MARKETING

The Accelerated Mahaweli Development Programme is aimed at providing a wider economic base in the rural agriculture sector, whilst creating the ability to upgrade and enhance the subsistence dry zone agriculture sector into a more modern commercially oriented agriculture, growing items which the markets can absorb introducing non-traditional export oriented crops, linking Mahaweli with external markets, reducing the import dependence of food which the country can grow, alleviating the chronic problems of rural urban migration and unemployment.

In the last decade, the Mahaweli Project has gone a long way in agricultural development in the country. The contribution of the Mahaweli Project to production and agricultural marketing is most noteworthy.

Paddy is one of the many major agricultural crops in Mahaweli both in the Maha and Yala seasons. The gigantic take off in the production of paddy in the country resulting from the expansion of paddy land and land development, and the use of high yielding varieties together with the use of other production inputs, undoubtedly had an impact. The provision of marketing services and the type of integration and co-ordination is not found elsewhere outside Mahaweli.

TABLE I

COMPARATIVE STATEMENT OF PRODUCTION OF PADDY IN SRI LANKA AND IN THE MAHAWELI AREA

Year	Extent cultivated (Ha.)			Production M/T			Average Yield Kg./Ha.	
	Country	Mahaweli	%	Country	Mahaweli	%	Country	Mahaweli
1981	877,000	19,831	2.3	2,230,000	81,813	3.7	3,014	4,126
1982	845,000	22,304	2.6	2,156,000	89,369	4.1	3,260	4,007
1983	824,000	56,775	6.9	2,484,000	239,613	9.6	3,606	4,230
1984	990,000	72,530	7.3	2,420,000	320,405	13.3	3,076	4,418
1985	881,000	76,372	8.7	2,661,000	325,714	12.2	3,464	4,737

TABLE II

MAHAWELI PRODUCTION, EXTENT CULTIVATED, PRODUCTION AND AVERAGE YIELD OF PADDY 1985

System	Extent cultivated (Ha.)	%	Production M.Tons	%	Yield per Ha. Kg.
H	33,126	43.4	142,455	43.7	4,300
B	4,969	6.5	23,526	7.2	4,735
C	12,508	16.4	45,475	14.0	3,636
G	4,052	5.3	2,071	6.3	5,109
Uda Walawe ..	21,717	28.4	93,557	28.8	4,308
	76,372	100.0	307,084	100.0	22,088

Paddy is marketed through various channels leading altogether to seven channels, which cannot be described under a mono-pattern compared with the marketing by Government at controlled prices. The existing pattern of paddy marketing in general in the country is similar to that prevailing in the Mahaweli areas.

The longest and most common, paddy/rice marketing channel in the Mahaweli Zone is from farmers to farm unit level assemblers to truck buyers, to out system rice millers to commission agents, to wholesale markets, to retailers and finally to consumers. The simplest channel is from farmers to miller/shopkeepers, to consumers; but this system is rarely practised in the Mahaweli Economic Zone.

The Paddy Marketing Board (PMB) with the assistance of the Marketing Services Division of the Mahaweli Economic Agency, procures paddy from its agents as well as from farmers and the farmer organizations. There are commission agents who collect and deliver paddy to the PMB. The paddy is collected by the PMB through its large network of stores and is distributed for processing among the PMB's rice mills and the private millers working on a contractual basis. The milled rice is sold by the PMB to the Food Commissioner, the Co-operative, Agents, etc.

The role of the PMB is to maintain and stimulate farm gate prices for paddy, while stabilizing the consumer prices during the low supply period by releasing the stocks into the market. In the Mahaweli areas, the private sector purchases paddy at a higher price then the PMB floor prices. So, in the Mahaweli areas, the procurement programme of the PMB cannot be effectively satisfactory. In this system paddy stocks flow from farmers to the PMB buying centres, through the farmers themselves or private agents, co-operatives, farmers' organisations to the mills owned by the PMB and private millers. Rice produced both by the PMB and the private millers comes to consumers through various means. Rice marketing channels of the PMB are more varied than those for paddy.

The actual marketing participants within the Mahaweli areas are farmers, middlemen such as unit level assemblers, trucker buyers, and rice millers in the areas. In some Systems, farmers sell to the Paddy Marketing Board through co-operatives or through private traders, because of the pressure on loan repayments from institutional and non-institutional sources. A substantial number of settler farmers depend on the private traders for agricultural inputs and consumption needs.

As far as marketing practices are concerned after harvesting is completed, most of the farmers bring their paddy to their farmhouses where cleaning and conditioning are done before packing into storage containers. Farmers generally clean the paddy they market to meet the quality specifications of the buyers. Jute bags which could hold 65 kg. are generally used for packing paddy.

The farmers are responsible for the transport of their produce to the purchasing point. The modes of transport used by the farmers vary from tractors, lorries, bullock carts and pack-bulls. Once the paddy reaches the co-operative or the private sector purchasing point, it is tested for quality before the sale is done. The quality specifications are 15% WB of moisture, 1% impurities by sight, 9% of chaff by volume, 10% of varietal mixture free of insects, etc.

The method of payment is generally in cash, although some organizations pay 10% – 20% of the value of paddy sold in cash and pay the balance by cheque encashable at the Rural Bank.

Crop diversification during Yala due to water conservation techniques, higher income from subsidiary food crops compared to paddy, the existence of a domestic and in some instances of export markets, the growth of domestic regional demand, and of course direct demand by agro-processing industries located in or outside the area, have contributed to the rapid interest and development of subsidiary food crops in coarse grains, oil seeds, condiments, legumes and even fruit and off-season vegetables, within the Mahaweli Systems. A certain amount of crop regional specialization is visibly taking place.

The dwindling of supplies from the Northern and Eastern regions of the country due to the ethnic problem has brought about an opportunity which has been well utilized by the Mahaweli farmers, thereby cutting down expenditure on imports. By cultivating subsidiary food crops Mahaweli farmers have earned fairly high incomes.

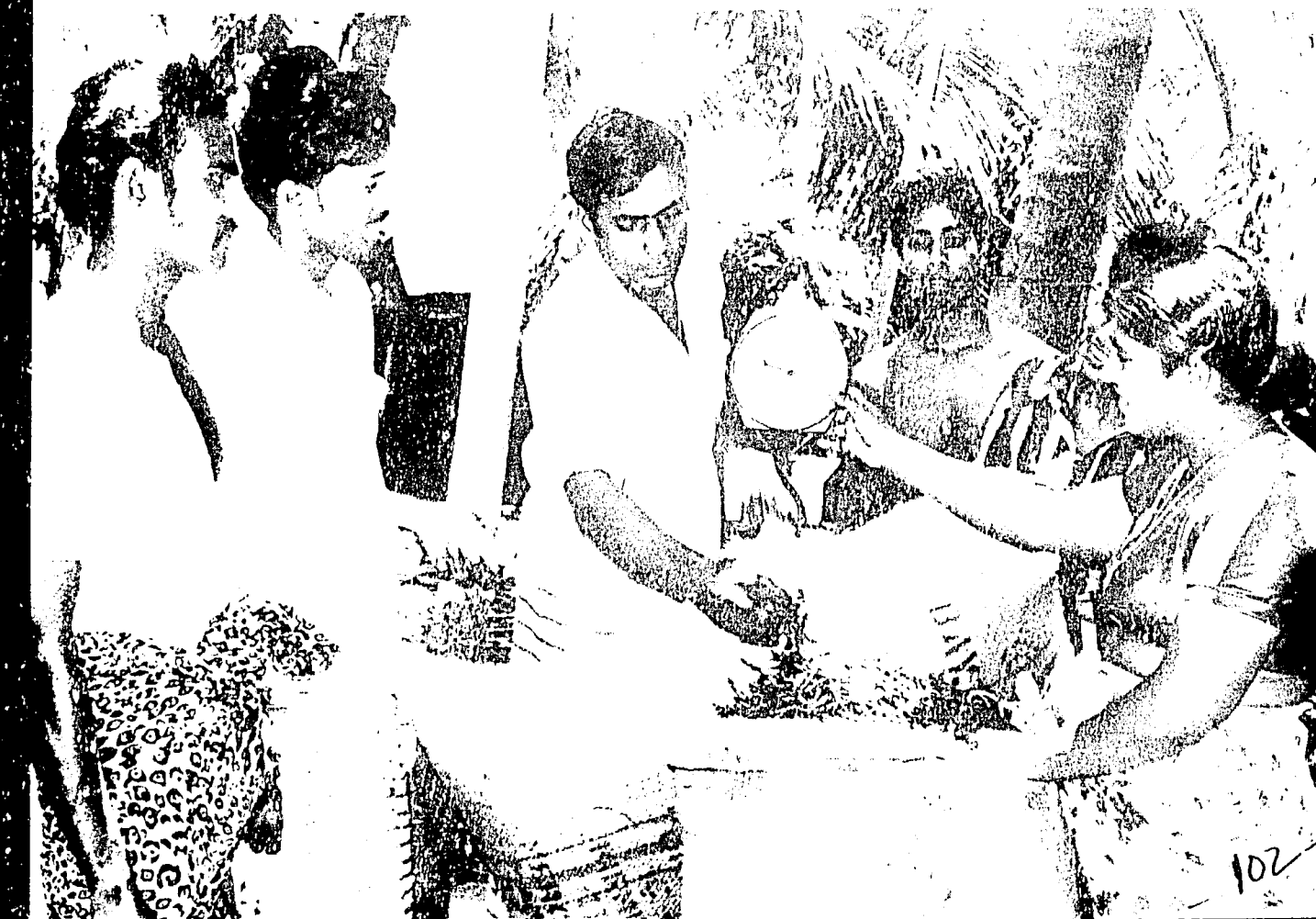
The Paddy Marketing Board operates a guaranteed price scheme for selected subsidiary food crops. These commodities are consumed locally Under liberalized market conditions, the guaranteed price acts as the floor price the farmer can get for such a selected basket of commodities. Therefore, in the subsidiary food crop sector, as in paddy, there exists a two-way mechanism of partial control and partial free marketing. The marketing of these commodities flows through two channels, namely, the public and the private free market channels, the latter being the more important channel.

The farmers of the Mahaweli Area have had difficulties with marketing their produce due to the wide range of commodities. At the beginning, in order to help the farmers, the Mahaweli Economic Agency of the Mahaweli Authority of Sri Lanka purchased limited quantities of commodities from the farmers at the initial stage of production, on its own account or on behalf of other marketing institutions, until other public/private institutions entered the business.

The Co-operative Wholesale Establishment (CWE) entered the Mahaweli Economic Zone in 1985, leading to the gradual withdrawal of the Marketing Services Division of the Mahaweli Economic Agency from undertaking direct procurement of agricultural produce. Thereafter, the Marketing Services Division acted as a collecting agent for maize and soya, for CARE, Raja Soya and John Keels Ltd. The Mahaweli Economic Agency releases on rent, stores space within

▲ Mahaweli farmers and urban traders were at a Seminar which was held at the Mahaweli Centre recently to formulate a systematic marketing procedure for the agricultural produce in Mahaweli Systems. Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake participated at the discussions with the farmers and traders.

▼ During the last Yala season production of dry chillies reached a record of nearly 15,000 tons in 'H' area alone.



each System to the CWE to purchase subsidiary food crops annually.

Generally, the CWE operates a total of 51 purchasing centres which are supported by another 10 reserve stores in Systems H and G.

Within the Mahaweli System, the CWE has no facilities of its own for marketing, such as stores, lorries, weighing scales, furniture, equipment and staff quarters. Therefore, the CWE depends on the Mahaweli Economic Agency and the Paddy Marketing Board for store space. The CWE purchased 210 M/T of chillies in 1983, 623 M/T in 1984, 3000 M/T in 1985 and 4,500 M/T in 1986. This exercise has resulted in reducing imports of chillies from 7,000 M/T in 1983 to 2,000 M/T in 1986.

In marketing, the rural assembly agents, traders or collectors play a dominant role. They collect substantial quantities of food crops from the farmers and send them in private lorries to commission agents who pay the lorry hire and other handling costs. The subsidiary food crops are sold to retailers on a wholesale basis and the commission agent sends the net proceeds to the suppliers after reducing the 10% commission charge. There are other channels as well – farm gate collectors, unit level assemblers, trucker buyers, polas or fairs, the CWE, PMB, Markfed, Co-operatives etc., who compete openly in the production areas.

In general, the commission agent/ trader offers non-institutional credit to farmers or suppliers. There are also a large number of small-scale farm gate collectors operating on bicycles in the growing areas. These collectors go from farm gate to farm gate and collect the commodities in bulk and delivers it to the agents.

In general, subsidiary food crops are not graded or sorted at the farm level. No proper on farm storage facilities are available for this. Most of the farmers dry the crops without satisfying the minimum requirements for proper storage and packs it in gunny bags. Stocking is usually done on the farm floor or the farmer's house floor or in a sheltered yard.

Due to poor grading, drying and improper storage, 10 – 15% of the crop is wasted after the harvest. Although chillies have to be dried for a minimum of 8 days and should have a moisture content of less than 14%, the farmers dry it only for 4–5 days, and deliver chillies to the purchasing centre with white buds without grading. Therefore, the CWE has to grade them as Grade II and pay Rs. 28/- per kilo. The CWE has to bear a driage of 10% and, thus, in order to minimize the loss, the CWE has to re-dry the purchased chillies. This entails an additional cost apart from interest payment for marketing credit taken at 19% per annum, which means that the retail price of chillies sold by the CWE works out to Rs. 42/- per kilo.

The same is the case for groundnut, cowpea and green gram where storage life is short and hence post-harvest technology in subsidiary food crops becomes very important within the Mahaweli in the years to come.

Unlike the public sector, the private sector maintains a regular clientele among the farmers through the provision of multiple economic services and social relationships, such as lending money for cultivation and other purposes, free transport of inputs, necessary seeds, as well as other inputs etc. Consequently, the trader/ financier who performs a production planning function gets the farmer's produce at pre-agreed prices. They are also not able to query malpractices such as underweighing, underinvoicing etc., resorted to by their trader financier patrons.

Attempts are being made by the Marketing Division of the MEA to organize farmers into production and marketing societies, and linking them with direct buyers. The MEA envisages the creation of Credit Unions among the farmers. Input procurement and distribution among the farmers are now done by the marketing service officers operating at field levels in each Mahaweli System.

In the Mahaweli areas, both local and exotic vegetables are grown for local consumption and surpluses are transported to areas outside the Mahaweli. In the marketing of vegetables and fruits, private marketing channels handle about 95% of the marketable surplus of vegetables.

Another important outlet for vegetables and fruits originating within the Mahaweli Economic Agency, is for export buyers. Green chillies from Galnewa in System H and System G have been exported to the Middle East and Maldives through Colombo based exporters. In 1983 green chillies worth over Rs. 700,000 were exported to the Middle East. In 1984 it was around Rs. 600,000. In 1986, it was around Rs. 900,000. 95% of green chillies are produced in an export village in Galnewa.

Large quantities of fruits and vegetables are also exported to the Middle East. A major part of the fruits and vegetables originate from System H (Galnewa, Madatugama, Nochchiyagama), System G (Bakamuna) and Uda Walawe areas. Fruits also find their way to the canning factories in Colombo, owned and managed by the public and private sector.

As regards private marketing channels, vegetables produced in the Mahaweli areas reach the consumers through varied marketing outlets such as farm gate collectors, trucker buyers, unit level assemblers, commission agents, local periodical markets (polas) and village boutiques.

The typical marketing practice in the private sector is for assembling agents to collect produce from producers and transport it in private lorries to the commission agents, who pay lorry hire and other handling charges. These vegetables are sold to retailers on a wholesale basis and the commission agents send the value to the suppliers after deducting 10% commission. The constraint in this practice is that the producer/supplier is kept out of the trading, and the checking of any malpractices becomes difficult.

Vegetables are usually marketed in an unprocessed form, without being subject to any cleaning, trimming, grading, and packing. The share accrued for all services is very low compared to what goes to the traders. The high risk in perishability compels the producers to sell to the available outlet during the harvest, which makes it difficult for traders to fill the gaps in supply that occur at particular markets.

There is much post harvest technology that can be imparted to the fruit and vegetable cultivators to minimize wastage in transit.

In the Mahaweli areas too, the rural market place or periodic markets (or polas) play an important role in the assembly or daily markets of produce.

Through these polas the Mahaweli farmers sell their produce and buy their daily needs. The polas are held once a week or twice a week. The lack of institutional marketing outlets is fulfilled by the weekly pola as an important firsthand marketing outlet. Besides, it acts as a social, cultural and recreational centre for the rural people.

In the case of agricultural commodities brought for sale by farmers, the prices are determined mostly through person to person bargaining. There is no auction system. Sales on commission basis are the commonest form of transaction. The

trader's bargaining power is greater than that of farmers, because farmers lack the knowledge about operative prices at wholesale markets. No price display boards are found in polas. Hence, farmers are ignorant of prevailing prices at major wholesale markets. However, the wholesale traders obtain their price information mainly by visiting wholesale markets themselves. The producer seller gathers price information by visiting other markets. The farmers are the least informed and they depend on fellow producers visiting the markets for such information. The Marketing Services Division of the MEA is now disseminating price information daily from Colombo, to each Mahaweli System by telephone. They publish a "Marketing Bulletin" monthly and have formulated a scheme to have price display boards in selected polas in Mahaweli Systems. Regular farmer training programmes have been started including visits by farmer groups to market centres. A farmer buyer forum was held before the Maha and Yala season to give the farmers an insight into crop and commodity trends of markets in urban centres.

The Mahaweli settler farmers are small-scale farmers, widely dispersed and located considerable distances away from the population concentrations. Although, the farmers began with paddy cultivation, they are today producing a variety of commodities and are diversifying their rural and crop economy linked to market demand.

But the farmers have to conduct their marketing operations with numerous problems such as the smallness of marketable volumes, perishability of products, non-availability of production and marketing credit, non-availability of transport, lack of market information, low bargaining power of farmers due to lack of farmer organization, lack of adequate storage, etc. Consequently, small farmers are usually in an unfavourable position when they sell agricultural products to the private traders.

These problems can be minimized by establishing farmer production and marketing societies in locations, to bring about efficiency in the pooling of production inputs and in produce marketing. This will place them in a better bargaining position and greater capacity in meeting market demands for their group's produce for joint shipment. This is a strategy adopted by the Marketing Services Division of the Mahaweli Economic Agency – at present at all levels of decision making.

▲ His Excellency, President J. R. Jayawardene presenting the Pooja Sannasa after declaring open the new Sanghawasa at the Girandurukotte Buddhist Centre. Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake is also present here.

▼ Offering robes to the Maha Sangha in System 'H'.

COMMUNITY DEVELOPMENT & CULTURAL ACTIVITIES

The Accelerated Mahaweli Development Programme came into being after much careful thought and intensive planning with commendable foresight. Its scope is therefore far wider than the building of massive dams, providing power to the country, giving precious water to arid and thirsty lands and settling families to cultivate their allotted lands and earn their living. It was the wish of those who envisaged this scheme and the intention of those at the helm, who are guiding it to its assured success, to make the lands enriched by the waters of the Mahaweli, populous with happy and contented settlers, green with waving paddy fields and rich with luxuriant highland crops. The once poverty-striken colonists will thus have the opportunity to enjoy full lives, marked by material prosperity, good health and reasonable comfort. This is not all, for the band of devoted Mahaweli officials will mould them into good men with spiritual awareness, moral cleanliness, and with an abiding interest in the welfare and well-being of the entire settler community. The life of the settler will not be one of unending toil and sweat, for there will be the thrills and excitements of sport for him to enjoy, community development work to satisfy his inner being, cultural preoccupations to refine his mind and religious pursuits to bring him solace, serenity and peace.

Community Development

No community can make any headway along the path of progress unless its members are fired with the spirit of working selflessly for the good and welfare of the entire group. It is therefore a matter for deep satisfaction that the Mahaweli settlers, the youths in particular, are imbued with a burning desire to work zealously towards the common good of the entire settler population. Economic well-being alone does not lead to progress, for it is a happy blend of material plenty and spiritual wealth, coupled with the awakening and bringing into blossom the finer qualities of man, that leads to true development. The Mahaweli authorities in their wisdom have realized this fact, and they have therefore left no stone unturned to give all possible help and encouragement to make the life of the settler satisfying, be it in the economic field, spiritual plane, cultural territory or the mental world.

It is a welcome sign that community development work is going on smoothly in the settled Systems H and G and partly settled Systems C and B. The health of the people has been given an important place in the community development programme. The common ailments that cause concern to the settlers and the authorities alike are bowel diseases and malaria. Every possible action is taken to combat these diseases. Trained

health volunteers, male and female, have been appointed, each in charge of about 25 families. To overcome the threat of malaria, they distribute the latest drugs issued by the medical officer in the area, among the families. The anti-malaria campaign officials are actively engaged in their war against malaria. All stretches of stagnant water, pools and other breeding places of mosquitoes are regularly sprayed. In certain areas blood tests of families are carried out to ascertain whether they are carriers of malaria or filaria and immediate treatment is given, if the tests prove positive.

It has been found that the chief cause of bowel diseases is the drinking of contaminated water. Emphasis is therefore made by officials and health volunteers on the importance of drinking boiled and cooled water. Every attempt is made to ensure that each house has a latrine for which the Mahaweli Authority gives part assistance. Financial assistance is also given for the construction of wells according to the approved plan.

Medical officers conduct clinics for the benefit of expectant mothers who are examined and advice given regarding their diet, exercise and care that should be taken. The children brought to these clinics are weighed and their growth monitored. They are also inoculated against tuberculosis, diptheria, polio, tetanus and whooping cough. The education of the mothers in health care and proper feeding of children will make malnutrition a thing of the past. The concern and interest shown by the mothers regarding the health of their children is most encouraging. There is rising hope that before long, any visitor to the Mahaweli area will be gladdened by the sight of romping little bright eyed and spritely children.

Volunteer health workers are given a training in first aid and instructions on preventive action, that should be taken against common diseases. A first aid box is given to each volunteer so that he or she could render first aid to a victim till arrangements are made to get medical attention. The health workers render a valuable service with a sense of dedication.

Great interest is paid to the education of children. School buildings, science laboratories and teachers' quarters are constructed by the Mahaweli Authority. In addition, furniture and equipment are supplied. The administration and the appointment of teachers are the responsibility of the Ministry of Education. Maha Vidyalayas have been established in central spots to enable children to pursue higher education. The portals of the centres of higher learning are open wide to the children of the farmer, carpenter and the artisan, unlike in the past when higher education was a prerogative of the rich and the influential. The day is not far away, when intelligent young lads and bright lasses of settler families will pass through universities and occupy high places in the public service or show their capabilities in the fields of medicine, engineering, law and commerce.

Townships have been established in suitable places in the different Systems. They have proved to be of great benefit to the people. The shops are well stocked with an array of goods. Everything from a needle to a tractor can be purchased in these townships. There are police stations to maintain peace, hospitals to treat the sick, post offices for communication needs, banks to maintain accounts and provide loans, playgrounds for recreation and cinemas for entertainment. In addition, filling stations, bus depots, co-operative

▲ All necessary steps have been taken to protect ancient religious places in the Mahaweli areas. Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake on his visit to Niyangamdora Purana Rajamaha Viharaya, Kotmale at a discussion with the Chief Incumbent of the Viharaya.

▼ The new Devale dedicated to Kirthi Bandara Deva of the Kirthi Bandarapura, built in place of the village of Senasun tenna which was submerged by the waters of the Randenigala Reservoir was declared open by Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake. District Minister Nuwara Eliya, Renuka Ranaweera and Mrs. Srima Dissanayake are also seen here.

establishments, garages and hotels cater to the various needs of the people. It is fascinating to recall how scarcely populated jungle areas, the haunt of the bear and the leopard a few years back, have been transformed by human effort into populous townships with all modern conveniences and bustling with activity.

The women of the Mahaweli area have shown a great interest in community development work. They no more want to remain passive onlookers, while others expend their sweat and toil in making the development programme a success. Keen on playing a meaningful role in community development, they have urged and succeeded in starting two Home Development Centres in System H. At these centres girls are taught about health matters, sanitation, home science, dressmaking, home gardening and animal husbandry. In System C, there is a project to help girls to become self-employed. Many girls now get a fair income from bee-keeping, dressmaking, holding home development classes and home gardening.

The Mahaweli Authority is alive to the fact that the human mind needs constant nourishment through stimulating mental pursuits and gathering of knowledge. It is by reading good books that the mind is enriched. Today many people limit their reading to the perusal of newspapers and magazines. This is totally inadequate for it is by reading books on lofty subjects like religion, philosophy, biographies of great men and women, history and science that character is moulded and the way of thinking profoundly influenced. Hence libraries have been established in the Mahaweli area to inculcate the reading habit. In Girandurukotte, a library containing many valuable books, magazines and periodicals has been opened. At present there are 489 members. Books are lent to members, while others are free to read books within the library. In System H there are 7 libraries for the use of officials. For the benefit of the settlers there is a mobile library, where books to be lent are taken to different places in a decorated cart. Indications are that the reading habit is growing steadily. It is hoped to open libraries in all the Systems, once settlement is completed.

Cultural Activities

We are the proud heirs of a rich cultural heritage coming down through two millenniums of history. The present Mahaweli area, during the time of our ancient Sinhala kings was a show piece of our high cultural attainments as evidenced by the Mahawansa, the writings of travellers of old, who visited our country and by the ruins of temples, dagobas, sculptures and paintings that have survived the ravages of time, royal baths and pleasure gardens all done with great skill and cultured taste.

These works of art and the massive irrigation works constructed with amazing engineering skill, will no doubt inspire the present settlers to greater effort in the pursuit of cultural attainments.

Mahaweli settlers, selected from different parts of the country, possess varied talents which have not come into bloom due to lack of opportunities. Numberless painters, sculptors, writers and others possessed of various skills have lived and died, unknown and unsung, with their talents allowed to fade and wither away. This will not be allowed to happen in the Mahaweli area, for the officials have taken action to provide all opportunities to develop the hidden skills of the settlers and thereby enrich our culture.

In the settled areas of the Mahaweli region, there is an appreciable number of men, women, and children, who have displayed their skills in painting. They are

now given a helping hand to perfect their art. Their works can now be displayed at the exhibitions organized by the Mahaweli officials. Competitions are also held as a further encouragement and attractive prizes offered for the best entries. Some youths possess the talent for wood carving. In System C the Resident Project Manager has made arrangements to market these productions of beauty, created by the deft fingers of these young men and women. Two individuals have already made this art a profitable venture and are now self-employed. Help is also given to craftsmen producing high quality goods by finding markets to sell them.

As a source of entertainment, drama has become popular. There are many capable actors and actresses among the young and the old alike. Often, after the harvesting, plays with a social and religious background are staged and many are able to show their inherent capabilities to the delight of hundreds of spectators. With the passing of time and the gaining of experience, men and women of promise can aspire to become Stars of the Silver Screen and heroes and heroines of the Stage.

Dancing, Kandyan dancing in particular, has cast its appeal on the young and the old. Many boys and girls have learnt this art. The Development Centre at Girandurukotte, train young men and women in dancing and also teach music and singing. There are now a considerable number of dance troups in the settled areas. They perform during various celebrations and display their talents to appreciate crowds.

Folk songs and folk dancing are given a prominent place in variety entertainments. Both males and females who take part in them have reached a good standard. The plaintive song of the chena cultivator keeping vigil over his crops, the lonely carter's high-pitched song breaking the silence of the night, the pilgrim's song filled with spiritual fervour, the exhilarating transplanting songs sung by groups of women in unison, the village Romeo's love song to his rustic Juliet and the soothing lullaby of a fond mother putting her child to sleep, once consigned to the limbo of forgotten things, have now been revived and have become very popular in the area. The Sri Lanka Broadcasting Station at Girandurukotte, gives every encouragement to boys and girls who have reached a good standard in music and song, by making them to participate in recitals that are broadcast.

The settlers have been exhorted to follow our ancient customs and traditions, in some of which are enshrined Buddhist values and therefore have the power to bring out their finer qualities to the surface.

The New Year celebrations are held at a central spot in each R.P.M's area and are attended by vast numbers of people. Apart from school children, young and middle-aged men and women, even grandfathers bent with age and wrinkled old grandmothers attend these celebrations in which a spirit of merriment prevails. Competitions such as races, pillow-fights, climbing the greasy pole, tug-of-war and many other items bring a great deal of enjoyment. Greetings, happy smiles and roaring laughter make the occasion one of sweet joy. No New Year celebration is complete without the thrills and excitements of a bicycle race.

Young men, bubbling with energy and eager to show their pedalling powers and plucky young women, intent on proving that they are more hardy than they are usually credited with, compete in these races, cheered by thousands of men, women and children lined along the route. After the celebrations prizes are

distributed, speeches are made and as dusk falls, all wend their way home, tired but happy.

After the harvest, cultivators organize Aluth Sahal Mangalyas in their areas and for this purpose they contribute a portion of paddy harvested by each. The quantity thus collected is offered to the temple. This custom not only teaches the people the art of gracious giving but also show the importance of seeing to the needs of the monks of the temple.

During the New Year, sweetmeats and delicacies, that are prepared are distributed among friends, relations and neighbours, without any distinction of caste, creed or race and thereby a fund of goodwill is created between all.

With the dawn of the New Year, children show their love and respect to their parents by worshipping them on bended knees and getting their blessings in return.

Hospitality is highly valued in our culture. The Mahaweli settler shows his hospitality to any visitor by welcoming him with a smile and treating him with kindness. A refreshing drink or at least a chew of betel is offered to him.

When parents become old and feeble, it is the common custom for the children to look after them with loving care. Generally no parents are sent to Homes for the Elders so long as there are children who are in a position to look after their wants.

Another important custom that is practised is having Alms Givings every year, in honour and remembrance of departed parents and relations. Apart from this, some families provide meals to patients in hospitals or to children in orphanages.

There is a custom of renewing friendships and forgetting old enmities with the offer of a sheaf of betel by one party to the other. Such renewed friendships often last the entire life time.

Many other good customs pertaining to marriages, births and deaths are followed by the Mahaweli settlers. Customs which are impracticable and out of tune with modern times have of course been abandoned.

With the progress made in community development, the interest shown in cultural activities and the stability reached in the economic front, we need no prophets to predict that happy times are ahead for the Mahaweli settler. Self-sufficiency in rice is within reach, while increased quantities of subsidiary food crops are produced for local consumption and for export. Many facilities like motorable roads, dispensaries, hospitals and banks have been provided. The power generated from the hydro-electric projects, not only turn the mills of big industry and air-condition city mansions, but also light the farmers homes, work the small man's lathe, turn the potters wheel and heat the blacksmiths furnace. Thus like the great sun, that enters the palaces of kings and the humble huts of the poor, the Accelerated Mahaweli Development Programme bestows its benefits on all alike, without any distinction.

OPERATION & MAINTENANCE OF HEADWORKS

Water resources development of Mahaweli basin consists of a series of reservoirs, inter-basin canals and tunnels, irrigation canals and distribution systems as also hydro-electric power stations along with associated water conductor systems.

For operation and maintenance of the works under the Mahaweli Complex as well as in the special area of Walawe Ganga, which falls under the purview of the Mahaweli Authority of Sri Lanka, there are three Agencies in addition to Irrigation Department who look after the Headworks and the irrigation systems. These Agencies are (i) Headworks Administration – Operation & Maintenance Division (HAO & M), (ii) Mahaweli Economic Agency (MEA) and (iii) Mahaweli Engineering Construction Agency (MECA). The power stations and appurtenant water conveyance systems are maintained and operated by the Ceylon Electricity Board.

Essentially the HAO & M is responsible for Headworks up to the outlet works for release of water from the reservoir; MEA for operation & maintenance of irrigation canals and distribution channels and MECA for canals and irrigation systems which are still under varying stages of development and construction. Irrigation Department however continues to look after the old irrigation systems in the basin which existed even before the Accelerated Programme was launched. However, there are minor variations in the general distribution as described above to meet any special exigencies. The actual distribution of operation and maintenance responsibilities among different Agencies & Departments is as follows:

Polgolla barrage, gates, power tunnel intake and tunnel.

Bowatenne dam, spillway & irrigation tunnel and canal to Dambulu Oya and to Kandalama reservoir (except power tunnel intake by CEB).

Kandalama dam, spillway & sluices (except operation of L/B sluice by MEA)

Dambulu Oya dam, spillway & sluices (except operation of L/B sluice by MEA).

Kalawewa dam, spillway & sluices (except operation of all sluices by MEA)

Minipe anicut & R/B sluice (except O & M of L/B sluice by I.D.).

R/B Main Canal spillway & embankments at Loggal Oya, Heppola Oya, Diyabana Oya. Also irrigation sluices to Mapakade, Dambarawe & Horabora.

Ulhitiya dam, spillway & sluices (except operation of L/B sluice by MEA).

Ratkinda dam and sluice (except operation of R/B sluice & Main Canal by MECA).

Link Tunnel from Ratkinda to Maduru Oya Reservoir.

Maduru Oya Headworks spillway, L/B & R/B sluices (except L/B Main Canal by MECA).

Maduru Oya R/B Main Canal – up to NDK dam, spillway & sluices.

Kotmale dam, spillway & low level outlets (except power tunnel from intake by CEB).

Victoria dam, spillway & low level outlets (except power tunnel from intake by CEB)

Randenigala dam, spillway & low level outlets (except power tunnel from intake by CEB).

Uda Walawe dam, spillway & sluices (except operation of sluices by MEA).

Mahaweli Economic Agency – Is responsible for the operation of irrigation sluices on Headworks mentioned above and operation & maintenance of irrigation canals (including structures) downstream of Headworks, (except the Maduru Oya L/B concrete lined main and branch canals & Ratkinda R/B Main Canal by MECA).

Mahaweli Engineering Construction Agency – Is responsible for Maduru Oya L/B Main and Branch Canals & Ratkinda R/B Main Canal.

Irrigation Department – Continues the operation and maintenance of all existing irrigation major works: Elahera Anicut, Sluice and Main Canal (Yoda Ela) up to reservoirs, eg. Minneriya, Giritale, Kantale, Kaudulla, Minipe L/B Head Sluices, Irrigation System "E". Angamedilla Anicut (on Ambanganga), Yoda Ela, Parakrama Samudra etc.

For optional utilisation of available resources of water at any instant of time for irrigation as well as generation of power, a co-ordinated approach is necessary. This is achieved by the Water Management Secretariat of the Mahaweli Authority which is equipped with a computer model of the system and determines the best use, consistent with the demand for irrigation and power, keeping in view the indents from the water using agencies. For this purpose, the HAO & M Division maintains a close link with Water Management Secretariat and every Friday the officials of HAO & M Division along with officials of ID, MEA and CEB meet the Water Management Secretariat and finalise water issues for the following week. Following this meeting, the HAO & M Division relays instructions on the following week's water issues to the Engineers-in-charge at Kotmale, Polgolla, Bowatenne, Victoria, Minipe, Randenigala/Rantembe and Maduru Oya.

The HAO & M Division does not make water issues to the Ceylon Electricity Board. Instead the water conduits between the reservoirs and the power stations are permanently open and the CEB draws water as needed to meet the electricity demand, within the limits agreed to at the weekly meetings.

Operation and Maintenance

Manuals for operation and maintenance have been prepared, or are under preparation, in respect of all major Headworks which involve complex components requiring careful and precise procedures of operation and maintenance to ensure safety of works.

These manuals contain description of works, functions of each component of works, drill for operation of hydro-mechanical equipment and maintenance procedures for the civil as well as mechanical works. These manuals serve as a guide to the operation and maintenance staff for routine and emergency conditions.

It has been arranged that the Headworks will be formally inspected twice a year by the Consultants, in January/February and August/September with a view to assess:

(i) Structural and operational safety of works.
(ii) Actual performance in relation to intended duty.
(iii) General health and standard of maintenance of works.
(iv) Technical, operational and managerial constraints which might be detrimental to efficient performance and/or may lead to accidents in case of emergency.
(v) General and special problems – both short range and long range – with recommended solutions and remedial measures for repair, rehabilitation, extension and improvement of safety and performance standard.

In addition, immediate inspections may be required in case of any special incident or accident, warranting instant attention.

For the assistance and guidance of the inspection team, detailed check-list of items to be seen and aspects of each item to be examined and reported upon have been prepared, to ensure that nothing vital is missed during inspection and there is uniformity in the reporting format.

Randenigala Dam Monitoring

As in the case of Kotmale, Dam monitoring is carried out at Randenigala by the Headworks Division in association with the Survey Department.

Survey monitoring is carried out weekly, monthly and every six months to check whether there are any significant movements, or settlement in the dam structure, relative to a fixed datum.

Instrumentation for Monitoring of Large Dams

Dam instrumentation and monitoring is required to determine the design criteria prepared for the foundations and that the Dam will safely carry the loads and water pressure imposed by the Dam and the Reservoir. The purposes of foundation instrumentation are to provide data to validate design assumptions, provide information on the continued behaviour of the foundations observing the performance optical known features etc.

Kotmale Dam Monitoring

The Kotmale Dam is a rock-fill structure on the crest length of 600 metres and a maximum height of 87 metres above river bed level.

A summary of instrumentation devices in both dam and foundation is described below:

Toe Drain Chambers

Seepages through the dam foundation are measured by a V notch weir at the downstream of the dam. This seepage weir can reach the foundation surface of the dam (the formation) downstream of the core trench by:

(a) Falling as rain on the downstream surface of the dam and draining through the downstream shoulder material.
(b) As seepage upwards from the foundations.
(c) As seepage through the core.

Pneumatic Piezometers

The Pneumatic Piezometers have been developed as a high precision instrument to remotely measure positive pore water pressure, in the range 0 – 200 M head of water. The system essentially comprises a piezometer tip in which pore water pressure is balanced by pneumatic pres-

sure. Six foundation piezometers and eight limestone piezometers have been installed at the dam site for the instrumentation.

Vertical Settlement Gauges (or Cells)

In this system, dam settlement is monitored weekly. The cells operate on a U – tube and overflow principle. There are 16 embankment cells and 12 phase settlement cells in four different elevations on the downstream of the dam. All cells were connected to four instrument houses.

Inclinometers

Inclinometers were installed as an additional check on movements of the dam towards the end of the construction phase, when stability was in question. There are three inclinometers that were installed along the membranes of the dam and displacement of the membrane profile is being checked weekly.

Joint Meters

Joint Meters are installed for monitoring of the displacement in the plinth membrane joints of the dam. These displacements can be monitored from top of the dam by the joint meter read out unit. There are three joint meters that were installed on the dam.

Horizontal Movement Gauges

These have been installed for monitoring of horizontal movement of the dam. The meter has been designed to measure the change in position of a steel plate using induction probes as the sensors. There are 12 pieces that were installed in three instrument houses and readings are being taken weekly.

Survey Beacons

Survey targets on the downstream face are made from a system of permanent survey stations adjacent to the dam. These are checked at intervals from other control survey stations. The control stations are sited at a sufficient distance from the dam, for it to be assumed that they will be unaffected by the influence of water thrust of dam.

Victoria Dam Monitoring:

The Victoria Dam is a double curvature concrete arch with a crest length of 520 m and a maximum height of 122 m above foundations. During operation, the dam and its foundation will deflect microscopically under the action of the water loads imposed upon them. The degree of these horizontal and vertical displacements, will depend both on the geometry of the works and also on the moduli of deformation of the foundation rock and dam concrete.

It is important to be able to verify that the dam and foundation behaviours are consistant with the design assumptions and analysis, and also with previously recorded behaviour patterns. To this end various types of instruments and other devices have been installed for monitoring purposes.

Location Installation

Dam	48 Survey Targets on the downstream face.
	2 Precise Survey Stations on dam crest.
	24 Precise level studs on the crest of the dam and in galleries C & E.
	7 Normal pendula.
	66 Groups of strainmeters (groups of 1, 4 & 9).
	66 Thermometers.
Foundation	7 Inverted Pendula.
	23 Piezometers (14 associated immediately with the dam).

Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake accompanied by Deputy Minister of State, Chandra Karunaratne and MP. Kotmale, Ananda Dassanayake inspects a new road which is being consructed around Kotmale Reservoir.

One of the main features in the Right Bank Canal was the aqueduct built over the Badulu Oya.

1 Extensometer Array (Triple Anchorage).
5 Groups of Clinometers (2 per group).

Monitoring by use of these instruments is supplemented by general observation of crack or fissure development within the dam, and also of any seepage flows within the dam or in the area immediately downstream. This is coupled with measurements of flow, from the drainage system within the body of the dam and from the drainage curtain in the foundation beneath.

Precise Geodetic Survey System consist of:

*48 Survey Targets on the downstream face of the dam.
*2 Survey Stations on the dam crest (used as extra targets).
*4 Survey Stations downstream of dam in river valley.
*5 Survey Stations further afield for reference purposes.

Precise Levelling System consists of:

*11 precise level studs along the crest of the dam.
*1 precise level Benchmark

Pendulums

Pendulums both normal (hanging) and inverted have been installed in seven locations in the dam. These devices are relatively quick and easy to read, and give an accurate measurement of the horizontal movement of the dam structure and its foundation, relative to a point of some 30 metres below the foundations which can be considered static.

The information derived from the pendulums, which can be easily and quickly obtained, supplements the survey monitoring to the downstream face of the dam which is carried out much less frequently.

Vibrating Wire Instruments

Vibrating wire instruments are used in the dam for measuring strains and temperatures in the concrete, by direct embedment of 250 mm long gauges and for measuring small rotational movements by surface mounted clinometers.

A total of 372 vibrating wire instruments are installed in the dam as follows:

V. W. Strainmeters . .	230
V. W. Corrector Strainmeters	66
V. W. Thermometers . .	66
V. W. Clinometers . .	10

Regular monitoring of these instruments enables a check to be kept on the stresses induced in the dam concrete and the movements of the dam at foundation level.

Extensometer

A three point extensometer array has been installed in the foundation of dam block 1, in order to measure the deformation of the foundations in the middle of the dam.

Drainage Curtain

Water seepage through the dam foundation is intercepted and monitored by a pattern of open drain holes, drilled downstream of the grout curtain.

In most cases the holes are 76 mm in diameter and are drilled downwards from Gallery G and upwards from the two flank drainage galleries, to form a comprehensive drainage curtain.

Piezometers

Piezometers are installed in holes drilled into the dam foundation from Gallery G and in holes drilled in the abutments downstream of the dam.

The Piezometers measure the ground water pressure level at a specific section, (response zone) in each of the drilled

holes and by regular monitoring give an indication of changes in the groundwater regime.

Water seepage and groundwater pressure control, is a very important aspect to be monitored on a high dam and a change in Piezometric pressure in an area, could give early indication of the inadequacy or deterioration of the grout an/or drainage curtain.

Action to Prevent Failure

An emergency action plan should be developed for each dam that constitutes a hazard to life and property, incorporating pre-planned emergency measures to be taken prior to and following assumed dam failure. The plan should be co-ordinated, with local governmental and other authorities involved in public safety, and be approved by appropriate top level agency or owner management. To the extent possible, the emergency action plan should define emergency situations that require immediate notification of local officials.

When it is determined that a dam may be in danger of failing, the public officials responsible for the decision to implement the evacuation plan, should be kept informed of the developing emergency conditions.

Telephonic communication should not be solely relied on in critical situations. A back up radio communication system should be provided and tested at least once, every 3 months. Consideration should be given to the establishment of a radio communication system, prior to the beginning of construction and to the maintenance of the system throughout the life of the project.

Safety of Dams

Project security is a matter of concern at all major dams. This includes preventing structural damage by vandals or saboteurs and unauthorized operation of outlet or spillway gates. In most cases, restricting public access is essential and in some instances, armed guards may be necessary.

Public safety is of paramount importance at all dams and reservoirs. Specifically, public safety on the reservoir, in areas adjacent to the reservoir and below the dam, particularly in bathing areas. Safety measures should include identification of high watermarks, to indicate past or probable reservoir levels and stream-flows, posting of safety instructions at highly visible and key locations, and providing audible safety warnings below outlets.

Communication should be maintained among affected governmental bodies and with the public, to enhance the safety aspects of the operation of the dam. Communication alternatives include written communications, radio, telephone, television and newspapers.

▲ His Excellency, President J. R. Jayewerdene declared open the Milk Processing Centre at the new town of Girandurukotte. Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake, Mrs. Srima Dissanayake and Consultant Livestock, Chris de Saram is also present.

▼ The co-operative milk collecting centres in System 'C' have proved a great success.

LIVESTOCK & CONNECTED ACTIVITIES

The Draught Animal & Dairy Development Programme of the Mahaweli Authority of Sri Lanka, which commenced in 1981 as a Draught Animal Programme only, has completed its fourth year of operations. The strategy for 1986 was one of consolidation of existing herd as opposed to further expansion, particularly as the farms in each of the Systems were now primarily concerned with the production of F 1 & F 2 offspring.

The on-farm activities saw the visual impact of offspring from the imported sires from Pakistan. At the commencement of these breeding units the foundation stock represented small and economic indigenous cows and heifers. The first objective was to produce offspring of better conformation and size and therefore the best available stud material in the island was utilised for this purpose. Cross bred female offspring has and combines to be mated to imported Tharparkar and Sahiwal from Pakistan. However, it takes five to six generations to achieve a grade animal and breeding programmes of this nature have to be extended over the period of time over which such grade females can be produced. The calving percentages on each of the farms are ahead of our projected targets at the moment and we have no doubt that the close of 1986, will see a total production figure in all Systems of both F 1 & F 2 offspring, numbering in the region of over 1000 calves.

The major focus of attention in the current year was the promotion of further extension and the rationalising of inputs, following the increasing number of new settler farmers in the downstream development strategy. Certain translocated Purana and encroacher settlers who were rationalised at the point of induction, have seen the wisdom of reducing their often sizeable herds of uneconomic value, retaining a few of the better stock for their future requirements. As an illustration it will be worth recording that an indigenous yearling is normally priced at around Rs. 700/- – Rs. 800/- an animal. An upgraded yearling changes hands at Rs. 2000/- and over. The extension component of the programme now forms the major part of the animal budget, being in the region of 70% -- 75%.

In regard to the Vaccination Programmes, all Systems except System A, the undermentioned number were recorded in respect of the July/August operations in the current year. System H – 14,205, System C – 12,573 & System B (part) 5,005. Usage of vaccine and all relative records and data are forwarded to the Department of Animal Production & Health and the Veterinary Research Institute. There have been no outbreaks of Haemorrhagic Septicaemia recorded in

the areas covered by the Draught Animal & Dairy Development Programme and the implementation of this disciplined programme over the last 3–4 years has been effective. Once again, the vaccination against Foot & Mouth in System H was not recommended by the Department of Animal Production & Health due to the fact that no outbreaks have occured in this area since 1981.

Swine production is now a feature on all farms in all Systems except System A and the increased interest by settler farmers to the raising of the odd pigling with the means of additional income generation.

A Cattle Show was held in April 1986 in System C, there being 395 entries from which 62 selected animals were paraded in eight different groups. Cattle Sales both ex-farm and on selected dates were held throughout the year, but the demand for upgraded stock continues to outstrip supply. As regards the field upgrading programmes, stud bull centres proved inadequate and a new concept named the "Board and Lodging System" was introduced with much more rewarding results. This particular System is practicable in settlement programmes such as Mahaweli.

Senior Veterinarians from both the University of Sri Lanka and the Veterinary Research Institute, together with undergraduates and our own staff visit a preselected Unit which comprises around 200 families, where the settlers owing cattle bring in all cows and breedable heifers for pregnancy diagnosis examination. Animals found to be pregnant are taken away by their owners whilst those which are cycling normally, are moved to a special area of the farm where over the subsequent 30 days, these are mated to Sahiwal and Tharparkar sires from Pakistan. By this means an accelerated programme of upgrading is envisaged and current projections indicate that within a matter of three years from the commencement of this programme, almost all cows and breedable heifers will have been mated to imported stud stock. This programme will mark the exit of indigenous stock to be replaced by 50% crosses off imported sires. The increase to GNP and to the value of farmer stock will be appreciable and the milk potential from the cross bred animal will naturally be higher than that of the local indigenous animal.

His Excellency, the President, visited Girandurukotte Farm when the new Township of Girandurukotte was inaugurated. He examined with interest, the prize winners from the previous week's Cattle Show, spoke to dairy settler farmers and also formally opened the new Mini Dairy called the Bintenne Milk Producers Union Ltd. This Union in System C is a federated body of 19 producer societies which were registered in September 1985. The societies manage their own affairs and 12 of them have already placed sums between Rs. 3,000/- & Rs. 5,000/- at fixed deposits from their savings which range from Rs. 5,000/- to Rs. 10,000/- per society.

Although a Union has not yet been set up in System H, this area has 24 societies in operation.

The animal returns to farmers who partake in this movement is around 1.5 Million Rupees per annum in each System. Introduction of a banking habit is a natural follow up to the Programme.

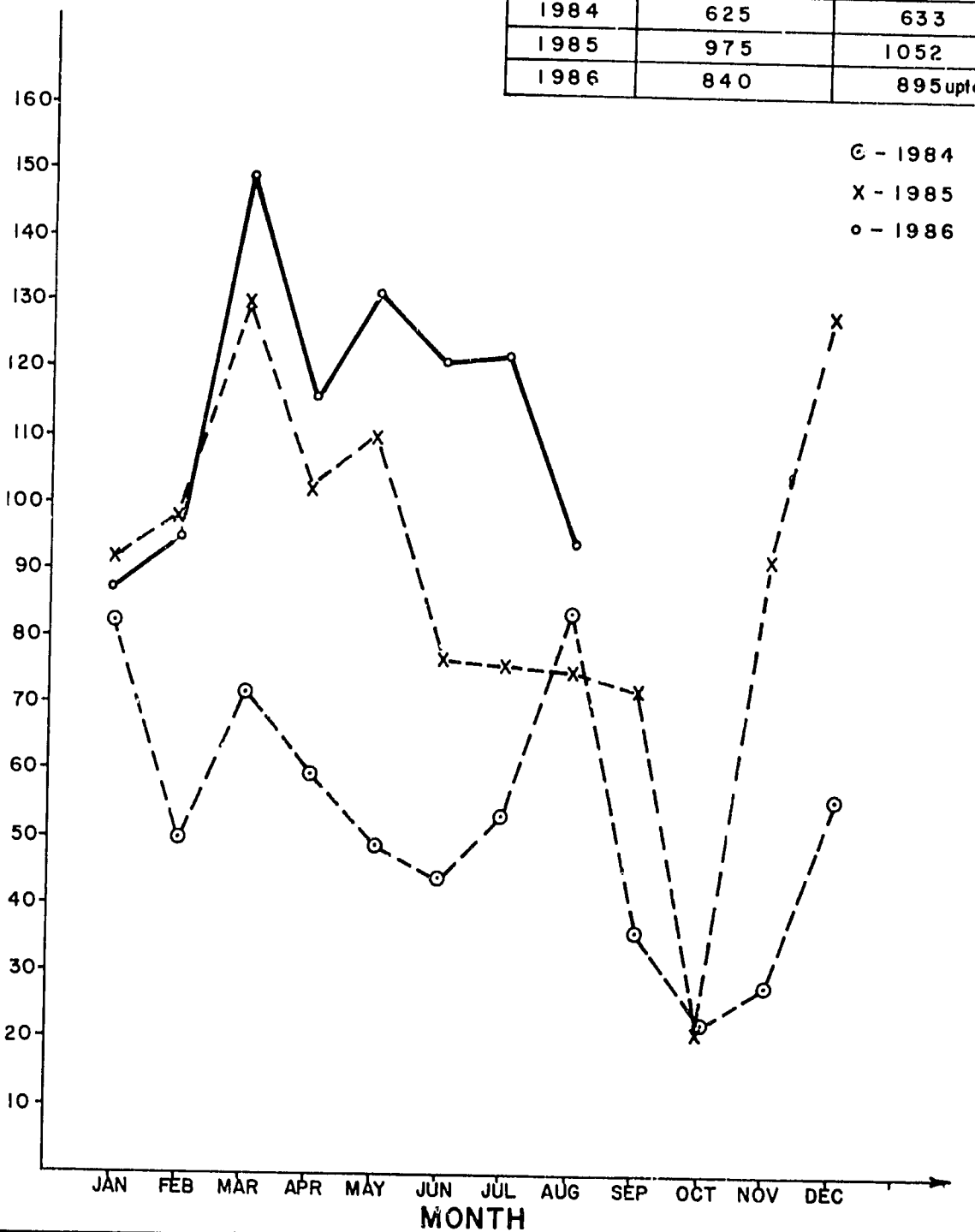
The Poultry Programme at Kantalai and Poonanai suffered as a result of the paucity of day old chicks and the ethnic unrest in the areas. However, work at Poonanai has now been consolidated and the reintroduction of the Poultry Programme is planned for the last quarter of 1986.

BIRTHS 1984 TO 1986 AUGUST.

UPGRADED STOCK IN ALL FARMS

D.A AND D.D.P

YEAR	PROJECTED BIRTHS	ACTUAL CALVINGS
1984	625	633
1985	975	1052
1986	840	895 upto Aug.



MILK COLLECTION

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
System "H"	10,624 25	13,714 75	18,704 75	19,142 75	20,225 50	23,436 25	29 602 00	32 353 85
System "C"	7,632 50	11,545 25	15,553 25	12,284 00	17,707 50	22,559 50	21 201 50	29 500 00

PAYMENTS TO SETTLERS

	Jan	Feb	Mar	Apr	May	Jun	July	Aug
System "H"	43,644 18	52,483 89	71,736 98	72,584 00	79,297 67	95,653 06	1,21,460 79	1,37,742 35
System "C"	31,560 02	45,350 82	59,209 89	45,657 32	65,457 41	86,837 50	1,12,190 74	1,10,954 73

Niraviya Farm:

The nucleus herd of imported Sahiwal and upgraded Sahiwal crosses is increasing, and the Department of Animal Production & Health, working through the Swiss Programme, is anxious to obtain semen from the best of these bulls for the Extension Programme both within Mahaweli and other parts of the island. Similar extraction of semen for the Tharparkar breeds is also planned.

The goat herd at Niraviya had been introduced to the improved stud specie raised at Kottukachchiya Farm and animals with better conformation, weaned at an earlier stage, will be available for sale and distribution towards the close of this year. The major pig breeding programme is at Niraviya.

More demand has been seen for the improved buffaloes at Kalankuttiya, a feature which is contrary to information received, namely, that the buffalo is proving to be of less interest than the upgraded neat cattle specie.

Girandurukotte & Sorabora Farms:

Two farm units have concentrated on upgrading and the calving rates are ahead of schedule. The Extension Units will make a thrust into the new areas of Zones 3 & 4 with the establishment of a nucleus station in the forward areas.

Poonanai Farm:

Although constantly on alert, Poonanai has re-established itself in the Eastern segment of System B and the pure bred Tharparkar are housed on the farm in addition to the upgraded stock. Foraging by the Poonanai herd of elephants continue to pose a problem and electric fencing will be introduced before the close of the current year.

Damminna Farm:

The nucleus station at Damminna has been replicated at Muthugala but the work at the latter station will not be completed until midway in 1987. Both these nucleus stations deal primarily with extension and upgrading.

Kantalai Farm:

This farm houses Khillari upgrading programme but, due to ethnic unrest and the isolated nature of this unit, the farm, although in excellent condition, is on a care and maintenance basis for the moment. Staff at Kantalai have responded despite terrorist pressure and the abduction and killing of Cattle Keepers.

As originally planned, the main work over the next two years apart from the breeding programmes on the farms themselves, will be geared to the wider dimension of extension and economic return. It is hoped that as a result of the producer participation, Farmer Unions will, in the course of the next 2–3 years assume the management mantle of not only running their own societies but, also incorporating the other aspects of extension and marketing of their own products.

WATER MANAGEMENT FOR POWER & IRRIGATION

The physical and organizational complexity of the Mahaweli Ganga development provides a difficult water management framework. Important physical constraints include the large differences in energy generation potential for alternative diversion routes and the lack of head pond storage at key diversion points Polgolla, Minipe and Elahera. Organizational constraints arise from the power irrigation trade off and the allocation of operational responsibilities to four separate Agencies: Headworks Operation & Maintenance Division (HAOM), Mahaweli Economic Agency (MEA), Irrigation Department (ID) and Ceylon Electricity Board (CEB).

The first benefits of the Mahaweli Project were realized in the middle 1970s, with the completion of the Polgolla diversion and its appurtenant works. The systems then benefited, comprising mainly in the Ambanganga and Kala Oya irrigation basins were operated essentially as a single purpose (irrigation) project, though a 40 Megawatt (MW) hydro plant had been installed at Ukuwela and another 40 MW power station was under construction at Bowatenne. The hydropower generation at this stage was viewed more or less as a by-product of the irrigation releases, and the responsibilities for both operational planning and system operation too lay mainly with one organization, the then Mahaweli Development Board. With the rapid growth of the project, in both magnitude and complexity, under the Accelerated Programme, the need arose for a more sophisticated approach in operational planning and a fresh demarcation of operational functions among the different agencies, consistent with their historical roles and specialized skills. In consequence, the operational responsibilities for the project are allocated today as follows:

CEB Power tunnels and power stations at Kotmale, Victoria, Randenigala, Bowatenne and the Ukuwela power station (excluding Polgolla tunnel).

HAOM All multi-purpose projects excepting those facilities in charge of the CEB as above, Polgolla barrage and tunnel, Minipe anicut and right bank transbasin canal, Ulhitiya–Ratkinda dam, Ratkinda –Maduru Oya link tunnel, Maduru Oya dam, Bowatenne dam and irrigation tunnel, Lenadora–Kandalama canal and the 3 tanks Kalawewa, Kandalama and Dambulu Oya (excepting operation of their head sluices)

MEA Kalawewa, Kandalama and Dambulu Oya tank head sluices, for irrigation of Systems H, C and B.

ID Elahera anicut, Elahera-Minneriya Yoda Ela, Minneriya–Kantalai, Yoda Ela, irri-

gation systems I (H) (Anuradhapura tanks), M (H) (Huruluwewa), G (Elahera), DI (Minneriya, Giritale, Kaudulla and Kantalai), D2 (Parakrama Samudra), E (Minipe left bank) and A (Allai scheme).

The tradition of irrigated agriculture in Sri Lanka has led to a long standing familiarity with basic water management issues, and to the development of a consultive approach to the resolution of conflicts. Thus with the rapid expansion of the project, it also became clear that a formal policy making body would be required at the national level, supported by a specialized technical unit, to lay down operational guide lines and to arbitrate in case of disputes. These needs were met with the establishment of the Water Management Panel and the Water Management Secretariat in 1982.

Water Management Panel

This is a policy making body headed by the Director-General of the Mahaweli Authority of Sri Lanka (MASL) and comprising all heads of government agencies involved with the management and operation of the Mahaweli Scheme.

The principal function of the WMP is to govern the management of the water resources of the Mahaweli system to achieve optimum benefits. The WMP makes operational policy decisions and sets overall cultivation programme for the irrigated areas served by the Mahaweli system. This is accomplished mainly through convening two formal meetings per year, prior to the Maha and Yala seasons. At these meetings, policy decisions are made regarding the allocation of water to irrigation areas, the cropping calendar to be followed, and operating guidelines to be followed at the principal control structures. Special meetings are convened occasionally, to decide on policy changes or to deal with water management situations requiring urgent resolution.

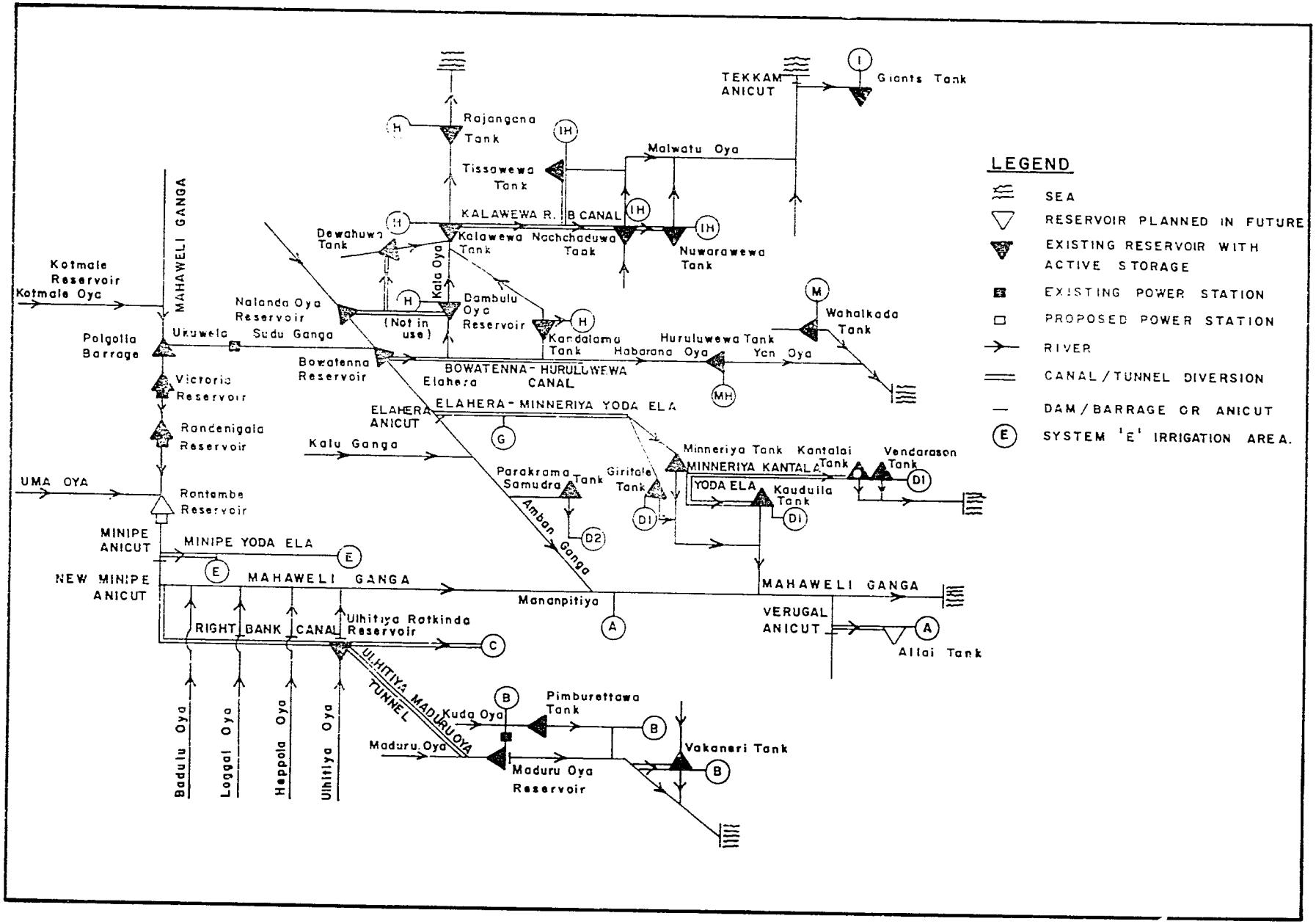
Decision making at WMP meetings is by concensus, rather than by vote. This approach has worked well in the past, when contentious water management issues were primarily related to allocation of scarce water resources among competing irrigation areas. More difficult power irrigation trade off question are likely to arise in the future and further study and dialogue will be required in these areas, to examine the long-range impact of alternative operating policies on the irrigation and power sectors.

Water Management Secretariat

The WMP is advised by a technically specialized unit, the WMS. Although it is, administratively speaking, a part of the MASL, the operational planning and co-ordination responsibilities of the WMS extend to the other operating agencies as well. The WMS provides information and recommendations to the WMP to assist it in reaching its operational policy decisions. Once the decisions are made, the monitoring of the total programme is directed by the WMS.

Operating policy advice is provided to the WMP, principally in connection with the two Seasonal Operating Plans (SOP) prepared each year.

In recent years, operating policy issues have become increasingly complex, necessitating the rigorous examination of broad operating policy options. The WMS has developed suitable reservoir operating rules, (rule curves and rationing policy) diversion policies (rules to govern the spatial distribution of water) and irrigation planning policies, priorities and assumptions for planning of dry season cropping.


TEKKAM ANICUT
Giants Tank
Rajangana Tank
Malwatu Oya
Tissawewa Tank
KALAWEWA R. B CANAL
Dewahuwa Tank
Kalawewa Tank
Nachchaduwa Tank
Nuwarawewa Tank
MAHAWELI GANGA
Kotmale Reservoir
Kotmale Oya
Kala Oya
Nalanda Oya Reservoir
(Not in use)
Dambulu Oya Reservoir
Wahalkada Tank
Polgolla Barrage
Urauwela
Sudu Ganga
Kandalama Tank
Huruluwewa Tank
Haburana Oya
Yan Oya
Bowatenna Reservoir
BOWATENNA - HURULUWEWA CANAL
Elahera
Victoria Reservoir
ELAHERA - MINNERIYA YODA ELA
ELAHERA ANICUT
Randenigala Reservoir
Kalu Ganga
Minneriya Tank
Kantalai Tank
Vendarasan Tank
MINNERIYA KANTALAI
UMA OYA
Parakrama Samudra Tank
Giritale Tank
YODA ELA
Kaudulla Tank
Rantembe Reservoir
Amban Ganga
MINIPE ANICUT
MINIPE YODA ELA
NEW MINIPE ANICUT
MAHAWELI GANGA
Mananpitiya
MAHAWELI GANGA
VERUGAL ANICUT
Allai Tank
RIGHT BANK CANAL
Ulhitiya Ratkinda Reservoir
ULHITIYA MADURUOYA TUNNEL
Badulu Oya
Loggal Oya
Heppola Oya
Ulhitiya Oya
Kuda Oya
Pimburettawa Tank
Maduru Oya
Vakaneri Tank
Maduru Oya Reservoir
LEGEND
SEA
RESERVOIR PLANNED IN FUTURE
EXISTING RESERVOIR WITH ACTIVE STORAGE
EXISTING POWER STATION
PROPOSED POWER STATION
RIVER
CANAL / TUNNEL DIVERSION
DAM / BARRAGE OR ANICUT
SYSTEM 'E' IRRIGATION AREA.

Operational Planning

Seasonal Operating Plans are prepared twice each year, to project system operations over the forthcoming irrigation season. These plans are prepared in respect of the 6 month periods October – March and April – September, corresponding to the two cultivation seasons, Maha and Yala.

Each SOP is prepared in accordance with an agreed schedule and consultative process. All operating agencies are required to submit their initial operational objectives for the season in question to the WMS, early in the SOP preparation schedule. These objectives are expressed in terms of target irrigated areas (MEA and ID) and national demands for power and energy (CEB). WMS staff are responsible for assessing the ability of the available resources (water in storage and generating capacity) to meet these objectives with an acceptably low risk of failure. They use three computer models to evaluate the ability of the Mahaweli system to meet the needs defined in the operating agency submissions.

(a) The Acres Irrigation Demand Model – to calculate monthly irrigation demands at all demand points.
(b) The Acres Reservoir Simulation Programme (ARSP) – to simulate the ability of the network of irrigation tanks, diversion and multi-purpose reservoirs to meet the computed irrigation demands.
(c) The NEDECO Macro Model – to simulate the ability of the Mahaweli, K–M complex, and thermal power stations to meet the total power requirements of the country.

These models are used with 32 years of hydrological data to examine system performance under the proposed operating conditions.

If their initial studies indicate that the objectives cannot be met (this normally occurs only in the Yala season), a consultative process is prescribed to reduce irrigation demands or re-allocate power generation priorities. The WMS then reasesses the supply demand balance and finalizes the SOP. The objective is to submit to the Water Management Panel a SOP that has been thoroughly discussed at the technical level, and that is operationally feasible.

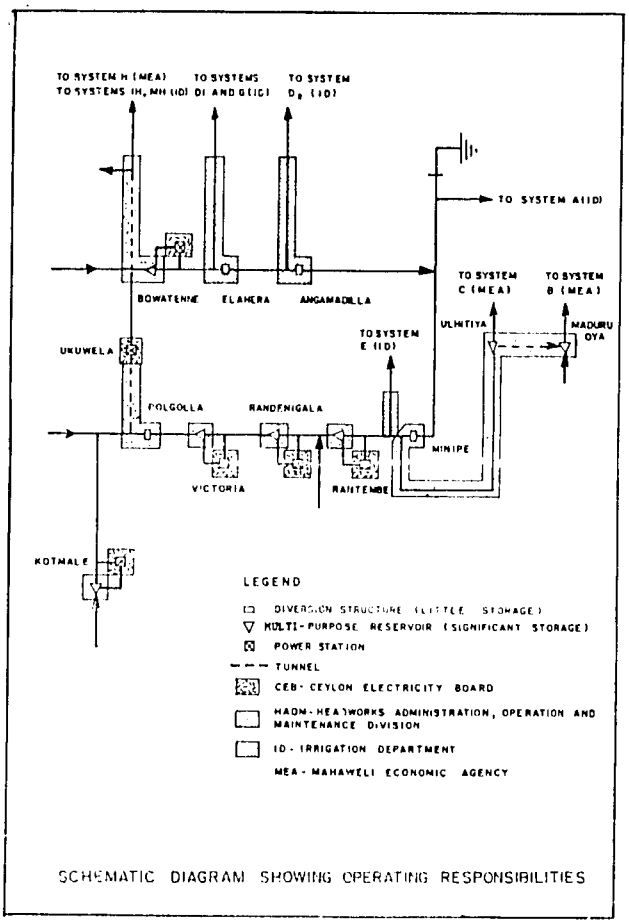
Routine Operations

The WMS is responsible for co-ordinating the implementation of the approved SOP. Data on system performance are regularly collected by the WMS from the operating agencies, and are compiled and summarized for direct or indirect use. Simulation models are used to project system performance over the balance of the current season, using updated information on hydrological conditions, progress of irrigation, and the availability of generating capacity. Meetings of senior operating staff are held at the WMS office each Friday morning, to review the events of the past week, and to assess possible problems in the coming week and over the balance of the season.

At the end of each season, a Seasonal Summary Report is prepared by WMS, documenting operational results in terms of irrigated areas, irrigation water consumption, diversion volumes, and power generation. These are compared with the projections made for the SOP, and any deviations are noted and explained. If problems arose during the season, these are highlighted for discussion at the next WMP meeting.

System Status

Since the commencement of the Accelerated Programme, the extent irrigated



SCHEMATIC DIAGRAM SHOWING OPERATING RESPONSIBILITIES

has steadily increased and at present stands at 120,000 ha (see attached Table 1).

All the recent cultivations have been quite successful from a water management stand point, and the farmers in the old irrigation schemes no longer have cause to be wary of chronic water shortages during the Yala season, as in the past. The growth in the hydropower capacity, though, has been much faster, and with the completion of the Randenigala Project, Mahaweli's contribution to the installed hydropower capacity has increased up to 546 MW, compared to the 321 MW installed hydropower capacity presently available to the CEB from all other sources. The impact of the Project on the island's electricity generation could be gauged from the fact that during the last 2 years, the CEB's energy needs were met practically from hydropower alone, thermal power generation being minimal during the period. In the 18 month period January 1985 – June 1986, 1650 GWH of energy were generated from the Mahaweli power stations (see attached table 2) constituting 45% of the CEB's output during the period.

TABLE I

IRRIGATION AREAS BENEFITTED BY THE MAHAWELI PROJECT

Irrigation System	*Diversion Point*	*Benefitted Tank*	*Capacity of Tank (MCM)*	*Extends under Cultivation ha.*
H	Bowatenne	Dambulu Oya	11.7	2,100
		Kandalama	33.8	4,900
		Kalawewa	123.3	24,100
		Rajangane	100.7	6,800
IH		Nachchaduwa	55.6	2,400
		Nuwarawewa	44.4	971
		Tissawewa	6.7	400
MH		Huruluwewa	67.8	4,300
G	Elahera	Under EMYE	—	4,500 (5,400)+
D1		Minneriya	135.7	8,900
		Giritale	24.0	3,000
		Kaudulla	128.3	4,500
		Kantalai/Vendarasan	157.9	9,900
D2	Angamedilla	Parakrama Samudra	134.4	10,100
E	Minipe	(Under Minipe LB Canal)	—	6,100
C		Soraborawewa	—	810
		Mapakadawewa	9.3	690
		Dambarawewa	—	610
		Ulhitiya/Ratkinda	146.0	11,000 (22,700)+
B	Maduru Oya	Pimburettewa	—	1,800
		Maduru Oya	586.5	5,000 (38,300)+
A		Allai Scheme	—	7,000 (20,300)+
TOTAL				119,881 ha. or 296,106 ac.

+Full potential area shown within brackets.

TABLE 2

ENERGY GENERATION IN GWH

	1985												1986						*Total*
	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*J*	*F*	*M*	*A*	*M*	*J*	
MAHAWELI																			
Kotmale	–	–	–	–	23	34	17	16	–	–	–	–	–	–	28	44	35	–	
Victoria	53	53	67	41	36	16	41	48	60	61	54	63	81	70	75	72	75	74	
Ukuwela	14	5	3	10	14	22	25	22	22	23	22	20	14	12	9	5	14	13	
Bowatenne	11	3	3	4	4	11	13	8	7	10	15	12	16	5	7	2	6	7	
Sub-total	78	61	73	55	77	83	96	94	89	94	91	95	111	87	119	123	130	94	1650
K–M COMPLEX	117	118	112	125	101	112	77	119	116	119	108	120	100	108	102	80	83	113	1930
(hydro) THERMAL	3	3	22	12	20	1	2	4	2	–	1	–	3	–	–	–	1	1	75
TOTAL	198	182	207	192	198	196	175	217	207	213	200	215	214	195	221	203	214	208	3655

SPORTS & RECREATION

The Mahaweli Authority is deeply conscious of the need to provide for facilities to promote sports and recreation in the new development area, in order that the emerging Mahaweli communities are well-structured and well-rounded. No matter what the environment is, people have an instinct for sport and they will accordingly look for opportunities to fill their leisure with some form of recreation. Young persons, especially feel the urge to exercise their physique and are drawn to games where they could excel competitively, either individually or as a team. The lack of opportunity to do so stultifies them, leading some to wasteful habits and even antisocial behaviour.

Sri Lankans no matter where they live have been sports bent, sports conscious and a sports loving people with an in-built sense of fair play, which is but second nature to sportsmen and sportswomen. This has been the subject of comment by well-known sports writers who have travelled here with foreign teams and been impressed by the fair-mindedness of local spectators. Sri Lankan sportsmen and sportswomen have been handsomely complimented for their sporting prowess and sportiness, and the high standards maintained on and off the field. The exacting standards required of our sportsmen and sportswomen at school, and in clubs, are mainly responsible for such discipline.

The wide exposure sports, and sports heroes and heroines receive in mass communications media have boosted sports enormously, resulting in sports clubs being established even in suburban areas, which now participate in the better known national leagues. Schools are hard put to it to provide facilities for the increasing numbers turning up for coaching in competitive sports.

The Ministry of Sports, sports promotional bodies, statutory organisations in the state sector and mercantile establishments have stepped in wherever possible to ensure that the promotion of sports does not suffer from the lack of funds, and that such promotion transcends urban boundaries and spills over into the rural sector. Still, quite obviously there is a lot to be done, to dispel the feeling prevalent in rural areas that they are being overlooked by the sports promotional campaign.

It is in this area that the Mahaweli Authority is poised to play a pivotal role.

The Mahaweli settlement zones, now familiar to the country at large as "Systems" are basically new development areas. But, some as in System 'H' have encompassed already developed old settlements. Such widespread development was made possible as a result of the diversion of the Mahaweli waters to the Kala Oya basin. The enmeshing of river basins by trans-basin water conveyance,

has provided as in this case, a broad region with a wide resource base for integrated development. The resulting regional development has taken note of the need to relate the new infrastructure to the existing facilities and the demographic patterns proposed. The influx of some 25,000 new families into this region and the establishment of new towns to serve clusters of villages has led to the emergence of cohesive communities, around the new and old townships, with a new vitality and new sense of purpose.

One-street towns of the past like Nochchiyagama, Tambuttegama, Telhiriyagama, Ipalogama, Medatugama, Awkana and Galkiriyagama – where earlier unherded cattle alone seemed to have the right of way – have now woken up from the sleepy subsistence economy to find themselves transformed by criss-crossing roads, connecting them to the national road, network, and the wider region on the periphery at Anuradhapura and Kurunegala.

Responding to the new purposiveness prevalent, the settlers have flexed their muscles and girded their loins to participate in the exciting experience of a rewarding life under the Mahaweli. With attractive prices for their produce, and money in their pockets and some stashed away in banks, Mahaweli settlers and the townsfolk servicing them have both, the ways and means, to savour the good things of life. And, one of the best things in life is sports.

Mahaweli settlements both in System 'H' and System 'C' have provided for aesthetically landscaped playing fields for the towns, villages and schools. It is the school playground which is perhaps most important as the schools play the nursery role in shaping the sportsmen and sportswomen of the future. The town playgrounds are being landscaped with the future in mind as they may have to be upgraded as stadia, for major national sporting events of the future.

The Mahaweli Authority is specially mindful of the promising prospects of aquatic sports, especially rowing, on the major reservoirs

The Mahaweli sports festival held recently at Galnewa, sponsored by the Mahaweli Economic Agency, was meant to draw attention to the facilities available to conduct a major national sports event in a new development area, and also as an earnest intention of the Mahaweli Authority to promote sports activities in Mahaweli settlements.

It is important to stress that the role of the Mahaweli Authority will be not only to support the promotion of sports by providing it with infrastructure and facilities, but also evolve a sports policy for the new development area with the assistance of the Sports Ministry, which will have to enthuse sports bodies and schools' authorities and draw the new area to the national mainstream of sporting activity.

It augurs well however, that already young persons use the playgrounds available for major team sports like football, while volley-ball, elle and softball cricket are popular anyhow. It is perhaps a matter of time before rugby football catches the imagination of Mahaweli settlements. Hockey is yet another team sports which has promising prospects in the new development area.

Cricket for all its mass appeal will take time to send down its roots in the Mahaweli settlements, in view of the cost of gear and facilities. It is entirely up to schools to nurse cricketing talent and then obtain support from the Cricket Foundation as further back up, to sustain the game in a new environment. The Mahaweli Authority could be expected to provide standard matting wickets for the major schools in the new development

area, when such facilities become necessary, together with practice pitches. Imaginative principals of schools elsewhere, have mobilised local enterprise to support sports activities in schools, and Parent/ Teachers' Associations are known to play a keen supporting role to encourage sporting activity, as a matter of prestige for the institution where their children are schooling. Though a team sport, cricket needs sharpening of individual skills and enormous resources, to sustain long practice sessions under the supervision of competent coaches.

In the related field of cultural recreation, the Mahaweli settlement efforts has certain responsibilities of a far wider significance, namely to keep alive the traditional performing arts, and traditional arts and crafts of the people. The preservation of these art forms are of national importance as they are part and parcel of our living heritage.

It is the song and dance forms, arts and crafts and ritual, that give our people their distinct cultural identity. The transfer of these art forms and ritual to a new environment of cultural aridity is rendered more vexatious, as their well-springs emanate from traditional temples. Even though entire villages, consisting of hundreds of people could be physically translocated, it is not possible to remove a place of worship or its hallowed precints and traditional ritual. In the event, the ceremonial attached to a temple ritual could die off due to disuse and the attendant art and crafts lost for ever. In the circumstances, the Mahaweli Authority has to ensure that the settlers are provided with their places of worship along with other infrastructure, especially in the new development area of System 'C', which has been carved out of thick jungle. Thereafter, these temples have to be sustained until such time they derive strength and support from the settlers. The settlers initial period of adjustment to the new environment is fraught with trauma. The new settlers could hardly be expected to be preoccupied with cultural objectives in such a social climate. It is precisely at such moments of crisis that traditional villagers, seek out their places of worship and look for guidance from the bhikkus. The bhikkus head the village leadership hierarchy and their advice is earnestly solicited by rural folk.

Having referred to sports in some depth and the vital subject of cultural well-being of the settlers, albeit briefly, it is opportune to state that the Ceylon Tourist Board has chosen Girandurukotte, in System 'C' as a venue for holding a traditional Games Festival with the assistance of the Mahaweli Centre, during the April festivities in 1987, as a tourist attraction.

It is proposed to enact ritualistic sports of "ang adeema" and "pora pol" for the benefit of tourists and publicise the event internationally.

Both these games are enacted as fertility rites and religious observances to ward off epidemics, and they derive from adherence to the Pattini cult. The Pattini cult is a strong binding force in the rural interior and people gather in large numbers, especially after harvest time, to propitiate this goddess by the enactment of the ritual drama of Sokari. Sokari is enacted on the threshing floor and is thoroughly enjoyed by the people on account of its risque humour.

The Mahaweli Centre has plans to encourage these ritualistic art forms in view of their significance in cohering rural society.

▲ The Mahaweli Authority of Sri Lanka takes pains in promoting the health of the Mahaweli settlers and in the prevention of diseases.

▼ Hon. Gamini Dissanayake, Minister of Lands & Land Development and Mahaweli Development after declaring open a new Divisional Office of the Anti-Malaria Movement at Giripokuna opened the new Ayurvedic Dispensary at Gajabapura.

HEALTH, NUTRITION & EDUCATION

The Planners decided to provide educational, health and other social facilities in the areas to be developed and settled under the Mahaweli Programme. The Ministries concerned were given the details of the settlement pattern - viz. hamlets, villages and townships, together with the populations that were anticipated in each of these areas and requested to inform what their requirements would be for each area. With the requirements for schools, hospitals, etc., known, the planners were able to formulate a comprehensive social infrastructure package consisting of schools, hospitals, roads, transport and communication systems, for each of the settlement areas. This included the construction of new towns and strengthening the infrastructure of existing towns to cater for the increased population. This package provided for all the social facilities for the Mahaweli settlement areas as were available in the rest of the country.

The complex social infrastructure model planned for the Mahaweli settlements was a new concept, and in keeping with this, the authorities gave the programme of community development work an importance as equal to that of irrigation and agriculture. The construction of the social infrastructure was carried out by the Mahaweli Authority with their own funds. This ensured that the lack of funds would not impede the completion of the construction work as it would normally have happened, if the programme was left to each department with its limited resources. The ideal method is to have the social infrastructure in readiness for service before the settlers are moved in. Due to various reasons, however, one of which was the accelerated nature of this programme, this was not possible. If the social facilities are available at the time of settlement, the settlers would settle down to normal life in full measure in the new areas, within a short period of time, and will be able to give their complete attention to the development of their new lands.

About 100–120 families are settled in a Hamlet. Each Hamlet is provided with a Co-operative Store, Post Box, Day Care Centre and wherever necessary, a Primary School. A Village Centre is built to cover 8 to 10 such Hamlets. A Village Centre consists of a Rural Bank, registered Co-operative Society, Community Training and Development Centre, Junior School, Sub-Post Office, a Weekly Fair and Commercial allotments for the development of Consumer Services. Besides these facilities, land is allocated to persons with technical aptitudes to start service industries such as, for bicycle repairs, tractor repairs, smithies and processing industries like small-scale rice mills.

A Township under a Mahaweli Project serves two to five Village Centres. A Township consists of, in addition to the commercial services, a Secondary School, Rural Hospital, Banks, Police Station, Marketing Department, Fisheries Stall, Co-operative Complex, Fuel Station and other facilities needed for an agricultural hinterland. Under the township development programme, plots of land are given out to businessmen and entrepreneurs to set up various businesses and trades.

In earlier settlement schemes in Sri Lanka, the Land Commissioner's Department did the land settlement, whilst the Irrigation Department constructed the irrigation system. Once the construction phase was over, the officials of these two Departments were withdrawn or thinned out leaving the settlement areas to be managed within the Government's normal system of administration comprising of a large number of functional departments. This proved very unsatisfactory and most of these schemes failed to meet their objectives fully. The Accelerated Mahaweli Development Programme, therefore, caters for the management of these systems in the post-settlement period as well.

The *raison d'etre* of the Mahaweli Authority continuing the management of its project areas after the completion of the infrastructure development and settlement phase, was to have the ground work for sustained and comprehensive development of the social and economic conditions of the settlers and others living in the project areas. The experiences gained from the earlier colonisation schemes clearly show that this could not be achieved through irrigated agriculture alone. It was necessary to implement an integrated set of social programmes for the community to develop along with the agricultural and infrastructural development. Experience shows that these new communities could not develop without external guidance and assistance. Therefore, the Mahaweli Authority decided to have a separate division for Community Services and an equal measure of importance was given to the Community Development Programme as was given to Agriculture, Water Management, etc.

Community Development plays an important part in the Mahaweli Economic Agency's project activities. The community development programme has as its main objectives, the social and economic development of the settlers not only as individuals, but also as cohesive groups. This programme further strives to develop the settlers skills and attitudes and their organisations, in order to develop self-reliance modes of social behaviour among them.

This strategy aims to ensure the participation of the settler families in all its activities and programmes. A prior condition indispensible in this regard is the settlement of the whole family in the project area. If some members of his family are still in their village of origin, the settler will not concentrate fully in project activities. To ensure that the whole family settles down with the farmer from the very beginning, it is imperative that the basic infrastructure facilities are available to them. Education, Health and Public Transport are the most important of these. Once the infrastructure for the provision of health and educational facilities are complete, the Departments of Health and Education take over these complexes and provide the same facilities as they do in other parts of the island.

In most of the settlement areas, some of these facilities are inadequate and have to be supplemented by programmes implemented by the Mahaweli Authority.

HEALTH

The health of the settlers and their families play an important role in the development process as it is a means to development as well as a necessary condition of development. Unless they are physically fit, it will not be possible for them to achieve the full potential of the new lands that they have been given, and to exploit all the opportunities in their new areas. They must be mentally alert to identify and adapt to the changes that are taking place and to be receptive to the advice and instructions of the Mahaweli officials.

On the other hand, if the economic growth does not enhance the standard of health of the settlers by extension of life span, reduction of infant mortality and diseases associated with malnutrition and poor sanitary conditions, it will not be possible to improve the quality of life of the settlers substantially.

In the light of this, the Community Development Programme pays special attention to the health and needs of the settler families. Some of the objectives of the Community Development Programmes are:–

(a) to raise the health and nutrition status of the settlers through provision of primary health care and safe drinking water supply with special emphasis placed on mothers, infants and pre-schoolers;
(b) to improve the quality of primary school education;
(c) to provide institutional child care services to children of pre-school age, whose families require such services.

It was increasingly evident that the wives of the farmers had to engage themselves fully in agricultural activity if the farmers were to keep to the cultivation calendars and programmes set out. As a result, the care of their pre-school children became a problem for the parents. There were many instances where children had fallen into wells and pits, or where they had been burnt as a result of having played with fire or close to the fireplace, and where children had been bitten by snakes, often with fatal results. As a result of these tragedies, the farmers at various meetings stressed the need for a Day Care Centre in the hamlet, as a solution to this problem. It was decided therefore, to establish Day Care Centres in some hamlets on a trial basis. It was not only care and protection that was afforded to the children at these Day Care Centres, but the mental, physical and social development of the children was also looked after.

One of the major health problems in the new settlement areas is the high incidence of malaria. The Anti-Malaria Campaign continues to carry out spraying programmes in all the project areas, but with only partial success. It appears that this coverage is, at times, inadequate. The spraying campaign has to be strengthened and those areas which were highly malarial has to be given priority.

Diarrhoea too became rampant in the settlement areas, mainly due to the settler families using water unhygienically without boiling. The Health Department also found it difficult to cope with this situation because of the inadequacy of staff and other resources. Health manpower is a national problem in Sri Lanka and as a result rural health facilities are generally inadequate.

With a view to solving these problems, the Community Development Programme of the Mahaweli Authority organised a Health Volunteer Scheme.

Four volunteers from each hamlet – one for every twenty-five families, was selected and trained, mainly in the distribution of

anti-malaria tablets and rendering of first aid. They were also given training in diarrhoea management with UNICEF supplying the necessary Oral Rehydration Salts. These volunteers were also asked to assist the Anti-Malaria Campaign in their spraying operations. The Health Volunteers were also trained in giving first aid to snake bite victims as snake bite is a frequent occurence in these areas. The Mahaweli Authority has extended the Health Volunteer Scheme, initially started in System 'H', to all project areas where the Volunteers have become a very useful health task force.

There are certain times of the year when the incidence of malaria rises to high proportions which requires intensive spraying on a seasonal basis. The Anti-Malaria Campaign does not have the necessary resources to conduct such intensive programmes, which are very necessary, during these periods. They do not have sufficient manpower, funds and other resources. Further, with the opening up of new project areas for settlement, the capacity and resources of the Anti-Malaria Campaign have not been adequately increased. The Mahaweli Economic Agency now proposes to carry out its own spraying programme, in collaboration with the Anti-Malaria Campaign, in the new project areas of System 'B' and 'C'. The Mahaweli Engineering & Construction Agency too has been asked to carry out a similar spraying programme to cover their areas of activity, especially the contractors' construction camps in the new projects.

A key health worker in the field is the Family Health Worker (FHW) who provides mother and child care services. This is a recent innovation in the provision of health services. Regular Anti-Natal Clinics for the mothers and Poly-Clinics for the children are held by the Health authorities assisted by the Mahaweli community development staff. There is a very high coverage of child immunisation in the project areas. Table I gives the details of the health facilities available in the Mahaweli Project areas.

Nutrition

A recent development in the field of development thinking is the universal recognition of the importance of nutrition as a means of improving the quality of life. The Mahaweli Programme has most appropriately made a pioneering effort to introduce and integrate nutritional programmes into its overall settlement and development strategy. On-site feeding programmes were started at the Day Care Centres and the homes of the Health Volunteers as a part of the nutrition programme. All children up to the age of 5 years are brought to the closest Day Care Centre or Health Volunteer's house, where they are individually given 50 grams of Thriposha and 30 grams of Anchor Milk daily.

This programme was very successful and had a definite impact on the nutritional status of the children in the project areas. To monitor this programme, all children under the age of 5 years are weighed every three months. The "weights for age" plotted on the WHO Growth Chart (1978) projected the nutritional performance of pre-school children in a Unit. The nutritional programme which has been carried out for over three years will now have to be re-programmed with suitable changes. The present programme is based to a great extent, on the participation of the Health Volunteers. It is difficult to continue to maintain a volunteer programme for a long period. It is felt that the authorities should also make more use of the data that is gathered from the regular weighing of children.

The Mahaweli Economic Agency employs a Doctor in each of its project areas to add strength to the supplementary health services it gives to the Health Department's activities. Agreement has been reached between the Mahaweli Authority and the Health Authorities on the future requirements of health staff at all levels in the project areas.

The Mahaweli Authority has agreed to fund the training of the additional staff required. This staff will be recruited from within the project areas.

Education

The Department of Education takes over the educational infrastructure from the Mahaweli Authority once construction is complete. The infrastructure includes class rooms, laboratories, teacher's quarters and playgrounds. Desks and chairs are also provided by the Mahaweli Authority. The Department of Education takes over these schools and links them up immediately with the overall system of national education. The network of schools in the project areas provide adequate educational coverage to the children of the settlers and the system is working fairly well. One of the main problems that the Department of Education is faced with is their inability to field adequate teachers in these schools. As a result, many of these schools do not reach their true potential in the education of settler children. This is a matter that the Department of Education and the Mahaweli Authority are seriously addressing their mind to.

The present education system in Sri Lanka caters to students who wish to enter the University. The curriculum is therefore designed mainly to assist students to achieve this end. However, only a small percentage of the students in this country go for higher education, whilst the majority leave school after their secondary education and go into different fields of activity.

Since most Mahaweli settler children go back to agricultural activities of one form or the other, it has been proposed by the Mahaweli Authority that, at least in the dry zone areas, the educational curriculum be changed to have a greater emphasis towards agriculture. This would mean that these students would derive a greater benefit from their education in the future.

The envisaged changes to the present curriculum must be in consonance with the regional agricultural activities. They must respond to the felt needs of the Dry Zone agricultural areas in general and the Mahaweli areas in particular. A greater emphasis should be placed on teaching modern agriculture at all levels in the schools, in these districts. A practical approach to teaching agriculture, both rainfed and irrigated, is what is proposed.

The annual cycle of Dry Zone agricultural activity is different to that of the Wet Zone. Therefore, for the present the proposals referred to in the foregoing may be implemented on a pilot basis in the Dry Zone administrative districts in which the Mahaweli Projects are located. As far as possible, the school vacations should coincide with the periodic needs of agriculture like planting, harvesting, etc., that needs labour and intensive agricultural activity.

Vocational Training is already a school subject. Agriculture is also a subject. It is proposed that provision be made for children in these districts to study both the theoretical and practical aspects of agriculture. Agriculture related subjects should include (a) crops grown in those areas, (b) animal husbandry, (c) community participation in agriculture, (d) environmental aspects, (e) food processing,

etc., With these changes, the teachers too will have to be given a rapid training in teaching agriculture.

If a greater emphasis is to be placed on teaching agriculture in the Mahaweli areas, it is suggested that the Department of Education consider the Mahaweli areas as a separate region or district for their administrative purposes. The Mahaweli Authority could assist the schools in the project areas by providing land, equipment and tools for practical agriculture.

Details of schools that are functioning now and those which are either proposed or under construction in the Mahaweli areas, are given in Table II.

TABLE I

HEALTH FACILITIES IN MAHAWELI SYSTEMS

SYSTEM	*DIVISIONAL HEALTH CENTRES*		*SUB-DIVISIONAL HEALTH CENTRES*		*GRAMODAYA HEALTH CENTRES*		*TOTAL*	
	Already Established	*Under Construction*	*Already Established*	*Under Construction*	*Already Established*	*Under Construction*	*Already Established*	*Under Construction*
System H	03	—	07	—	27	—	37	—
System B	01	01	01	04	10	11	12	16
System C	01	—	06	01	16*	—	23	01
System G	01	—	02	—	10	07	13	07
Uda Walawe	02	—	02	—	29	—	33	—
TOTAL	08	01	18	05	92	18	118	24

*There are no separate Gramodaya Health Centres in System C. At present 16 Family Health Workers conduct their clinics at Unit Service Centres.

TABLE II

Project Area	*No. of Functional Schools*			
	Primary	*Junior Secondary*	*Senior Secondary*	*Total*
System 'H'	31	48	13	92
System 'C'	28	13	02	43
System 'G'	05	10	04	19
System 'B'	44	05	08	57
Uda Walawe	16	25	08	49
TOTAL	124	101	35	260

TABLE II

Project Area	*No. of Schools under Construction/ Proposed*			
	Primary	*Junior Secondary*	*Senior Secondary*	*Total*
System 'H'	—	—	—	—
System 'C'	17	07	01	25
System 'G'	05	—	—	05
System 'B'	07	01	01	09
Uda Walawe	—	—	—	—
TOTAL	29	08	02	39

AGRICULTURAL DEVELOPMENT

The direct economic benefits intended to achieve by all the efforts in irrigation, infrastructure, development, etc., will ultimately come from agriculture Therefore, major emphasis is laid in agricultural activities in the implementation programmes. The mechanism, organization and other support services for the implementation of the agricultural development programme in Mahaweli are set up taking three main factors into consideration. They are:–

(a) the different levels of technology of the settlers;
(b) diverse agro-climatic conditions, the agro-climatic (ecological) divisions and sub-divisions;
(c) the improvement of economic levels of the settlers.

An agricultural implementation programme was prepared solely for the Mahaweli Systems this year. Earlier this programme was prepared along with the agricultural implementation programme of the Ministry of Agriculture which did not reflect all the Mahaweli Systems individually. The main emphasis was given to paddy. But the production programme for other crops is developed to achieve regional specialization in them. This decision was prompted by the following facts:

(a) to avoid an over production level in a particular crop thus changing the settlers market to a buyers market;
(b) to facilitate the extension efforts to be carried out in a better organised and more concentrated way.

		Paddy				*(Ha)*
		B	*C*	*G*	*H*	*U/Walawe*
1985/86	Maha	3676	6754	3153	22124	9719
1986	Yala	3968	9010	1422	7484	10670
1986/87	Maha	5900	12523	3703	28751	11820

The high priority given to research in the previous years was continued in this year too. The research programmes are conducted by the Department of Agriculture on behalf of Mahaweli. A decision was taken to develop the Aralaganwila Research Station in System 'B' as a regional research station to benefit not only Mahaweli but also the similar agro-climatic regions of the country.

The research activities of the research stations in Maha-Illupuluma, Girandurukotte, Aralaganwila, Angunakolapelessa and Kalankuttiya are carried out according

to the five year research programme developed in the latter part of 1984. This five year programme makes an attempt to co-ordinate the activities of the research stations and to avoid the overlapping of research activities carried out by them.

The research programmes take into account not only the agronomic conditions in the areas, but also the alienation patterns, availability or non-availability of water and the improvement of individual farmer family incomes.

The overall research programme lays emphasis on the following objectives:

(a) development of suitable varieties of rice and other crops taking agronomic conditions and market ability into consideration;
(b) research on the micro-nutrient requirements for paddy and other crops;
(c) testing of cropping patterns and varieties of crops in different land classes;
(d) identification and monitoring of the prevalence of important pest and pathogenes in the regions with a view to find out the ways and means to control them;
(e) studies on water requirement and efficient use of water;
(f) adaptive research on the varieties already developed in other regions.

The progress of the research programmes and the extension and training requirements are constantly reviewed and discussed at the Regional Technical Working Group and Mahaweli Research Committee meetings.

Top priority is given to efforts directed towards the narrow leaf disease, which has affected the chillie cultivation and spreading very fast. While Maha Illupulama is gearing their research towards identifying the cause, the Girandurukotte station is directing the efforts towards breeding a more resistent variety by cross-breeding with indigenous varieties.

The research findings, the agricultural knowledge, market information could be effectively disseminated only through an efficient and well spread extension network. Mahaweli has built up an extensively well spread qualified extension staff. The extension staff is headed by the Deputy Resident Project Manager (Agriculture) comprising of Block Level Agricultural Officers, Unit Level Unit Managers and Field Assistant. Subject Matter Officers assist the staff in specialized fields. Constant renewal of their knowledge is achieved exposing them to training programmes here as well as abroad.

The extension strategy adopted by Mahaweli is the uniform extension system of the country. Under this system the extension message is given to the farmer groups directly.

Around 30 farmers belonging to 2 or 3 adjacent turn-outs are organized into a group. A group leader or leader farmer is selected to liase between the farmers and extension staff. Organization of visits, demonstrations, training, etc., is done for this group. The FA who generally serves 250 farmers visits each farmer group bi-weekly to impart the extention message and ascertain field level requirements.

Constant monitoring and evaluation are done to find out the effective and

AGRICULTURAL STAFF

	DRPM	PAO	BAO	SMO	UM	FA
"B"	01	---	5	2	53	53
"C"	01	—	6	3	46	32
"G"	—	01	02	---	20	20
"H"	02	01	12	11	100	100
"UW"	01	--	07	04	96	90

degree of acceptance of the extension message by the farmers.

The current extension efforts were organized towards:

(a) achieving a uniform technical level of all the farmers, especially in newly settled areas, mainly in paddy;

(b) regional specialization in other crops;

(c) mix farming, alternative crops and crop rotation;

(d) prudent use of irrigation water;

(e) cost saving practice in production, i.e. cutting down the use of agro-chemicals using methods such as Irrigated Post Control (IPC).

The input delivery to the farmers is organized and co-ordinated with the Fertilizer Corporation and the private Agro-Chemical Manufacturers and the Dealers. The agricultural credit disbursements were carried out by the two State Banks in all the areas and by the Hatton National Bank in "H5" Area.

The re-scheduling of the agricultural credit was introducted in Yala. Under this scheme the past defaulters who could not pay back their loans due to reasons beyond their control would be considered if they agree to repay their arrears in 10 cultivation seasons. Further, the maximum level of credit for paddy was raised to Rs. 3,175/-. This will enable more farmers than the 10% at present the access to increased credit.

Three seed farms are being developed in System B, C and H to satisfy the needs of paddy and other crops. In addition, the seed production programmes are carried out with the involvement of the farmers who are on contract to supply seed materials to the Department of Agriculture and exchange between themselves.

System	*Farm*	*Extent (Ha)*
"B"	Aralaganwila	121
"C"	Girandurukotte ..	268
"H"	Malwanagama	53

The area under paddy was increased due to the progress in settlement and irrigation work. Production was increased due to this and higher average yields. During 1985/86 Maha, all Mahaweli Systems recorded averages higher than the national average which is 3.57 mt/ha. Two areas namely, System "B" (15.4 mt/ha) and System "G" (5.448 mt/ha) recorded average above 100 whereas the highest average for an agricultural district outside Mahaweli was recorded in Polonnaruwa at 4.857 mt/ha.

Average Yields

System	*B/A.*
"B" ..	5.396 mt/ha.
"C" ..	4.309 mt/ha.
"G" ..	5.466 mt/ha.
"H" ..	4.603 mt/ha.
"UW" ..	4.831 mt/ha.

The total paddy production in Mahaweli was 212272 Metric Tons (mt) against a national production of 1680993 mt accounting for 12.6%.

Chillies were very extensively grown during 1986 Yala. Total extent was 11760 ha which was an increase on 7661 ha in 1985 Yala which will yield a production of 17640 mt of chillies.

The cultivation of 2,023 ha of cashew is in progress in System "C" Zone 5. Once the plantation is fully developed by the Cashew Corporation, 1,618 ha

Cultivation of subsidiary food crops in System 'H' has been a success. Up-country vegetables like carrot and cabbage grow well in this area.

1986 Yala Programme	*Irrigated (Ha).*				
	"B"	*"C"*	*"G"*	*"H"*	*"U/W"*
Chillies	68	76	6548	10846	103
B'Onions	1	10	—	105	2
Red Onions	—	—	6	69	14
Cowpea	8	9	20	769	10
Black Gram	—	—	3	254	—
Green Gram	12	1	289	403	50

will be distributed among the settlers retaining 404.6 ha for the nucleus estate.

Upland Irrigation Scheme in System "B" is envisaged to attract large scale farmers to grow crops other than paddy. It is envisaged to alienate blocks of 20 ha with irrigation facilities provided up to farm gate. 13 blocks were alienated but satisfactory progress was witnessed only in one block.

Agriculture has transformed itself to a dynamic activity as dynamic as any other economic activity from its subsistance level of operations. It not only has to produce a surplus from the non-expanding land resource to an ever expanding population, but also to enhance the buying power of the farmer in order to improve their standard of living in a competitive society. The future projects and programmes of agriculture in Mahaweli is designed to satisfy this demand as well as to create it where it is necessary to create.

HOUSING IN THE MAHAWELI SETTLEMENTS

The Mahaweli Settlement Environment

Settlement policy in the Mahaweli Development Programme seeks to achieve two primary objectives: The optimum use of limited resources of land and water in terms of the social and economic requirements of the Sri Lankan society, and using Mahaweli as a lead project to generate maximum impulses towards the overall progress in the country. With these basic objectives in view, settlement has been effected by allocating irrigable land to selectees from the landless poor, so that the main thrust is directed at reducing the unemployment problem and enhancing the domestic food production effort.

In addition to the selectees from the landless category who have been given 1 ha of irrigable land and 0.2 ha of homestead per family, the sponsored settlement exercise has also included supportive groups provided with opportunities for the services sector, within a network of hamlet centres, village centres and townships. In this context, the Mahaweli areas have already attracted a fair mix of different categories of people, with different social and economic backgrounds. Therefore even during the very early stages of settlement, a certain degree of social and economic differentiation has set in, which is sufficient to spark off further progress in capital formation, provided that these settlements are supported further by the necessary strategies to consolidate and enhance this progress.

Since the main focus of this settlement pattern is the family scale farming structure, it is imperative that the whole family as a unit is stablized in this new habitat as early as possible. The basic requirement for the achievement of this objective is adequate shelter. In this sense, the establishment of a decent core-house with minimum requirements for the family is therefore of paramount importance in the whole package of activities, that makes this effort a success.

The immediate attempt on the part of the settler usually results in a substandard core-house, meeting only the rudimentary requirements of 'shelter'. Experience has shown that this initial attempt, unless supported by supplementary assistance and guidance, is in effect an impediment to the settler family's progress and the process of stabilization. The worst affected by poor housing are the most needy, the very young and the old members in the family. The health problems associated with these vulnerable groups invariably become an unnecessary burden on the family. With this problem in view, the Mahaweli Programme endeavours to help the settlers to construct their initial core-houses and related amenities up to certain minimum standards.

The Mahaweli Authority has attempted to draw several lessons in this respect from past experience in the previous colonization scheme in Sri Lanka. On the one hand, wherever a completely built house has been provided to the settler in the early colonization schemes, the provision of such free housing has unfortunately not brought about the desired goals. In many instances such houses were either not occupied and utilized properly by the settlers, or they were neglected in the process of occupation. On the other hand, in the schemes where the settlers were given financial assistance to construct their own core-houses, the assistance was improperly utilized by the settlers who preferred to put up only sub-standard core-houses, unsuitable for human habitation. In general, the settlers have tended to concentrate more on developing their irrigable plots neglecting their homesteads, resulting in a fairly satisfactory production effort over the time, and a total neglect of the settler house, latrine and domestic water supply.

The Objectives of the Mahaweli Housing Programme

Since the Mahaweli settlers are inducted somewhat ahead of the availability of irrigation water, the main objective has been to encourage the settler to use this interim period optimally, to construct his own core-house up to adequate basic standards and to develop the hornestead plot. In this sense, the main thrust of this effort has not been restricted merely to the construction of the house, but has been designed to develop the homestead as a whole. A well developed homestead becomes a congenial environment in which the core-house is only one element of many components. The Mahaweli housing programme is in fact a Homestead Development Programme. Instead of just the House (Geya), attention is focussed on the Homestead (Gedera). The Homestead encompasses the house and its immediate environment, the home garden, the well, the latrine and even the fence.

The broad objectives of this strategy are as follows:

(i) To help the new settlers to take root in the new soil fast, thereby promoting physical and psychological stability.

(ii) To prepare the environment necessary for a settler family as a unit to realize the social and economic objectives of the overall Mahaweli Development Programme, fully and faster.

(iii) To promote social values conducive to community development, needed for harmonious and peaceful but industrious and vigorous living.

(iv) To maximize the use of land, particularly in the homestead.

(v) To enhance the family income by way of optimally utilizing the homestead area, reflecting on the traditional concept of 'gewatha'.

(vi) To extract maximum opportunities from the homestead environment for the essential nutritional needs of the family.

(vii) To create a healthy environment taking into consideration particularly, the needs of the old and the young within the family.

(viii) To support the settler family to develop a decent and pleasant home environment, depicting not only their desired economic and social status, but also their sense of aesthetic values.

▲ First houses built by the Mahaweli settlers was wattle and daub mud houses.

▼ Wattle and daub mud houses at the Purana village.

Constraints

Firstly, the major constraint confronted through this effort is the attitudinal problem. A certain degree of complacence on the part of the majority of the settler families, in being tolerant towards living under squalid conditions, in spite of the opportunities given to them, and a rather fatalistic attitude, (perhaps reflecting some of the reasons as to why the previous experiences in the early colonization schemes, have failed to produce the desired results in this respect) have frustrated most of our enthusiastic attempts.

Secondly, the housing effort is constrained by the relatively high cost element involved in house construction. The highest single item of expenditure in any family's budget is the construction of the house, the latrine and the well, from which no economic return is achieved. Although the assistance provided by the Mahaweli Authority for the core-house (around Rs. 2000) and for other amenities (around Rs. 3000) is a substantial support at the very early stage of their induction into new habitats, the settlers invariably find it difficult to supplement this assistance with their own resources.

Thirdly, the normal State intervention mechanisms which are designed to assist the people of this category, cannot be made fully operational, due to the same reason of low resources endowment. Most formal credit arrangements are based on collateral requirements for housing loans. The only asset the settler has at this stage is his block of land which unfortunately he cannot use as collateral for borrowing money, for the simple reason that such land has not been transferred to him at this stage. The legal grant document can be issued only on the full recovery of the assigned land development cost from the settler.

Fourthly, the new settler is constrained in his house construction activity by the lack of cheap labour. Similarly, transport facilities and availability of building materials are also problems which cause great discomfort in his new environment. His erstwhile friends, the carpenter, the mason, the lorry owner, are all hundreds of miles away from his new habitat. Since the period of induction is one of trauma and discomfort, the use of his family labour is also restricted for this kind of activity.

Finally, the hard soil of the dry zone offers him very little assistance if he chooses to prepare the land or excavate the foundations through his own family labour, and long periods of drought conditions and difficult access to water, makes his task much more difficult in this environment.

Action Programme

The Mahaweli Development Programme, offers excellent opportunities for action to be directed at improving the conditions of rural housing. The Action Programme, therefore, is an attempt to match this opportunity with possible solutions to the identified constraints, and has the following main features.

(i) The housing activity is incorporated as an essential component of the overall homestead development effort. This strategy provides sufficient flexibility, for the settler to switch resources made available to him for the various items, such as the core-house, latrine, well, land clearing, building material and food aid.

This package of activities requires the helpful intervention of a number of officials, involved in community development, health education, extension, agronomy, technical advice and Unit Management.

Minister of Lands & Land Development and Mahaweli Development, Gamini Dissanayake inspects a house built by a pioneer Mahaweli settler.

Progress of House Construction as at 30.4.1986

Project	*Permanent Houses*	*Semi-Permanent Houses*	*Partly Built Houses*
Nochchiyagama (H5)	557	1430	3178
Tambuttegama (H4)	1478	3158	2824
Galnewa	2116	3530	3856
Elahera (G)	1114	1124	–
Maduru Oya (B)	6712	1446	488
Ulhitiya–Ratkinda (C)	828	1217	7909
Uda Walawe	4124	4474	6205
Total	16929	16379	24460

(ii) The cluster arrangement for homesteads makes it convenient to provide services such as hamlet roads, community parks and pastures, and transportation of material.

(iii) The settlers are encouraged to obtain their quota of State sponsored assistance, in the form of materials such as tiles, roofing material and cement, rather than in cash.

(iv) A house of at least 500 sq.ft., a standard latrine and a safe supply of domestic water, either through closed shallow / deep wells or through open shallow wells are considered as minimum requirements. At least two bedrooms in the house are envisaged in view of the large family unit.

(v) The settler families are encouraged to form into small groups, with identified leadership preferably based on their experience and knowledge in carpentry and masonry.

(vi) Project oriented donor assistance has been arranged for the establishment of a Trust Fund for Housing in Zone 2 of System C, Zones 2 and 3 of System B, and System G. A housing loan ranging from Rs. 6,000 to Rs. 10,000 can be obtained from the Trust Fund in these areas. For other project areas, National Housing Development Authority (NHDA) assistance in small loans, and USAID supported loans through the State Mortgage Bank are envisaged.

(vii) Additional State sponsored assistance is provided for transportation and the preparation of the land. The production of low cost bricks is encouraged with the free supply of the necessary equipment on a group basis.

(viii) In addition to the settler houses, those who are involved in the services sector are also encouraged to have their own housing in the project areas. For this purpose several housing schemes have been started in the major townships in the Mahaweli areas. One of them in System G is supported by the Trust Fund.

The provision of houses for the technical and managerial personnel involved in the Development Programme, within the project areas is an additional impetus to the Mahaweli housing effort. These houses will provide some demonstration effect in encouraging better housing facilities in Mahaweli areas. The Mahaweli Authority has also constructed a few demonstration houses in the project areas, as well as within the premises of the Mahaweli Architectural Unit at Digana.

Excluding the basic core-houses which have been constructed in the early stages of the Mahaweli Development Programme, the progress of the current attempt in pursuing this activity is indicated in the Table given below.

It is a useful management strategy to aim at targets. The Accelerated Mahaweli Development Programme envisages the settlement of about 145,000 farmer families, and the incorporation of a further number of non-farming families as supportive groups. Therefore if we refer to these numbers of families to be resident in the Mahaweli project areas, the Mahaweli Development Programme will have a housing component of its effort to construct 200,000 houses for about one million people.

FINANCIAL ASPECTS

ACCELERATED MAHAWELI PROGRAMME – FOREIGN FUNDING

All figures in Millions

Country/ Organization	*Aid Type*	*Amount*		*Project Assisted*	*Amount*	
		US$	SDR		US$	SDR
IDA & IBRD	Loans	53.00		Stage I – Polgolla/Bowatenna	29.00	
	Loans		73.30	Stage II – System H	19.00	
				Diversion Studies	5.00	
				Minipe TBC & System C (3–6)		73.30
	Total	US$ 53.00	SDR 73.30	Total	US$ 53.00	SDR 73.30
			Hfl.			Hfl.
Netherlands	Grants		3.50	Stage II – System H		13.00
	Loans		13.00	Draught Animal & Dairy Dev.		3.50
	Total		Hfl. 16.50	Total		Hfl. 16.50
			C$			C$
Canada	Grants		11.60	Stage II – System H		6.00
	Loans		95.80	Maduru Oya	Rs. 292.08	85.60
	Grants (Food Aid)	Rs. 492.69		N.D.K.	Rs. 132.28	13.90
				System B (LB) – 1 & 5	Rs. 68.33	--
				W. M. Secretariat	—	2.80
	Total	Rs. 492.69	C$ 107.40	Total	Rs. 492.69	C$ 107.40
			£			£
U. K.	Grants		117.30	Stage II – System H		4.30
	Loans		20.00	Victoria		133.00
	Total		£ 137.30	Total		£ 137.30
			Skr.			Skr.
Sweden	Grants		1,395.00	Kotmale		1,651.20
	Loans		256.20			
	Total		Skr. 1,651.20			Skr. 1,651.20
			DM			DM
West Germany	Grants		8.50	Randenigala		408.50
	Loans		400.00			
	Total		DM 408.50			DM 408.50
			Belfr.			Belfr.
Belgium	Grants		Belfr. 60.00	System G		Belfr. 60.00
		Rs.	ECU		Rs.	ECU
E.E.C.	Grants		39.82	Stage II – System H		2.00
	Grants (Food Aid)	721.00		System G	235.00	2.42
				System C	122.00	15.40
				System B (LB)	134.00	20.00
				Road to Mahiyangana	230.00	
	Total	Rs. 721.00	ECU 39.82	Total	Rs. 721.00	ECU 39.82
			A$			A$
Australia	Grants (Food Aid)		A$ 15.00	System B (LB) – 1 & 5		A$ 15.00
			US$			US$
O.P.E.C.	Loans		12.15	Stage I - Bowatenna		3.15
				System B (LB) – 1 & 5		9.00
	Total		US$ 12.15	Total		US$ 12.15

Country/ Organization	*Aid Type*	*Amount*	*Project Assisted*	*Amount*
1. Japan	Loans	JY 11,000.00	System C Canal	JY 11,000.00
	Grants	Rs. 996.00	System C Tertiary Dev.	Rs. 137.00
	Grants (Food Prod.)	Rs. 673.00	System C Farm	996.00
			Peripheral Dev. Vic. /Kotmale	279.00
			Stage II – System H	107.00
			System B (LB)	150.00
	Total	Rs. 673.00 JY 11,996.00	Total	Rs. 673.00 JY 11,996.00
2. Kuwait	Loans	KD 12.86	System C (3–6)	KD 12.86
3. U.S.A.	Loans	US$ 125.20	Stage II System H	US$ 15.09
	Loans (Sector Support)	50.00	System B (LB) Canal	120.00
	Grants	5.00	System B (LB)	9.11
			System C	14.83
			System G	0.65
			Minipe T.B.C.	4.63
			Access Roads	0.60
			Peripheral Development – Victoria	7.21
			Peripheral Development – Kotmale	3.08
			Systems B and C (Environment)	5.00
	Total	US$ 180.20	Total	US$ 180.20
4. Saudi Arabia	Loans	S.R. 85.00	System B (LB) – 2 & 3	S.R. 85.00
5. A. D. B.	Loans	US$ 19.80		US$
	Loans	SDR 10.86	Stage I – Bowatenna	6.00
			Access Roads	13.80
			Udawalawe	SDR 10.86
	Total	US$ 19.80 10.86	Total	US$ 19.80 10.86
6. China	Loans	RMB Y 1.70	Stage II – System H Mahawanagama Farm	RMB Y 1.70
7. U. N. (UNDP, UNFPA, UNTCDC, UNICEF, WFP)	Grants	US$ 41.95	Planning & Monitoring Unit MASL	US$ 1.00
			Headworks	0.50
			Stage II – System H	8.12
			System B (LB)	22.55
			System C	9.78
	Total	US$ 41.95	Total	US$ 41.95

TRAINING PROGRAMME FOR FARMERS

The Settlement Programme under the Accelerated Mahaweli Programme is not limited to the purpose of providing land for cultivation. In these newly carved out areas, the farmers are not only provided with the much required water for cultivation, their social, religious and medical needs at the time of settlement, but also their post settlement needs. Further, the Mahaweli Economic Agency which looks after the post settlement needs of a settler has also begun a training programme for farmers, with the intention of building a rural leadership. Initially, the officers too are trained along with the farmers in agriculture, water management and community development. The main purpose of this programme is to organize the farmers, particularly to make them aware as to who would eventually be responsible for their welfare, mainly with regard to agriculture and water.

This training programme which has already commenced in System C and B, is implemented in two ways. Initially an Unit Manager who has at least 240 families under him, would identify at least 15 farmers who would be taught various aspects of agricultural extension work, water management and above all to maintain a direct dialogue with the officers. These farmers who participate in the training programmes would be actually the representatives of the entire unit.

The implementation of this programme will also take the officers to the field and necessarily establish a strong bond between the farmer and the officer. This group of farmers are known as turn-out groups. The turn-out group consists of representatives of the entire unit, which has a minimum of at least 200 families settled. This would also lead to the laying of a foundation for the growth of farmer organizations.

In the process of settlement in the Mahaweli areas, an unit is the smallest form of settlement. Here one finds an Unit Manager living with around 200 farmer families and looking after their welfare. Also in an unit there is a health centre, a community centre, a market place, a sub-post office, and a secondary school. The next step in a settlement area is a Block where a Block Manager has under him at least seven units. In a block there is a medical centre, a senior school, a health centre, a market place, recreation centre, a co-operative store and a post office. Further, various self-employment projects too have begun in a block area. In overall charge of a settlement area is a Resident Project Manager. In addition, there are others who are responsible for water management, community development, health

and land problems. Therefore, what one finds is an unified system of management. This form of management not only helps the Mahaweli Economic Agency, but also enables the farmer to maintain a close relationship. Further, with the view of making a farmer self-sufficient, the Mahaweli Economic Agency (MEA) is promoting the breeding of cattle and the planting of subsidiary crops along with many cottage industries in a settlement area.

The Managing Director of the MEA, explained the importance of the training programmes carried out, which would eventually enable a leadership to emerge from among the farmers who would gradually take over from the administration. He further added that the Mahaweli area should have a strong centre for training, planning, and the implementation of development, social and economic activities. The new Development Centre in System C which was opened by His Excellency President Jayewardene on the 11th of April this year, would meet this need for training, Considering the facilities at the Development Centre, also equipped for vocational training, one could say that this would ultimately become the National Development Centre for the country.

The ultimate goal of a settlement would be to make the maximum use of the land through all round development. Therefore as the Managing Director stressed, there should be an organization based on the traditional turn-out or a smaller group which would gradually become larger to meet the needs and the aspirations of the farmers. This would also pave the way for the creation of a self-contained hamlet based on agricultural, religious, and other social needs. The implementation of these turn-out based programmes is quite significant, in that it would facilitate to a great extent the organization of farmers who would point out the needs and requirements, and also be responsible for the smooth functioning of a settlement.

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