

SULIT

# RANCANGAN MALAYSIA KEEMPAT 1981-1985

KEMENTERIAN PERTANIAN



**INSTITUT PENYELIDIKAN  
DAN KEMAJUAN PERTANIAN  
MALAYSIA**

# M A R D I

## FOURTH MALAYSIA PLAN 1981 - 1985

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## FOURTH MALAYSIA PLAN 1981-1985

### SUMMARY

#### 1.1 INTRODUCTION

The Malaysian Agricultural Research and Development Institute (MARDI) was established in 1969 with the main objective of undertaking scientific, technological, economic and sociological research in agriculture covering all crops (except rubber) livestock, and freshwater fisheries. In September, 1979, with the establishment of Palm Oil Research Institute (PORIM), the responsibility for oil palm research was taken out of MARDI.

Since becoming operational in February 1971, MARDI has concentrated full efforts in the following areas of activity namely:-

- (i) Determination and development of research facilities and infrastructure such as land acquisition and development, construction of laboratories, glasshouses, workshops, office space, staff quarters and procurement of farm machineries and research equipment in a number of locations/stations in line with its research strategies and activities.
- (ii) Recruitment and training of research scientists of various disciplines together with their subordinate operative and development of an efficient research organization which could cater for the research requirements of the country.
- (iii) Strengthening ongoing and instituting new research programmes and activities that could effectively meet the agricultural developmental needs of the country utilizing all resources available at its disposal.

#### 1.2 DEVELOPMENT OF INFRASTRUCTURE

The development of research facilities and infrastructure has been the most trying experience for the Institute. Although it has been allocated sufficient financial support (\$27.7 million for SMP, and \$63.372 million for TMP), it was faced with a number of

constraints many of which were beyond its capacities to solve. The Institute was established with a total of seven research stations which were taken over from the Department of Agriculture. During the Second and Third Malaysia Plan periods, 20 more experimental stations were identified and were subsequently being developed.

Among the major constraints encountered by the Institute in the development of research facilities include:-

- (i) The delay in land acquisition process.
- (ii) The delay in the completion of many of the civil/construction works planned for the various Institutes' research stations due to delinquent contractors who either could not complete their works according to schedule or who left their jobs unfinished due to certain problems faced by them.
- (iii) The delay in acquisition of laboratory and field equipment due in part to the above two reasons.
- (iv) As a result of these constraints, the Institute has not been able to spend the full development budget of \$63,372 million ringgit allocated to it in the TMP. It is estimated that by the end of 1980, the amount to be expended (actual and committed) will be about 48.8 million ringgit or 77.1% of the total allocation.



### 1.3 RECRUITMENT AND TRAINING OF STAFF

The recruitment and training of staff has been and will continue to be a major activity of the Institute for quite some time. When the Institute started in 1971, it has a complement of only a few research scientists seconded from the Department of Agriculture. By the end of the TMP, it was planned for the Institute to have a total of at least 597 research scientists, 585 Research Assistants and 1155 Junior Technicians. However, by 1980 it is expected that the Institute would only have a total of 417 posts for Scientists, 472 posts for Research Assistants and 771 posts for Junior Technicians. These figures indicate that the Institute has been able to achieve about 70% of its overall staff requirement target for the TMP. While the number of staff recruited might reflect a satisfactory manpower build up for the Institute, the effective working manpower resource is however, much lesser. Throughout the TMP period a significant proportion, as high as a third of the scientists were mostly overseas undertaking postgraduate training programmes. The training programme was however considered essential in order to build up a pool of highly trained and competent scientists who have the capabilities to undertake research. One major constraint faced by the Institute has been the fact that the majority of the staff are still very young and inexperienced. Although they are highly qualified, they still lack the experience and the exposure to the scientific field of research. The Institute has to spend a total of about \$11.964 million ringgit in the training programme for all categories of staff during the Third Malaysia Plan Period covering costs for undergraduate, postgraduate, certificate and short-terms training programmes.

As a stop gap measure the Institute had hoped to recruit a number of foreign specialists to work with the Institute under the World Bank Project Programme. However, it has not managed to get the numbers required, due primarily to the unavailability of these experts and the not so attractive terms and conditions of service that the Institute could offer. A total of 10 expatriates have so far been recruited on a long term employment with the Institute.

### 1.4 RESEARCH PROGRAMMES AND ACTIVITIES (1971-1980)

In the Second and Third Malaysia Plan periods the Institute gave top most priority to research programmes and activities which aimed at solving the problems of the farmers. The primary objective

was to increase the farmers capability and to maximize farm productivity thereby obtaining a higher income. Other priorities included activities aimed at substituting import of agricultural products, improvement of exports crops, end use research, studies on viability of new crops and agricultural product utilization.

In consonance with these identified priorities the Institute gave its research emphasis on such commodities as rice, cocoa/coconut, oil palm, pineapple, pepper, livestock and freshwater fisheries. In the latter part of the TMP more emphasis on research was given to tobacco, fruits, field crops, spices, beverages and vegetables. The Institute also strengthened its on farm research activities designed to test packages of technology developed at the experimental stations and laboratories, with farmer participation. This was to ensure that whatever technology that has been developed by the Institute is relevant to the agro-climatic and socio-economic environment of the farm communities.

In spite of the rather scarce human and physical resources in its early stages of development, during the 1971-1980 period the Institute has made a number of significant achievements which have contributed directly or indirectly towards the improvement of both the quantity and quality of major commodities thereby contributing towards increasing of farmers income, strengthening the food production capability of the nation, increase of exports as well as reduce of imports. The main achievements are summarised as follows:-

(a) Rice

During the SMP period, five high yielding varieties were released. This included Murni and Masria (Pulut) (1972), Jaya (1973) Sri Malaysia I, Sri Malaysia II and Pulut Malaysia I (1974). In 1979, after extensive testing, three more varieties were released. These were Sekencang variety for Tanjong Karang, Kedah and the East Coast, Setanjung for Province Wellesley and Kedah/Perlis and Sekembang for Kemubu, Besut and Kuala Trengganu. These varieties had yield potential of between 700-1,000 gtgs. per acre.

(b) Oil Palm

The Institute produced more than 700,000 commercial

seeds per year for Government Schemes during SMP and TMP. A total of about 180,000 genetic materials of diverse types of oil palms were collected from Nigeria to widen and accelerate the potential of palm breeding in Malaysia. Comprehensive and extensive agronomic studies were also undertaken for crop improvement.

(c) Field Crops and Vegetable

The Institute developed the MARDI - Composite a high yielding maize variety for feed grains. Groundnut varieties of V 13, Matjam Sungai Siput and 47-5 were tested extensively in an effort to improve farmers productivity. The Institute was also successful in the testing and introduction of low-land cabbages and cauliflower throughout the country. Shallot, chilli, tomato, and ginger were tested extensively to encourage local production of these valuable crops.

(d) Cocoa and Coconut

Germplasm collection and extensive progeny and clonal trials were undertaken. Significant progress has been achieved in vegetative propagation of cocoa as well as in their management practices.

(e) Fruits

Two new lines from a hybrid cross of Singapore Spanish and Sarawak pineapple varieties with good potential for canning have been successfully produced. A new high yielding cashew nut variety clone (C 11) has also been found.

(f) Livestock

Promising cultivars of pasture for livestock feeds have been identified. Evaluation of various grass-legumes pastures has enabled a determination of optimum stocking rate for various breeds of animals.

(g) Freshwater Fish

Induced spawning of Big Head, Silver and Gras. Carps, Indian Carps has been achieved. Success was also achieved in hatching and the rearing technique of Udang Galah either as more or policulture.

(h) Agricultural Product Utilization

The Institute developed a number of food items such as dried meat products, dehydrated rice, and dehydrated vegetables for the armed forces. Low cost convenience food items such as soya cookies, coconut biscuit, noodles and extruded products were also developed. Other products developed included canned foods, fruits, sausages, chilli sauce, pickles and soya sauce.

1.5 STRATEGIES AND POLICIES FOR THE FMP (1981-1985)

In consonance with the Government's national objective of increasing income and alleviating poverty among the farming community the Institute will continue to give the greatest emphasis on the development of new or improved agricultural technologies which are technically, economically and socially suitable for adoption by farmers.

1.5.1 Research Priorities

The major priority areas of research for the FMP will be:-

(i) Solving the Problems of the Farmers

Research emphasis will be given towards alleviating the technical and socio-economic constraints of small farmers in increasing farm productivity, particularly in crops where a relatively high incidence of poverty among farmers is found, such as rice, cocoa/coconut/coffee, pineapple, tobacco and fruits.

(ii) Commodities with Import Substitution Potential

Research programmes will be primarily geared towards increasing productivity and quality of food and feed grains with reduced costs and high incomes to the farmers. These include such crops as fruits, coffee, tea, maize, sorghum, soyabean, livestock and livestock products.

(iii) Improvement of Export Orientated Crops

Research will be directed towards the increase of both

the quality and quantity of the commodities which have been a major source of foreign exchange earnings of the country. These include crops such as pineapple, pepper, cocoa, and coconut. This will enhance the technical and economic competitiveness of the products in the world market.

(iv) Agricultural Product Utilization

Research emphasis will be directed towards tackling the post harvest problems of food handling, storage, processing and marketing of the major agro-commodities. It will also give emphasis on exploring investment opportunities for the development of agro-based industries.

(v) Studies on New Crops

Research of lower priority will be given to studies on the potential of new crops. These mainly pertain to those temperate or sub-tropical origin such as strawberries, apples, pears, and Irish potatoes.

1.5.2 Strategies

In undertaking the research activities and programmes certain shifts in a strategies will be undertaken during the FMP. Farm orientated research will be given major emphasis as opposed to station centred research. Research activities will be problem-orientated and location-specific designed to produce results which are compatible with the agro-climatic and socio-economic environments of any particular region or locality.

Another major strategy is the emphasis on the development of integrated farming systems as opposed to commodity oriented research approach. This strategy is expected to result in the development of farming systems involving optimum combinations of crops or crop/livestock/freshwater fisheries mix in a particular farm, area or zone with similar agro-climatic and socio-economic environment. Through integrated farming system approach a more efficient utilization of the farmers resources is expected.

Concomitant with the new Strategies, the Institute has taken action to bring about change in its organizational structure, giving emphasis to development or operational research divisions.

### 1.5.3 Development Expenditure (1981 - 1985)

During the FMP the Institute will continue its efforts in the development of the research facilities and infrastructure of its ongoing research programmes and activities. It will devote its activities in (a) completing the various projects which were put up in the TMP which due to various constraints were not completed and (b) expanding and developing research facilities which are necessary in order to meet requirements for research of some programmes which were not given adequate emphasis during the TMP. Examples are the fruit, spices and beverages and vegetables Research Programmes which did not receive sufficient attention in the past. One major component of the development activity is the acquisition and development of land, for experiments. Another will be the construction of buildings such as laboratories, office space and essential staff quarters. The purchase of research equipments and the necessary transport will also cost a substantial amount. The allocation made to the Institute for the FMP is \$81,054,000. Of this amount \$20,354,000 represent continuation projects.

Due to the emphasis on location specific research programmes provisions had to be made to set up office space, provide transport and even experimental lands at outreach or regional development areas such as Krian, Sungai Manik, Johor West, Kuala Trengganu, Kuala Pilah, Pahang Barat, Barat Laut Selangor, etc. These will add cost substantially.

### 1.6 STAFF RECRUITMENT AND DEVELOPMENT

During the FMP period, the number of staff is expected to increase by at least 34%. This means that the Institute will have a total staff strength of 5,192 compared to 4,025 as at the end of TMP. The increase in staff requirement is necessary in view of the Institute's strategy to undertake location specific farmer oriented operational research programmes in various regions and the need to strengthen a number of ongoing research programmes which in the past were not given adequate priority, such as fruits spices and

beverages and vegetables. There is also a need to strengthen administrative support to cope with the expected expansion of scope and responsibility of the Institute's research programmes. The breakdown of the request is as follows:-

<u>Staff Categories</u>	<u>Requirements in TMP</u>		<u>Requirements in FMP</u>
	<u>Request</u>	<u>Approved</u>	
<u>Group A</u>			
1. Management	25	16	41
2. Professional	597	430	599
<u>Group B</u>			
1. Executives	25	22	31
2. Sub-Professional	585	472	669
<u>Group C</u>			
1. Clerical	174	147	239
2. Technical	1,155	774	1,192
<u>Group D</u>			
1. Other Junior Staffs and manual workers	2,628	2,164	2,421
	5,155	4,025	5,192

#### 1.7 STAFF TRAINING

During the FMP period, the Institute will continue to undertake an aggressive and comprehensive training programme not only for its scientists but also for the supporting and administrative staff. The training programme will be in the form of post-graduate degree courses, short-term courses and on the job attachments as well as participation in seminars and workshops. The Institute hopes to have a complement of at least a total of 100 Ph.D, 200 Masterate and 170 Bachelor degree research officers by the end of FMP. The cost of training is estimated to be in the region of \$13.5 million ringgit for the five year period.

The estimated number of scholarships to be offered during FMP are as follows:-

<u>Courses</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
(i) Ph.D	15	5	5	5	5
(ii) M.Sc	15	15	12	10	10
(iii) B.Sc	5	5	5	5	5
(iv) Short Courses (Technical)	35	35	35	35	35
(v) Post-Graduate (Management)	1	1	1	1	1
(vi) Short Courses (Management)	3	3	3	3	3

#### 1.8 OPERATING BUDGET

The Institute's operating budget has had normal increase from year to year during the SMP and the TMP periods. During the TMP, the budgets were as follows:-

<u>Year</u>	<u>Allocation</u>	<u>% Salary Component</u>
1976	\$ 23,500,000	54.41
1977	\$ 29,425,500	54.03
1978	\$ 34,877,750	56.98
1979	\$ 40,271,000	61.83
1980	\$ 44,400,000	63.81
Total allocation	\$172,474,250	Average 58.21

During the FMP, the operating budget is expected to increase in the same pattern as that of the TMP period. The rate of increase is envisaged to be in the region of about 13% per annum. The major increases are expected in the salaries of staff and increase in costs in the purchase of consumables and services needed for research.



## 1.9 REVISED PROGRAMMES/EXPENDITURE (1981-1985)

Except for the following there are no major revisions of programmes over those proposed in the first phase of submission of the FMP.

### (i) Fruits

An additional 50 acres site at IPRS, Pontian, Johor is requested for a new pineapple station with research emphasis in relation to developing suitable agronomic practice for new pineapple varieties.

There is also a token request of \$10 for a new fruits station. The project is essential; a suitable site is being determined.

### (ii) Livestock

There is an approximate increase of \$0.6 million for this programme attributable to the following reasons:-

- (a) The carry-over metabolism house project costing about \$400,000 (Feed Resources Branch);
- (b) Additional requirements of calf pens, sick bays and equipments for dairy processing;
- (c) Certain on-going projects, expected to be completed this year, have to be carried over for completion in 1981. These include the animal house, dairy and laboratory buildings and other minor projects.

### (iii) Freshwater Fish

There is a slight increase in the revised figures for freshwater fish, accommodating the construction of a new station in Pahang with research emphasis on river fishes. It is hoped that the station can be equipped and functional before the end of 1981.

### (iv) Research Services

The acquisition of a computer is not expected to

materialise by 1980 as envisaged. The partial allocation for that year has therefore been brought forward to 1981, hence accounting largely for the increased allocation of approximately \$1.67 million in the Plan period.

The delay in the completion of the on-going Analytical Services building also accounts to some extent in the increased allocation.

## 1. RICE RESEARCH PROGRAMME

### I. BACKGROUND AND OBJECTIVE

In line with the importance of rice to the country both economically and sociologically the generalised objectives of the rice policy are,

- . to reduce dependence upon rice imports,
- . to increase the incomes of padi growers and
- . to provide high quality, reasonably-priced rice to consumers.

In 1956, Peninsular Malaysia was only about 55% self-sufficient in rice, after which there was a progressive increase in rice production until it attained a peak of 95% self-sufficiency in 1975. Presently Peninsular Malaysia is about 85% self-sufficient in rice. The increase in rice production to-date has been mainly ascribed to the increase in rice acreage under double-cropping and the use of new high yielding padi varieties. With the decline in the potential areas that can be further opened for double-cropping of rice, the strategy to increase rice production would necessarily be in the further increase of yield at farm level. Peninsular Malaysia has maintained the highest yield per unit area in Tropical Asia surpassing that of India, Sri Lanka, Burma, Thailand, Indonesia and Philippines.

The present rice research planning essentially entails the formulation of sound research programmes on a regional basis with a full understanding of the prevailing conditions and requirements of the area. Padi yield in the single and double cropping areas can be further increased with the identification of the biophysical and socio-economic constraints to yield and with effective control measures. In line with these concepts the padi varietal improvement programme has been

re-designed to stress work on a regional basis rather than on centralised development of varieties. While it is envisaged to develop stable padi varieties adaptable to a broad range of environments it is also designed to meet the requirements of specific agro-ecological and social conditions of the major rice growing areas of the country. Component technologies developed by the Rice Research Branch are finally evaluated in farmer participation trials by the Project Development Branch of MARDI and in Pilot Projects by related implementing Extension Agencies to ascertain the economic viability and farmer acceptability.

## II. PROJECT DESCRIPTION

The rice varietal improvement programme is the pivot of the research activities of the rice research programme. The Agronomy and Plant Protection activities are geared towards providing the necessary support to the varietal improvement programme. The primary objective of the integrated varietal improvement programme is to develop suitable varieties for the various agro-ecological rice growing areas of Peninsular Malaysia, taking into consideration the specific preferences and requirements of the farmers, the millers and the consumers.

### Rice Varietal Improvement Programme

The rice varietal improvement programme is directed to three main rice growing areas in Peninsular Malaysia.

- . Irrigated double-cropping rice areas.
- . Rainfed lowland rice areas.
- . Problem soil rice areas.

In Peninsular Malaysia approximately 940,000 acres of land are under rice cultivation. About 586,000 acres are provided with irrigation and drainage facilities to enable double-cropping, while

about 240,000 acres comprise the single crop rainfed lowland areas. Problem soil rice growing areas include the acid sulphate soils and the coastal saline areas. The largest extent of acid sulphate rice soils lie within the Muda Scheme Area, estimated at about 54,000 acres.

The current concepts in the varietal improvement programmes are as follows:

- . There is an appreciation of the importance of location-specificity of varieties. Emphasis is placed on work on a regional basis rather than on centralized development of rice varieties. Early generation materials are sent out to the major rice growing areas of Peninsular Malaysia.
- . There is a need for several rice varieties to be made available in the different padi growing areas of the country at any one time, so that farmers will have a choice of varieties to plant. Specific varieties will be identified for the two crop seasons and for the rainfed and problem soil areas.
- . It is realized that in general farmers are not able to supply the high input requirements of the nitrogen responsive modern varieties in order to achieve the potential high yields. Hence the varietal improvement programme has been geared to the development of low-nitrogen-responsive varieties capable of high yields at low input levels.
- . The importance of rice quality (grain, cooking and eating qualities) as a premier factor was realized following the non-acceptance of the earlier released varieties by the farmers, the millers and the consumers. The main physical characteristics of rice grains that would meet the

requirements of the three groups have been specifically identified.

- . The change in philosophy in the varietal improvement programme invariably means that potential rice varieties for release need to possess the important requirements of adaptability, low-nitrogen-responsiveness, stable moderate yields and quality. Some of these characteristics are present in most of the local traditional varieties as well as the popular varieties like Mat Chandu, Seribu Gantang and Mahsuri. Presently, the varietal improvement programme widely utilizes the local traditional and popular varieties as parents in hybridization. In addition, varieties like Mat Chandu, Seribu Gantang and Mahsuri are being screened for specific defects in them in an attempt to further improve these varieties.

Based on the above concept, the objectives of the varietal improvement programme are as follows:

- . To develop high yielding varieties with acceptable rice quality.
- . To incorporate resistance to blast disease as well as other relevant disease/pest as may be required from time to time.
- . To breed for early maturing-varieties for the advanced doubled-cropping areas.
- . To investigate the physico-chemical characteristics responsible for differences in rice grain quality and conduct routine analysis to establish quality levels of the selected materials.
- . To evaluate new and promising selections, for adaptability

and performance under a wide range of conditions using appropriate improved husbandry methods so as to identify and recommend varieties suited for the various agro-ecological and edaphic environments.

While hybridization will be carried out at Bumbong Lima, the  $F_2$  materials will be distributed to Kubang Keranji, Alor Star, Krian and Tanjong Karang for screening and selection on location as part of the regional programmes. Specific programmes on disease/pest resistance, quality, drought and semi-deep water will be handled in the initial stages at Bumbong Lima and only later generation materials will be sent for location screening.

#### Agronomy/Physiology

In the coordinated padi varietal improvement programme of the Rice Research Branch it is necessary to ensure that the new varieties developed will be able to express their full potential in the various environments in which they are grown. The main directions of the Agronomy Programme, in order to meet this objective, are as follows:

- . Understand the various soil, water and agro-meteorological requirements for optimum crop growth and yield.
- . Study the various bio-physical factors that cause positive crop responses or impose a constraint on the plant growth and grain yield.
- . Analyse the economic viability of the various technological developments in agronomy in order to ascertain their acceptance as recommendations at farm level.

The Agronomy programme cover studies on:

- . Fertilizer (NPK) studies in rice.
- . Nutritional studies in rice.
- . Rotational cropping with rice.
- . Studies on water stress problems in the rice crop.
- . Studies on acid-sulphate soils.

The fertilizer programme has been given prominence in view of the rapid developments in fertilizer technology and the need for an indepth understand of the various aspects of nutrient behaviour in the rice-soil and uptake by plant growth and grain yield. It has been established that nitrogen fertilizer gives the highest increase in grain yield in the high yielding rice varieties. Hence, the studies to-date has mainly concentrated on the use of nitrogen and directed specifically to the derivation of economic levels of recommendations. Studies on phosphorus and potassium were given less attention as the response in grain yield was only marginal. More recently it is realised that with the continued double-cropping of rice, the crop removal of phosphorus and potassium would be high and would in due course impose limiting factors on rice-yield. It is also realised that while the application of nitrogen could give a high rice yield, it would be necessary to provide phosphorus and potassium to further enhance the response to nitrogen. In the research programme it is therefore intended to emphasise on:

- . Studies on the various forms of nitrogen fertilizers and time of application in order to improve the nitrogen use efficiency of the rice plant.
- . Studies on the various forms of phosphorus fertilizers and their residual effects in the soil.



- . Studies on the rate and time of application of potassium.

The fertilizer trials are planned to study the efficient management of the different nutrients and to formulate economic levels of recommendations in the various soil types and conditions. Studies on acid sulphate soils will concentrate on efforts to characterise the soil, and study the various amelioration practices to improve the soils in order to obtain an economic return of rice crop.

Agronomic studies on cultural practices are aimed at developing component technologies in the nursery management and main-field crop husbandry. The trials are intended to be located in various water regimes and soil types so that suitable cultural practices can be developed in the various environments. Development of cultural practices in agronomy will normally be of the nature of 'non-cash' inputs, like age of seedlings at transplanting, seedling density or plant spacing etc. The adoption of new cultural practices by the farmer will not be an easy task as it may involve changes in his present cultural practices. As reported by Umali (1976), an effort is also made to try and understand the current cultural practices of the farmer in his environment, improve upon them and return it to the farmer as improved technologies.

The studies on soil, water and agro-meteorological factors on crop performance is included under the line project on water stress problems in the rice crop. The project will essentially cover the development of rice varieties for drought and flood conditions. It was found necessary to arrange the programme to be carried out by a special team comprising of a physiologist, breeder and agronomist so that the various components of the study can be directly related to the varietal improvement programme.

Weed management studies, which was previously under crop

protection section, is now placed under Agronomy. The studies will cover the ecology and succession of weed flora in the rice field, weed competition in rice and chemical control of weeds.

In the formulation of agronomic recommendation, it is felt that with the relative advances made in padi production in Malaysia, a 2:1 marginal benefit-cost ratio would be sufficient to allow for uncertainty and related cost factors, like cost of labour for applying the additional inputs and for harvesting the increased production of padi.

### Crop Protection

The tropical rice field is conducive to rapid pest population increases, and given the appropriate conditions, a particular pest species may break-off from natural control factors to attain pest status. In Malaysia, the relative importance of the various rice pests (insects, plant diseases, rodents, and weeds) have changed in the last decade, due to changes in cropping patterns, cultural and agronomic practices including changes in varieties, fertiliser rates and pesticide usage. Other less obvious factors, for example, weather pattern, also play a role in the shift of the pest spectrum.

An important development in crop protection approach was formulated for the rice entomology programme. This arose from the awareness that over-reliance on any single-factor control approach had often failed in the long-term control of pests. This concept of Integrated Pest Control (IPC) attempts to utilize all available control methods in a compatible manner to keep the population of a pest species below damaging numbers. This approach requires a thorough understanding of the biology of the pest species and its interaction with the host species, in relation to its environment - the agro-ecosystem. The

proposed IPC approach will incorporate other areas of rice crop protection work in the future.

In relation to IPC the need for an effective surveillance system was highlighted. A comprehensive proposal was drawn up by MARDI and is now followed-up by the Department of Agriculture for implementation in the various rice growing areas. A surveillance system is a pre-requisite for full-scale implementation of IPC programmes. A tentative IPC programme for entomology has been tested at some farmers' plots and the result are promising.

In Entomology, there are major changes in the layout of the line projects in line with the research concepts. The eight 'new' line projects, are organised along disciplines which will allow flexibility in accomodating the ever-changing pest spectrum, coupled with location-specific pest problems.

The Pathology research programme will continue to emphasize the use of varietal resistance to control diseases. More detailed genetic analysis of host/parasite interactions will be conducted. Together with studies on the population genetics and dynamics of pathogen these analysis are expected to provide the rice improvement programme with better strategies for the management of resistance genes in the future. Concurrently an attempt will be made to identify sources of 'durable' resistance and to utilize such sources in the breeding programme. Chemical and cultural methods of control will continue to receive attention. It seems likely that an integrated approach may be the most successful in delaying pathogen evolution, and provide the best hope for maintaining low disease levels in the crop. Epidemiologic and yield loss studies will also be conducted to broden our understanding of pathogenesis and allow a more critical appraisalment of control measures.

Rodent research will continue to focus on the ecology and biology of the rice field rat, chemical control, and crop loss studies.

The ultimate objectives on any agricultural research programme is that the farmers must benefit from the research efforts. For Rice Crop Protection, this will be in the form of the implementation of the 'tentative' IPC programme at the farm level. The success of the programme will require the full cooperation and help of plant breeders, agronomists, physiologists, economists, sociologists, extension and other specialists.

## II. PROJECT JUSTIFICATION AND BENEFITS

A total of \$9,548,000 has been requested for Rice Research Programme for the Fourth Malaysia Plan Development Estimate. The major component of the expenditure (45 percent) is earmarked for the construction of administrative building, laboratories and other ancillary structures to be sited at the new National Rice Research Centre at Bertam. The next largest expenditure item is the acquisition of land in Kedah, Kelantan and Perak.

The present National Rice Research Centre at Bumbong Lima was set up by the Department of Agriculture in 1968 and with the termination of research function of the Department when MARDI was established the Centre was transferred to the new Institute. Since the Centre was occupied by MARDI, very limited physical expansion was possible since land was limited. However, since the facilities were taken over there has been a three fold increase in the staff number and a similar increase in the extent of the research programme. The present facilities at Bumbong Lima are grossly inadequate to meet the expanding demand for office space, laboratories, experimental field area and other ancillary structures.

A new location in Bertam extending over an area of 148 ha has been acquired during the Third Malaysia Plan and this Station is proposed to be developed as the new National Rice Research Centre not only to undertake research activities in plant breeding, agronomy and crop protection but also to integrate other rice related research elements on soils, water management.

Additional experimental lands in Muda and Kemubu Irrigation Schemes are required to enable researchers to conduct long term experiments under controlled conditions and to provide protection against loss of experimental crops through damages by stray animals and human pilforage. Presently, most of the trials are conducted on rented farmers land. Though on farm research will be given emphasis and will continue to receive our attention, there are some areas of investigations which require a more permanent site to locate them which the present rental arrangement does not permit.

Rice has been accorded a priority crop in the previous five year development plans and is expected to continue to receive priority status for some period in the future. The existing national rice policy for the development of the rice sector is aimed at attaining the objectives of increasing the incomes and standard of living of the farming population; and increasing the domestic rice production to achieve a high degree of self-sufficiency in rice as is economically feasible. Among the approaches that can lead to the achievement of these policy objective are:

- . increase in the productivity of existing padi lands through improved agricultural practices.
- . increase in cropping intensity.

MARDI rice research programmes in breeding, agronomy, crop protection, water management, economics etc. are aimed at evolving

technological inputs that will increase the productivity and enhance the cropping intensity of padi lands. The contribution of the programme is evident in the release of suitable rice varieties and the steady increase in padi yield in Peninsular Malaysia. In Muda, the yield increase was from 500 gtg/ac with single cropping to about 750 gtg/ac with the use of improved rice varieties under double-cropping conditions. In Kemubu, the yield increase was from 300 gtg/ac to the present level of 550 gtg/ac. Similar increases in padi yields are observed in the other rice areas of the country. It is reported that higher record yield levels are obtained in 1979 crop harvest with the use of fertilizer recommendations of MARDI under the Government Fertilizer Subsidy Scheme.

## JADUAL 1

## ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

JABATAN: MARDI

MAKSUD

PEMBANGUNAN: PENYELIDIKAN PADI

BIL. PROJEK: 1

KETERANGAN: LIHAT LAMPIRAN-LAMPIRAN

	Tahun							Pecahan Kos Pembangunan
	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985	Tukaran Asing
<u>Kos Pembangunan</u>								
Pembinaan (Lampiran A)	-	2,985,000	1,220,000	915,000	20,000	-	5,140,000	
Alat-alat dan Jentera (Lampiran B)	-	882,000	510,000	286,000	152,000	-	1,830,000	
Pelaburan								
Pengambilan Tanah (Lampiran C)	-	1,200,000	1,000,000	-	-	-	2,200,000	
Lain-Lain Perbelanjaan Pembangunan (Lampiran D)	-	208,000	100,000	70,000	-	-	378,000	
JUMLAH KOS PEMBANGUNAN	-	5,275,000	2,830,000	1,271,000	172,000	-	9,548,000	
<u>Kos Berulang</u>								
Gaji dan Upahan	1,922,600	2,126,000	2,270,000	2,374,000	2,539,000	2,638,000	11,947,000	
Perjalanan dan Pengangkutan Orang	135,000	226,800	245,500	266,000	288,600	313,500	1,340,400	
Kemudahan Awam (Api, Air, Letrik dan lain-lain)	-	-	-	-	-	-	-	
Sewa	78,200	54,200	59,600	65,600	72,100	79,400	330,900	
Bekalan dan Bahan-Bahan	342,500	259,200	285,100	313,500	344,600	379,100	1,581,500	
Penyelenggaraan dan Pembaikan Yang Dibeli	17,800	23,700	23,700	23,700	23,700	23,700	118,500	
Lain Perkhidmatan Professional dan Keraian	7,300	26,800	29,300	32,400	35,600	39,100	163,200	
Lain-lain Perbelanjaan Berulang	3,200	22,800	22,800	22,800	22,800	22,800	114,000	
JUMLAH KOS BERULANG	2,506,600	2,739,500	2,936,000	3,098,000	3,326,400	3,495,600	15,595,500	

ANGGARAN KOS PEMBINAAN

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
1. <u>Alor Star</u>							
Workshop	-	-	50,000	-	-	-	50,000
Plant house	-	-	-	60,000	-	-	60,000
2. <u>Bumbong Lima</u>							
Admin. Building (1)	-	500,000	-	-	-	-	500,000
Research Building (4)	-	500,000	500,000	500,000	500,000	-	2,000,000
Entomology Plant House (5)	-	240,000	-	60,000	-	-	300,000
Plant Breeding House (3)	-	120,000	-	60,000	-	-	180,000
Physic/Agronomy Plant House (3)	-	120,000	-	60,000	-	-	180,000
Weed Science Plant House (1)	-	60,000	-	-	-	-	60,000
Working Sheds Plant House (5)	-	160,000	160,000	80,000	-	-	400,000
Pathology Plant House (3)	-	120,000	-	60,000	-	-	180,000
Animal House (1)	-	60,000	-	-	-	-	60,000
Seed Store (Air-con)(1)	-	40,000	-	-	-	-	40,000
Semi-deep Water Ponds (3)	-	15,000	-	15,000	-	-	30,000
Dry Floors (2)	-	-	10,000	-	-	-	10,000
Store, Field Equipment/Fert./Padi(3)	-	20,000	-	20,000	20,000	-	60,000
Store, POL (1)	-	10,000	-	-	-	-	10,000
Workshop/Impl. Shed (1)	-	30,000	-	-	-	-	30,000
Carpentry Shed	-	20,000	-	-	-	-	20,000



Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
Quarters ARO's (3)	-	100,000	-	-	-	-	100,000
" RA's (4)	-	60,000	-	-	-	-	60,000
" IMG (10)	-	80,000	-	-	-	-	80,000
3. <u>Krian/Sungai Manik</u>							
General Office & Lab.	-	200,000	-	-	-	-	200,000
Garage & Workshop	-	50,000	-	-	-	-	50,000
Store	-	60,000	-	-	-	-	60,000
Drying Yard	-	10,000	-	-	-	-	10,000
Working Shed	-	80,000	-	-	-	-	80,000
4. <u>Tanjong Karang</u>							
Quarters ARO's (2)	-	70,000	-	-	-	-	70,000
" RA's (4)	-	60,000	-	-	-	-	60,000
5. <u>Kubang Keranji</u>							
Field Station Building	-	200,000	-	-	-	-	200,000
		2,985,000	720,000	915,000	520,000	-	5,140,000

ANGGARAN KOS ALAT-ALAT DAN JENTERA

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
1. <u>Alor Star</u>							
Office Equipment & Furniture	-	8,000	2,000	5,000	-	-	15,000
Combie/Van (3)	-	-	80,000	40,000	-	-	120,000
Landrover (1)	-	-	40,000	-	-	-	40,000
Pedestrian Tractor (2)	-	7,000	7,000		-	-	14,000
2. <u>Bumbong Lima/Bertam</u>							
Office Equipment & Furniture	-	15,000	15,000	30,000	-	-	60,000
Combie/Van (2)	-	40,000	40,000	-	-	-	80,000
Landrover (i)	-	40,000	-	-	-	-	40,000
Lorry (1)	-	60,000	-	-	-	-	60,000
Coaster/Minibus (1)	-	50,000	-	-	-	-	50,000
Pedestrian Tractor (6)	-	14,000	14,000	14,000	-	-	42,000
Trailer (1)	-	-	-	5,000	-	-	5,000
Laboratory Equipments							
i) Balances (10)							
ii) UV Spectrophotometer (1)							
iii) Amino acid analyses (1)							
iv) Ovens (8)							
v) CO2 Analyses (1)							
vi) Winnowers (13)							

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
vii) Dehusers (6)							
viii) Grain Separator (3)							
ix) Electronic Calculators (9)							
x) Others	-	250,000	150,000	150,000	152,000	-	702,000
3. <u>Krian/Sungai Manik</u>							
Furniture	-	5,000	-	-	-	-	5,000
Landrover (2)	-	80,000	-	-	-	-	80,000
Pedestrian Tractor (6)	-	7,000	14,000	21,000	-	-	42,000
Trailer (2)	-	-	10,000	-	-	-	10,000
4. <u>Tanjong Karang</u>							
Landrover (1)	-	40,000	-	-	-	-	40,000
Combie/Van (1)	-	-	40,000	-	-	-	40,000
Pedestrian Tractor (2)	-	7,000	-	7,000	-	-	14,000
5. <u>Kubang Keranji</u>							
Office Eq. & Furniture	-	5,000	-	-	-	-	5,000
Combie/Van (1)	-	40,000	-	-	-	-	40,000
Landrover (2)	-	40,000	40,000	-	-	-	80,000
Lorry (1)	-	-	60,000	-	-	-	60,000
Pedestrian Tractor (2)	-	7,000	-	7,000	-	-	14,000

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
6. <u>Parit</u>							
Landrover (1)	-	40,000	-	-	-	-	40,000
Pedestrian Tractor (2)	-	7,000	-	7,000	-	-	14,000
Trailer (1)	-	-	5,000	-	-	-	5,000
7. <u>Kuala Trengganu/Desut</u>							
Combie/Van (1)	-	40,000	-	-	-	-	40,000
Landrover (2)	-	80,000	-	-	-	-	80,000
	-	875,000	517,000	286,000	152,000	-	1,830,000

ANGGARAN KOS PENGAMBILAN TANAH

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
1. <u>Alor Star</u> 55 acres	-	200,000	-	-	-	-	200,000
2. <u>Krian/Sungai Manik</u> 30 acres - New Station	-	500,000	500,000	-	-	-	1,000,000
3. <u>Kubang Keranji</u> 20 acres Station and Exp. field	-	500,000	500,000	-	-	-	1,000,000
	-	1,200,000	1,000,000	-	-	-	2,200,000

ANGGARAN KOS LAIN-LAIN PERBELANJAAN

ANGGARAN KOS LAIN-LAIN

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
1. <u>Alor Star</u> Infrastructure	-	100,000	-	-	-	-	100,000
2. <u>Bumbong Lima/Bertam</u> Infrastructure	-	80,000	100,000	70,000	-	-	250,000
3. <u>Krian/Sungai Manik</u> Infrastructure	-	18,000	-	-	-	-	18,000
4. Kubang Keranji	-	10,000	-	-	-	-	10,000
	-	208,000	100,000	70,000	-	-	378,000

## 2. TOBACCO RESEARCH PROGRAMME

### I. BACKGROUND AND OBJECTIVES

Tobacco is one of the most important short term crops in Peninsular Malaysia in which more than 62,000 farm families are directly involved in its cultivation. The crop is being grown on a range of soil type and under different range of weather patterns found in the eastern and western states of Peninsular Malaysia. However, more than 85 percent of the crop are found in Kelantan and Trengganu.

Research on tobacco was initiated in MARDI in the early 1970s and with the initial shortage of trained scientific manpower and other supportive facilities it was then not accorded priority. However, the need to strengthen research and evolve technology on varietal improvement, fertilizer application, crop protection measures, water management, mechanisation etc and accordingly a branch for tobacco research was established in 1977.

Broadly, tobacco research is conducted with the objective of improving the yield and quality of tobacco at reasonable levels of inputs so as to maximise production and increase the income level of tobacco growers.

Specially, investigation on tobacco are oriented and directed towards:

- . Improving the yield and quality of Malaysian Flue-Cured Virginian Tobacco.
- . Concentrating in the lighter texture soils of the East Coast States and at the same time, enhancing the technology on the traditional areas of padi where tobacco is grown in rotation and the granite wash.

- . Ensuring that the research efforts are orientated to the cigarette market trends.
- . Ensuring that all verified research findings are effectively disseminated to the appropriate agencies.

#### I. PROJECT IDENTIFICATION

Research projects on tobacco for the period 1981-1985 are expected to encompass the following areas:

##### A. Breeding and Selection

- . Germplasm Collection
- . Varietal Introduction and Evaluation
- . Breeding and Selection.

##### B. Agronomy

- . Fertilizer studies in relation to soil type and crop, taking into consideration the method and time of fertilizer application.
- . Plant Spacing
- . Direct Planting
- . Topping and sucker control.

##### C. Crop Protection

- . Survey and identification of pests and diseases and assess their economic importance.
- . Nematicides, Fungicides and Insecticides Screening.
- . Crop hygiene and rotation as a measure for disease control.



D. Mechanisation

- . Introduce, test and develop tools, implements or equipment for tobacco husbandry. Method of primary land preparation and ridge making.
- . Sources of fuel.
- . Design, specification and materials for barn constructions. (Agriculture engineer from engineering branch).

E. Irrigation

- . Methods of irrigation
- . Rate and time of irrigation.

F. Sociological Studies

- . Socio-economic studies of tobacco farmers and producers. To be carried out by the rural sociology and agribusiness branch.

G. Farm Management

- . Economic feasibility of other system of production.
- . Socio-economic problems in adopting new system of production. To be carried out by the production economic branch.

H. Development Research

Efforts will also be devoted to the development research on the farmers land in the following areas of work:

- . Fertilizer side dressing

- . Varietal adaptation
- . Crop Protection.

The above projects will be conducted on a collaborative efforts with the appropriate branches/divisions in MARDI and Government agencies.

## II. PROJECT JUSTIFICATION AND BENEFITS

The provision of administrative building, laboratories and ancillary structures at the Central Tobacco Research Station accounts for 65 percent of the development expenditure for the Fourth Malaysia Plan. The Station covers an area of 50 acres located in the Mukim of Telong, Bachok Kelantan and once developed it will serve as the nerve centre of research planning and implementation for tobacco in Peninsular Malaysia.

Tobacco is one of the more important short term crops grown in the economically depressed areas in the East Coast States of Kelantan and Trengganu. More than 62,000 farm families are directly involved in its cultivation. MARDI's expanded development programmes are geared at providing adequate infrastructure to meet the increasing scope of research work and number of research personnel.

MARDI embarked on tobacco research in 1977 and since then has focused its efforts in evolving appropriate technology for the cultivation of tobacco on bris, in collaboration with the Malaysian Tobacco Company. As a result of the joint effort, in early 1980, recommendation was put up on fertilizer application, cultural practices, irrigation system for tobacco grown on bris that ensure satisfactory yield and quality of flue cured tobacco. This technology does not only mean that bris which has been considered as problematic, can be exploited for agricultural development but its adoption will ensure

higher income to the growers. The Institute with the additional facilities can extend its research scope to benefit a greater number of the tobacco farming community.

JABATAN: MARDI

MAKSUD

PEMBANGUNAN: PENYELIDIKAN TEMBAKAU

BIL. PROJEK: 2

KETERANGAN: LIHAT LAMPIRAN-LAMPIRAN

	Tahun							Pecahan Kos Pembangunan
	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985	Tukaran Asing
<u>Kos Pembangunan</u>								
Pembinaan	-	890,000	770,000	-	-	-	1,660,000	
Alat-alat dan Jentera	-	190,000	140,000	-	-	-	330,000	
Pelaburan								
Pengambilan Tanah		274,000	50,000	-	-	-	324,000	
Lain-Lain Perbelanjaan Pembangunan	-	150,000	100,000	-	-	-	250,000	
JUMLAH KOS PEMBANGUNAN	-	1,504,000	1,060,000	-	-	-	2,564,000	
<u>Kos Berulang</u>								
Gaji dan Upahan	359,000	424,000	485,000	553,000	616,000	642,000	2,720,000	
Perjalanan dan Pengangkutan Orang	60,000	65,000	70,000	75,000	80,000	85,000	375,000	
Kemudahan Awam (Api,Air,Letrik dan Lain-lain)	-	2,000	3,000	4,000	5,000	6,000	20,000	
Sewa	1,500	10,000	12,000	14,000	16,000	18,000	70,000	
Bekalan dan Bahan-bahan	75,500	101,700	121,800	141,900	161,900	182,100	709,400	
Penyelenggaraan dan Pembaikan Yang Dibeli	2,000	11,700	12,700	13,700	14,700	15,900	60,500	
Lain Perkhidmatan Professional dan Keraian	17,000	4,000	5,000	6,000	7,000	8,000	30,000	
Lain-Lain Perbelanjaan Berulang	400	21,600	26,600	31,100	35,600	41,100	156,000	
JUMLAH KOS BERULANG	512,900	640,000	736,100	830,700	936,200	997,900	4,148,900	

ANGGARAN KOS PEMBINAAN

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
<u>Tembakau</u>							
Administrative Building	-	100,000	100,000	-	-	-	200,000
Agronomy Building	-	100,000	100,000	-	-	-	200,000
Pathology/Ento./Breeding Building	-	100,000	100,000	-	-	-	200,000
Chemistry and Physical testing building	-	100,000	100,000	-	-	-	200,000
Bulking & Grading Building	-	100,000	100,000	-	-	-	200,000
Stringing sheds/Store	-	80,000	20,000	-	-	-	100,000
Curing Barns (20 units)	-	80,000	20,000	-	-	-	100,000
Workshop (1 unit)	-	80,000	80,000	-	-	-	160,000
Quarters Staff (ARO's, RA's, IMG)	-	150,000	150,000	-	-	-	300,000
	-	890,000	770,000	-	-	-	1,660,000

ANGGARAN KOS ALAT-ALAT DAN JENTERA

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
<u>Tembakau</u>							
Car	-	40,000	-	-	-	-	40,000
Landrover	-	-	40,000	-	-	-	40,000
Tractors, Sprayers and implements (1 Tractors sprayers)	-	50,000	30,000	-	-	-	80,000
Laboratory Equipment							
Balances, Humidity and Temp. controllers, Microscopes, Ovens, Autoclave	-	100,000	70,000	-	-	-	170,000
	-	190,000	140,000	-	-	-	330,000

ANGGARAN KOS PENGAMBILAN TANAH

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
Tembakau ( 50 acres)	-	274,000	50,000	-	-	-	

ANGGARAN KOS LAIN-LAIN PERBELANJAAN PEMBANGUNAN

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
<u>Tembakau</u> Roads, Fencing, Irrigatio layout, reservoir	-	150,000	100,000	-	-	-	250,000



### 3. FIELD CROP RESEARCH PROGRAMME

#### I. BACKGROUND AND OBJECTIVE

Research activities of the Field Crops Branch are currently confined to crops broadly classified into the following units: Grain Legumes, Coarse grain cereals (excluding rice), Root Crops and Sugarcane. The main objective of the program is to maximise productivity of the crops in small and large scale farming systems. This is ultimately anticipated to promote the use of these crops for export earning, import substitution and crop diversification.

The function of the branch is to solve problems of field crop production which are related to agronomy, breeding, diseases, pests, nutrition, weeds, physiology and mechanization.

There are a wide variety of field crops grown or utilised in Malaysia. The size of plantings range from commercial scale, such as sugarcane and cassava, to small farms, eg. groundnut, maize and mungbean. Cultivation of most of these crops are expanding and there is an increasing demand for their products. Preliminary studies have shown that the productivity of these crops may be improved through proper crop management practices.

Currently, very limited information are available on most of the field crops and very few institutions conduct research on the crops. This indicates that research should be expanded and intensified to:

- . Provide information on the cultivation of promising field crops;
- . Maximise the productivity of field crops planted under different agroecosystems.

## II. PROJECT DESCRIPTION

Emphasis of the field crops research program would therefore be on the following:-

- . Collection, evaluation and cataloging of germplasm.
- . Basic studies on agronomic, pest and disease problems.
- . Verification, adaptation and crop improvement studies at representative locations.
- . Mechanization studies.

Results of the above studies are expected to enable the farming community to intensify the use of farm land for better income and to provide other crop alternatives.

## III. JUSTIFICATION AND BENEFITS

The largest budgetary requirement under this programme for the Fourth Malaysia Development Estimate is for the provision of office, laboratory, ancillary structures and farm equipments for the new Legume/Cereal Research Station in Pasir Puteh Kelantan.

The Station covers an area of 116 acres and is being developed as the main centre for legume and cereal research, though other research activities on fruits and tobacco will also be conducted at the site.

Grain legumes (groundnut, soyabean and mungbean), coarse grain cereals (maize) root crops (cassava) and sugarcane are important food and feed crops. Among these cassava occupies the largest acreage (51,666 acres). Sugarcane comes next with about 23,000 acres mainly in Perlis and Kedah. Groundnut is cultivated on approx. 14,000 acres annually. Maize and soybean are relatively less important in acreage occupying 8,767 and 623 acres respectively.

Cassava can be cultivated on a wide variety of edaphic environments whose physiographic features are relatively flat. It can also be grown on peat which occurs extensively in the country. The product is utilised mainly as animal feed and presently accounts for about 11 percent of the raw materials used in the compound feed rations. This proportion could be raised to about 18 to 20 percent of the rations for pig and poultry while maintaining their nutritional qualities. There is a significant domestic demand for cassava products that can reduce imports of maize and other feed grains.

Groundnut and other legumes are suitable for integration in the cropping system on single cropped rainfed padi area and cultivated in rotation with padi. Legumes especially groundnut have been demonstrated to give lucrative returns, in addition to their capability of enriching the soil through the inherent nitrogen fixing ability.

Domestic demand for maize is high and estimates show that demand would increase to 414,000 tons in 1985 and the acreage needed to meet all requirement by 1985 is estimated at 180,00 acres. The potential for developing maize cultivation is mainly on the rainfed padi areas. Though the crop except when grown for the green cobs, is found presently not remunerative, research efforts in selecting high yielding varieties, agronomy and crop protection may evolve the technological inputs that can possibly make the crop economically viable to meet the high domestic demand for animal feed.

JABATAN: MARDI

BIL. PROJEK: 3

MAKSUD

KETERANGAN: LIHAT-LIHAT LAMPIRAN

PEMBANGUNAN: PENYELIDIKAN TANAMAN LADANG

	Tahun							Pecahan Kos Pembangunan
	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985	Tukaran Asing
<b>Kos Pembangunan</b>								
Pembinaan	-	250,000	250,000	250,000	-	-	750,000	
Alat-Alat dan Jentera	-	100,000	50,000	100,000	-	-	250,000	
Pelaburan	-							
Pengambilan Tanah	-	40,000	-	-	-	-	40,000	
Lain-Lain Perbelanjaan Pembangunan	-	100,000	100,000	100,000	100,000	-	400,000	
<b>JUMLAH KOS PEMBANGUNAN</b>		490,000	650,000	200,000	100,000		1,440,000	
<b>Kos Berulang</b>								
Gaji dan Upahan	1,261,000	1,417,000	1,500,000	1,592,000	1,673,000	1,729,000	7,911,000	
Perjalanan dan Pengangkutan Orang	87,000	142,000	142,000	142,000	142,000	142,000	710,000	
Kemudahan Awam (Api, Air, Letrik dan lain-lain)	-	8,000	8,000	8,000	12,000	12,000	48,000	
Sewa	18,000	29,000	29,000	29,000	33,000	33,000	153,000	
Bekalan dan Bahan-Bahan	157,500	177,700	177,800	177,800	177,900	178,100	889,400	
Penyelenggaraan dan Pembaikan Yang Dibeli	1,200	31,700	31,700	31,700	37,700	37,700	170,500	
Lain Perkhidmatan Professional dan Keraian	18,000	14,000	14,000	14,000	18,000	18,000	78,000	
Lain-Lain Perbelanjaan Berulang	-	46,600	46,600	46,600	57,600	57,600	255,000	
<b>JUMLAH KOS BERULANG</b>	1,544,800	1,866,000	1,949,100	2,041,200	2,151,200	2,207,400	10,214,900	

STESEN: PASIR PUTIH (TANAMAN LADANG)

	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
Pembinaan							
General Office (1)	-	100,000	100,000	-	-	-	200,000
Laboratory (1)	-	100,000	100,000	-	-	-	200,000
Working Shed (2)	-	-	60,000	-	-	-	60,000
Workshop & Store (1)	-	50,000	100,000	-	-	-	150,000
Planthouse Insect Proof (6)	-	-	120,000	-	-	-	120,000
Drying Floor (2)	-	-	20,000	-	-	-	20,000
		250,000	500,000				750,000
Alat-Alat dan Jentera							
Office Equipment & Furniture	-	-	-	20,000	-	-	20,000
Combie/Van (1)	-	15,000	-	-	-	-	15,000
Station Wagon (1)	-	19,000	-	-	-	-	19,000
Land Rover (2)	-	40,000	-	-	-	-	40,000
Tractor, 4 Wheel (3)	-	12,000	12,000	12,000	-	-	36,000
Sprinkler system	-	-	30,000	-	-	-	30,000
Farm Implements							
Mist Blower, Water pumps, Bush cutters, Mowers etc.	-	14,000	-	-	-	-	14,000
Workshop tools, Drills, Jack, etc.	-	-	-	10,000	-	-	10,000

	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
Lab Equipments							
Ovens (6), Balances (3), Gas Chromatography (1), Microscopes (3), Autoclave (1)	-	-	8,000	58,000	-	-	66,000
		100,000	50,000	100,000			250,000
Pengambilan Tanah							
Land Area 116 acres	-	40,000	-	-	-	-	40,000
Lain-Lain Perbelanjaan Berulang							
Infrastructure	-	100,000	100,000	100,000	100,000	-	400,000

#### 4. VEGETABLE AND ORNAMENTAL RESEARCH PROGRAMME

##### VEGETABLE SUBPROGRAMME

##### I. BACKGROUND AND OBJECTIVES

The total area under vegetable in Peninsular Malaysia is approximately 21,000 acres of which about 3000 acres are located in the highlands. Vegetable production comprises mainly of market gardening and small scale backyard farming operations. Farms are usually of small size in scattered areas near town and cities though several major vegetable growing areas can be identified. The production is mainly for home consumption and local markets though about 15% of the total production is exported to Singapore annually. Cameron Highlands which specialises in highland vegetables produces a substantial amount (\$15 million) of vegetables per year.

Vegetables form about 15% of the caloric intake of Malaysians. An estimate made on per capita consumption of vegetables in Peninsular Malaysia between 1966 and 1975 gave a very low figure of 79 lbs per year. Basing on population and income growth the projected domestic demand of vegetables for consumption in Peninsular Malaysia is expected to increase from 498,000 tons in 1980 to 780 tons in 1990.

Although vegetable production in Malaysia is expected to increase in accordance to population and income growth it is generally far from adequate to ensure required nutritional standards. Moreover Peninsular Malaysia imports annually about 112,000 tons (valued at \$41.00 million) of vegetables mainly onions, garlic, beans, chillies and potatoes.

## II. PROJECT DESCRIPTION

MARDI's research programme on improvement of vegetables has been planned to take into account the deficiencies in the vegetables production in this country. The research activities which will be carried out in Serdang, Jalan Kebun, Cameron Highlands, Kubang Keranji and Pontian are as follows:

### . Varietal improvement

The majority of vegetables grown locally has been introduced from overseas. Natural crossings among the varieties have resulted in genetic impurity and poor yield. It is necessary to develop genetic purity and superior varieties to suit local condition.

### . Improvement of crop husbandry techniques

Studies to be undertaken to determine growth requirements of vegetables would include spacings fertilizer requirement, crop rotation, cropping and intercropping system, water requirements and nursery management.

### . Increase productivity through physiological studies

Physiological studies into the growth pattern, environmental and agro-climatic effects on crop performance, flowering, fruiting and use of growth regulators would provide useful information for improving productivity of the crops.

### . Reducing damages by pests and diseases

The predominance of pests and diseases is a major constraint in vegetable production. Effective control measures including chemical and biological control would be looked into.



In order to achieve the objective of increasing the productivity of vegetables and ornamentals, correct research strategies should be worked out. The lines of action for the successful implementation of the vegetable and ornamental programme would include the following.

#### Problem solving research

The research programme would be geared towards the solving of existing farming problems and overcoming the yield limiting factors and other constraints which hinder the development of the vegetable and ornamental industry.

#### Familiarisation with farming conditions

The research personnel would be made to be more knowledgeable and familiar with the overall situation and actual farming conditions of the vegetables and ornamental industry. If necessary newly recruited personnel would be sent to the farming community or attached to the Project Development Division for a short period of training before they are allowed to embark on doing research. Regular visits to the farms would be arranged. Sufficient literature review and consultation with other fellow workers would have to be undertaken before the planning and implementation of the projects.

#### Identification of research priorities

Clear cut research priorities for the programme would be identified and consistently followed until the satisfactory achievement of the objectives.

#### Intensification of activities

Research efforts and activities would be intensified and expanded to cope up with the increased responsibilities of the programme. Research personnel and other resource would be correspondingly increased.

### Project monitoring

Progress of research projects would be monitored closely to ensure the smooth implementation of the projects. Supervision and advice would be given to guide the programme towards the right direction and to take remedial actions if necessary.

### Developing 'package technology'

Attempts to develop 'package technology' for immediate use by the farmers to solve farming problems would be intensified.

### Liaison with other divisions and agencies

Close liaison with the Project Development Division and other extension agencies to ensure the rapid dissimulation of the research findings to the farmers, would be maintained. The liaison would also provide feed back information useful for future research.

The success of the programme would depend on the successful implementation of these strategies. Therefore every effort should be made to ensure that the research personnel clearly understand these strategies and play their role effectively in attaining the objectives.

## III. JUSTIFICATION AND BENEFITS

The biggest expenditure item is the construction of a laboratory in Jalan Kebun and the provision of ancillary structures at research stations where the vegetable research activities are being conducted. The laboratory cum office proposed to be constructed in Jalan Kebun will provide the space and analytical facilities for researchers at this Central Vegetable Research Centre.

Additional facilities required for the Fourth Malaysia Plan are to augment the existing infrastructure so as to meet the proposed

expansion of research and the concomittant increase in personnel.

The success of the research programme would stimulate the vegetable production and the industry of the country. This in turn would benefit the farmers and the country and helps towards the achievement of the following national objectives and implications as outlined by the Ministry of Agriculture.

- . Reduce import of vegetable through import substitution and cultivation of the imported vegetables in the country.
- . Improved nutrition of Malaysian especially the low income groups through the increased production of vitamin rich vegetable.
- . To accelerate vegetable production and development to meet increasing national and overseas demand with increasing national and overseas demand with increasing population and improving standard of living. The local demand for vegetables would be double between 1975 to 1990. There would be an equivalent expansion of the export potential in Singapore.
- . Establishment of agro-based industries.
- . Increase income of farmers and contribute towards eradication of poverty in the rural areas.
- . Provide job opportunities both on farm activities and agro-based industries.
- . To utilise idle land through 'Buku Hijau' programme.

## ORNAMENTAL SUBPROGRAMME

### I. BACKGROUND AND OBJECTIVES

The ornamental industry in Malaysia consists mainly of floriculture, production of ornamental nursery plants and amenity horticulture such as landscaping and maintenance of parks and ornamental plants. The industry at the moment is rather small and at its early stages of development. Commercial floriculture in this country comprises mainly the cultivation of orchids in the lowlands and temperate types of lowers such as chrysanthemums, carnations and roses in the highlands. In terms of the cut flower trade in Malaysia, orchids by far, are the most important flowers being cultivated.

Statistics on cut flower trade show that fourteen major industrial countries of the world imported about M\$1200 million worth of cut flowers in 1975. In 1976 only about M\$25 million of tropical orchids from Asean countries were exported and this constitutes only 2% of the world cut flowers export. There is no official figure on the volume of export of Malaysian orchids. The turnover of orchid trade in Malaysia is estimated to be around \$10 million per year. About 800 acres of land the under orchid cultivation. The farms consist mainly of small holdings of a few acres though there are some larger ones of more than twenty acres.

In the highlands about 150 to 200 acres of land are under cultivation for cut flowers. The annual turnover is estimated at about \$4 million.

The demand for cut flower is increasing every year. Per capita flower consumption in the major industrial countries has been shown to increase from at least 50 to 100 percent between 1970 and 1975. The increase in the standard of living, expansion of air cargo

and technological advancement in the flower industry have contributed to the rapid growth of the flower trade. Flower production in industrial countries is becoming more and more expensive and there is a trend to relocate cut flowers producing areas to the tropical countries. Malaysia is endowed with abundant orchid species and an ideal climate for growing tropical orchids and therefore encouragement should be given to develop our orchid industry to its full potential and transforms the vast potential foreign demand for orchids into valuable foreign exchange for Malaysia.

The objectives and strategies of ornamental subprogramme are more or less similar to that of the vegetable programme as outlined earlier on.

JABATAN: MARDI

MAKSUD

PEMBANGUNAN: VEGETABLES AND ORNAMENTALS

BIL. PROJEK: 4

KETERANGAN: LIHAT LAMPIRAN-LAMPIRAN

	Tahun							Pecahan Kos Pembangunan
	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985	Tukaran Asing
<u>Kos Pembangunan</u>								
Pembinaan	-	335,000	390,000	-	-	-	725,000	
Alat-Alat dan Jentera	-	112,000	91,000	67,000	-	-	270,000	
Pelaburan	-	-	-	-	-	-	-	
Pengambilan Tanah	-	-	-	-	-	-	-	
Lain-Lain Perbelanjaan Pembangunan	-	30,000	-	-	-	-	-	
JUMLAH KOS PEMBANGUNAN		477,000	481,000	67,000			1,025,000	
<u>Kos Berulang</u>								
Gaji dan Upahan	361,000	499,000	633,000	691,000	691,000	779,000	3,345,000	
Perjalanan dan Pengangkutan Orang	42,000	83,000	96,900	105,500	115,300	126,500	527,200	
Kemudahan Awam (Api, Air, Letrik dan lain-lain)	-	400	400	400	400	400	2,000	
Sewa	-	300	300	300	300	300	1,500	
Bekalan dan Bahan-Bahan	77,500	110,200	126,800	145,900	166,900	192,100	741,900	
Penyelenggaraan dan Pembaikan Yang Dibeli	1,600	4,900	4,900	500	5,100	5,200	25,100	
Lain Perkhidmatan Prosessional dan Keraian	-	8,600	8,600	8,800	8,800	8,800	43,600	
Lain-Lain Perbelanjaan Berulang	150	1,600	1,500	1,600	1,600	1,600	7,900	
JUMLAH KOS BERULANG	482,250	708,000	872,400	958,500	1,041,400	1,113,900	4,694,200	

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
1. <u>Serdang</u>							
Nursery with irrigation stores working shed, and fencing	-	65,000	65,000	-	-	-	130,000
Orchid House (2)	-	35,000	35,000	-	-	-	70,000
2. <u>Jalan Kebun</u>							
Lab. Multipurpose/Office	-	150,000	150,000	-	-	-	300,000
Insect proof house/store	-	50,000	-	-	-	-	50,000
3. <u>Cameron Highlands</u>							
Office block 1/3 only share with fruits and crop protection	-	-	50,000	-	-	-	50,000
Glass House (1)	-	20,000	-	-	-	-	20,000
Insect Proof House (1)	-	15,000	-	-	-	-	15,000
Multipurpose cold room 1/2 shared with fruits	-	-	75,000	-	-	-	75,000
4. <u>IPRS Pontian</u>							
Insect Proof House (1)	-	-	15,000	-	-	-	15,000
		335,000	390,000				725,000

ANGGARAN KOS LAIN-LAIN PERBELANJAAN PEMBANGUNAN

Stesen	1980	1981	1982	1983	1984	1985	Jumlah 1981-1985
1. <u>Serdang</u> Infrastructure	-	10,000	-	-	-	-	10,000
2. <u>Jalan Kebun</u> Infrastructure	-	10,000	-	-	-	-	10,000
3. <u>IPRS Pontian</u> Infrastructure	-	10,000	-	-	-	-	10,000
		30,000					30,000



Stesen	1980	1981	1982	1983	1985	1985	Jumlah 1981-1985
1. <u>Serdang</u>							
Office Equipment & Furniture	-	4,000	1,500	2,000	-	-	7,500
Lab Equipments							
Ovens, Refrigerator, Microscopes, Balances, Insect traps, watersheds	-	43,000	24,500	35,000	-	-	102,500
2. <u>Jalan Kebun</u>							
Laboratory Equipment							
Balances, centrifuge, microscopes, Thermohygrograph, Calculators, Ovens, Mills, Camera, Seed storage chambers	-	50,000	50,000	10,000	-	-	110,000
3. <u>Cameron Highlands</u>							
Laboratory Equipments							
Autoclave, spectrophotometer, Incubators, Balances, Ovens	-	110,000	10,000	10,000	-	-	30,000
4. <u>IPRS Pontian</u>							
Laboratory Equipments							
Oven, Mills, Spectrophotometer	-	5,000	5,000	10,000	-	-	20,000
		112,000	91,000	67,000	-	-	270,000

## 5. COCOA AND COCONUT RESEARCH

### I. BACKGROUND AND OBJECTIVE

The cocoa industry is currently undergoing a rapid rate of expansion. This is primarily due to the very favourable prices for the product in recent times.

The growing interest in the crop is clearly demonstrated by the increase in the area under cocoa in Malaysia particularly that in Peninsular Malaysia. In Peninsular Malaysia, the total sole equivalent of cocoa in 1976 was 20,796 ha while that in Sabah and Sarawak was 9,823 ha and 2,843 ha respectively. In national statistical returns, the sole crop equivalent of cocoa in coconut/cocoa interplantings is presented as 50% of the coconut area. It is apparent that the relatively dramatic increase in Peninsular Malaysia is mainly accounted for the cocoa/coconut intercropping system the adoption of which has led to a substantial smallholder participation in the industry. The increasing importance of cocoa is also registered in raw cocoa production figures which increased from 2,000 metric tons in 1968/69 to 22,000 metric tons in 1979/80 (Gill and Duffus, Cocoa Market Report).

It has been estimated that there are at least 90,000 to 100,000 families whose livelihood depends on their coconut holdings. Estimates show that the average income derived by these coconut smallholders is one of the lowest in the country. Apart from intercropping, especially with cocoa, the availability of high-yielding hybrid coconuts offers considerable scope for increasing productivity of coconut land including bris soils.

The objectives of the cocoa and coconut research as a whole are to increase productivity and minimise production costs as well as improve the quality of the product.

## PROJECT DESCRIPTION

### A. Research Programme

It is important that research programmes should be geared towards the solution of current problems in the cocoa and coconut industries and the generation of new technology for improvement and expansion.

To-date nearly all commercial cocoa plantings in Malaysia are derived from hybrid seed materials produced in seed gardens. There are excellent prospects for the exploitation of clonal plantings. (Ramadasan and Arasu, 1976; Byrne, 1976). If individual tree selection is carried out with care, then, given the variability of even the highest yielding seedling progenies, one could expect a 50% - 100% increase in yield over the progenies from which the clones were selected (Ramadasan and Arasu, 1976). MARDI is still in the process of evaluating a large number of clones and many of these appear to be very promising. Also, improved techniques for production of vegetatively-propagated material are being developed and tested (Ramadasan, Hashim and Broughton, 1976; Ramadasan, 1978; Ramadasan and Fatimah Osman Palil, 1980). The shaping of clonal plants derived for readily available fan shoots need not pose any problems, if in the first instance, the clones are also selected for an upright branching habit (Ramadasan, Mohd Sharif Ahmad and Mohd Yunus Ahmad, 1978).

The use of economic shade trees for cocoa is an attractive proposition, particularly in the context of agricultural diversification and increased productivity per unit area. There is keen interest in the 'simultaneous' establishment of 'cocoa-coconut' and 'cocoa-oil palm' combinations. In fact, there is growing evidence that, given the right spacing for high yielding hybrid coconuts (Ng and Chan, 1976), and provision of (Vanialingam, Khoo and Choo, 1978) shade for cocoa by means of ancillary shade trees, the former system

may be feasible. From the results of an experiment from FELDA (Lee & Hanafi, 1968) and some other observational plantings elsewhere the latter system appears to have considerable potential, given an appropriate palm density and planting pattern. Economic computations support the view that the cocoa/coconut combination is the most profitable, followed by cocoa as a monocrop, oil palm and rubber in the order (Tunku Mansor Yaacob and St. Clair-George, 1979).

With rapid expansion in cocoa cultivation, diseases and pests are likely to become of greater significance. Care must be exercised in replanting in order to avoid root diseases from other crops and reduce the incidence of Vascular Streak Dieback (VSD). With proper management procedures (Jayawardena, Patmanathan and Ramadasan, 1978) and the use of tolerant or resistant materials, VSD should not pose a problem. Research on integrated pests and disease control could help to prevent or minimise any serious outbreaks in the future. Also, there is a need to ensure that more virulent pathogens from Africa and South and Central America continue to be excluded from South-East-Asia (Turner and Shepherd, 1978).

It is clearly evident that the quality of Malaysia cocoa beans should be high so that it is competitive in international markets. Research and quality control measures are imperative in achieving this goal. It is evident that research on coconuts should not only take into accounts the requirements of replanting and rehabilitation programmes for existing areas, but also realise its potential as an economic shade tree for cocoa. Research into intercrops other than cocoa will also merit attention for improving productivity of coconut areas on bris, acid sulphate and peat areas.

Research will cover breeding, agronomy, physiology, pathology, entomology and mammalogy. Also, research activities will be increased in other locations, i.e. Jerangau, Kemaman,

Bukit Ridan, Kluang and IPRS to cater for the requirements of development programmes in the country.

Special research programmes proposed under the Fourth Malaysia Plan will encompass the following areas:-

#### Breeding

The production of improved cocoa and coconut planting materials assumes the highest priority, as already indicated. The work will include:-

i) Germplasm and genetic collection

For cocoa, while some newer materials have already been brought in from South America, there is still a need to further widen the genetic base with of fresh introduction. The situation is similar in coconut, where the major advances in hybrid development have been based on one or two tall introductions. Conservation of germplasm reserves within the existing Malayan Tall population is clearly important.

ii) Selection of cocoa progenies and clones showing high yield, good bean characteristics and with a low coefficient of variation

Hybridization programmes will be carried out in order to produce progeny varieties from which individual tree selection can be performed to obtain more desirable clones. Apart from yield and seed quality, factors such as pest and disease resistance, shade requirements, drought tolerance soil specificity and plant type will also merit attention.

iii) Breeding and selection of coconut

Work will involve selection of superior palms among local materials as well as the development of high-yielding hybrid varieties-involving tall x tall and dwarf x tall hybridization programmes.

For both crops, location-specific testing will be a paramount feature.

#### Agronomy

Effort will be mainly concentrated on:-

- i) Studies on the role of shade in cocoa growth and yield, and identification of suitable shade trees other than coconuts.
- ii) Cultural practices for monoculture cocoa.

There has been a tremendous surge of interest in planting monoculture cocoa in the country. In Peninsular Malaysia, in particular, the knowledge on the cultural practice for monoculture cocoa planting is still limited.

- iii) Cultural practices for coconut.

This will include development of (a) suitable nursery techniques to maximise later yields, (b) efficient planting systems for high-yielding hybrids as a monoculture or with intercropping and (c) suitable planting practices for coconut in the coastal as well as in the inland areas.

- iv) Cultural practices suitable for cocoa/coconut intercropping.

The intercropping of cocoa under coconuts is becoming increasingly popular. The cultural practices being adopted are derived largely on a trial and error basis. A number of questions remain as to field preparation, fertiliser application, water management, etc.

- v) Intercropping studies with coconut.

Though cocoa has been found to be one of the most profitable crops to be intercropped with coconut not all areas planted with coconut are suitable for cocoa. In areas where

soil conditions are not suitable for cocoa such as acid sulphate, saline and peat soil, or where farm size is too small, cocoa cannot provide sufficient income to farmers. Alternative crops have to be found.

#### vi) Nutritional Studies.

There is still inadequate information on the nutritional requirements of cocoa and coconut under the different environments these crops are cultivated in Malaysia. Studies will include the determination of the most suitable frequency and method of fertiliser application in relation to other crop management operations.

#### Crop Protection

Pests, diseases and weeds result in crop losses. Studies will include black pod disease of cocoa, cocoa dieback as well as the rhinoceros beetle problem in coconut. Attention will be focused on etiology and epidemiology including effective and economical control measures.

#### Crop Physiology

Studies during the Fourth Malaysia Plan will include:-

- a) Vegetative propagation and related problems in cocoa.

In Malaysia, where cocoa appears very promising as a major cash crops, it is obviously desirable that the maximum area should be planted with high-yielding clonal materials rather than seedlings of variable performance.

- b) Studies on the influence of environment on growth, development and performance of both crops.

There is a need for greater understanding of the physiological factors limiting growth and yield so as to facilitate the development of more efficient cultural practices. Such information will also provide physiological criteria for breeding and

selection.

- c) Studies on the growth, flowering and fruiting patterns of both crops.

Such knowledge is important because they represent periods of intense physiological activity within the plant. This information will help in developing more effective cultural practices, e.g. in the timing of manurial applications to provide the nutrients when they are most critically required or can be effectively utilised.

#### B. Research facilities

In order to carry out the proposed research programme, existing facilities will need to be expanded and new facilities developed during the Fourth Malaysia Plan. Those constitute the following:-

##### 1. Land facilities

Currently, research is being mainly pursued at the MARDI Station in Hilir Perak, with efforts on a smaller scale at the stations in Jerangau, Kemaman and Kluang.

- a) Development of existing land

##### i) Hilir Perak

This will continue to be the central Cocoa and Coconut research station apart from serving the research needs of coconut areas on the West Coast.

##### ii) Jerangau

Research work will be mainly directed towards vascular streak dieback (VSD) disease. The station will also serve as the site for agronomic and breeding trials and thus also serve as an operational centre for meeting the research needs of cocoa/coconut development in the



region.

iii) Kemaman

The difficult terrain does not lend itself readily to general cocoa/coconut experimentation. However, breeding and agronomic investigations will be carried out, mainly with cocoa, under the specific conditions prevalent in this location so as to cater for development programmes in Ketengah and similar terrain elsewhere.

iv) Bukit Ridan

These locations have environmental advantages over Kemaman for general cocoa/coconut experimentation and it is proposed that one of them be developed into a sub-centre, with work being mainly concentrated on the development of cocoa monoculture systems. The results of research should be applicable not only for the entire eastern region but also for the southern region.

v) Serdang

This would be ideal as a centre of germplasm introductions and quarantine measures, because of its distance from major cocoa-growing areas.

vi) IPRS

This will be the operational centre to meet the specific research needs of Johor Barat.

b) Acquisition of new land

In order to fulfill additional requirements for land, it is proposed to make the following new acquisitions:-

- i) An additional area of 1,000 acres at the Hilir Perak Station to serve the needs for coconut research,

including germplasm collections. To date, coconut research has been severely handicapped by the shortage of land.

ii) An area of 100 acres of bris soil in the Sungai Bagin; area to serve the requirements of coconut research. Coconuts offer one of the most promising approaches to improve the productivity of such land.

## 2. Laboratory and office facilities

Laboratory and office space provision has been made for quarters at stations other than Hilir Perak. Where housing problems exist, e.g. Bukit Ridan, Kemaman, provision has been made for quarters. Other minor projects include store and garages for the normal form operations.

## 3. Laboratory and field equipment

This will constitute an essential part of the facilities required for research operations. Equipment will be mainly standard items for field preparation and maintenance and laboratory equipment to carry out research programmes, particularly those relating to physiological aspects.

# III. JUSTIFICATION AND BENEFITS

## a) Research programmes

On the context of the rapid rate of expansion and the growing importance of the cocoa and coconut industries, there is a clear justification for intensification and acceleration of research programmes.

The cocoa industry has been favoured by the very favourable prices for the product in recent times. Knowledgeable circles hold the view that overall future market prospects of cocoa are favourable, at least in the medium term while the increase in

supply will be absorbed by expanded consumption. In fact, taking all factors into consideration, Lim and Chai (1978) have considered £800 per tonne c.i.f. London as probably realistic to serve as the average future price in computations on the economies of cocoa cultivation.

In cocoa, successful research into the technology for exploitation of clonal plantings could result in a 50% - 100% increase in yield over the progenies from which the clones were selected. An important area of research would be the use of economic shade trees for cocoa in line with the need for agricultural diversification and increased productivity per unit area, i.e. coconuts and oil palm, especially the former, established 'simultaneously' with cocoa.

Currently, the area under cocoa is estimated at 40,000 acres of monocrop 89,000 acres of intercrops. With high prices, which have prevailed for the last few years, there is optimism and the general consensus of opinion in most cocoa circles is that in the next 20 years, there will be an increase in area of an additional 160,000 acres as a monocrop and 120,000 as an intercrop in Malaysia. In Sabah, cocoa is grown as a monocrop and the present area of 30,000 acres will be increased to 150,000 acres by the end of the century but availability of labour may be a major constraint. Altogether, cocoa promises to be a major export item and foreign exchange earner.

It is apparent that coconut development will be closely geared to that of cocoa, with exploitation of the cocoa-coconut cropping system. There are some half a million acres of coconuts in the country, most of which are under smallholdings. Coconut smallholdings constitute one of the poorest sectors of the agricultural economy and it is imperative that research effort be intensified towards the development of high-yielding hybrid varie-

ties apart from intercrops, especially cocoa in order to improve the productivity of coconut land. While existing coconuts on coastal areas provide ready-made shade for cocoa, successful research on the establishment of new coconuts. Stands as shade for cocoa could lead to extension and expansion of coconuts in inland areas. To this end, research into the performance of coconut on inland locations merits the highest priority. In this context, research into coconut cultivation as a monoculture on bris soils also assumes importance to increase the utilisation and productivity of such land. Research into intercrops other than cocoa will also merit attention for coconut areas where cocoa cultivation is not possible i.e. bris, acid sulphate and peat areas.

From the above discussion, it would appear that the cocoa and coconut industries in Malaysia have a bright future and could constitute one of the major revenue earners for the economy. With tremendous potential for substantial smallholder participation, development will be in line with the objectives of the New Economic Policy.

b) Development budget

The proposed development budget for the Fourth Malaysia Plan period is 16,324.0 ringgit. The major item in the budget is land acquisition (67%) namely, 1,000 acres in Hilir Perak and 100 acres on bris soils in Sp. Basing. This is imperative in order to intensify and accelerate coconut research in particular. To date, research on the crop has been hampered by land availability. With the emphasis on the coconut smallholder sector for the Fourth Malaysia Plan, this situation cannot be allowed to continue. Perennial crop research is very demanding for land resources, not only in terms of the scale of operations and area required for experimentation but also from the long-term commitment to the crop.

A sizeable portion of the land will be employed for germplasm collections which cannot be delayed any more, if research progress is to be maintained.

There is provision in the budget for construction for important research facilities, including laboratory and office space at various locations. Also, land clearing and development constitute an important element. The requirements for laboratory equipment are necessary to cater for the needs of breeding, physiology and crop protection research. The availability of all these facilities is imperative for the successful implementation of the research programmes for the Fourth Malaysia Plan.

#### IV. FINANCIAL AND MANPOWER REQUIREMENTS

To meet the financial needs for undertaking the research programmes proposed for the Fourth Malaysia Plan Period, the following budget has been proposed.

	Budget ('000)					
	1981	1982	1983	1984	1985	Total
Development	2,950.1	4,065.1	3,444.1	501.3	363.4	16,324.0
Operating	2,151.7	2,422.3	2,513.6	2,835.4	3,065.3	13,038.3
Total	5,101.8	6,487.4	10,957.7	3,386.7	3,428.7	29,362.3

JABATAN - MARDI

BIL. PROJEK - 6

MAKSUD PEMBANGUNAN - COCOA AND COCONUT RESEARCH

KETERANGAN - LAMPIRAN A, B, C, D

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
A. Pembinaan		1,409.6	309.5	103.0	204.9	85.5	2,112.5	Lampiran A
B. Alat-alat dan Jentera		469.5	326.4	168.9	93.5	100.6	1,158.9	Lampiran B
C. Pengambilan Tanah		-	3,040.0	8,000.0	-	-	11,040.0	Lampiran C
D. Lain-lain Perbelanjaan Pembangunan		1,371.0	389.2	172.2	202.9	177.3	2,012.6	Lampiran D
Jumlah Kos Pembangunan		2,950.1	4,065.1	8,444.1	501.3	363.4	16,324.0	
E. Kos Berulang (Jumlah)	1,127.6	2,151.7	3,422.3	2,513.6	2,885.4	3,065.3	13,038.3	(Keterangan berikut)

## JADUAL I (CONT')

## ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

JADATAN - MARDIMAKSUD PEMBANGUNAN - COCOA AND COCONUT RESEARCHBIL. PROJEK - 6KETERANGAN - LIHAT LAMPIRAN A, B, C, D

Object	Proposed Expenditure ('000)							Remarks
	1900	1901	1902	1903	1904	1905	Total 1901-05	
<u>Kos Berulang</u>								
1. Gaji dan upahan	655.0	322.0	911.0	993.0	1,107.0	1,156.0	4,989.0	
2. Perjalanan dan Pengangkutan orang	57.3	143.2	108.9	231.4	246.2	250.3	1,068.0	
3. Kemudahan Awam		41.8	42.8	45.5	42.0	52.2	232.3	
4. Sewa		5.1	5.1	5.3	5.4	5.4	26.3	
5. Bekalan dan Bahan-Bahan	323.4	950.0	1,005.1	1,159.9	1,270.6	1,393.0	5,874.6	
6. Penyelenggaraan dan Pembaikan yang dibeli	34.0	106.0	112.2	8.0	129.0	129.0	484.2	
7. Perkhidmatan Iktisas & Lain-lain Perkhidmatan dibeli & Hospitaliti	44.7	14.4	10.0	10.5	10.7	11.4	57.0	
8. Lain-lain Perbelanjaan Berulang	13.0	61.2	67.2	59.0	59.5	60.0	306.9	
Jumlah Kos Berulang	1,127.6	2,151.7	2,422.3	2,513.6	2,885.4	3,065.3	13,030.3	

JABATAN - MARDI

PROJECT - COCOA & COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
A. Pembinaan								
1. Hilir Perak		710.0	110.0	24.0	24.0		868.0	„Lampiran A <sub>1</sub>
2. Kluang		13.0	7.5	11.0	5.0	13.5	50.0	Lampiran A <sub>2</sub>
3. Bukit Ridan		203.0	20.0	3.0	5.0	12.0	243.0	Lampiran A <sub>3</sub>
4. Kemaman		273.6	167.0	55.0	90.9	55.0	641.5	Lampiran A <sub>4</sub>
5. Jerangau		210.0	5.0	10.0	60.0	5.0	310.0	Lampiran A <sub>5</sub>
		1,409.6	309.5	103.0	204.9	85.5	2,112.5	



JABATAN - MARDI

PROJECT - COCOA & COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
<u>Kos Pembinaan</u>								
<u>A. Pembinaan</u>								
1. <u>Stesen: Hilir Perak</u>								
1.1 General Utility Building		-	30.0	-	-	-	30.0	Cocoa research/management. 750 sq. ft. @ \$40.00/sq. ft.
1.2 Garage & Workshop		-	-	24.0	24.0	-	48.0	1920 sq. ft. @ \$25.00/sq. ft.
1.3 Office Block		500	80.0	-	-	-	580	1100 sq. ft. @ \$50.00/sq. ft.
1.4. Store - Farm		35.0	-	-	-	-	35.0	1167 sq. ft. @ \$30.00/sq. ft. (\$25,000 - 28,000 each)
1.5 Tank - Water Tower		59.0	-	-	-	-	59.0	60 ft. high/1000 gal.
1.6 Quarters		116.0	-	-	-	-	116.0	1981 - ARO - 1 x \$30,000 RA - 2 x \$25,000 Lab - 3 x \$12,000
JUMLAH		710.0	110.0	24.0	24.0	-	868.0	

JABATAN - MARDI

PROJECT - COCOA &amp; COCONUT RESEARCH

Object	PROPOSED EXPENDITURE ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
2. <u>Stesen</u> : Kluang								
2.1 Building/Structure		5.0	5.0	5.0	5.0	5.0	25.0	625 sq. ft. @ \$40.00/sq. ft.
2.2 Nursery Structure		3.0	-	3.0	-	3.5	9.0	\$9,000/acre
2.3 Office space 100 x 200'		5.0	-	3.0	-	5.0	13.0	260 sq. ft. @ \$50.00/sq. ft.
2.4 Lab Space		-	2.5	-	-	-	2.5	50 sq. ft @ \$50.00/sq. ft.
JUMLAH		13.0	7.5	11.0	5.0	13.5	50.5	

JABATAN - MARDI

PROJECT - COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
3. <u>Stesen</u> : Bukit Ridan								
3.1 Building Structure		20.0	5.0	-	5.0	-	30.0	600 sq. ft @ \$50.00/sq. ft.
3.2 Nursery - Structure		3.0	-	3.0	-	-	6.0	\$9,000/acre
3.3 House plant		-	-	-	-	12.0	12.0	400 sq. ft. @ \$30.00/sq. ft.
3.4 Drying yard & fermentory		-	15.0	-	-	-	15.0	\$5.00/sq. ft.
3.5 Quarters		180.0	-	-	-	-	180.0	1981 - ARO - 2 x \$30,000 Lab - 6 x \$20,000
JUNLAH		203.0	20.0	3.0	5.0	12.0	243.0	

JADATAN - MARDI

PROJECT - COCOA & COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4. <u>Stesen:</u> Kemaman								
4.1 Farm Store	30.0	-	27.0	-	-	-	27.0	\$27,000 each (900 sq. ft. @ \$30.00/sq. ft)
4.2 Insect - House	-	70.0	-	-	-	-	70.0	\$70,000 each
4.3 Plant - House	-	70.0	-	-	-	-	70.0	\$70,000 each
4.4 Laboratory space	-	30.0	-	-	-	-	30.0	500 sq. ft. @ \$60.00/sq. ft.
4.5 Guard House	-	1.6	-	-	1.9	-	3.4	170'sq. ft @ \$20.00/sq. ft.
4.6 Workshop - Garage	-	22.0	-	-	24.0	-	46.0	1840 sq. ft. @ \$25.00/sq. ft.
4.7 Building structure (Carpenter, Stores & other buildings)	80.0	30.0	40.0	30.0	30.0	30.0	160.0	4000 sq. ft. @ \$30.00/sq. ft.
4.8 Sprinkler Irrigation	-	50.0	-	25.0	-	25.0	100.0	\$20,000/acre - pipes, sprinkler heads, pumps & other accessories
4.9 Nursery structure	-	30.0	-	-	35.0	-	65.0	\$8,400/acre
4.10 Office - Block	-	-	100.0	-	-	-	100.0	2000 sq. ft. @ \$50.00/sq. ft.
JUMLAH	110.0	273.6	167.0	55.0	90.0	55.0	641.5	

JABATAN: MARDI

PROJECT: COCCA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
5. <u>Stesen</u> : Jerangau								
5.1 Building & Structure (Stores, Carpenter, Workshop & Others)	-	-	5.0	10.0	-	5.0	20.0	800 sq. ft. @ \$25.00/sq. ft.
5.2 House - insects	-	70.0	-	-	70.0	-	140.0	\$70,000 each
5.3 Nursery Structure & drains	-	30.0	-	-	10.0	-	40.0	\$12,000/acre
5.4 Quarters	-	110.0	-	-	-	-	110.0	ARO - 2 x \$30,000 JRA - 2 x \$25,000
JUMLAH	10	210.0	15.0	10.0	80.0	5.0	310.0	

JABATAN: MARDI

PROJECT: COCOA & COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
2. <u>Alat-alat &amp; Jentera</u>								
1. Hilir Perak		186.0	195.0	62.0	4.5	20.5	368.0	Lampiran B1
2. Kluang		28.6	1.0	3.1	15.0	2.6	50.3	Lampiran B2
3. Bukit Ridan		10.0	28.0	22.0	2.0	1.0	63.0	Lampiran B3
4. Kemaman		88.7	42.2	56.1	47.2	46.2	280.4	Lampiran B4
5. Jerangau		156.2	160.2	25.7	24.8	30.3	397.2	Lampiran B5
JUMLAH		469.5	326.4	168.9	93.5	100.6	1158.9	

JAJATAN - MARDI

PROJECT - COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
B. <u>Alat-alat &amp; Jentera</u>								
1. <u>Stesen: Hilir Perak</u>								
1.1 Boxes, kiln/dryer	30.0							
1.2 Farm equipment -	20.0							
- Hayter			1.0			1.0	2.0	2 x \$500.00
- Trailer		4.5			4.5		9.0	2 x \$450.00
- Trailer-water-tank			8.0			8.0	16.0	4 x \$4,000
- Other equipments		15.0		10.0		10.0	35.0	example: (sprayer, fogging machines, tools)
1.3 Office equipment -	60.0							
- Typewriter				2.0			2.0	2 x \$1,000
- Water Cooler		0.5				0.5	1.0	2 x \$500.00
1.4 Vehicle -	20.0							
- Pickup/lorry			16.0				16.0	Combi = 1 x \$16,000
- Combi		16.0					16.0	Pickup = 1 x \$32,000
1.5 Research equipment & Chemicals		150.0	70.0	50.0		1.0	271.0	Lihat lampiran B. Supplementary
JUMLAH		186.0	95.0	62.0	4.5	20.5	368.0	

JABATAN: MARDI

PROJECT: COCOA & COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
2. <u>Stesen:</u> Kluang								
2.1 Office equipment - - Table/Chair/Cabinet & others		1.0	1.0	0.5	1.0	1.0	4.5	
2.2 Lab equipment		25.0			14.0		39.0	Lihat lampiran B supplemen- tary
2.3 Farm equipment - - water tank		1.6		1.6		1.6	4.8	\$600 each
2.4 Furniture - - office		1.0		1.0			2.0	Table/Chair/Cabinet/Stools
JUMLAH		28.6	1.0	3.1	15.0	2.6	50.3	



JABATAN: MARDI

PROJECT: COCOA & COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
3. <u>Station:</u> Bukit Ridan								
3.1 Laboratory equipment		10.0	20.0	20.0			50.0	Lihat lampiran B supplementary
3.2 Farm equipment								
- water tank			2.0		2.0		4.0	2 x \$2,000
- boon sprayer				2.0		1.0	3.0	3 x \$1,000
- furniture - lab			3.0				3.0	Desk/Chair/Cabinet/Stool, etc
- office			3.0				3.0	- as above -
JUMLAH		10.0	28.0	22.0	2.0	1.0	63.0	

JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4. Station: Kemaman								
4.1 Printing equipment								
- Gesterner		5.0					5.0	single paper
- Xerox machine			10.0				10.0	
- Others					1.0		1.0	
4.2 Office equipment	4.0							
- Typewriter		2.0				1.0	3.0	3 x \$1,000
- Calculator		1.0		1.0		1.0	3.0	3 x \$1,000
- Water Cooler			1.6				1.6	2 x \$800
4.3 Lab equipment	40.0							
- Rotavator					5.0		5.0	1 x \$5,000
- Plough				4.0			4.0	2 x \$4,000
- Hayter			1.0			1.0	2.0	2 x \$1,000
- Trailer		4.5		4.5		4.5	13.5	3 x \$4,500
- Field water tank		1.6		1.6			3.2	1 unit = \$1,000
- Pedestrian tractor			8.0				8.0	1 unit = \$8,000
- Crop protection equipment		2.0			2.0	3.0	7.0	eg. spraying equipment
- Fogging			3.5			3.5	7.0	2 x \$3,500
- Welding gate & accessories		5.0			5.0		10.0	2 x \$5,000
- Jacks		1.6					1.6	5 tons & 10 tons 2 x \$300.00

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
- Battery charger		3.0					3.0	1 x \$3,000
- Air pump		3.0					3.0	1 x \$3,000
- Tools (workshop)		2.0	1.0		1.0		4.0	Small tools
- Tools - field			3.0	5.0	3.0	3.0	14.0	
- Field balance				5.0			5.0	Platform scale \$5,000
- Generators			5.0				5.0	1 x \$5,000
- Chain saw		1.5			1.5		3.0	2 x \$3,000
- Siren			2.5				2.5	1 x \$2,500
- Water pump					2.5		2.5	1 x \$2,500
- Harrow					5.0		5.0	1 x \$5,000
- Tine 9			3.0				3.0	1 x \$3,000
- Others		1.0	1.0	2.0	2.0	2.0	6.0	
JUMLAH		68.7	42.2	56.1	47.2	46.2	260.4	

JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
5. Station: Jerangau								
5.1 Office - equipment								
- Typewriter		1.0			1.0		2.0	2 x \$1,000
- Calculator			1.0			1.0	2.0	2 x \$1,000
- Others		0.7	0.7	0.7	0.8	0.8	3.7	
5.2 Laboratory equipment		150.0	150.0	20.0	20.0	20.0	360.0	Lihat lampiran B supplementary
5.3 Farm equipment								
- Boom sprayer		2.0		2.0		2.0	6.0	6 x \$1,000
- Fogging machine			3.5			3.5	7.0	2 x \$3,500
5.4 Furniture								
- office		2.5	2.0	1.0	1.5	1.5	6.5	Desks, chair, cabinet, stools, etc.
- laboratory			3.0	2.0	1.5	1.5	8.0	Desk, chair, cabinet, stools, benches, etc.
JUMLAH		156.2	160.2	25.7	24.8	30.3	397.2	

JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
<u>Land Acquisition</u>								
1. Station Hilir Perak			2,000.0	8,000.0			11,000.0	Lampiran C1
2. Station Sungai Baging							40.0	Lampiran C2
JUMLAH				8,000.0			11,040.0	

JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
<u>Land Acquisition</u>								
1. Station: Hilir Perak				8,000.0			11,000.0	1000 acres x 11,000.0
JUMLAH				8,000.0			11,000.0	

SABATAN: MARDI

PROJECT: COCOA & COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
2. <u>Station</u> : Sungai Baging		40.0					40.0	Penyelidikan kelapa 200 ac. x \$20
JUMLAH		40.0					40.0	

JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1930	1931	1932	1933	1934	1935	Total 1931-35	
<u>Lain-lain Perbelanjaan Pembangunan</u>								
1. Hilir Perak		539.0	190.0	55.0	32.5	37.5	854.0	
2. Kluang		29.8	29.8	37.3	13.8	37.8	149.0	
3. Bukit Ridan		70.0	32.8	12.0	24.8	12.0	159.6	
4. Kemaman		388.2	32.6	17.4	13.8	10.0	110.0	
5. Jerangau		36.2	32.6	17.4	13.8	10.0	110.0	
JUMLAH		1071.0	389.2	172.2	202.9	177.3	2012.6	



JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
D. <u>Lain-lain Perbelanjaan Pembangunan</u>								
1. <u>Station: Hilir Perak</u>	60.0							
1.1 Bridges		50.0	25.0		25.0		100.0	4 x \$25,000
1.2 Drainage - s,000 chains		40.0			5.0	20.0	65.0	1 chain = \$60.00
1.3 Water gates		14.0					14.0	7 x \$7,000
1.4 Electricity		20.0	10.0			10.0	40.0	For new area (office & other building)
1.5 Fencing - chain link		150.0	150.0				300.0	Existing & future area 1 ft. x \$10.00
1.6 Road - farm	200.0	80.0					80.0	\$13.00 cu. yd. mining balast
1.7 Road metallic		170.0	5.0	50.0			225.0	1 chain x \$105.00
1.8 Telephone & others		5.0			2.5	2.5	10.0	Buildings in new area
1.9 Water facilities		10.0		5.0		5.0	20.0	15,000 ft x \$2.00
JUMLAH		539.0	190.0	55.0	32.5	37.5	854.0	

JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
2. <u>Station:</u> Kluang								
2.1 Clearing of land		13.8	13.8	13.8	13.8	13.8	69.0	100 acres x \$690.0
2.2 Farm road-laterite		8.0	8.0	12.0		12.0	40.0	800 lorries x \$50.00
2.3 Drainage		8.0	8.0	12.0		12.0	40.0	667 chains x \$60.00
JUMLAH		29.8	29.8	37.8	13.8	37.6	149.0	

JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
3, <u>Station:</u> Bukit Ridan								
3.1 Land clearing		12.4	24.8		24.8		61.6	\$620.00/acre
3.2 Drainage		16.0	8.0	12.0		12.0	48.0	800 chains x \$60.00 100 chains x \$25.00
JUMLAH		28.4	32.8	12.0	24.8	12.0	102.6	

JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4. <u>Station:</u> Kemaman								
4.1 Land clearing	75.0	12.0	12.0		36.0		60.0	100 acres x \$600.00
4.2 Road - farm		50.0		50.0		70.0	170.0	1 chain x \$400.0
4.3 Drainage	50.0	25.0					25.0	417 chains x \$60.00
4.4 Fencing - chain link	50.0	100.0	50.0		50.0		200.0	20,000 ft x \$10.00
4.5 Electricity	10.0	50.0	10.0			10.0	70.0	new buildings
4.6 Bridges		90.0	30.0		30.0		150.0	6 x \$25,000
4.7 Water tank	10.0	45.0					45.0	1 x 1,000 gal x \$45,000
4.8 Water facilities		15.0					15.0	Pipe and pumps
4.9 Communication facilities			2.0		2.0		4.0	Intercom 2 sets x \$2,000
- walkie talkie								
- Telephone		1.0					1.0	For field buildings
JUMLAH		388.0	104.0	50.0	118.0	80.0	740.0	

JABATAN: MARDI

PROJECT: COCOA &amp; COCONUT RESEARCH

Object	Proposed Expenditure ('000)							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
5. <u>Station</u> : Jerangau								
5.1 Land clearing		13.8	27.6		13.8		55.2	80 acres x \$690.00
5.2 Drainage		17.4		17.4			34.8	1 chain = \$160.00
5.3 Farm - Road (laterite)		5.0	5.0			10.0	20.0	400 lorries x \$50.00
JUMLAH		36.2	32.6	17.4	13.8	10.0	110.0	

LAMPIRAN B (SUPPLEMENTARY)

JABATAN: MARDI

PROJECT: COCOA & COCONUT RESEARCH

No.	Laboratory Equipments	Estimated Cost	Quantity				
			1981	1982	1983	1984	1985
1.	Autoclave (4)	10,000					
2.	Rotary evaporator						
3.	Hot plate (8)	6,000	8				
4.	Automatic leaf area meter (1)	35,000		1			
5.	Insect trap, light (3)	20,000		8			
6.	Microscope, various magnification (3)	40,000		3			
7.	Plant meter digital (4)	25,000		4			
8.	Plant moisture stress equipment (1)	50,000	1				
9.	Freezer, deep 4 cm ft (4)	9,000	4				
10.	Freezer, deep 15 cm ft (2)	10,000		2			
11.	Anemometer with recorder (2)	20,000			2		
12.	Balance, various ranges (5)	30,000			6		
13.	Bath water, thermostate controlled (4)	9,000	4				
14.	Gas, liquid chromatograph (1)	40,000			1		
15.	Oven (5)	14,000	5				
16.	Refrigerator, 9cm ft (4)	12,000	4				
17.	Thermohygraph (12)	10,000	12				
18.	Light meter with quantum sensor (1)	20,000	1				
19.	Peioniser (5)	10,000	5				
20.	Leaf - temperature measuring equipments (2)	12,000	2				
21.	Centrifuge, temperature control (2)	20,000	2				
22.	Camera, hemispherical plus accessories (3)	48,600		3			
23.	Camera, standard plus attachments (4)	12,000			4		
24.	Cabinet drying (8)	40,000		8			
25.	Moisture tester (soil) (4)	16,000	4				

LAMPIRAN B (SUPPLEMENTRY)

No.	Laboratory Equipments	Estimated Cost	Quantity				
			1981	1982	1983	1984	1985
6.	Moisture tester (seeds) (2)	6,000	2				
7.	Hot plate (8)	6,000	3				
8.	Pressure chamber for plant moisture (2)	30,000	2				
9.	Shaker, various type (4)	6,000	8				
10.	Freeze dryer (2)	24,000	2			2	
11.	Solarmeter, recording (2)	40,000					2
12.	Grinder for plant tissues (2)	6,000	2				
13.	Spectro photometer, u.v./vis for physiological studies (1)	70,000	1				
14.	Water still, fully automatic 5/6 litres (4)	29,200				4	
15.	Ultra - violet sterilizer (2)	8,200					2
16.	Flaw chamber (Lamina) (2)	20,000			2		
17.	Colony counter (4)	14,000		4			
18.	Blender - Stainless steel (4)	10,000		4			
19.	Incubators (6)	18,000	6				
20.	Balance (precision) (10)	20,000	10				
21.	pH Meter (4)	4,000	4				
22.	Air compressor (5)	6,500	5				
JUMLAH BESAR		856,500					

.6. PROJECT: FRUIT RESEARCH

I: BACKGROUND AND OBJECTIVE

The fruit industry in Malaysia is relatively undeveloped when compared to the major crops in the country, notably rubber and oil palm. Nevertheless, the fruit acreage is by no means negligible nor its socio-economic importance insignificant.

It is estimated there are in excess of 133,00 acres (on a sole crop equivalent basis) of fruit plantings scattered in various parts of the country and from these areas, some 650,00 tons of fruit are produced annually. It must be stressed that these statistics are gross approximation and data on the fruit industry is sparse. Furthermore, as we are only too well aware, a substantial quantity of fruits, in particular papaya, rambutan and mango are produced from the garden of domestic homes for which no statistics are available,

From available data on the acreage and pattern of distribution of the major fruits in the country, it would appear that the most important fruit grown in this country in term of acreage is pineapple. Johore, the main producer accounts for 85% of the planted acreage for this crop in the country. With regards the other fruits, banana, durian, cashew and rambutan are the next important followed by citrus and mango. The major fruit areas in the country the Johore (Pineapple, durian and banana), Perak (durian, rambutan and banana), Pahang (banana, rambutan, and cashew) and Kelantan (banana, rambutan and water melon). Together, these states account for some 80% of the total fruit acreage in the country. With the exception of pineapple (with several large plantations) and cashew (the bulk of the planting are by CIMA), the industry is almost wholly organised on a smallholder,



basis, each usually involving less than 1 hectare. As such, the sector of the rural population which wholly or partly derives a source of income from this industry is substantial.

In addition, fruits form a very essential part of the diet and the availability of a plentiful supply of fruit at reasonable prices is an important consideration.

The government through its various strategies including taxation arrangements have given much encouragement to the further expansion of the fruit industry but the success achieved have been far from satisfactory.

Why this is so is not fully understood. Domestic production is inadequate to meet local demand and large quantities of fresh and processed fruits are imported annually to a value estimated at 50 million ringgit. In addition, in the case of some fruits, the potential for export also exist. Malaysia is already a major exporter of pineapple and limited quantity of other fruit eg. durian, rambutan and duku, largely from Johore find ready market in Singapore.

Several fruits including rambutan, durian, banana and langsat are indigenous to the region and as such agro-climatic conditions should not be a severe constraint. Pest and disease problems of course do occur but these are insufficient to explain the general lack of interest towards fruit cultivation. In fact, extrapolation from available data would suggest that fruit cultivation can be extremely profitable, surpassing that for oil palm and rubber.

Why then should there be such a lack of interest in fruit cultivation. Reliable information regarding the fruit industry is scarce but apart from pest and disease problem, the factors which may be contributory to the unsatisfactory situation are

- i) Excessively long period before the trees come into bearing and thus a long delay before income is forthcoming eg. durian and mangostean.
- ii) marked seasonal production leading to glut situations eg. rambutans.
- iii) erratic and unpredictable annual production levels leading to unreliable income levels.
- iv) highly perishable produce which, together with the seasonal and erratic annual production levels prevent the development of a well organised marketing systems.
- v) variable quality of the produce.

Thus at present levels of technology, management and marketing, practices, fruit cultivation is a highly risky enterprise involving uncertainty with regards to its success and level of income that can be expected.

The solution to these problems must depend on the joint efforts of the extension and marketing agencies but research efforts are necessary to overcome the problems of variable quality of planting material, lack of understanding of the agro-climatic requirements for fruits and to develop suitable agronomic practices.

The primary objective of fruit programme is therefore to develop improved planting materials and generate suitable technology to meet the needs of existing fruit industry and also to stimulate further expansion of the industry.

## II. PROJECT DESCRIPTION

### A. Research Programme

In considering the proposals to be put forward in the research programme from 1981 to 1985, it would be

appropriate to examine the current status with regards to the fruit industry and its problems and where knowledge is lacking on these crops. It is with this basic understanding that a balanced and relevant research programme can be developed to provide the necessary support for maintaining and perhaps also, for expansion of the fruit industry.

Fruit cultivation in this country, as mentioned earlier, is largely carried out on a small-holder basis, and usually in very small units with several types of fruits grown in the same farm. The fact that the fruit industry is organised on this basis represents a major problem with regards to building up an accurate picture of the industry and obtaining a reliable feed-back on actual problems facing the farmers. An attempt has been made to bridge this gap through a Techno-Economic Survey carried out in 1980 but it is envisaged that further surveys in greater detail and of a more specific nature will need to be carried in Fourth Malaysian Plan period to obtain additional data.

Another aspect of the fruit industry is that annual production is extremely variable and fruit areas are very scattered throughout the country, the result being that in some areas, fruit production is excessive and the resultant price being too low for the farmer while in other areas, as a result of scarcity, the price is too high for the consumer. This factor together with the perishable nature of the produce and seasonality of the production does not lend itself readily towards a proper development of an efficient distribution and marketing systems. Some of these problems, at least those of a technical nature can be resolved through development of suitable technology eg. improved storage methods, more stable varieties and perhaps a better pattern of distribution of the

fruit plantings in the country. In the latter case, there is a need to identify suitable agro-climatic zones for the different crops and to develop better crop management methods to reduce excessive annual fluctuation in productivity of the plantings.

The quality of fruits produced in the country is also variable largely because the bulk of the production is derived from plantings established with unimproved planting materials. The need to develop improved planting materials with respect to quality and yield is clearly an important consideration.

Finally, of course, as land resources become more limited in this country, the cultivation of fruits will depend on its competitiveness in terms of its economic and social returns in relation to alternative uses of the land in particular, rubber, oil palm and cocoa. There is therefore need to devise and develop appropriate crop management practices such that the economics of fruit cultivation becomes favourable by comparison with the other crops.

A large number of fruit types are cultivated in the country but priority will be given in the proposed programme for the Fourth Malaysia Plan period to pineapple, cashew, nangka, durian, rambutan, mango, papaya, water melon and citrus. In the case of pineapple, the main emphasis will be for canning varieties under peat, considering the availability of large tracts of peat land for which at present, there is very limited use. Similarly in the case of cashew the main thrust will be for the Bris Soils which has also very limited use.

The specific studies proposed under the Fourth Malaysia Plan will cover the following areas:

### Varietal Improvement

The need to provide improved quality planting material has been stressed earlier and this will be given the greatest emphasis in the research programme.

The types of activities envisaged in the programme include:

- i) development of germplasm and genetic collection. This forms the main source of parents and varieties and as such is an important area of research activity. This is particularly so as several indigenous fruit species eg. duku, langsai, mangosteen are gradually being eroded and lost as these areas are being replanted either with improved varieties or other crop species. Introductions of those species not found locally will also receive close attention.
- ii) development and initiation of a more systematic breeding and hybridisation programme. This is envisaged for those crops where the breeding efforts are relatively more advanced, eg. papaya, pineapple, durian and cashew.
- iii) and finally, a comprehensive testing of the existing varieties under different soil and agro-climatic conditions. This is to identify the types of fruits suitable for the different regions in the country, the level of production possible, the most suitable variety and the problems likely to be associated with cultivation of a fruit type in a particular location.

### Crop Husbandry

Attention will be given to improvement in fruit husbandry practices through,

- i) developing optimum fertilizer practices. At present there is inadequate information on optimum fertilizer composition, levels, and method of application with increasing acreage of the fruits being cultivated on a mono-crop basis, the need for such information become more urget.
- ii) developing optimum practices relating to establishment, spacing, pruning and other related aspects for which there is at present inadequate understanding.
- iii) developing suitable mixed cropping systems to cater for the current system of mixed fruit cultivation in the dusuns. An understanding of how the different fruit types interact is important to developing suitable crop husbandry practices for such mixed stands and for integration with other crops and livestock to obtain maximum productivity.

#### Crop Protection

Crop losses due to pests, diseases and weeds cause higher production cost and a reduction in yield and for many fruits eg. mango, durians, carambola, jackfruits, is a limiting factor towards successful sultivatib of the crop. Studies envisaged on identifying and understanding the major pest and disease problems and developing suitable crop protection practices.

#### Crop Physiology

The types of fruit physiological studies proposed for the Fourth Malaysia Plan period include,

- i) studying the flowering behaviour in mangoes and pineapple in relation to the agro-climatic conditions and

developing suitable methods for inducing flowering in these crops.

- ii) developing suitable vegetative propagation methods and these will involve studying and evaluating the various propagation methods, stock-scion interaction effects, and bud wood nursery management practices.
- iii) a general understanding of the various crop physiological processes in relation the agro-climatic factors. This will enable us to better manipulate the plant and its environment through breeding and agronomic practices to achieve higher yields.

#### B. RESEARCH FACILITIES

To implement the proposed research programme, there will be a need to expand existing facilities and develop new facilities. The elements involved under the Fourth Malaysia Plan are as follows:-

##### 1. Land facilities

Research on fruits, in common with other perennial crops, eg. oil palm and rubber, is extremely demanding on land resources.

As a basis for considering the additional land requirements, it would be appropriate to examine the current usage of the existing land.

Research on fruits is conducted at several stations namely:-

- i) Serdang, Selangor.
- ii) I.P.R.S., Pontian, Johore.
- iii) Kluang, Johore.
- iv) Kuala Kangsar, Perak.

- v) Jerangau, Trengganu.
- vi) Cameron Highlands, Pahang.
- vii) Bukit Ridan, Pahang.
- viii) Jalan Kebun, Selangor.
- ix) Sungai Baging, Pahang.

At each of the station, research is conducted only on a very limited number of crops, the choice being made primarily on the basis that these stations represent the most suitable areas for the crops concerned. Thus, the stations at the Jalan Kebun and Pontian cater mainly for pineapple research. The reason for this is that the soil at these stations is peat and this is main type of soil on which pineapple is currently being cultivated. Considering that peat soil has extremely limited use in relation to the type of crops that can be grown on it, this concentration of pineapple research on peat would appear to be most appropriate. It is extremely unlikely that pineapples can compete, in terms of economic viability and social returns, with the other crops in particular rubber, oil palm and cocoa, for a place in mineral soils.

Similarly, in the case of cashew, much of the present research activities are centred at Sungai Baging Station, Pahang where the soil type is "Bris". Soils of this type are very extensive in the east coast of Peninsular Malaysia. These soils are extremely poor and apart from cashew which offers an important potential use of the land, very few crops can grow and yield well on this marginal soil.

The Cameron Highlands Station is devoted mainly to research on temperate fruit types eg. oranges, apple and pears.

At the other stations are located the research on the other fruit namely, durian, mango, rambutan, nangka and papaya, but acreages involved in each of the stations are extremely small.



To meet the research needs for land, it is proposed under the Fourth Malaysia Plan to:-

- a. develop existing land at the station. However, this is extremely limited both in relation to the quality available and to suitability. Existing land will be opened up in the station at Jalan Kebun, Selangor. Serdang; Selangor. Bukit Ridan, Pahang. Pasir Puteh, Kelantan. Jerangau, Trengganu. Bertam, Pulau Pinang and Kuala Kangsar, Perak. Much of the land will be used to test the performance of varieties under varying environmental conditions and for specific fertilizer studies.
- b. acquisition of new land. To meet the additional need for land, it is proposed to make the following new acquisitions:-
  - i) an area of 1000 acres for a central fruit research centre. The choice of the area has not been fully considered but the location and type of land should be suitable for durian, mango, rambutan, papaya and nangka. It might of course even be necessary to consider several parcels of land to meet the specific requirements of each fruit type. However, some compromise may be necessary as it is proposed to establish the new station as a centre for research of the important local fruits other than pineapple and cashew.
  - ii) an additional area of 300 acres at Cameron Highlands, Pahang for temperate fruit research. The present station at Cameron Highlands is fully committed to vegetable and tea research and only a very limited amount of land is available for fruit research. Interest in temperate fruit is recent but fruit trees

like oranges offer considerable scope. The proposed new site is also at lower elevation (3,000 ft.) and this is considered more suitable for fruit cultivation.

- iii) an additional 50 acres at IPRS, Pontian, Johore. This is mainly to cater for additional needs for pineapple research at this location, particularly in relation to developing suitable agronomic practices for the new pineapple varieties.

## 2. Laboratory and office facilities

It is proposed under the Fourth Malaysia Plan to establish new laboratories at the new fruit research station, at Cameron Highlands station and at Jalan Kebun station.

The new laboratory at Jalan Kebun is an additional block to cater for the expanding staff and activities. At the other locations which are new station, these are intended to provide basic laboratory and office infrastructures for undertaking the research activities.

Apart from the laboratory and office space provision has been made for quarters at some of locations to cater for the staff that to be at station outside hours namely, at Jalan Kebun station and for those locations where private housing facilities sufficiently close is not available namely, at Comeron Highlands station and at Sungai Baging station, Pahang.

Other minor constructions proposed include store and garage for the normal farm operations.

## 3. Laboratory and field equipment

An essential part of the facilities required for any research operations are laboratory and field equipments.

The field equipments are largely standard implement required to carry our field preparation. With regards laboratory equipment, this is required to equip the new laboratories and to provide the necessary tools for carrying out new research programmes. Much of the equipments proposed for purchase are to develop capabilities to undertake fruit research with request to physiological aspects.

### III. JUSTIFICATION AND BENEFITS

The need to strengthen and accekerate fruit research in this country may be justified in relation to the following factors:-

- i) to support the existing fruit industry. Much of the information relating to the current status of the fruit industry has been described earlier under "Background and Objective". However, it worth nothing some of the salient features regarding this industry. Basically, the fruit farm or dusun, sonsists of mixed planting of several fruit types and other crops or livestock and very small acreage, usually between 1 to 2 acres, are involved. Agricultural practices are difficult to defined but are usually considered to be not satisfactory. The income levels are usually also not satisfactory. The main problems are marketting (attrivutable to perishability of produce, seasonality of production and very scattered plantings), variable quality of produce (due to poor planting materials) and very inconsistent annual productions levels (due to inadequate management and lack of proper understanding of the agroclimatic requirements of the fruit). Technological inovations and information can contribute much to minimising much of these problems and hence the need to intensify research efforts.

The acreage of fruit planting in this country is estimated at 133,000 acres and this is largely in the form of small holdings. Hence the fruit farmer represents a very sizeable sector of the rural population and any effort to improve the income of the fruit farmer will contribute greatly to eradicating poverty among the rural sector.

- ii) to ensure the availability of an adequate supply of fruits at reasonable prices. Fruits are very essential part of the diet and the availability of an adequate supply of fruits at reasonable prices is an important consideration. The Government through its various policies and strategies including taxation arrangements, have given much encouragement to expansion of the fruit industry but the success achieved have not been very satisfactory. Domestic production is inadequate to meet local demand and large quantities of fresh and processed fruit to the value of between 50 to 100 million ringgit are imported annual. Local fruits, from the studies carried out are very nutritious and given adequate technological and marketing support, there is no reason why the need to import cannot be minimised.
- iii) to maximise the use of marginal soils. Among the marginal soils, bris and peat are extremely important in terms of acreage. The former soil covers an area of well in excess of 300,000 acres, mainly in the East Coast of Peninsular Malaysia while the latter consist well over 5 million acres of which about half is in Peninsular Malaysia. For both these soil types, very few crops can grow and yield well.

iv) to diversify the agriculture and exports earnings. In attempting to identify suitable crops for diversifying the agriculture and export earnings of this country, one is faced with dilemma that very few crops can offer an income comparable to that for oil palm, rubber and cocoa. Fruits in particular papaya, durian, rambutan, mango, carambola appear to be among the few crops that are able to yield income comparable to that for plantation crops. The computations are, of course, based on the local fresah fruit market which is somewhat limited. Nevertheless, while the price may not be as good, the processed fruit market holds good potential.

Currently, the only processed fruit industry is pineapples but there is no reason why given suitable technological inovations that rambutans, mango, nangka, guava and soursop cannot develop into an important industry.

The proposed development budget for the Fourth Malaysia Plan period is 6,702,400 ringgit. The relative distribution of the budget is as follows:-

i) Construction	-	45%
ii) Equipment and field equipments	-	20%
iii) Land acquisition	-	5%
iv) Other infrastructures	-	30%

The major item in the budget is land acquisition. it is proposed under the Fourth Malaysia Plan to acquire 3 parcels of land consisting:-

- i) 1000 acres in the lowland
- ii) 300 acres in the highlands
- iii) 50 acres in peat soil.

The 1000 acre land is intended to be used to establish a centre for fruit research and to provide adequate land for research on the important lowland fruits, namely, durian, mango, banana, rambutan, nangka, guava and carambola.

Fruit research, in common with research on other perennial crops eg. rubber and oil palm, are extremely demanding on land resources. On one acre, it is possible only to plant up between 40 to 50 plants and a single experiment can take up to 50 acres. This compares with 10,000 plants per acre for a short term crops. Furthermore, with perennial crops the land is tight down for up 25 to 30 years, where as short term crops can be replanted annually.

The proposed land is intended to be used mainly for breeding and germplasm collection. There are several fruits types indigenous to this region, the more important are durian, rambutan, langsung and duku and there is every risk that these genetic materials will permanently be lost with the rapid expansion in agriculture activity. Areas currently planted with these fruit trees will soon be replanted with rubber, oil palm and cocoa. There is therefore an urgency for the germplasm Collection to be initiated as soon as possible. In the past, such work have not been possible due to shortage of land.

The additional 300 acres proposed for Cameron Highlands is intended for temperate fruit research. Through studies recently carried out at MARDI, it has been possible to induce several fruits, eg. apples and pears, to flower and set fruit in the country for first time and there is now renewed interest in examining the possibility of cultivating these fruits in this country. However, the main fruit type which

has the potential for cultivation orange. Small acreages of oranges are currently being cultivated and the income possible from cultivation of this fruit is extremely encouraging.

The land currently available at the station is fully utilised for tea and vegetable research and no land is available for fruit research. The proposed land is intended to be used for establishing the large introduction of fruit varieties from temperate countries and evaluating them for suitability under our conditions. Emphasis will be given to oranges, apples, pears, persimmons and peaches.

The additional 50 acres of peat land at IPRS station in Pontian Johore, is intended to cater for the additional needs for pineapple research. Through the research efforts, a new high yielding pineapple variety has been developed and extensive studies need to be undertaken to develop suitable cultural practices to obtain the full potential from this variety.

The next major item in the budget is the provision for constructions. The major proposed expenditure is intended to establish laboratories and other facilities for the proposed fruit research centre. In proposed plan for the research complex, it is intended to provide laboratory facilities for breeding, physiology, agronomic and crop protection research. Other facilities proposed for the research complex include office space, library, seminar room and data processing rooms.

Also included in budget for constructions are additional laboratory and office space at Jalan Kebun station and Sungai Baging station to cater for the expansion in the staff and research activities at these stations on pineapple and cashew research.

The main expenditure proposed under "other infrastructures" are land clearing and development for locating the fruit experiments. In carrying fruit research, security is major problem due to theft of fruit and the provision of adequate fencing is of great importance for proper conduct of the experiments.

Finally, under "equipments and field implement", the main expenditure proposed is laboratory equipments. In research work, laboratory equipments are a very essential item and the proposed equipments are intended to cater for the needs for breeding, physiology and crop protection research. These are intended to equip the new laboratories at the new Fruit Research Centre.

#### IV. FINANCIAL AND MANPOWER REQUIREMENTS

To undertake the research programmes proposed under the 4th. Malaysian Plan Period, the following budget has been proposed.

	<u>Budget (1,000)</u>					
	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>Total</u>
Development:	2,304.3	1,923.5	915.5	1,232.4	326.5	16,702.4
Operating	1,673.6	1,911.1	2,096.5	2,203.2	2,317.2	10,201.6
Total:	<u>3,977.9</u>	<u>3,834.6</u>	<u>3,012.0</u>	<u>3,435.8</u>	<u>2,643.7</u>	<u>16,904.0</u>

The details with regards the proposed budget are shown in Lampiran A, B, C, and D.



## ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

MAKSUD PEMBANGUNAN - PENYELIDIKAN BUAH-BUAHAN

KETERANGAN - LAMPIRAN A,B,C,D

[illegible]

	Tahun (\$000)							Pecahan Kos Pembangunan ('000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak Langsung	Langsung
Sewa	-	-	-	-	-	-	-			
Bekalan dan Bahan-Bahan	171.95	239.2	268.2	292.2	313.2	316.2	1,429			
Penyelenggaraan dan Pembaikan yang dibeli	2.4	13.8	14.8	14.8	14.8	14.8	73			
Lair-lain Perkhidmatan professional dan Keraian	3	27.8	38.3	39.3	45.3	47.3	193			
Lein-lain Perbelanjaan Berulang		28.0	23.0	23.0	23.0	23.0	120			
JUMLAH KOS BERULANG	1,264.85	1,673.6	1,911.1	2,096.5	2,203.2	2,317.2	10,201.6			

JABATAN - MARDI  
PROJECT - FRUIT RESEARCH

LAMPIRAN - A 1

Object	Proposed Expenditure					1985	Total 1981-85	Remarks
	1980	1981	1982	1983	1984			
1. <u>Buildings</u>								Central pineapl
1.1 <u>Station Jalan Kebun Selangor</u>								
(i) General utility building			45,000	45,000			90,000	2,000 sq. ft. @ \$50 per sq. ft.
(ii) Laboratory cum officer building			45,000	45,000			90,000	2,000 sq. ft. @ \$50 per sq. ft.
(iii) Quarters - Class F		40,000	40,000				80,000	2 units
Class G		60,000	60,000				120,000	6 units
Class H		75,000	75,000				150,000	10 units
(iv) Garage		20,000					20,000	
		195,000	265,000	90,000			550,000	

## Project: Fruit Research

Object	Proposed Expenditure							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
1.2 <u>Station Cameron Highlands</u> <u>Pahang.</u>								
i) Multipurpose laboratory cum office		90,000	90,000				180,000	3,000 sq. ft. @ \$60/per. sq. ft.
ii) Glass house		80,000					80,000	
iii) Insect proof		40,000					40,000	
iv) Cold room storage building		25,000	50,000				75,000	
v) Quarters - Class C		160,000		160,000		160,000	480,000	6 units
Class G		90,000	90,000				180,000	9 units
Class I		75,000	75,000				150,000	10 units
vi) Garage and workshop		50,000	-	-	-	-	50,000	2,000 sq. ft. @\$25/per sq. ft.
Sub-total		610,000	305,000	160,000		160,000	1,235,000	

Object	Proposed Expenditure							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
1.3 <u>Station Sungai Dering</u> <u>Pahang</u>								
i) General store		60,000					60,000	2,000 sq. ft. @\$30/per sq. ft.
ii) Garage		30,000					30,000	
iii) Pejabat Ladang					60,000		60,000	2,000 sq. ft. @\$30/per. sq. ft.
iv) Quarters - Class C			100,000				100,000	2 units.
Class J			60,000				60,000	2 units 5 units
Class G			100,000				100,000	10 units
Class H			100,000				100,000	
		90,000	360,000		60,000		510,000	

Object	Proposed Expenditure							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
<u>1.4 New Fruit Station.</u>								
i) Office and laboratory complex				300,000	300,000		600,000	10,000 sq. ft. @ \$60/ per sq. ft.
ii) Store				90,000			90,000	3,000 sq. ft. @ \$30/per sq. ft.
iii) Garage				40,000			40,000	2,000 sq. ft. @ \$20/per sq. ft.
				430,000	300,000		730,000	

Jabatan: MARDI  
Project: Fruit Research

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Lampiran: B1

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
2. <u>Laboratory, field and other equipments.</u>								
2.1 Station Serdang		133,500	110,500	55,500	79,000	61,500	440,000	as per attached list.
		133,500	110,500	55,500	79,000	61,500	440,000	

Jabatan: MARDI

Lampiran: B1 (Supplementary)

Project: Fruit Research

Laboratory Equipments	Estimate Cost	Year Required
1. Automatic leaf area meter	30,000	1981
2. Anemometer with recorder	10,000	1982
3. Balance, various ranges (4)	20,000	1981
4. Bath water, thermostate controlled (2)	4,500	1982
5. Gas, liquid chromatograph	50,000	1985
6. Centrifuge, temperature controll	10,000	1983
7. Camera, hemispherical plus accessories.	15,000	1981
8. Camera, standrad plus attachments	3,000	1983
9. Cabinet drying	40,000	1982
10. Extraction set, soxlet (3)	7,500	1983
11. Freezer, 4 cu. ft. (3)	8,000	1982
12. Freezer, deep 15 cu. ft. (2)	9,000	1982
13. Flaw chamber (laminar)	10,000	1981
14. Insect trap, light (4)	10,000	1981
15. Moisture texture (soil)	4,000	1982
16. Moisture texture (seeds)	3,000	1982
17. Microscope, various magnification (3)	20,000	1983
18. Oven (3 units)	8,000	1981
19. Plant meter, digital	6,000	1981
20. Refrigerator, 9 cu. ft. (2)	3,000	1981
21. Thermogyrograph (12)	10,000	1983
22. Plant moisture stress equipment	5,000	1983
23. Light meter with quantum sensor	8,000	1984
24. Deioniser (3)	6,000	1981
25. Leaf temperature measuring equipments.	6,000	1984
26. Photosynthesis apparatus	8,000	1985
27. Rotary evaporator	5,000	1982



Laboratory Equipments	Estimated Cost	Year Required
28. Hot plate (3)	2,000	1981
29. Pressure chamber for plant moisture	3,500	1985
30. Shaker, various types (3)	4,500	1981
31. Spectro photometer, u.v./vis. for physiological studies	65,000	1984
32. Water still, fully automatic 5/6 litres (2)	14,000	1981
33. Freeze dryer	12,000	1982
34. Grinder for plant tissues	2,500	1981
35. Solarmeter, recording	15,000	1982
36. Autoclave	2,500	1981
	<hr/> 440,000 <hr/>	

## Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
2.2 Station Jalan Kebun, Selangor.								
i) Field equipments								
a) Rotavator		5,000					5,000	
b) Plough		3,000					3,000	
ii) Office equipments								
a) Cyclostyling machine		3,500					2,500	1 unit, 1 unit
b) Xerox machine		5,000					5,000	2 units
c) Typewriter		4,000					4,000	
d) Visual aids		5,000					5,000	
iii) Vechicles								
a) Tractor			30,000				30,000	1 unit
b) Pedestrian tractor			20,000				20,000	2 units
iv) Laboratory fittings		10,000					10,000	
		34,500	50,000				84,500	

## Project: Fruit Research

Object	Proposed Expenditure							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
2.3 Station Cameron Highlands Pahang.								
i) Field equipments							5,000	3 units
a) Garage tools		5,000					1,000	
b) Walkie talkie		1,000					2,500	
c) Lawn mower		2,500					2,000	
d) Hedge trimmers for tea bush		2,000					500	
e) Water pumps		500					1,000	
f) Fogging machine		1,000						2 units
ii) Office equipment							6,000	
a) Xerox machine		6,000					2,000	
b) Cyclosting machine		2,000					3,000	
c) Typewriter		3,000						
iii) Vehicles							40,000	
a) Land rover		40,000					50,000	
b) Tractor plus trailer (60 HP)		50,000					5,000	
c) Pedestrian tractor		5,000					20,000	
iv) Laboratory fittings			20,000					
		118,000	20,000				138,000	

Object 1	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
2.4 Station I.P.R.S., <u>Pontian</u>								
i) Vechiles								
a) Staff car		30,000					30,000	
b) Land rover		30,000					30,000	
c) Lorry		50,000					50,000	
d) Kombi		30,000					30,000	
e) Pedestrian tractor		20,000					20,000	2 units
ii) Field Implements		3,000					3,000	
		163,000					163,000	

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981 - 1985	
2.5 Station Sunrai Easing <u>Pahang.</u>								
i) Field equipments								
a) Power sprayer		3,000					3,000	2 units, 1 unit
b) Fogging machine		1,500					1,500	
c) Rotary cutter		4,000					4,000	
d) Pumps		1,200					1,200	
ii) Office equipment								
a) Water cooler		1,600					1,600	1 unit
iii) Vehicles								
a) Land rover		40,000					40,000	1 unit
b) Combi/Van				35,000			35,000	1 unit
c) Water tank with trailer		7,000					7,000	

Jabatan: MARDI

LAMPIRAN

B 5 (ii)

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
d) Tractor		40,000			40,000		80,000	2 units
		98,3000		35,000	40,000		173,300	

## Project: Fruit Research

Object	Proposed Expenditure						Total 1981-85	Remarks
	1980	1981	1982	1983	1984	1985		
2.6 <u>New Fruit Station</u>								
i) Field equipments								
a) Disc plough			3,000				3,000	
b) Rotavator			5,000				5,000	
c) Rotary cutter			4,000				4,000	
d) Water pumps			3,000				3,000	
e) Lawn mover			2,500				2,500	
g) Power sprayer			3,000				3,000	2 units
h) Fogging machine			1,500				1,500	1 unit

Project: Fruit Research

Object	Proposed Expenditure							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
ii) Office equipment								
a) Xerox machine					5,000		5,000	
b) Cyclostyling machine					2,000		2,000	
c) Typewriter					3,000		3,000	2 units
d) Water cooler					1,600		1,600	2 units
iii) Vehicles								
a) Land rover			40,000		40,000		80,000	2 units
b) Kombi			25,000		25,000		25,000	1 unit
c) Lorry					50,000		50,000	1 unit
d) Tractor			50,000		50,000		100,000	2 units
e) Trailer			5,000		5,000		10,000	2 units
f) Water tank			7,000		7,000		14,000	2,units
iv) Laboratory fittings					20,000		20,000	2 units
			124,600		208,600		332,600	



## Project: Fruit Research

Object	Proposed Expenditure							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
3 <u>Acquisition of new land</u>								
3.1 New fruit station 1,000 acres (token)		10	1,000,000				10	For low land fruit research
3.2 Additional land at Cameron Highlands 300 acres @ \$100/ per acre.		30,000					30,000	For Highland fruit research
3.3 Additional land at I.P.R.S. Pontian, 50 acres @ \$6,000 per acre.		300,000					300,000	For pineapple research
3.4 Addition-land at Sg. Baging 100 acres @ \$20 per acre		10,000	10,000				20,000	For Cashew research
Total		1,340,010	4,010,000				7,350,010	

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4. <u>Land development and other infrastructures</u>								
4.1 <u>Jln. Kebun Station, Selangor</u>								
i. Land clearing and development		35,000	10,000	10,000	10,000	-	65,000	Central Pineapple and V Vegetable Research Station. 65 acres @ \$1,000 per acres. 300 chains @ \$100/ per chain
ii Road construction		30,000	-	-	-	-	30,000	
iii Fencing					45,000	45,000	90,000	
iv. Culverts			5,000	-	-	-	5,000	
v. Electricity supply			-	-	30,000	-	30,000	
Sub-total		65,000	15,000	10,000	85,000	45,000	220,000	

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.2 <u>Station I.P.R.S., Pontian, Johor</u>								Function mainly as pineapple and peat research station
i. Land clearing and develop-		20,000	-	20,000		10,000	50,000	50 acres @ \$1,000 per acre
ii Other infrastructures eg. drains, roads, culverts etc.		15,000	-	-	10,000	5,000	30,000	200 chains @ \$150 per chain
iii. Fencing			20,000		30,000		50,000	
Sub-total		35,000	20,000	20,000	40,000	15,000	130,000	

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.3 <u>Station Sg. Baging, Pahang</u>								Cashew and Bris Soil Station
i) Land clearing and develop-		20,000			20,000	10,000	50,000	100 acres @ \$500/ per acre
ii) Provision of roads		50,000	50,000				100,000	@ \$35,000 per mile
iii) Provision of drains, Culvert etc.		40,000	40,000				80,000	
iv) Fencing		25,000			25,000		50,000	
v) Electricity supply			90,000				90,000	Conversion to supply by LLN
vi) Water supply			70,000				70,000	Conversion to supply by JKR
		135,000	250,000		45,000	10,000	40,000	

Jabatan: MARDI

Lampiran: D 4

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.4 Station Cameron Highlands, Pahang								
i) Land clearing and deve- lopment.			150,000		150,000		300,000	100 acres @ \$3,000/ per acre
ii) Road construction		50,000		50,000			100,000	
iii) Fencing			50,000				50,000	
		50,000	200,000	50,000	150,000		450,000	

Jabatan: MARDI

Lampiran D 5

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.5 <u>Station Serdang, Selangor</u>								
i) Land clearing and develop- ment.		10,000	15,000				25,000	25 acres @ \$1,000 per acre
ii) Fencing		30,000					30,000	
iii) Provision road and drains		20,000					20,000	
		60,000	15,000				75,000	

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.6 <u>Station Bukit Riden, Pahang.</u>								
i) Land clearing and deve- lopment.		50,000		25,000		25,000	100,000	100 acres @ \$1000 per acre
ii) Field sheds and minor infrastructures.		2,000	2,000		3,000		7,000	
iii) Fencing		20,000		10,000		10,000	40,000	
		72,000	2,000	35,000	3,000	35,000	147,000	

Jabatan: MARDI

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.7 <u>Station Kluang, Johor</u>								
i) Land clearing and develop- ment			25,000		25,000		50,000	50 acres @ \$1,000 per acre
ii) Fencing			10,000		10,000		20,000	
iii) Minor infrastructures eg. field sheds.			2,000		2,000		4,000	
			37,000		37,000		74,000	



Jabatan:.. MARDI

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.8 <u>Station Pasir Puteh, Kelantan.</u>								
i) Land clearing and develop- ment.		20,000			20,000		40,000	40 acres @ \$1,000 per acre.
ii) Fencing and other minor infrastructures.		10,000			10,000		20,000	
		30,000			30,000		60,000	

Jabatan: MARDI

Lampiran: D9

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.9 Station Jerangau, Trengganu.								
i) Land clearing and development		15,000	25,000		25,000		50,000	50 acres @\$1,000 per acre
ii) Fencing and other minor field infrastructures.			10,000		10,000		20,000	
			35,000		35,000		70,000	

Jalanan: MARDI

Lampiran: D10

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.10 Station Bertam, <u>Pulau Pinang.</u>								
i) Land clearing		25,000			25,000		50,000	50 acres @ \$1,000 per acre
ii) Minor infrastructures eg. nursery shade, field shade etc.		10,000			10,000		20,000	
		35,000			35,000		70,000	

Jabatan: MARDI

Lampiran: D11

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984	1985	Total 1981-85	
4.11 Station Kuala Kangsar, <u>Perak.</u>								
i) Land clearing and development		20,000	20,000				40,000	40 acres @ \$1,000 per acre
ii) Fencing		20,000					20,000	
iii) Electricity supply				30,000			30,000	
		40,000	20,000	30,000			90,000	

Jabatan: MARDI

Lampiran: D12

Project: Fruit Research

Object	Proposed Budget							Remarks
	1980	1981	1982	1983	1984 :	1985	Total 1981-85	
4.12 <u>New Fruit Station</u>								
i) Land clearing and development.			50,000		50,000		100,000	100 acres @ \$1000 per acre
ii) Provision of roads and drains.			25,000		25,000		50,000	100 acres @ \$50 per acre
iii) Fencing			10,000		10,000		20,000	
			85,000		85,000		170,000	

## 7. SPICES & BEVERAGES BRANCH

### I. BACKGROUND AND OBJECTIVE

The main responsibility of this Branch is to undertake research on pepper, coffee and tea. At the present moment informations regarding location specific variety/clones which are high yielding, fertilizer requirement for a particular soil type, diseases and pests and their control, an economical cultural practices and the physiological constraints experienced by the crop are lacking or at best insufficient.

A complete knowledge of these constraints would help in formulating ways to overcome them and will result in the realisation of the full yield potential of the crop.

#### 1. Pepper

The main research in pepper would be breeding. In the past, the Sarawak Department of Agriculture have been doing the breeding work. With the establishment of this branch, MARDI should now venture into breeding. At the moment, only one clone of pepper is being cultivated extensively in Malaysia. Although this Kuching clone is high yielding, it is very susceptible to the foot rot root disease. New clones and varieties have to be developed for cultivation so that there would be enough variability in cultivation to prevent the total destruction or eradication of the crop in case of a disease epidemic. At the same time, germplasm collection have to be done so that it could be utilized in breeding for disease resistant and high yielding varieties or clones.

To exploit the high yielding capacity of the clone or variety and a long economic life span, the nutritional requirement of the crop have to be looked into. A preliminary fertilizer recommendation have been worked out based on the results of an

NPK trial (which have to be terminated due to disease and nematode problems) and on the work of De Waard in Sarawak. This recommendation is good only on the Rengam type of soil.

Based on the weather pattern, the flushing and flowering pattern and the soil type, a system of fertilizer application viz the time and placement of fertilizer for maximum utilization have to be looked into. Fertilizer requirements at the nursery stage too have to be looked into in order to produce a healthy and vigorous growing cutting. This may indirectly contribute to a high and sustained yield.

The cultural practices and the management of the pepper plant from planting till bearing will determine indirectly the yield and economic life span of the crop. Proper pruning practices and the number of climbing shoots allowed per vine to maximize yield have to be investigated. An alternative planting system have to be devised in order to minimise the cost of establishment of the crop. This would also involve the planting of pepper on life support. The effect of deflowering on yield have to be substantiated.

In pepper cultivation, the crop is subjected to maximum water and light stress. The physiological state of the crop subjected to these stresses have to be looked into in order to understand its effect on yield and a long and economical life span. Thus there is a need to know the nutrient uptake by the roots, root growth, effect of shade and mulching, photosynthetic activity, etc. When the vines are subjected to these stresses. Effects of hormone on flowering pattern, even ripening, induction of lateral shoots on every climbing node is not available. Knowledge regarding these would enable us to manipulate the time of fruiting and harvesting and also in the increase of yield.

Much have been talked regarding the disease of pepper. The real causal organism(s) of pepper yellowing and dieback have

not been identified. Other diseases have to be monitored and its most effective and economical mode of control be found. Besides chemical control, a biological control of pests and diseases have to be identified and this would benefit the environment as well. Thus in case of the nematode, the possibility of finding an alternative host for them will benefit the pepper vine. However the complication like fertilizer uptake and possible water stress as a result of this have to be studied too.

At the present moment, the main insect problem is due to the stem borer. The most effective way of controlling this have to be worked out. Other insect pests have to be identified and also its most effective and economical mode of control.

## 2. Coffee

In coffee, the main research will be in the nutrient requirements of the crop on problem soils such as peat, peat muck, acid sulphate and saline soils. This line of research is followed because coffee have in the past been planted on such soils; on soils other than those mentioned, cocoa is the preferred crop.

In Malaysia these are about 2.4 million hectares of peat and out of this 1.0 million hectares is in Peninsula Malaysia and the rest in Sabah. It has been estimated that less than 1% of peat soil in Malaysia is utilized for agricultural purposes. Thus there is a great potential in coffee planting on such soil if the nutrient requirement particularly the micro element is properly worked out.

In breeding work besides germplasm collection, selection from local plantings and its evaluation on peat soil, etc. for location specificity will be the initial line of work. Once a few location specific variety/clones have been identified, breeding for high yielding, disease resistant, compact and erect type of



tree, etc. would be looked into. In this programme, a breeding design whereby the inheritance pattern of the traits could be obtained at the same time will be used characterisation of the varieties or clones will follow for the sake of registration.

The physiological problems of coffee like the effect of shade on yield, root growth, nutrient uptake by the roots, physiological diseases, etc. have to be investigated. Knowledge on nutrient translocation during flowering and berry development with help in the pruning practices. Effects of hormone on flowering and even ripening and in the suppression of water shoot growth will indirectly reduce the labour input in crop maintenance. The development of vegetative propagation techniques for rapid clonal multiplication and plantings will help in the breeding programme.

Cultural practices involving planting density; pruning practices and multiple stem crop will be studied in relation to yield. Effect of shade on yield in the general sense will be looked into.

Monitoring and identifying of plant diseases and its effective and economical mode of control would be looked into. Similar line of work too will be done with respect to pests. Besides chemical, a biological mode of control should be identified.

### 3. Tea

The main research activity is to evaluate suitable clones that can perform well in the lowland. Evaluation will be based on high yield and of high quality. Further improvement towards high yield and quality will follow later and its objective will be in the identification of location specific variety or clone.

Response to NPK levels on the different soil types and at the different elevations where tea is to be planted will be

looked into with reference to high yield and quality tea. Time and place of fertilizer application and type of NP and K sources will be investigated in terms of maximum utilization and uptake by the crop. Nutritional requirements at the nursery stage for a vigorous and healthy cuttings will be studied too.

Pruning practices for maximum yield have to be worked out. This will go hand in hand with the planting system and spacing adopted for that particular clone.

Effect of shade, particularly on lowland cultivation will be investigated in the context of plant water status, photosynthetic activity, nutrient uptake by the roots, root development and good vegetative growth for maximum yield. An economical and an effective method of vegetative propagation technique and its related problems have to be worked out. This will have relevance when new clones are found and there is a need to multiply it as quickly as possible.

Pathological and entomological work will involve in the identification of diseases and pests and their most effective and economical mode of control. Both chemical and biological control will be looked into.

As tea picking is very labourious and since in the near future, labour is hard to come by, mechanical harvesting should be looked into. Research effort must make sure that yield is not lowered by this mode of harvesting.

## II. PROJECT DESCRIPTION

### A. Research programmes

Based on the above background informations, the following research programmes are proposed for the action of the Beverages and Spices Branch.

Pepper

1. Breeding and Selection of pepper

PR-BS-SB-2/80

- a) Pepper germplasm collection and the multiplication of breeding material (Kluang)
- b) Evaluation of selected pepper clones under local conditions for location specificity (Kluang etc).
- c) Breeding of high yielding, disease resistant and an erect type of pepper (Kluang)

2. Studies on the nutrient requirement of pepper

PR-BS-SA-1/79

- a) Effects of N & K on the growth and yield of pepper on Rengam series (Kluang).
- b) N, P and K requirements of pepper on soils other than the Rengam series.
- c) Studies on the micro nutrient requirement of pepper.

3. Management studies on pepper

PR-BS-SA-2/79

- a) Density, shoot density and fertilizer requirement in relation to growth and yield of pepper (Kluang).
- b) Growth and productivity of pepper under different planting systems.
- c) Effects of shoot/root ratio on the growth and yield of pepper.
- d) Pepper grown under life support - its performance and fertilizer requirement.

4. Studies on pepper diseases and its control

PR-BS-SC-1/80

- a) Elucidating/monitoring of pepper diseases in Kluang and smallholders farm.
- b) Nursery practices (phytosanitary measures) and the production of pest free (disease and nematode) planting materials (Kluang).
- c) Effects of nematicide and fungicide on nursery infected (yellowing) cuttings planting materials (Kluang).
- d) Asystasia, marigolds, legumes and others as covers and biological control of rootknot nematode and disease in pepper (Kluang).
- e) "LD<sub>50</sub>" of presently recommended fumigants/nematicides and fungicide and their phytotoxic levels to pepper (Kluang).

5. Physiological studies on pepper

PR-BS-SP-3/80

- a) Growth regulators studies on even ripening and yield of pepper (Kluang).
- b) Effects of hormones on flowering and yield of pepper (Kluang).
- c) Effects of hormones on inducing lateral branch growth on every node of the climbing shoot (Kluang).
- d) Studies on the vegetative propagation techniques and its related problems (Kluang).

6. Studies on pepper pests and its control

PR-BS-SC-1/82

- a) Monitoring and elucidation of pepper pests and its mode of control (Kluang).

Coffee

1. Breeding and selection of coffee

PR-BS-CF3-1/80

- a) Coffee germplasm collection and the multiplication of clonal material (Kluang).
- b) Coffee varietal/clonal trial on peat (Jalan Kebun).
- c) Evaluation of coffee varieties/clones for location specificity (Kluang, Jalan Kebun, Pontian, etc).
- d) Coffee varietal/clonal trial under shade (Jalan Kebun, Jerangau).
- e) Breeding high yielding, disease resistant and quality coffee (Kluang, Jalan Kebun).

2. Nutritional requirements of coffee

PR-BS-CFA-2/80

- a) Nutritional requirement of coffee under saline condition (Hilir Perak).
- b) Effects of N, P, K and Mg level on growth and yield of coffee (Kluang).
- c) Nutritional requirements of coffee on peat (Jalan Kebun/Pontian)
- d) Micronutrient requirement of coffee on peat (Jalan Kebun/Pontian).
- e) Nutritional requirement of seedlings/cuttings for vigour and healthy root growth (Kluang, Jalan Kebun and Pontian)

3. Physiological studies on coffee

PR-BS-CFP-3/80

- a) Effect of growth regulators on even ripening and yield of coffee (Jalan Kebun/Pontian).
- b) Studies on the vegetative propagation techniques and its problem (Kluang).
- c) Effects of hormones on the control/suppression of water shoot growth (Kluang, Jalan Kebun, Pontian).
- d) Effect of shade on the yield and economic life span of coffee (Jalan Kebun).
- e) Effects of water stress on yield of coffee (Kluang).

4. Studies on the disease of coffee

PR-BS-CFC-4/80

- a) Elucidation and monitoring of the diseases of coffee and its mode of control (Kluang, Pontian).

5. Studies on pests of coffee

PR-BS-CFC-1/81

- a) Studies on the pests of coffee and its control (Pontian, Kluang, Jalan Kebun).

6. Management studies of coffee

PR-BS-CFA-5/80

- a) Pruning practices in relation to yield (Jalan Kebun, Pontian, Kluang).
- b) Studies on the cultural practices of coffee (Jalan Kebun, Pontian, Kluang).

Tea

1. Breeding and selection of tea

PR-BS-TB-1/80

- a) To investigate the performance of selected tea juts in Cameron Highlands.
- b) Evaluation of clones, suitable for the lowland

(Kluang, Jalan Kebun, Pontian, etc.)

- c) Breeding tea varieties or clones that are high yielding and of good quality for both the highland and the lowlands (Kluang, Cameron Highlands, Jalan Kebun, Pontian).

2. Studies on the nutrient requirements of tea

PR-B8-TA-2/80

- a) To investigate the effect on yield and quality of green leaf with soil application of three nitrogen carriers (Cameron Highlands).
- b) To investigate the optimum levels of applied NPK on mixed Indian Juts in Cameron Highlands.
- c) Studies on the NPK requirements of tea on the lowland (Kluang, Jalan Kebun, etc).

3. Studies on the cultural practices of tea

PR-B8-TA-3/81

- a) Planting density in relation to pruning practices on the different clones of tea (Cameron Highlands, Jalan Kebun, Kluang, etc).
- b) Planting system studies in relation to ease of harvesting and maximization of yield (Cameron Highlands, Kluang, Jalan Kebun, etc).

4. Physiological studies on tea

PR-B8-TT-4/81

- a) Studies on the vegetative propagation techniques of tea and its related problem (Kluang, Cameron Highlands, etc).

III. PROJECT JUSTIFICATION AND BENEFITS

The implementation and success of the proposed projects depends on expenditure requested and on the staff allocated to the

Branch. The budget requested and also the staff requirements are as in the first submission of the Fourth Malaysia Plan.

However there are some amendments to be made regarding station establishment budget and are based on the followings.

- (i) Coffee, tea and pepper projects are to be implemented at Kluang Station. Extra costs are incurred due to the high cost of the wood support for the pepper vines. About 70% of the cost of establishment of pepper project is due to the wood; which now costs \$4.50/10 feet Kulim wood.
- (ii) Land clearing in Kluang is more economical if 100 acres is cleared at one time rather than 20 acres/year throughout the FRP. Land clearing is at the rate of \$500/acre and this would cost \$50,000.00 for 1981.
- (iii) As Jalan Kebun is the next most important station for the branch, at least 3 officers plus the corresponding junior officers have to be placed there. Their function is to look into coffee and tea research on peat and lowland respectively. As no office space is available for these staff, an office building to accomodate about 12 people have to be build there 1981.

Although the previous submission is included here with amendments shown in ink, a separate form showing amendments is also included for easy reference.

#### Pepper

All pepper projects are to be implemented in Kluang, Johore. Kluang is situated in the pepper growing country of Peninsula Malaysia and results obtained will have an immediate and direct application to this area. Project at other areas that show differences in soil type and climatic condition will be initiated towards



the end of F.M.P.

The twenty projects proposed are all geared to answer the following questions.

- a) What pepper clones or varieties are high yielding and disease resistant for a particular area that is showing a specific soil type and climatic condition?
- b) What are the combinational levels of N, P, K, Mg and trace elements that should be applied to the vines growing on a particular soil type in order to get the maximum yield?
- c) What are the cultural and management practices to be applied to the crop in order to minimize the cost of establishment and management but at the same time to maximize yield?
- d) What are the diseases and pests that attack the pepper vines and how do we effectively and economically control them through chemical and biological means?
- e) How do we regulate the flowering and even ripening pattern of pepper and to induce lateral branch growth from every node of a climbing shoot? (with going through the process of pruning).

Answers obtained from these projects will benefit the farmers in raising his income. This is because there will be increased yield due to improved varieties whose potential yield is realized by the optimum N, P, K and Mg levels applied to it coupled by the sound management and cultural practices. Profit margin is further increased when less labour force is needed when hormonal methods could replace management and cultural practices. When all the questions are answered, pepper will be an easy and safe crop to cultivate and more and more smallholders will be drawn to grow them.

Besides increasing the farmers income it indirectly increase the foreign exchange that Malaysia could get through the sales of pepper. The export figure of Malaysia in 1978 was \$145 million and in 1979 it was about \$154.4 million. With more acreages planted more sales will result.

#### Coffee

Justification for the coffee projects follow the same reasonings as put forward for pepper. Additional answers that are required for coffee are:

- a) What could be done to suppress water shoot growth on the lateral branches rather than going round removing them manually?
- b) Does shade given a better environment to give better yield and a longer economic life span?
- c) How are nutrient and manufactured food translocated in the plants so as to work out a pruning practice for maximum yield?

Most of the coffee work will be done at Jalan Kebun and Hilir Perak MARDI Stations. These area are chosen because it is situated on problem soil area, peat in particular. Out of 1 million hectares of peat land in Peninsula Malaysia only 1% is utilized for agricultural purposes. Peninsula Malaysia is a net importer of coffee as local production amounts to two-third of her domestic requirements. In 1978 Peninsula Malaysia exported coffee to the value of \$12.5 million consisting mainly of unroasted beans and coffee powder. However it is likely that a portion of this consists of re-exports. Thus if coffee can be made to grow successfully on peat, then farmers benefit from them, more land can be made available to the landless to plant coffee and production

level of the country will be increased thus more foreign exchange. Thus the priority work will be on the nutrient requirements on peat followed by saline soils, peat much and acid sulphate areas. Clones and varieties suitable for such lands will be evaluated at the first instance and later bred into them other desirable characteristics.

Work is concentrated on problem soils because coffee and cocoa can thrive on the same type of soil. If the farmers is given the choice, they will grow cocoa. However cocoa cannot be grown on these problem soils and thus leaving it to be planted with coffee. Therefore to carry out these researches on peat, MARDI Jalan Kebun will serve as the centre because it is situated in the coffee growing country of Peninsula Malaysia. Selangor, accounts for 75% of the total production of the country and Johore only about 18%. Therefore at least three officers, six ARO and 6 RA are needed at Jalan Kebun to carry out these researches. These staffs too can work on tea projects which are being carried out at Cameron Highlands and the lowland areas of Perak, Pahang and Selangor.

#### Tea

Similar reasonings as put forward for pepper are put forward to justify the tea projects. However the immediate answers required are what type of clones can be grown on the lowland and what are the nutrient requirements of both the lowland and highland tea.

Unlike pepper and coffee which are a smallholders crop, tea out of the 7,623 acres presently grown only 9% is under smallholdings. However, the SADC of Pahang and Perak are growing tea on the lowland and besides the smallholders, the states will benefit from these research. Indirectly the success of lowland tea cultivation will result in more employment for the jobless. In 1977 the total tea production of Malaysia was 14.72 tons for green tea and

7.65 tons for ready tea and Malaysia imported 2,681 tons of ready tea and 340 tons of green tea. Therefore Malaysia is far from being self sufficient in her tea production and in her domestic requirements. World demand for tea is expected to grow at an average annual rate of 3% until 1985. Therefore from the research finding more acreage particularly on the lowland will be planted with tea which will result in more employment, more production and all these will benefit Malaysia as a whole.

IV. FINANCIAL AND MANPOWER REQUIREMENTS

To undertake the projects proposed under the Fourth Malaysia Plan, the following budget has been proposed.

	Budget ('000)					
	1981	1982	1983	1984	1985	Total
Development	1043	930	312	443	140	2868.0
Operating	709.5	831.5	1006.5	1060.5	1168.0	4776.0
Total	1752.5	1761.5	1318.5	1503.5	1308.0	7644.0

The details with regards the expenditure proposed are shown in Lampiran A, B, C, D and E, which are given by the stations where the research work is being undertaken.

JADUAL 1  
ANGGARAN KOS DAN KEPERLUAN GUNATANAGA

Jabatan: **MARDI**

Maksud Pembangunan: **Spices and Beverage Research.**

Bil. Projek: **7**

Keterangan: **Lihat Lampiran A to E**

	Tahun (\$000)							Pecahan Kos Pembangunan ('000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempahan	Tukaran Asing	
									Tidak langdung	lanes
<b>Kos Pembangunan</b>										
Perbinaan .. .. .		480	240	170	300	140	1330			
Alat-alat dan Jurutera .. .. .		320	54	70	7	-	451			
Pelaburan .. .. .										
Pengambilan Tanah .. .. .		300	-	-	-	-	300			
Lain-lain perbelangan Pembangunan .. .. .		243	36	72	136	-	487			
<b>JUMLAH KOS PEMBANGUNAN</b>		1343	330	312	443	140	2568			
<b>Kos Berulang -</b>										
Gaji dan Upahan .. .. .		456	572	651	691	778	3148.0			
Perjalanan dan Pengangkutan orang Kemudahan Awam (Api, Air, Listrik dll.) .. .. .		57.2	58.2	65.2	80.7	96.7	358.0			
Sewa .. .. .		8.0	8.0	14.6	14.5	17.5	62.5			
Bekalan dan Bahan-bahan .. .. .		5.0	6.5	18.5	9.5	11.0	41.5			
Penyelenggaraan dan pembaikan yang dibeli .. .. .		83.8	108.8	158.8	158.8	163.8	674.0			
Lain-lain perkhidmatan professional dan kerian .. .. .		21.3	27.3	29.8	33.8	34.8	147.0			
Lain-lain perbelanjaan berulang		15.3	11.3	13.3	15.8	17.8	73.5			
<b>JUMLAH KOS BERULANG</b> .. .. .		-	-	-	-	-	-			
		646.6	792.1	942.1	1004.1	1119.6	4504.5			

	Bangunan/alat-alat	Keterangan	Harga
1. Perbinann	i) Two unit of glasshouse cum insect proff of 1800 sq. ft. per unit - incorporating louvers, sprinkler system with pressure pump system.	For physiological, pathological, entomological & breeding purpose	140,000.00
	ii) Nursery shade of 20,000 sq. ft. in dimension incorporating louvers & sprinkler system, and gravel plus sand flooring	For propagating planting materials viz pepper, coffee & tea.	30,000.00
	iii) Brick store building of 1,200 sq. ft. dimension	To store fertilizers etc. & to serve as a working space for the labourer eg. weighing, label preparation etc. in the 50 acres pepper area.	30,000.00
			200,000.00

	Ban, unan/alat-alat	Kerunaan	Marga
2. Alat-alat			
i)	Binocular microscope with camera attachments & high resolution lenses viz Olympus Vanex (ML 260)+ Camera (ML 911)+ Exposure meters (ML 940)+	Photographing research findings for visitors (slides) & for incorporating into write ups for publication.	\$ 8,000.00
ii)	35mm. SLR camera with belows, close up, wide angle & telefore lenses & computerised electronic flash	for branch use in field visit to reproduce situations in slide forms for visitors.	\$ 2,000.00
iii)	Inclined binocular microscope - 2 units of Olympus ML 226 model FHT 533 (Gallenkamp)	For pathological & cytological	\$ 7,000.00
iv)	Zoom stereo microscope 3904 - Cole - Parmer 1979/80 2 units	-	\$ 5,000.00
v)	Table top magnifier (9805-82) plus accessories viz lenses	-	\$ 1,000.00
vi)	Rotatorque heavy duty rotator	For agitation of tubes, washing of precipitates	\$ 1,000.00
vii)	Table to centrifuge	For physiological work	\$ 1,000.00
viii)	High efficiency stainless steel fume cabinet with explosion containing glassscreen, high suction, gas, light & water fixtures.	For physiological & agronomical work	\$ 7,000.00
ix)	Pipettes washer/drier combination	-do-	\$ 1,000.00
x)	Microsyringes & micropepettes set	Physiological work for ulter small volumes of 100 ul. & less	\$ 3,000.00
xi)	Automatic electronic planimeter	Physiological work for leaf area measurements	\$ 3,000.00
xii)	Lambda light meter	For studies of canopy penetration absorption etc. of light	\$ 2,000.00

	Bangunan/alat-alat	Kepunaan	Harga
<u>Sambungan</u> <u>Alat-alat</u>	xiii) Top loading balance P 163N, 1-913-87 Fisher Scientific Co.		\$ 4,000.00
	xiv) Infra red drying accessory for top loading balance LP 11, 1-913-97 Fisher Scientific Co.		\$ 2,000.00
	xv) Mettler Analytical balance H64, 1-999-64 (2units) Fisher Scientific Co.		\$10,000.00
	xvi) Mettler top loading balance 10,000g capacity P11N, 1-913-90 Fisher Scientific Co.		\$ 5,000.00
	xvii) Hot plate magnetic stirrer		\$ 300.00
	xviii) TLC apparatus, Quickfit		\$ 500.00
	xix) UV lamp (254nm) - high intensity with land	For detecting compound on TIC	\$ 700.00
	xx) pH meter with automatic temperature compensator		\$ 800.00
	xxi) Freeze drier	For rapid freezing for storage without degradation prior to analysis of carbohydrates, hormones etc.	\$ 6,000.00
	xxii) Deep freezer	For storage of samples	\$ 3,000.00
	xxiii) Homogenizer/blender	With stainless steel container & blades for macerating samples	\$ 400.00
	xxiv) Rotary thin film evaporator	With refrigerated condenser, electric vacuum pump & water bath - for physiological work	\$ 5,000.00
	xxv) Sphadex column with uv setector & fraction collector & chart recorder	For physiological work	\$ 5,000.00



	Bangunan/alat-alat	Kegunaan	Harga
<u>Sambungan</u> - Alat-alat	xxxvi) Motorised slasher 4 units	For slashing of cover crops in the field	\$ 2,000.00
	xxxvii) Lable catosing machine		\$ 1,275.00
	xxxviii) Magnetic porcelin writing board (8 units)		\$ 5,000.00
	XI) Asbestos glove - 2 pairs volve station wagon		\$ 25.00
		TOTAL	<hr/> \$240,000.00 <hr/>

	Bangunan/alat-alat	Kegunaan	Harga
3. Lain-lain Perbelanjaan	Opening & developing and area of 100 acres	For pepper, coffe & tea work.	\$ 50,000.00
		Total	<u>\$ 50,000.00</u>
		Grand total	<u>\$490,000.00</u> =====

	Bangunan/Alat-alat	Kegunaan	Harga
1. Pembinaan	i) Modification of existing laboratory into: a) Weighing room (air conditioned) b) Oven room c) Inoculation room for pathological work - including Uv chamber. d) Meeting room for the branch		\$ 20,000.00
	ii) Drying shade cum processing centre for pepper & coffe. Brick building of 450 sq. ft. for processing purpose & 300 sq. ft. shed to accomodate 4 layers of drying trays on railings.		\$ 40,000.00
	iii) Brick store building cum field office - 1,200 sq. ft. dimension	To store fertilizer etc. & to serve as field office & working space in the 100 acres new are to be opened.	\$ 30,000.00
	iv) Nursery shade with sprinkler system & digging of pond as water source - 8,000 sq. ft.	Propagation of planting materials for the new 100 acres to be opened up.	\$ 10,000.00
		Total	\$100,000.00
2. Lain-lain Perbelanjaan	To open & develop another 50 acres of land		\$ 30,000.00
		Total	\$ 30,000.00

	Bangunan/Alat-alat	Kegunaan	Harga
1. Pembinaan	i) Quarters for junior staff at the branch, 5 units		\$ 100,000.00
		Total	\$ 100,000.00
2. Alat-alat	i) Incubating oven (2 units) (Clemco inoculating chamber)	For pathological purposes	\$ 10,000.00
	ii) Ovens	For agronomical etc. purposes	\$ 4,000.00
	iii) Refrigerators - 2 units		\$ 4,000.00
	iv) Laboratory glass ware driers - model 1616 Cole-Palmer 1979/80 - 3 units		\$ 3,000.00
	v) Air conditioners 2 h.p. - 10 units	For air-conditioning laboratory when modification of laboratory takes place after PORIM leaves the laboratory.	\$ 20,000.00
	vi) Power sprayer		\$ 5,000.00
	vii) Insect trapping equipments		\$ 5,000.00
	viii) Olympia typewriters - 2 units		\$ 1,000.00
	ix) "Bix photocopier using ordinary papers		\$ 5,000.00
	x) Slide projector Rollei auto fours plus tape recorder & extension cable		\$ 2,000.00
	xi) P.A. system	For use for field visits of	
		Total	\$ 60,000.00
		Grand total	\$ 160,000.00

	Pembangunan/Alat-alat	Kegunaan	Harga
1. Pembinaan	i) Quarters for junior staffs of the branch, 5 units		\$100,000.00
		Total	<u>\$100,000.00</u>
2. Alat-alat	-		
3. Lain-lain perbelanjaan pembangunan	i) To open another 50 acres of land for the branch		\$ 30,000.00
		Total	<u>\$ 30,000.00</u>
		Grand total	<u>\$130,000.00</u> =====

	Bangunan/Alat-alat	Kegunaan	Harga
1. Pembinaan	i) Quarters for junior staff, 5 units		\$ 100,000.00
		Total	\$ 100,000.00
		Grand total	\$ 100,000.00
			=====

	Bangunan/Alat-alat	Kegunaan	Harga
1. Pembinaan	i) Offices space for three RO's, 6 ARO's & 6 RA's	For staffs stationed at Jalan Kebun	\$ 80,000.00
	ii) Nursery shade - with louvers & sprinkle system - 4000 sq. ft.	Propagating planting - materials	\$ 6,000.00
	iii) Store cum working space for workers		\$ 14,000.00
	iv) Quarters for ARO & RA - 4 units		\$100,000.00
		Total	\$200,000.00
2. Alat-alat	i) Top loading balance P163N - 1-913-87		\$ 4,000.00
	ii) Mettler analytical balance H 64, 1-909-64		\$ 5,000.00
	iii) Hot plate with magnetic stirrer, 2 units	For pathological, agronomical & breeding work	\$ 600.00
	iv) pH meter with automatic temperature compensator	- do -	\$ 800.00
	v) Ovens	- do -	\$ 4,000.00
	vi) Refrigerators	- do -	\$ 4,000.00
	vii) Laboratory glassware drier model 1616 - 2 units	- do -	\$ 2,000.00
	viii) Table top centrifuge	- do -	\$ 1,000.00
	ix) Inclined biocular microscope ( 2 units)	- do -	\$ 6,000.00
	x) Stereo microscope (dissecting microscope 2 units)	- do -	\$ 4,000.00
	xi) Knapsack sprayers 6 units	- do -	\$ 2,000.00

Pembangunan/Alat-alat	Kegunaan	Harga
xii) Homogenizer/blender	With stainless steel container & blades for macerating samples	\$ 400.00
xiii) Magnetic porcelin writing board (3 units)	Officers use	\$ 1,500.00
xiv) Spectronic mini 20 spectrophotometer	Agronomical work	\$ 2,000.00
xv) Desiccators (6 units)	- do -	\$ 1,000.00
xvi) Micrometers (3 units)	- do -	\$ 300.00
xvii) Vernier calipers (4 units)	- do -	\$ 300.00
xviii) Test tube supports	- do -	\$ 100.00
xix) Pipette washer dryer combination	Physiological & agronomical work	\$ 1,000.00
xx) Water bath (Blue M Magni-Whirl) 1066	- do -	\$ 2,000.00
xxi) Kjeldhal apparatus	- do -	\$ 2,000.00
xxii) Muffle furnace FR-614	- do -	\$ 2,500.00
xxiii) Combinational soil outfit with refill	- do -	\$ 500.00
xxiv) Inert red drying accessory for top loading balance IF II, 1-913 - 97	- do -	\$ 2,000.00
xxv) Table top magnifier plus accessories	- do -	\$ 1,000.00
	Total	<u>\$50,000.00</u>



	Bangunan/alat-alat	Kepunaan	Harga
3. Lain-lain	i) Membuka & membersihkan tanah seluas 10 acres		\$ 3,000.00
		Total	\$ 3,000.00
		Grand Total	\$253,000.00 =====

	Pembelian/alat-alat	Kegunaan	Harga
1. Pembinaan	i) RA quarters (1 unit)		\$ 20,000.00
		Total	\$ 20,000.00
2. Alat-alat	ii) Hygromograph (4 units) plus accessories 8356-00	For monitoring R.H.	\$ 4,000.00
	iii) Thermograph (4 units) 8366-00	For monitoring temperature	\$ 5,000.00
	iii) Hygrothermograph (4 units)	For monitoring RH & temperature	\$ 4,000.00
	iv) Multiple hammer pulverizing mills (4020-02)	For grinding purpose	\$ 2,000.00
	v) Analytical mill (4300)	- do -	\$ 1,000.00
	vi) Tototorque heavy duty totator	Agitation of tubes, washing precipitates etc.	\$ 2,000.00
	vii) Ultrasonic cleaner with timer		\$ 1,000.00
	viii) Corvical flasks (2 doz.) of different sizes		\$ 1,000.00
	ix) Beakers		
	50 cc 1 doz		\$ 500.00
	100 cc 1 doz		
	250 cc 1 doz		
	500 cc 1 doz		
	x) Volumetric flasks		
	100 cc 1 doz		\$ 1,000.00
	500 cc 1 doz		
	1 litre 1 unit		
	250 cc 2 units		

	Ban/unan/Alat-alat	Kepunaan	Harga
	xi) Test tubes of different sizes		\$ 1,000.00
	xii) Camera set with flash		\$ 2,000.00
	xiii) Pipettes of different capacity & burette		\$ 1,000.00
	xiv) Autoclave (compact type)		\$ 2,500.00
	xv) Insect trapping equipments		\$ 3,000.00
	xvi) Tensiometer (4 units)		\$ 800.00
	xvii) Maximum min. thermometer (4 units) plus replacement magnets		\$ 500.00
	xix) Metal strip labeller plus accessories		\$ 700.00
	xx) Light meter		\$ 100.00
	xxi) pH meter tester (2 units) (5657-00) Plus adaptor (5983-25)		\$ 200.00
	xxii) Coffee depulper machine & separating machines		\$ 7,000.00
		Total	<u>\$34,000.00</u>
3. Lain-lain perbelanjaan pembangunan	i) To open & clear 20 acres of land		\$ 6,000.00
		Grand total	<u>\$60,000.00</u>

	Banyunan/Alat-alat	Kepunaan	Harga
1. Pembinaan	i) 2 units quarters for ARO & RA		\$ 60,000.00
2. Alat-alat	-		-
3. Lain-lain perbelanjaan pembangunan	i) to open up & clear 40 acres of land		\$ 12,000.00
		Grand total	\$ 72,000.00 =====

	Bangunan/Alat-alat	Kepunaan	Harga
1. Pembinaan	i) 2 units quarters for RA		\$ 40,000.00
2. Alat-alat	-		-
3. Lain-lain per- perbelanjaan pembangunan	1) to open up & clear 20 acres of land		\$ 6,000.00
		Grand total	<u>\$ 46,000.00</u> =====

	Bangunan/Alat-alat	Kegunaan	Harga
1. Pembinaan	i) Nursery shed with sprinkler		\$ 10,000.00
2. Alat-alat	i) Metal labeler plus accessories		\$ 700.00
	ii) Micrometers 2 units		\$ 200.00
	iii) Venier calipers 2 units		\$ 100.00
	iv) Combinational soil outfit plus refills		\$ 500.00
	v) Seggatiars (4 pieces)		\$ 100.00
	vi) Tensiometers (4 units)		\$ 800.00
	vii) Lighe meter (2 units)		\$ 150.00
	viii) Various assortments of laboratory glasswares		\$ 200.00
	ix) Top loading balance P 163N - 1 - 913-87		\$ 4,000.00
	x) Infra red drying accessory for top loading balance LP 11.1-913-97		\$ 2,000.00
	xi) Digital counters (4 units)		\$ 150.00
	xii) Hygrothermograph		\$ 1,000.00
	xiii) Hygrothermograph charts (8367-90) 3 rolls		\$ 100.00
		Total	\$ 10,000.00
3. Lain-lain pembelanjaan pembangunan			\$ 60,000.00
		Grand total	\$ 80,000.00

	Bangunan/Alat-alat	Kegunaan	Harga
1. Pembinaan	Two units of houses for quarters of an ARO & RA		\$ 6,000.00
2. Alat-alat & Jurutera	- -		-
3. Lain-lain per-pertbelanjaan pembangunan	..		-
		Grand total	<u>\$ 60,000.00</u> =====

	Bangunan/Alat-alat	Kegunaan	Harga
1. Pembinaan	i) Store cum drying shade		\$ 10,000.00
2. Alat-alat-jurutera	i) Depulping & separator machine for coffee		\$ 7,000.00
	ii) oven		\$ 3,000.00
		Total	\$ 12,000.00
3. Lain-lain perbelanjaan pembangunan	i) To acquire & develop 10 acres of land		\$ 60,000.00
		Grand total	\$ 80,000.00
			=====



	Bangunan/Alat-alat	Kegunaan	Harga
1. Penbinaan	i) Quarters for ARO & RA		\$ 60,000.00
2. Alat-alat & Jurutera	i) Tensiometer (4 units)		\$ 300.00
	ii) Metal labeller plus accessories		\$ 700.00
	iii) Combinational soil outfit plus refills		\$ 500.00
	iv) Light meters		\$ 150.00
	v) Hygrothermograph (4units)		\$ 4,000.00
	vi) Hygrothermograph chart (6 tolls)		\$ 200.00
	vii) Top loading balance P 163N - 1 - 913-87		\$ 4,000.00
	viii) Infra red drying accessory for top loading LP 11,1-913-97		\$ 2,000.00
	ix) Digital counters (4 units)		\$ 150.00
	x) Oven		\$ 2,000.00
	xi) pH meter with automatic temperature compensator		\$ 800.00
	xii) Pruning knives		\$ 100.00
	xiii) pH meter tester with adaptor		\$ 100.00
	xiv) Power sprayer		\$ 2,000.00
	xv) Muffle furnaces FR-614		\$ 2,500.00
		Total	\$ 20,000.00

	Bangunan/Alat-alat	Kegunaan	Harga
2. Lain-lain , perbelanjaan perbangunan	i) To open & develop 100 acres of land (new land)		\$100,000.00
		Grand total	<div style="border-top: 1px solid black; margin-bottom: 5px;"></div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;"></div> <div style="border-bottom: 3px double black; margin-bottom: 5px;"></div>

	Bangunan/alat-alat	Kegunaan	Barga
1. Perbinaan	i) Building for working space, store in new area (1,800 sq. ft.)		\$ 60,000.00
2. Alat-alat & Jurutera	-	-	-
3. Lain-lain perbelanjaan pembangunan		-	-
		Grand total	<u>\$ 60,000.00</u> =====

	Bangunan/alat-alat	Kegunaan	Harga
1. Pembinaan	i) Quarters for RO & a glass house/nursery shade		\$ 100,000.00
2. Alat-alat & Jurutera	i) Presision balance of 5kg. capacity		\$ 2,000.00
	ii) Inclined binocular microscope		\$ 3,000.00
	iii) Stereo dissecting microscope		\$ 2,000.00
		Total	\$ 7,000.00
3. Lain-lain perbelanjaan pembangunan	i) To open & develop 100 acres of land (new land)		\$ 100,000.00
		Grand total	\$ 207,000.00 =====

	Bangunan/alat-alat	Kegunaan	Harga
1. Pembinaan	i) To build a nursery shade plus sprinkle syst. at Pontian Station (1,800 sq. ft.)		\$ 10,000.00
2. Alat-alat	-		-
3. Pengambilan Tanah	i) To acquire 50 acres of peat land at IPRS Station for coffee research @ \$600 per acre		\$300,000.00
4. Lain-lain perbelanjaan pembangunan	i) To open & develop 50 acres of land (Pontian)		\$ 30,000.00
		Grand total	<u>\$340,000.00</u> =====

	Bangunan/alat-alat	Kegunaan	Harga
1. Pembinaan	-		-
2. Alat-alat	<ul style="list-style-type: none"> <li>i) Metal labeler</li> <li>ii) Vernier calipers (2 units)</li> <li>iii) Tensiometer</li> <li>iv) Hygrothermographs (4 units)</li> <li>v) Top pan balance P 163 N - 1 - 913 - 27</li> <li>vi) Infra red drying accessory for top loading balance LP 11, 1-9,3-97</li> <li>vii) Digital counter (2 units)</li> <li>viii) pH meter with automatic temperature compensator</li> <li>ix) pH meter tester with adaptor</li> <li>x) Saggetiers (5 units)</li> <li>xi) Motor blower</li> <li>xii) Combinational soil outfit with refill</li> <li>xiii) Beakers, pipettes, conical flasks, test tubes volumetric flasks</li> <li>xiv) Ovens</li> </ul>		<ul style="list-style-type: none"> <li>\$ 700.00</li> <li>\$ 200.00</li> <li>\$ 800.00</li> <li>\$ 4,000.00</li> <li>\$ 4,000.00</li> <li>\$ 2,000.00</li> <li>\$ 100.00</li> <li>\$ 800.00</li> <li>\$ 100.00</li> <li>\$ 100.00</li> <li>\$ 2,000.00</li> <li>\$ 500.00</li> <li>\$ 700.00</li> <li>\$ 4,000.00</li> </ul>
		Total	\$ 20,000.00
		Grand total	\$ 20,000.00

	Bangunan/alat-alat	Kegunaan	Barga
1. Pembinaan	i) To build 2 units of Ra quarters at Pontian		\$ 40,000.00
		Grand total	<u>\$ 40,000.00</u> =====

## 8. ANIMAL PRODUCTION RESEARCH PROGRAMME

### I. BACKGROUND AND OBJECTIVES

The animal production research programme covers animal species like cattle, buffaloes, goat and sheep, poultry and pigs. The products from these animals viz. beef, milk, mutton, goat meat, pork, poultry and eggs, are nutritious protein food and are relished by the consumers. Malaysia is able to produce poultry meat, eggs and pork to meet the country's requirement but imports 95 per cent (%) of milk and dairy products, 80% of mutton and 35% of beef to satisfy the local demand. The value of imported animal protein foods and animal feedingstuffs is estimated to be more than \$400 million annually. This is quite a drain on the country's foreign exchange. Besides loss in foreign exchange heavy dependence on imported foods is quite dangerous and contrary to our national policy of increasing food production and attainment of self-sufficiency.

Although there has been progress in the animal industry in the last decade, there are a number of constraints hindering the rapid development of livestock production especially in the ruminant sector. Poor breeds, shortage of animal feedingstuffs, poor management, disease problems and marketing system need solution. Research support is therefore essentially required to provide information and solution such that the productivity of each animal species is improved and the production of animal protein food increased. Efficient and low cost production should be our goal. This approach may open up opportunities for the small farmers to participate in livestock production and thus provide employment or extra income to their families.



During the Third Malaysia Plan period the main thrust of research has been directed to projects related to increasing the supply and improving the quality of animal feedingstuffs. This is very important in view of immediate need and future demand to support the increasing animal population. Work on the assessment and utilisation of local feedstuffs include grain and root crops, agricultural wastes and by-products, pasture and fodder, and animal waste. Encouraging results were obtained which could be put into practical application by feedmillers and farmers.

Another important area of work has been in the breed improvement. Local cattle, buffaloes, goat and sheep were evaluated and compared with exotic animals and their crosses. Breeding and selection work is time consuming and may take a few generations before any meaningful conclusion can be made.

Concurrently work on management practices on all species of animals were conducted. Good genetic materials alone without the provision of nutritious feed and appropriate management would not possibly increase productivity. This is relevant in the formulation of package technology which can be disseminated to the farmers.

## II. PROJECT DESCRIPTIONS

### A. BEEF PRODUCTION BRANCH

The main function of the Branch is to conduct research and to develop new technology that would lead to increase productivity of meat from cattle and buffaloes. The areas of work can be broadly divided into breeding and selection for improvement of

cattle and buffaloes, nutrition and management system.

It is estimated that the local supply of beef can only meet 60-65% of total requirement and the other 35-40% has to be imported. The local beef is derived mainly from local cattle, crossbred and culled animals from dairy sector and buffaloes. The resources available now can be exploited if the right production system is adopted both for small farmers and large scale farming. However, the emphasis in development is more towards encouraging the small farmers to participate in this enterprise.

There are two aspects of research being conducted namely, the in-station research where work is more discipline oriented and the other is the in-field or on-farm research where farmers participate directly in the application of new technology. MARDI has three major stations i.e. Kluang, Bukit Ridan and Serdang, where beef production research is carried out and several chosen locations such as Alor Setar, Pasir Puteh, Teluk Anson, Tanjung Karang and Batu Pahat where location specific research is undertaken.

The estimates for development and operating expenditure are in appendix A.

#### B. DAIRY PRODUCTION BRANCH

The function and objectives of this Branch are to conduct research and develop new technology for increasing the productivity of milk cattle and ultimately leading to efficient milk production. The research projects currently being carried

out can be classified as long-term and short-term. These include selection and breeding for breed improvement, nutrition, management and location specific research.

Much emphasis has been given by the Ministry of Agriculture on dairy-beef projects and the agencies concerned viz. Veterinary Division and Majuternak, have already taken the lead to expand their development programmes. However, the scope for expansion should be channeled through smallholder participation such that they would benefit financially from the projects.

Although development projects have been going on and expanding there are a number of problems which have not been solved and need to be researched. Thousands of cattle have been imported (at the rate of 10,000 - 15,000 annually) from Australia and New Zealand, and crossbreds are also produced locally. The genetic potential of these animals have to be evaluated and their overall performance tested. The nutrition and management aspects have to be determined and standardised. In addition to these a package technology has to be developed for the consumption of small farmers in the M.C.C. areas.

Research backing is therefore essential to support this multi-million dollar projects scattered all over the country. Currently MARDI has only a handful of research officers and very limited farm acreage at Serdang Station. In order to handle breeding and selection programmes in a more meaningful way a new farm has to be established and field research be strengthened.

The estimates for development and operating expenditure are in Appendix B.

### C. POULTRY AND PIG RESEARCH BRANCH

The function of this Branch is to conduct research and develop technology for the consumption of the non-ruminant sector of the animal industry. Compared to ruminant production the available technologies for poultry and pig production are quite advance and have been well accepted by the farmers. Being prolific, these two species are more efficient than the ruminants in animal protein production. However, the cost of production of poultry meat, eggs and pork is still considered high compared to the neighbouring countries.

The research programme in the Fourth Malaysia Plan will cover work on the effective utilisation of local feedingstuffs to partly replace the imported ingredients, the management practices and also testing the performance of commercial crossbred poultry and pigs. Supportive research in the field of basic nutrition and environmental physiology will also be carried out.

The poultry and pig industry has been well established in Malaysia and the gross turnover value of their products is well above \$600 million annually. What is more important is the involvement and participation of small farmers in poultry and pig rearing to supplement the family income. Malaysia is also self-sufficient in these products and the price of these stuffs has remained quite stable for almost a decade.

Research in poultry and pig production will be directed to reducing the production cost further. The Branch is making only a modest request to strengthen the existing status.

Please refer Appendix C for estimates on development and operating expenditure.

D. GOAT AND SHEEP PRODUCTION BRANCH

The function of this Branch is to conduct research and investigation to increase the productivity of goats and sheep in the country. As Malaysia is presently producing only 18-20% of goat meat and mutton for the local market there is great potential and scope for increasing the production of this commodity.

In the past little work was done to evaluate the performance of these animals critically. Initial start was made during the Third Malaysia Plan period and it is intended that more efforts should be made to strengthen the research in this field. The research emphasis will be in the breeding and selection for the improvement of these species through crossbreeding, applied nutrition, management system and reproduction.

As the present facilities in Serdang are limited it is felt that there is an immediate need to expand the goat and sheep breeding stations. Besides Serdang Station two more substations in Kedah and Kelantan, where the goat and sheep population is high, have been earmarked. It is also planned that work with smallholders will be intensified to provide support to the development projects envisaged by the Veterinary Division.

The estimates for development and operating expenditure are given in Appendix D.

#### E. FEED RESOURCES AND NUTRITION PROGRAMME

The Branch is concerned with feed resources and animal nutrition research. It has within it, the following units: Pasture/fodder, feed analyses, nutrition, ruminant physiology and micro-biology and biochemistry units.

The branch envisages the realisation of four main objectives during the Fourth Malaysia Plan period:

- (i) identification, characterisation and definition in terms of quality and quantity of all categories of the feed resources including agro-industrial by-products for farm animals,
- (ii) evaluation and effective utilization of the feeds produced,
- (iii) definition of appropriate feeding systems, and
- (iv) construction of nutrient requirements of farm animals.

Feed resources embrace all aspects of forage production, including the availability of various agro-industrial by-products in Malaysia. The research programme with forage will be concerned with the screening and production of various grasses and legumes, plant-soil-animal inter-relationships and utilization by ruminants (buffaloes, cows, goats and sheep). Effective utilization by the animal involves initially the evaluation of the nutritive value of the feed by both *in vitro* and *in vivo* means and then in appropriate feeding systems that are consistent with the function of the animal. The assessment work with regard to both quality and quantity of

feeds will have as one of its central objectives the value of these to the feeding of individual classes of animals in small-holder farming.

In view of the variable nature of, and quality of feeding-stuffs, attention will be directed at the nutritive value of a range of feedingstuffs for both non-ruminants and ruminants. The evaluation will entail the use of both chemical and biological methods. With feeds for ruminants, the nutritive value of the feeds will be determined by continuous digestibility trials and also parallel *in vitro* tests. With poultry and pigs, the research programme will focus particular attention on the metabolisable energy (ME) value of a variety of energy sources, while with protein feeds attention will be directed at their importance in the content of amino acids in feeding systems for non-ruminants. In both instances, and in order to furnish and seek a better understanding of the assimilation and utilization of individual nutrients, there will be supportive research using such techniques as cannulation, markers and also radioisotopes.

The total research programme of the branch has the final aim of making available appropriate feeding systems consistent with a definition of nutrient requirements for individual classes of farm animals in Malaysia.

The estimates for development and operating expenditure are given in Appendix E.

### III. JUSTIFICATION AND BENEFITS

The strategy for research and development on various aspects of animal production during the Fourth Malaysia Plan (FMP) is to support the Government's objectives in the drive to achieve self-sufficiency in animal protein food. This is mainly directed at achieving total self-sufficiency in beef and 20 per cent self-sufficiency in milk by 1990. These targets are envisaged within a bold programme of development involving the development of a network of state farms, the intensification of cattle rearing among smallholders, the participation of estate management in cattle production and the participation of companies in joint ventures.

The research thrust to support these objectives has therefore been formulated during the Third Malaysia Plan period, and which will be continued into the FMP period. Research support is primarily directed at dairy-beef production, currently undertaken mainly by the Division of Veterinary Services and Majuternak. Presently Malaysia is about 65 per cent self-sufficient in beef and about 6 per cent in milk. This is equivalent to about 3.0 kg of beef and 3.5 kg of milk per person per year in 1980. It is envisaged that the corresponding per capita consumption figures by 1990 are 3.4 kg and 3.6 kg for beef and milk respectively.

The realisation of the targets set up by the National Livestock Development Committee (NLDC) depends to a very large extent on the effective utilisation of the manpower and resources available to overcome existing problems and keep to a minimum the constraints that affect production. MARDI attaches priority to this programme of work and the importance in supporting the goals



set up by the NLDC. In particular, special emphasis is directed at the value and importance of suitable cattle breeds for dairy and beef production, and their effective management such that high performance and profitability are simultaneously realised. The research programme also places considerable emphasis on environmental components, of which it is realised, feeding and managements are especially important.

The research programmes, having taken into account the Government's aims and objectives, have therefore been proposed accordingly within the Dairy and Beef Branches of the Division.

While research on cattle production is the priority, there will also be emphasis on goat and sheep production. It is realised that both species are commonly kept by most smallholders to serve as a source of meat and also supplementary income. Even more important is the fact that the demand for meat from both species currently far exceeds supply, and efforts are therefore being directed at finding effective ways of increasing the contribution from both species.

Concerning poultry and pig production, both aspects are given lower priority since the industries are both advanced and developed. There will be continuing programmes however, on problem-oriented research.

The research programme of the Division involves both the commodity from individual animal species and multi-disciplinary involvement. These are integrated with each of the 6 Branches.

However, and in cognisance of the fact that feed availability and effective utilisation represent a major constraint to animal production, and an area of considerable importance, there will be intensive research on all aspects of this work with the Feed Resources and Animal Nutrition Branch. This effort is justified by the fact that feed prices are spiralling, the current feed bill for farm animals is around 280 million ringgit and is expected to reach approximately 340 million ringgit by 1990.

The end products and benefits which could be accrued from research work are difficult to measure in monetary terms. What is more important to Malaysia presently is to provide opportunity to farmers to get extra income through livestock keeping. Technologies which are produced or developed locally could be adopted by farmers for efficient production. The increase in productivity of every animal species will ultimately boost up the total animal protein production in the country and thus helps us to reduce the import. Over and above all these the health status of the nation depends greatly on the intake of animal protein.

#### IV. FINANCIAL AND MANPOWER REQUIREMENTS

Please refer to Table on development and operating expenditure for the Animal Production Research Division.

JADUAL 1  
ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

JABATAN - MARDI  
MAKSUD PEMBANGUNAN - BAHAGIAN PENGELUARAN TERNAKAN

BIL. PROJEK - 8  
KETERANGAN - LAMPIRAN A,B,C,D,E

	Tahun (\$000)						Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing
									Tidak Langsung      Langsung
<b>Kos Pembangunan -</b>									
Pembinaan	-	1,232	615	436	10	-	2,293		
Alat-alat dan Jentera	-	415.5	409	448	198	97	1,567.5		
Pelaburan	-	-	-	-	-	-	-		
Pengambilan Tanah	-	55.5	-	-	-	-	55.5		
Lain-lain Perbelanjaan Pembangunan	-	633.2	337.5	62.4	17.4	12.4	1,062.9		
<b>JUMLAH KOS PEMBANGUNAN</b>	-	2,336.2	1,361.5	946.4	225.4	109.4	4,978.9		
<b>Kos Berulang -</b>									
Gaji dan Upahan	-	-	-	-	-	-	-		
Perjalanan dan Pengangkutan Orang	-	183	204	226	242	257	1,112		
Kemudahan Awam (Api, Air, Letrik dll.)	-	12	12	12	12	12	60		
Sewa	-	23.5	23.5	26.5	26.5	26.5	126.5		
Bekalan dan Bahan-Bahan	-	1,538.7	1,685.5	1,845.4	2,026.4	2,252.4	9,348.4		
Penyelenggaraan dan Pembaikan yang dibeli	-	38.6	40.9	54.4	62.4	67	263.3		
Lain-lain Perkhidmatan professional dan keraian	-	59.1	64.9	69.2	76	83.4	352.6		
Lain-lain Perbelanjaan Berulang	-	246	127.2	118.6	120.4	122.4	734.6		
<b>JUMLAH KOS BERULANG</b>	-	2,100.9	2,158	2,352.1	2,565.7	2,820.7	11,997.4		

JADUAL 1  
ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

JABATAN - MARDI  
MAKSUD PEMBANGUNAN - LEMBU DAGING

BIL. PROJEK - 8  
KETERANGAN - LAMPIRAN A

	Tahun (\$000)						Pecahan Kos Pembangunan (000)			
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempat	Tukaran Asing	
									Tidak Langsung	Langusng
Kos Pembangunan -										
Pembinaan		500	205	90			795			
Alat-alat dan Jentera		170	120	100	50	50	490			
Pelaburan		-	-	-	-	-	-			
Pengambilan Tanah		-	-	-	-	-	-			
Lain-lain Perbelanjaan dan Pembangunan		430	80	-	-	-	510			
JUMLAH KOS PEMBANGUNAN		1,100	405	190	50	50	1,795			
Kos Berulang -										
Gaji dan Upahan										
Perjalanan dan Pengangkutan Orang	39	49	55	65	70	75	314			
Kemudahan Awam (Api, Air, Letirk dll.)										
Sewa		5	5	5	5	5	25			
Bekalan dan Bahan-Bahan										
Penyelenggaraan dan Pembaikan yang dibeli	556	560	610	610	660	714	3,154			
Lain-lain Perkhidmatan professional dan Keraian	5	5	5	5	5	5	25			
Lain-lain Perbelanjaan Berulang	30	100	100	100	100	100	500			
JUMLAH KOS BERULANG	630	719	775	785	840	899	4,018			

BREAKDOWN OF DEVELOPMENT ITEMSA. KLUANG STATION

- |  |               |
|--|---------------|
| 1. Land development and clearing of 400 acres area for cattle breeding @ \$750.00 per acre | \$ 300,000.00 |
| 2. Fencing of 400 acres area   | 100,000.00    |

Construction and Buildings

- |  |            |
|--|------------|
| 1. 1 unit of meat laboratory               | 150,000.00 |
| 2. 1 unit sick bay and clinical laboratory | 50,000.00  |
| 3. 2 units feeding stalls                  | 60,000.00  |
| 4. 1 unit Veterinary Quarters              | 40,000.00  |
| 5. 2 units A.R.O. Quarters                 | 25,000.00  |
| 6. 3 units of R.A. Quarters                | 25,000.00  |

Farm Equipments and Vehicles

- |                                  |           |
|----------------------------------|-----------|
| 1. Land Rover (1 unit)           | 30,000.00 |
| 2. Jeep (1 unit)                 | 16,000.00 |
| 3. Spinner broadcaster (2 units) | 20,000.00 |
| 4. Weighing scale (3 units)      | 36,000.00 |
| 5. Cattle trailer (1 unit)       | 10,000.00 |

B. BUKIT RIDAN STATIONConstruction and Buildings

- |                    |            |
|--------------------|------------|
| 1. Farm office     | 20,000.00  |
| 2. Cattle complex  | 150,000.00 |
| 3. Laterite road   | 40,000.00  |
| 4. Electric supply | 25,000.00  |
| 5. Fencing         | 50,000.00  |

Farm Equipment and Vehicles

1. Tractors (a) 1 unit four wheel drive	\$ 120,000.00
(b) 2 units two wheel drive	
2. Forage harvester (1 unit)	25,000.00
3. Vehicles (2 Land Rover, 2 St. Wagon, 2 Combi)	160,000.00

C. ALOR SETAR STATION

Construction and Buildings

1. Earth filling, site preparation and cattle shed (Tobiar)	85,000.00
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Vehicles and Equipment

1. Jeep (1 unit)	16,000.00
2. Weighing scale (1 unit)	12,000.00

D. PASIR PUTEH STATION

Construction and Buildings

1. Cattle sheds	20,000.00
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Equipments and Vehicles

1. Weighing scale (2 units)	20,000.00
2. Straw chopper (1 unit)	4,000.00
3. Straw pelleting machine (1 Unit)	25,000.00

E. TANJONG KARANG STATION

Construction and Buildings

1. Cattle sheds (2 units)	30,000.00
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Equipment

1. Weighing scale (1 unit)	5,000.00
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F. HILIR PERAK STATION

Construction and Buildings

1. Cattle sheds (3 units)	\$ 40,000.00
2. Fencing and water supply	35,000.00

Equipment and Vehicles

1. Weighing scale (1 unit)	10,000.00
2. Jeep (1 unit)	16,000.00

GRAND TOTAL	\$ 1,795,000.00
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JABATAN - MARDI  
MAKSUD PEMBANGUNAN - CAWANGAN TENUSU

BIL. PROJEK - 8  
KETERANGAN - LAMPIRAN B

	Tahun (\$000)						Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing
									Tidak Langaug      Langsung
<b>Kos Pembangunan -</b>									
Pembinaan	-	-	150	-	-	-	150		
Alat-alat dan Jentera	-	60	187	121	131	30	529		
Pelapuran	-	-	-	-	-	-	-		
Pengambilan Tanah	-	-	-	-	-	-	-		
Isin-lair Perbelanjaan Pembangunan	-	60	60	30	-	-	150		
<b>JUMLAH KOS PEMBANGUNAN</b>	-	120	397	151	131	30	829		
<b>Kos Berulang -</b>									
Gaji dan Upahan*	-	-	-	-	-	-	-		
Perjalanan dan Pengang- kutan Orang	-	30	34	40	45	50	199		
Kemudahan Awam (Api, Air, Listrik dll.)	-	-	-	-	-	-	-		
Sewa	-	5	5	7	7	7	31		
Bekalan dan Bahan-Bahan	-	-	-	-	-	-	-		
Penyelenggaraan dan Pem- baikan yang Dibeli	-	237	275	312	361	415	1,600		
Lain-lain Perkhidmatan professional dan Keraian	-	17	20	22	26	30	115		
Lain-lain Perbelanjaan Berulang (3300)	-	10	10	10	10	10	50		
<b>JUMLAH KOS BERULANG</b>	-	299	344	391	449	512	1,995		



## APPENDIX B

### BREAKDOWN OF DEVELOPMENT ITEMS

Land Acquisition - Nil

## Buildings and Infrastructure

Calf pens	\$ 100,000
Sick bays	50,000
	<hr/>
	\$ 150,000

### Farm Machinery and Equipments

(a)	Mini dairy and processing equipments	\$ 150,000
(b)	3 units of tractors @ \$45,000 each	130,000
(c)	2 units of forage harvesters @ \$40,000 each	80,000
(d)	3 units of trailers @ \$18,000 each	54,000
(e)	1 unit of weighbridge	25,000
(f)	A.I. laboratory equipments	50,000
(g)	4 units of portable weighbridge	40,000
		<hr/>
		\$ 529,000

## Vehicles

(a) 5 units of Land Rover/Jeep	\$ 150,000
	<hr/>
TOTAL	\$ 829,000
	<hr/>

JABATAN - MARDI

MAKSUD PEMBANGUNAN - CAWANGAN AYAM/BAHI

BIL. PROJEK - 8

KETERANGAN - LAMPIRAN C

		Tahun (\$000)						
		1980	1981	1982	1983	1984	1985	Jumlah 1981-85
Kos Pembangunan:								
Pembinaan		N/A	210 <sup>*</sup>	130 <sup>+</sup>	130 <sup>+</sup>	10 <sup>#</sup>	-	480
Alat-alat dan Jentera			56.5 <sup>*</sup>	-	-	-	-	56.5
Lain-lain Perbelanjaan Pembangunan (Infrastruktur)			30	20	20	5	-	75
JUMLAH KOS PEMBANGUNAN			296.5 <sup>*</sup>	150	150	15	-	611.5
Kos Berulang:								
Perjalanan dan Pengangkutan Orang	2100	18	19.8	21.8	24	26.4	29.0	121
Bekalan dan Bahan-Bahan	2700	240	288	346	415	498	598	2,145
Penyelenggaraan dan pembaikan yang dibeli	2800	8.6	10.3	12.4	14.9	17.9	21.5	77
Lain-lain perkhidmatan professional dan keraian	2900	8.0	9.6	11.5	13.8	16.6	20	71.5
Perabut danengkapan alat kelengkapan dan ternakan	3300	5	6	7.2	8.6	10.4	12.4	44.6
JUMLAH KOS BERULANG		279.6	333.7	398.9	476.3	569.3	680.9	2,459.1

BREAKDOWN OF DEVELOPMENT ITEMS

1. Land Acquisition - Nil

2. Construction of Buildings

(a) Poultry grower shed (2 units)	\$ 60,000
(b) Poultry house (physiological work)	40,000
(c) Pig Metabolism house	60,000
(d) Pig Waste disposal unit	50,000
(e) Pig Farrowing house	100,000
(f) Pig holding unit	100,000
(g) Poultry layer shed	30,000
(h) Poultry Nutrition shed	30,000
(i) Duck shed with run	10,000

Total	<u>\$ 480,000</u>
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3. Equipments

(a) Blood gas apparatus	\$ 10,000
(b) Top pan balance/electrical balance	6,500
(c) Equipment for waste disposal	20,000
(d) Equipment/apparatus for physiological studies	20,000

Total	<u>\$ 56,500</u>
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4. Lain-lain

(a) Infrastructure e.g. Road, Water and electricity supply	\$ 75,000
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Grand Total	<u>\$ 611,500</u> =====
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JABATAN - MARDI

MAKSUD PEMBANGUNAN - KAMBING DAN BIRI-BIRI

BIL. PROJEK - 8

KETERANGAN - LAMPIRAN D

	Tahun (\$000)							Pecahan Kos Pembangunan (\$000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak Langsung	Langsung
Kos Pembangunan -										
Pembinaan	-	237	230	66	-	-	533			
Alat-Alat dan Jentera		100	100	100	-	-	300			
Pengambilan Tanah		-	-	-	-	-	-			
Lain-lain Perbelanjaan Pembangunan		40	160	-	-	-	200			
JUMLAH KOS PEMBANGUNAN		377	498	166	-	-	1,033			
Kos Berulang -										
Gaji dan Upahan										
Perjalanan dan Pengangkutan Orang	12	13	15	15	16	16	75			
Kemudahan Awam (Api, Air, Letrik)	-	-	-	-	-	-	-			
Sewa		5	5	5	5	5	25			
Bekalan dan Bahan-Bahan	55	70	80	90	100	110	450			
Penyelenggaraan dan Pembaikan yang dibeli	4.5	10	10	20	25	25	90.5			
Lain-lain Perkhidmatan Professional dan keraian	2	2	2	2	2	2	10			
Lain-lain Perbelanjaan Berulang	4	130	10	-	-	-	140			
JUMLAH KOS BERULANG	77.5	230	122	132	148	158	790.5			

KEPERLUAN BAGI 1981-1985

1. Tanah

Sedia ada - 15 ekar

Untuk kambing - jumlah diperlukan 70 ekar (tambahan 55 ekar)

Untuk biri-biri - seluas 100 ekar telah diperuntukan bagi

Unit Biri-Biri di Serdang (Anggaran perbelanjaan perolehan tanah - tiada)

2. Perbelanjaan Pembangunan

Tanah 100 ekar yang diperuntukan akan dibersihkan untuk ditanam dengan rumput bagi kegunaan biri-biri dan kambing.

Anggaran Perbelanjaan Kontrek

\$ 78,000

3. Bangunan

(a) 6 kandang biri-biri di Serdang (80' x 20')	120,000
(b) 2 kandang kambing di Gajah Mati (80' x 20')	30,000
(c) 2 kandang kambing di Serdang (40' x 20')	30,000
(d) 1 kandang kambing di Serdang (80' x 20')	20,000
(e) 2 kandang biri-biri di Bukit China (80' x 20')	40,000
(f) Bangunan Pejabat di Unit Biri-Biri, Serdang	15,000
(g) Bangunan Pejabat di Pusat Biri-Biri, Bt. China	8,000
(h) Setor dan Tempat Letak Kereta di Serdang	10,000
(i) Setor dan Tempat Letak Kereta di Bukit China	9,000
(j) 4 unit Rumah Papan Panjang di Bukit China	20,000
(k) 4 unit Rumah Papan Panjang di Gajah Mati	23,000

4. Jalan Dan Parit

(a) Jalan Tar serta Parit ke Unit Biri-Biri Serdang	40,000
(b) Jalan Tar serta Parit ke Pusat Biri-Biri Bt. China	25,000
(c) Jalan Tar serta Parit ke Pusat Kambing Gajah Mati	15,000

5. Pagar

(a) Pagar 7 kaki Chain-Link di Unit Biri-Biri Serdang	30,000
(b) Pagar 7 kaki Chain-Link di Pusat Biri2 Bt. China	18,000
(c) Pagar 7 kaki Chain-Link di Pusat Kambing Gajah Mati	12,000

Unit Kambing, Serdang = Kompleks Unit Kambing, MARDI, Serdang.  
 Unit Biri-Biri, Serdang = Kompleks Unit Biri-Biri, MARDI, Serdang.  
 Pusat Kambing, Gajah Mati = Pusat Penyelidikan Kambing, Gajah Mati, Kedah.  
 Pusat Biri-Biri, Bt. China = Pusat Penyelidikan Biri2, Bt. China, Kelantan.

6. Ternakan

(a) Kambing Baka Luar Negeri - sedia ada	
(b) Biri-Biri Baka Luar Negeri - 3 jenis 40 ekor betina dan 10 ekor jantan tiap-tiap satu jenis	\$ 130,000
(c) Biri-Biri Tempatan 600 ekor (\$70 seekor)	42,000

7. Peralatan Ladang

(a) Traktor 4 Roda	1 buah
(b) Trailer 3 Ton	2 buah
(c) Trailer 1 Ton	1 buah
(d) Mesin Pemotong Rumput (Forage Harvester)	1 buah
(e) Pedestrian Tractor (Kedah dan Kelantan)	2 buah
(f) Broadcaster	1 buah
(g) Spinner Broadcaster (Fertiliser dan Manure)	1 buah
(h) Boom Sprayer	1 buah
(i) Power Sprayer (Knapsack Type)	2 buah
(j) Rotory Cultivator	1 buah
(k) Water Pump (Pam Air) 200 mm	4 buah
(l) Elektrik Generator (portable) - Kedah dan Kelantan	2 buah
(m) Land Rover (Kedah dan Kelantan)	2 buah

8. Peralatan Makmal

(a) Peti Sejuk (Refrigerator - 12.5 cu. ft.)	4 buah
(b) Freezer (5' x 3' x 2') approx.	2 buah
(c) Hot Air Sterilizer	2 buah
(d) Water Distiller	2 buah
(e) Binocular Microscope	2 buah
(f) Hot Plate	2 buah
(g) Liquid Nitrogen Tank	3 buah
(h) Liquid Nitrogen Storage Tank	1 buah
(i) Slide Warmer	2 buah
(j) Water Bath with Shaker	1 buah
(k) Wool Shearer	2 buah
(l) Weighbridge 150 kg (0.1 kg)	1 buah
(m) Weighing Crate 100 kg	2 buah
(n) Baker Mixer	1 buah
(o) Air Conditioner	1 buah
(p) Glassware dan lain-lain yang diperlukan	4 buah

9. Lain-Lain Keperluan

(a) Benih Rumpun 50 kg	
(b) Senior Officer Tables	10 buah
(c) Senior Officer Chairs	10 buah
(d) Junior Officer Tables	10 buah
(e) Junior Officer Chairs	10 buah
(f) RA/Clerical Staff Tables	15 buah
(g) RA/Clerical Staff Chairs	15 buah
(h) Bookshelves	10 buah
(i) Filing Cabinets	10 buah
(j) File Racks	10 buah
(k) Steel Cabinets	4 buah
(l) Index Card Cabinets 6" x 4"	10 buah
(m) Typewriter - Olympia	2 buah
(n) Typist Tables	2 buah
(o) Typist Chairs	2 buah
(p) Lain-Lain yang diperlukan	-

Jumlah Besar bagi peralatan Ladang, peralatan Makmal  
dan lain-lain keperluan

\$ 300,000  
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JABATAN - MARDI

MAKSUD PEMBANGUNAN - SUMBER MAKANAN & PEMAKANAN TERNAKAN

BIL. PROJEK - 8

KETERANGAN - LAMPIRAN E

	Tahun (\$000)						Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing
									Tidak Langsung      Langsung
<b>Kos Pembangunan -</b>									
Pembinaan		385	-	-	-	-	385		
Alat-alat dan Jentera		79	52	17	17	17	182		
Pelaburan		-	-	-	-	-	-		
Pengambilan Tanah		55.5	-	-	-	-	55.5		
Lain-lain Perbelanjaan Pembangunan		33.2	17.5	12.4	12.4	12.4	87.9		
<b>JUMLAH KOS PEMBANGUNAN</b>		<b>552.7</b>	<b>69.5</b>	<b>29.4</b>	<b>29.4</b>	<b>29.4</b>	<b>710.4</b>		
<b>Kos Berulang -</b>									
Gaji dan Upahan		-	-	-	-	-	-		
Perjalanan dan Pengangkutan Orang		71.14	78.08	82.08	84.58	87.08	407.96		
Kemudahan Awam (Api, Air Letrik dll.)		12	12	12	12	12	60		
Bekalan dan Bahan-Bahan		378.7	374.5	418.4	407.4	415.4	1,994.4		
Penyelenggaraan dan Pem- baikan yang dibeli		18.3	18.5	19.5	19.5	20.5	96.3		
Lain-lain Perkhidmatan professional dan Keraian		25.5	26.4	26.4	26.4	26.4	131.1		
Lain-lain Perbelanjaan Berulang		-	-	-	-	-	-		
<b>JUMLAH KOS BERULANG</b>		<b>519.14</b>	<b>517.98</b>	<b>567.88</b>	<b>559.38</b>	<b>570.88</b>	<b>2,735.26</b>		



APPENDIX E

BREAKDOWN OF DEVELOPMENT ITEMS

1. Acquisition of Land - Nil	
2. Land clearing and planting	
(a) 22 acres in Serdang for evaluation of pasture species @ \$500 per acre	\$ 11,000.00
(b) 60 acres in Kluang for pasture work @ \$500 per acre	30,000.00
(c) 18 acres at Sungai Daging for pasture and forage @ \$500 per acre	9,000.00
(d) 11 acres at Gajah Mati, Kedah for pasture research @ \$500 per acre	5,500.00
	<hr/>
	\$ 55,500.00
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3. Construction of Buildings	
1 unit of metabolism house at Serdang for nutrition studies (B/F from T.M.P.)	\$385,000.00
4. Farm and Laboratory Equipments	182,000.00
5. Infrastructure and other developments	87,900.00
	<hr/>
Grand Total	\$710,400.00
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## 9. FRESHWATER FISHERIES RESEARCH PROGRAMME

### I. BACKGROUND AND OBJECTIVE

From all available information, the potential exploitable natural fish resources in Malaysia is estimated at a total of 1,118,000 tons. Out of this over 550,000 tons are currently being harvested. The remaining available fish resources if fully exploited will be just sufficient to meet local demand by the year 2,000 A.D. provided the export of fish is curtailed. However, full exploitation of the resources require high capital investment especially in the deep sea fishing grounds.

The alternative means of obtaining the required fish protein is through aquaculture which can be subdivided into freshwater fish culture, brackish-water fish culture and mariculture. The present production from aquaculture is estimated at 61,165 tons of which 76 per cent (%) is from cockle culture and about 9,137 tons or 15% is from freshwater pond culture.

The potential of increasing fish production through aquaculture is tremendous but the industry currently has its own inherent problems. Technically, aquaculture production is constrained by several factors such as seed production, feeding system and inadequate biological information.

The objective of this programme is to develop new technology through research to support the development programmes envisaged by the Government. The emphasis in fishery development projects has been towards increasing the production of cheap protein food for the rural poor as well as providing employment to those farmers

who wish to go into commercial farming or integrated farming. Research results obtained during the Third Malaysia Plan period has pointed that farmers can increase the family income through fish culture.

## II. PROJECT DESCRIPTION

The following projects have been formulated by the Freshwater Fisheries Research Branch and will be continued in the Fourth Malaysia Plan. They are:

1. Culture, breeding and selection of Chinese carps and local carps of economic importance.
2. Breeding and mass production of aquarium fishes.
3. Juvenile production of Macrobrachium rosenbergii.
4. Culture and breeding of air breathing species.
5. Integrated farming.
6. Cage and Pen culture of Freshwater fishes.
7. Nutritional Research for formulating Artificial feeds for Fishes and Prawns.
8. Fish Pathology.
9. Selective Breeding and Hybridisation of freshwater fishes.

Presently most of the research work is being carried out at Batu Berendam, Freshwater Fishery Research Station. It is high time now that outreach station be established in specific locations for studies on fish production in riverine area, natural lakes, mining pools, reservoirs and even in canals and padi fields. For the Fourth Malaysia Plan it is proposed that an outreach station be built in Pahang for studies on riverine fishes.

### III. JUSTIFICATION AND BENEFITS

The achievements made during the Third Malaysia Plan period have given new hope for the expansion of freshwater fish industry in the country.

#### (a) Breeding

Techniques for the induced breeding of two out of the three species of Chinese Carps namely bighead carp (Aristichthys nobilis) and silver carp (Hypophthalmichthys molitrix) have been standardised. Another species of the Chinese carps viz. the grass carp (Ctenopharyngodon idellus) have also been bred but needs further standardisation. Another exotic species, rohu (Labeo rohita), an Indian major carp have also been bred. This species have been identified to have potential to be incorporated as one of the polyculture species. One of the indigenous carp, Jelawat (Leptobarbus hoevenii) have also been bred. Techniques for the induced breeding of the Jelawat as well as Labeo rohita will be standardised.

Breeding of three species of the aquarium fishes namely Puntius tetrazona, Trichogaster trichopterus and Puntius schwanefeldii was successful. Breeding of the former two was by environmental manipulation whereas induced breeding technique was used for P. schwanefeldii.

Production of udang galah, Macrobrachium rosenbergii juvenile was initiated in 1973. Initially a clear water rearing system was utilised. Some of the problems encountered include infection of larvae with filamentous bacteria. This has led to considerable decrease in juvenile production

especially in 1975. In early 1976, the station began using the 'greenwater' as a medium for rearing the larvae. Between 8 - 10 juveniles could be produced from 1 litre medium. This technique has been adopted ever since. In the last quarter of 1979, the 'greenwater' system of juvenile production has been further standardised and the project has currently been producing 15 - 19 juveniles per litre medium, consistently. Closed or recirculating system has also been experimented on and has yielded encouraging results. An improved biological filter bed using cockle shells are being tested but experiment indicate that about 17.4 juveniles could be produced from a one - litre medium. The closed system technique will have to be further standardised.

(b) Nutrition

Experiments to determine the nutrient requirement for the grass carp (Ctenopharyngodon idellus) and the Jelawat (Leptobarbus hoevenii) was conducted.

Experiments using semipurified diet showed that the protein requirement of grass carp was about 32%.

Similarly, Jelawat also require a diet containing 32% C.P. for best growth.

(c) Husbandry

Polyculture of prawns and carps have been carried out satisfactorily. About five pikuls of prawns and between 8 - 9 pikuls of fish (comprising of Aristichthys nobilis, Puntius gonionotus and Ctenopharyngodon idellus) could be produced within 6 months. This is equivalent to a production

of about 4149.60 kg/ha/yr.

Integration of chicken rearing together with polyculture of prawns and fish has enabled the culture period to be shortened to about four months without jeopardising the yield of fish or prawns. Between 14000 kg to 16000 kg of proteins can therefore be produced from a 1 - hectare area of farm.

Semi - intensive culture of Clarias batrachus yielded 5335 kg/ha/yr of fish. The stocking rate used was still low i.e. 7 fish/sq.m. Despite the high yield availability of feed especially trash fish still poses a considerable limitation to the production of this species.

Physicochemical studies of the Durian Tunggal Reservoir showed that this reservoir is suitable for cage culture. With a stocking rate of 300 fish per cage of 5m x 5m x 2m, fish of initial average weight of 6.3 gms attained an average weight of 340 grams after 3 months.

Though other factors such as supply and demand, environmental suitability, legality, establishment of priority programmes and infrastructure can limit the development in aquaculture, a great deal of the technical limitations can be resolved with greater research inputs and the evolution of the appropriate technology.

Despite the constraints listed, the potential for increasing the production of freshwater fish and crustaceans in Malaysia is bright. Besides excavated ponds which is intended for

fish culture a number of freshwater ecosystems such as rivers, streams, irrigation canals, natural lakes, reservoirs, dug - out pits, abandoned mining pools and swamps can be rationally utilised for fish culture. Currently, the limited exploitation of these ecosystems for culture can be attributed to insufficient technology especially in terms of their rationale management.

Shortage of fish fry of the cultured species and the lack of information about the biology of some of the indigenous species which have potential for culture has impeded the development of freshwater fish culture. Similarly in the case of udang galah, eventhough its market potential is high, juvenile production still lags behind demands. Though production of juveniles is no longer considered a major problem, operational efficiency in the prawn hatchery needs reexamination. Incidentally the development phase of this industry viz. through greater participation of farmers as well as entrepreneurs needs effective transfer of technology.

With the development of the aquaculture industry, greater emphasis should also be given towards research on crustacean and finfish. Being an agricultural country rationale utilisation of agro-wastes should be given its due attention especially for the development of feeds for livestock and fish.

#### IV. FINANCIAL REQUIREMENT

Please see Appendix F for development and operating expenditure.

JABATAN - MARDI  
MAKSUD PEMBANGUNAN - IKAN AIR TAWAR

BIL. PROJEK - 9  
KETERANGAN - LAMPIRAN F

	Tahun (\$000)							Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak Langsung	Langsung
Kos Pembangunan -										
Pembinaan	-	525	450	305	15	-	1,295			
Alat-alat dan Jentera	-	554	195	60	16	4	829			
Pelaburan	-	-	-	-	-	-	-			
Pengambilan Tanah	-	100	-	-	-	-	100			
Lain-lain Perbelanjaan Pembangunan	-	81	119	58	±8	-15	291			
JUMLAH KOS PEMBANGUNAN		1,260	764	423	49	19	2,515			
Kos Berulang										
Gaji dan Upahan	-	-	-	-	-	-	-			
Perjalanan dan Pengang- kutan Orang	-	19.9	22.2	44.7	45.7	47.8	180.3			
Kemudahan Awam (Api, Air, Letrik dll.)	-	54	60	81	87	93	375			
Sewa	-	0.5	0.5	0.5	0.5	0.5	2.5			
Bekalan dan Bahan-Bahan	-	507.7	554.5	676.7	707.2	706.1	3,152.2			
Penyelenggaraan dan Pem- baikan yang dibeli	-	40	50	80	90	100	360			
Lain-lain Perkhidmatan professional dan keraian	-	15	18	31	34	37	135			
Lain-lain Perbelanjaan Berulang	-	16	19	31	37	41.5	144.5			
JUMLAH KOS BERULANG	-	653.1	724.2	944.9	1,001.4	1,025.9	4,349.5			



BREAKDOWN OF DEVELOPMENT ITEMS

1. Proposed New Station for Riverine Fish (Pahang)	
(a) Acquisition of 10 acres of land in Pahang @ \$10,000/acre.	\$ 100,000.00
(b) Land clearing and site preparation @ \$4,000/acre.	40,000.00
(c) Pond construction on 7 acres @ \$6,000/acre.	42,000.00
(d) Construction of office and laboratory	100,000.00
(e) Residential quarters for farm manager, supporting staff and workers.	150,000.00
(f) Chain Link fencing	28,000.00
(g) Infrastructure e.g. road, electricity and water supply.	100,000.00

Vehicles

Land rover/	25,000.00
Speed boat (2 units)	30,000.00

Equipments

Trawls and nets	10,000.00
Electrofishing equipments	15,000.00
Limnological equipments	10,000.00
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	\$ 650,000.00
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2. Expansion of Batu Berendam Station

Land acquisition - Nil

Construction

(a) Two storey office block (180' x 20')	\$ 324,000.00
(b) Central air conditioning	100,000.00

APPENDIX F

(c) Electrical facilities	\$ 7,000.00
(d) Water facilities	6,000.00
(e) Sewerage and septic tanks	5,000.00
(f) Road	25,000.00
(g) Others	14,000.00
(h) Garage and workshops	30,000.00
(i) Improvement to aquarium	60,000.00
(j) Improvement to tanks	30,000.00
(k) Additional ponds	230,000.00
(l) Extension of operation room, library, existing laboratory and Ketua Station office	60,000.00
(m) Store and laboratory for fish feed processing	50,000.00
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	\$ 941,000.00
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Farm Machinery and Vehicles

(a) Drag line	\$ 150,000.00
(b) Power tiller	7,000.00
(c) Hand by Generator - 2 units	40,000.00
(d) 4" pump diesel	6,000.00
(e) 3" pump diesel	3,000.00
(f) Fibre glass (Trailer)	10,000.00
(g) Pond aerators (diesel), 15 units	60,000.00
(h) Back pack grass cutter, 15 units	30,000.00
(i) Pick up (1½ - 2 ton), 2 units	32,000.00
(j) Combi	25,000.00
(k) Ford transit, 2 units	36,000.00
(l) Multi-purpose stationwagon	37,000.00
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	\$ 436,000.00
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Laboratory Equipments

(a) Equipments for nutrition laboratory	\$ 205,000.00
(b) Equipments for limnology laboratory	27,700.00
(c) Equipments for crustacean physiology	16,300.00
(d) Equipments for fish breeding laboratory	67,200.00
(e) Equipments for fish disease (pathology lab.)	120,000.00
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	\$ 436,500.00
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Office Equipments

Calculators (statistical use)	\$ 12,000.00
Photocopy machine	6,000.00
Stencil cutter	4,000.00
Punch card	2,000.00
Fire fighting equipment	5,000.00
Audio-visual aids and public address system	12,000.00
Furniture and furnishings	10,000.00
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	\$ 51,000.00
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GRAND TOTAL	\$ 2,515,000.00
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## 10. DEVELOPMENT PROJECT DIVISION

### I. BACKGROUND AND OBJECTIVE

From the inception of the Malaysian Agricultural Research and Development Institute in 1969, the main objectives of the Institute have been twofold, namely, that of conducting scientific research on crops excluding rubber and recently oil palm and that of promoting the development of the farming sector through effective use of the research results. Until October 1979, the responsibilities of meeting the latter objectives rest on the Project Development and the Sociological Studies Branch. However as a result of several breakthroughs and the great demand for research support at various areas in the country the branch was expanded to that of a full division comprising four branches, namely, Cawangan Wilayah Utara, Cawangan Wilayah Tengah, Cawangan Wilayah Timur and Cawangan Wilayah Selatan.

It is estimated that there are over 500,000 farm holdings in the country which require research backing. It has also been recognised that there is a great gap between the performance of technologies in laboratories and stations and those that are tested in farmers fields. The differences in the performance of these technologies can be due to environmental, biological and socio-economic conditions which varies from one location to another. It is essential therefore that the development of the farming sector must be done simultaneously with the Institute's research activities so that there will be a concurrent feedback of agricultural problems to the research laboratories for furthering and intensifying research. This will ensure the development of location specific technologies that is tailored to the needs of each agro-ecological, socio-economic and cultural conditions of each location in order to improve the income and living standard of the rural community. The farming community, in this manner, will stand to benefit from the Institute's research activities thereby

hastening agricultural development in the country. This will also ensure that with the expansion of this division, the linkages between MARDI and the other government agencies which are involved in executing the agricultural development plans can be further strengthened and the Institute can play its role through the Gerak Tani Centres.

The broad aims of the Division are to synthesise, test, evaluate, modify and improve new technology arising from the Institutes' laboratories and stations in relevant areas with farmers participation in order to develop component or package technologies that are location specific. The output from such tests would:-

- i. Result in the identification of crop varieties suitable for new areas as well as for existing farmers;
- ii. Result in obtaining results of performance of new inputs at farm level;
- iii. Enhance feedback of research limitations of any new technology, and
- iv. Provide information of the latest viable farming systems and their expected returns in the form of a package deal for the utilisation of the local extension agencies.

## II. PROJECT DESCRIPTION

In order to facilitate the undertaking of development projects and administration of staff and finance, Peninsular Malaysia is divided into 4 zones with their respective branches:-

<u>Zone</u>	<u>State under zone</u>	<u>Branch Hqrs.</u>
1. North Zone (Cawangan Wilayah Utara)	Kedah, Perlis, Penang Central/North Central Perak	Bertam

<u>Zone</u>	<u>State under zone</u>	<u>Branch Hqrs.</u>
2. Central Zone (Cawangan Wilayah Tengah)	South Perak, Selangor and Negeri Sembilan	Serdang
3. South Zone (Cawangan Wilayah Selatan)	Malacca and Johore	Batu Pahat
4. East Zone (Cawangan Wilayah Timur)	Kelantan, Trengganu and Pahang	Kuala Trengganu

At each zone, Regional Development, Area Development and Special Projects will be undertaken as the case may be. The branches will be responsible to the Headquarters which will be in Serdang for technical guidance and administration. The Branch Heads will be in close liaison with the local extension agencies in their area as well as with other research teams in their areas. Such close liaison will be essential for the successful undertaking of development projects and the extension of such projects to other areas.

The staff of Development Project Division will be stationed in strategic positions in order to enable satisfactory guidance and supervision of the farmers or agencies involved in the projects. While the Senior Staff will be stationed at MARDI Stations, most of the junior staffs will be stationed at the respective agricultural development centres or at the State Departments where the projects are undertaken.

The head of branches will be stationed centrally in each region to ensure that they will be able to coordinate and control efficiently the work of their research teams with those agencies that are executing the government's agricultural development plans in their respective regions.

In the North, the activities of the branch are concentrated in the Kedah Valley, MUDA area, Seberang Prai and Balik Pulau Integrated Agricultural Development Project, and Krian area. In

the Central Region the activities of the branch will be centred mainly in Sg. Manik/Labu Kubang, Hilir Perak, North West Selangor, Sepang, Selangor Coast and Negeri Sembilan Timur. The Southern Region will support the Malacca Integrated Agricultural Development Project, Johor Barat and the Mersing Endau Project. The Eastern Region will focus their attention to the North Kelantan Projects, KESEDAR, Besut, Ulu Trengganu/Kuala Trengganu, Pahang Barat, Endau/Rompin and Pahang Timur. Except for the Cawangan Wilayah Timur the other branches have secured or about to secure office space for their branch headquarters at various MARDI Stations or Geraktani centres.

In view of the diversified nature of our farmers farming practices and the wide array of crops that are planted by our farmers the activities of the divisions have to be centred towards improving the production of the major crops, introducing entirely new crops, and/or livestock in their farming systems so that they could utilise their resources efficiently. Crops that will be given emphasis will be rice, field crops, cocoa-coffee-coconut, vegetables, fruits, and livestock. Trials will be in the form of adaptive trials, local varification trials, and Pilot Projects.

### III. PROJECT JUSTIFICATION AND BENEFITS

There exist a large potential performance gap between the potential yield and the yield obtained by farmers in a particular location. This gap exists mainly due to various constraints such as environmental, biological and socio-economic constraints. In order to reduce this gap there is a dire need to identify these constraints before any new technology could be modified and improved to suit the needs of any particular location. Therefore the need to carry out location specific research need no further emphasis.

In order to develop location specific technologies, there

is a need to develop, test, evaluate, modify and improve the technology in a given area. The trials can be in the form of research managed trials or with farmers participation. The farmers and his farms will become the instrumentation under the guidance of the researcher to varify new inputs and technologies derived from the Institute's research activities. The nature of work handled by these researchers requires them to make frequent visits to participating farmers, extension agencies or their research fields in order to ensure the success of the projects undertaken. In most cases these researchers has to cover remote and difficult areas. Therefore there is a strong need to provide them with vehicles such as land rovers and jeeps to transport them to these remote and difficult areas. Apart from vehicles, there is also a necessity to provide them with sufficient amount of field equipments as well as providing them with the necessary laboratory facilities to allow them to be more effective and efficient in carrying out their trials. These supporting services are insufficiently provided to the Cawangan Wilayah Timur in Trengganu. Therefore there is a strong need to provide these researchers with these services.

Currently, there are 9 research officers that requires these facilities. Three of these officers are from the Project Development Division, 1 from the Economics Branch, 1 from the Crop Protection Branch and 4 from the Annual Crop Division. Unless they are provided with suitable office space, laboratory facilities and equipments their research activities will be very much curtailed especially in undertaking their research efforts in Ulu Trengganu and Trengganu coast including Besut. There is already a potential for the improvement and expansion of groundnut and field crop industry in Ulu Trengganu, while there is also the strong potential for the development, improvement in the transfer of technology in the tobacco, padi, fruits and cocoa cultivation as well as silkworm



rearing in this area. Therefore the benefits that could be obtained by the farming community in this region can be enormous. This will certainly improve the income and living standard of the farming community in this region.

#### IV. FINANCIAL AND MANPOWER REQUIREMENTS

The financial requirements of this programme is aimed mainly at providing the necessary office and laboratory facilities for the Cawangan Wilayah Timur and the purchase of field and laboratory equipments that are needed by the other cawangan and the Cawangan Wilayah Timur. The total requirements of the programme is given in Jadual IA. A total of \$1.140 million is required for infrastructure developments, \$0.30 million is required for the acquisition of 5 acres of land in Kuala Trengganu in order to set up a station for the Cawangan Wilayah Timur and \$0.96 million is required for the purchase of vehicles and equipments.

Except for Cawangan Wilayah Timur, the financial requirements are mainly for the purchase of equipments and vehicles as shown in Jadual IC, ID, IE and lampiran AI.

The financial requirements of Cawangan Wilayah Timur is shown in Jadual IF. The requirements are mainly for the acquisition of 5 acres of land, for buildings, and infrastructure as shown in lampiran A2 as well as for the purchase of vehicles and equipments.

JABATAN - MARDI  
MAKSUD PEMBANGUNAN - PENYELIDIKAN PROJEK PEMBANGUNAN

	Tahun (\$000)							Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak langsung	Langsung
Kos Pembangunan -										
Pembinaan		200.0	740.0	100.0	60.0	40.0	1,140.0			
Alat-alat dan Jentera		353.0	347.0	85.0	85.0	46.0	916.0			
Pelaburan										
Pengambilan Tanah		300.0					300.0			
Lain-lain Perbelanjaan Pembangunan										
JUMLAH KOS PEMBANGUNAN		853.0	1,087.0	185.0	145.0	86.0	2,356.0			
Kos Berulang -										
Gaji dan Upahan	1,079.0	1,785.0	2,275.0	2,768.0	3,057.0	3,316.0	13,201.0			
Perjalanan dan Pengangkutan Orang	229.3	230.8	441.8	532.2	674.1	723.7	2,602.6			
Kemudahan Awam (Api, Air, Listrik, dll.)		11.0	12.0	13.0	14.0	15.0	65.0			
Sewa		30.0	35.0	40.0	45.0	50.0	200.0			
Bekalan dan Bahan-Bahan	200.0	230.0	260.0	300.0	340.0	380.0	1,510.0			
Penyelenggaraan dan Pem- baikan yang dibeli	5.7	50.0	100.0	100.0	100.0	100.0	450.0			
Lain-lain Perkhidmatan professional dan keraian	10.0	50.0	57.0	66.0	76.0	87.0	336.0			
Lain-lain Perbelanjaan berulang		33.0	36.0	40.0	44.0	48.0	201.0			
JUMLAH KOS BERULANG		2,419.8	3,216.8	3,859.2	4,350.1	4,719.7	18,565.6			

	Tahun (\$000)							Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-95	Tempatan	Tukaran Asing	
									Tidak langsung	Langsung
Kos Pembangunan -										
Pembinaan										
Alat-alat dan Jentera										
Pelaburan										
Pengambilan Tanah										
Lain-lain Perbelanjaan										
Pembangunan										
JUMLAH KOS PEMBANGUNAN										
Kos Berulang -										
Gaji dan Upahan										
Perjalanan dan Pengangkutan Orang	10.0	20.0	20.0	20.0	20.0	20.0	100.0			
Kemudahan Awam (Air, Api, Letrik, dll.)										
Sewa	10.0	10.0	10.0	20.0	20.0	20.0	80.0			
Bekalan dan Bahan-Bahan										
Penyelenggaraan dan Pembaikan yang dibeli		10.0	15.0	15.0	15.0	15.0	70.0			
Lain-lain Perkhidmatan professional dan keraian	10.0	10.0	20.0	20.0	20.0	20.0	90.0			
Lain-lain Perbelanjaan Berulang		5.0	5.0	5.0	5.0	5.0	25.0			
JUMLAH KOS BERULANG		55.0	70.0	80.0	80.0	80.0	365.0			

JABATAN - MARDI

BIL. PROJEK - 10

MAKSUD PEMBANGUNAN - PROJEK PEMBANGUNAN

KETERANGAN - WILAYAH UTARA

	Tahun (\$000)							Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak langsung	Langsung
Kos Pembangunan -										
Pembinaan										
Alat-alat dan Jentera		81.0	79.0	15.0	15.0	12.0	202.0			
Pelaburan										
Pengambilan Tanah										
Lain-lain Perbelanjaan										
Pembangunan										
JUMLAH KOS PEMBANGUNAN		81.0	79.0	15.0	15.0	12.0	202.0			
Kos Berulang -										
Gaji dan Upahan										
Perjalanan dan Pengangkutan	50.	50.0	101.0	122.0	155.0	165.0	593.0			
orang										
Kemudahan Awam (Air, Api,										
Letrik, dll.)		1.0	1.0	1.0	1.0	2.0	6.0			
Sewa			5.0	5.0	10.0	15.0	35.0			
Bekalan dan Bahan-Bahan		50.0	55.0	65.0	75.0	85.0	330.0			
Penyelenggaraan dan Pembaikan										
yang dibeli		10.0	20.0	20.0	20.0	20.0	90.0			
Lain-lain Perkhidmatan										
professional dan keraian		10.0	20.0	20.0	20.0	20.0	90.0			
Lain-lain Perbelanjaan										
Berulang		7.0	7.5	8.0	9.0	10.0	41.5			
JUMLAH KOS BERULANG		128.0	209.5	241.0	290.0	317.0	1185.5			

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PROJEK PEMBANGUNAN

BIL. PROJEK - 10

KETERANGAN - WILAYAH TENGAH

	Tahun (\$000)							Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak langsung	Langsung
Kos Pembangunan -										
Pembinaan										
Alat-alat dan Jentera		81.0	79.0	15.0	15.0	12.0	202.0			
Pelaburan										
Pengambilan Tanah										
Lain-lain Perbelanjaan										
Pembangunan										
JUMLAH KOS PEMBANGUNAN		81.0	79.0	15.0	15.0	12.0	202.0			
Kos Berulang -										
Gaji dan Upahan										
Perjalanan dan Pengangkutan										
Orang		45.8	95.8	115.2	159.1	173.7	589.6			
Kemudahan Awam (Air, Api,										
Letrik, dll.)		3.0	3.5	3.5	3.5	3.5	16.5			
Sewa		7.5	7.5	10.0	10.0	10.0	45.0			
Bekalan dan Bahan-Bahan		55.0	60.0	70.0	80.0	90.0	355.0			
Penyelenggaraan dan Pembaikan										
yang dibeli		10.0	20.0	20.0	20.0	20.0	90.0			
Lain-lain Perkhidmatan										
professional dan keraian		10.0	20.0	20.0	20.0	20.0	90.0			
Lain-lain Perbelanjaan										
Berulang		7.0	7.5	9.0	10.0	11.0	44.5			
JUMLAH KOS BERULANG		138.3	213.8	247.7	302.6	328.2	1230.6			

JADUAL 11  
ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PROJEK PEMBANGUNAN

BIL. PROJEK - 10

KETERANGAN - WILAYAH SELATAN

	Tahun (\$000)							Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak langsung	Langsung
Kos Pembangunan -										
Pembinaan										
Alat-alat dan Jentera		81.0	79.0	15.0	115.0	12.0	202.0			
Pelaburan										
Pengambilan Tanah										
Lain-lain Perbelanjaan										
Pembangunan										
JUMLAH KOS PEMBANGUNAN		81.0	79.0	15.0	15.0	12.0	202.0			
Kos Berulang -										
Gaji dan Upahan										
Perjalanan dan Pengangkutan										
Orang		55.0	105.0	130.0	165.0	175.0	630.0			
Kemudahan Awam (Air, Api, Letrik, dll.)		3.0	3.0	3.5	3.5	3.5	16.5			
Sewa		7.5	7.5	10.0	10.0	10.0	45.0			
Bekalan dan Bahan-Bahan		55.0	60.0	70.0	80.0	90.0	355.0			
Penyelenggaraan dan Pembaikan										
yang dibeli		10.0	20.0	20.0	20.0	20.0	90.0			
Lain-lain Perkhidmatan										
professional dan keraian		10.0	20.0	20.0	20.0	20.0	90.0			
Lain-lain Perbelanjaan										
berulang		7.0	8.0	9.0	10.0	11.0	45.0			
JUMLAH KOS BERULANG		147.5	223.5	262.5	308.5	329.5	1271.5			

Bahagian: Projek Pembangunan

Program: Cawangan Wilayah Utara, Tengah, Timur dan Selatan

Nama Stesen/Projek	PERBELANJAAN Dijangka					Catitan
	1980 (2)	1981 (3)	1982 (4)	1983-85 (5)	Jumlah 1981-85 (6)	
<u>Bahagian Projek Pembangunan</u>						
1. Weighing Machine		\$17,600(10)	\$5,800(3)	\$19,160(9)	\$42,560.00(22)	
2. Soil Test Kit		\$ 1,320(8)	\$ 750(4)	\$ 2,400(12)	\$ 4,470(24)	
3. Pocket Calculators		\$ 800(8)	\$ 400(4)	\$ 1,200(12)	\$ 2,400(24)	
4. Camera with accessories		\$ 6,000(5)	\$2,640(2)	\$ 8,700(6)	\$17,340(13)	
5. Overhead Projector		\$ 1,500(3)	-	\$ 1,200(2)	\$ 2,700(5)	
6. Slide Projector (Audio Visual)	\$10,000(4)	\$ 1,050(4)	\$ 380(1)	\$ 1,260(3)	\$ 2,690(7)	
7. Film Projector		\$ 5,200(2)	-	-	\$ 5,200(2)	
8. Irrigation Pump (Diesel)	\$10,000(4)	\$ 5,600(2)	\$6,000(2)	\$12,000(4)	\$23,600(8)	
9. Irrigation Pump (Petrol)		\$ 1,650(3)	\$1,200(2)	\$ 3,960(6)	\$ 6,810(11)	
10. Power Blowers		\$ 2,600(5)	\$1,700(3)	\$ 5,670(9)	\$ 9,970(17)	

RANCANGAN MALAYSIA KEEMPAT  
ANGGARAN PERMULAAN PEMBANGUNAN. 1981-85

Lampiran A1

Bahagian : Projek Pembangunan

Program : Cawangan Wilayah Utara, Tengah, Timur dan Selatan

Nama Stesen/Projek	Perbelanjaan Dijangka					Catitan
	1980 (2)	1981 (3)	1982 (4)	1983-85 (5)	Jumlah 1901-85 (6)	
11. pH Meters (Portable)		\$ 1,600(2)	\$ 1,600(2)	\$ 4,800(6)	\$ 8,000(10)	
12. Long Wheel Base Landrover		\$237,600(4)	\$237,600(4)		\$ 475,200(8)	
13. Station Wagon						
14. Spring Balance		\$ 1,400(7)	\$ 600(3)	\$ 2,160(9)	\$ 4,160(19)	
15. Dessicator Cabinet		\$ 2,800(7)	\$ 1,320(3)	\$ 4,220(9)	\$ 8,340(19)	
16. Rice Moisture Meter		\$ 1,400(7)	\$ 660(3)	\$ 2,160(9)	\$ 4,220(19)	
17. Pedestrian Two Wheeled Tractor with accessories			\$ 30,000(5)	\$ 39,000(6)	\$ 69,999(11)	
18. Typewriter		\$ 6,000(4)	\$ 6,000(4)	\$ 18,000(12)	\$ 30,000(20)	
19. Furniture		\$ 30,600	\$ 18,800	\$ 43,600	\$ 93,000	
JUMLAH		\$324,720	\$315,450	\$169,490	\$ 809,660	



JADUAL IV  
ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PROJEK PEMBANGUNAN

BIL. PROJEK - 10

KETERANGAN - WILAYAH TIMOR

	Tahun (\$000)							Pecahan Kos Pembangunan (000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak langsung	Langsung
Kos Pembangunan -										
Pembinaan		200.0	740.0	100.0	60.0	40.0	1140.0			
Alat-alat dan Jentera		110.0	-	40.0	40.0	10.0	310.0			
Pelaburan		-	-	-	-	-	-			
Pengambilan Tanah		300.0	-	-	-	-	300.0			
Lain-lain Perbelanjaan Pembangunan										
JUMLAH KOS PEMBANGUNAN		610.0	740.0	140.0	100.0	50.0	1750.0			
Kos Berulang -										
Gaji dan Upahan										
Perjalanan dan Pengangkutan Orang		60.0	120.0	145.0	175.0	190.0	690.0			
Kemudahan Awam (Air, Api, Letrik, dll.)		4.0	5.0	5.0	6.0	6.0	26.0			
Sewa		15.0	15.0	15.0	15.0	15.0	75.0			
Bekalan dan Bahan-Bahan		60.0	65.0	75.0	85.0	95.0	380.0			
Penyelenggaraan dan Pembaikan yang dibeli		10.0	25.0	25.0	25.0	25.0	110.0			
Lain-lain Perkhidmatan professional dan keraian		10.0	20.0	20.0	20.0	20.0	90.0			
Lain-lain Perbelanjaan Berulang		7.0	8.0	9.0	10.0	11.0	45.0			
JUMLAH KOS BERULANG		166.0	258.0	294.0	336.0	362.0	1416.0			

RANCANGAN MALAYSIA KEEMPAT  
ANGGARAN PERMULAAN PEMBANGUNAN. 1981-85

Lampiran A2

Bahagian : Projek Pembangunan

Program : Projek Pembangunan

Nama Stesen/Projek	Perbelanjaan <del>Dijangka</del>					Catitan
	1980 (2)	1981 (3)	1982 (4)	1983-85 (5)	Jumlah 1981-85 (6)	
<u>Kuala Trengganu</u>						
1. Land acquisition 5 acs.		500,000			500,000	
2. Fencing, road, drainage, electricity & telephone		300,000	200,000		500,000	
3. Service workshop		40,000	-		40,000	
4. Administrative Building		300,000	200,000		500,000	
5. Garage		20,000			20,000	
6. Store		40,000			40,000	
7. Drying Floors		20,000			20,000	
8. Working shed		20,000			20,000	
9. Laboratory Equipment		30,000	30,000	50,000	110,000	
					1,750,000	

## 11. FUNDAMENTAL RESEARCH PROGRAMME

### I. BACKGROUND AND OBJECTIVE

The Fundamental Research Programme plays a supportive and complementary role to that of the research programmes on crops. The Crop Production Research Programmes are concerned with the immediate improvement of the performance of specific crops. These are often large and expensive programmes. In order to ensure that these programmes are planned and implemented effectively there is a pressing need to gather basic information as well as develop more effective research methods. For these reasons the Fundamental Research Programme concentrates on basic studies, building up expertise in specialised areas of research. It is intended that ultimately, specialists in the Fundamental Research Programme will function as in-house consultants on specific areas of research to research workers in a variety of crop research programmes. The benefits of such basic studies and supportive activities will therefore be indirect - reaching the farming community by way of accelerated progress and research by the Crop Research Programmes generating newer and more efficient agricultural technologies. In addition, research requiring sophisticated techniques and/or equipment will also be incorporated in the Fundamental Research Programme as a means of achieving maximum effective use of expensive equipment and scarce personnel resources. Research in farm mechanisation and water management resources are two major examples of this. The rapid development of the economy of the country and the resultant socio-economic changes has created considerable demands for agricultural labour. Significant shortage of labour has already been felt in established sectors of Malaysian agriculture including rice production. Progressive mechanisation of relevant agricultural operations is expected to be an important approach

to solving the growing shortage in agricultural labour. A successful development of farm mechanisation programmes would be of direct benefit to very large sections of the farming community.

An efficient management of water is an important tool in improving agricultural productivity. In many agricultural areas water may well be regarded as a scarce resource in the sense that enough water may not be available at critical periods. It is therefore imperative that sound water management practices be developed so that the agricultural sector gets maximum benefit from the available resources. The water management studies and the technology that it should generate will therefore also be of direct relevance to the agricultural sector.

Further, the Fundamental Research Programme also undertakes long-term research on more intractable programmes such as agriculture on problem soils. There are some 600,000 acres of peat, 400,000 acres of tin tailings, 400,000 acres of acid sulphate soils and 500,000 acres of bris soils in Peninsular Malaysia. The acreages for the above four types of soil for Malaysia as a whole are much larger. Some of these soils, eg. bris, are situated in areas occupied by very poor rural communities. Others such as a substantial part of tin tailings, and some of the peat areas occupy highly favoured locations in terms of proximity to urban communities and the provision of infrastructure such as roads, etc., and would therefore constitute potentially valuable land for development. Unfortunately, the basic characteristics of the soils constitute limitations to agricultural production. It has therefore been decided that long-term studies, much of it of a basic nature, be undertaken to understand and evolve a solution to problems of using these areas for agriculture. Solutions to these problems will lead to a substantial increase in the total area of land available to agriculture and will also lead to a

substantial increase in the income and standard of living of the communities living in these areas.

## 11. PROJECT DESCRIPTION

The Fundamental Research Programme is made up of five Sub-programmes, viz:-

- i. The Plant Science Sub-programme
- ii. The Soil Science Sub-programme
- iii. The Crop Protection Sub-programme
- iv. The Agricultural Engineering Sub-programme
- v. The Water Management Sub-programme

In each Sub-programme there are a number of activities each covering a discrete area of research.

### 1. Plant Science Sub-programme

The Plant Science Sub-programme is made up of the following activities:-

- i. Taxonomy and morphology
- ii. Genetics and cytology
- iii. Plant physiology
- iv. Tissue culture
- v. Seed science and technology

#### 1.1 Taxonomy and morphology

The basic aims here are to build up a comprehensive catalogue of plant characteristics for individual crop species and to develop/assess systems for classifying plants of agricultural importance at specific and sub-specific levels.

For this purpose, apart from the techniques of formal taxonomy

which rely heavily on morphology and histology, the more modern approaches of numerical and chemical taxonomy will also be considered. The information gathered and techniques developed will be of great value in characterising and classifying the plant material being used and new 'varieties' being developed by the production research branches. This, in turn, will be of importance in monitoring the production (as well as the purchase/sale) of recommended planting material true to type.

In this connection, a herbarium will be built up to accommodate a reference collection of preserved (dried) plant specimens. Ultimately this herbarium will contain specimens representing all the crop varieties/clones, ornamentals, weed species and species related to crop plants. A herbarium will be of great value in confirming the identity of plants.

An understanding of the normal pattern of embryologic development and the way in which various factors influence it will be important in planning research aimed at affecting fruit/seed yield. Basic studies on embryologic development will be undertaken in order to provide this background information to production research personnel.

The root systems of plants have rarely received the attention commensurate with their importance. Basic studies will be undertaken on the structure and development of root systems of the more important crops. For this purpose, a root laboratory will be constructed which will enable the growth behaviour of intact roots to be observed in their normal environments. The techniques developed and information gathered will be of great value to production research personnel in planning agronomic investigations and interpreting their results.

## 1.2 Genetics and cytology

Background information will be gathered regarding the cytological status and cytogenetic behaviour of the various crop plant species and varieties. The chromosomes are the carriers of genetic information. Therefore, some information on their behaviour will be of great help to plant breeders in their approach to crop improvement problems.

A large proportion of agriculturally important traits are under polygenic control. Various methods of handling quantitative traits will be investigated. Their relationship to the breeding system of the crop and potential breeding methods will be examined. The information so gathered will be of considerable value to plant breeders (in the crop research branches) in their approaches to crop improvement.

Several physiological parameters affect yield traits and there often exists a good association between physiological parameters in the juvenile and in the adult. Investigations will be undertaken to gather basic information regarding the relationship between the three traits and the genetics of this relationship. The basic information gathered will be of value in assessing the potential value of physiological genetics as a tool in crop improvement.

In conventional breeding programme, one attempts to bring together, in a new combination, traits all of which already exist in the breeding material. In mutation breeding, one can hope to create a new trait. Thus, beginning with a population of say, genetically tall rice, one would hope to obtain short strawed individuals (mutants). However, mutation breeding is very expensive and should be undertaken only in special circumstances. In order to determine when circumstances

as to the frequency and nature of the mutations that arise in response to appropriate treatments and the way they handle in breeding populations. This information is lacking for most of the crops important to Malaysia. For this purpose, the response of selected crops to mutagens will be studied.

A breeder selects intensively for the traits (usually a very small proportion of the total number of traits possessed by the plant population) he is interested. Unmonitored by him, there is also a response for the other traits. This sometimes leads to the build up of unfavourable characteristics. The behaviour of populations under different systems of selection will be studied in order to build up background information which will enable breeders to avoid pitfalls in future.

Plant species differ in their natural breeding system, some are completely inbreeding, some outcrossing and others intermediate, and a wide variety of devices occur to enforce the breeding system normal to the species. The breeding systems of the species need to be taken into account in planning a crop improvement programme. In broad terms, the breeding systems of the main crop is known but that of the newer crops and many local fruits need to be studied. Self-incompatibility is an outbreeding mechanism that occur in a number of crop species. A detailed understanding of the mechanism will enable breeders to deal effectively with incompatibility in their breeding programmes.

Sometimes a trait of great importance (eg. resistance to a major pest) may not occur within the crop species concerned. It may be present in a related species which is otherwise agriculturally useless. In such a case, it would be necessary to cross the two species and breed from the hybrid to try and



combine all the traits desired. Unfortunately, interspecific hybrids are often difficult to produce and to handle. Basic studies will be undertaken aimed at improving techniques for producing and handling interspecific (and other wide) hybrids.

### 1.3 Plant physiology

Most plants trap the sun's energy through photosynthesis. However, a major part of the photosynthate is used up for the plants' own needs. A plant is agriculturally useful only when it has a considerable excess of photosynthesis over respiration and the excess energy is stored in a form usable by man. A major concern in agriculture is to maximise this difference between photosynthesis and respiration - nett assimilation. As part of the basic studies in plant physiology, the factors (both plant characteristics and environmental conditions) that affect photosynthesis and respiration will be investigated to see if these can be adjusted to maximise assimilation. For this, an understanding of the specific effects and interactions of the different environmental factors is essential. In order to study these effects it is necessary to have a complex of growth chambers/ environmental rooms in which different environmental factors can be controlled.

Conditions of stress, in the form of salinity, acidity, water shortage, etc., may occur on a long or a short-term basis in areas where agriculture is important. There is a limit to the extent to which agronomic treatments can be applied to ameliorate conditions. Detailed studies into the response of plants to stress conditions will lead to a better appreciation of how these responses can be utilised or modified to the advantage of the agriculturist.

Study on the physiology of flowering and fruit development will be concentrated on a number of fruit crops.

Plant growth substances have a wide range of effects on the growth and form of plants. Detailed studies will be undertaken to assess the response of our crop plants to growth substances and to evaluate their potential use in investigations by crop production research branches.

#### 1.4 Tissue culture

The technique of growing excised plant tissues in aseptic culture has received considerable attention in centres of plant research. In several species, it has been possible to induce plant tissues to dedifferentiate and grow as a callus; and the callus has subsequently been made to redifferentiate into plantlets. These features can be used to develop techniques for the vegetative propagation of plants which are usually difficult to propagate. Studies are already underway to work out techniques for vegetative propagation of a number of crops. This work will be continued and strengthened. The value of such propagation techniques in producing disease-free planting material from valuable plants having systemic infections (eg. virus infections) will also be examined.

In some plant species, young leaves, stems and inflorescences can be induced to proliferate plantlets. The feasibility of this form of micropropagation will be studied using the facilities developed for tissue culture work. This micropropagation technique has certain advantages over tissue culture per se since the tissues are subject to less extreme changes and so the plantlets formed are more likely to be true copies of the 'parent' individual, i.e. clones.

The tissues in cultures will form useful material for study in themselves unencumbered by the gross bulk or organisational regime of the whole individual. The physiological response of such 'exposed' tissues and cells will be of value in understanding the physiology of the whole plant.

Attempts will be made to develop suitable techniques for 'anther culture'. Here immature anthers will be grown in aseptic culture aimed at raising haploid plants. By doubling the chromosomes, these haploid plants will give rise to completely homozygous diploids. This approach could have considerable value in certain areas of plant breeding. Another technique which uses tissue culture facilities is 'protoplast culture'. Here the cell wall is broken down and the naked protoplast allowed to grow. Sometimes the protoplast of two species can be induced to hybridise (cell hybridization). The hybrid cell is then induced to regenerate cell wall and to grow as a hybrid callus and then differentiate (hybrid) plants. The potential value of these techniques in the context of MARDI's research programme will be examined.

#### 1.5 Seed science and technology

The cultivation of various types of crops is becoming increasingly more important in Malaysia, both in connection with crop diversification as well as livestock production. Many of these crops are propagated from seeds, or otherwise seeds are used to produce rootstocks for vegetative propagation. Hence, for successful expansion of crop cultivation, high quality seeds must be made available locally so as to ensure high field establishment and yield.

Seed studies especially on tropical crops in Malaysia, is very lacking and there is an urgent need to look into the

various seed problems in view of our country's crop diversification programme and seed extension project.

Basic information on seed maturity, germination and seedling growth of most tropical crops needs to be gathered. In addition, there is a need to study and develop techniques and methods of drying, processing, treating, packaging and storage of various important crop seeds so as to provide guidelines for the production and maintenance of good quality seeds.

## 2. Soil Science Sub-programme

The research activities of the Soil Science Sub-programme are divided into:-

- i. Soil survey and landuse studies
- ii. Soil fertility
- iii. Fertilizer technology
- iv. Soil chemistry and clay mineralogy
- v. Soil physics
- vi. Soil erosion and conservation
- vii. Soil microbiology
- viii. Agrometeorology

### 2.1 Soil survey and landuse studies

Detailed soil survey and landuse studies are undertaken in areas where commodity and development research are carried out by MARDI. The main objective of this investigation is to identify the soil types and to produce a landuse map which will provide the basis for the development of a cropping system and discriminatory fertilizer recommendations, especially for the rainfed non-irrigated areas.

The Soil Survey and Landuse Section will also carry out a systematic characterisation of the different soils in the country so that ultimately, a soil data bank can be set up.

There are four problem soils: the acid sulphate, bris, tin tailings and peat soils. They are referred to as problem soils because each has certain very serious limitations for optimal crop production. These limitations, in the case of sand tailings and bris are poor water and nutrient holding capacities, with acid sulphate soil, low pH and with peat, poor physical and chemical properties.

Studies carried out on these soils encompass research activities carried out by all the other research units of the Soil Science Branch and interact directly with crop suitability studies which are also being carried out by the commodity branches.

## 2.2 Soil fertility

Soil fertility studies are carried out to increase the efficiency of applied fertilizer by identifying factors affecting nutrient recovery by plants and nutrient losses by soils. This study includes the development of methods for the prognosis of nutrient status including the use of radio-isotope techniques. This research unit is also carrying out nutrient deficiency and toxicity studies, micronutrient studies, and plant nutrition studies on the problem soils especially on tin tailings and bris soils. In addition, and in view of the acidic nature of Malaysian soils, which is one of the major factors limiting plant growth, studies on the effect of lime application on soil condition and plant growth are also being carried out.

### 2.3 Fertilizer technology

The objective of this investigation is to (i) develop and evaluate new fertilizers; (ii) study the factors affecting the dissolutions, transformations, and movement of fertilizer nutrient in soils; (iii) carry out fertilizer balance studies and quantify the recoveries and losses, and (iv) develop new ways of fertilizer applications in order to improve recoveries of applied fertilizers. This research unit will be responsible for the development and evaluation of new fertilizers, such as slow-release fertilizers. Studies on the physical, chemical, blending, mixing, handling and storage properties of the new fertilizers will also be undertaken. A lysimeter will be required to facilitate these studies.

### 2.4 Soil chemistry and clay mineralogy

Soil chemical investigations involve the study of the nature and forms of nutrient reserve and the changes due to nutrient additives when interacted with different soil systems. It also includes the use of adsorption isotherms to predict the status and availability of the nutrient in the soil for a particular crop.

The Soil Mineralogy Section identifies and quantitatively analyses the clay fraction of Malaysian soils by the use of various sophisticated equipment such as X-ray diffraction spectrometry, thermogravimetric analyser and differential thermal analyser. These studies will provide information on the crystal structure, disorder and micro-morphology of our clay minerals which are of importance to soil chemistry and soil fertility research.

## 2.5 Soil physics

The main activities in the soil physics studies are the determination of soil moisture characteristics, hydraulic conductivity, infiltration and other soil physical properties such as soil porosity, bulk density, shear strength, dispersion index, etc. There are two projects currently carried out, namely

(i) Studies on soil moisture of Malaysian soils, and (ii) Soil physical studies. The main objective of these investigations is to relate the various soil physical properties with the potential for crop production.

## 2.6 Soil erosion and conservation

This research unit is responsible for identifying ways of preventing soil erosion, testing the methods of preventing soil erosion adopted by other countries, development of mathematical models capable of predicting soil losses, and developing techniques of reclaiming or conserving soils. The name of the project carried out by this research unit is "Soil erosion and conservation studies".

## 2.7 Soil microbiology

The research on soil microbiology is concentrated on rhizobia, azolla and mycorrhiza studies. In addition, studies on soil microbiological properties of the soil are also undertaken.

The rhizobial research involves the isolation, identification and inoculation studies to select *Rhizobium* strains which are effective in fixing nitrogen, competitive in nodule formation, and are able to move and persist under the acidic soil environment.

In the azolla research programmes; the collection, identification, propagation and studies on the soil and water properties that affect N-fixation by azolla are undertaken.

The ultimate objective of the mycorrhizal investigations is to increase the uptake of applied phosphorus. The work will involve fungal strain-host genotype interactions on the benefits of inoculation.

### 2.8 Agrometeorology

Agrometeorological activities in MARDI will include setting up a network of agrometeorological stations cooperatively with the Malaysian Meteorological Services. From these stations agrometeorological data will be collected. These data include temperature, rainfall, humidity, evaporation, solar radiation, phenological status of crops, occurrences of pest and diseases, and soil moisture status. One of the objectives of the agrometeorological research is to develop models and obtain quantitative relationship between the weather and the development of crops, yields, soil moisture storages, evapotranspiration, incidence of plant and animal diseases, etc. The investigation will be undertaken with the cooperation of other branches in MARDI such as Plant Science, Water Management, Crop Protection, Statistics, the Annual and Perennial Crop Production Division, and the Animal Production Division. The title of the project is "Studies of the agrometeorology of Malaysian crops".

### 3. Crop Protection Sub-programme

The research activities of the Crop Protection Sub-programme are grouped as follows:-

- i. Disease and pest research
- ii. Pesticide residues research
- iii. Silkworm research



### 3.1 Disease and pest research

The specific research objectives for both Disease Research Section and Pest Research Section are essentially similar except that the pest organisms covered are different. The Disease Research Section covers agents like fungi, bacteria, viruses, etc., while the Pest Research Section covers insects, nematodes, mammalian and bird pests, weeds, etc. Additionally, research in non-pest fungi like edible mushrooms is also undertaken by the Disease Research Section.

Under the research programmes of these Sections, investigations will be conducted on such fundamentals as the etiology of plant diseases; taxonomy, biology, physiology and behaviour of pest organisms; the establishment of baseline data of pesticides; the development and mechanisms of pesticide resistance; phyto-toxicity mechanism, etc. These information will provide the bases for the development and formulation of new and improved techniques or concepts in pest control. The scope of the programme will also include the development and maintenance of pest specimens and pest culture collection. This is essential for monitoring of local pests and their comparative studies, the knowledge of which are fundamental in their control.

Seed pathology is relatively new in this country. Research into this aspect would be emphasised to reduce or overcome diseases that arise from infected seeds. This is particularly important since any success achieved at this stage would reduce tremendously the disease problems in the planted fields, hence minimising the cost for control measures.

Concerning storage pests, emphasis would be made on the identification of major pests and assessing the losses inflicted. Control measures will also be evaluated and developed.

The projects in these Sections directly complement and supplement those of Production Research Divisions. As such, they will therefore expedite the Division's implementation of research programmes which have been formulated with relation to the New Economic Policy and the Agricultural Policy.

Currently, cost is an important drawback in excessive reliance on chemicals in pest control, particularly for small-holders in the rural sector. As such, the crop protection programmes are developed to find means of minimising usage of pesticides such as replacing scheduled applications with those based on pest population assessment. This would mean substantial savings for the farm community especially the poorer farmers in the rural areas. Moreover, reduction in the use of pesticides would greatly lessen any direct hazards to the farmers, particularly the less literate ones.

Integrated and biocontrol approaches to pest control constitute the framework of the research programmes in the Crop Protection Branch. Such approaches are less demanding of energy-input as they tend to rely more on the exploitation of existing natural resources, eg. plant resistant factors, natural enemies of pests, etc. Generally, these are quite permanent and self-perpetuating, thus incurring little or no recurring expenses. Furthermore, they involved no drastic changes in the habits of the farmers, and are easily adopted. Such approaches are thus well suited for the farming system in the rural areas. Some initial successes already implemented are the release of rice varieties resistant to diseases, and the grafting of tomato to resistant brinjal rootstocks against bacterial wilt of tomato.

### 3.2 Pesticide residues research

Research in this Section covers mainly the following areas:-

- i. determination of the undesirable effects of pesticides on the environment such as residues in food crops, livestock, paddy field fishes, soils, water, etc.
- ii. identifying the factors affecting the deposition and biological activity of pesticides including their bioaccumulation and biodegradation potential.
- iii. determination of tolerance levels of pesticides on crops.
- iv. development of chemical and bioassay techniques (in close collaboration with Disease and Pest Research Sections).

The increasing use of pesticides in Malaysia in recent years has necessitated an urgent need to find means of maintaining a clean stable environment while producing adequate and uncontaminated food for a rapidly expanding population. This is also essential for export commodities where there is a need to meet with the sanitary requirements quite often strictly imposed by the developed countries. Unless such standards as required are met, we would run the risk of our export agricultural commodities being rejected.

With increased knowledge of pesticide residues that lead to correct and reduced usage of pesticides, greater safeguards of consumers from pesticide poisoning and their long-term deleterious effects (eg. carcinogenic, teratogenic, and many others still unknown) would be better ensured. This is especially so for the poorer and small farmers, and the rural community who

are more likely to consume products immediately obtained from the farms, eg. contaminated paddy field fishes, etc.

### 3.3 Silkworm research

The renewed interest in silkworm rearing in the country makes it necessary to gather as much as possible the fundamental information needed in sericulture. Such investigations include:-

- i. selection of hybrids suitable to the local conditions.
- ii. best rearing methods under the local environmental conditions.
- iii. silk production/quality in relation to culture conditions.
- iv. susceptibility to local natural enemies and the insecticidal residues on food plant.
- v. proper cultivation of mulberry.
- vi. control of mulberry pests.

Sericulture offers much with respect to agricultural and industrial diversification in the country. Having good potential in economic returns, its success would thus greatly help in the eradication of poverty in the country.

Much of sericulture work is light and simple, and as such are suited for children, women and old folks. It thus provides good opportunity to utilise excess labour, especially among rural farmers, fishermen and plantation workers. This would also help to ease unemployment and under-employment problems, at the same time increasing rural income and standard of living conditions. More generally, greater opportunity is provided for more intensive and extensive utilisation of

agricultural resources as well as the means towards setting up of new agro-based industries.

4. Agricultural Engineering Sub-programme

The objective of the Agricultural Engineering Sub-programme is to undertake research and development towards the solution of farmers' production constraints of labour and power shortages, non-timeliness of operations, yield losses, and drudgery of agricultural work.

The scope of research activities within this research programme during the FMP would include:

- i. testing, evaluating and adapting imported machinery to meet identified local production problem areas needing research attention.
- ii. undertake original design and development of suitable machinery not otherwise obtainable from import but needed to solve farmers' problems.
- iii. undertake field research on machinery usage on the farms.

During the FMP, research undertaken in the TMP would be continued, intensified and expanded. The crops/commodities that will be covered by this programme are: rice, crops grown on peat soil, field crops, tobacco, cocoa/coconut, livestock production, and spices and horticultural crops in order of reducing priority.

The research programme for each commodity would consist of a core programme and a location specific programme. Emphasis would be given to the following in carrying out research:-

- i. mechanisation would be selective, i.e. concentrating on the bottleneck operations.

- ii. a total system's approach to mechanisation.
- iii. the programme would be integrated with and complementary to the commodity programmes.
- iv. "team-work" approach in research would be adopted for each major problem area.

Some of the specific research aspects that would be covered under each crop commodity would be as follows:-

- a. Rice - The total rice production system from land preparation up to infield transportation of produce would be covered. Emphasis would be placed on the mechanisation of transplanting/establishment, harvesting in soft areas, infield transportation, and land tillage and preparation conducive to mechanised operations. Location specific research would cater for special localised conditions of deep water, different soil types and the socio-economic environment.
- b. Peat soil - The development of the multi-purpose prime mover for peat soil would be continued; and so would be that of the mechanised method of land clearing and buried log/stump removal. Mechanisation of pineapple growing such as for weed control, hormone application, replanting operations (removal of old plants and new planting), infield transportation, and field drain maintenance/construction would be studied. Mechanisation of growing new crops on peat such as tapioca would be studied.
- c. Field crops - The development of the tapioca root lifting implement would be continued. Mechanisation of field crop growing (eg. grain legumes, coarse grain cereals, root crops, sugarcane) in the local context would be studied.

- d. Tobacco - The development of the land cultivation machinery would be continued. Research into local tobacco curing would be intensified (in cooperation with the Agricultural Product Utilisation Research Division). Simple mechanisation for the seedling preparation, transplanting, fertilising and irrigation would be studied.
- e. Cocoa/coconut - Research effort would cover harvesting, infield transport, fermenting/drying and copra making (in cooperation with Agricultural Product Research Division).
- f. Livestock production - Research effort in this commodity would cover aspects of fodder production, special feed preparation (rice straw-molasses), livestock structures, and freshwater fishery production, eg. pond aeration.
- g. Spices & horticultural crops - Mechanisation research effort here would cover mainly that for pepper production, and vegetable production on peat.

5. Water Management Sub-programme

The objective of this branch's research programme is to conduct research towards achieving an optimum water regime to stimulate productivity of agricultural land by manipulating the rhizosphere in order to derive maximum benefit from the introduction of improved technology and inputs. Research will be conducted on different crops under different environment to overcome existing water-related problems.

The scope of research within this branch would include both basic and applied research in the following areas of specialties:-

- i. Agrohydrology
- ii. Irrigation at farm level
- iii. Drainage at farm level
- iv. Hydraulics of small farm structures and water conveyance devices
- v. Water quality in relation to crop growth
- vi. Operational research (farm level evaluation or pilot project)

Research during the FMP will be planned and coordinated nation-wise and relevant uncompleted TMP research programmes will be continued. Otherwise new programmes will be initiated with more emphasis given to priority areas. Research programmes will be developed for the major crop commodities of rice, field crops, vegetable crops and orchards. Some of the programmes according to disciplines are:-

- i. Crop-soil-water interrelationships
- ii. Irrigation - requirements, technology and management
- iii. Drainage - standards, methods and management
- iv. Water resources development at farm level
- v. Management of soil and water under intensive cropping
- vi. Field evaluation of irrigation system performance of the major rice growing areas and the impact of improved irrigation practices on productivity and other relevant factors.
- vii. Water management of reclaimed problem soils for different crops (peat, bris, etc.)



Wherever possible these research programmes will be implemented in collaboration with the relevant crop commodities so that a more comprehensive coverage can be achieved. For instance, in the case of rice, collaboration with officers from the Rice Branch and Farm Mechanisation Branch is needed for agronomic and mechanisation requirements respectively. Similarly, with tobacco and other crops.

The implementation strategy during the FMP will include:-

- i. Establishing a central station at Bertam to provide controlled sites for intensive testing of padi, vegetables, field crops and perennials.
- ii. Establishing regional units (east coast, central, northern and southern).
- iii. Recruiting qualified research manpower to serve as core staff at the central station and recruitment of relevant personnel for the regional units.
- iv. Acquiring equipments and facilities.
- v. Maintaining linkages with branches within MARDI and other agencies.
- vi. Training of personnel.

### III. PROJECT JUSTIFICATION AND BENEFITS

The Fundamental Research Programme plays a supportive role to the research programmes on crops. Therefore much of the benefits derived from this programme will be indirect - by making improvements in the research programmes on commodities. For instance, sound seed handling techniques evolved by studies on seed technology in the Plant Science Sub-programme have led to the adoption of a more effective, better coordinated soyabean varietal improvement programme. Genetic studies that are underway using induced mutations, are expected to lead to new sources of resistance to important

diseases like blast. This would be a great help to the rice improvement programme.

On the other hand, some of the research could lead to direct benefits to the farming community as well. For instance, if studies on a "problem" soil like peat result in removing the constraints to good crop production on this type of soil, this would result in making available an additional 2 million acres for agriculture. A detail examination of the benefits of the Fundamental Research Programme is presented below.

#### 1. Plant Science Sub-programme

The overall objectives of the programme are to carry out basic studies aimed at obtaining a fuller understanding of the plant populations that constitute our crops. This constant gathering of basic materials and information on taxonomy and morphology, genetics and cytology, plant physiology, tissue culture, seed science and technology, will enable us to provide tools and techniques to assist the Crop Production Research personnel. Their justifications are further elaborated under the various projects below:-

##### 1.1 Taxonomy and morphology

Basic information and techniques in taxonomy and morphology of Malaysian crops need to be gathered and developed so as to assist in characterising and classifying the plant material being used and new 'varieties' being developed by the Production Research Branches. This includes the setting up of a herbarium which will be of great value in confirming the identity of plants. Basic studies on normal pattern of embryologic development, and structure and development of root systems of important crops is essential in order to obtain useful background information. The latter is especially

useful to Production Research personnel in planning agronomic investigations and interpreting their results.

### 1.2 Genetics and cytology

More background information on genetics and cytology of various crop plant species and varieties need to be gathered as this will be of great help to plant breeders in their approaches to crop improvement problems. Such studies will also assist the plant breeders in dealing with their breeding programmes more effectively and provide improved techniques for producing and handling plant populations.

### 1.3 Plant physiology

Basic information on effects of plant characteristics and environmental conditions on photosynthesis and respirations need be gathered in order to assist in formulating maximum assimilation of crop plants. In addition, studies on response of plants to various stress conditions will be of great value as it provides information on how these responses can be utilised or modified to the advantage of the agriculturist. Detailed basic studies on plant growth substances, physiology of flowering and fruit development of crop plants will provide useful information to Crop Production Research Branches in their efforts to increase crop yield.

### 1.4 Tissue culture

In such a diversity of crop plants that are being handled by MARDI, it is no wonder that research personnel are sometimes faced with problems of crops that are difficult to propagate and having systemic infections. It is with this thought in mind that studies on tissue culture are formulated

aiming at developing techniques for vegetative propagation of plants and producing disease-free planting materials. In addition, the techniques developed for 'anther culture' will be of great value to plant breeding programmes in Crop Production Research Branches. Studies on tissues in cultures will also be of value in understanding the physiology of the whole plant.

### 1.5 Seed science and technology

Presently in Malaysia, seed studies especially on tropical crop plants is very lacking and there is an urgent need to look into the various seed problems. In these days of plant breeding achievements, studies in seed science and technology should keep abreast in order to ensure the production and maintenance of improved good quality seeds. Thus, there is a need to gather basic information, to study and develop methods and techniques on seed science and technology of various important crop seeds so as to provide guidelines for the production and maintenance of good quality seeds.

## 2. Soil Science Sub-programme

Soil is the key factor in any agricultural development. Before any crop is introduced to an area, a detail understanding of the soil is required. The information needed are the types of soils, their physical and chemical properties, their fertility status, and their limitations. With these data and information on climates and socio-economics, a proper landuse and management recommendation is made.

A more detail justification for undertaking basic research on the various disciplines of soil science is described below.

## 2.1 Soil survey and landuse studies

Prior to any development of land for agriculture, detail soil survey of the area is required. In the context of research activities carried out by MARDI, this would apply to the commodity and development research sites, and the development of new research stations.

By having a detail soil survey, the types of soils can be identified and their crop suitability and the type of management can be recommended. For example, in the Johore Barat Project areas, as a result of the soil survey acid-sulphate areas were identified and a proper management, such as controlled watertable, was recommended.

The four "problem soils" are the acid-sulphate, bris, tin tailing and peat soils. They are referred to as "problem soils" because each has certain very serious limitations for optimal crop production. These limitations, in the case of sand tailing and bris are poor water and nutrient holding capabilities, with acid sulphate soil, low pH and with peat, poor physical and chemical properties.

There are approximately 400,000 acres of tin tailings; 400,000 acres of bris; 350,000 acres of acid-sulphate, and 2 million acres of peat in Peninsular Malaysia. Most of these are in the poverty areas of fishermen, coconut smallholders and padi farmers.

Investigations on the "problem soils" will encompass all the disciplines mentioned above with an overall objective of improving the crop production capacity of these areas.

## 2.2 Soil fertility

Soil fertility studies carried out by the Soil Science

Branch will concentrate more on explaining why a certain response will concentrate more on explaining why a certain response was observed rather than describing what was observed, as commonly done by the commodity branches. One good example was the continuous application of a certain recommended fertilizer rates for cassava. After a few years, the fertilizer is not giving the usual response in terms of yields. An investigation is required to explain this behaviour.

Also, one of the activities of the Soil Fertility Unit is to develop the methods for the prognosis of the nutrient status of crops, including the use of radio-isotopes. The accuracy and precision of the methods used in the prognosis of the nutrient status of crop is very vital for fertilizer recommendations and managements.

### 2.3 Fertilizer technology

Most of the applied conventional fertilizer is not taken up by the plants. The applied fertilizer is lost through leaching, fixation in soils, and losses to the atmosphere. Under the best of management conditions, the recovery of applied nutrients is only about 70%.

The Fertilizer Technology Unit will undertake studies (i) on factors affecting the dissolutions, transformations, and movement of fertilizer nutrient in soils and (ii) to develop new ways of fertilizer applications in order to improve recoveries of applied fertilizers. In addition, due to the rising costs of conventional fertilizers, the unit will undertake studies on the development and evaluation of new fertilizers with the objective of reducing our dependence on petroleum based fertilizers.

#### 2.4 Soil chemistry and clay mineralogy

Available information on the chemical properties and types of clay present in Malaysian soils is lacking. This information is required to explain the behaviour of nutrients in soils, such as the mechanisms or pathways of their availability to plants. The chemical properties of soils can be related with potentials for crop production.

The Soil Chemistry Unit is also responsible for the development of analytical methods in soil and plant analyses suitable for the Malaysian conditions.

#### 2.5 Soil physics

The Soil Physics Unit will undertake studies on soil moisture characteristics, hydraulic conductivity, infiltration and other soil physical properties such as soil porosity, bulk density, shear strength, dispersion index, etc. The above information on the Malaysian soils is very scanty. These information can be used for soil suitability recommendations and soil potentials for crop yields.

#### 2.6 Soil erosion and conservation

Malaysia is opening up thousands of acres of new land for agricultural as well as other purposes, namely for housing, industries, roads, etc. Opening up of lands without proper timing and control measures will lead to serious erosion of rich soils and the silting of our waterways. One need only to drive around Kuala Lumpur to look at the seriousness of soil erosion in this country.

An intensive investigation is required to identify and evaluate ways of preventing soil erosion. Basic studies on the

soil properties that affect soil erosion is needed to develop mathematical models capable of predicting soil losses, and developing techniques of reclaiming or conserving soils.

## 2.7 Soil microbiology

In soils there are a number of microorganisms that are beneficial for agriculture. One group of them (the rhizobia) is capable of fixing nitrogen from the atmosphere and converting the nitrogen to forms that can be taken up by the plants. The ability of rhizobia to fix atmospheric nitrogen reduces the crops' dependence on the petroleum-based nitrogen fertilizers.

Our investigations indicated a significant increase in yields of groundnuts between the inoculated (with rhizobia) and non-inoculated plants.

Detail investigation which involves the isolation, identification and inoculation studies to select *Rhizobium* strains which are effective in fixing nitrogen must be carried out to take advantage of the nitrogen-fixing behaviour of this microorganism.

Other investigation carried out by the Branch includes Mycorrhizal and *Azolla* studies with the aim of increasing the efficiency of recovery of applied phosphorus and reducing our dependence on conventional N-fertilizers, respectively.

## 2.8 Agrometeorology

Apart from soil, the climate is another important factor that affects crop production, animal husbandry, and the occurrences of pests and diseases. Studies on the effects of climates on crop phenology, animal production and pest and



disease incidence should be carried out to maximise our natural resources.

The role of the Soil Science Branch in this investigation is mainly to collect information on soil and air temperature, rainfall, humidity, soil moisture, evaporation and solar radiation. The data are then correlated with crop phenology, animal production and incidence of pests and diseases.

### 3. Crop Protection Sub-programme

#### 3.1 Disease and pest research

The section investigates diseases caused by fungi, bacteria, viruses, viroids and mycoplasma. Under this programme, investigation will be conducted on fundamental aspects of plant pathology including studies of etiology of plant diseases, taxonomy, biology, physiology, behaviour of pathogens in the natural habitats, and host/parasite interaction. These information will provide the bases for the development and formulation of new and improved techniques or concepts in disease control. The section will develop control measures with the view of minimal usage of chemical pesticides since excessive and indiscriminate use of chemicals will lead to increased environmental pollution, increased pest resistance and ecological imbalances. The section will investigate the use of organic and inorganic amendment for disease control. This is important since such control measures are more economical and safe. Besides providing protection, the amendment will also provide nutrients to the plants as well as improving soil structure. The section also maintains a fungal culture collection which is essential for the development of a workable taxonomic key of microorganisms for local references. Proper identification of pathogens is necessary

before these pathogens can be adequately controlled, either biologically or chemically. Furthermore, the collection can also be used by other researchers for comparative study purposes.

Seed pathology is another important aspect of the research in the section. Many of the diseases in the field are carried through seeds, either in the testa or within the seed embryo. Much losses due to viruses, bacteria, fungi, etc. can be reduced by simple indepth studies on whether the pathogens are seed-borne, and upon subsequent development of physical control measures such as heat treatment and irradiation.

New coded compounds will be tested in relation to the resistance built up by the pathogens, ED<sub>50</sub> values phytotoxicity and mechanism of action. The information obtained will be invaluable to the commodity branches in their subsequent selection of chemicals for field evaluation. Basic understanding of host/parasite interaction will also ensure better control of the diseases concerned. An understanding on the influence of pesticides on natural antifungal compound formation within the host plants will lead to more judicious use of pesticides.

Research in pests covers the insects, mammals, birds, nematodes and weeds. In the research programme, investigations will be conducted on fundamental aspects such as taxonomy, ecology, biology, physiology, behaviour, population dynamics, baseline pesticide data of pests, mechanisms of pesticide resistance, etc.

In the taxonomical studies, an intensive collection and the detailed taxonomy of all known pests and potential pests in Malaysia will be made. Specimens of such organisms will provide a reference for identification purposes. Keys to the pests will be established from the studies. These can

provide rapid identification of specimens to the production researchers. To help formulate effective pest control, it is essential to keep accurate and basic records of the pests. These data will serve as the baseline information for the purpose.

Fundamental concepts of ecology will also be studied in this section. These studies include density-dependent factors, prey-predator relationships, quantifications of ecological components and the effects of pesticides on ecological balance. It is through a better understanding of these ecological parameters that pest management programmes can be formulated and improved. Efforts will also be made to investigate all possible integration of control strategies. Such studies will play an important role in supporting the various pest control research programmes in the Production Research Division. In addition, research on sampling procedures, pest management models and pest monitoring schemes of all crops will be conducted. These would provide the basic inputs for the development of a surveillance scheme.

Studies on baseline information such as the LD50's of different chemicals on the pests, will also be conducted. These information will assist in the detection of pesticide resistance and building of resistant models which can help predict the development of resistance.

Physiological studies of the various pests and weeds are also conducted in this section. Such research activities will provide better understanding of pest population behaviours, mechanisms of resistances, mode of pesticide actions and some density dependent factors. In weed control, physiological studies are basic. Some insect control techniques such as the use of JH are fundamentally physiological control techniques.

Post-harvest pest control is another area of importance.

The commodity research branches do not cover this aspect. Since a substantial amount of loss is incurred in stores, effective pest control strategies in these areas are needed.

### 3.2 Pesticide residues research

Pesticide residues research involves basic and indepth studies into pesticide properties which are conducted in biotic and abiotic conditions. The increasing use of pesticides in Malaysia in recent years has necessitated an urgent need to take measures to maintain a clean stable environment while producing adequate and uncontaminated food for the rapidly expanding population. This is also essential for export commodities where there is a need to meet with the sanitary requirements quite often strictly imposed by the developed countries. Unless such standards as required are met, we would run the risk of our export agricultural commodities being rejected.

With increased knowledge of pesticide residues that lead to correct and reduced usage of pesticides, greater safeguards of consumers from pesticide poisoning and their long-term deleterious effects (eg. carcinogenic, teratogenic and many others still unknown) would be better ensured.

The whole pesticide residues programme is geared towards supporting production research in pesticide usage in the fields. The findings would ensure improvement on the pesticide recommendations that are in practice through the basic and indepth understanding of the chemical pathways. In addition, the development of analytical techniques for pesticide residues in the various food crops will help to enlarge and improve on the existing research in the country.

### 3.3 Silkworm research

Research activities in sericulture are being intensified to provide adequate control strategies for diseases and pests of silkworm and the mulberry. Presently, since sericulture is a budding project, serious constraints exist largely due to lack of information on pest control technology workable under the local condition. Basic research to overcome these are therefore essential.

The studies in local rearing conditions (humidity, nutrition, densities, etc.), selection and breeding (pureline and polyhybrid production) and biology of important pests and diseases are basic to any sericulture understanding and project development. These aspects are thus given major emphasis. The success of these researches leading to the development of a viable sericulture industry is potentially critical as sericulture offers much with respect to agricultural and industrial diversification in the country.

### 4. Agricultural Engineering Sub-programme

With the increasing effort at intensification, diversification and expansion of the agricultural sector as well as the greater pace of industrialisation in the country, the need for farm mechanisation would be stronger in view of seasonal agricultural labour shortages that would occur. Seasonal labour shortages are already being felt in the intensive rice areas and in pineapple growing areas. Mechanisation could help overcome these shortages.

The reducing number of emergent farmers caused by the migration of rural youth to the towns have partly been encouraged by the drudgery, "hard work" and low income associated with agricultural work. Mechanisation could reduce drudgery, simplify operations and increase income of farmers through greater acreage

that would be worked on through contractual work. Mechanisation support industries and services could also be a vehicle for employment generation in the rural areas and help achieve the objective of income distribution.

Local research in farm machinery is needed because the above demand for and benefits of mechanisation could not be readily achieved as imported farm machineries are not always directly suitable for Malaysian situation. This is because of different physical, agronomic and socio-economic conditions in Malaysia compared to those in the exporting country. Since the market size is small, international farm machinery companies would be reluctant to produce special machines to suit our conditions. Thus, local research and development (i.e. testing, evaluating, adapting, field studies, and design) is required.

The potential adverse effect of large-scale mechanisation on rural employment and poverty is recognised. Research is required to evaluate and develop the most appropriate form of farm mechanisation to suit our rural under-employment and poverty level.

As the sub-programme was concentrating on the development of its facilities during the TMP, most of the projects are still in progress. These projects are in the problems of harvesting, transplanting, and land preparation of rice; land cultivation and alternative fuel for curing in tobacco; harvesting of tapioca; and the problems of mechanisation in the soft peat soil. Apart from projects that are in progress, the sub-programme had made the following specific achievements during the TMP:-

- i. Some of the factors influencing the capacity of padi soils to support machinery have been studied and identified. These are being used to develop ways of overcoming tractor "bogging" in soft areas. In this

context several traction aids have been evaluated and some have been found to be generally suitable under specific conditions.

- ii. Officers from the sub-programme were involved in the cooperative projects with MADA and the Japanese TARC in the evaluation of the Japanese-mounted rice transplanters, and rice combines for which a suitable prototype design had been identified.
- iii. Officers from the sub-programme were actively involved in field research of the post-harvest losses studies carried out by TPI in Muda in 1975. The studies came out with estimations of losses and identified their sources.
- iv. Several land cultivation machinery for tobacco have been test-evaluated and modified. The promising machines that have been developed were: single axle 7 hp pedestrian tractor, and the rotary tiller cum ridger combination.

#### 5. Water Management Sub-programme

Water can directly and indirectly affect crop production. Timely supply of moisture to the root zone at the right amount is essential to promote growth and production. Good understanding of the requirement of water as an input component complementing other inputs, judicious utilisation of this resource in relation to its availability and the optimum management practices at farm level are important.

Thus, knowledge on the interaction of water and plant in an environment and the optimum management practices of this production commodity is essential for productive agriculture.

For instance in rice cultivation, excessive use of water not only increases cost of production and wastes water but also has detrimental effects on rice yield and soil structures. In order to improve the situation, improved irrigation practices and better water distribution methods are needed to exploit the maximum benefit from the crop.

Information obtained from water management research can be utilised by other disciplines in their endeavour to upgrade farming and in general crop production such as in tobacco where substantial yield increase has been achieved on bris soil with only timely minimal irrigation.

#### IV. FINANCIAL AND MANPOWER REQUIREMENTS

Refer to Appendices attached.



JABATAN - MARDI

ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

MAKSUD PEMBANGUNAN - PROGRAM PENYELIDIKAN ASAS

BIL. PROJEK - 11

KETERANGAN - LIHAT LAMPIRAN I,  
II, III, IV, V

	Tahun				Jumlah 1981-85	Catitan
	1980	1981	1982	1983-85		
Kos Pembangunan -						
Pembinaan	600,000	2,190,000	1,540,000	500,000	4,230,000	
Alat-alat dan Jentera	444,000	1,951,875	1,868,425	1,032,250	4,852,550	
Pelaburan	-	-	-	-	-	
Pengambilan Tanah	-	56,000	-	-	56,000	
Lain-lain Perbelanjaan Pembangunan	-	280,000	80,000	-	360,000	
JUMLAH KOS PEMBANGUNAN	1,044,000	4,477,875	3,488,425	1,532,250	9,498,550	
Kos Berulang -						
Gaji dan Upahan	4,009,000	4,839,000	5,351,000	18,113,000	28,303,000	
Perjalanan dan Pengangkutan Orang	282,000	382,000	430,000	1,445,000	2,257,000	
Kemudahan Awam (Api, Air, Letrik, dll)	-	-	-	-	-	
Sewa	18,900	33,800	38,000	122,000	193,800	
Bekalan dan Bahan-bahan	654,500	575,000	630,000	2,251,000	3,456,000	
Penyelenggaraan dan Pembaikan Yang Dibeli	62,800	88,600	92,700	340,500	521,800	
Lain-lain Perkhidmatan Professional Dan Keraian	50,200	72,300	76,000	286,000	434,300	
Lain-lain Perbelanjaan Berulang	78,900	152,000	189,000	636,000	977,000	
JUMLAH KOS BERULANG	5,156,300	6,142,700	6,806,700	23,193,500	36,142,900	

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PROGRAM PENYELIDIKAN ASAS

BIL. PROJEK - 11

KETERANGAN - LIHAT LAMPIRAN I-A, I-B

	Tahun				Jumlah	Catitan
	1980	1981	1982	1983-85	1981-85	
<u>Sains Tumbuhan</u>						
1. Pembinaan						
1.1 Makmal Sains Tumbuhan	500,000	1,200,000	80,000	-	1,280,000	Continuation from TMP
1.2 Bangunan Environment System	100,000	500,000	-	-	500,000	Continuation from TMP
1.3 Makmal Kaji Akar	-	-	200,000	100,000	300,000	Lampiran I-A
2. Alat-alat dan Jentera						
2.1 Equipments for Environmental System	444,000	888,000	666,000	666,000	2,220,000	Continuation from TMP
2.2 Alat-alat Makmal	-	51,250	56,500	92,250	200,000	Lampiran I-B
3. Pelaburan	-	-	-	-	-	
4. Pengambilan Tanah	-	-	-	-	-	
5. Lain-lain Perbelanjaan Pembangunan	-	-	-	-	-	
JUMLAH	1,044,000	2,639,250	1,002,500	858,250	4,500,000	

Lampiran I-A

Root Studies Laboratory

The root systems of plants play an important part in the growth and development of plants as well as their yield performance. The root systems are influenced by a wide range of factors which include fertilizer and other chemical application, cultural practices, etc. Many pests and diseases also infect the plant through the root system. Studies on the root systems of Malaysian crop plants are grossly inadequate. An important reason for this is the inherent difficulty of studying root systems without disturbing the environment in which they are growing. Such a study will be facilitated by the construction of a root studies laboratory.

This laboratory will consist of a building, part of which will be below ground. The walls of the underground portion will be of glass, and the soil environment and the roots adjoining these glass walls can be studied without disturbing the root environment. Such studies in recent years have led to considerable improvement in the understanding of crop growth in many advanced countries. It is therefore proposed to construct a root studies laboratory in MARDI in order to help in studying the root systems of important crops and to see how they are affected by different cultural treatments.

Lampiran I-B

Laboratory Equipments 1981-85

No.	Description	1981	1982	1983-85
1.	Analytical Balance	-	-	(1) 6,000.00
2.	Top Pan Balance	-	-	(1) 3,000.00
3.	Autoclave	-	-	(1) 19,000.00
4.	Cart (Trolley)	-	-	(1) 5,000.00
5.	Centrifuge (Table Top)	-	-	(1) 2,500.00

No.	Description	1981	1982	1983-85
6.	Microscope, dissecting	-	-	(1) 2,500.00
7.	Olympus Drawing Attachment	(1) 1,000.00	-	-
8.	Water Distiller (Glass)	-	-	(1) 1,200.00
9.	Electrophoresis Apparatus	-	-	(1) 8,000.00
10.	Freezer (-70° to -75°C)	-	(1) 16,000.00	-
11.	Hot Plate Magnetic Stirrer	-	-	(2) 1,000.00
12.	Incubators	-	-	(1) 5,000.00
13.	Oven TV 40 UL	-	-	(1) 2,500.00
14.	pH Meter, digital	(1) 3,500.00	-	-
15.	Refrigerator with freezer, 15 cu.ft.	-	-	(1) 2,000.00
16.	Horizontal Shaker	-	-	(1) 5,000.00
17.	Slide Cabinet	(1) 1,250.00	-	(1) 1,250.00
18.	Water Bath Equipment	-	-	(1) 3,800.00
19.	Waring Blender	-	-	(1) 1,500.00
20.	Dazer Magnifier & Light	(1) 1,000.00	-	(1) 1,000.00
21.	Slide Projector	-	-	(1) 1,500.00
22.	Compound Microscope	-	-	(1) 5,000.00
23.	Herbarium Cabinet	(10) 7,000.00	-	(10) 7,000.00
24.	Porometer	(1) 10,000.00	-	-
25.	Thermister & Recorder - measure leaf, soil and air temperature	(1) 5,000.00	-	-
26.	GLC Accessory (Integrator)	(1) 10,000.00	-	-
27.	GLC Accessory (Electron Capture Detector)	(1) 7,500.00	-	-
28.	Freezer Drier	-	-	(1) 5,000.00
29.	Vacuum Pump	-	-	(1) 2,000.00
30.	Radiometer/Photometer - measure photosynthetically active radiation	-	(1) 16,000.00	-
31.	Pressure Chamber - measure water potential of leaves	-	(1) 10,000.00	-
32.	Infrared Gas Analyser Accessories	-	(1) 10,000.00	-
33.	Tissue Homogenizer	-	(3) 1,500.00	(3) 1,500.00
34.	Camera Lucida	-	(1) 3,000.00	-
35.	Sprayer	(3) 1,000.00	-	-
36.	Water Pump	(2) 2,000.00	-	-
37.	Motorized Sprayer	(3) 2,000.00	-	-
Jumlah		51,250.00	56,500.00	92,250.00

JADWAL - MADDI

MAKSUD PEMERANGUNAN - PROGRAM PENYELIDIKAN ASAS

BIL. PROJEK - 11

KETERANGAN - LAMPIRAN  
III-A -  
III-E

	Tahun				Jumlah 1981-85	Catit in
	1980	1981	1982	1983-85		
<u>Keselamatan Tumbuhan</u>						
1. Pembinaan						
1.1 Rumah kaca (Serdang)	-	-	120,000	-	120,000	Lampiran III-B
1.2 Makmal (Ajil)	-	-	50,000	50,000	100,000	Lampiran III-A
1.3 Penovation & Improvement of existing insect-proof houses	-	300,000	-	150,000	450,000	Lampiran III-C
2. Alat-alat Makmal (Serdang termasuk Ajil)	-	237,500	262,500	-	500,000	Lampiran III-D
3. Pelaburan	-	-	-	-	-	
4. Pengambilan Tanah						
4.1 Pembelian Tanah (Ajil)	-	10,000	-	-	10,000	Lampiran III-A
5. Lain-lain Perbelanjaan Pembangunan						
5.1 Penyediaan Tanah (Ajil)	-	60,000	-	-	60,000	Lampiran III-A
5.2 Fencing, Road & Drains (Ajil)	-	-	30,000	-	30,000	Lampiran III-A
JUMLAH	-	607,500	462,500	200,000	1,270,000	

Lampiran III-A

Pembelian/Penyediaan Tanah (Ajil, 30 ekar)  
Makmal dan Alat-alat Penyelidikan

Although MARDI is collaborating with DOA in several sericulture studies, presently there is still a tremendous lack of research facilities, most of which are on loan from DOA. To strengthen our research activities in sericulture, MARDI would have to acquire its own facilities. Many of these aspects can only be fulfilled through organisation and facility build-ups.

With the rapid expansion of sericulture in DOA and the recent embankment on a full-scale sericulture programme by SEDC, MARDI would need to further improve and expand its existing facilities and equipments in order to ensure effective support of the growing sericulture activities and industry.

To fulfil the above requirements, approximately 30 acres of land (costing \$10,000) located at Ajil would have to be required for the necessary development.

The area would have to be able to supply the increased volume of mulberry cuttings needed both for the rearing and related research activities. The latter would include:-

- 1) Mulberry agronomic studies
- 2) Varietal evaluation and improvement studies
- 3) Pest control problems
- 4) Quality improvement of mulberry
- 5) New propagation techniques, etc.

Besides, the land would also be used to site a new laboratory building (costing \$100,000). This new building is required to cope with the following:-

- 1) Expansion of staff (officers and the supporting personnel)
- 2) Greater space required for rearing
- 3) Space for expanded research activities e.g. cocoon storage studies, drying systems, etc.
- 4) Space for processing studies
- 5) Enough room for housing the major equipments, e.g. drying units, temperature control, processing equipments, etc.
- 6) Storage spaces for miscellaneous items

Lampiran III-B

	<u>Perbelanjaan Dijangka</u>				<u>Jumlah</u> 1981-85	<u>Catitan</u>
	1980	1981	1982	1983-85		
Glasshouse	-	-	1(60,000)	1(60,000)	2(120,000)	

All the glasshouses are currently being fully utilised for the various research activities of the Branch such as experiments, culturing of pests and pathogens, and propagation of planting material. Every building is being used by several officers as there is insufficient space for all on-going projects. In some of the glasshouses, nurseries and plants bearing pest cultures together take up most of the floor space, so that there is insufficient room left for experiments planned for those buildings. Lack of working areas is limiting proper spacing of plants in pot trials and other experiments. Plants thus crowded together have resulted in unthrifty growth or microclimates conducive to build-up of foliar diseases.

With this overcrowding it is inevitable that recurrent problems will occur as illustrated by the frequent cross-contamination of pot-cultures (eg. fungi, nematodes, insects) due to suitable hosts placed in close proximity. There have been instances where healthy control plants in experiments and other planting materials have been infested by myriad pests from cultures or trials close-by. Because of overcrowding, drift of chemical sprays to non-target plants has resulted in leaf-scorch or pest cultures dying when fed contaminated foliage.

The present problems are being faced by all the existing crop protection staff even though this is only two-thirds of the full complement of the Branch. The situation will undoubtedly be aggravated in the near future when several more officers return soon from their post-graduate training overseas. This, together with the rest of the staff due under the Fourth Malaysia Plan plus the expanded activities of the Branch will certainly magnify and multiply the current problems encountered unless more glasshouses are available.

Lampiran III-G

	Perbelanjaan Dijangka				Jumlah 1981-85	Catitan
	1980	1981	1982	1983-85		
Renovation and improvement of existing insect-proof houses	-	12 (300,000)	-	12 (150,000)	12 (450,000)	

The insect-proof houses were built in the beginning of the Third Malaysia Plan. After using the houses, it is felt that extensive renovation and improvement are necessary both to maintain as well as to make them more suitable for the Branch's research activities and also expanded programmes.



It is generally felt that these houses are too hot for optimum plant growth. Thus several methods, including evaporative cooling and exhaust fans need to be tried and if suitable, installed for all houses to lower the temperature.

The roofs required extensive repairs because they leak and the iron framework holding the glasses get rusty.

The steel structures and the walls need to be repainted.

In certain cases, partition and humidifying systems need to be installed where appropriate, like in fungal and bacteria studies.

The present bronze wire meshes continually get corroded and need to be replaced by stainless steel meshes which are more lasting. This is essential to keep them insect-proof and bird-proof.

Also, new plant benches will be required to cater for the expanded research activities.

The breakdown of the costs for the above renovation and repairs are as follows:-

<u>Year</u>	<u>Renovation and Improvement</u>	<u>Cost</u>
1981	a) Fitting of evaporative cooling systems and exhaust fans	\$150,000
	b) Repairs of roofs	90,000
	c) Painting	10,000
	d) Partition, humidifying system	30,000
	e) Miscellaneous	20,000
		<hr/> \$300,000
1983-85	a) Replacement of stainless steel mesh (60 mesh)	\$ 60,000
	b) Plant benches	50,000
	c) Miscellaneous, eg. service of evaporative cooling system, humidifying system	40,000
		<hr/> \$150,000
	TOTAL	<hr/> \$450,000

Lampiran III-D

Laboratory Equipment 1981-85

No.	Description	1981	1982	1983-85
1.	Gas Liquid chromatography (Lamp. D-1)	1(80,000)	1(80,000)	2(160,000)
2.	Leaf area meter	1(20,000)	-	1(20,000)
3.	Computer terminal with print-out (Lamp. D-2)	-	1(50,000)	1(50,000)
4.	Image analyser (quantment) (Lamp. D-3)	-	1(100,000)	1(100,000)
5.	Refrigerated Centrifuge	1(10,500)	-	1(8,000)
6.	Table-top centrifuge	1(4,000)	1(4,000)	2(8,000)
7.	Refrigerator	1(1,500)	2(3,000)	3(4,500)
8.	Deep freezer	1(2,500)	1(2,500)	2(5,000)
9.	Glass-blowing kit	1(3,500)	-	1(3,500)
10.	Forced connection oven	1(10,000)	-	1(10,000)
11.	Explosion-proof blender	1(7,000)	-	1(7,000)
12.	Incubators	1(5,000)	1(5,000)	2(10,000)
13.	Camera lucida	1(10,000)	-	1(10,000)
14.	Slide cabinet	1(2,000)	-	1(2,000)
15.	Mist blower	1(2,500)	-	1(2,500)
16.	Fogging machine	1(2,000)	-	1(2,000)
17.	Devac sampler	1(2,000)	-	1(2,000)
18.	Research microscope	2(12,000)	2(12,000)	4(24,000)
19.	Dissecting microscope	2(6,000)	2(6,000)	4(12,000)
20.	Mechanical orbital shaker	1(4,000)	-	1(4,000)
21.	Flameless electric burner	6(6,000)	-	6(6,000)
22.	Chromatoview complete with camera attachment	1(12,000)	-	1(12,000)
23.	Micro-sampling accessory (infra-red)	1(15,000)	-	1(15,000)
24.	FPD detector (GLC)	1(20,000)	-	1(20,000)
Jumlah		237,500	262,500	500,000

Lampiran D-1

	Perbelanjaan Dijangka				Jumlah 1981-85	Catatan
	1980	1981	1982	1983-85		
Gas Liquid Chromatograph Serdang	-	-	1(80,000)	1(80,000)	2(80,000)	

In the years 1980-85, the Pesticide Laboratory will expand and strengthen in the present activities. As pesticides comprise a large group of compounds, the present two GLC will evidently be not enough. The existing two available are mainly for the analysis of insecticides and fungicides involving the use of 3 detector types. When the activities are expanded to cover the area of herbicide and other toxicant studies, then it would be necessary for additional GLC (2 units). These GLC are also to provide for in-service training.

Lampiran D-2

	Perbelanjaan Dijangka				Jumlah 1981-85	Catatan
	1980	1981	1982	1983-85		
Computer terminal with printer	-	1(50,000)	-	-	1(50,000)	

In the pest and disease forecasting programme, MARDI is playing a significant role in advisory and on-line decision-making. Data collected by DOA will be sent by phone/post to MARDI HQ. Action decisions are made and the recommended action sent back via the same media for implementation.

The time lapse required for efficient operation of the scheme is about 1-2 days. To enhance rapid decision making, the computer terminal connected to the main computer is desired. When more agricultural areas are implementing this scheme, the work will be extremely high. Everyday decisions will be required by a number of localities.

MARDI is also responsible for computer model building. This requires frequent simulation studies, programme editing and model modifying. MARDI is also responsible for analysing data collected from all the localities. Some of the softwares required are highly specialised. The terminal will thus enhance such software development.

The MARDI main computer will have a few VDU terminals, probably without immediate printing facilities like this one. The printing facilities are desirable because in model building, often only a short portion of the programme needs to be printed for immediate editing. The printed output is also required to be sent back to the field by post.

Since the workload and responsibilities of MARDI in this National Pest Management Programme is expected to be high, the request for such a unit to be placed in Crop Protection Branch should be justified.

Lampiran D-3

	Perbelanjaan Dijangka				Jumlah 1981-85	Catita
	1980	1981	1982	1983-85		
Image Analyser -	-	-	1(100,000)	-	1(100,000)	

The image analysers look at images from optical and electron microscopes, photographs, negatives, cine and strip films, slides, radiographs and from macro objects. The analysers select chosen objects and features of interest automatically by gray level, optical density, size, shape or semi-

automatically using a light pen. They can make rapid automatic geometric and densitometric measurements, count and classify selected objects and features by shape, size, density, orientation, morphology, etc. They have changed many previously difficult, tedious, or even impossible tasks into routine research techniques.

All areas of research in Crop Protection Branch will require the help of the image analyser to make measurements and classification quickly, accurately, automatically and reproducibly. For example, studies on pest damage of economic crops are one of the on-going projects in the Branch. Leaf damages due to insects or leaf spot diseases, root damages due to nematodes and insects are presently being assessed manually. This is not only subjected to human errors but also highly difficult and tedious. The use of image analyser will overcome much of these problems. In addition, the image analyser will be able to measure and classify cell organelles in ultrastructure studies using transmission and scanning electron microscopes.

## ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PROGRAM PENYELIDIKAN ASAS

BIL. PROJEK - 11

KETERANGAN - LIHAT LAMPIRAN II-A -  
II-G

	Tahun				Jumlah 1981-85	Catitan
	1980	1981	1982	1983-85		
<u>Sains Tanah</u>						
1. Pembinaan						
1.1 Pusat Penyelidikan Tin-tailing		-	200,000	-	200,000	Lihat Lampiran II-A
1.2 Tapak Penyelidikan Asid-sulfet (Kuala Linggi)		-	250,000	-	250,000	Lihat Lampiran II-B
1.3 Renovation and Improvement of existing glasshouses (Serdang)		90,000	-	-	90,000	Lihat Lampiran II-C
2. Alat-alat dan Jentera						
2.1 Kenderaan		35,000	95,000	135,000	265,000	Lihat Lampiran II-D
2.2 Jentera Ladang		-	-	100,000	100,000	Lihat Lampiran II-E
2.3 Alat-alat Kelengkapan Makmal		96,000	230,000	174,000	500,000	Lihat Lampiran II-F
2.4 Alat-alat Kelengkapan Pejabat (Kuala Linggi)		-	40,000	40,000	80,000	Lihat Lampiran II-G
3. Pelaburan						
		-	-	-	-	

	Tahun				Jumlah 1981-85	Catitan
	1980	1981	1982	1983-85		
4. Pengambilan Tanah						
4.1 Pusat Penyelidikan Tin-tailing		10,000	-	-	10,000	Lihat Lampiran II-A
4.2 Tapak Penyelidikan Asid-sulfet (Kuala Linggi)		36,000	-	-	36,000	Lihat Lampiran II-B
5. Lain-lain Perbelanjaan Pembangunan						
5.1 Pusat Penyelidikan Tin-tailing (Penyediaan Tanah)		10,000	-	-	10,000	Lihat Lampiran II-A
5.2 Tapak Penyelidikan Asid-sulfet (Penyediaan Tanah, Kuala Linggi)		90,000	-	-	90,000	Lihat Lampiran II-B
5.3 Pusat Penyelidikan Tin-tailing (Infrastructure)		100,000	-	-	100,000	Lihat Lampiran II-A
5.4 Tapak Penyelidikan Asid-sulfet (Kuala Linggi)		-	50,000	-	50,000	Lihat Lampiran II-B
		467,000	865,000	399,000	1,781,000	

Tin-Tailing Soil Research

It is estimated that there are 400,000 - 500,000 acres of tin-tailings in the country. With continued mining activity the acreage of tin-tailings will inevitably increase.

Preliminary studies have indicated the possibility of reclaiming tin-tailing through the mixing of slime to sand tailing. When this is feasible, it is possible to limit the increase of tin-tailing soil in the future.

Tin-tailings are sited adjacent to the major population centres of the country and should consequently be exploited for food production.

Enterprising farmers have shown the possibility of cultivating a wide range of crops, in particular vegetables. However, the demand for vegetables is limited. Research into the cultivation of more long-term crops such as fruit trees should be attempted.

Current investigations on tin-tailings undertaken by the branch centred mainly on a detail understanding of the physical and chemical properties of tin-tailings, reclamation studies, and soil management studies in relation to crop establishment.

The investigations are being carried out on a temporary site in Puchong courtesy of the Air Hitam Tin Mines. This temporary arrangement makes it impossible to undertake any long-term studies.

In view of the above, a permanent site for tin-tailing soil research is required. It is proposed that a 50-acre site be acquired and the estimated cost for establishing the station is as follows:-



Lampiran II-A

	<u>1981</u>	<u>1982</u>	<u>1983-85</u>	<u>1981-85</u>
1. Land acquisition for 50 acres @ \$200/acre	10,000	-	-	10,000
2. Land acquisition for 50 acres @ \$200/acre	10,000	-	-	10,000
3. Infrastructure				
i) roads           40,000				
ii) fencing       20,000				
iii) electricity, water, telephone   10,000				
iv) drainage      15,000				
v) sewerage       15,000				
	<hr/> 100,000	100,000	-	-
				100,000
4. Buildings				
i) Office and laboratory	-	40,000	-	40,000
ii) Staff quarters	-	60,000	-	60,000

Lampiran II-B

Acid Sulphate Soil Research

The acid sulphate soils in Peninsular Malaysia is estimated to be around 350,000 acres. This soil is often referred to as a "problem soil" because of its extreme acidity (less than pH 3.2) and toxic effects of aluminium, iron and possibly manganese. Under these conditions, the soil is not productive for virtually all agricultural crops.

Investigations carried out by the Soil Science Branch include characterising the acid sulphate soils, detail studies of its physical and chemical properties, soil amelioration studies, and soil management studies in relation to crop production.

The investigations are currently being carried out in the Johor Barat Project areas, Ban Merbok (Kedah) and Malacca. Our studies indicate that with proper soil management, such as controlled watertable and judicious use of lime, crop production is significantly improved.

Most of the investigations are carried out on farmers' lands. These arrangements proved to be unsatisfactory as a proper control and supervision of the investigations were not possible.

The laboratory studies and analyses of acid sulphate soils are currently undertaken at Batu Berendam. However, the laboratory space and facilities at Batu Berendam is congested and inadequate due to the expansion of activities of the Fresh Water Fishery Branch.

In view of the above limitations, a permanent site for laboratory and field experiments are required. It is proposed that the laboratory be in K. Linggi together with the field station.

B. Kuala Linggi

		<u>1981</u>	<u>1982</u>	<u>1983-85</u>	<u>1981-85</u>
1.	Land acquisition for 180 acres @ \$200/acre	36,000	-	-	36,000
2.	Land clearing for 180 acres @ \$500/acre	90,000	-	-	90,000
3.	Infrastructures				
	i) roads 20,000				
	ii) fencing 15,000				
	iii) electricity, water, telephone 7,000				
	iv) drainage 5,000				
	v) sewerage 3,000				
	<hr/> 50,000	-	50,000	-	50,000
4.	Buildings				
	i) Staff quarters	-	50,000	-	50,000
	ii) Laboratory and office		250,000	-	476,000

Lampiran II-C

Renovation and Modification of  
Four Glasshouses at Serdang

Glasshouses are required to undertake some of the investigations carried out by the Soil Science Branch. Four glasshouses have been allocated to the Branch since 1977. However, by 1978, all the four glasshouses were found to be in a very "bad" shape and were not fit for undertaking basic studies. The roof leaked, the iron bolts rusted and when it rained droplets of water containing the rust fell to the floor. The glass roof was not placed properly; as such it can fall down or be blown off easily. Some of the glass roofs have fallen down or been blown away. There are many other reasons making the present glasshouses unfit and unsafe for any experiment.

The glasshouses are not supplied with 3-phase electricity. 3-phase electricity is required in one of the 4 glasshouses for conducting nutrition experiments using water culture technique.

It is estimated that \$90,000 is required to renovate and modify the 4 glasshouses so that they can be used for Fundamental research in Soil Science.

Nama Stesen/Projek	Perbelanjaan Dijangka (\$)				Catitan
	1981	1982	1983-85	1981-85	
1. Pusat Penyelidikan Tin-tailing	-	60,000	-	60,000	Sebuah "4-wheel drive" (Landrover + trailer) untuk kegunaan penyelidikan tin-tailing.
2. Makmal Sains Tanah (Malacca)	-	-	50,000	50,000	Sebuah "4-wheel drive" (Landrover) untuk Peg. Peny./ Pen. Peg. Peny./ Pem. Peny. pergi balik ke K. Linggi.
3. Serdang	-	-	50,000	50,000	Sebuah "4-wheel drive" untuk kegunaan unit Kajibanci Tanah.
4. Alor Star	-	35,000	-	35,000	Sebuah "4-wheel drive" (Landrover) untuk kegunaan unit Kajibanci Tanah.
5. Kubang Keranji	35,000	-	-	35,000	Sebuah "4-wheel drive" untuk kegunaan unit Kajibanci Tanah.
6. Pontian	-	-	35,000	35,000	Sebuah "4-wheel drive" (Landrover) untuk kegunaan kajian Hakisan Tanah dan Penyelidikan Asid-sulfet di Johor Barat.
JUMLAH	35,000	95,000	135,000	265,000	

Jentera Ladang

Nama Stesen/Projek	Perbelanjaan Dijangka (\$)				Catitan
	1981	1982	1983-85	1981-85	
1. Pusat Penyelidikan Tin-tailing	-	-	50,000	50,000	Sebuah tractor
2. Tapak Penyelidikan Asid-sulfet (Kuala Linggi)	-	-	50,000	50,000	Sebuah tractor
JUMLAH	-	-	100,000	100,000	

Lampiran II-F

Kelengkapan Makmal

	<u>1981</u>	<u>1982</u>	<u>1983-85</u>	<u>1981-85</u>
1. Gamma Scanner	--	200,000	--	200,000
2. Colour Additive viewer	--	--	--	--
3. Neutron Moisture Meter	--	--	27,000	27,000
4. Tecator Digestion Block	11,000	--	--	11,000
5. Rainfall and Humidity equipment with recorders	6,500	2,000	--	8,500
6. Barometers	2,000	--	--	2,000
7. Solarimeters with recorders	--	3,000	--	3,000
8. Anemometers (wind) with recorders	--	--	5,000	5,000
9. Continuous infusion pump	30,000	--	--	30,000
10. Rainfall simulator	--	10,000	--	10,000
11. Vacuum pumps	--	5,000	--	5,000
12. Vacuum dessicators	--	--	5,000	5,000
13. Leaching columns	--	--	10,000	10,000
14. Wet sieving apparatus including nests of sieves	10,000	5,000	1,000	16,000
15. Turdimeter	5,000	--	--	5,000
16. Cassagrande apparatus	2,000	--	--	2,000
17. Automatic recorders for measurement of raindrop impact	3,000	--	--	3,000
18. Bulk density probe	--	5,000	--	5,000
19. Apparatus for Proctor tests	--	--	1,000	1,000
20. Pyranometers with recorders	--	--	3,000	3,000
21. Sieve shakers	--	--	4,000	4,000
22. Sample splitting machine	--	--	3,000	3,000
23. Aggregate samplers	--	--	--	--
24. Office equipment	10,000	--	--	10,000
25. Digital pH meters	--	--	20,000	20,000
26. Refrigerators, freezers shakers	--	--	45,000	45,000
27. Farm machinery	--	--	50,000	50,000
28. Mermet oven (40 UVL)	9,000	--	--	9,000
29. Deep freezer (15 cu. ft)	2,500	--	--	2,500
30. Weighing scales	5,000	--	--	5,000
	96,000	230,000	174,000	500,000

Lampiran II-G

Kelengkapan Pejabat

Nama Stesen/Projek	Perbelanjaan Dijangka (\$)				Catitan
	1981	1982	1983-85	1981-85	
1. Makmal Sains Tanah (kuala Linggi)	-	40,000	40,000	80,000	
JUMLAH	-	40,000	40,000	80,000	

BIL. PROJEK - 11

KETERANGAN - LIHAT LAMPIRAN IV-A -  
IV-E

	Tahun				Jumlah 1981-85	Catitan
	1980	1981	1982	1983-85		
<u>Kejuruteraan Pertanian</u>						
1. Pembinaan						
1.1 Agric. Eng. Workshop Complex Phase IV (Serdang)		40,000	20,000	50,000	110,000	Lihat Lampiran IV-A
1.2 Modification W/shop & Laboratory (Bertam)		20,000	30,000	-	50,000	Lihat Lampiran IV-B
1.3 Modification W/shop & Laboratory (Alor Star)		20,000	30,000	-	50,000	Lihat Lampiran IV-B
1.4 Modification W/shop & Laboratory (IPRS)		10,000	20,000	20,000	50,000	Lihat Lampiran IV-B
1.5 Modification W/shop & Laboratory (Kubang Keranji)		10,000	20,000	30,000	60,000	Lihat Lampiran IV-B
2. Alat-alat dan Jentera						
2.1 Research Equipment (Agr. Eng.)		245,000	40,000	55,000	340,000	Lihat Lampiran IV-C
2.2 Workshop Equipment (Agr. Eng.)		180,000	35,0-0	15,000	230,000	Lihat Lampiran IV-D
2.3 Prototype Equipment (Agr. Eng.)		30,000	20,000	30,000	80,000	Lihat Lampiran IV-E
3. Pelaburan						
		-	-	-	-	



	Tahun				Jumlah 1981-85	Catitan
	1980	1981	1982	1983-85		
4. Pengambilan Tanah	-	-	-	-	-	
5. Lain-lain Perbelanjaan Pembangunan						
5.1 Letrik (Serdang)	-	20,000	-	-	20,000	Continuation from TMP
JUMLAH	-	575,000	215,000	200,000	990,000	

Lampiran IV-A

Pembinaan Bangunan

i) Agric. Eng. Workshop Complex (Ph. IV) - Serdang

Requested allocation is for continuation of development of facilities at Branch main base station (Agr. Eng. Workshop Complex Phase IV) - Continuation from TMP.

<u>Year</u>	<u>Item</u>	<u>Cost Estimate</u>
1981	1. Renovation of workshop building 1. Continuing project (50% of cost)	\$10,000
	2. Engine test room and machinery weighing bridge c/w control room.	30,000
1982	3. Sheds for prototype machine storage and under-shed testing of machinery.	20,000
1983-85	Additional space for offices and design/drafting room.	50,000

Lampiran IV-B

ii) Modification Workshop cum Laboratory at Bertam, Alor Star, IPRS, Kota Bahru (Kubang Keranji)

Allocation requested are for the construction of modification workshop cum agricultural engineering laboratory at these stations where the location specific, machinery evaluation, and some commodity specific research projects are carried out supplementary to the work at Serdang.

These stations are chosen for the following reasons:-

- |                             |  |
|-----------------------------|--|
| Bertam                      | - To be the sub-centre for rice mechanisation research.  |
| Alor Star                   | - For the machinery evaluation and field research on rice mechanisation in Muda area.                                      |
| IPRS (Pontian)              | - To be sub-centre for peat mechanisation research projects.   |
| Kota Bahru (Kubang Keranji) | - To be sub-centre for mechanisation research in tobacco field crop and rice - location specific and machinery evaluation. |

The facility planned at each of the stations above-mentioned would comprise:-

- a) Modification workshop - suitable for minor modifications work on prototype machinery.
- b) Machinery indoor work area for experimentation test runs, functional observation, and of storage of prototype machinery under test evaluation.
- c) Storage rooms for field equipments and workshop instruments.

Lampiran IV-C

Alat-alat dan Jentera

Requested allocation are for equipments that would be centrally purchased at Branch level at Serdang for subsequent use at the five stations from where this programme operates.

i) Research equipment (Agr. Eng.)

	<u>No.</u>	<u>Cost p.c.</u>	<u>Total cost</u>
<u>1981</u>			
1. Portable Analogue Cassette magnetic recorder	1	25,000	25,000
2. Computing Voltmeter/Time domain analyser	1	25,000	25,000
3. Weighbridge (5 ton)	1	30,000	30,000
4. Hydraulic Flow and Pressure measuring unit	1	15,000	15,000
5. Ground Speed and Distance measuring unit	1	2,000	2,000
6. Miscellaneous Lab. and Field equipment at stations:-			
force gauge	2	1,000	2,000
measuring tapes	4	50	200
pressure gauge	2	1,000	2,000
stop watches	4	150	600
rev./frequency counter	4	500	2,000
soil density meter	2	3,000	6,000
soil sampler	4	1,000	4,000
soil moisture meter	2	3,000	6,000

	<u>No.</u>	<u>Cost p.c.</u>	<u>Total cost</u>
7. Calibration Equipment (sub-standard) - part of total package:-			
a) Temperature & humidity control devices for calibration room	1 set	30,200	30,200
b) Thermometer calibrator	1 set	15,000	15,000
8. 50% of cost of equipment approved up to 1980, tendered in 1980 (delivery 1980-81)			80,000
<u>TOTAL FOR 1981</u>			<u>245,000</u>

1982

1. Calibration equipment:-			
a) ohm meter	1 set	20,000	20,000
b) precision weights	1 set	20,000	20,000
<u>TOTAL FOR 1982</u>			<u>40,000</u>

1983-85

1. Calibration equipment:-			
a) slip gauge, length calibrator	1 set	25,000	25,000
b) potentiometer/ammeter calibrator	1 set	30,000	30,000
<u>TOTAL FOR 1983-85</u>			<u>55,000</u>

TOTAL 1981-85

385,000  
=====

Lampiran IV-D

ii) Workshop equipment (Agr. Eng.)

	<u>No.</u>	<u>Cost p.c.</u>	<u>Total cost</u>
<u>1981</u>			
1. Welding & cutting equipment arc + gas	4 sets	8,000	32,000
2. Plate shape cutting equipment	1	10,000	10,000
3. Press drills	4	3,000	12,000
4. Hand drills + attachment	5	500	2,500
5. Grinders	5	300	1,500
6. Circular saw	4	1,000	4,000
7. Misc. hand tools for mechanic and research staff and common use	5 sets	9,300	46,500
8. Misc. additional w/shop measuring equipment eg. rivertor pip bender, gauges, vices, pullers, etc.	1 set	33,500	33,500
9. Various electrical motors & engines for test rigs & prototypes		8,000	8,000
10. 50% cost of equipment approved up to 1980 & tendered in 1980 (delivery 1980-81)			30,000
<u>TOTAL FOR 1981</u>			<u>180,000</u>
<u>1982</u>			
1. Floor crane & material handling equipment	1 set	10,000	10,000
2. Work benches	10	500	5,000
3. Surface plate	1	20,000	20,000
<u>TOTAL FOR 1982</u>			<u>35,000</u>
<u>1983-85</u>			
1. Portable generator sets	5	3,000	15,000
<u>TOTAL FOR 1983-85</u>			<u>15,000</u>
<u>TOTAL 1981-85</u>			<u>250,000</u>

iii) Prototype farm machinery

The allocation requested is for the purchase of commercial machines from overseas to be evaluated, adapted and developed to suit the specific local requirements according to the crop, soil and socio-economic conditions.

The precise machinery could not be identified at time of writing as detailed study would need to be undertaken prior to importation. However, generally the machinery would cover the following:-

- . rice - harvester, thresher, infield transporter, transplanter, direct seeder
- . field crop - harvester, thresher 30,000
- . tobacco - small tractor, transplanter, curing barns
- . peat soil - peat tractor c/w attachments, destumper
- . cocoa-coconut - dehusker, etc.

JABATAN - MARDI

## ANGGARAN KOS DAN KEPERLUAN GUNATENAGA

MAKSUD PEMBANGUNAN - PROGRAM PENYELIDIKAN ASAS

BIL. PROJEK - 11

KETERANGAN - LIHAT LAMPIRAN

V-A -  
V-D

	Tahun				Jumlah 1981-85	Catatan
	1980	1981	1982	1983-85		
<u>Pengurusan Air</u>						
1. Pembinaan						
1.1 Makmal/Pejabat (Bertam)		100,000	400,000	-	500,000	Lampiran V-A
1.2 Greenhouse (Bertam)		-	120,000	-	120,000	
2. Alat-alat dan Jurutera						
2.1 Jentera Ladang		57,000	200,000	-	257,000	Lampiran V-B
2.2 Alat-alat Makmal		15,700	509,850	-	525,550	Lampiran V-C
3. Pelaburan		-	-	-	-	
4. Pengambilan Tanah		-	-	-	-	
5. Lain-lain Perbelanjaan Pembangunan		-	-	-	-	
JUMLAH		172,700	1,229,850	-	1,402,550	

Lampiran V-A

Pembinaan Makmal/Pejabat

The Water Management Branch is a newly formed branch and as it is all the following facilities are required:-

- 1) General office for management and research staff.  
Area approximately 500 M<sup>2</sup>.
- 2) Analytical laboratories for research purpose.  
Area approximately 150 M<sup>2</sup>.
- 3) Fluid hydraulic laboratory. Area approximately 250 M<sup>2</sup>.
- 4) Work shed. Area approximately 250 M<sup>2</sup>.
- 5) Drying floor. Area approximately 3600 M<sup>2</sup>.

All the above requirement totalling \$500,000 will be utilised for the period from 1982 (\$100,000) and 1982 (\$400,000).

The office space is needed to accommodate both the research and management personnel. The analytical laboratory and hydraulics laboratory will be used to carry out supporting analyses of field tests. The workshed and drying floor will be needed for crop samples processing and drying, respectively.

Lampiran V-B

Jentera Ladang

These equipments and machinery are needed for the initial research facilities development at the Bertam Station and subsequent implementation of research trials and also maintenance of the established infrastructures.



No.	Description	1981	1982	1983-85
1.	Harvester, Combined, Self-Propelled, 2m cwt.	-	(1) 130,000.00	
2.	Rice Transplanter (6 row type)	(1) 8,000.00		
3.	4-point ridger/fur	(1) 2,000.00		
4.	Water Level Recorder	(15) 41,000.00		
5.	Soil Penetrometer	(2) 3,000.00		
6.	Tensiometers (drift length) 10, 20, 40, 60 cm.	(24) 3,000.00		
7.	Neutron Probe & accessories		(2) 70,000.00	
Jumlah		57,000.00	200,000.00	

Lampiran V-C

Alat-alat Makmal

Research equipments comprise of analytical laboratory facilities for routine soil and water analysis, instruments to measure water supply and discharge both in the station's research plots and in the field. Meteorological equipments are needed to monitor climate fluctuations to support and explain the field findings pertaining to moisture balance and crop growth characteristics.

No.	Description	1981	1982	1983-85
1.	Stainless Steel Sampling cans 90cc. & 250cc.	(200) 3,000.00		
2.	Particle Size Analyser		(1) 40,000.00	
3.	Light Meter	(2) 1,000.00		
4.	pH Meter	(2) 2,500.00		
5.	Conductivity Meter	(1) 1,500.00		
6.	Eh Meter	(1) 1,500.00		

No.	Description	1981	1982	1983-85
7.	Water Bath (still)		(2) 3,000.00	
8.	Vacuum Pressure Pump		(3) 3,650.00	
9.	Mechanical Analysis Equip.	(1) 700.00		
10.	Sieve Shaker Set		(2) 1,600.00	
11.	Immersion Thermometer	(6) 1,000.00		
12.	Grain moisture Meter	(2) 1,000.00		
13.	Weighing Scale 2-10 kg.	(1) 700.00		
14.	Grain Grading Machine		(1) 2,000.00	
15.	Pressure Membrane Plate		(3) 9,000.00	
16.	Moisture Probe		(2) 32,000.00	
17.	Gas Burner	(6) 800.00		
18.	Dry Rack & acc.		(6) 1,400.00	
19.	Seed Cleaner		(1) 2,000.00	
20.	Grain Batch Drier, Single Layer		(1) 1,500.00	
21.	Weighing Scale, bulk, platform type 25-30 kg., ± 0.5 kg.	(1) 1,000.00		
22.	Vacuum Cleaner	(1) 1,000.00		
23.	Grain Thermometers		(6) 1,200.00	
24.	Bomb Calorimeter		(1) 10,000.00	
25.	Automatic Epa. Recorder		(1) 2,500.00	
26.	Lysimeter		(1) 400,000.00	
Jumlah		15,700.00	509,850.00	
Jumlah Besar		\$525,550.00		

12. AGRICULTURAL PRODUCTS UTILISATION DIVISION  
PROGRAMME FOR THE FOURTH MALAYSIA PLAN

**I. BACKGROUND AND OBJECTIVE**

The Agricultural Products Utilisation Division of MARDI started in 1969 as a Division of Food Technology in the Ministry of Agriculture. The main objectives of the project are as follows:

- 1) To carry out applied research on problems related to handling, storage, processing and test marketing of food and byproducts.
- 2) To provide advice and training in these fields to personnel from the Government and industrial sectors at all levels.
- 3) To give particular attention to the improvement of the existing industries so that they could be expanded into larger, more productive and economical units.
- 4) To explore investment opportunities for the development of new food industries for both local and export market.

The project will essentially contribute to the development of the agricultural industry as well as the agrobased industry. The orientation of research and development in the Fourth Malaysia Plan will be to provide support to:-

- 1) developing small business enterprises so as to encourage these units to be the nucleus for future large scale food processors;
- 2) the middle level processors such as SEDCs, FIMA etc. to continue to develop into major food processors;
- 3) the development of the agricultural sector particularly the development of technology that will ensure better utilisation and less wastage of harvests for stabilisation of prices by the provision of good primary and secondary processing technology.

The complementary inputs from other agencies will essentially be close collaboration on research and development requirements as well as to obtain feedbacks from agencies such as MIDA, FIMA and SEDCs on potential of the industry as well as future developments. Regular meetings and discussions on the development of agrobased industry will have to be institutionalised.

However, the development of the physical facilities will be requested from Jabatan Kerja Raya (JKR).

## II. PROJECT DESCRIPTION

### 1. Development of Physical Facilities

Under the Third Malaysia Plan, the proposed extension of the existing laboratory facilities was not started due to difficulties in getting the plants and specifications drawn up. In MARDI there was a shortage of civil engineering experts to prepare the proposal and request for the use of consultants for the preparation of the drawings and specifications to the EPU were turned down. After lengthy negotiations, the JKR finally consented to undertake the project.

At the moment, the extension to the present laboratories will be tendered in 1980 as promised by the JKR. The cost of the building will be \$2 million. The purchase of equipments has also been affected due to the lack of space in the Third Malaysia Plan.

Under the Fourth Malaysia Plan, a new block of administrative building is proposed to take care of expansion in staff and the increasing needs of the Division to carry out its objectives started earlier.

### 2. Programme of Work

The projects planned are in line with the stated objectives and are described here by the Branches:

#### (A) Utilisation Engineering Branch

In the development of post-harvest technology, the Utilisation Engineering Branch with the help of the other branches continue to carry out collaborative projects, paving the way towards improvement of the handling of fruits, vegetables, fish and rice from harvest to the market. The projects include the development of returnable containers for fish.

A survey on the methods of handling bananas as well as the marketing situation is continued. Other studies included the changes that occur during the ripening of mango, storage of ciku, vegetables and other fruits (watermelon and durian). Post-harvest studies on rice such as storage, drying and handling of wet paddy are also continued.

Research on the waste utilisation programme concentrated on the treatment of liquid pineapple waste whereby a fermentation technique using Candida obtusa (yeast) to yield single cell protein was carried out. This process will be developed to a stage further to the pilot scale for the production of single cell protein for animal feed.

The other activities of the Utilisation Engineering Branch included the development of pineapple graders, storage and drying of tapioca tubers and chips with the aid of chemicals and the development of standards for grading of bananas.

#### (B) Plant Product Utilisation Branch

The Plant Product Utilisation Branch together with the Animal Product Utilisation Branch, will continue to develop food for the Armed Forces. Food items processed that will be freeze dried include meat and fish products; dehydrated rice, dehydrated vegetables as well as the formulation of different types of light-weight rations are continued to be tested for their acceptability. These developments are carried out as part of the collaborative work with the Ministry of Defence and the Defence Research Centre.

Low cost convenience food developed will be further developed based on soya/coconut/other beans in different forms.

Work on solving the acidity and flavour of local cocoa beans was undertaken. It was found that the drainage and oxidation of fermentation mass was critical in affecting acidity levels. Improved drainage will lead to lower acid development and retention. Other work on cocoa beans quality research on the microbiology and biochemistry of fermentation will be continued. These will add to the greater knowledge in efforts towards ensuring that the cocoa beans produced will be of acceptable quality. Analysis on cocoa butter fat of local beans are also continued in comparison to the cocoa butter fat obtained from Ghana.

Methods of processing of locally grown coffee will also be examined and the problems identified. Certain remedial measures are being tested. The status of tea processing in the country is also being examined and rehabilitation of the tea factory will be pursued.

In the efforts towards greater utilisation of oil and fat in the country, the Division has strengthened this area of lipid chemistry and fat/oil technology research. Products such as mayonnaise and salad dressing can be developed from olein. The use of stearin fractions in ice cream and peanut butter are being tested. There is a good possibility for extended use of such fractions in producing a greater number of locally processed products.

The use of green pepper in the developed countries has created a new outlet for Malaysian peppercorn. The Division continues the technology in the processing of green pepper as a dehydrated product or preserved in jars or cans.

Other products such as pineapple/tomato juice and water-melon juice will be commercially tested in an effort to diversify the uses of locally available fruits. Various legumes are evaluated to increase the availability of protein food and these evaluations were based on those that are locally cultivated.

#### (C) Animal Products Utilisation Branch

The Animal Product Utilisation Branch has undertaken studies into the storage of marine and freshwater fish. These studies will indicate the changes in the quality of stored fish. The handling of freshwater fish will continue to be examined in view of the potential of aquaculture in Malaysia. The products from freshwater fish that were developed were found to be acceptable; such products will continue to be developed.

Various meat products developed based on local tastes were tested and were found to be acceptable by the Armed Forces; these products will be further developed in line with requirements agreed by the Defence Food Study Group Committee. These products are being incorporated into the new rations which are being tested. The Animal Products Utilisation Branch also examined the technology of making 'budu' with inclusion of some additional innovations. Other products that are continued to be developed are fish meat and chicken sausages, fish meat floss, crackers, jellied chicken, chicken floss, canned beef and chicken rice. The problems associated with the development of these products and packaging them are being studied. The

research on manufacture of imitation dairy products continued with the isolation and modification of protein from soyabean to improve its solubility. Products such as coffee whitener were developed using locally available ingredients.

The work on producing animal feed continued using available local materials.

(D) Non-Food Products Research Branch

The Non-Food Products research programme will undertake analyses of tobacco samples from the crop production research division (tobacco branch). This area of research is being strengthened; the branch is equipped with automated analytical equipment for the analysis of nicotine, total reducing sugars and chloride in the samples. The other activity of the Non-Food research is to examine the potential for developing high fructose syrup by the use of an enzymatic process. The syrup will be further tested for use in the preparation of canned fruit slices and cocktails. The Non-Food research programme also examined the feasibility of producing gelatin from animal byproducts as well as to look into problems relating to the leather industry.

(E) Quality Control Branch

The Quality Control Branch will continue to monitor the quality of food that is available in the market. Part of the function is carried out in coordination with the activities of the Sub-Committee of Food Regulation (Ministry of Health). These activities included analytical services, microbiological analysis and evaluation of nutritional value.

The Branch will carry out research on the evaluation and quality control on traditional and novel fermented food products. This will include the examination of 'ragi' from various sources and isolation of organisms for experimental trials to determine their performance in producing good fermented products such as 'tapai'.

Pickling technology is adapted for local fruits and vegetables. Cabbage, sawi, cucumbers, mangoes, gherkins, chillies, and papaya are some of the products that could be pickled during the periods of abundance.

The ASEAN Protein Project also supports the development of facilities and programme that will improve the technology of soya

sauce manufacturing. The work on soya sauce has progressed satisfactorily and acceptable quality soya sauce was produced using pure strain inoculation. A compilation of a Directory of Soya Sauce Manufacturers was undertaken. Samples of soya sauce are continued to be collected and analysed. Pure cultures are now available in our laboratory to assist factories to produce a more consistent quality of soya sauce.

Fish silage is a new fermented product developed from fish trash for use as animal feed. This method of preparing the high protein food is simple and requires small capital investment and thus would be useful for adoption by the fishermen. Advisory services to the frozen prawn industry is continued. Training programmes will be conducted for the industry mainly for the technicians, in the area of quality control. Analytical services' reports and publications will be prepared to support the development of the frozen seafood industry.

#### (F) Commercialisation and Advisory Services

The Commercialisation and Advisory Services Branch will prepare a directory of food factories under the different categories such as the bakery industry, tapioca industry, snack food industry, etc. A survey on the market situation of various food products is continued, to understand the status of different market systems that prevail.

Technical and advisory services are being extended mainly to small businesses. The number of training programmes is increased in response to the increase in the number of requests and enquiries for information on food processing. These included the training of entrepreneurs in the areas of simple processing techniques, preparation of technical papers for their consideration, the evaluation of technical feasibilities as well as a follow-up of on-going projects and suggestions for expansion.

### III. FEASIBILITY

Continuation of the project Food Technology Research and Development.

### IV. FINANCIAL AND MANPOWER REQUIREMENT

The total is as indicated in Table 1.



V. PROJECT JUSTIFICATION AND BENEFIT

(A) Administrative and Project Development Block

A new administration block to include a small seminar room, a library, a small exhibition foyer, a Director's and Assistant Director's room with stenographer's and a general office, will be required in the Fourth Malaysia Plan. It is estimated that the cost will be in the region of \$1,000,000.

The small seminar room is to be used for courses and lectures on food processing for the development of small business processors so that it will not interfere with the normal requirements of meetings and other official briefings that may be required.

The requirement of a permanent exhibition foyer is also necessitated by the number of regular visits made by visitors, an exhibition foyer will enable exhibits to be permanently placed and this will not increase the demand on the officer's time to arrange exhibits on an ad hoc basis. The presentation of exhibits will also be improved with more permanent collections.

The library space needs to be increased as the volume of books are increased and there is a need to improve the condition of the library to preserve the collection of books mainly to serve the food technology and other aspects of utilisation technologies.

The present space for administration needs to be improved so that the Director and Assistant Director and stenographers will have the better facilities for the execution of administration function. The present rooms are affected by steam from the processing area which cannot be ameliorated.

There is also a need for increased general office space as the existing space was developed in 1969 and the needs have increased. There will be a total of 34 staff in the administrative block while in 1980 only 15 staff are being housed in an area of 40' x 20'.

(B) Purchase of Equipments

The major bulk of the equipment is being purchased under the Third Malaysia Plan. However, there are some major equipments listed as below that are required to continue further development in the field of food and non-food processing.

(1) Ultra High Temperature (UHT) Equipment

The equipment is for processing milk, fruit juices, santan, etc. that require ultra high temperature short time process for complete sterilisation. This is necessary in view of the fact that the existing techniques of sterilisation process are of conventional nature. The new equipment would enable processes to be done faster and enables flexibility in utilising packaging materials under sterile conditions for longer shelf life of product.

(2) Packaging Machine

The machine is required to pack dried and semi-dried products for dehydration studies carried out for new products especially for the Defence Food Studies. The machine would enable studies to be conducted for various packing regimes such as nitrogen gas filled packs or vacuum pack rations.

(3) Snack Extruders

The extruder machine is required for extruded products such as snack foods. This equipment also may be required to improve products such as fish crackers (keropok) in the form of extruded products as opposed to conventional processing.

(4) Ribbon-type Extruders

The machine enables products to be produced in the form other than the normal extruded product. Ribbon extruders may diversify the nature of products to be developed.

(5) Hide and Leather Processing Equipment

Research studies on existing leather and hide industry requires basic facilities, especially in terms of cottage scale processing methods. These equipments are required to stimulate conditions existing under actual processing techniques.

(6) Fibre Processing Equipment

Further development of the laboratory needs to be satisfied in order to improve the existing conditions. The laboratory will be able to look into various aspects of fibre processing utilising various agricultural products existing in the country.

(7) Miscellaneous Equipments

Some of the equipment required would not be specifically categorised which are sometimes reviewed and require replacements.

(8) Word Processor

As the volume of work is increased, the word processor would be required for rapid multiplication of reports and information documents. These will facilitate the preparation of simple training manuals for the training programme.

(9) Audio Visual Aids

This is required for the new seminar room for purposes of lectures, training and courses. Under the Fourth Malaysia Plan, training of small business entrepreneurs will be stepped up in line with the policy of intensifying the development of agro-industries.

(10) Shelves and Elevated Floors for Library

To cope with the volume of documents and books for the Divisional library.

(11) Photocopying Machine

Required for rapid multiplication of documents and papers for administration purposes.

(12) Vans - 2 units

With the increase in the number of staff and volume of workload, an extra 2 units of vans are required.

(C) Project Benefit

These facilities will complement the existing facilities which are becoming overloaded. The physical facilities such as the administration block will reduce the congestion; and allow better training facilities of small business entrepreneurs, technicians from industries in technical areas of food processing.

The contribution from research in food technology and also utilisation of agricultural crops research undoubtedly will support the growth of the agricultural sector and the development of agro-based industries. For every new technology developed such as santan processing a gross turnover from one factory is estimated to be in the region of \$1.8 million, whilst research cost is estimated to be in the region of \$30,000 for that particular purpose.

Anggaran Kos Dan Keperluan Gunatenaga

Jabatan: MARDI

Maksud Pembangunan: Penyelidikan dan Kemajuan Teknologi  
Penggunaan Hasil Pertanian.

Bil. Project: 12

Keterangan: Ibu Pejabat  
Serdang - Sila lihat Lampiran A

	Tahun (\$000)						Jumlah 1981 - 85
	1980	1981	1982	1983	1984	1985	
<b>Kos Pembangunan:</b>							
Pembinaan	300.00	1,200.00	2,000.00	150.00	-	-	3,350.00
Alat-alat dan Jurutera	-	200.00	200.00	500.00	-	-	900.00
Pelaburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	-	-	-	-	-	-
Lain-lain Perbelanjaan	-	-	-	-	-	-	-
Pembangunan	-	-	-	-	-	-	-
<b>Jumlah Kos Pembangunan</b>	<b>300.00</b>	<b>1,400.00</b>	<b>2,200.00</b>	<b>650.00</b>	<b>-</b>	<b>-</b>	<b>4,250.00</b>
<b>Kos Berulang:</b>							
Gaji dan Upahan Orang	2,810.00	3,157.00	3,363.00	3,565.00	3,739.00	3,913.00	17,737.00
Perjalanan dan Pengangkutan							
Orang.	150.00	180.00	180.00	190.00	190.00	200.00	940.00
Kemudahan Awam (Api, Air, Elektrik dll.)	115.00	140.00	240.00	250.00	250.00	250.00	1,130.00
Sewa	3.00	4.00	4.00	5.00	6.00	6.00	25.00
Bekalan dan Bahan-Bahan	648.50	700.00	900.00	900.00	900.00	1,000.00	4,400.00
Penyelenggaraan dan Pembaikan yang dibeli.	70.00	70.00	90.00	90.00	90.00	100.00	440.00
Lain-lain Perkhidmatan							
Professional dan Keraian	1.00	10.00	10.00	10.00	10.00	10.00	50.00
Lain-lain Perbelanjaan							
Berulang.	60.00	70.00	90.00	115.00	120.00	125.00	520.00
<b>Jumlah Kos Berulang</b>	<b>3,857.50</b>	<b>4,331.00</b>	<b>4,877.00</b>	<b>5,125.00</b>	<b>5,305.00</b>	<b>5,604.00</b>	<b>25,242.00</b>

PROGRAMME FOR THE FOURTH MALAYSIA PLAN  
FOR THE STATIONS UNDER THE AGRICULTURAL  
PRODUCTS UTILISATION DIVISION, MARDI.

I. BACKGROUND AND OBJECTIVES

There are eight stations under the Agricultural Products Utilisation Division. These stations are located as follows:-

1. Rice Processing Station, Bukit Raya, Kedah.
2. Cocoa Processing Station, Teluk Anson, Perak.
3. Tea Processing Station, Cameron Highlands, Pahang.
4. Fruit Processing Station, Bukit Ridan, Pahang.
5. Fish Meal Processing Station, Tumpat, Kelantan.
6. Animal Feed Processing Station, Pasir Putih, Kelantan.
7. Fish Processing Station, Kuala Trengganu, Trengganu.
8. Fruit and Vegetable Processing Station, Tampoi, Johor.

The objectives of the stations are stated and are specific for each station.

II. PROJECT DESCRIPTION

Stated in each programme.

III. FEASIBILITY

Continuation of the Project Food Technology Research and Development.

IV. FINANCIAL AND MANPOWER REQUIREMENTS

The total for all eight stations is as indicated in the following table. Each station's financial requirement is given in the tables following each programme description.

V. PROJECT JUSTIFICATIONS AND BENEFIT

Provided under each station statement.

Anggaran Kos Dan Keperluan Gunatengah

Jabatan: MARDI

Bil. Project: 12

Maksud Pembangunan: Pembangunan Stesen

Keterangan: Jumlah Stesen-Stesen APU.

	Tahun (\$000)						
	1980	1981	1982	1983	1984	1985	Jumlah 1981 - 85
<b>Kos Pembangunan:</b>							
Pembinaan	-	300.00	500.00	-	-	-	800.00
Alat-alat dan Jurutera	-	220.00	280.00	190.00	150.00	140.00	980.00
Pelaburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	1.00	-	-	-	-	-
Lain-lain Perbelanjaan	-	-	-	-	-	-	1.00
Pembangunan	-	-	-	-	-	-	-
<b>Jumlah Kos Pembangunan</b>	-	<b>521.00</b>	<b>780.00</b>	<b>190.00</b>	<b>150.00</b>	<b>140.00</b>	<b>1,781.00</b>
<b>Kos Berulang:</b>							
Gaji dan Upahan Orang	-	820.48	984.59	1,181.48	1,417.70	1,697.29	6,101.54
Perjalanan dan Pengangkutan	-	-	-	-	-	-	-
Orang	-	37.16	44.59	53.51	64.17	77.08	276.51
Kemudahan Awam (Api, Air, Elektrik dll.)	-	68.46	82.20	98.66	118.38	142.00	509.70
Sewa	-	13.98	16.77	20.13	24.15	28.99	104.02
Bekalan dan Bahan-bahan	-	373.56	448.23	537.92	645.60	773.71	2,779.02
Penyelenggaraan dan Pembaikan yang dibeli	-	46.66	57.06	68.48	82.18	98.61	352.99
Lain-lain Perkhidmatan	-	-	-	-	-	-	-
Professional dan Keraian	-	62.02	18.40	22.07	26.47	31.86	160.82
Lain-lain Perbelanjaan Berulang	-	13.06	15.67	18.70	22.44	26.90	96.77
<b>Jumlah Kos Berulang</b>	-	<b>1,435.38</b>	<b>1,667.51</b>	<b>2,000.95</b>	<b>2,401.09</b>	<b>2,876.44</b>	<b>10,381.37</b>

## PROGRAMME FOR THE FOURTH MALAYSIA PLAN

1. Rice Processing Station, Bukit Raya, Kedah.

### I. BACKGROUND AND OBJECTIVES

The Rice Processing Station, Bukit Raya, Kedah, has the following main objectives:

1. To carry out applied research on problems related to handling, storage and processing of padi and rice.
2. To provide training in these fields to personnel in the government as well as the private sector.
3. To give particular attention to the areas of post-harvest losses and develop technology to reduce losses.

The project will contribute to the development in the reduction of post harvest losses in padi and rice.

### II. PROJECT DESCRIPTION

Most of the civil work and supply of equipment to this station has been completed under the Third Malaysia Plan. The work includes:

1. construction of parboiling plant;
2. land clearing and preparation for building;
3. construction of 'drying yard'.

Under the Fourth Malaysia Plan, a new block of laboratory building is proposed. The building is required to expand work on post-harvest technology. A processing laboratory is required for the development of cottage scale model in the area of post-harvest technology.

### III. FEASIBILITY

Continuation of the project in padi and rice processing as well as problems of identification to reduce losses due to post harvest handling.

### IV. FINANCIAL AND MANPOWER REQUIREMENTS

The total is as indicated in Table 1.

## V. PROJECT JUSTIFICATION AND BENEFITS

The new proposed laboratory will consist of lecture rooms, analytical laboratories and processing laboratories for post-harvest technology studies. These are required in view of the fact that the existing facilities are limited in their utilisation for post-harvest losses work.

Work in post-harvest losses will benefit farmers and small scale processors to salvage the substantial losses due to improper handling after harvest. This work is necessary to identify problems as well as finding the correct techniques to reduce losses.

When the new building is complete, other essential equipments are necessary to enhance applied research in post-harvest technology. Various equipments such as dryers, moisture monitoring devices, controlled gas chambers, etc. are necessary to stimulate conditions in the field before the findings could be recommended for implementation by farmers.



Anggaran Kos Dan Keperluan Gunatengah

Jabatan: MARDI

Bil. Project: 12

Maksud Pembangunan: Membangunkan Program Lepastuai Padi dan Industri Asastani.

Keterangan: Stesen Bukit Raya

	Tahun (\$000)						Jumlah 1981 - 85
	1980	1981	1982	1983	1984	1985	
<b>Kos Pembangunan:</b>							
Pembinaan	-	100.00	200.00	-	-	-	300.00
Alat-alat dan Jurutera	-	30.00	50.00	30.00	30.00	20.00	160.00
Pelaburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	-	-	-	-	-	-
Lain-lain Perbelanjaan	-	-	-	-	-	-	-
Pembangunan	-	-	-	-	-	-	-
<b>Jumlah Kos Pembangunan</b>	-	130.00	250.00	30.00	30.00	20.00	460.00
<b>Kos Berulang:</b>							
Gaji dan Upahan Orang	138.50	166.20	199.44	239.33	287.19	344.63	1,236.79
Perjalanan dan Pengangkutan							
Orang	7.00	8.40	10.08	12.10	14.52	17.42	62.52
Kemudahan Awam (Api, Air, Elektrik dll.)	10.00	7.68	9.22	11.07	13.27	15.93	57.17
Sewa	3.00	3.60	4.32	5.18	6.22	7.46	26.78
Bekalan dan Bahan-bahan	15.00	18.00	21.60	25.92	31.10	37.32	133.94
Penyelenggaraan dan Pembaikan yang dibeli.	3.00	3.60	4.32	5.18	6.22	7.46	26.78
Lain-lain Perkhidmatan							
Professional dan Keraian	4.00	4.80	5.76	6.91	8.29	9.95	35.71
Lain-lain Perbelanjaan							
Berulang	4.50	5.28	6.34	7.60	9.12	10.95	39.29
<b>Jumlah Kos Berulang</b>	185.00	217.56	261.08	313.29	375.93	491.12	1,618.98

PROGRAMME FOR THE FOURTH MALAYSIA PLAN

2. Cocoa Processing Station, Telok Anson, Perak.

I. BACKGROUND AND OBJECTIVES

The cocoa processing plant, Telok Anson, has the following main objectives:

1. To undertake applied research into the correct processing of local cocoa with the idea to improve quality.
- (2) To provide advice and short term training courses for cocoa processors from the government agencies as well as private individuals.

II. PROJECT DESCRIPTIONS

The processing laboratory is to be erected to complement the production of cocoa from MARDI farms in an area of 400 acres. Purchase of equipments for processing has been delayed due to the delays in land acquisition and plan specification for the buildings for tendering purposes.

Under the Fourth Malaysia Plan, these are hoped to be achieved so that the processing laboratory is able to house the processing equipments to be purchased, as approved under the Third Malaysia Plan.

III. FEASIBILITY

As a result of the 'low' quality of cocoa produced by Malaysia, it is necessary that the problem of quality be looked into. The technical knowledge on the production of good quality cocoa will benefit the farmers as well as cocoa processors in general.

IV. FINANCIAL AND MANPOWER REQUIREMENTS

This is indicated in Table 1.

V. PROJECT JUSTIFICATION AND BENEFITS

The processing equipments to be bought would include the fermentary, drying equipments and other equipments to monitor a controlled fermentation and drying rates that related to the quality performance of the cocoa beans.

The techniques will be investigated on both small scale as well as large scale production of dried beans. The small scale fermentary will benefit the smallholders and large scale production would help the estate plantations.

Anggaran Kos Dan Keperluan Gunatanaga

Jabatan: MARDI

Bil. Project: 12

Maksud Pembangunan: Untuk Memproses Koko Hasil Dari Ladang MARDI.

Keterangan: Stesen Teluk Anson

	Tahun (\$000)						
	1980	1981	1982	1983	1984	1985	Jumlah 1981 - 85
<b>Kos Pembangunan:</b>							
Pembinaan	-	-	-	-	-	-	-
Alat-alat dan Jurutera	-	30.00	30.00	30.00	30.00	20.00	140.00
Pelaburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	-	-	-	-	-	-
Lain-lain Perbelanjaan	-	-	-	-	-	-	-
Pembangunan	-	-	-	-	-	-	-
<b>Jumlah Kos Pembangunan</b>	<b>-</b>	<b>30.00</b>	<b>30.00</b>	<b>30.00</b>	<b>30.00</b>	<b>20.00</b>	<b>140.00</b>
<b>Kos Berulang:</b>							
Gaji dan Upahan Orang	79.40	95.28	114.34	137.20	164.64	195.57	707.03
Perjalanan dan Pengangkutan							
Orang	2.50	3.00	3.60	4.32	5.18	6.22	22.32
Kemudahan Awam (Api, Air, Elektrik dll.)	4.30	5.16	6.19	7.43	8.92	10.70	38.40
Sewa	0.30	0.36	0.43	0.52	0.62	0.75	2.68
Bekalan dan Bahan-bahan	30.00	36.00	43.20	51.80	62.20	74.46	267.66
Penyelenggaraan dan Pembaikan yang dibeli	4.60	5.22	6.62	7.95	9.54	11.45	40.78
Lain-lain Perkhidmatan Professional dan Keraian	1.20	1.44	1.73	2.07	2.49	2.99	10.72
Lain-lain Perbelanjaan Berulang	0.30	0.36	0.43	0.52	0.62	0.75	2.68
<b>Jumlah Kos Berulang</b>	<b>122.60</b>	<b>146.82</b>	<b>176.54</b>	<b>211.81</b>	<b>254.21</b>	<b>302.89</b>	<b>1,092.27</b>

PROGRAMME FOR THE FOURTH MALAYSIA PLAN

3. Tea Processing Station, Cameron Highlands, Pahang.

I. BACKGROUND AND OBJECTIVES

MARDI has a small tea factory within the grounds of the Cameron Highlands Station. The factory had not been operational for a long time. The factory was only brought back to use by the Blue Valley Tea Estate when their factory was burnt down. The factory was producing good tea from blue valley leaf.

MARDI has about 60 acres of tea plantation, most of which were planted out in 1927 and 1928. After rehabilitation, and as a result of improved techniques of plucking and new fertilizer recommendation, the tea bushes are looking better than before in terms of colour and vigour. Presently, fresh tea leaves are being sold to Bharat Tea for further processing. When the rehabilitation programme is complete, it is estimated that the yield would be in the region of 1,000/1,200 lb per acre per annum which amounts to 45,000 lb per annum minima leaf production.

It is hoped that MARDI would be able to process its own tea with the following objectives:

- (1) To demonstrate to the industry the manufacture of good tea

Good tea begins on the bush. A rehabilitation programme was done on the station's own run-down bushes. By producing our own black tea in our factory, MARDI can demonstrate the improved quality and value of the product which is attainable with well-grown leaf and correct manufacturing.

- (2) Demonstration and training in the establishment of a small tea plantation and factory

By establishment of good field practices and tea manufacturing, MARDI can demonstrate and train personnel in the methods, costs, rehabilitation and processing of tea to smallholders on any cooperative that is interested in manufacturing tea.

(3) Service to the Industry

MARDI will organise a small permanent exhibition information about the role and importance of the tea industry in Malaysia.

(4) Research

By having the factory the manufacturing research is integrated with field research on field management. In the manufacture of tea, the optimum environment for withering depends on the conditions under which the leaf has been plucked and transported. Similar studies of the optimum environment are relevant to fermentation. MARDI should be able to provide information to improve and update existing factory processes.

II. PROJECT DESCRIPTION

Firstly, the present existing factory needs to be reopened. Since the plant has been idle for some time, some repair work and modification needs to be undertaken.

Secondly, the present factory should be given a re-design and machinery rearranged. The factory is of an old design. If the factory is to be a model manufacturing unit to fulfil the above mentioned objectives, some additional facilities need to be provided.

III. FEASIBILITY

In the long run more uniform tea standards for tea should result from improved quality control all along the line. While the present market seems to be willing to buy any grade of tea, if the quality rises it will be better able to face competition from imports and better able to compete with other beverages when the present market of tea is saturated by domestic production. As the consumer appreciates better tea, he will be willing to pay higher price for it and the industry will obtain better returns on its investment.

With that in view, there is an increasing need for proper research facilities to be established. This is also based on the long term requirement of the tea industry after discussions with three major tea producers were held.

#### IV. FINANCIAL AND MANPOWER REQUIREMENTS

The requirements are given in Table 1.

#### V. PROJECT JUSTIFICATION AND BENEFITS

##### (A) Alterations to the existing factory

The main alterations are as follows:

- (1) The floor and positions should be changed as to conform to some modern design and conform to good manufacturing practices.
- (2) The layout of the rooms and operations can be re-organised so that there is a continuous progression in manufacture.
- (3) A complete change from present diesel motor to all motor systems. With machines having individual motors, the area will be cleaner and spacious.
- (4) To extend the building slightly so as to accommodate:- testing table, tea makers table, toilet etc.

The total cost for extension of the building with some filling, building of retaining wall etc. would be \$200,000. Cost of purchasing new equipments and alterations, as mentioned, would be \$140,000.

Jabatan: MARDI

Bil. Project: 12

Maksud Pembangunan: Untuk Penyelidikan Memproses Teh

Keterangan: Kilang Memproses Teh  
Di Cameron Highlands.

	Tahun (\$000)						Jumlah 1981 - 85
	1980	1981	1982	1983	1984	1985	
Pembangunan:							
Pembinaan	-	100.00	100.00	-	-	-	200.00
Alat-alat dan Jurutera	-	40.00	30.00	30.00	20.00	10.00	130.00
Palaburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	-	-	-	-	-	-
Lain-lain Perbelanjaan	-	-	-	-	-	-	-
Pembangunan	-	-	-	-	-	-	-
Jumlah Kos Pembangunan	-	140.00	130.00	30.00	20.00	10.00	330.00
Perulangan:							
Gaji dan Upahan Orang	-	19.00	22.80	27.40	32.80	39.40	141.40
Perjalanan dan Pengangkutan Orang	-	5.00	6.00	7.20	8.60	10.40	37.20
Kemudahan Awam (Api, Air, Listrik dll.)	-	4.30	5.16	6.19	7.43	8.92	32.00
Sewa	-	0.30	0.36	0.43	0.52	0.62	2.23
Bekalan dan Bahan-bahan	-	60.00	72.00	86.40	103.70	124.40	446.50
Penyelenggaraan dan Pembaikan yang dibeli	-	7.00	8.40	10.08	12.09	14.50	52.07
Lain-lain Perkhidmatan	-	1.20	1.40	1.70	2.00	2.5	8.80
Professional dan Keraian	-	2.5	3.0	3.5	4.2	5.0	18.20
Lain-lain Perbelanjaan	-	-	-	-	-	-	-
Perulangan	-	2.5	3.0	3.5	4.2	5.0	18.20
Jumlah Kos Perulangan	-	99.3	119.12	142.92	171.34	205.74	738.40



PROGRAMME FOR THE FOURTH MALAYSIA PLAN

4. Fruit Processing Station, Bukit  
Ridan, Pahang.

I. BACKGROUND AND OBJECTIVES

The Fruit Processing Factory, Bukit Ridan, Pahang, has the following main objectives:

- (1) To carry out trials on the economic feasibility of commercial production of fruit products from MARDI farms.
- (2) To establish a model system for integrated farming in the area of production of fruits and fruit products.

II. PROJECT DESCRIPTION

Under the Third Malaysia Plan, a fruit processing factory has been built. In addition to that some processing equipments have been supplied and installed. Other equipments such as laboratory and office equipments have also been allocated to the end the Third Malaysia Plan.

III. FEASIBILITY

Continuation of the project that could establish a model for an integrated system of fruit production and processing.

IV. FINANCIAL AND MANPOWER REQUIREMENTS

This is indicated in Table I.

V. PROJECT JUSTIFICATION AND BENEFITS

The equipments purchased so far are for the processing of medium scale production of fruit and fruit products (3,000 cans open day). These equipments need servicing as well as maintenance cost to be allocated under the Fourth Malaysia Plan.

However, the station will also look into small scale production, particularly in the area of improving traditional cottage scale productions of fruit products. This will not only benefit the small scale producers, but it will also provide information on the performance of an integrated fruit farming and processing system. Some equipments are needed to simulate the above conditions.

Jabatan: MARDI

Bil. Project: 12

Maksud Pembangunan: Untuk Memproses Buah-Buahan Hasil  
Dari Ladang MARDI Secara 'Commercial'

Keterangan: Kilang Memproses Buah-Buahan  
Bukit Ridan.

	Tahun (\$000)						
	1980	1981	1982	1983	1984	1985	Jumlah 1981 - 85
<b>Kos Pembangunan:</b>							
Pembinaan	-	-	-	-	-	-	-
Alat-alat dan Jurutera	-	20.00	40.00	20.00	20.00	20.00	120.00
Peleburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	-	-	-	-	-	-
Lain-lain Perbelanjaan	-	-	-	-	-	-	-
Pembangunan	-	-	-	-	-	-	-
<b>Jumlah Kos Pembangunan</b>	-	20.00	40.00	20.00	20.00	20.00	120.00
<b>Kos Berulang:</b>							
Gaji dan Upahan Orang	79.40	95.28	114.34	137.20	164.64	195.57	707.03
Perjalanan dan Pengangkutan Orang	2.50	3.00	3.60	4.32	5.18	6.22	22.32
Kemudahan Awam (Api, Air, Listrik dll.)	4.30	5.16	6.19	7.43	8.92	10.70	38.40
Sewa	0.30	0.36	0.43	0.52	0.62	0.75	2.68
Bekalan dan Bahan-bahan	100.00	120.00	144.00	172.80	207.36	248.32	892.48
Penyelenggaraan dan Pembaikan yang dibeli	4.60	5.22	6.62	7.95	9.54	11.45	40.78
Lain-lain Perkhidmatan Professional dan Keraian	1.20	1.44	1.73	2.07	2.49	2.99	10.72
Lain-lain Perbelanjaan Berulang	0.30	0.36	0.43	0.52	0.62	0.75	2.68
<b>Jumlah Kos Berulang</b>	192.60	230.82	277.34	332.81	399.37	476.75	1,717.09

PROGRAMME FOR THE FOURTH MALAYSIA PLAN

5. Fish Meal Processing Station,  
Tumpat, Kelantan.

I. BACKGROUND AND OBJECTIVES

The Fish Meal Processing Station, Tumpat, Kelantan, has the following main objectives:

- (1) To carry out applied research into the commercialisation of good quality fish meal.
- (2) To carry out applied research in the utilisation of fish silage for purposes of fish feed and other animal feed.
- (3) To provide training and technical advice to fish meal processors in terms of maintaining good quality control of fish meal production.

The project, especially fish silage production, will contribute to the development of small scale fish industry.

II. PROJECT DESCRIPTION

This Station has a land area of 1.3 acres and payment has been settled for this. Further payments to the contribution for the supply of electricity has also been made. Under the Third Malaysia Plan, the following work has been completed:

- (1) Processing factory building
- (2) Landing platform
- (3) Supply and installation of processing equipment.

An extra wooden building to house the administration block and laboratories for elementary quality control work has been planned to be built by the end of 1980.

III. FEASIBILITY

Continuation of the project in fish meal and fish silage production on a commercial scale as a pilot scale study.

IV. FINANCIAL AND MANPOWER REQUIREMENTS

The total is indicated in Table 1.

#### V. PROJECT JUSTIFICATION AND BENEFITS

Since the station has undertaken studies into the utilisation of fish silage, it is proposed that equipment for the pilot scale production of the commodity be purchased. Fish silage has many uses in animal feed and one of the important aspects is for the production of fish feed. This is in line with the national emphasis on the expansion of in-land fisheries which requires the basic need of feed for the fish.

Some equipment has been purchased under the Third Malaysia Plan. Some other equipments necessary for the successful implementation of the fish silage project on a commercial scale are required. Since silage can be produced in small batches by fishermen, requiring minimal capital cost, the production is greatly encouraged. However, MARDI must be able to monitor the quality and changes that occur during processing in order to understand the basic techniques for good production of fish silage.

Anggaran Koa Dan Keperluan Gunatanaga

Jabatan: MARDI

Bil. Project: 12

Maksud Pembangunan: Penyelidikan dan Kemajuan Memproses  
Hampas Ikan dan Sallej Ikan

Keterangan: Stesen Memproses Hampas Ikan,  
Tumpat, Kelantan.

	Tahun (\$000)						Jumlah 1981 ~ 85
	1980	1981	1982	1983	1984	1985	
<b>Kos Pembangunan:</b>							
Pembinaan	-	-	-	-	-	-	-
Alat-alat dan Jurutera	-	20.00	20.00	30.00	20.00	20.00	110.00
Pelaburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	-	-	-	-	-	-
Lain-lain Perbelanjaan	-	-	-	-	-	-	-
Pembangunan	-	-	-	-	-	-	-
<b>Jumlah Kos Pembangunan</b>	-	20.00	20.00	30.00	20.00	20.00	110.00
<b>Kos Berulang:</b>							
Gaji dan Upahan Orang	79.46	95.28	114.34	137.20	164.64	197.57	709.03
Perjalanan dan Pengangkutan Orang	2.30	2.76	3.31	3.97	4.77	5.72	20.53
Kemudahan Awam (Api, Air, Listrik dll.)	4.50	5.40	6.48	7.78	9.33	11.20	40.19
Sewa	3.00	3.60	4.32	5.18	6.22	7.46	26.38
Bekalan dan Bahan-bahan	20.00	24.00	28.80	34.56	41.47	49.77	178.60
Penyelenggaraan dan Pembaikan yang dibeli	5.00	6.00	7.20	8.64	10.37	12.44	44.65
Lain-lain Perkhidmatan							
Professional dan Keraian	1.50	1.80	2.16	2.59	3.11	3.73	13.39
Lain-lain Perbelanjaan							
Berulang	0.50	0.60	0.72	0.86	1.04	1.24	4.46
<b>Jumlah Kos Berulang</b>	116.26	139.44	167.33	200.78	240.95	289.13	1,037.63

PROGRAMME FOR THE FOURTH MALAYSIA PLAN

6. Animal Feed Processing Station,  
Pasir Putih, Kelantan.

I. BACKGROUND AND OBJECTIVES

The Animal Feed Processing Station, Pasir Putih, Kelantan, has the following main objectives:

- (1) To do applied research and development in the processing of animal feed for commercialisation using locally available raw materials.
- (2) To provide advice and technical training for personnel in the government agencies as well as individuals who are related to animal feed processing.
- (3) To look into the feasibility of investment in animal feed processing industry utilising locally available non-conventional raw materials to achieve low-cost feed rations.

II. PROJECT DESCRIPTION

Land for this station totals approximately 5 acres. Payments have been settled. Consumer contribution for electrical supply has been settled. Under the Third Malaysia Plan, a processing factory has been built and processing equipment has been purchased and are now operational.

In the Fourth Malaysia Plan some equipments for the purposes of quality control of animal feed produced needs to be strengthened as supplement to the existing equipments housed in the analytical laboratory. Also, for the purposes of maintenance of the existing processing equipments, spare parts and other maintenance costs need to be allocated for in the Fourth Malaysia Plan.

III. FEASIBILITY

Beneficial to local government agencies, such as SEDCs, in the provision of technical know-how and investment feasibility in the area of animal feed production utilising raw materials produced by local farmers.

IV. FINANCIAL AND MANPOWER REQUIREMENTS

This is indicated in Table 1.

#### V. PROJECT JUSTIFICATION AND BENEFITS

The plant is capable of producing animal feed at the rate of 1-1½ tons per hour. The plant could be a model for correct and economic methods of producing animal feed using non-conventional ingredients as developed by MARDI from time to time. Also it helps to process animal feed utilising conventional raw materials produced by the local farmers. This may add extra income for the smallholders engaged in crops produced for animal feed. At the same time the farmers engaged in animal production would experience cheaper cost of feed thereby reducing the cost of production of animal protein in general.

The station, in collaboration with the fish silage production and freshwater fishery station, would be engaged in the production of fish feed. This is in line with the national emphasis on the expansion of inland fisheries.

Anggaran Kos Dan Keperluan Gunatenaga

Jabatan: MARDI

Bil. Project: 12

Maksud Pembangunan: Penyelidikan dan Kemajuan Memproses Makanan Ternakan

Keterangan: Stesen Pasir Putih, Kelantan.

	Tahun (\$000)						
	1980	1981	1982	1983	1984	1985	Jumlah 1981 - 85
<b>s Pembangunan:</b>							
Pembinaan	-	-	-	-	-	-	-
Alat-alat dan Jurutera	-	10.00	30.00	30.00	20.00	10.00	80.00
Pelaburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	-	-	-	-	-	-
Lain-lain Perbelanjaan	-	-	-	-	-	-	-
Pembangunan	-	-	-	-	-	-	-
<b>umlah Kos Pembangunan</b>	-	10.00	30.00	30.00	20.00	10.00	80.00
<b>s Berulang:</b>							
Gaji dan Upahan Orang	79.40	95.28	114.34	137.20	164.64	197.57	709.03
Perjalanan dan Pengangkutan							
Orang	2.50	3.00	3.60	4.32	5.18	6.22	22.32
Kemudahan /wam (Api, Air, Letrik dll.)	4.30	5.16	6.19	7.45	8.92	10.70	38.40
Sewa	0.30	0.36	0.43	0.52	0.62	0.75	2.68
Bekalan dan Bahan-bahan	30.00	36.00	43.20	51.80	62.20	74.46	267.66
Penyelenggaraan dan Pembaikan yang dibeli.	4.60	5.22	6.62	7.95	9.54	11.45	40.78
Lain-lain Perkhidmatan							
Professional dan Keraian	1.20	1.44	1.73	2.07	2.49	2.99	10.72
Lain-lain Perbelanjaan							
Berulang	0.30	0.36	0.43	0.52	0.62	0.75	2.68
<b>umlah Kos Berulang</b>	122.60	146.82	176.54	211.81	254.21	307.89	1,094.27



PROGRAMME FOR THE FOURTH MALAYSIA PLAN

7. Fish Processing Station, Kuala  
Trengganu, Trengganu.

I. BACKGROUND AND OBJECTIVES

The Fish Processing Station, Kuala Trengganu, has the following main objectives:

- (1) To carry out applied research and development related to processing of fish and other fishery products.
- (2) To provide training and technical advice to fish processors as well as government agencies related to fish processing.
- (3) To look into the problem of post-harvest losses in fish handling and transportation, with the view to improve techniques to reduce losses.

The project will contribute to the development of small scale fish industry.

II. PROJECT DESCRIPTION

This station has a land area of 0.624 acres and also possesses a processing plant and a storage area. Part of the processing area has been converted into a temporary analytical laboratory. In the Third Malaysia Plan, construction of additional buildings has been planned to intensify research and processing. A 2 storey office-cum-laboratory is in the implementation stage and will be completed in the middle of 1980.

III. FEASIBILITY

Continuation of the project in fish processing as well as handling of marine and fresh water fish during distribution.

IV. FINANCIAL AND MANPOWER REQUIREMENTS

The total is indicated in Table 1.

V. PROJECT JUSTIFICATION AND BENEFITS

Some of the equipments that are in use now were purchased under the Second Malaysia Plan. These require replacements. Other equipments not purchased under the Third Malaysia Plan are requested

Jabatan: MARDI

Maksud Pembangunan: Penyelidikan dan Kemajuan Memproses Ikan

Bil. Project: 12

Keterangan: Stesen Kuala Trengganu.

Tahun (\$000)

	1980	1981	1982	1983	1984	1985	Jumlah 1981 - 85
<b>Kos Pembangunan:</b>							
Pembinaan	-	-	-	-	-	-	-
Alat-alat dan Jurutera	-	30.00	30.00	20.00	20.00	10.00	110.00
Pelaburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	-	-	-	-	-	-
Lain-lain Perbelanjaan	-	-	-	-	-	-	-
Pembangunan	-	-	-	-	-	-	-
Jumlah Kos Pembangunan	-	30.00	30.00	20.00	20.00	10.00	110.00
<b>Kos Berulang:</b>							
Gaji dan Upahan Orang	194.30	233.16	279.79	335.75	402.90	483.48	1,735.08
Perjalanan dan Pengangkutan							
Orang	7.00	8.40	10.08	12.10	14.52	17.42	62.52
Kemudahan Awam (Api, Air, Listrik dll.)	22.50	27.00	32.40	38.88	46.66	55.99	200.93
Sewa	3.00	3.60	4.32	5.18	6.22	7.47	26.79
Bekalan dan Bahan-bahan	40.30	48.36	58.03	69.64	83.57	100.28	359.88
Penyelenggaraan dan Pembaikan yang dibeli	5.00	6.00	7.20	8.64	10.37	12.44	44.65
Lain-lain Perkhidmatan							
Professional dan Kerajinan	1.50	1.80	2.16	2.59	3.11	3.73	13.39
Lain-lain Perbelanjaan							
Berulang.	0.50	0.60	0.72	0.86	1.04	1.24	4.46
Jumlah Kos Berulang	274.10	328.92	394.70	473.64	568.39	692.05	2,447.70

PROGRAMME FOR THE FOURTH MALAYSIA PLAN

8. Fruit and Vegetable Processing  
Station, Tampoi, Johor.

I. BACKGROUND AND OBJECTIVES

The Fruit and Vegetable Processing Station, Tampoi, Johor, has the following main objectives:

- (1) To carry out applied research on problems related to processing of fruits and vegetables.
- (2) To provide training and technical advice to food processors as well as government agencies related to food processing.
- (3) To be sensitive to existing food industry development with the idea to improve for more productive and economical methods of processing.

The project will contribute to the development of agro-based industries.

II. PROJECT DESCRIPTION

Under the Third Malaysia Plan, the station has been equipped with all the necessary equipments towards processing of fruits and vegetables. The proposed project of a new building has to be delayed to the Fourth Malaysia Plan because of the problem of suitable land acquisition.

III. FEASIBILITY

Continuation of the project in fruit and vegetable processing technology.

IV. FINANCIAL AND MANPOWER REQUIREMENTS

The total is indicated in Table 1.

V. PROJECT JUSTIFICATION AND BENEFITS

It is expected that some of the existing equipment needs to be replaced. These equipment, such as the retorts, dryers and the other processing equipment are relatively old. These need replacements.

At the same time, new equipment such as tunnel dryers, necessary for pilot scale drying methods and other equipment are required to further expand the need in fruit and vegetable processing technology.

Anggaran Kos Dan Keperluan Gunatanaga

Jabatan : MARDI

Bil. Project : 12

Maksud Pembangunan : Untuk Penyelidikan dan Kemajuan  
Memproses Buah-buahan Dan Sayur-sayuran

Keterangan : Stesen Memproses &  
Sayur-sayuran Tampoi, Johor

	Tahun (j000)						Jumlah 1981 - 85
	1980	1981	1982	1983	1984	1985	
<b>Kos Pembangunan:</b>							
Pembinaan	-	100.00	200.00	-	-	-	300.00
Alat-alat dan Jurutera	-	30.00	40.00	40.00	10.00	10.00	130.00
Pelaburan	-	-	-	-	-	-	-
Pengambilan Tanah	-	1.00	-	-	-	-	1.00
Lain-lain Perbelanjaan Pembangunan	-	-	-	-	-	-	-
<b>Jumlah Kos Pembangunan</b>	-	131.00	220.00	40.00	10.00	10.00	431.00
<b>Kos Berulang :</b>							
Gaji dan Upahan Orang	-	21.00	25.20	30.20	36.25	43.50	156.15
Perjalanan & Pengangkutan Orang	-	3.60	4.32	5.18	6.22	7.46	26.78
Kemudahan Awam (Api, Air Listrik dll)	-	8.60	10.37	12.45	14.93	17.95	64.30
Sewa	-	1.80	2.16	2.60	3.11	3.73	13.40
Bekalan & Bahan-bahan	-	31.20	37.40	45.00	54.00	64.70	232.30
Penyelenggaraan dan Pembaikan yang dibeli	-	8.40	10.08	12.09	14.51	17.42	62.50
Lain-lain Perkhidmatan Professional & Kewangan	-	1.44	1.73	2.07	2.49	2.98	10.71
Lain-lain Perbelanjaan Berulang	-	3.00	3.60	4.32	5.18	6.22	22.32
<b>Jumlah Kos Berulang</b>	-	79.04	94.80	115.91	136.69	162.96	588.46

### 133. CENTRAL SERVICES PROGRAMME

#### I. BACKGROUND AND OBJECTIVE

Research is viewed as a process of investigation and evaluation to create or generate new information and technology. The Malaysian Agricultural Research and Development Institute, first established in 1969 has been engaged in research and development for all crops (except rubber, and recently oil palm) designed to develop locally adapted technology to serve the farming community. As the activities of MARDI progressed, new plans have been developed to consolidate old gains and in a recent reorganization, the division of Central Services was established in late 1979.

The primary function of this division is to expand the capabilities of the service units of MARDI to provide better support for the expanding research and development programmes of MARDI. In order to fulfil this task, five branches, namely, information and public relation, publication, library, workshop services and technical training are consolidated within the Central Services Division to implement and support the overall activities of MARDI.

#### II. PROJECT DESCRIPTION

The Division do not undertake specific projects of its own, but functions as a supportive division, each branch within the Division providing specific services to other Divisions and branches. The five branches include:-

##### (i) Information and public relation

The information and public relation branch serves to promote effective relationship with other agencies and organisations within and outside the country. More specifi-

cally, the branch organises seminars, press release, press conference and attends to visitors and other public relation activities. In addition, the branch maintain an audiovisual aids such as slides library and pamphlets for use by research officers.

(ii) Publication

As a research organisation, dissemination of research results is of vital importance. Currently, MARDI produces six regular publications, namely, MARDI Research Bulletin, MARDI Research Reports, Annual Report, Risalah MARDI, Berita Penyelidikan and Seri Maklumat Teknikal. In addition, MARDI special reports and proceedings of conferences/seminars/workshops are produced and the Publication Branch oversees the publication of these reports. The Branch also undertakes design and artwork services for most of the need of MARDI.

(iii) Library

MARDI Central Library, a specialised agricultural library, is an essential and integral component of MARDI research and development programme. The library serves not only as a storehouse of information, but also as a technical reference and information centre to service the need of researchers and administrative personnel in support of their research and management activities. Currently, the library has 50,000 volumes, comprising of 10,000 books, 800 serial titles, 165 theses and 40 titles of abstracts and indexes. The collection represent only a small assemblage of library information, and effort have been planned to accelerate acquisition of relevant publications. Plans have also been made to expand the service facilities and encourage greater use of the MARDI central library in Serdang. Concomittantly, facilities for the regional libraries are being

expanded to serve crop commodities stations, namely, rice in Bumbong Lima, cocoa in Hilir Perak and fishery in Batu Berendam.

(iv) Technical Training

As research result from MARDI becomes available, the information is transferred to various public agencies, and the Technical Branch functions as an effective link in the transfer of technology from MARDI to other public agencies. Training course includes various aspects of crop husbandry for rice, cocoa, coconut, vegetables and pepper. Special training in fish culture and pest control of rice are also conducted. The Branch organises training at specific locations with full participation from individual research officers each an expert in his own field of research. In this manner, it is hoped that technology developed at MARDI could be transmitted to the farming community effectively and rapidly.

(v) Central Workshop

Basically, the activities of the central workshop are geared towards the maintenance and servicing of all MARDI vehicles and machineries at the headquarters in Serdang as well as other vehicles at other research stations.

III. FINANCIAL AND MANPOWER REQUIREMENTS

Capital cost and operating expenditure for the Division is entered in Table 13. The budgetary provisions include proposed development and operation costs for all the branches (Tables 13.1 - 13.6).

IV. PROJECT JUSTIFICATION AND BENEFITS

Central Services Division is a service oriented division and with the rapid expansion of MARDI research and development

activities, specialised services becomes necessary to support these programmes. For this reason alone, the Central Services programmes are justifiable. But more important, the Division provides more effective link between technology developed in MARDI and other public and private agencies to ensure that research results are communicated and transferred into development to produce major benefit to the farming community. This is in line with the objectives of the New Economic Policy to improve the agricultural productivity of the rural farmers.

Provision for \$2,424 towards construction of facilities including buildings is essential to provide expansion of the library and construction of the printing workshop. Since Central Services is a new division, these facilities were not budgetted in the Third Malaysia Plan.

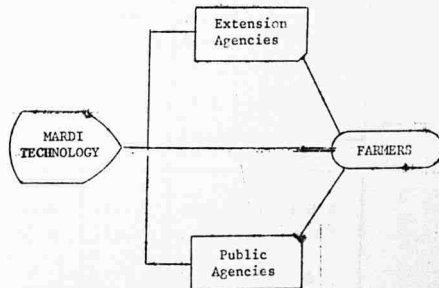
The estimates also includes \$6,000 for other necessary purchases such as equipment, machinery and furniture to equip the office, workshop, training centre and library.

#### V. PROJECT IMPLEMENTATION

The Division organises its resources of the five branches to coordinate, plan and implement the service projects within MARDI. A summary of the implementation programmes is entered in Figure 1.



<u>Service Projects</u>	<u>Implementation</u>
Public Relation	Liaison and Information
Publication	Printing of reports, Dissemination
Library	Information Store house, Technical Information Service
Central Workshop	Repairs and Service of Vehicles
Technical Training	In-service training, Other Training



Maksud Pembangunan: Perkhidmatan Pusat

	Tahun							Pecahan Kos Pembangunan
	1980	1981	1982	1983	1984	1985	Jumlah 1981 - 1985	Tukaran Asing
<b>Kos Pembangunan</b>								
Pembinaan	257	1219	90	← 250 →			1559	
Alat-alat dan Jentera	-	390	245	← 230 →			865	
Pelaburan	-	-	-		-		-	
Pengambilan Tanah	-	-	-		-		-	
Lain-lain Perbelanjaan Pembangunan	-	-	-		-		-	
Jumlah Kos Pembangunan	257	1609	335	← 480 →			2424	
<b>Kos Berulang</b>								
Gaji dan Upahan	741.0	1080.0	1224.0	1377.0	1471.0	1566.0	6718.0	
Perjalanan dan Pengangkutan Orang	58.0	94.5	113.5	137.3	146.0	152.5	643.8	
Kemudahan Awam*	-	-	-	-	-	-	-	
Sewa	9.8	11.2	12.6	14.5	16.3	18.2	72.8	
Bekalan dan Bahan-bahan	598.0	691.5	889.6	1155.3	1378.5	1586.3	5701.2	
Penyelenggaraan dan Pembaikan yang dibeli	94.6	107.8	110.1	120.0	131.7	136.4	606.0	
Lain-lain Perkhidmatan Professional dan Keraian	19.0	30.9	39.9	52.8	60.4	75.5	259.7	
Lain-lain Perbelanjaan Berulang	182.6	246.0	304.5	275.0	267.5	297.5	1390.5	
Jumlah Kos Berulang	1703.0	2261.9	2694.2	3131.9	3471.4	3832.6	15392.0	

\* included in estimates of Administration as utility services in Headquarters are paid directly by Administration.

RANCANGAN MALAYSIA KEEMUKATAN  
ANGGARAN PERMULAAN PEMBANGUNAN. 1981-85

Bahagian: Perkhidmatan Pusat

Program: Technical Training

Nama Stesen/Projek	PERBELANJAAN DIJANGKA ('\$000)					Catitan
	1980 (2)	1981 (3)	1982 (4)	1983-85 (5)	Jumlah 1981-85 (6)	
<u>Construction</u>						
Classroom facilities in Bg. Lima and Hilir Perak		600	-	-	600	Facilities necessary for teaching.
Buildings for training centre Bg. Lima Hilir Perak		-	-	-		
<u>Alat-alat</u>						
Teaching aids, and equipment		40	120	30	190	
Furniture for students	-	10	30	20	60	
Other purchases PA system, graphics		50	-	-	50	
		700	150	50	900	

RANCANGAN MALAYSIA KEEMPAT  
ANGGARAN PERMULAAN PEMBANGUNAN. 1981 - 85

Bahagian: Perkhidmatan Pusat

Program: Perhubungan

Nama Stesen/Projek	PERDELANJAAN DIJANGKA (\$'000)					Catitan
	1980 (2)	1981 (3)	1982 (4)	1983-85 (5)	Jumlah 1981-85 (6)	
<u>Construction</u>  Provision for office space, exhibition room etc - two-storey of 96000 sq.ft.			-	-		This new branch has no office of its own.  Exhibition room is essential to display MARDI activities as PR strategy.  Equipment necessary to support activities.
<u>Alat-alat</u>  Audiovisual equipment			15	15	30	
 Jumlah			15	15	30	

RANCANGAN MALAYSIA KEEMPAT  
 ANGGARAN PERMULAAN PEMBANGUNAN. 1981 - 85

Bahagian: Perkhidmatan Fusat

Program: Penerbitan

Nama Stesen/Projek	PERDELANJAAN DIJANGKA (\$000)					Catitan
	1980 (2)	1981 (3)	1982 (4)	1983-85 (5)	Jumlah 1981-85 (6)	
<u>Construction</u>						Expected completion of printing workshop already in progress
Completion of printing workshop	257	619	40	-	659	
<u>Alat-alat</u>						
Machinery, collator, jogger, offset.		190	-	50	240	
Furnishings and other equipment		30	-	15	45	
	257	839	40	65	944	

RANCANGAN MALAYSIA KEEMPAT  
ANGGARAN PERMULAAN PEMBANGUNAN, 1981 - 85

Bahagian: Perkhidmatan Pusat

Program: Bengkel Pusat

Nama Stesen/Projek	PERBELANJAAN DIJANGKA (\$'000)					Catitan
	1980 (2)	1981 (3)	1982 (4)	1983-85 (5)	Jumlah 1981-85 (6)	
<u>Construction</u>						
Workshop extension	-	-	50	-	50	Expansion of workshop facilities anticipated.
<u>Alat-alat</u>						
Servicing equipment, tools.	-	50	50	50	150	
		50	100	50	200	

RANCANGAN MALAYSIA KEEMPAT  
 ANGGARAN PERMULAAN PEMELANGUNAN. 1981 - 85

Bahagian: Perkhidmatan Pusat

Program: Perpustakaan

Nama Stesen/Projek	PERBELANJAAN DIJANGKA (\$'000)					Catitan
	1980 (2)	1981 (3)	1982 (4)	1983-85 (5)	Jumlah 1981-85 (6)	
<u>Construction</u>  Extension of present library (4000 sq. ft)			-	250	250	Present space would not be enough for future expansion.   Copier need for fast information service
<u>Alat-alat</u>  Book shelves, racks, chairs, desks etc.  Photocopy machine		8 12	30	35 15	73 27	
		20	30	300	350	

#### 14. RESEARCH SERVICES PROGRAMME

##### 1. BACKGROUND AND OBJECTIVE

The research programmes of the Institute require supporting services in the planning, implementation and evaluation of their projects. The Research Services Programme was established with the objectives of providing some of these services and to conduct specific research projects, particularly in the areas of production economics, rural sociology and agribusiness in collaboration with the commodity research programmes.

These services are provided by the five Branches or activities of the programme viz Production Economics; Statistics and Experimental Design; Data Processing Services; Sociology and Agribusiness; and Analytical Services.

##### II. PROJECT DESCRIPTION

The Research Services Programme consists of five Branches with each of the Branches having specific functions. The five Branches and their functions are detailed below:-

###### 1. Analytical Services Branch

The functions of the Analytical Services Branch are to provide analytical services, centralised analytical instrumentation facilities, glassblowing services, and laboratory advisory services to other research programmes of the Institute.

The analytical services to be provided will cover the determination of major and trace nutrients in plants, animal feeds and wastes, soils, fertilizer, and water samples and the analysis of amino acids and proteins, vitamins, enzymes, sugars and carbohydrates, and physiologically active compounds in plant and animal products.



The centralised analytical instrumentation facilities will be equipped with essential research instruments such as gaschromatographmass spectrometer, emission spectrometer, preparative scale liquid chromatograph, spectrofluorometer, counter-current apparatus, ultraviolet and infrared spectrophotometers. These facilities are for the use by other research programmes of the Institute.

The Branch will also provide glassblowing services for the repair and fabrication of glass apparatus and advisory services covering laboratory instrumentation, safety and requirements.

The financial requirements of this Branch are given in Appendix A.

## 2. Data Processing Services Branch

The Data Processing Services Branch is established with the primary objective of supporting data processing and information management needs of MARDI. Specifically, four interactive categories are identified:

Firstly, the branch provides data processing facilities for all levels of agricultural research, continuously undertaken by MARDI, with the aim of improving the research environment with respect to the scope, the quality and the efficiency of the entire research activities. Such services, include, among others, the analyses of experimental data, analyses of big-volume data, for example surveys, the development and use of new applications programs for specialised projects such as simulation, modelling, etc.

Also, the branch will provide services in support of information management needs of the administrative sector. This will assist the administration to function smoothly and speedily in the various administrative tasks such as inventory control, employees record, accounts etc. The creation of an appropriate

size data base system for the administrative needs is envisaged in the near future.

The development of an agricultural data base system is the long-term major project of this Branch. Under this program the component activities involved are the identification and collection of information, storage and retrieval processes, and information updating and system improvement. This data base system will be ready for full implementation some two years after installation of the computer systems.

In complement to the agricultural data base, a computerised library information system is also planned to cater for the storage, retrieval and dissemination of information available in the library of MARDI.

Related to the above objectives, a major supplementary activity of the Branch is the training and education of MARDI's officers and personnel in interactive computer usage. Such training will provide them with the necessary know-how to enable the use of the computer facilities, via terminals. The financial requirements of this Branch are given in Appendix B.

### 3. Production Economics

The main function of the Production Economics Branch is to provide economic support and inputs to the commodity research programmes of the Institute. The major area of research undertaken is the economic analysis of technical projects to ensure that the results of these projects are not only technically feasible but also economically viable. Apart from economic analysis of technical projects another function of the Branch is to undertake costs and returns studies in the production of various agricultural commodities.

The conduct of agro-economic surveys also comes under the purview of the Production Economics Branch. These are baseline or diagnostic surveys undertaken in areas where location-specific research are to be undertaken. These surveys are undertaken with the object of assessing the existing resources and their patterns of utilisation and identifying problems which need research attention. The results of these surveys are passed on to the commodity research programmes of the Institute for use in the formulation of their research programmes.

The financial requirements of the Branch are given in Appendix C.

#### 4. Sociology and Agribusiness Branch

The Sociology and Agribusiness Branch is composed of two Units - Sociology Unit and Agribusiness Unit - with each having its own objectives and functions. The objective of the Sociology unit is to conduct surveys/studies pertaining to the attitude, values and motivations of rural farm communities in particular with respect to the adoption of new technologies. In addition it will also conduct studies to evaluate the social implications resulting from the adoption of MARDI's research results.

During the 4th Malaysia Plan, the Sociology Unit will carry about 45 surveys/studies relating to the following areas of research:-

- (i) Transfer of Technology/Research - Adoption, diffusion and communication
- (ii) Social effects of new technology on farm communities
- (iii) Man-land Relationship - Land tenure systems
- (iv) Social Organisation of Agricultural Production
- (v) Migration

These studies will be undertaken in areas where the Institute plans to carry out its location-specific research and will complement the Institute's technical research programmes.

The objectives of the Agribusiness Unit ~~is to~~ to conduct research into the management of agricultural and agro-based enterprises with respect to planning, organising, staffing, directing and controlling human and material resources. It incorporates such research areas as agricultural production, processing, milling, storage, marketing and consumption.

Under the 4th Malaysia Plan the Agribusiness Unit plans to carry out feasibility studies, case studies (including adoptive case studies), situational and environmental analysis, and surveys based on commodities and their products. The commodities suggested in order of priority are fruits, padi, tobacco, groundnuts, beef production, fresh-water fish, coffee, cocoa, coconut, pepper, cassava, cashewnuts and poultry.

The financial requirements of the Branch are given in Appendix D.

#### 5. Statistics and Experimental Design Branch

The objectives of the Statistics and Experimental Design Branch are aimed primarily at giving statistical advice on planning, analysis and interpretation of all experiments conducted by MARDI, covering on wide range of disciplines, and crops, livestock, and fresh-water fisheries. The role of this Branch is to provide sound experimental designs leading to efficient utilisation of search resources and maximising the amount of information from any one experiment.

With the purchase of the mainframe computer expected to be implemented in the early part of the 4th Malaysia Plan.

The Statistics and Experimental Design Branch will give emphasis on developing the skills of research officers in the analysis and interpretation of their experiments. In this scheme research officers will be trained in given instructions on the use of statistical packages which will enable officers to work and analyse data with the assistance of the Statisticians. In addition to this consultatory role, the statisticians will be more involved in the designing aspects, the use of efficient plans and the maximum utilization of the collected data in terms of interpretation. Also, regional centres in the North and South would have programmable mini computers (those currently used at Headquarters) to satisfy the on-site computer requirements.

The financial requirements of the Branch are given in Appendix E.

### III. PROJECT JUSTIFICATION AND BENEFITS

The Research Services Programme provides supportive services which are essential to the other research programmes of the Institute and because of this the benefits from this programme could only be indirect that is through the other research programmes.

The Research Services Programme is essential to the other research programmes of the Institute because its services are required in the planning, execution and evaluation of their research projects. Statistics and experimental design services are required for sound experimental designs, and statistical analysis and interpretation of all experimental data; services from the Production Economics Branch are required to assess the technical feasibility and economic viability of projects; analytical services and instrumentation facilities are required to carry out as well as to obtain in-depth understanding of experiments; sociological and agribusiness research is necessary to determine the attitudes, values and motivation of farm communities in the adoption of new technologies and to assess social implications

resulting from the adoption of new technologies as well the management aspects of agricultural and agrobased enterprises; data processing services are required to support the data processing needs of research projects, for efficient documentation of research activities, and information management of the Institute.

#### IV. FINANCIAL AND MANPOWER REQUIREMENTS

The financial requirements of the Research Services Programme under the Fourth Malaysia Plan are summarised in Jadual I.

The financial requirements of the 5 Branches and Director's Office under the Research Services Programme are given in Appendices A, B, C, D, E, and F.

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PERKHIDMATAN PENYELIDIKAN

BIL. PROJEK - 14

KETERANGAN - SILA LIHAT LAMPIRAN  
A, B, C, D, E, F.

	Tahun (\$000)							Pecahan Kos Pembangunan (\$000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak langsung	langsung
<b>Kos Pembangunan</b>										
Pembinaan	664	1475	80	-	-	-	1555	1555		4605
Alat-alat dan Jentera	100	3960	285	200	80	80	4605			
Pelaburan	-	-	-	-	-	-	-			
Pengambilan Tanah	-	-	-	-	-	-	-			
Lain-lain Perbelanjaan Pembangunan	-	-	-	-	-	-	-			
<b>JUMLAH KOS PEMBANGUNAN</b>	764	5435	365	200	80	80	6160			
<b>Kos Berulang</b>										
Gaji dan Upahan	1565	1762	1998	2165	2250	2412	10587			
Perjalanan dan Pengangkutan orang	94	122	131	139	146	152	690			
Kemudahan Awam	-	-	-	-	-	-	-			
Sewa	6	10	10	10	10	10	50			
Bekalan dan Bahan-bahan	152	207	235	268	292	311	1313			
Penyelenggaraan dan Pembaikan yang dibeli	27	163	171	172	172	173	85			
Lain-lain Perkhidmatan Professional dan Keraian	16	77	80	82	87	92	418			
Lain-lain Perbelanjaan Berulang	5	9	10	15	15	15	64			
<b>JUMLAH KOS BERULANG</b>	1865	2350	2635	2851	2972	3165	13973			

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PERKHIDMATAN PENYELIDIKAN

BIL. PROJEK - 14

KETERANGAN - LAMPIRAN A  
ANALYTICAL SERVICES  
BRANCH

	Tahun (\$000)							Pecahan Kos Pembangunan (\$000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran	
									Tidak Langsung	Langsung
<u>Kos Pembangunan</u>										
Pembinaan	514	1220	80	-	-	-	1300			
Alat-alat dan Jentera	100	1260	75	30	20	20	1405			
Pelaburan	-	-	-	-	-	-	-			
Pengambilan Tanah	-	-	-	-	-	-	-			
Lain-lain Perbelanjaan Pembangunan	-	-	-	-	-	-	-			
JUMLAH KOS PEMBANGUNAN	614	2480	155	30	20	20	2705			
<u>Kos Berulang</u>										
Gaji dan Upahan										
Perjalanan dan Pengangkutan Orang	3	5	6	6	7	7	31			
Kemudahan Awam	-	-	-	-	-	-	-			
Sewa	-	-	-	-	-	-	-			
Bekalan dan Bahan-bahan	140	157	186	210	226	238	1017			
Penyelenggaraan dan Pembaikan yang dibeli	5	17	26	27	28	29	127			
Lain-lain Perkhidmatan Professional dan Keraian	-	-	-	-	-	-	-			
Lain-lain Perbelanjaan Berulang	1.5	-	-	-	-	-	-			
JUMLAH KOS BERULANG	149.5	179	218	243	261	274	1175			



Breakdown Of Development Expenditure Requirement

1. Pembinaan - \$1,300,000

Laboratory Building \$1,300,000

This sum is required for the Analytical Services Building which is under construction and scheduled to be completed in 1981.

2. Alat-alat dan Jentera - \$1,405,000

(a) Laboratory Equipment - \$1,340,000

(i) Gas Chromatograph - Mass Spectrometer

(ii) ICP Emission Spectrometer

(iii) Spectrofluorometer

(iv) Preparative Scale L C

(v) Counter-current Apparatus

(vi) Infrared Data Station

These equipment were planned and approved for the TMP but due to delay in the completion of the building the purchases have to be delayed to the F.M.P.

(b) Furniture - \$65,000

This sum is required for furnishing the analytical services building.

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PERKHIDMATAN PENYELIDIKAN

BIL. PROJEK - 14

KETERANGAN - LAMPIRAN B  
DATA PROCESSING SERVICES  
BRANCH

	Tahun (\$000)							Pecahan Kos Pembangunan (\$000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak Langsung	Langsung
<b><u>Kos Pembangunan</u></b>										
Pembinaan	150	255	-	-	-	-	255			
Alat-alat dan Jentera	-	2700	210	130	80	80	3200			
Pelaburan	-	-	-	-	-	-	-			
Pengambilan Tanah	-	-	-	-	-	-	-			
Lain-lain Perbelanjaan Pembangunan	-	-	-	-	-	-	-			
<b>JUMLAH KOS PEMBANGUNAN</b>	<b>150</b>	<b>2955</b>	<b>210</b>	<b>130</b>	<b>80</b>	<b>80</b>	<b>3455</b>			
<b><u>Kos Berulang</u></b>										
Gaji dan Upahan	-	-	-	-	-	-	-			
Perjalanan dan Pengangkutan Orang	5	9	13	14	15	15	66			
Kemudahan Awam	-	-	-	-	-	-	-			
Sewa	6	-	-	-	-	-	-			
Bekalan dan Bahan-bahan	3	24	29	35	42	45	175			
Penyelenggaraan dan Pembaikan yang dibeli	8	130	130	130	130	130	650			
Lain-lain Perkhidmatan Professional dan Keraian										
Lain-lain Perbelanjaan Berulang	0.8	-	-	-	-	-	-			
<b>JUMLAH KOS BERULANG</b>	<b>22.8</b>	<b>163</b>	<b>172</b>	<b>179</b>	<b>187</b>	<b>190</b>	<b>891</b>			

Breakdown of Development Expenditure Requirement

1. Pembinaan - \$255,000

Computer Room - \$255,000

The sum is required for construction of special rooms to house the computer which is expected to be installed in 1981.

2. Alat-alat dan Jentera - \$3,200,000

Computer main frame and peripherals

This sum is required for the purchase of the computer system which has been approved under the TMP and expected to be installed in 1981.

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PERKHIDMATAN PENYELIDIKAN

BIL. PROJEK - 14

KETERANGAN - LAMPIRAN C

PRODUCTION ECONOMICS BRANCH

	Tahun (\$000)							Pecahan Kos Pembangunan (\$000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak Langsung	Langsung
<u>Kos Pembangunan</u>										
Pembinaan	-	-	-	-	-	-	-			
Alat-alat dan Jentera	-	-	-	-	-	-	-			
Pelaburan	-	-	-	-	-	-	-			
Pengambilan Tanah	-	-	-	-	-	-	-			
Lain-lain Perbelanjaan Pembangunan	-	-	-	-	-	-	-			
JUMLAH KOS PEMBANGUNAN										
<u>Kos Berulang</u>										
Gaji dan Upahan	-	-	-	-	-	-	-			
Perjalanan dan Pengangkutan Orang	22	22	25	30	35	40	152			
Kemudahan Awam	-	-	-	-	-	-	-			
Sewa	-	-	-	-	-	-	-			
Bekalan dan Bahan-bahan	4	7	7	8	8	10	40			
Penyelenggaraan dan Pembaikan yang dibeli	-	-	-	-	-	-	-			
Lain-lain Perkhidmatan Professional dan Keraian	10	12	14	16	20	25	87			
Lain-lain Perbelanjaan Berulang	0.5	1	2	7	7	7	24			
JUMLAH KOS BERULANG	36.5	42	48	61	70	82	303			

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PERKHIDMATAN PENYELIDIKAN

BIL. PROJEK - 14

KETERANGAN - LAMPIRAN D  
SOCIOLOGY AND AGRIBUSINESS  
BRANCH

	Tahun (\$000)							Pecahan Kos Pembangunan (\$000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak Langsung	Langsung
<u>Kos Pembangunan</u>										
Pembinaan	-	-	-	-	-	-	-			
Alat-alat dan Jentera	-	-	-	-	-	-	-			
Pelaburan	-	-	-	-	-	-	-			
Pengambilan Tanah	-	-	-	-	-	-	-			
Lain-lain Perbelanjaan Pembangunan	-	-	-	-	-	-	-			
JUMLAH KOS PEMBANGUNAN										
<u>Kos Berulang</u>										
Gaji dan Upahan	-	-	-	-	-	-	-			
Perjalanan dan Pengangkutan Orang	45	65	65	65	65	65	325			
Kemudahan Awam	-	-	-	-	-	-	-			
Bekalan dan Bahan-bahan	-	9	3	3	3	3	21			
Penyelenggaraan dan Pembaikan yang dibeli	-	-	-	-	-	-	-			
Lain-lain Perkhidmatan P Professional dan Keraian	5	64	64	64	64	64	320			
Lain-lain Perbelanjaan Berulang	1	8	8	8	8	8	40			
JUMLAH KOS BERULANG	51	146	140	140	140	140	706			

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PERKHIDMATAN PENYELIDIKAN

BIL. PROJEK - 14

KETERANGAN - LAMPIRAN E  
STATISTICS AND EXPERI-  
MENTAL DESIGN BRANCH

	Tahun (\$000)							Pecahan Kos Pembangunan (\$000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak Langsung	Langsung
<u>Kos Pembangunan</u>										
Pembinaan	-	-	-	-	-	-	-			
Alat-alat dan Jentera	-	-	-	-	-	-	-			
Pelaburan	-	-	-	-	-	-	-			
Pengambilan Tanah	-	-	-	-	-	-	-			
Lain-lain Perbelanjaan Pembangunan										
JUMLAH KOS PEMBANGUNAN										
<u>Kos Berulang</u>										
Gaji dan Upahan	-	-	-	-	-	-	-			
Perjalanan dan Pengangkutan Orang	12	18	19	20	20	20	97			
Kemudahan Awam	-	-	-	-	-	-	-			
Sewa	-	10	10	10	10	10	50			
Bekalan dan Bahan-bahan	1	5	5	6	6	7	29			
Penyelenggaraan dan Pembaikan yang dibeli	12	16	15	15	14	14	74			
Lain-lain Perkhidmatan Professional dan Keraian	-	-	-	-	-	-	-			
Lain-lain Perbelanjaan Berulang	0.7	-	-	-	-	-	-			
JUMLAH KOS PERULANG	25.7	49	49	51	50	51	250			

JABATAN - MARDI

MAKSUD PEMBANGUNAN - PERKHIDMATAN PENYELIDIKAN

BIL. PROJEK - 14

KETERANGAN - LAMPIRAN P

DIRECTOR'S OFFICE

	Tahun (\$000)							Pecahan Kos Pembangunan (\$000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981-85	Tempatan	Tukaran Asing	
									Tidak Langsung	Langsung
<u>Kos Pembangunan</u>										
Pembinaan	-	-	-	-	-	-	-			
Alat-alat dan Jentera	-	-	-	-	-	-	-			
Pelaburan	-	-	-	-	-	-	-			
Pengambilan Tanah	-	-	-	-	-	-	-			
Lain-lain Perbelanjaan Pembangunan	-	-	-	-	-	-	-			
JUMLAH KOS PEMBANGUNAN										
<u>Kos Berulang</u>										
Gaji dan Upahan	-	-	-	-	-	-	-			
Perjalanan dan Pengangkutan Orang	7	3	3	4	4	5	19			
Kemudahan Awam	-	-	-	-	-	-	-			
Sewa	-	-	-	-	-	-	-			
Bekalan dan Bahan-bahan	4	5	5	6	7	8	31			
Penyelenggaraan dan Pembaikan yang dibeli	2	-	-	-	-	-	-			
Lain-lain Perkhidmatan Professional dan Keraian	1	1	2	2	3	3	11			
Lain-lain Perbelanjaan Berulang	0.5	-	-	-	-	-	-			
JUMLAH KOS BERULANG	14.5	9	10	12	14	16	61			

## 15. ADMINISTRATION AND MANAGEMENT

### I. BACKGROUND AND OBJECTIVE

The objectives of the administrative arm of the Institute are as follows:

- i) Plan, coordinate, control and execute laid-down policies on behalf of the Governing Board;
- ii) Plan ~~manpower~~ requirements, developments and staff welfare as well as establish and effective administration;
- iii) Establish an effective and comprehensive financial and physical development system;
- iv) Establish and maintain effective and comprehensive accounting and auditing procedures.

The administration of the Institute started on a 'skeleton' basis with the establishment of the Institute in 1969. From a meagre staff, the administration support service has increased annually and currently stands at a strength of approximately 185 (in categories A, B and C only). Of this approximately 159 are placed on the ground floor of the 2-storey administration block in Serdang. The first floor is utilised by the offices of the Director-General, the Deputy Director-Generals and the Research Directors.

The Institute's administration set-up is divided into 3 Divisions, viz (a) Personnel, (b) Finance and (c) Accounts and Internal Audit.



## II. PROJECT DESCRIPTION AND JUSTIFICATION

The projects to be implemented in the Plan period are as follows:

### 1. Construction

#### 1.1. Additional administration block

An additional 3-storey administrative building is needed urgently to accommodate the growth of the administrative sector of the Institute. As mentioned above, the current staff strength of the 3 Divisions at Headquarter's is approximately 159. Only the ground floor of the main administration block is now used to house the administrative staff and this is grossly inadequate. The proposed project is expected to commence in the middle of 1981 and be completed in 1983. The completed complex is expected to house all the 3 administrative divisions of the Institute, viz Personnel, Finance and Accounts. The total staff strength for the 3 Divisions by the end of the Plan period is expected to be as follows:

i) Personnel	117
ii) Finance	74
iii) Accounts	71

The Finance Division includes the Engineering Branch and the nature of work of this Branch requires ample working space.

#### 1.2. Additional Car Park

The existing car park accommodating about 250 vehicles, including motor-cycles, is inadequate and is proposed to be expanded and completed in 1981. The project would also be aimed towards

better traffic control as cars are currently parked haphazardly.

1.3. Multipurpose Hall

A multipurpose hall costing almost \$1 million is proposed with construction beginning in 1981. The project has been approved in principle by the Institute's Governing Board in February 1980. Sports facilities which will be incorporated include the more popular games such as sepak takraw, basket ball, volley ball, ping pong, squash and badminton. Facilities for football and tennis are already available. Other facilities will include a dining hall and offices for unions. The Institute's Finance Committee has required the project to be handled by Consultants.

1.4. Farm Office Complex

1.4.(i) Office (40'x130')

The function of this office is to serve the research requirements of all the Divisions in Serdang. At the moment, the work is conducted from an inadequate building accommodating about 20 office staff and this number will be increased during the Plan period. It is expected to start the project in early 1981 and it would be also incorporate a conference hall.

1.4.(ii) Canteen (25'x50')

The farm office is now located about 1½ miles from the Headquarters complex. The total number of people employed by the farm office is about 500. At the moment, there is no canteen facility on the farm.

Most of the farm staff comes from the IMG which has problems of own transport.

- 1.4.(iii) Garage (40'x100'), Store and Tractor Shed (200'x80'), Lorry Shed (60'x60') and Heavy Machinery Shed (60'x60')

The current sheds are inadequate and many are of a temporary nature. Besides providing security for vehicles, the new sheds would be also used for 'indoor' research (e.g. 'research specimens')

- 1.4.(iv) P.O.L. Store (35'x40'), Store (100'x40') and Toilets (3 units)

The current stores are also of a temporary nature and need to be replaced. The toilets are deemed necessary since there are none available at the moment.

- 1.4.(v) Prayer House

A small prayer house is required as there is none available at the moment. When completed, it expected to serve about 300 - 400 people.

- 1.4.(vi) Quarters

The following class of quarters are needed:

- a) 2 units of Class 'D' for the Station Head and Farm Manager.
- b) 3 units of Class 'E' for the Research Assistants.
- c) 8 units of Class 'G' for Junior Research Assistants.
- d) 20 units of Class 'H' for essential IMG workers.

The quarters will accommodate only the essential staff needed to look after the Station

## 2. Infrastructure

### 2.1. Fencing, Water and Electrical Supply, Irrigation System and Telephone

Funds being made available, the above projects will commence in early 1981. The problem of treated water supply for human consumption as well as for specific animal needs is currently rather acute. Consumption is anticipated to become greater than generation despite the ad hoc supply of water from new pools and wells. The water problem is compounded with erratic supply as well as insufficient pressure from the main JKR pipes which has been rather frequent of late. The daily supply requirements is approximately 200,000 gallons. Electrical supply is also insufficient at the moment. The problem would become more acute in coming years with growing consumption, especially with the setting up of the Controlled Environment System in Serdang.

## III. FINANCIAL AND MAN-POWER REQUIREMENTS

The financial requirements of project Administration and Management are as attached in the accompanying table. Briefly stated, the total requirements for the Plan period are as follow:

a) Construction	:	\$2,953,000
b) Equipments	:	\$932,150
c) Infrastructure	:	\$1,034,000

The corresponding total requirement for operating expenditure is \$118,326,600, the biggest allocation being made for personnel emoluments and supplies.

In respect of personnel requirements in Categories A, B and C to meet the projections and demands of the Plan period, it is hoped to obtain the following requirements for Administration:

<u>Group A</u>	<u>Current</u>	<u>Plan Period</u>
Management	16	47
<u>Group B</u>		
Executive	22	31
<u>Group C</u>		
Clerical	147	239

ANGGARAN KOS DAN KEPERLUAN CUNATENAGA

JABATAN: MARDI

BIL. PROJEK: 15

MAKSUD: PENTADBIRAN DAN PENGURUSAN (IBU PEJABAT)

KETERANGAN: LIHAT LAMPIRAN 'A', 'B' DAN 'C'

	Tahun (\$'000)							Pecahan Kos Pembangunan (\$'000)		
	1980	1981	1982	1983	1984	1985	Jumlah 1981 - 85	Tempatan	Tidak Langsung	Langsung
Kos Pembangunan										
Pembinaan		1,720	1,800	1,299	134	-	4,953			
Alat-alat & Jentera		411	222	134	112	-	932.15			
Pelaburan		-	-	-	-	53.15	-			
Pengambilan Tanah		-	-	-	-	-	-			
Lain-lain Pembangunan		732	282	20	-	-	1,034			
JUMLAH KOS PEMBANGUNAN		2,863	2,304	1,453	246	53.15	6,919.15			
Kos Berulang (termasuk Pengurusan Stesen)										
Gaji & Upahan		3,229	3,428	3,612	3,854	3,991	18,114			
Perjalanan & Pengangkutan Orang		370	394	420	450	485	2,119			
Kemudahan Awam (Api, Air, Elektrik dll.)		533.5	613.3	705	810.7	931.5	3,594			
Sewa		13.8	15.9	18.3	21	24.1	93.1			
Bekalan & Bahan-bahan		428.6	492.9	565	650	745	2,881.5			
Penyelenggaraan & Pembaikan yang dibeli		113	128	146	167	191	745			
Lain-lain Perkhidmatan Professional & Keraian		747.5	859	980	1,120	1,280	4,986.5			
Lain-lain Perbelanjaan Berulang		4,067.2	3,639	3,451.9	3,418.1	3,207.7	17,783.9			
JUMLAH KOS BERULANG	7,098.2	9,502,600	9,570,100	9,898,200	10,490,800	10,855,300	50,317,000			50,317,000

<u>Pembinaan</u>		<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>Total</u>
1. Administrative Block		\$ 245,000	\$ 735,000	<del>\$1,286,000</del>	\$134,000	-	<del>\$2,400,000</del>
2. Car Park		\$ 60,000	-	-	-	-	\$ 60,000
3. Multipurpose Hall		<del>\$ 500,000</del>	\$ 400,000	-	-	-	\$ 900,000
4. i) Farm Office		\$ 200,000	\$ 80,000	\$ 8,000	-	-	\$ 288,000
ii) Canteen		\$ 30,000	-	-	-	-	\$ 30,000
iii) Garage and Sheds		\$ 25,000	\$ 225,000	-	-	-	\$ 250,000
iv) Stores		\$ 30,000	\$ 200,000	\$ 5,000	-	-	\$ 235,000
v) Prayer House		\$ 30,000	-	-	-	-	\$ 30,000
vi) Quarters		\$ 600,000	\$ 160,000	-	-	-	\$ 760,000
Total		<u>\$1,920,000</u>	<u>\$1,800,000</u>	<u>\$1,299,000</u>	<u>\$134,000</u>	<u>-</u>	<u>\$4,953,000</u>
		=====	=====	=====	=====	=====	=====

Lampiran 'B'

<u>Alat-Alat dan Jentera</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>Total</u>
1. Office Equipment and Furniture for new Administration Block and Farm Office ) ) ) ) )						
2. Vehicle for Accounts Division ) ) ) ) )	\$411,000	\$222,000	\$134,000	\$112,000	\$53,150	\$932,150
3. Farm Implements (Bush Cutter, Mowers Mist Blowers and Water Pumps) ) ) ) ) )						
4. Farm Vehicles )						



<u>Infrastructure</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>Total</u>
1. Fencing	\$ 94,000	\$ 25,000	-	-	-	\$ 119,000
2. Electrical Supply	\$180,000	-	-	-	-	\$ 180,000
3. Irrigation	\$ 20,000	\$160,000	\$20,000	-	-	\$ 200,000
4. Telephone	\$ 80,000	-	-	-	-	\$ 80,000
5. Road Improvements	\$ 75,000	\$ 75,000	-	-	-	\$ 150,000
6. Water Supply	\$218,000	\$ 22,000	-	-	-	\$ 240,000
7. Imhoff Tank	\$ 35,000	-	-	-	-	\$ 35,000
8. Land Clearing	\$ 30,000	-	-	-	-	\$ 30,000
<b>Total</b>	<b>\$732,000</b>	<b>\$282,000</b>	<b>\$20,000</b>	<b>-</b>	<b>-</b>	<b>\$1,034,000</b>

SUMMARY OF DEVELOPMENT EXPENDITURE PERFORMANCE  
(THIRD MALAYSIAN PLAN)

Tajuk atau Penerangan Projek	Peruntukan (1976 - 1980) \$	PRESTASI PERBELANJAAN									
		1976		1977		1978		1979		1980	
		Peruntukan \$	Sebenar \$	Peruntukan \$	Sebenar \$	Peruntukan \$	Sebenar \$	Peruntukan \$	Sebenar \$	Peruntukan \$	Sebenar \$
Komplek Ibu Pejabat Serdang	20,991,000	4,452,400	2,585,781	6,000,000	3,249,709	6,342,000	4,374,825	4,900,000	4,216,661	5,934,100	5,934,100
Memproses Hasil Pertanian Serdang	5,000,000	802,000	134,284	1,700,000	160,210	1,400,000	589,036	1,600,000	761,773	2,516,400	624,000
Penyelidikan Menas Jalan Kebun, Kelang	1,141,000	200,000	122,818	100,000	136,596	110,000	417,925	234,000	272,244	229,600	229,600
Penyelidikan Padi Tanjung Karang	600,000	47,000	34,778	100,000	18,380	138,000	113,342	220,000	311,621	213,500	150,000
Penyelidikan Ikan Air Tawar Batu Berendam	890,000	216,000	47,530	200,000	58,212	103,000	44,767	590,000	284,428	181,550	181,550
Penyelidikan Tanaman Perkebunan Cameron Highlands	259,000	60,000	-	-	27,390	170,000	12,579	(Namaan)	3,431	(Namaan)	100,000
Penyelidikan Tanah Bris Sungai Baging	800,000	70,000	32,015	-	60,472	182,000	56,861	295,000	325,081	400,000	400,000
Penyelidikan & Memproses Buah-buahan Bukit Ridan	2,560,000	1,000,000	448,666	500,000	659,380	578,000	279,383	595,000	326,186	577,500	577,500
Stesen Penyelidikan Kubang Keranji	463,000	135,000	91,051	-	85,688	80,000	183,535	121,000	81,647	150,000	150,000
Memproses Makanan Ternakan Pasir Puteh	708,000	220,000	132,248	200,000	151,519	63,000	37,791	231,000	11,310	112,400	112,400
Memproses Ikan Baja Tumpat, Kelantan	496,000	225,000	280	21,000	110,980	25,000	132,445	100,000	75,796	152,200	152,200
Stesen Kemaman, Trengganu Tengah	2,625,000	509,000	27,284	500,000	127,984	617,000	188,839	895,000	70,663	897,000	560,000
Stesen Penyelidikan Jerangau	344,000	86,000	33,464	-	20,399	32,000	124,879	80,000	41,508	85,200	85,200
Memproses Ikan Kuala Trengganu	1,000,000	50,000	7,346	100,000	9,384	173,000	25,332	150,000	72,402	600,000	260,000
Memproses Buah-buahan & Sayor-sayoran Tampoi	702,928	20,000	-	-	2,928	-	-	-	-	700,000	70,000
Stesen Penyelidikan Kluang, Johor	3,839,000	1,463,000	385,654	1,500,000	650,860	1,406,000	332,292	600,000	612,385	630,000	630,000
Stesen Penyelidikan Pontian, Johor Barat	1,046,916	34,000	73,805	500,000	120,494	450,000	182,960	350,000	124,995	550,000	550,000
Penyelidikan Menas Alor Bukit	50,155	20,000	31,454	-	18,702	-	-	-	-	-	-
Penyelidikan Buah-buahan Kuala Kangsar, Perak	185,000	160,000	21,860	100,000	4,750	75,000	30,947	75,000	31,733	52,400	52,400
Penyelidikan Padi Padang Kangar, Parit	736,000	56,000	8,841	30,000	83,991	415,000	14,505	150,000	137,954	100,000	100,000
Penyelidikan Koko & Kelapa Hilir Perak	7,356,000	968,000	312,336	2,800,000	270,786	2,000,000	708,686	3,000,000	270,922	3,064,100	4,300,000
Memproses Padi & Beras Bukit Raya	575,000	200,000	76,961	25,000	169,620	150,000	71,401	60,000	9,785	197,000	197,000
Penyelidikan Padi Alor Star	788,000	278,400	126,211	170,000	62,655	160,000	110,541	100,000	97,116	379,500	379,500
Penyelidikan Tebu Gajah Mati	470,000	241,000	44,602	300,000	118,655	162,000	124,974	70,000	33,053	36,100	36,100
Memproses Ayam & Telor Mergong	500,000	100,000	2,253	33,000	1,725	20,000	1,886	(Namaan)	-	-	-
Penyelidikan Padi & Tanaman Ladang Bumbong Lima & Bertam	3,000,000	813,000	545,336	700,000	316,196	1,000,000	401,630	952,000	240,746	784,800	784,800
Penyelidikan Tembaku Pasir Puteh	3,526,000	-	-	-	-	1,250,000	363,809	1,078,000	558,967	1,198,000	958,400
PARDI Sarawak	-	-	-	-	-	-	-	-	-	-	-
PARDI Sabah	304	-	-	-	304	-	-	-	-	-	-
Controlled Environment System	2,720,000	-	-	-	-	-	-	-	-	2,720,000	1,360,000
JUMLAH	63,372,303	12,425,800	5,326,858	15,579,000	6,697,969	17,101,000	8,925,170	16,446,000	8,972,407	22,461,350	18,934,750

SUMMARY OF PROPOSALS (ORIGINAL)

MAJOR PROGRAMMES (Provisional List)	TOTAL DEVELOPMENT EXPENDITURE (\$1,000)					OPERATING COSTS (\$1,000)					MANPOWER REQUIREMENTS (DIVS I and II)					
	Est. 1980	1981	1982	1983-85	1981-85	Approved 1980	1981	1982	Approved 1985	Increase 1981-85	1980		1981	1982	Approx 1985	Increas 1981-85
											Posts	Vacancies				
1. Rice	4,262	2,107		5,721	12,090	2,506.6	2,739.5	2,936	3,495.6	15,595.5	184	23	193	200	207	23
2. Tobacco	1,844	1,050		130	3,024	512.9	640	736.1	997.9	4,148.9	40	1	48	51	60	20
3. Field Crops	490	650		300	1,440	1,544.8	1,866	1,949.1	2,207.4	10,214.9	131	6	143	150	155	24
4. Vegetables	477	481		67	1,025	482.25	708	872.4	1,113.9	4,973.2	44	7	63	60	85	41
5. Cocoa Coconut	2,433	8,733		8,818	19,784	1,127.6	2,151.7	2,422.3	3,065.3	13,038.3	74	19	95	98	107	33
6. Fruit	7,791	7,007		1,081	15,879	1,264.85	1,673.85	1,911.1	2,317.2	10,201.6	144	30	142	64	178	64
7. Spices and Beverages	355	348		618	1,321	440.8	709.5	831.5	1,168	4,776	22	10	43	55	63	41
8. Livestock	1,337	1,848		680	3,865	4,106.3	5,030.9	5,655.4	7,403	31,059.1	350	78	422	472	532	182
9. Freshwater Fishery	580	740		450	1,770	485	990.7	1,040.2	1,334.3	5,840.9						
10. Project Development	651	1,087		416	2,356	2,239.9	2,767.5	3,557.5	3,558.8	19,533.8	102	22	179	232	282	180
11. Fundamental Research	5,831	3,295		4,287	3,213	5,156.3	6,142.7	6,806.7	8,036.6	36,142.9	451	82	510	555	603	152
12. Agricultural Product Utilisation	1,820	2,380		1,530	6,230	3,657.5	4,331	4,877	5,604	25,242	382	14	409	414	425	43
13. Central Services	1,664	440		185	2,289	1,692.4	1,964.9	2,694.2	3,609.8	14,872.2	142	19	182	196	213	84
14. Research Services	3,835	360		290	4,485	1,869	2,378.7	2,631.2	3,159.8	13,914.6	148	22	166	184	207	49
15. Station Management	-	-		-	-	10,019.9	10,959	12,642.4	15,278.2	68,009.6	1,501	151	1,730	1,755	1,795	294
16. Administration (Including Offices of Director General Deputy Director General's and World Bank)	3,218	1,746		2,478	7,442	7,098.2	9,502.6	9,570.1	19,855.3	50,317	310	7	247	261	280	113
TOTAL PLAN MARDI	36,590	32,772		26,851	96,213	44,404.3	55,556.3	61,134.57	74,464.7	327,880.5	4,025	491	4,567	4,667	5,192	1,343

## FOURTH MALAYSIA PLAN

## SUMMARY OF PROPOSALS: MARDI (REVISED)

MAJOR PROGRAMMES (Provisional List)	TOTAL DEVELOPMENT EXPENDITURE (\$000)					OPERATING COSTS (\$000)					MAN-POWER REQUIREMENTS (DIVS. I and II)					
	Est. 1980	1981	1982	1983-85	1981-85	Approved 1980	1981	1982	Approved 1985	Increase 1981-85	1980 Position		1981	1982	Approx. 1985	Increase 1980-85
											Posts	Vacancies				
Rice		5,275	2,830	1,433	9,548	2,506.6	2,739.5	2,936	3,495.6	15,595.5	184	23	193	200	207	23
Tobacco		1,504	1,060	-	2,564	512.9	640	736.1	997.9	4,148.9	40	1	48	51	60	20
Field Crops		490	650	300	1,440	1,544.8	1,866	1,949.1	2,207.4	10,214.9	131	6	143	150	155	24
Vegetables		477	481	67	1,025	482.25	708	872.4	1,113.9	4,694.2	44	7	63	80	85	41
Cocoa/Coconut		2,950.1	4,065.1	4,308.8	11,324.0	1,127.6	2,151.7	2,422.3	3,065.3	13,083.3	74	19	95	98	107	33
Fruits		3,304.3	5,923.5	2,474.6	11,702.4	1,264.85	1,673.6	1,911.1	2,317.2	10,201.6	144	30	142	164	178	64
Spices and Beverages		1,343	330	895	2,568	440.8	646.6	792.1	1,119.6	4,504.5	22	10	43	55	63	41
Livestock		2,336.2	1,361.5	1,281.2	4,978.9	4,106.3	2,100.9	2,158	2,820.7	11,997.4	350	78	422	472	532	182
Freshwater Fishery		1,260	764	491	2,515	485	653.1	724.2	1,025.9	4,349.5						
Project Development		853	1,087	416	2,356	2,239.9	2,419.8	3,216.8	4,719.7	18,565.6	102	22	179	232	282	180
Fundamental Research		4,477.875	3,488.425	1,532.25	9,498.55	5,156.3	6,142.7	6,806.7	8,036.6	36,142.9	451	82	510	555	603	152
Agricultural Product Utilisation		1,921	2,980	1,130	6,031	3,857.5	5,766.38	6,544.51	7,706.05	35,623.37	382	14	409	414	425	43
Central Services		1,609	335	480	2,424	1,692.4	2,261.9	2,694.2	3,832.6	15,392	142	19	182	196	213	84
Research Services		5,435	365	360	6,160	1,869	2,350	2,635	3,165	13,973	148	22	166	184	207	49
Station Management		-	-	-	-	10,019.9	11,959	12,642.4	15,278.2	68,009.6	1,501	151	1,730	1,755	1,795	294
Administration (Including Offices of Director General, Deputy Director General's and World Bank)		2,863	2,304	1,752.15	6,919.15	7,093.90	9,502.6	9,570.1	10,855.3	50,317	310	7	247	261	280	113
TOTAL PLAN: MARDI		35,098.475	24,024.525	21,931.00	81,054.00	44,400	53,581.78	58,611.01	71,756.95	311,526.57	4,025	491	4,567	4,867	5,192	1,343