

GOVERNMENT OF MALAYSIA

**FEASIBILITY STUDY
ON
RATIONALIZATION AND
CROP DIVERSIFICATION
IN
NON-GRANARY IRRIGATED AREAS
IN MALAYSIA**

Volume 5-7

State Report - Melaka

October 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

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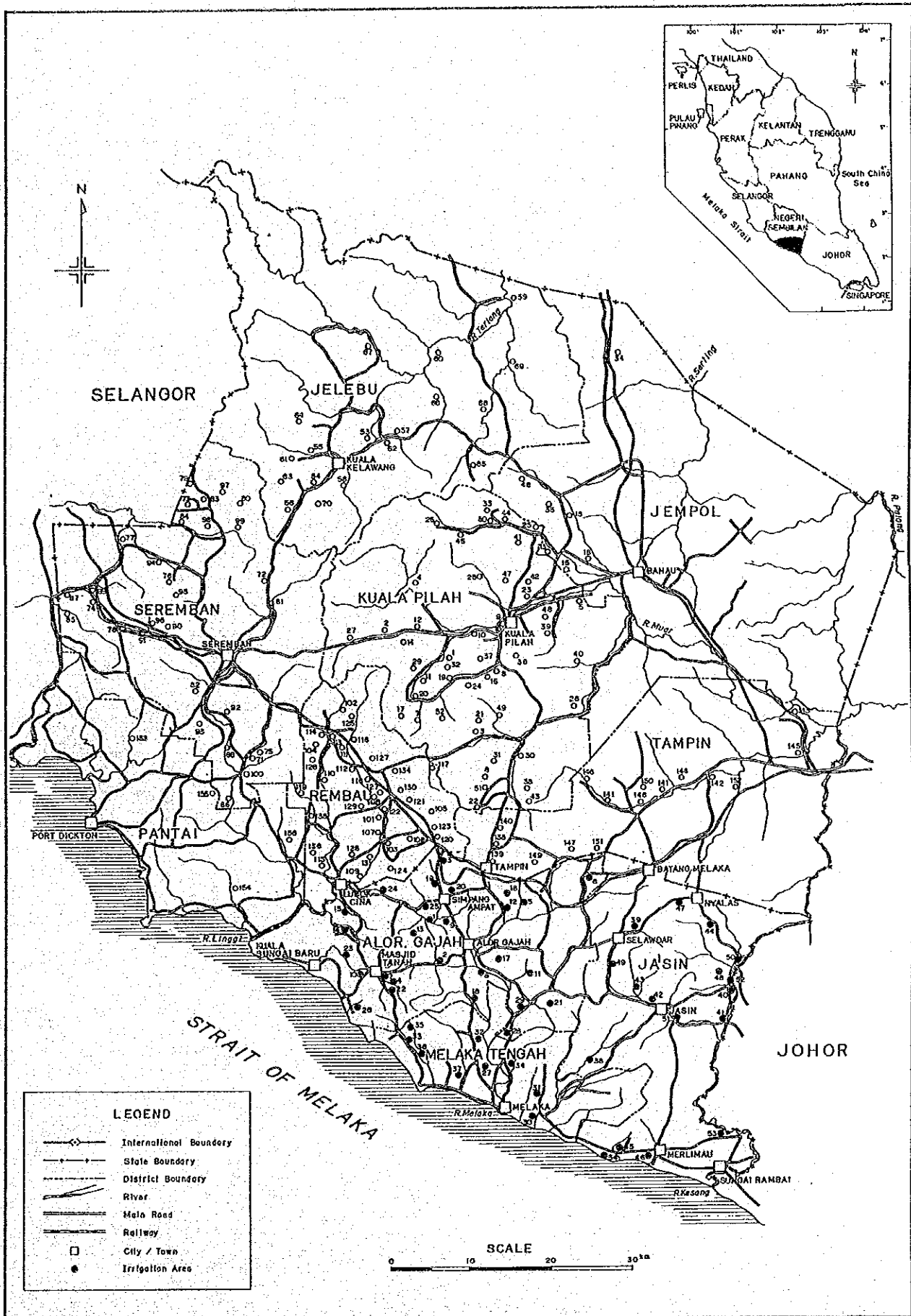
*Feasibility Study on Rationalization and Crop Diversification
in Non-granary Irrigated Areas in Malaysia*

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Location of Non-granary Irrigation Schemes
Melaka

FEASIBILITY STUDY ON RATIONALIZATION AND
 CROP DIVERSIFICATION IN NON-GRANARY
 IRRIGATED AREAS IN MALAYSIA
 Japan International Cooperation Agency

*Feasibility Study on Rationalization and Crop Diversification
in Non-granary Irrigated Areas in Malaysia*

Volume 5-7

State Report - Melaka

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RESULTS OF EVALUATION FOR CROP DIVERSIFICATION POTENTIAL

1. INTRODUCTION

This is the State Report - Melaka, Volume 5-7, of the Final Report for Feasibility Study on Rationalization and Crop Diversification in Non-granary Irrigated Areas in Malaysia. This report includes the criteria, procedure and results of evaluation of crop diversification potential of non-granary irrigation schemes in the State of Melaka.

Detailed information on the criteria and procedure for evaluation is presented in Volume 2 of the Final Report, and the results of evaluation of crop diversification potential for each scheme are given in the Appendix attached to this Volume.

2. GENERAL CONDITIONS

2.1 Socio-economic Situation

Melaka is situated on the western coast of the Peninsular Malaysia and has its neighbours Negeri Sembilan to the north and Johor to the south. Its physical area is 1,650 km² in total and divided into three administrative districts. The estimated population was 494,300 persons in 1985 and 512,500 persons in 1988. The population density was 311 person/km². Rural population ratio was 77% each in 1985 and 1988. The proportion of population by ethnic group in 1987 was 55% for Bumiputera, 36% for Chinese, 8% for Indian and less than 1% for others.

In Melaka, GDP in 1988 totalled M\$1,598 million at 1978 constant prices. The manufacturing sector contributed to 32% of GDP followed by the service sector of 22%, while the agricultural sector's contribution was 16%. Per capita GDP was M\$2,781 in 1986 and M\$3,089 in 1988, both of which were below to some extent compared with the country's average of M\$3,551 in 1986 and M\$3,858 in 1988. According to the Household Income Surveys, the mean monthly income slightly declined from M\$1,040 in 1984 to M\$1,034 in 1987, being lower than M\$1,095 and M\$1,074 of the 1984 and 1987 averages of Peninsular Malaysia, respectively. While, the poor households were improved from 15,100 in number and 15.8% in the incidence of poverty against the total households of 95,600 in 1984 to 12,100 in number and 11.7% in the incidence for the total of 103,400 households in 1987.

In respect to social infrastructure services in 1985, the coverage ratio was 70.9% by electricity, 100% by urban piped water supply and 81.7% by rural piped water supply. The road network was 980 km in the total length, 590 m/km² in density and 1,990 m per 1,000 population in per capita length. The registered number of motor vehicles was 283 per 1,000 population. There were 3.3 doctors and 1.9 acute care hospital beds per 1,000 population. One health center

took care of 20,300 rural people on an average. The infant mortality rate was 1.1 per 1,000 population.

Under the revised 5MP, M\$859 million were allocated as development expenditure from the Federal Government and NFPEs with a share of 2.8% for the total amount for all States. In the new development strategy, traditional imbalance caused by having stressed to agriculture and commerce is now being rectified and the current thrust of economic development is directed towards medium and large-scale industries. The Malacca State Development Corporation (PKNM) is playing a leading role in promoting development activities in the industry, tourism, housing, business and commerce sectors. As for agricultural development, the State Government has launched the Melaka Integrated Agricultural Development Project (MIADP) involving an area of 6,000 ha of uncultivated land, in which the State Government is working with FELCRA and other agencies in order to promote agricultural development.

2.2 Present Agriculture

In Melaka, agricultural land occupies 128,540 ha or 78% of the whole territory of the State. The coverage of paddy field is 10,720 ha, while that of tree crop area amounts to 114,940 ha. Productive area of oil palm is increasing and covers 20,660 ha at present. On the other hand, productive rubber area has been converted year by year to oil palm and its coverage is now 20,900 ha. Cocoa planting area occupies 4,120 ha in total. In the State, 73 miscellaneous crops are grown and fruits planting is very popular. About 50% of the miscellaneous crop area is shared by durian, rambutan, mango and banana. The State produced paddy of 10,300 tons, oil palm of 233,000 tons as FFB, rubber of 80,300 tons and dry cocoa beans of 2,200 tons in 1987.

The followings show the total demand for food crops, vegetables, fruits and freshwater fishes according to the projection made by FAMA.

Produce	Net Consumption (ton)	Outflow to Other States (ton)	Post-harvest Loss (ton)	Total Demand (ton)
Food crops	5,971	230	1,550	7,751
Vegetables	46,234	1,165	11,851	59,250
(Leafy)	(19,716)	(542)	(5,065)	(25,323)
(Fruit)	(18,438)	(485)	(4,731)	(23,654)
(Root)	(5,579)	(120)	(1,425)	(7,124)
(Other)	(2,510)	(18)	(630)	(3,149)
Fruits	16,620	2,777	4,849	24,246
Freshwater fishes	149	0	37	186

Maize production in the State can cover the local demand and the surplus can meet the demand in the outside of Melaka. The projected quantities of local supplies comprise food crops of 1,762 tons, vegetables of 2,291 tons, fruits of 7,204 tons and freshwater fishes of 112 tons. The market potential projected is summarized below.

Produce	Market Potential (ton)	Major Crops (ton)
Food crops	5,989	Groundnut (4,679)
Vegetables	56,959	
(Leafy)	(24,791)	Mastard (8,960), Cabbage (6,539)
(Fruit)	(21,895)	Yard long bean (5,195), Cucumber (5,174)
(Root)	(7,124)	Shallot (6,061)
(Other)	(3,149)	Garlic (2,284)
Fruits	17,042	Banana (4,892), Durian (3,121)
Freshwater fishes	74	Haruan (38)

2.3 Present Situation of Non-granary Irrigation Schemes

In Melaka, agricultural land occupies 128,540 ha or 78% of the whole territory of the State. The coverage of paddy fields are 11,497 ha, while that of tree crop area amounts to 117,043 ha. Productive area of oil palm covers 20,660 ha at present, while productive rubber area has been converted year by year to oil palm and its coverage is now 20,900 ha. Cocoa planting area occupies 4,120 ha in total. In the State, 73 miscellaneous crops are grown and fruits planting is very popular. About 50% of the miscellaneous crop area is

shared by durian, rambutan, mango and banana. The irrigable paddy fields are 7,149 ha in total and fully demarcated as non-granary irrigated areas.

- Number of schemes : 54
- Irrigable area : - main season = 7,149 ha
- off season = 2,279 ha
- Type of schemes : gravity; 48 pump; 2
controlled drainage; 2
converted; 2
- Irrigation water resources availability by scheme
(except controlled drainage and converted schemes)
 - : - sufficient for double cropping; 9
 - insufficient for off season
presaturation; 34
 - limited to only single cropping; 4
 - insufficient for main season
cropping; 1
- Average cropping intensity (paddy + upland crops)
for previous three years
 - : - main season = 37%
 - off season = 17%
- Average cropping intensity (paddy only)
for previous three years
 - : - main season = 28%
 - off season = 8%
- Utilization of scheme : - main season paddy cropping
intensity of 100%; 4
 - main season paddy cropping
intensity of more than 50%; 17
 - main season paddy cropping
intensity of less than 50%; 23
 - fully idle; 8
 - fully converted; 2

Crop diversification has been promoted under the Melaka IADP. The proportion of upland cropping area is 17%. Vegetables and fruits

with high value added have been introduced and there are many successful cases by converting paddy fields to upland crop cultivation areas. These include a group farming to grow asparagus and honey melon and also to have found markets in Singapore and Kuala Lumpur. Another successful case is to grow asparagus on a large scale under irrigated condition. On the contrary, there exist completely idle irrigation schemes in the low-lying areas along the coast due to poor drainage conditions.

3 EVALUATION OF CROP DIVERSIFICATION POTENTIAL FOR NON-GRANARY IRRIGATION SCHEMES

This section presents a general concept, criteria and procedure of evaluation in order to facilitate understanding of the results of the evaluation of potential for crop diversification by scheme attached in Appendix of this volume. A detailed explanation of the evaluation is given in Volume 2.

3.1 Basic Considerations for Evaluation

The intended shift from paddy cultivation to diversified crops in non-granary irrigated areas would invariably require investigations on a range of issues such as the selection of the appropriate crops based on agronomic and economic factors, institutional support systems, and additional investments for providing new or upgrading of facilities. Since the areas concerned are both extensive and widespread, it is only proper that a coordinated study be carried out in order to evaluate the prevailing scheme conditions and to prepare crop diversification strategies including the selection of the suitable crops.

To prepare crop diversification options for revitalization of the non-granary irrigation schemes with a wide range of constraints, the potential for crop diversification in each scheme area has to be evaluated and then indicated as the crop diversification patterns. Such procedure is to be defined as evaluation of resource potential for crop diversification. Its outcome will provide indications of the crop diversification patterns being a basis for formulating development plans and programs.

For non-paddy crops, irrigation has recently become an important input for crop production in Malaysia like irrigation for paddy. In order to accommodate crop diversification in the existing rice-based irrigation systems, special considerations are required for

the differences between paddy and non-paddy crops as well as paddy farmers behavior in addition to basic parameters such as soil-plant-water relations, water resources, climate, geographic, economic and social.

3.1.1 Differences between paddy and non-paddy crop

Paddy is very tolerant to fully saturated or flooded conditions, which is the main reason for it being planted in flood prone areas with heavy soils and poor drainage conditions. Non-paddy crops on the other hand need non-saturated and well aerated soils for healthy growth. Therefore poorly drained areas as found in most of the schemes can seriously affect growth and yields of non-paddy crops.

Sensitivity to water stress varies between their growth stages and also crop types. Cultural practices and production systems can be vastly different between types and varieties and the produce also tend to be more perishable than paddy.

These basic differences need some general criteria for the system design to be established. Irrigation for paddy is designed for continuous supply and drainage adequate for excess surface flow. Whereas for non-paddy, supply is intermittent since demand depends on available soil water storage and evapotranspiration rate. Besides irrigation, water is also required for fertilizer and pesticide application for non-paddy crops. Its drainage design will need to consider both surface and subsurface flows.

3.1.2 Paddy farmers' behavior

Paddy areas have a very long history of mono-cropping, and traditions and culture have evolved around paddy. Most paddy farmers are usually experienced and knowledgeable only in paddy production. Thus, diversification will require changes to deep-rooted life styles, values and technology of paddy farmers. On the other hand,

diversification will also require appropriate adjustments on its part to match with their behavior.

In this connection, a Socio-economic Sample Survey was performed in all non-granary irrigation scheme areas to identify paddy farmers' intentions and local community opinion leaders' view towards crop diversification. The results of the Socio-economic Sample Survey are presented in Appendix B for farmers' intentions and Appendix C for the leaders' opinions.

3.1.3 Determination of categories

In deciding options for crop diversification, it is apparent that there exists various possibilities for diversifying land utilization such as double cropping of paddy, combination of the main season paddy with short-term crops in the off-season, mix-farming, perennial tree crop cultivation, freshwater aquaculture, and cattle grazing ground. Any one of these taken singly or in combination with any other option can be a category. Taking into consideration the purpose of the evaluation under the Study, the following eight categories are to be made:

- Category 1 : Schemes to be converted to high value crop cultivation under irrigated condition,
- Category 2 : Schemes to be converted to tree crop cultivation;
- Category 3 : Schemes to introduce two-cropping system planting paddy during the main season and short-term annual crops during the off-season;
- Category 4 : Schemes to be converted to animal feeding crop cultivation or cattle raising fields;
- Category 5 : Schemes to be converted to freshwater fish culture ponds;
- Category 6 : Schemes to be positively maintained as mini-granary areas;
- Category 7 : Schemes to be maintained as paddy cultivation areas within a definite period of time for social welfare purposes and thereafter to be further categorized; and
- Category 8 : Schemes to be converted to housing/industrial and other uses.

3.2 Criteria for Evaluation

3.2.1 General

Inevitably, crop diversification involves the question of which crop or crops to be recommended based on a variety of factors. In the process to evaluate potential for crop diversification, each non-granary irrigation scheme is subjected to a screening process on a variety of factors. For this purpose, seven main factors are taken into account.

- Water resources availability,
- Farmers' intention towards continuation of paddy cultivation and introduction of crop diversification,
- Land suitability for carrying out direct seeding and mechanized plowing and harvesting for growing paddy,
- Soil and climatic suitability and limitations for the cultivation of specific crops,
- Crop profitability,
- Crop marketability, and
- Investment performance with regard to crop diversification.

3.2.2 Water resources availability

The evaluation of water resources in quantitative and qualitative terms is based on the information collected during the Scheme Inventory Survey. Reconfirmation of water resources availability is carried out through supplementary investigations on rainfall data, catchment characteristics, river discharges, reference on the existing hydrological procedures, and previous study reports on the availability of water resources on a specific catchment. The criteria for evaluating water availability of each non-granary irrigation scheme is expressed in the following four terms:

- A. Irrigation water is sufficient for double cropping of paddy;
- B. Sufficient for supplying irrigation water to the main season paddy cultivation but insufficient for meeting presaturation water requirement for the off season paddy cultivation;
- C. Limited to single cropping of the main season paddy and upland crop cultivation; and
- D. Insufficient for paddy cultivation but no limitation to grow upland crops for the main season.

The detailed information on water resources evaluation for the various non-irrigation schemes is compiled in Appendix A of Volume 2.

3.2.3 Farmers' intention towards continuation of paddy cultivation and introduction of crop diversification

This factor is important as the success of the crop diversification program is depended on farmers' willingness to participate and also their attitude and preference to move towards a more diversified cropping pattern. To evaluate this factor, the Socio-economic Sample Survey results are referred to in respect to paddy farmers' intention towards continuation of paddy cultivation and introduction of crop diversification.

The evaluation criteria established are based on the proportion of respondent farmers who strongly intend to continue the present paddy cultivation pattern among the total sample farmers and that of paddy planted area for the last three years (1985-1987) against the irrigable area of each scheme. The evaluation method is to identify the State in which more than half of the respondent farmers show intentions towards continuation of paddy cultivation and to screen out the scheme with paddy cropping intensity of more than 50%.

- Schemes possible for promoting double cropping of paddy in case that the proportion of intended farmers against the total samples in each State is over 50%. Also, possible for promoting double cropping of paddy if the scheme-by-scheme planted area for the last three years is more than 50% every year in case of the State with the above proportion of less than 50%.

- Schemes impossible for promoting intensive paddy cultivation when the above proportion on the State basis is less than 50% and the cropping intensity is below 50%.

3.2.4 Land suitability for mechanized farming practices

This factor is optionally evaluated to clarify suitability of undertaking modern farming practices of paddy cultivation in case of schemes where intensive double cropping of paddy can be promoted. To evaluate this factor, special attention is paid to soil physical characteristics, size of scheme, availability of mechanical service centers and distance between schemes and available service sources. The evaluation criteria is established taking into account soil physical characteristics among others as below.

- Schemes suitable for mechanized farming practices are expressed in terms of the existence of alluvial soils.
- Schemes not suitable for mechanized farming practices are indicated by inappropriate soil physical conditions derived from peat soils and organic mac soils which are featured by low bearing capacity for using tractors and harvesters commonly used in Malaysia.

The detailed information is presented in Appendix D of Volume 2.

3.2.5 Soil and agro-climatic suitability and limitations for the cultivation of specific diversified crop

These factors are the basis to identify crops suitable for each scheme from the agronomic viewpoints. In identifying suitable crops, soil criteria for optimum crop growth is prepared for the following 28 crop groups referring to documents such as "Soil-Crop Suitability Classification for Peninsular Malaysia" prepared by the Department of Agriculture (DOA), "The Land Capability Classification" collected from DOA, Sabah and "Sarawak Land Capability Classification and Evaluation for Agricultural Crops" issued by DOA, Sarawak.

Short-term food crops:

maize, sorghum, wet paddy and upland rice as food crops, and ginger, groundnut and vegetables as vegetable crops,

Fruits:

mango/durian, guava, banana, cashewnut, papaya, citrus, pineapple and watermelon,

Perennial industrial crops:

coconut, oil palm, cocoa, rubber, sago palm, coffee, tea, clove, tobacco, sugarcane and pepper,

Feeding crops:

fodder grasses and pasture.

As the basic information to evaluate soil suitability and limitations, soil services that distribute in each scheme are identified referring to the available reconnaissance soil maps and those limitations to growth of each of 28 crops are evaluated on the basis of the soil criteria. The evaluated limitations are expressed in the form of soil suitability classed with a symbol indicating the specific limitation such as acid sulphate layer, depth to compacted layer, drainage, nutrient imbalance, organic horizon, salinity, and texture and structure. The followings are the grade of limitations to crop growth.

- Class 1 soils with no limitation or only minor limitations to crop growth are suitable for the widest range of crops.
- Class 2 soils with moderate limitations to crops growth are suitable for a narrower range of crops than Class 1 soils. Minor management practices according to limitations are required.
- Class 3 soils with one serious limitation to crop growth are restricted to an even narrower range of crops. Necessary management practices involve moderate expenses.
- Class 4 soils with more than one serious limitation to crop growth are suitable for a very narrow range of crops with provision of major amelioration measures.
- Class 5 soils with at least one very serious limitation to crop growth are least suitable for crop growth.

Through the identification and grading of limitations to crop growth for soil series which is identified in each non-granary irrigation scheme, soil suitability of 28 crops is classified into four groups such as suitable, marginally suitable, very marginally suitable and not suitable for promoting crop diversification.

The correlation between suitability grades and soil classes as follows:

Suitable:

Class 1 soils,

Marginally suitable:

Class 2 soils and partly Class soils of which limitations can be physically improved,

Very marginally suitable:

Class 3 soils with limitations of which limitations can be hardly graded up by direct physical measurements, and

Not suitable:

Classes 4 and 5 soils.

After evaluating soil suitability in the above procedure, identified crops with suitable to very marginally suitable grades are to be succeedingly confirmed from the agro-climatic viewpoint. For this purpose, two basic references are utilized, being "Agro-ecological regions in Peninsular Malaysia" and "Climatic and Agricultural Planning in Peninsular Malaysia" both prepared by the Malaysian Agricultural Research and Development Institute (MARDI). Among the identified crops, those which are not suited to regional climatic conditions in the specific scheme are eliminated from a list of suitable crops identified on the basis of soil conditions.

The detailed information is presented in Appendix D of Volume 2.

3.2.6 Crop profitability

To confirm the net income difference between paddy cultivation and other diversified crops, crop budget is computed based on average crop yield under normal farming practices, production cost and selling price. For this, "Guideline on Economic Viability of Selected Crops" prepared by the Ministry of Agriculture (MOA) is used as the basic reference. This includes crop budget data on 25 food crops and vegetables, 14 fruits and one industrial crop. With regard to other industrial crops, data on crop budgets are supplemented from MOA, DOA and agencies concerned. All the information is presented in Appendix E of Volume 2. The evaluation criteria is set up as below.

- Crop suitable for promoting diversified cropping are more profitable as compared with net income derived from the single cropping of paddy.
- Crops not suitable for incorporating in diversified cropping are less profitable in comparison with the net income obtained from the single cropping of paddy.

3.2.7 Crop marketability

This factor is also very important when crop diversification is promoted in specific areas, because most paddy farmers are aware that success of diversified cropping especially for short-term upland crops demand largely on availability of markets where they can expect to sell their produce at profitable price levels.

In terms of export-oriented perennial crops, the respective responsible agencies provide smallholder farmers with easy access to the existing marketing channel actively maintained. As for short-term upland crops, the Federal Agricultural Marketing Authority (FAMA) is responsible for promotion of marketing activities to encourage growers. Every year, FAMA gives a guideline for market potential in each State for about 30 varieties of vegetables and cash crops, 20 varieties of fruits and 15 kinds of freshwater fishes and livestock products. The data on market potential is compiled in Annex F of

Volume 2. By referring to this guideline, the crop marketability is evaluated in terms of quantified market potential on the administrative district-by-district bases. The evaluation criteria is set up as below.

- Crops suitable for promoting crop diversification have less marketable volume as compared with the demand of a specific administrative district where one particular scheme is located major market situated nearby or easily accessed from the scheme.
- Crops not suitable for promoting crop diversification have marketable quantity exceeding over more than twice of the demand in the specific administration district.

3.2.8 Investment performance with regard to crop diversification

This factor is evaluated for the purpose of judging the priority among categories and crops of which suitability to promote crop diversification are both identified. The evaluation procedure is based on economic viability indicated by net present value and benefit-cost ratio.

3.3 Procedure of Evaluation

3.3.1 General procedure

The potential of crop diversification for each non-granary irrigation scheme is evaluated category by category based on the following seven stepwise procedure as illustrated in Fig. 1.

Step 1 : Evaluation water resources availability,

Step 2 : Evaluation of farmers' intention towards continuation of paddy cultivation and introduction of crop diversification,

Step 3 : Evaluation of land suitability for carrying out direct seeding and mechanized plowing and harvesting in growing paddy,

Step 4 : Evaluation of soil and climatic suitability and limitations for the cultivation of specific crops,

Step 5 : Evaluation of crop profitability,

Step 6 : Evaluation of crop marketability, and

Step 7 : Evaluation of investment performance with regard to crop diversification.

The flow chart of evaluation procedure is illustrated in Fig. 2. In general, evaluation of factors in each Category starts from Step 1 and ends Step 7 for the respective schemes. As Step 3 is the optional gate to evaluate land suitability for conducting mechanized paddy cultivation practices, all Categories other than Category 6 jumps evaluation in Step 3. Before entering Step 1, the following two items are preliminarily checked to understand the present condition on how a scheme is utilized by beneficially farmers:

- Type of irrigation water intake facilities, and
- Planted area for the last three years.

3.3.2 Evaluation procedure for Category 1

In Step 1, one scheme has potential for promoting intensive short-term upland crop cultivation under irrigated condition if available water resources are enough for double cropping of paddy and short during the presaturation period of the off season. Upland crops can be grown maximum twice a year under irrigated condition in case that available water resources can meet irrigation water demand only for the main season paddy. Irrigated cropping of upland crops are limited to the main season if available water resources are insufficient for paddy cultivation. Therefore, each scheme can pass Step 1 with the exceptions of control drainage and inundation schemes.

In Step 2, schemes are evaluated as possible for promoting crop diversification and then go to Step 4. To provide information on technical and economical choice of upland crops if requested, other schemes also move down to Step 4 additionally.

In Step 4 after skipping Step 3, suitable upland crops are firstly identified through soil-crop-suitability assessment. Further, suitable varieties of upland crops are selected among the above crops identified paying special attention agro-climatic condition in lowland areas. If there is an identified and selected crop, schemes enter into the next step.

In Step 5, net income data of the selected crops are compared with that earned from single cropping of paddy. In case of higher net income expected, schemes shift to the next step.

In Step 6, marketability of upland crops confirmed its profitability are evaluated through comparison with the local demand in the District where schemes are located and in the local marketing centers. Usually, mono-cropping of the specific upland crop is very risky from the viewpoints of crop management and marketing. In this connection, crop production is estimated based on such assumed figures as the national average yield and the maximum planted area equivalent to 50% of the scheme's irrigable area for each of profitable crops.

In Step 7, economic viability is evaluated in terms of benefit-cost ratio and net present value. For this, benefit and cost are estimated on the basis of the assumption as below. The result is used for determining the priority among marketable upland crops and in comparison with other categories.

- Cost and benefit are estimated on the unit area basis,
- Cost required for upgrading drainage and access conditions is assumed to be M\$8,000/ha and time required for constructing these on-farm service facilities is one year, and
- Benefit born before diversification depends on single cropping of paddy and after diversification comes from marketable upland crops in the same planted area of paddy. Crop budget figures refer to those used in evaluating crop profitability. Buildup period to reach the target yields of upland crops is also assumed to be five years.

3.3.3 Evaluation procedure for Category 2

In Step 1, consideration is given only to improve drainage and farm access conditions for evaluating potential for converting paddy fields to perennial crop fields. Thus, all the schemes except control drainage and inundation types go to the next step.

In Step 2, the same procedure taken for Category 1 is applied and therefore schemes jump Step 3 and enter to Step 4.

In Step 4, suitability of fruit and industrial tree crops is assessed from the viewpoint of soil-crop suitability relationship. Then, identified tree crops as suitable are evaluated on the basis of agro-climatic condition of each scheme. When a tree crop is identified and selected, schemes shift to the next step.

In Step 5, annualized net income is calculated according to the economic life of a tree crop and then compared with net income gained from single cropping of paddy. If the annualized income is higher, schemes enter into the next step.

In Step 6, profitable tree crops are evaluated to confirm those marketability as compared with local demand on the administrative district basis firstly and in major markets secondly. Crop production amount is equal to the annualized yield used for estimate of crop profitability.

In Step 7, the same procedure as taken for Category 1 is applied. Cost required for upgrading drainage and farm access conditions is assumed to be M\$4,000/ha for scheme of which soils have marginally drainage limitation to crop growth and M\$8,000/ha for the case of very marginally drainage limitation.

3.3.4 Evaluation procedure for Category 3

In Step 1, schemes with sufficient water resources for the main season paddy cultivation are identified as possible schemes where two cropping system can be promoted. While, schemes with water shortage problems during the main season are deleted from further evaluation in Step 2 and onward.

In Step 2, schemes that are evaluated as possible for promoting crop diversification and intensive double cropping of paddy go to Step 4. In case of schemes with no possibility of improving the present paddy cultivation pattern, further evaluation in Step 4 and onward is made to get information on suitable crops with those profitability and marketability as reference data.

In Step 4 after skipping Step 3, short-term upland crops suitable for the off season cultivation are identified resulting from assessment of soil-crop-suitability. Then, crop selection is made after confirming crop adaptability to agro-ecological situation in each scheme. If there is identified and selected crop, schemes move to the next step.

In Step 5, net income of the main season paddy is estimated taking into account increase in average unit yield from 2.25 ton/ha to 3.5 ton/ha through improvement of farming practices. The off season upland crops have the same yield level of Category 1.

In Step 6, evaluation of marketability is made for the off season upland crops by applying the similar method to Category 1.

In Step 7, additional investment requirement is assumed to be M\$4,000/ha. Benefit estimate and economic viability confirmation are made following the same procedure employed for Category 7.

3.3.5 Evaluation procedure for Category 4

In Step 1, no attention is paid to availability of water resources so that all the schemes can pass this step.

In Steps 2 and 3, no evaluation of these two factors is made as possibility of introducing this Category is examined from the technical and economical viewpoints.

In Step 4, soils with excessively drained feature are evaluated as possible for converting paddy fields to animal grazing land. In case of growing animal feeding crops, those suitability is assessed from the soil-crop-suitability assessment. When both results indicate as suitable for conversion of paddy fields for the livestock purpose, schemes go to the next step.

In Step 5, profitability is evaluated focussing upon the contribution of both grazing and feeding practices to livestock outputs. For this purpose, the average annual income is estimated based on beef production value obtained from unit yield of animal feeding crops. If the profit is higher than that derived from single cropping of paddy, schemes enter into the next step.

In Step 6 and , marketability is evaluated with the same procedure of Category 1.

In Step 7, additional investment cost is assumed to be M\$500/ha for the use of paddy fields to rear animals and M\$4,000/ha for growing animal feeding crops. Benefit is estimated referring to the result of profit evaluation.

3.3.6 Evaluation procedure for Category 5

In Step 1, special attention is paid to availability of sufficient water resources to meet daily freshwater requirement. If the available water resources are enough to grow paddy twice a year, schemes enter into the next step. For the case of control drainage schemes located along the coast in Sarawak, intake of brackish water is evaluated according to topographic condition.

In Steps 2 and 3, all the schemes with sufficient water resources skip these two steps with the same reason of Category 4.

In Step 4, soils with heavy texture are prerequisite to convert paddy fields to fish ponds. From the agro-climatic viewpoints, schemes with no effect of flooding are recognized as possible for promoting freshwater fish pond culture. Schemes that can pass these two checking points move to the next step. In case of brackish water fish culture, flooding or excess inundation problem is only assessed.

In Step 5, profitability is evaluated on the basis of annualized net income earned from carp, freshwater shrimp and brackish water prawn cultures by in excavated fish pond with modern practices. If higher profit is expected as compared with single cropping of paddy, schemes shift to the next step.

In Step 6, the evaluation procedure of marketability is the same as Category 1.

In Step 7, required cost for excavating fish pond is assumed to be M\$10,000/ha. Benefit is estimated by referring to the profitability evaluation results.

3.3.7 Evaluation procedure for Category 6

In Step 1, supply of irrigation water for the off season is the most important key factor for this category. Schemes pass this step if available water resources can meet the normal irrigation water demand for the off season paddy.

In Step 2, schemes evaluated as possible for promoting double cropping of paddy enter into the next step.

In Step 3, land suitability for performing mechanized farming practices is evaluated. Schemes identified as suitable pass this step and go to the next step.

In Step 4, soil and agro-climatic suitabilities are reconfirmed and schemes with no limitation shift to the next step.

In Step 5, assumption is made in terms of increase in unit yield of paddy from 2.25 ton/ha to 3.5 ton/ha per one season. Schemes pass this step.

In Step 7 after skipping Step 6, cost is assumed to be M\$4,000/ha to improve on farm-service facilities matching with undertaking of mechanized farming practices. Benefit estimate is made referring the results of profitability evaluation.

3.3.8 Evaluation procedure for Category 7

Evaluation of potential for the Category 7 is to be made in case that a scheme is presently used for the paddy cultivation purpose and no potential use for the Categories 1 to 6 is identified.

In Step 1, schemes with available water resources for the main season paddy cultivation goes to the next step.

In Step 2, schemes shift the next step if identified as impossible for promoting crop diversification from the social viewpoint.

In Step 4 after skipping Step 3, soil limitations to growth of paddy are reconfirmed. If schemes have poorly drained soils caused by frequent flooding and stagnant water problems, these are deleted from further evaluation. In this connection, inundation and controlled drainage schemes can be taken into consideration only for the case that more than half of the irrigable area is grown with paddy for the last three years. All the schemes that pass this step are identified as Category 7 without further evaluation of factors in Step 5 and onward.

3.3.9 Evaluation procedure for Category 8

If no crop diversification potential is found through evaluation for the Categories 1 to 7, the following factors are to be evaluated. These are water availability and soil limitation to crop growth. Schemes with no available water resources and unsuitable soils for crop growth are defined as Category 8.

4. RESULTS OF EVALUATION

The evaluation results of crop diversification potential are adjusted to agro-climatic factors, regional market demand for diversified crops and investment performance. The State of Melaka is included in one agro-ecological zone, Region 12. This regional climate has the advantages in growing perennial crops as described in Appendix D of Volume 2. Taking into account regional climatic suitability, recommendable crops are selected with the priority order as shown in Table 1 and some of crops judged as suitable in each step of the potential evaluation are deleted.

If marketable quantities of specific crops produced in one non-granary irrigation scheme is over the local demand within an administrative district, possibility of marketing to larger consumption centers, Johor Bahru and Kuala Lumpur, is examined by comparing surplus of marketable quantities with the regional market demand.

As a result of the above process, the crop diversification potential is adjusted to the present condition category by category for each scheme. Table 2 shows the summary of crop diversification potential evaluation. The process of evaluation is attached to this Volume 5 as Appendix in a form of scheme-by-scheme description sheet.

Among 54 non-granary irrigation schemes, as shown in Table 2, nine schemes are given with the Category 1 as the super category. With provision of regional marketing promotion activity, potential for irrigated upland crop cultivation can be expected in another 11 schemes. With respect to perennial crop cultivation under the Category 2, the first priority is given to 38 schemes and the second priority to 13 schemes. For another two schemes, the first priority is put to the Category 3. While, five schemes are grouped into the Category 7 due to no possibility introducing other crops.

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State Report

Tables & Figures

Table 1 Priority Order of Selected Crops for Each Scheme

State : Melaka (1/3)

Code No.	Scheme	Annual Crops	Perennial Crops
MA001	Air Paabas	SP	DM, RB, GV*
MA002	Air Hitam Lendu		OP
MA003	Cerana Puteh	SP	DM, RB, GV*
MA004	Durian Daun	SP	DM, RB, GV*
MA005	Kemuning		DM, RB, GV*
MA006	Kuala Sungga	SP	DM, RB, GV*
MA007	Kg. Lakok, Pekan Masjid Tanah	SP	DM, RB, GV*
MA008	Melaka Pindah	SP	DM, RB, GV*
MA009	Melekek	SP	DM, RB, GV*
MA010	Masjid Tanah	SP	RB, DM*, GV*
MA011	Parit Melana		DM, RB, GV*
MA012	Padang Sebang 1 & 11	SP	RB, DM*, GV*
MA013	Rantau Panjang	SP	DM, RB, GV*
MA014	Ramuan Cina Besar	VG, SP, GG*	DM, CN, PR, SC, PL*, CR*
MA015	Ramuan Cina Kechil	VG, SP, GG*	DM, CN, PR, SC, PL*, CR*
MA016	Rembia		DM, RB, GV*
MA017	Solok Melaka Pindah	SP	DM, RB, GV*
MA018	Solok Jementeng		DM, RB, GV*
MA019	Simpang Empat	SP	RB, DM*, GV*
MA020	Solok Kemus		DM, RB, GV*
MA021	Solok Padang Keladi		DM, RB, GV*
MA022	Solok Duku	VG, SP	CN, PR, SC, PL*, GV*
MA023	Sg. Baru Lir	SP, VG*	CN, PR, SC, PL*, GV*
MA024	Sg. Siput	VG, SP	CN, PR, SC, PL*, GV*
MA025	Sg. Buloh	SP	DM, RB, GV*

Remarks: Priority order is shown from left to right for each crop group.

*; Needs for regional marketing promotion

SP; Single cropping of paddy

VG; Vegetables

GG; Ginger

DM; Durian/mango

GV; Guava

CN; Cashewnut

CR; Citrus

PL; Pineapple

OP; Oil palm

CC; Cocoa

RB; Rubber

SC; Sugarcane

PR; Pepper

Table 1 Priority Order of Selected Crops for Each Scheme

State : Melaka (2/3)

Code No.	Scheme	Annual Crops	Perennial Crops
MA026	Tanjung Bidara	VG, SP, GG*	CN, PR, SC, DM*, PL*, GV*, CR*
MA027	Bachang	VG, SP	CN, PR, SC, PL*, GV*
MA028	Batu Berendam		CN, PR, SC, DM*, PL*, GV*, CR*
MA029	Durian Tunggal	VG*, GG*	CN, PR, SC, DM*, PL*, GV*, CR*
MA030	Duyong	SP, VG*	CN, PR, SC, PL*, GV*
MA031	Parit China	SP, VG*	CN, PR, SC, PL*, GV*
MA032	Paya Rumput Alor Gajah	SP, VG*	CN, PR, SC, PL*, GV*
MA033	Paya Rumput, Sungai Udang	SP, VG*	CN, PR, SC, PL*, GV*
MA034	Sungai Putat	SP, VG*	CN, PR, SC, PL*, GV*
MA035	Sungai Udang	VG, SP	CN, PR, SC, PL*, GV*
MA036	Tangga Batu	SP, VG*	CN, PR, SC, PL*, GV*
MA037	Tanjung Minyak	SP, VG*	CN, PR, SC, PL*, GV*
MA038	Air Panas	SP	DM, RB
MA039	Bukit Senggeh	SP	DM, RB
MA040	Chabau	VG, SP, GG*	DM, CN, PR, SC, CR, PL*, GV*
MA041	Chohong	SP	RB, DM*
MA042	Jasin 1 & 2	SP	RB, DM*
MA043	Kemenggang		CC
MA044	Lembah Nyalas	SP	DM, RB
MA045	Lubok Buaya	VG, SP, GG*	DM, CN, PR, SC, PL*, CR*, GV*
MA046	Merlimau	VG, SP	CN, PR, SC, DM*, PL*
MA047	Nyalas Gapis	SP	DM, RB
MA048	Parit Keliling	SP	DM, RB
MA049	Selandar 1 & 2	SP	DM, RB
MA050	Sempang Asahan	SP	DM, RB

Remarks: Priority order is shown from left to right for each crop group.

*; Needs for regional marketing promotion

SP; Single cropping of paddy

VG; Vegetables

GG; Ginger

DM; Durian/mango

GV; Guava

CN; Cashewnut

CR; Citrus

PL; Pineapple

OP; Oil palm

CC; Cocoa

RB; Rubber

SC; Sugarcane

PR; Pepper

Table 1 Priority Order of Selected Crops for Each Scheme

State : Melaka (3/3)

Code No.	Scheme	Annual Crops	Perennial Crops
MA051	Sempang Rim	SP	
MA052	Tambak Merlang	SP	DM, RB
MA053	Telok Rimba	SP	RB, DM*
MA054	Umbai Serkam	SP	PL*

Remarks: Priority order is shown from left to right for each crop group.

- *; Needs for regional marketing promotion
- SP; Single cropping of paddy
- VG; Vegetables
- GG; Ginger
- DM; Durian/mango
- GV; Guava
- CN; Cashewnut
- CR; Citrus
- PL; Pineapple
- OP; Oil palm
- CC; Cocoa
- RB; Rubber
- SC; Sugarcane
- PR; Pepper

Table 2 Crop Diversification Potential for Each Scheme

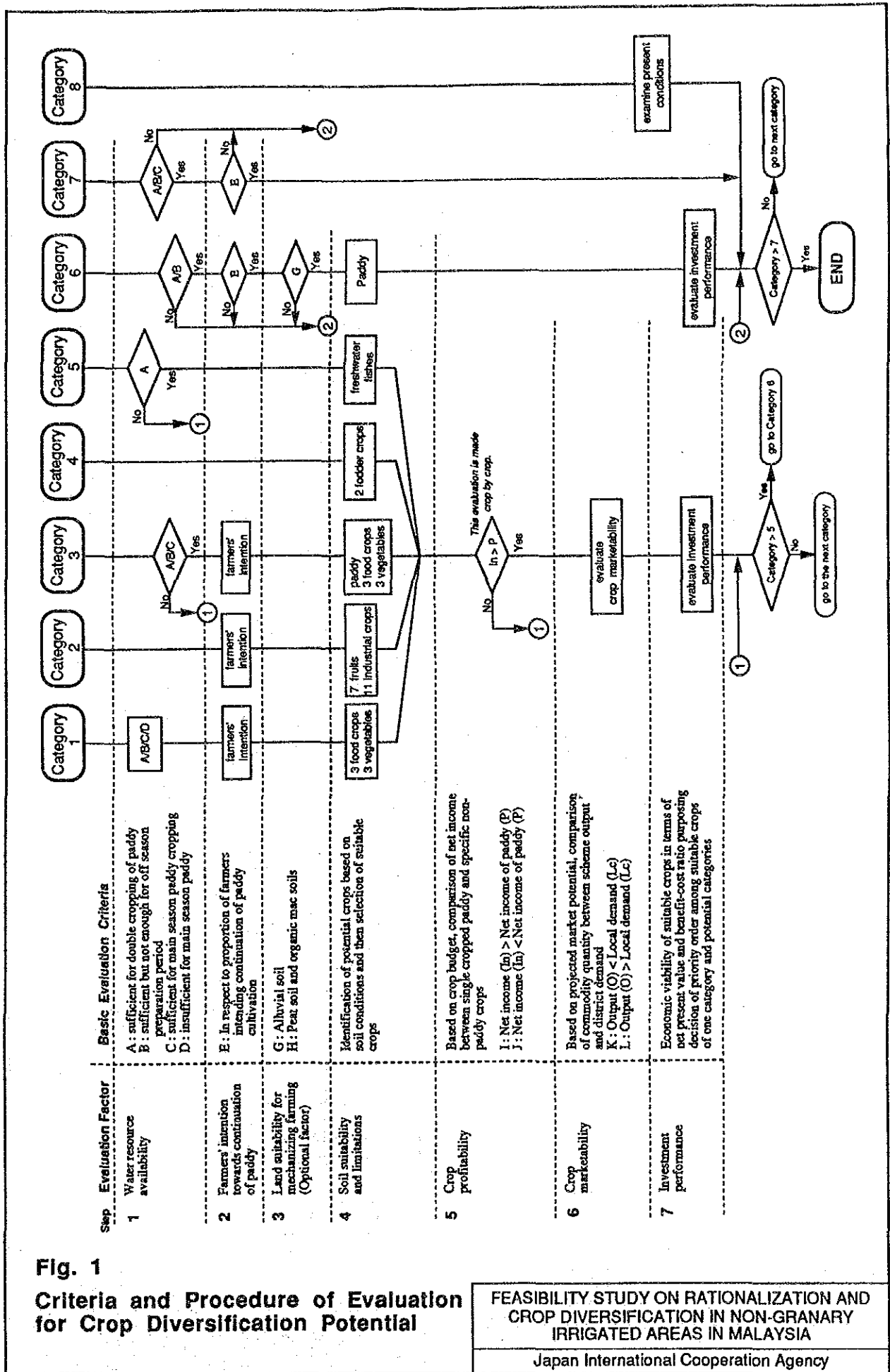
State : Melaka (1/2)

Code	Scheme	Category							
		1	2	3	4	5	6	7	8
MA001	Air Paabas	.	*1	.	.	.	.	*2	.
MA002	Air Hitam Lendu	.	*1	.	.	.	.	.	.
MA003	Cerana Puteh	.	*1	.	.	.	.	*2	.
MA004	Durian Daun	.	*1	.	.	.	.	*2	.
MA005	Kemuning	.	*1	.	.	.	.	.	.
MA006	Kuala Sungga	.	*1	.	.	.	.	*2	.
MA007	Kg. Lakok, Pekan Masjid Tanah	.	*1	.	.	.	.	*2	.
MA008	Melaka Pindah	.	*2	.	.	.	.	*1	.
MA009	Melekek	.	*1	.	.	.	.	*2	.
MA010	Masjid Tanah	.	*2	.	.	.	.	*1	.
MA011	Parit Melana	.	*1	.	.	.	.	.	.
MA012	Padang Sebang 1 & 11	.	*2	.	.	.	.	*1	.
MA013	Rantau Panjang	.	*1	.	.	.	.	*2	.
MA014	Ramuan Cina Besar	*1	*2	.	.	.	.	*3	.
MA015	Ramuan Cina Kechil	*1	*2	*2	.	.	.	*3	.
MA016	Rembia	.	*1	.	.	.	.	.	.
MA017	Solok Melaka Pindah	.	*1	.	.	.	.	*2	.
MA018	Solok Jementeng	.	*1	.	.	.	.	.	.
MA019	Simpang Empat	.	*1	.	.	.	.	*2	.
MA020	Solok Kemus	.	*1	.	.	.	.	.	.
MA021	Solok Padang Keladi	.	*1	.	.	.	.	.	.
MA022	Solok Duku	*1	*2	.	.	.	.	*3	.
MA023	Sg. Baru Lilir	*4	*1	.	.	.	.	*2	.
MA024	Sg. Siput	*1	*2	.	.	.	.	*3	.
MA025	Sg. Buloh	.	*1	.	.	.	.	*2	.
MA026	Tanjung Bidara	*1	*2	.	.	.	.	*3	.
MA027	Bachang	*4	*2	*1	.	.	.	.	.
MA028	Batu Berendam	*4	*1	.	.	.	.	.	.
MA029	Durian Tunggal	*4	*1	*1	.	.	.	.	.
MA030	Duyong	*4	.	.	.	.	.	*2	.
MA031	Parit China	*4	*1	.	.	.	.	*2	.
MA032	Paya Rumpit Alor Gajah	*4	*1	.	.	.	.	*2	.
MA033	Paya Rumpit Sg. Udang	*4	*1	*4	.	.	.	*2	.
MA034	Sungai Putat	*4	*1	.	.	.	.	*2	.
MA035	Sungai Udang	*1	*2	*2	.	.	.	*3	.
MA036	Tangga Batu	*4	*1	.	.	.	.	*2	.
MA037	Tanjung Minyak	*4	*1	.	.	.	.	*2	.
MA038	Air Panas	.	*1	.	.	.	.	*2	.
MA039	Bukit Senggeh	.	*1	.	.	.	.	*2	.
MA040	Chabau	*1	*2	*2	.	.	.	*3	.

Table 2 Crop Diversification Potential for Each Scheme

State : Melaka (2/2)

Code	Scheme	Category								
		1	2	3	4	5	6	7	8	
MA041	Chohong	.	*1	.	.	.	.	.	*2	.
MA042	Jasin 1 & 2	.	*1	.	.	.	.	.	*2	.
MA043	Kemenggang	.	*1	.	.	.	.	.	.	.
MA044	Lembah Nyalas	.	*1	.	.	.	.	.	*2	.
MA045	Lubok Buaya	*1	*2	*2	.	.	.	.	*3	.
MA046	Merlimau	*1	*2	*2	.	.	.	.	*3	.
MA047	Nyalas Gapis	.	*1	.	.	.	.	.	*2	.
MA048	Parit Keliling	.	*1	.	.	.	.	.	*2	.
MA049	Selandar 1 & 2	.	*1	.	.	.	.	.	*2	.
MA050	Sempang Asahan	.	*1	.	.	.	.	.	*2	.
MA051	Sempang Rim	.	.	.	.	.	.	.	*1	.
MA052	Tambak Merlang	.	*1	.	.	.	.	.	*2	.
MA053	Telok Rimba	.	*1	.	.	.	.	.	*2	.
MA054	Umbai Serkam	.	*4	.	.	.	.	.	*1	.
*1	Super category	9	38	2	.	.	.	.	5	.
*2	2nd priority category	.	13	5	.	.	.	.	29	.
*3	3rd priority category	.	.	.	.	.	.	.	9	.
*4	4th priority category with needs of regional marketing promotion	11	1	1	.	.	.	.	.	.



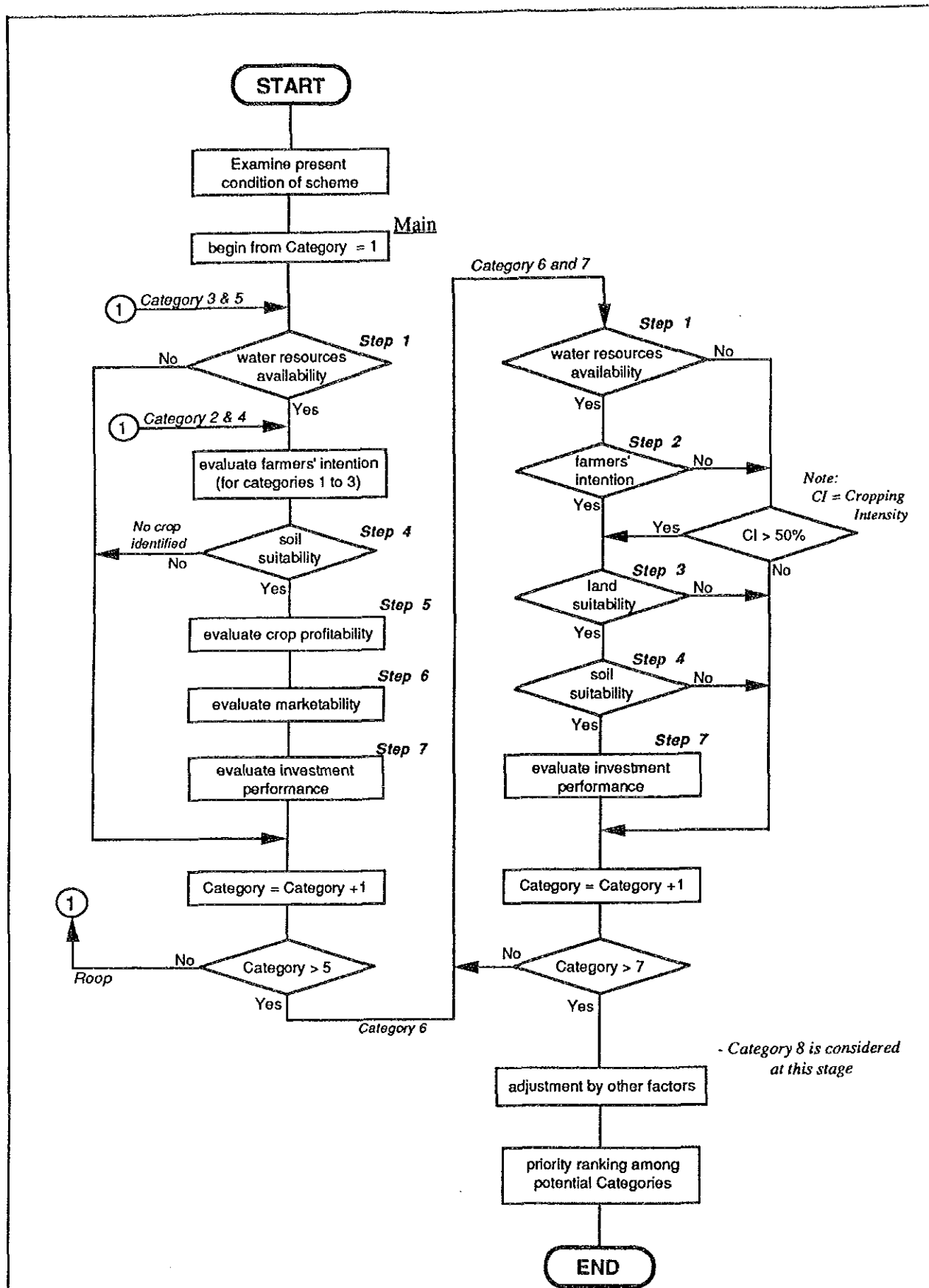


Fig. 2
General Flow of Evaluation
for Crop Diversification Potential