# Paddy farmers, irrigation and agricultural services in Malaysia

A case study in the Kemubu Scheme

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This monograph is the result of an interdisciplinary research project on irrigated paddy farming in West Malaysia. The field study was carried out in the Kemubu irrigation scheme and focused on a paddy area near Ketereh, in the state of Kelantan, in 1982.

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# I. IRRIGATED PADDY FARMING IN THE KEMUBU SCHEME

## Research orientation and methods

Although irrigated paddy farming presents itself as an agricultural activity of great complexity, a review of the literature on this subject indicates that most research projects focus on one aspect of agricultural activity only. Most studies appear to be limited to the scope of one particular discipline, e.g., agricultural economics, rural sociology, agronomy, or physical engineering. In recent years, however, much interest has been expressed in research methodologies which combine several dimensions so as to generate a more composite and balanced analysis of the complex nature of an agricultural activity. The present study is an example of the latter approach: through interdisciplinary field work and analysis, it attempts to obtain a better understanding of the many-faceted and interrelated processes of irrigated paddy farming.

To obtain a proper theoretical framework for the projected interdisciplinary study, the researchers first investigated the concept of integrated rural development. Based on an overview of the literature on this topic, Cohen (1980) identified four dominant approaches to the definition of the concept. The first conceives of integrated rural development as a process of combining components of a rural development project, considered essential to its planned outcome. The second structures its meaning on project objectives, such as increased production, income distribution or popular participation. A third approach circumscribes the concept in terms of project characteristics, such as coordinated national programmes directed at a wide population and sectoral programmes focused upon the removal of constraints or promoting social services, such as public works, education and health. The fourth approach centers on spatial planning, especially of the rural service centre, designed to benefit primarily the small, low-income farmer and populations living in nearby towns.

From these various approaches it can be deducted that there is a lack of conceptual clarity about the term. Also, the term is centered more on strategies designed by international organizations and government agencies than on decisions taken by farm households. Consequently, the concept integrated rural development was abandoned as being an insufficient base for an interdisciplinary field research with a focus on the activities of farmers in their specific environment. The prime motivation of the researchers, then, was not so much the selection and testing of a particular theory or concept, but rather to study the phenomenon of irrigated paddy farming in a comprehensive way.

The research could be typified as a descriptive field study with an emphasis on the discovery of insights in the vast and complex nature of irrigated paddy farming. The study focused on the actors in paddy production within their particular domain or environment. The undertaking of an interdisciplinary research project was seen as an experiment in itself. The research was designed to obtain sufficient information to characterize and explain the various phenomena encountered in a particular paddy area. These included the household structure and resource base of paddy farmers, the supply and distribution of irrigation water, the role of farmers' organizations, and the marketing channels of paddy. It was agreed to undertake interdisciplinary field work in a selected paddy area in West Malaysia; the disciplines involved were: agricultural economics, rural sociology and organizational sociology, irrigation engineering, agronomy and marketing.

*Research objectives*

To unravel some of the complex and interrelated processes of irrigated paddy farming, the following broad areas were delineated for field research (Daane et al., 1982, p.3):

- the physical environment, in particular the irrigation system, conveying water to paddy fields;
- the socio-economic context of paddy production which forms one important source of income to the farm families concerned; and
- the institutional framework through which services as irrigation water, fertilizers, and marketing outlets are provided to the farmers.

Of particular interest in the study were first, the activities of farm families as prime producers of paddy, within an environment of double cropping. The study was also concerned with the way in which agricultural services are provided by government agencies within the irrigation scheme. The Kemubu scheme in Kelantan was chosen as it represents one of the major irrigated paddy areas in West Malaysia, where the various operations of paddy farming could be observed in a regional context. Within this scheme only few research projects had been undertaken.

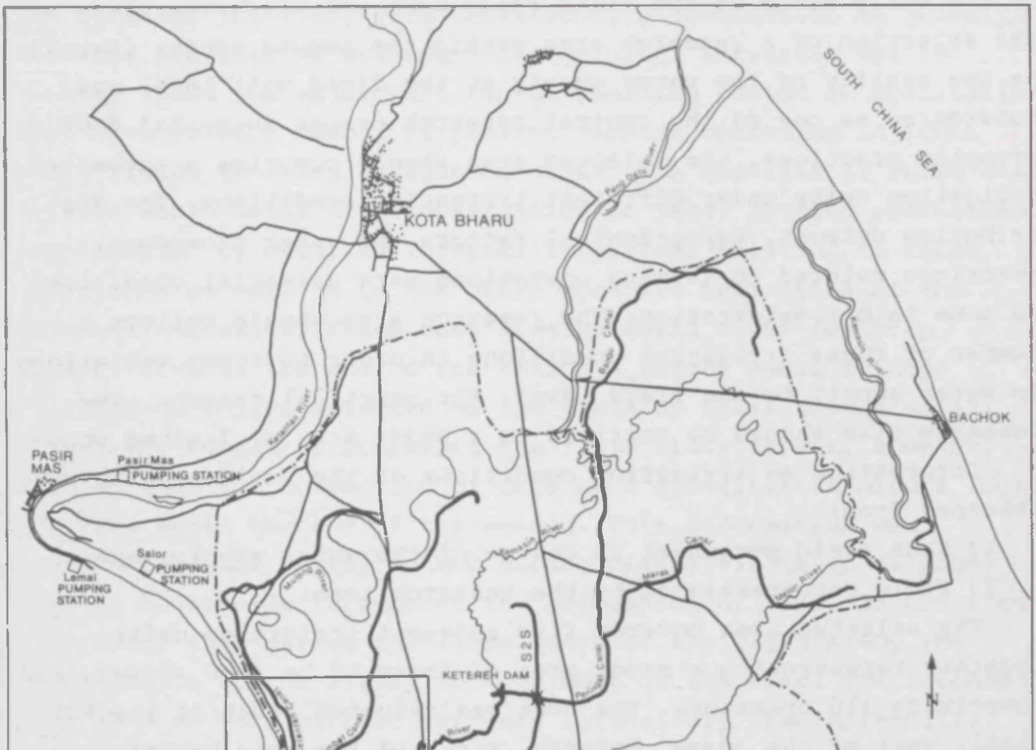
The major research objectives were the following:

1) To undertake interdisciplinary research in a specific agricultural setting, to obtain a better understanding of the interplay between social, economic, agricultural and technical factors which influence paddy farming practices; and
2) Based on the research findings, to formulate practical recommendations for improving paddy cultivation and the provision of agricultural services to farmers.

In the preparatory phase of the study the following components of paddy farming were distinguished:

(i) The farm household as the basic social unit, making use of scarce resources (land, water, inputs) in paddy cultivation;
(ii) The paddy farm as a unit of production, providing rice to the farm family and the market;
(iii) The irrigation unit, where irrigation water is supplied from a canal system and is distributed to individual farm lots;
(iv) The paddy marketing structure as the outlet for paddy producers; and
(v) The institutional structure, i.e. the set of government agencies, providing services to the farm population.

It is clear that these components are much interrelated; although they cannot be separated from each other in reality, each can be viewed as a useful abstraction to facilitate investigation by the participating disciplines. The relationship of the various research components is depicted in Appendix 1.




*Map 1. Kemubu irrigation project*

*The research area*

In the early stage of the field study much attention was given to the selection of a research area within the Kemubu scheme (Map 1). As the quality of the water supply at the field unit level was considered as one of the central research issues in actual double cropping practices, the selected area should comprise a number of irrigation units under different irrigation conditions. The distribution network, topographical factors and water management practices related to farming operations were essential conditions to take into consideration. The research area should reflect a number of these irrigation conditions in order to study variations in water supply to the field level. For practical reasons, the research site should be confined to a paddy area of limited scope.

Information on irrigation conditions of the various units was obtained from:

1) KADA field personnel in charge of the water supply; and
2) Field reconnaissance by the research team.

The selected area covered five adjacent irrigation units, together representing a paddy area of about 60 ha (150 acres), and comprising 110 operators. The area was situated south of the S2L canal, west of the river Ketereh, north of the road between Ketereh and Kg. Kedondong, and east of the road through Kg. Pasir. In the immediate vicinity of the area, two *kampungs*, Kg. Pasir and Kg. Binjal, were located. The majority of the farmers who operated a paddy lot in the area, lived in these two *kampungs*.

The area was part of the *mukim* (administrative sub-district) of Badak and Patek. It was served by the Farmers' Organization Sungei Ketereh; one large cooperative rice mill and a number of small cooperative rice mills were located in the immediate neighbourhood of the area. Considering prevalent farming conditions in Kemubu, the paddy area selected is considered as fairly representative of the cultivated part of the Kemubu scheme. Field work was implemented throughout the year 1982, but mainly focused on farm activities undertaken in the off-season.

*Research methods*

The data for the study were obtained by a combination of quantitative and qualitative methods.[1] The original intention was to firstly spend the major part of the research period on qualitative case studies of a number of peasant farmers operating adjacent paddy fields in a few irrigation units. The emphasis of these case studies would be on close observation of paddy growing operations, supplemented by detailed informal interviews relating to these operations as well as to the other economic activities of the peasants concerned. These case studies would cover one crop season. Towards the end of the season a survey would be done focusing on topics selected on the basis of these case studies.

In the course of preparing the field study it was, however, decided that the collection of data of a quantitative nature could not wait until the end of the season. This information was collected by the survey method during weekly visits to 45 paddy growing households throughout the off-season of 1982. In practice this meant that during the first month of the field study the organization of the survey took up most of the time. The intended case studies were carried out less intensively than originally envisaged. The survey respondents were taken from the irrigation units selected for the intensive case studies and included the farmers involved in these detailed analyses.

A third method of data collection involved the measurement of water levels in a specially selected field of each survey respondent and a crop cutting test as an indicator of the yield in this field. Additional crop cutting tests were carried out in fields which had been affected by water shortages or surplusses, or by pests. Finally the discharge of irrigation water to the research units was measured and a number of topographic measurements were done to check whether the command height of small canals at field level was sufficient to irrigate the higher sections of some units.

*Selection of respondents.* It was intended that the survey should cover the population of paddy growing households who operated fields within the selected irrigation units. This was done for two reasons. Firstly, it enabled a close link-up of survey information with that obtained by the case studies. Information obtained from the survey indicated interesting questions for further analysis by case studies, which in their turn provided more insights into the survey data. Secondly, it was one of the basic assumptions that the paddy growing operations of field neighbours were highly interdependent. The manner in which operators of paddy fields in the selected irrigation units were identified is contained in Appendix 2. At the start of the off-season about half of the 110 operators had been identified. The selection method caused a bias in favour of owner-operators living near the irrigation units studied.

Of the 60 paddy operators identified 45 farmers were eventually selected consisting of the following categories:

- FO members and non-members,
- Large, medium and small paddy farms (in terms of total paddy acreage operated both in and outside the research area),
- Owner-operators, owner-tenants and a few tenants.

Throughout the field research interviews were held with KADA staff at its headquarters near Kota Bharu. These informal interviews were mainly used to obtain information on the scope and organization of KADA's activities and its work programme. Of particular interest were KADA's relations and ways of communication with its field personnel, based in the Farmers' Organizations. Also, discussions were held with staff of other agencies such as DOA, MARDI and LPN. Cooperative rice mills in the scheme were also visited to assess their operations.

*Questionnaires.* Three types of questionnaires were used for the survey:

1) An inventory, assessing household composition, land tenure (paddy as well as other land), income sources of each household member, and ownership of production capital.
2) A weekly questionnaire covering such aspects as labour utilization of the household members, non-agricultural incomes, production costs and gross income of various agricultural activities. This questionnaire also focused on

water control and paddy growing practices on one selected paddy field per farmer, covering varieties grown, dates of operations, quantities and costs of inputs, methods of application, mobilization of labour and other inputs.

3) A questionnaire on the market conduct and performance of individuals engaged in paddy marketing (Appendix 2 gives more information on the questionnaires).

The combination of qualitative case studies, involving detailed observation of a number of farmers in the research area, with quantitative information obtained from the same persons by the survey method proved very rewarding. It enabled the researchers to considerably improve the reliability of the survey data by checking the answers given by the farmers. This happenend in a large number of cases and it can be stated that the reliability of the survey would have been below acceptable limits if it had been the only method used. The observation method also proved helpful to overcome survey errors in cases where the survey method appeared to be too rigid.

## Rural society in Kelantan

Rural society in Kelantan consists of farmers, fishermen, labourers, petty traders and lower echelon bureaucrats who live in villages *(kampung)* and businessmen (shopkeepers, workshop owners, money lenders) and higher echelon white collar workers who live in small commercial townships of a few thousand inhabitants. The inhabitants of these townships are connected to the business circles and the administrative bureaucracy in the state capital Kota Bharu and a few other big towns (Nash, 1974).

The ties between the village and township are manifold; not only is there a trade of agricultural inputs and products, but many of the villagers also work in the transport, business and government sector as labourers and clerks. In the administrative and political field the villages are tied to the townships by the formal relationship between village headmen *(penghulu)* and sub-district or district officers, and by the political parties with their branches at village level. Many government services are centered in the townships and send their officers out into the surrounding villages.

This integration of the village has developed progressively since the 19th century. Even in those days the Malay village was not a self-sufficient entity; it depended on imports (of clothes, foodstuffs and other necessities) and exports (of agricultural surplusses and jungle products) within a framework of order maintained by the state. Malays congregated in villages for purposes of protection and control by the district chiefs and because of advantages in having a large continuous paddy area and concentration of population (shops, labour exchange).

*Historical background*

In the 19th century the state of Kelantan had a diversified peasant economy with paddy as the main staple, but it also produced maize, coconuts, fruits, cattle and fish, mainly for domestic consumption. Occasional exports of rice were small. At times cultivation suffered from wars of succession or natural disasters, such as epidemics affecting human labour and cattle plagues, reducing the number of draught animals. These events occasionally precipitated large scale migration to other states on the peninsula and desertion of complete villages. The latest example occurred from 1870 onwards and was due to a combination of these disasters, resulting in the emigration of thousands of farm families. By the early 20th century the state seemed to have recovered.In 1911 the population was estimated at around 300.000 (Hill, 1977).

The centre of peasant agriculture was the coastal deltaic plain which accommodated three-quarters of the state's population. The remainder of the population lived in the foothills and small valleys which adjoin the plain, whereas the largest part of the state was made up of sparsely inhabited mountains covered with dense tropical forests. Isolated from the plain, a Chinese gold mining community in the middle of the jungle formed the only alien element. There were no industries, except for a small number of artisan workshops around the state capital (Hill, 1977).

The state had no role in paddy production and often did not have more than nominal control over much of its hinterland. It was headed by a sultan who ruled through district chiefs, members of the royal and noble families appointed over a sub-area of the state. As in the other Malay sultanates on the peninsula, its influence was mainly based on its control of imports and exports from the strategic location of the state capital on the mouth of the main traffic artery, the Kelantan river. The duties levied were a major source of state revenue (Gullick, 1965).

The basic social and economic unit was the household consisting of a nuclear family in a bilateral kinship system. Most villages were less than 100 years old and had been formed around entrepreneurial individuals who mobilized a group of kinsmen and neighbours from their home village to clear a piece of jungle with the consent of the district chief (Gullick, 1965).

Each large village, or cluster of adjacent small villages had a headman, a local commoner appointed by the district chief after consultation with the villagers. The village did not have indigenous institutions for self-government independent from the state and the few communal tasks in the village were performed by occasional *ad hoc* mobilization of labour from each household for the repair of a bridge or the mosque. The main task of the headman inside the village was to keep the peace by reconciling quarreling villagers. He had little formal power to achieve this end and had to rely on his conciliatory efforts and ability to maintain good relationships with all groups in the village. If conflicts could not be controlled without the use of coercion, the headman needed the help of the districts chief's strong arm (Gullick, 1965).

The colonial period (1902 - 1957) brought important changes in the structure of these villages. Firstly, the colonial administrators undercut the power of the district chiefs and appointed civil servants in their place (Beaglehole, 1976). In their role as peace keepers in the village, the headmen - who remained outside the civil service although they formed a part of the administrative hierarchy - could no longer rely on the personal support of the traditional district chief, but had to manage with the more circumscribed powers of the district officer. This reduction in outside support made them even more dependent on their conciliatory ability to solve conflicts than in the pre-colonial period. At the same time their role as exclusive intermediary between village and district also came under pressure. As this role became increasingly complicated, alternative communication channels, such as the rural secular schoolteachers, rose to a position of influence next to the existing channels, such as headman and *imam* (cf. Husin Ali, 1975).

Secondly, whereas until the early 20th century villages were strings of houses along the banks of the rivers which were the only means of transport, the colonial road construction caused a movement of houses from the riversides to locations along the newly constructed roads. As this process occurred on an individual household rather than on a village basis, the roadside villages which replaced the riverside ones were inhabited by a population originating from various villages. Whereas the original villages had been settled by groups of kinfolk and neighbours mobilized by a "natural" leader who guided them in opening up the jungle, the inhabitants of the roadside villages came as individual households and did not recognize one "natural" leader (cf. Affifudin, 1972).

Thirdly, the colonial land registration separated the connection between ownership and cultivation. In the pre-colonial period land could not be appropriated permanently without working it, cultivation was a necessary condition for control. Differences among households in land ownership and wealth, a major status criterion, must have been limited and mainly based on differences in control of labour. There was no collective control over land centered in the village community. Since the introduction of the colonial land registration, land could be accumulated without working it, as real property for its own sake, it became a commodity that could be sold and bought.

Fourthly, there was a slow growth of non-peasant occupations which accompanied the expansion of state services and construction of roads. Workers were required in workshops, small factories and commercial enterprises and as labourers in state services. As several villagers went into these occupations either on a full-time or part-time basis, there developed a still latent cleavage between those whose social and economc existence remained rooted in land and the peasant way of life and those who became partly or wholly dependent on the modern sector of the economy. The latter included such immigrants into the villages as local schoolteachers and other government servants.

*Social organization at village level*

The Kelantanese villages at the time of the fieldwork for this study could be described as relatively loosely structured co-residential groups, without internal governing institutions and without strong community feelings. The main function of the village leaders - consisting of the headman, *imam* and, informally, a number of other "contact brokers" such as the schoolteachers - was to serve as a communication link between individual villagers and the state. The politization of these leadership positions since independence has contributed to the development of politically opposed groups. The traditional functions of the leaders inside the village, such as the sporadic and *ad hoc* mobilization of labour for the upkeep of the few existing village facilities and the settling of quarrels by conciliation, can no longer be exercised, except within the leaders' own group of followers.

Social organization is based on dyadic relationships between individuals and households, i.e. on ego-focused networks which do not stop at the physical boundaries of the village. Long term corporate groups above the household level are conspicuously absent. Groups are formed on an *ad hoc* basis to solve a particular problem by the people affected and are dissolved immediately afterwards. Rights and obligations of members in these short lived groups are seldom clearly structured and roles often have to be "filled in" or "negotiated" between the individuals involved. The same holds more or less for dyadic relationships. Although they exhibit more permanence and predictability, this is limited to the short term and partners keep all options open to act differently in future. In dyadic relationships where partners are able to sanction each other's behaviour because they need each other to promote common interests, cooperation works well and can be relatively long-lived. However, where these sanctions do not apply and where successful cooperation requires full dedication of more than a few people at the same time, cooperation is problematic, especially if, as in many cases, people can become "free riders", i.e. enjoy the fruits of cooperation without actually making the contributions required of them (cf. Olson, 1969).

*Early paddy cultivation*

Within the Kelantan delta paddy was planted annually, on plots of bunded land. Most of the paddy grown was *padi-cedungan*, transplanted rice, where water was supplied mainly by rainfall or uncontrolled flooding of rivers, only seldom by controlled irrigation.[2] More inland, but still on the plain, *padi tugalan*, dibbled rice was predominant. It was grown on flat, dry fields without bunds (Graham, 1911). Given the occasional large scale migration movements, peasants were not eager to supply the large amounts of labour necessary to construct irrigation appliances (Gullick, 1965). Furthermore controlled irrigation in the natural conditions of the plain would have required the construction, maintenance and operation of large scale irrigation works involving hundreds or even thousands of peasants connected to the system. Except for the state, which was too weak to provide the necessary organization for these purposes, traditional Malay society had no organizations of this size and permanence. Apparently, no elaborate systems of water control were developed, as in the irrigation cultures of other parts of South and South-East Asia (Short and Jackson, 1971).

The agricultural policies of the colonial administrators of Kelantan aimed to construct a modernized version of the Malay sultanate based on a sturdy peasantry. The main aim was to promote paddy production. The in-migration of non-Malays and the development of commerce were deliberately constrained. Although this policy was successful in slowing down the development of non-agricultural economic activities, it failed to make paddy production attractive enough to form the stable footing on which a sturdy peasantry could prosper. In the colonial period land in the plain had become a closed resource and population pressure had increased due to political stability and improved health care. Peasants had to subsist on smaller pieces of land than before and land ownership became more polarized due to sub-division of lots and concentration, for instance because some peasants had to sell land to others in periods of hardship. Some land was also bought by urban elite groups and the rural salariat who rented it out on a share crop basis. In general, material conditions for the peasants tended to deteriorate in the colonial era (Kessler, 1978).

The developments originating in the colonial period continued after independence. In addition there was a further change in village structure and its articulation with the outside world due to the introduction of universal suffrage and political parties in the countryside. Simultaneously there was a proliferation of government service agencies that each established contact committees in the villages.

### *Large scale irrigation*

After World War II and independence, development of the Kelantan plain continued to emphasize paddy production as a major activity. During this period the federal government began implementing policies of rice self-sufficiency while improving the standard of living in the traditional rice growing areas which formed islands of poverty in a quickly developing and relatively affluent country. In these areas the major Malay opposition party had become most influential.

To achieve these development goals a number of large scale irrigation projects were constructed in various Malaysian traditional rice growing areas, including the Kelantan plain. The projects in Kelantan started with the completion of the Salor scheme in 1951 and ended with the Kemubu project in 1971. For the latter financial assistance was given by the World Bank. Société Grenobloise d'Etudes et d'Applications Hydrauliques (SOGREAH) undertook studies and prepared final engineering designs for the scheme, under supervision of the Drainage and Irrigation Department (DID). This work, which consisted purely of engineering matters, was completed in 1965. Actual construction work took three years, and the first dry-season cropping took place in 1972 (World Bank 1975).

The Kemubu scheme (19.000 ha) is by far the largest scheme, as compared to the four others - Lemal (9300 ha), Pasir Mas (2090 ha), Salor (850 ha) and Alor Pasir (560 ha). All schemes are managed by the Kemubu Agricultural Development Authority (KADA), which is responsible for the management and implementation of the scheme's development activities.

In the early stage of the project, Kemubu was considered mainly as a means of achieving double cropping of paddy in the area. Consequently, only secondary attention was given to potential yield increases and there was little consideration of crops other than paddy. Also, very few activities were undertaken on the appropriate level of on-farm development and on the distribution of irrigation water at the field level (World Bank, 1975).

## Conditions of paddy production in Kemubu

Rice forms the most important sector within Kelantan's agriculture, constituting the main activity of the farmers' population. Even after the introduction of double cropping practices paddy farming is still subsistence oriented, although production exceeds farm consumption. Basically, four conditions dominate paddy production presently:

1) the socio-economic position of the paddy farm families,
2) the physical environment, including the irrigation infrastructure,
3) cultivation practices of the farmers, and
4) the organizational framework of public agencies servicing the paddy sector.

### *Socio-economic position of the paddy farmers*

Paddy farmers in Kemubu belong to the poorer strata of Malaysia's population, and have an annual net income of $852 from paddy (Taylor, 1981).[3] In most villages the average income is below the official poverty line of $3024 per year (for 1979), non-paddy income included. In fact, most paddy farmers in Kemubu have sources of income other than paddy-production; Shand (1982) states that 60 percent of paddy farmers are engaged in off-farm activities. Thus, part-time farming is a common feature in Kemubu. There is also a tendency for the younger generation to leave the farms in search of more rewarding job opportunities elsewhere.

Paddy holdings in Kemubu tend to be small and sub-divided, with 0,89 ha as an average (Taylor, 1981). The long history of settlement practices and the gradual division of land according to Muslim inheritance laws, have contributed to the small sizes of paddy land. There are three main tenure categories: "owner operators" who work only their own land, "tenants" operating only rented land, and "owner-tenants" who operate both owned and rented land. Landlords, renting out their land but not cultivating paddy are in Kelantan mostly of old age, not able to work on their lands themselves, or they are people with another full-time job, such as teachers. Landless labourers are rare. The outcome of Taylor's survey in 1979 of the 50:25:25 proportions among owners, owner tenants and tenants in Kemubu are close to the 43:30:27 proportions for paddy farms in Malaysia, as indicated by Selvadurai (1979). According to an evaluation mission of the World Bank (1981) there is no evidence of any concentration of landowning since the introduction of double-cropping.

*Physical environment*

The wet season lasts from August to February, when the northeast monsoon winds from the South China Sea bring torrential rains, particularly in November and December. Flooding is a common feature in these months, sometimes damaging the crops. The dry season lasts from February to June, although fluctuations in monthly rainfall occur through the years (Fig. 1).

The Kelantan plain is characterized by undulating topography: paddy is cultivated on the flat land and its depressions, excess water is drained in abandoned river beds (Dobby, 1951). Houses are situated on the higher sites and usually screened by coconut palms and fruit trees. Small rubber holdings are a common feature of the landscape, although many are left untapped. The two research villages fall within the main soil association which is made up of a number of soil series with varying drainage and texture. The

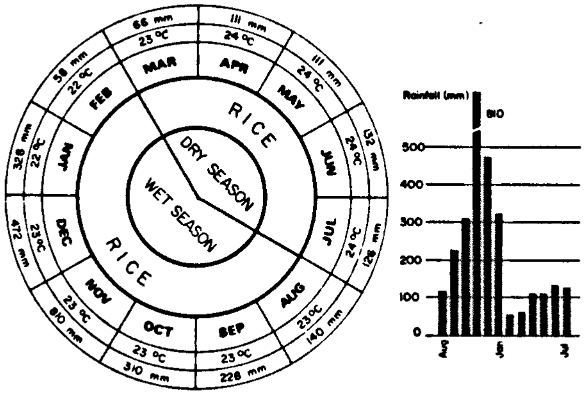



*Fig. 1. Average monthly rainfall and minimum temperature, (Kota Bharu Meteorological Station, 1967-1971), Kelantan, Malaysia*
*Source: IRRI (1975, p. 203)*

texture of the riverine alluvial soils varies from loamy clay to heavy clay soils; they are considered to be of poor quality.

The paddy fields in the Kelantan plain are served by the Kemubu irrigation scheme. The scheme obtains its water from the Kemubu pumphouse, which is located on the east bank of the Kelantan river (see Map 2). The scheme was designed to deliver a continuous supply of irrigation water, which is channeled through a system of primary, secondary, tertiary and quaternary canals. The rolling topography of the area makes it difficult to achieve a timely and equitable distribution of water. In some areas it takes three to four weeks for the water to reach the fields; when it finally arrives, some parts of the fields are deeply flooded, while other parts lack adequate water. The uneven distribution of water is also complicated by current practices of the farmers, who are not accustomed to a controlled regime of irrigation supply (Hassani, 1979). Physical and organizational problems impede adherence to water scheduling, an important factor in a double-cropping system.

*Paddy cultivation practices*

Paddy cultivation in Kemubu is of an extensive nature, mainly because of the absence of adequate water management and the prevalent interest of farmers in off-farm income. Since double cropping began, land preparation has been undergoing considerable changes, with tractors replacing traditional methods. Four-wheel tractors rented from KADA or private owners, are now in use for rotovating the land. Mechanized land preparation is practised by 99% of Kemubu's farmers (Shand, 1982). The water buffalo, however, is still in use by some farmers, mostly for harrowing.

Seedbed preparation and transplanting is done by hand. These are very labour intensive methods, requiring 25 to 35 working-days per hectare. Labour for paddy farming is characterized by the lack of communal labour organizations and the prevalence of family work. Paddy varieties in use by the farmers can be divided in two main groups: 1) short-strawed, modern varieties and 2) semi-tall, semi-traditional varieties. The last-mentioned are planted in low-lying patches of land, where the crop suffers from excess standing water. On fields with a higher elevation, short varieties are often grown. There is a regular change in varieties over the seasons.

The extremely high rainfall in November and December makes it difficult to adopt an efficient cropping calendar with suitable periods for growing two paddy crops. The best time for starting the nursery sowing is around 1 March and 1 September; in practice, it has not been possible to follow a strict cropping calendar. Sowing has been so delayed that in 1982 the cropping calendar was about two months behind the official schedule. Adequate water management at the unit level is virtually absent as a result of problems in the distribution of irrigation water. The prevalent interest of farmers in off-farm activities contribute to the loss of water through neglected field bunds, and the poor condition of the drainage system. Serious weed problems occur as farmers do not use weedkillers, neither operate weeding machines.

Since the main season of 1979/80 fertilizers were supplied free to farmers as an incentive to increase paddy production. The application of the compound fertilizer is usually undertaken between three and five weeks after transplanting. Depending on rainfall and drainage conditions fertilizers are applied into varying depths of standing water. Farmers who do not receive subsidized fertilizers have to buy them from other sources, and usually apply less than the recommendated amounts.

Climatic conditions, double-cropping practices, staggered planting over a long period, and the presence of abandoned and unplanted paddy fields aggravate the problems of insect and other pests attacks. Occasionally, control measures are undertaken by some farmers, but broad and effective measures are virtually absent.

Harvesting and threshing operations are carried out by hand: the sickle is used for harvesting. Owing to difficulties in adhering to the water schedule, most harvesting of the off-season crop is done under wet conditions. Under dry weather conditions, the paddy is always winnowed in or near the field. Most of the harvested paddy is threshed immediately, by beating the stalks in a bin. Harvesting and threshing operations require about 35 to 40 working days per hectare. Paddy yields vary extremely from season to season and over the years; with an average of 2.67 t/ha.

*Organizational framework*

In the Kemubu scheme eight Farmers' Organizations are located, operating under the jurisdiction of the Agricultural Division of KADA. These organizations provide services as a means to stimulate paddy farming in the scheme. Most important services are the distribution of the paddy fertilizer subsidy, provision of seeds of improved paddy varieties, tractor services and paddy purchase on behalf of LPN. The provision of short-term production credit was previously the organizations' major function; this has become less important with the introduction of free fertilizers in 1979.

Besides the provision of inputs, KADA also manages the supply of irrigation water through its Division of Engineering. In the present situation, a water schedule is prepared by KADA specifying the dates on which irrigation units receive water and should be drained. The schedule also shows the dates when farmers are expected to sow and transplant their paddy, and the beginning and end of the harvesting period. In practice it has not been possible to follow a strict cropping calendar. Owing to topographical factors and flaws in the design of the system, farming operations have been delayed from season to season. At the beginning of each season it is considered to postpone the supply of irrigation water so as to attune the schedule to the monsoon. Expectations of paddy farmers and political considerations impede such measures from being implemented.

*Related agencies.* Before the creation of KADA the operation and maintenance of the five irrigation schemes were responsibility of the State Drainage and Irrigation Department (DID). In 1974 the entire responsibility for operation and maintenance of the irrigation and drainage works was transferred from DID to the new authority. DID, however, remains an important agency for KADA, as it provides technical assistance with the design and construction of additional irrigation works within the schemes.

With the formation of KADA in 1973, agricultural extension services remained the responsibility of the State Department of Agriculture (DOA). In 1983 agricultural extension was transferred to KADA; DOA remained responsible for crop production, soil survey and investigation, seed production, plant protection, and agricultural subsidy schemes other than the fertilizer scheme.

Agricultural research comes under the Malaysian Agricultural Research and Development Institute (MARDI). There is a field research station near Khota Bharu, where agricultural research is undertaken on all crops except for rubber and oil palm.

The National Paddy and Rice Authority (Lembaga Padi dan Beras Negara-LPN) plays an important role as it provides marketing, drying, storage, and milling facilities for paddy. LPN is in charge of the guaranteed minimum price programme to support farm incomes. Within the Kemubu scheme, this agency operates two large drying and milling complexes. Through its paddy subsidy scheme LPN holds a powerful position in controlling the paddy market and in setting up the paddy price mechanism. Middlemen, however, continue to play an active role, especially in providing cheap transport to farmers.

Milling facilities for paddy are also provided by cooperative rice mills; one large mill is located near the research area, while several small mills are scattered over the scheme. These mills perform two major types of activities; commercial milling and milling for home consumption. In addition, some trading in paddy is undertaken. The cooperative mills sell their paddy to the LPN, particularly in the off-season. KADA is involved in a programme to rehabilitate commercial mills willing to become units of Farmers' Organizations. Furthermore, these organizations under KADA operate as agents for LPN, thus providing marketing outlets for their members and non-members. This, however, is undertaken sporadically, as paddy marketing appears a risky business for these institutions.

# II. SOCIAL ORGANIZATION AND RESOURCE BASE OF PADDY FARMING HOUSEHOLDS

## Paddy farming in the rural economy of Kelantan

Despite the fact that paddy is the main staple in Kelantan and important to secure the subsistence security of a large section of the population, paddy has never become the important commercial crop that the administrators hoped for. Traditionally the Kelantanese farmers have always looked for important additional sources of income in the form of fruit orchards, maize, tobacco, fishing and cattle raising, as well as various handicrafts and, since the early in the century, also rubber. Until the introduction of double cropping the Kelantanese also went to the Kedah paddy plain on the West coast to help with the harvest as migrant wage labourers.

The importance of non-paddy activities has not diminished since double cropping; although some of them have been reduced in importance, other non-paddy activities have come to replace them. In the last 10-15 years the non-agricultural income sources have become very important. Many villagers or their children have joined the salariat (soldiers, office clerks, schoolteachers, agricultural technicians), small factories and workshops have opened in the rural areas and urban construction has been brisk. The income that entered the villages in this way stimulated other activities such as the running of trishaws and village coffeeshops; some of the savings were invested in a taxi or van.

In recent years the greatly improved road connections have stimulated large scale labour migration to Singapore. The migrants are men below 50 years of age, who leave their family at home. On their first trip they travel with friends who already work in Singapore and have good contacts with employers, usually Chinese building contractors. The contractor provides board and lodging. Daily wages range from $20-$25 compared to $9-$12 in Kelantan (Horii, 1982). Migrants return home once in 3 - 6 months with money and electrical utensils such as radios and colour television sets. Their visits coincide with religious holidays or, if they operate paddy fields, with periods of peak labour demand in paddy production. Their wives do the rest of the paddy work alone in their absence. It is still too early to judge the effect of this migration process on the local economy both in terms of the absence of male labour and of the cash injections and the eventual return of the migrants.

The growth of other employment opportunities than paddy is generally welcomed by both young and old. The last thing parents want is that their children will become mainly dependent on paddy production. Education is considered as very important both for boys and girls, as it provides access to white collar jobs that give higher status, regular pay and a considerable number of fringe benefits (subsidized loans for cars and housing, free living quarters). The boys and girls of primary school age (7-12 years) in the 45 sample households all went to school. For the children in the 13-15 age group (lower secondary school) the percentages were 82% for boys and 100% for girls, whereas of the 16-18 age group 54% of the boys and 63% of the girls were still schooling. Primary school children were seldom allowed to take part in paddy work and were often sent home by their parents when they came out into the fields while the parents were working there. Secondary school children only lent an occasional helping hand when this was absolutely necessary, mostly at their own discretion. In general, children were not taught to grow paddy and only seriously started to learn the art when they were about to marry and had found no other alternative (cf. Kuchiba, 1980).

Of the 61 children above 20 years of age that were born from the 45 operating households interviewed, only 10 had become fully dependent on agricultural income. The other children sometimes operated a small paddy field, but were mainly dependent on non-agricultural sources of income (20 were labourers, 9 nurses and teachers, 8 soldiers, 7 clerks and 2 shopkeepers; 5 were unmarried and jobless, and still depended on their parents). Some 28% of the 61 had moved to urban areas, mainly inside Kelantan. An almost equal proportion still lived with their parents (25%) or in the same village (11%). The rest had moved to other villages in Kelantan (26%) or land settlement schemes (10%). Crude population statistics collected for the four villages and hamlets from which most of the sample households came, indicated that there was a net out-migration of 1.5% per year between 1970 and 1980.

Because of the young people's preference for non-paddy occupations there is a tendency for the average age of the paddy operators to increase. Three large-scale surveys conducted in 1968, 1976 and 1981 give the average age of the paddy farmers in the Kemubu scheme as 44, 47 and 49 years respectively (Selvadurai *et al.*, 1969, KADA, 1976, Shand *et al.*, 1982). Due to the aging of the farming population, its educational standard is also relatively low compared to that of the Kelantanese population as a whole. The majority of the operators sampled had no formal education at all, 10 (22%) had an incomplete and only 6 (13%) a complete primary education. Only one operator, a woman with small children, whose husband worked in an army camp, had a secondary education. This distribution is similar to that found for the Kemubu farmers as a whole (see Shand *et al.*, 1982).

## Household structure and income

The size of the sample households ranged from 2 to 10 with an average of 5.8 and a median of 5.7. More than three quarters of the households consisted of 4 to 8 members. In the socio-economic context of village life in Kelantan, the income earning unit is formed by the married couple of husband and wife, who combine their land, labour and capital resources and operate them jointly. Non-agricultural income is practically always earned by the husband, whereas the wife concentrates on household tasks. Agricultural labour is done by both husband and wife, depending on their availability. In some cases the wife does all the agricultural work alone, when the husband is permanently away from home (24% of the sample households) or when she is a widow or divorcee (9%). Men are seldom found in this position, because they remarry sooner.

The married couple combines its agricultural and non-agricultural income in one "pot" which is kept by the wife. Thus, in cases of nuclear households formed by the married couple and their unmarried dependent children, it is relatively easy to define "household income". In fact, most of the households sampled are found in this category (see Table 1). However, households were not always nuclear. The married couple (or single woman) forms part of a household or domestic group which passes through a certain life cycle. Initially a newly married couple stays with either of their parents, but when its members have one or two children, they build their own house and set up their own household. In a later stage this nuclear family household is extended again with parents who become too old to stay on their own. When the paddy-producing couple (or single woman) is part of a larger household involving at least one other married couple or a single adult, the definition of "household income" becomes more complicated. The question is whether one should take the income of the couple sampled, or add all incomes that flow into the extended household.

*Table 1. Kinship structure of sample households (n=45, with an average of 5.8 persons per household)*

| | % of households |
|---|---|
| Married couple without children | 4 |
| Married couple (or single woman) with unmarried children | 69 |
| Married couple (or single woman) with married children and grandchildren | 16 |
| Married couple (or single woman) with father and/or mother of either husband or wife and unmarried children of couple | 7 |
| Married couple with grandchildren | 2 |
| Married couple with married sibling of either husband or wife + sibling's children | 2 |

These extended households should not be considered as forming a single unit socially and economically. Although the members live in one house and usually eat from one pot, the various married couples and single adults each have separate economic activities and, except for the common household chores, rarely contribute labour to each other's enterprises. Paddy production is usually undertaken by only one of the couples and forms no exception to this rule.

The incomes of the various couples are not combined into one "pot" and usually there is not even a collective household budget. Each couple contributes food items for the common meals and pays for other collective expenditures, such as electricity bills, according to its ability on a completely voluntary basis. The rest of a couple's income is used to satisfy their individual needs and those of their dependent children. Nevertheless, despite of the fact that the house and all durable consumer goods and other capital items are owned by individual couples, not collectively, it is obvious that many of these items are used by all members of the household. Thus one can find a relatively poor farming couple (when judged by the couple's own income) having a house filled with good furniture, colour tv, table fan and other appliances, all belonging to a son or daughter staying with them. In this situation, an old couple benefits from the cash income earned by the younger household members whereas the latter do not have to pay for the rice they eat and the house they live in. Thus, the separate incomes of the individual couples are not a good indicator of their level of living. For this reason we have taken the total income of all household members as the "household income". However, in specific cases the income of the sampled couple has been taken separately under the name "income of operating couple".

From the viewpoint of the individual household member the income position is often unstable and can undergo sudden changes, either because of divorce of an operating couple, which is very frequent, or because married children of the couple leave the household to set up one of their own, taking along a substantial part of the parent household's non-agricultural income. The reverse happens when parents move in with children with a well paid job or when the operating couples' children who still stay with their parents find a good job.

The total household income for the 5 months covered the survey ranged from $749 to $6518 with an average of $2472 and a median of $2040. One third of the sample earned less than $1520, one third between $1520 and $2700 and the rest more than $2700. Twenty-two percent earned an income below the poverty line.

Table 2 gives an impression of the degree of dependence of the sample households on paddy income. It shows that few paddy farmers were fully dependent on paddy and that a large majority owes less than 60% of their total income to the production of paddy. For the sample as a whole only 31% of the total household income came from paddy.

*Table 2. Proportion of net paddy income in total household income and in total income of the operating couple (n=45)*

| Proportion of net paddy income in total household income is less than | Cumulative frequency (% of households) | Proportion of net paddy income in total income of operating couple is less than | Cummulative frequency (% of households) |
|---|---|---|---|
| 20% | 31 | 20% | 16 |
| 40% | 56 | 40% | 44 |
| 60% | 87 | 60% | 73 |
| 80% | 98 | 80% | 98 |
| 100% | 100 | 100% | 100 |

If one considers that in most cases agricultural income other than paddy - i.e. income from rubber, fruit orchards, a small vegetable plot, cattle, goats and poultry and a small sum earned as agricultural wage labourer - was much less than paddy income, and that on average 74% of the total agricultural income of the sample households came from paddy, it follows that a substantial proportion - in fact 58% - of the household income came from non-agricultural sources of the types mentioned earlier in this chapter. Shand (1982) mentions similar percentages: 34% of total household income from paddy, 12% from other agricultural activities and 54% from non-agricultural sources.

Non-agricultural income was earned by 35 (78%) of the operating couples, always only by the husband except for two households where the woman also earned off-farm income as a seamstress. When one considers the situation of the household as a whole (including other incomes than those earned by the operating couple), it appears that only 2 households earned no non-agricultural income at all, whereas in 11 households (24%) there were even two persons earning non-agricultural income. Such factors as operated paddy area and tenure status of the operator hardly had an influence on the level of the household incomes of the sample. A large paddy farm did not mean a higher income, but often indicated that the operator had more household labour available than others and did not want or could not get non-agricultural employment. These operators' preoccupation with paddy reduced their opportunities to earn non-agricultural income. Operators of small acreages, on the other hand, compensated their low paddy incomes with non-agricultural work. The type of non-agricultural work was mainly determined by the education level of the farmers concerned. Those with more remunerative jobs clearly earned more than their colleagues, even when the latter operated much larger paddy acreages. It seems therefore, that the major factor affecting the household income level and the income distribution was the type of non-agricultural work to which the household has access.

The importance of non-agricultural income sources is striking in contrast to, for instance, the paddy areas on the West Coast of the peninsula, where dependence on paddy is much greater (Selvadurai, 1972; Jegatheesan, 1977; Daane 1982). When one considers that the sample households came from a good double cropped area and that only paddy operators were selected for the sample, it can be concluded that the contribution of paddy to the incomes of the population of the Kelantan plain as a whole must be relatively small. Large sections of the plain were not double cropped or even completely idle and, for instance in one of the research sub-districts (*mukim* Badak) 33% of the 136 households did not farm paddy at all.

These observations do not mean, however, that paddy was of minor importance to the operators in the research area. Some of them were still primarily dependent on paddy as a major source of income. But even the farmers for whom paddy represented a relatively small proportion of their total income, considered paddy production as an important aspect of their economic activities, because it guaranteed the basic subsistance security on the basis of which non-agricultural activities could be undertaken with relatively low risk.

## Resource base of paddy farming households

*Land resources*

Within the socio-economic context of the Kemubu region, paddy farming is constrained by the access to and control by farm households over productive resources (land and labour in particular) and the opportunity cost of their use in paddy production. The Kemubu region is characterized by a preponderance of subsistence sized farms with more than 80% of farm households operating under 1.2 ha (three acres) of paddy land; this is the minimum necessary to generate a poverty line income for an average family (World Bank, 1981). Thus, while in Kemubu inequities in land distribution exist, the central issue remains the inadequacy of paddy farms to provide even subsistence level incomes for farm households.

Of the 45 sample farms, the total paddy area cultivated was 40.3 ha or an average 0.90 ha per farm household. By tenure category, owner-tenants were the largest category while there were only 2 tenants. By farm size and tenure category (see Tables 3 and 4), all farm size categories rented in paddy land, the lowest percentage being in the small farm category, while about half of the total area operated in the other two size categories were rented-in. Owner-operators cultivated on average the smallest farms followed by owner-tenants and tenants, in increasing order of size. Owner-tenants rented in about half the size of their operational acreages.

Although six forms of paddy land tenure prevail in Malaysia[4], the common forms of tenure (apart from owner-operatorship) were *sewa* (fixed rent tenancy) and *pawah* (share tenancy) among the sample farmers. Under the former, tenants acquire the right to operate paddy land subject to a fixed rental payment in cash or kind. The most common arrangement, the share tenancy agreement, subjects the tenant to rental payments of a pre-determined proportion of the crop: *bagi dua* if the harvest is equally divided between landlord and tenant and *bagi tiga* if two-third of the harvest accrues to the tenant. The *bagi dua* system predominates in the research area[5] with payments in kind or in cash. The former payment is the most popular method of paying rent either as *padi bersih* (winnowed paddy), or *pohon padi* (unharvested paddy).

In the first mode of payment which was predominant among the sample farmers, the landlord is paid his half share of the harvest in winnowed paddy. In the latter arrangement, the paddy crop is divided before the harvest with the landlord responsible for harvesting his share of the crop.[6]

It is clear that production cost sharing arrangements prevailed among the paddy farmers renting-in or renting-out land. Under the *bagi dua* system, the landlord bears all the costs of tractor services in 70% of all the rental contracts; 91% of all contracts indicate that all fertilizer cotsts are borne by him, while all harvesting costs are his responsibility in 42% of all the contracts. In fact, in nearly half of all *pawah* arrangements the landlord bears all tractor costs, supplies all the fertilizer, while the tenant undertakes the harvesting operations himself. Equal cost sharing is less prevalent under the *bagi dua* system; only 13% and 2% of the contracts indicate this situation for tractor and fertilizer costs respectively. In comparison, the tenant in a *bagi dua* arrangement bears all tractor, fertilizer and harvesting costs in 18%, 7% and 58% of the rental contracts. In 11 out of the 15 *sewa* contracts, the landlord supplies only the fertilizer, leaving the tenant to bear the major production costs. It should, however, be noted that fertilizers are fully subsidized by the government and, in theory, can only be provided to the legal owners of the land.

Approximately two decades ago, share crop contracts have undergone important changes (Bray and Robertson, 1980). Formerly, land was scarce and the contract terms favoured the landlord. The tenant had to perform all operations and bear the costs of all inputs; only at harvest time the field was split in 50-50 shares and the landowner and tenant each harvested their own share. At present, however, the pressure on land has been reduced by the growth of non-agricultural income opportunities that provide an attractive alternative to share cropping. At the same time the subsistence needs could be provided for by a smaller piece of land, due to increased land productivity under the irrigation scheme. No tenant is now prepared to pay all production costs and landowners have to offer more favourable terms to find a tenant. The landowners contribute at least 50% of the cash production costs and sometimes 100%.[7]

In the latter case the tenant is frequently obliged to harvest the landlord's share of the crop which has remained at 50%. In actual practice the content of share crop contracts shows a tremendous variety in terms of the obligations and rights of the parties involved. They vary from those in which the tenant provides all labour inputs required and the landowner pays all cash production costs, to various combinations of sharing in harvest labour inputs and cash costs between tenant and owner. The terms of the contract depend on the amount of financial risk that each party is prepared to bear, the availability of family labour, the quality and location of the field, the reputation of the tenant as a farmer and the kin relationship between him or her and the owner.

One other dimension of the tenurial system is the length of the relationship between landlord and tenant. The majority of tenancies were only of a six month duration although the range varied between six months and 20 years. The high incidence of share tenancy and short duration of the tenancy agreements suggest a high degree of variation associated with paddy production in Kemubu. This was underscored by the inability of tenant farmers in providing definite answers as to whether and which fields they planned to rent in the following crop season.

Apart from the relatively small sized operational holdings in the sample, another distinctive characteristic of the land resource base was its sub-divided and fragmented nature. Traditionally, the incidence of sub-division/fragmentation had been related to rapid rates of population growth, Muslim inheritance law, high paddy land values, lack of employment opportunities and immobility of labour and capital resources.

Tables 3 and 4 indicate that the total paddy operated area was sub-divided into 121 lots; each lot, thus, had an average size of only 0.33 ha. The number of lots per farm varied from 1 to 5 spread over the five irrigation units within which the

*Table 3. Acreage and number of lots operated by tenurial status, off-season of 1982*

| Acreage (ha) | Owner-operator (n=16) | | Owner-tenant (n=27) | | Tenant (n=2) | | Total (n=45) | |
|---|---|---|---|---|---|---|---|---|
| | total | per farm | total | per farm | total | per farm | total | per farm |
| hectares operated | 11.7 | 0.7 | 26.1 | 1.0 | 2.6 | 1.3 | 40.4 | 0.9 |
| owner-operated | 11.7 | 0.7 | 12.4 | 0.4 | | | 24.1 | 0.5 |
| *pawah* | | | 9.9 | 0.4 | 1.3 | 0.6 | 11.2 | 0.2 |
| *sewa* | | | 3.8 | 0.1 | 1.3 | 0.6 | 5.1 | 0.1 |
| Lots | number | ha's per lot | number | ha's per lot | number | ha's per lot | number | ha's per lot |
| total number | 34 | 0.3 | 82 | 0.3 | 5 | 0.5 | 121 | 0.3 |
| owner-operated | 34 | 0.3 | 36 | 0.3 | | | 70 | 0.3 |
| *pawah* | | | 36 | 0.3 | 2 | 0.6 | 38 | 0.3 |
| *sewa* | | | 10 | 0.3 | 3 | 0.4 | 13 | 0.4 |

*Table 4. Total acreage and number of lots operated by farm size, off-season of 1982*

| | Farm size | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0-0.6 ha (n=17) | | 0.6-1.0 ha (n=15) | | above 1.0 ha (n=13) | | total | |
| | total | per farm | total | per farm | total | per farm | total | per farm |
| Acreage | | | | | | | | |
| ha's operated | 8.1 | 0.5 | 12.3 | 0.8 | 20.0 | 1.5 | 40.4 | 0.9 |
| owner-operated | 6.6 | 0.4 | 6.8 | 0.4 | 10.7 | 0.8 | 24.1 | 0.5 |
| *pawah* | 1.3 | 0.1 | 3.5 | 0.2 | 6.4 | 0.5 | 11.2 | 0.2 |
| *sewa* | 0.2 | 0.1 | 2.1 | 0.1 | 2.9 | 0.2 | 5.1 | 0.1 |
| Lots | total | ha's per lot | total | ha's per lot | total | ha's per lot | total | ha's per lot |
| total | 34 | 0.2 | 41 | 0.3 | 46 | 0.4 | 121 | 0.3 |
| owner-operated | 27 | 0.2 | 21 | 0.3 | 22 | 0.5 | 70 | 0.3 |
| *pawah* | 6 | 0.2 | 13 | 0.3 | 19 | 0.3 | 38 | 0.3 |
| *sewa* | 1 | 0.2 | 7 | 0.8 | 5 | 0.6 | 13 | 0.4 |

sample farmers operated. However, several farmers also farmed lots outside the five units. In terms of tenurial status, tenant farmers had the largest sized lots followed the owneroperators and owner-tenants. Furthermore, a large majority of farms were made up of dispersed lots. This created fragmentation of the farm, the diseconomies of which were related to actual distance of one lot from all the others, although some advantages (spread of risks) were also apparent. The exact pattern in the mosaic of lots constituting a single operational unit (the farm) would, apart from inheritance, appear to depend upon the availability of lots to be rented, their physical location and the desire to spread risks between extremely high lots (which might not obtain any irrigation water) and low lying lots (which might be flooded).

*Capital and livestock resources*

The inventory of livestock resources reflects the diversity of on-farm activities with cattle, goats and poultry being reared for supplementary income. About 90% of the sample households owned cattle, with half of them owning two to three heads of cattle each. Cattle was reared primarily for meat while poultry was mainly for home consumption. None of the farmers reported owning a tractor.

*Characteristics of labour supply*

Although the average farm household size was 5.8, the sample households report that only 1.4 persons per household were actively involved in paddy production - while an additional 1.6 persons per household were partially involved. This low rate of household labour participation in paddy cultivation can be explained by three factors: (a) the farm enterprise is not attractive to younger cohorts of the household labour force and is often seen as a last resort or marginal employment for those members unable to obtain employment elsewhere; (b) the subsistence nature of paddy production in the Kemubu region related primarily to the prevalence of share cropping; and (c) the relatively high opportunity costs of labour involved in paddy production.

The size of the farm family household is a crucial determinant of family labour supply and its involvement in paddy production. However, the demographic structure of farm households exerts significant influences as age, sex and educational status determine the number and extent of involvement of household members in paddy and competing activities or occupations. Tables 5 and 6 provide different estimates of labour supply and availability for paddy growing based on the actual household size. Labour Stock 'A' is rough approximation of household members available for work as it includes everybody above 10 years old. Labour Stock 'B', however, is a relatively more refined concept as it excludes school children and household members either too old or too young to work.

Although in aggregate the labour stock 'A' and 'B' are highest for the tenant category, the rate of full and partial involvement in paddy cultivation is higher for the owner-operator class (Table 5). By farm size, the largest farms have a total of 3.5 persons per household fully and partly involved in the paddy enterprise compared to 2.9 and 2.6 in small and medium size farms respectively. It is pertinent to note, too, that the gross labour supply per household and by Labour Stock 'A' is not variant among the different farm size classes.

Tables 7 and 8 analyse the allocation of family and hired labour resources in the various paddy production operations by tenure and farm size. Three sources of farm labour are differentiated, the "other labour" category refers to community or social labour inputs utilised on a *gotong royong* basis. On the two major categories, family labour supplies 77% of all labour inputs used in paddy cultivation. The farmer and his wife typically constitute the most important sources of family labour, together contributing more than 80% of the total family labour supply in paddy production work. It is relevant here to note the estimates of family labour units reporting full involvement in paddy cultivation. Hired labour contributes 22% to the aggregate labour input in paddy farms; the balance is supplied by community labour used primarily in harvesting activities. The phenomenon

*Table 5. Labour supply by tenure status, off-season of 1982 (in number of persons)*

| Tenure status | Household size | | Labour stock A[1] | | Labour stock B[2] | | Involvement in paddy production | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | total | average | total | average | total | average | full | part | |
| owner-operated | 90 | 5.6 | 64 | 4.0 | 48 | 3.0 | 20 | 29 | 49 |
| owner-tenant | 161 | 6.0 | 100 | 3.7 | 69 | 2.6 | 41 | 37 | 78 |
| tenant | 14 | 7.0 | 10 | 5.0 | 5 | 2.5 | 2 | 5 | 7 |
| total | 265 | 5.8 | 174 | 3.9 | 122 | 2.7 | 63 | 71 | 134[3] |

[1] *Labour stock A is defined as the household population above 10 years of age*

[2] *Labour stock B is defined as the potential labour supply available for paddy production after taking into account the following: (a) school children;*
*(b) members of labour force too old to work;*
*(c) members of labour force too young to work.*

[3] *School children also report partial involvement in paddy production activities during peak periods*

*Table 6. Labour supply data by farm size, off-season of 1982 (in number of persons)*

| Farm size (ha) | Household size | | Labour stock A[1] | | Labour stock B[2] | | Involvement in paddy production | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | total | average | total | average | total | average | full | part | |
| 0 - 0.6 | 97 | 5.7 | 60 | 3.5 | 48 | 2.8 | 22 | 27 | 49 |
| 0.6 - 1.0 | 82 | 5.5 | 53 | 3.5 | 38 | 2.5 | 23 | 16 | 39 |
| above 1.0 | 86 | 6.6 | 61 | 4.7 | 36 | 2.8 | 18 | 28 | 46 |
| total | 265 | 5.9 | 174 | 3.9 | 122 | 2.7 | 63 | 71 | 143[3] |

[1] *Labour stock A is defined as the household population above 10 years of age*

[2] *Labour stock B is defined as the potential labour supply available for paddy production after taking into account the following: (a) school children;*
*(b) members of labour force too old to work;*
*(c) members of labour force too young to work.*

[3] *School children also report partial involvement in paddy production activities during peak periods*

*Table 7. Labour inputs in paddy production activities by source and tenure status, off-season of 1982 (in working days)*

| | Family labour: Operator m | Family labour: Operator f | Family labour: male | Family labour: female | Family labour: child | sub-total | Hired labour: male | Hired labour: female | total |
|---|---|---|---|---|---|---|---|---|---|
| **Land preparation** | | | | | | | | | |
| owner-operator | 14.5 | 9.8 | 2.1 | 3.7 | - | 30.1 | - | - | 30.1 |
| owner-tenant | 27.1 | 17.3 | 8.5 | 3.1 | - | 55.9 | - | - | 55.9 |
| tenant | 4.5 | 0 | 1.5 | - | - | 6.0 | - | - | 6.0 |
| **Nursery** | | | | | | | | | |
| owner-operator | 5.1 | 5.8 | 1.0 | 2.0 | 0.1 | 14.0 | - | - | 14.00 |
| owner-tenant | 21.1 | 4.7 | 2.5 | 2.9 | - | 31.2 | - | - | 31.2 |
| tenant | 1.2 | 0 | - | 0.5 | - | 1.7 | - | - | 1.7 |
| **Transplanting** | | | | | | | | | |
| owner-operator | 74.3 | 64.6 | 21.7 | 78.4 | - | 239 | 19.4 | 23.9 | 282.2 |
| owner-tenant | 157.6 | 81.5 | 55.5 | 105.5 | - | 400.1 | 2.5 | 59.4 | 462.0 |
| tenant | 22.7 | 0 | 3.5 | 6.7 | - | 32.9 | - | - | 32.9 |
| **Fertilizer and field maintenance** | | | | | | | | | |
| owner-operator | 13.0 | 13.3 | 0.4 | 0.5 | - | 27.2 | - | - | 27.2 |
| owner-tenant | 38.0 | 5.2 | 3.0 | 6.1 | - | 52.3 | - | - | 52.3 |
| tenant | 2.8 | 0 | - | 1.1 | - | 3.9 | 1.7 | 1.7 | 7.3 |
| **Harvesting** | | | | | | | | | |
| owner-operator | 107.2 | 80.5 | 80.3 | 124.6 | 7.6 | 400.2 | 45.7 | 115.3 | 561.7[a] |
| owner-tenant | 201.4 | 152.3 | 115.1 | 185.4 | 27.9 | 682.1 | 163.4 | 157.2 | 1,937.8[a] |
| tenant | 27.5 | 0 | 3 | 32.6 | 7.2 | 70.3 | 6.1 | 4.5 | 80.9 |

[a] *Other labour included*

*Table 8. Labour inputs in paddy production activities by source and farm size (ha), off-season of 1982 (in working days)*

| | Operator | | Family labour | | | sub-total | Hired labour | | Other labour | | total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | m | f | male | female | child | | male | female | male | female | |
| **Land preparation** | | | | | | | | | | | |
| 0 - 0.6 | 8.6 | 23.5 | 5.2 | 3.1 | - | 40.4 | - | - | - | - | 40.4 |
| 0.6 - 1.0 | 17.8 | 1.3 | 2.2 | 3.7 | - | 25 | - | - | - | - | 25 |
| above 1.0 | 19.7 | 2.3 | 4.6 | - | - | 26.6 | - | - | - | - | 26.6 |
| sub-total | 36.1 | 27.1 | 12.0 | 6.8 | - | 92.0 | - | - | - | - | 92 |
| **Nursery** | | | | | | | | | | | |
| 0 - 0.6 | 4.4 | 6.9 | 2.5 | 1 | - | 14.8 | - | - | - | - | 14.8 |
| 0.6 - 1.0 | 10.6 | 1.9 | - | 3 | - | 15.5 | - | - | - | - | 15.5 |
| above 1.0 | 12.4 | 1.7 | 1 | 1.4 | 0.1 | 16.6 | - | - | - | - | 16.6 |
| sub-total | 27.4 | 10.5 | 3.5 | 5.4 | 0.1 | 46.9 | - | - | - | - | 46.9 |
| **Transplanting** | | | | | | | | | | | |
| 0 - 0.6 | 52.9 | 124.3 | 55.0 | 43.7 | - | 275.9 | 1.0 | 11.9 | - | 1.1 | 291.0 |
| 0.6 - 1.0 | 146.7 | 6.0 | 6.0 | 117.7 | - | 276.4 | 18.4 | 51.7 | - | - | 346.5 |
| above 1.0 | 55.0 | 15.7 | 19.7 | 29.1 | - | 119.5 | 2.5 | 19.6 | - | - | 141.6 |
| sub-total | 254.6 | 146.0 | 80.7 | 190.5 | - | 671.8 | 21.9 | 83.2 | - | 1.1 | 779.1 |
| **Fertilizer and field maintenance** | | | | | | | | | | | |
| 0 - 0.6 | 6.1 | 14.0 | 0.4 | 1.6 | - | 22.1 | - | - | - | - | 22.1 |
| 0.6 - 1.0 | 30.9 | 2.4 | 2.3 | 3.9 | - | 39.5 | - | - | - | - | 39.5 |
| above 1.0 | 16.8 | 2.1 | 0.7 | 2.2 | - | 21.8 | 1.8 | 1.8 | - | - | 25.4 |
| sub-total | 53.8 | 18.5 | 3.4 | 7.7 | - | 83.4 | 1.8 | 1.8 | - | - | 87.0 |
| **Harvesting** | | | | | | | | | | | |
| 0 - 0.6 | 87.6 | 163.0 | 112.9 | 120.6 | 7.6 | 491.7 | 26.2 | 67.9 | 22.4 | 7.2 | 615.4 |
| 0.6 - 1.0 | 112.3 | 50.1 | 60.3 | 92.7 | 5.4 | 320.8 | 167.9 | 98.9 | 1.3 | 2.8 | 591.7 |
| above 1.0 | 136.2 | 19.7 | 25.2 | 129.3 | 29.7 | 340.1 | 21.0 | 110.2 | - | 2.0 | 473.3 |
| sub-total | 336.1 | 232.8 | 198.4 | 342.6 | 42.7 | 1,152.6 | 215.1 | 277.0 | 23.7 | 12.0 | 1,680.4 |
| grand total | 708.0 | 434.9 | 298.1 | 553.2 | 42.8 | 2,047.2 | 237.1 | 362.1 | 23.7 | 13.1 | 2,685.0 |

reflects the low level of labour productivity in paddy production. Similarly, the greater proportion of female to male hired labour mirrors the tight paddy labour market situation.

By activity, land preparation, nursery care, fertilizer application and field maintenance were virtually completely undertaken by family labour resources. Land preparation was a largely male activity but female family members contributed 33.8 working-days or 38% of the total labour accounted for by this activity. By tenure status, tenants did not report the use of any female household members while owner-operators used more female than male inputs compared to owner-tenants, no doubt reflective of the household structure. Large farms reported a minimal use of female labour inputs in land preparation, while females contributed about five times the labour inputs in small as compared to medium farms.

Nursery preparation was almost equally divided among males and females, with females contributing 42% and an insignificant percentage by child labour. The operator and/or spouse were the sole sources of labour used in transplanting for the medium size farms and the tenant category.

By activity, only transplanting and harvesting required substantial inputs of hired labour. Transplanting was undertaken by labour resources 14% of which is hired, including old female relatives. Female labour was particularly predominant in this activity, in particular among the hired labour group and to an important degree, among the family labour units involved. Tenants were not dependent at all on hired labour resources despite of the large size of their operational area; however, they were even less dependent on female household members than the other two tenure groups. All farm size groups however, were dependent upon hired labour for transplanting. The least dependence was by the small farms who generally use less female household labour compared to the other two groups.

Fertilizer application and field maintenance were solely undertaken by the farm family in the case of owner-operators and owner-tenants. These tasks were, moreover, a primarily male activity (75%) undertaken predominantly by the farm operator. For the tenant category, hired labour contributes about half of the total labour requirements, while females are relatively more visible than in the owner-operator/owner-tenant classes.

Harvesting also involved a heavy input of hired labour and proportionally more than in transplanting. While females predominated over male hired labour, the latter were relatively more important than in transplanting. In the family labour component, the role played by the operator in harvesting was less than in transplanting. Moreover, child labour contributed a substantial input into harvesting. By tenure status, the tenants were most dependent on hired labour inputs and least on female labour in sharp distinction to owner-operators and owner-tenants. The operator contributed equally to this labour-intensive task in all tenure categories. By farm size, the smallest farms were the least dependent on hired labourers, followed by the large and medium farms. It is the farm operator whose role was relatively less important in the medium and large farms when contrasted with the small farm operator.

Shand *et al.* (1980) have noted, as have other observers, that the introduction of rice double cropping has brought significant changes in labour utilization patterns in Kemubu. The aggregate demand for labour inputs has increased with higher cropping intensities, hired labour inputs have declined while family labour inputs in certain operations such as land preparation have declined markedly because of mechanization. Another significant change has been the breaking-down of the sex and role differentiation in the activities associated with the paddy growing cycle. Where previously land preparation (construction and repair of bunds and digging of trenches to drain excess water) was a male dominated activity, 38% of the total labour inputs are now contributed by females. Sexual specialization of labour in fertilizer/field maintenance and nursery preparation has traditionally not been clear although fertilizer application has tended to be male dominated. Transplanting was traditionally a female occupation with males involved in planting while females were responsible for uprooting and planting. With the actual input of females into this activity of 54% transplanting has become an activity undertaken by both sexes. In contrast, harvesting was a tedious task associated with male labour with women undertaking the cutting of the paddy stalks while males threshed the paddy. In the sample, 51% of the total labour input in harvesting was accounted for by females. In total for all operations, females contributed 50% of all labour inputs.

The estimates of labour use intensities per ha of paddy cultivated are given in Tables 9 and 10 which are based upon and should be examined alongside Tables 7 and 8. On average, total labour input per ha of paddy land cultivated amounted to 67.5 working-days compared to 87 working-days given in Shand *et al.* (1980), with 77% provided by family labour resources. Across the different tenure groups, however, the tenant farmers made most use of their family labour supply in each ha of paddy cultivation (90%) compared to 78% and 73% for owner-operators and owner-tenants respectively. By farm size, the smallest farms exhibited the highest dependence per ha of paddy cultivated on the household for their labour requirements (86%) followed by the large farms (79%) and medium-size farms (only 65%).

Labour intensities per ha were highest among the owner-operators (nearly 80 man-days), followed by owner-tenants labour allocation pattern should be related to the average paddy farm size of three tenure groups; it was largest for the tenant groups and least for the owner-operators (refer to Table 3). By task performed, a varying picture emerges: for the most labour-intensive activities, the highest labour intensities were recorded for the owner-operator farms followed again by owner-tenants and tenants. As the estimates show in Table 9, the variations in labour use in these tasks can be quite considerable and relate primarily to differences in hired labour use between the owner-operators and tenants (who do not depend on hired labour at all in transplanting operations). For the other activities, no large variations by tenure status can be discerned.

The pattern of the allocation of labour per ha of paddy cultivated is most striking when analysed by the different farm size groups. The highest aggregate labour intensities per ha are shown by the small farm reflective of the intensive nature of cultivation followed by medium and large farms and, conversely,

*Table 9. Labour inputs in paddy production activities by source and tenure status, off-season of 1982 (in working days per ha)*

| Activity (ha) | Family labour | Hired labour | Other labour | Total |
|---|---|---|---|---|
| Land preparation | | | | |
| owner-operator | 2.57 | - | - | 2.57 |
| owner-tenant | 2.15 | - | - | 2.15 |
| tenant | 2.35 | - | - | 2.35 |
| Nursery | | | | |
| owner-operator | 1.19 | - | - | 1.19 |
| owner-tenant | 1.19 | - | - | 1.19 |
| tenant | 0.67 | - | - | 0.67 |
| Transplanting | | | | |
| owner-operator | 20.42 | 3.68 | - | 24.10 |
| owner-tenant | 15.36 | 2.37 | 0.05 | 17.78 |
| tenant | 12.89 | - | - | 12.89 |
| Fertilizer and field maintenance | | | | |
| owner-operator | 2.32 | - | - | 2.32 |
| owner-tenant | 2.00 | - | - | 2.00 |
| tenant | 1.53 | 1.33 | - | 2.86 |
| Harvesting | | | | |
| owner-operator | 34.20 | 13.75 | 0.05 | 48.00 |
| owner-tenant | 26.20 | 12.32 | 1.33 | 39.85 |
| tenant | 27.53 | 4.15 | - | 31.68 |
| Total all operations | | | | |
| owner-operator | 60.99 | 17.46 | 0.05 | 78.50 |
| owner-tenant | 47.16 | 14.67 | 1.41 | 63.24 |
| tenant | 44.91 | 5.48 | - | 50.39 |

*Table 10. Labour inputs in paddy production activities by source and farm size, off-season of 1982 (in working days per ha)*

| Activity (ha) | Family labour | Hired labour | Other labour | Total |
|---|---|---|---|---|
| Land preparation | | | | |
| 0 - 0.6 ha | 4.99 | - | 0 | 4.99 |
| 0.6 - 1.0 ha | 2.02 | - | 0 | 2.02 |
| over 1.0 ha | 1.33 | - | 0 | 1.33 |
| Fertilizer and field maintenance | | | | |
| 0 - 0.6 ha | 2.72 | - | 0 | 2.72 |
| 0.6 - 1.0 ha | 3.21 | - | 0 | 3.21 |
| over 1.0 ha | 1.09 | 0.17 | 0 | 1.26 |
| Nursery | | | | |
| 0 - 0.6 ha | 1.83 | - | 0 | 1.83 |
| 0.6 - 1.0 ha | 1.26 | - | 0 | 1.26 |
| over 1.0 ha | 0.84 | - | 0 | 0.84 |
| Transplanting | | | | |
| 0 - 0.6 ha | 34.07 | 1.58 | 0.12 | 35.77 |
| 0.6 - 1.0 ha | 22.52 | 5.70 | - | 28.22 |
| over 1.0 ha | 6.00 | 1.11 | - | 7.11 |
| Harvesting | | | | |
| 0 - 0.6 ha | 60.69 | 11.60 | 3.65 | 75.94 |
| 0.6 - 1.0 ha | 26.15 | 21.75 | 0.77 | 48.67 |
| over 1.0 ha | 17.06 | 6.59 | 0.10 | 23.75 |
| Total all operations | | | | |
| 0 - 0.6 ha | 104.30 | 13.19 | 3.78 | 121.27 |
| 0.6 - 1.0 ha | 55.16 | 27.46 | 0.32 | 82.94 |
| over 1.0 ha | 26.32 | 7.88 | 0.10 | 34.30 |

the variations in average physical productivity of labour. Research data suggest that small farms, on average, use a higher labour input per ha than large farms; similarly, medium size farms tend to use a greater labour intensity than the large category. What appears even more illustrative of the intensive-extensive nature of small-to-large farms is the labour use by task performed in the cultivation of paddy. In all important tasks, the most intense labour use is by small farms followed by medium and large farms. The large variations in labour use per ha of paddy land transplanted and harvested deserve acute attention. With particular reference to harvesting operations, the variation in labour use can be explained by differences in both family and hired labour inputs utilized.

*Paddy productivity and incomes*

Tables 11 and 12 summarise the yields, cost per ha of agricultural inputs used and different definitions of income generated from paddy cultivation by farm size and tenure.

Paddy productivity was, in reality, unusually high for the off-season of 1982 as compared to the average output of only 2673 kg per ha. By tenure status, owner-operators recorded the highest yields followed by tenants and owner-tenants. These differences were statistically significant at the 5% level. By farm size, yields per ha were highest in the smallest farms due to their intensive nature of cultivation. The next highest productivity is shown by the large farm size group followed by the medium class. However, these differences were not significant at a 5% level.

In terms of total production costs (excluding rental payments), 44% was accounted for by hired labour employed more in harvesting operations than in transplanting paddy. The widespread use of mechanized ploughing in the area was reflected in the importance of tractor costs which account for the next largest proportion (42%). On average, $160.50 per ha was paid for two "rounds" of ploughing a field undertaken by the majority of farmers.[8] The balance in per ha ploughing costs related to mechanized preparation of nurseries.

*Table 11. Paddy production costs and net paddy income, per farm and per ha by tenure status, off-season of 1982 (M$)*

| | Owner-operator | Owner-tenant | Tenant | Total |
|---|---|---|---|---|
| Yield kg per ha | 3600.6 | 2954.3 | 3243.2 | 3160.5 |
| Seed per ha | 31.1 | 25.7 | 26.4 | 27.2 |
| Ploughing (& nursery) per ha | 173.1 | 170.12 | 170.6 | 170.9 |
| Fertilizer per ha | 14.1 | 18.8 | 5.7 | 16.5 |
| Insect./pest. per ha | 2.2 | 1.2 | 4.4 | 2.0 |
| Transplanting labour per ha | 46.7 | 32.3 | 0 | 34.6 |
| Harvesting labour per ha | 205.7 | 126.7 | 29.4 | 143.5 |
| Transport per ha | 23.0 | 7.9 | 17.5 | 12.8 |
| Fixed rents per ha | 0 | 37.8 | 156.8 | 34.3 |
| *Pawah* less cost sharing per ha | 0 | 240.0 | 414.3 | 181.5 |
| Net paddy income 'A' | | | | |
| per farm | 725.6 | 579.2 | 627.5 | 633.4 |
| per ha | 992.1 | 600.5 | 491.9 | 707.2 |
| Imputed family labour | | | | |
| per farm | 355.3 | 362.0 | 460.5 | 364.0 |
| per ha | 485.7 | 375.3 | 361.0 | 406.4 |
| Net paddy income 'B' | | | | |
| per farm | 370.3 | 217.2 | 167.0 | 269.4 |
| per ha | 506.4 | 225.2 | 130.9 | 300.7 |
| Rent from paddy land | | | | |
| per farm | 161.5 | 9.3 | 0 | 63.0 |
| per ha | 13.8 | 0.2 | 0 | 1.5 |
| Total paddy income 'C' | | | | |
| per farm | 531.8 | 226.5 | 167.0 | 332.4 |
| per ha | 520.2 | 225.4 | 130.9 | 302.2 |

*Table 12. Paddy production costs and net paddy income, per farm and per ha by farm size, off-season of 1982 (M$)*

| | 0-0.6 ha | 0.6-1.0 ha | over 1.0 ha | total ha |
|---|---|---|---|---|
| Yield kg per ha | 3371.6 | 2986.4 | 3180.9 | 3160.5 |
| Seed per ha | 38.8 | 30.4 | 20.7 | 27.2 |
| Ploughing (& nursery) per ha | 197.5 | 169.9 | 168.1 | 170.9 |
| Fertilizer per ha | 37.3 | 9.4 | 12.6 | 16.5 |
| Insect./pest. per ha | 2.5 | 0.3 | 2.2 | 2.0 |
| Transplanting labour per ha | 60.7 | 45.9 | 16.8 | 34.6 |
| Harvesting labour per ha | 129.6 | 201.7 | 131.1 | 143.5 |
| Transport per ha | 10.9 | 10.6 | 15.1 | 12.8 |
| Fixed rents per ha | 7.4 | 49.1 | 36.0 | 34.3 |
| *Pawah* less cost sharing per ha | 112.6 | 208.4 | 174.8 | 181.5 |
| Net paddy income 'A' | | | | |
| per farm | 301.3 | 463.7 | 1263.4 | 663.4 |
| per ha | 632.3 | 566.7 | 824.2 | 707.2 |
| Imputed family labour | | | | |
| per farm | 393.1 | 355.9 | 335.4 | 364 |
| per ha | 824.9 | 435.1 | 88.6 | 406.4 |
| Net paddy income 'B' | | | | |
| per farm | w91.8 | 107.8 | 928 | 269.4 |
| per ha | -192.6 | 131.6 | 605.4 | 300.7 |
| Rent from paddy land | | | | |
| per farm | 111.9 | 49.1 | 15.1 | 63.0 |
| per ha | 234.8 | 60.0 | 9.9 | 70.4 |
| Total paddy income 'C' | | | | |
| per farm | 20.1 | 156.9 | 943.1 | 332.4 |
| per ha | 42.2 | 191.6 | 615.3 | 371.1 |

Hired labour costs varied not only by operation (transplanting, harvesting, winnowing, threshing) but also by whether relatives are employed. It is significant to note that the highest hired labour costs per ha were incurred by owner-operators followed by owner-tenants and tenants. Although one would expect the reverse relationship, the same order of intensity of family labour use (imputed at a conservative $1.00 per hour) is shown for the three tenure groups. By farm size, a somewhat similar pattern prevailed: medium sized farms incurred the highest hired labour costs per ha followed by the small and large farms. Family labour input costs were highest for the small farms followed by the medium and large farms. Thus, although one would assume a compensation for the less intense hired labour use by family labour inputs, the relationship does not hold creating a situation where labour use intensities vary greatly by tenure status and farm size. This aspect is dealt with in greater detail in the concluding section on labour allocation patterns and the structure of household income.

The next largest input is seed costs whose variation per ha by tenure status and farm size indicates a differential rate of seeding which is highest on small and owner-operated farms. Given that chemical fertilizers, which were in widespread use, were fully subsidized by the government, it is seemingly incongruous that the farmers reported any real costs for the use of this input. However, as noted elsewhere in this publication, political biases in the distribution of fertilizer have forced some farm operators to purchase this essential input from friends or relatives. Field observations confirmed that farmers who had obtained the subsidized fertilizers applied sufficient quantities while those who paid for their supplies applied less than the optimal requirements. It is clear that the actual income generated from paddy cultivation was over-estimated to the extent that farmers utilized free fertilizers as this would have otherwise represented a considerable cash outlay. Another significant pattern is the extremely low use of preventive chemicals (insecticides/herbicides/rodenticides/weedicides) indicating a low propensity to incur costs for preventive measures or lack of information resulting in crop losses.

The per ha rental costs for *sewa* and *pawah* (less production costs borne by landlords) were, in a way, underestimates of the actual values because total rents are divided by the total acreage in each tenurial or farm size group. On an actual basis (i.e., rent payments divided by the actual number of ha rented-in), *sewa* rentals were, on average, less than half of the *pawah* rental values ($274.00 per ha compared to $654.00 per ha). This, of course, reflects a similar situation by tenurial group and farm size and can be attributed to the higher than ordinary yields for the off-season 1982. By tenure, tenants paid more than twice per ha *sewa* ($617) than owner-tenants ($259), a comparison affected by the small acreage rented-in by tenants. The variation for *pawah* rentals were of a small order; $815 per ha for tenant and $632 per ha for owner-tenants. By farm size, the differences in *sewa* among the three groups were not large: $296, $304 and $249 per ha for small, medium and large farms. In comparison, for the same farm size groups respectively, *pawah* payments per ha were $681, $733 and $605.

*Net paddy income 'A'* defines the income accruing to the farm operator after deduction of input costs and rental payments. The actual production input costs (excluding rents) were $407 per ha on average with the highest for owner-operators, $494 compared to $383 and $254 for the owner-tenants and tenants. Small sized farms, intensively cultivated, showed the second highest input costs ($459) compared to $469 and only $348 for the medium and large sized farms. Apart from the fairly uniform costs for ploughing, these variations in production input costs are explained largely by variations in hired labour utilization.

After taking into account rent payments (which do not affect the economic position of owner-operators, but affect the other two tenurial groups and all farm size classes), net paddy income 'A' was highest per ha for owner-operators followed by tenants and owner-tenants in that order of magnitude. In fact, despite of the average operational area differences, the owner-operators' average net paddy income 'A' per farm was higher than the tenants' group, who have the largest paddy farms. By farm size, the position is reversed: per farm and per ha incomes were highest for the largest farms because the rental cost burden was spread across all size categories.

*Net paddy income 'B'* defines net paddy income 'A' less imputed costs of family labour resources utilized in paddy cultivation. Despite of the significantly varying family labour intensities across tenure groups, owner-operated farms generated the highest per ha and per farm incomes followed by owner-tenants and tenants. The situation is drastically altered in the distribution of net paddy income 'B' by farm size categories because of the heavier family labour intensities in the small and medium size farms. Thus, large farms generated an income substantial larger than medium size farms; the comparison with small farms is acute as negative returns were earned by the latter category.

*Total paddy income 'C'* adds rentals received from paddy lands to net paddy income 'B' improving, not unexpectedly, the relative position of owner-operators, small and medium-size farms. A significant point to note from the perspective of the New Economic Policy and poverty eradication strategies is that even in the best paddy income definition, i.e., *net paddy income* 'A', no farm even reaches about half of the minimum poverty income of $286 per household per month for 1980. The position is exacerbated when imputed family labour costs involved in paddy production are considered; conversely, the addition of rentals from rented-out paddy land improves this position but not significantly.

### *Structure of farm household income*

The significance of paddy production and income for the sample farmers can be assessed by its relative position in the structure of total farm household incomes. Over the off-season of 1982, the researchers recorded all incomes generated from agricultural and non-agricultural sources of employment for the various members of the sample households. The sources of household income included paddy production and other agricultural income (agricultural wage labour, livestock and crop production) and non-agricultural income (wage employment, petty trading, etc.).

Overall, paddy income (inclusive of income from paddy land rented-out, see Tables 13 and 14) constituted only about 29% of total household income, which projects the marginal and subsistence nature of paddy production in the Kemubu area. When other agricultural income is added to paddy income - about 21% of total agricultural income comes from non-paddy agricultural enterprises, primarily rubber and livestock production - the dependence rises to 40% compared to 50% overall in Kemubu (Shand, 1980) and 82% in the Muda area. Non-agricultural incomes were, therefore, the major source of sustenance for the sample households while paddy and other agricultural enterprises are of lesser significance from an economic perspective, but not, as pointed out elsewhere, culturally.

Variations are noted, nonetheless, by the tenurial status and size of farm operated by the sample farmers. Tenant farmers were more dependent on their paddy enterprises than either owner-operators or owner-tenants, largely because of their relatively larger farms. The significance of other agricultural income for owner-tenants illustrates their lower dependence on paddy; on the other hand, the relative importance of non-paddy agricultural enterprises (involving the operating couple and other household members almost equally in terms of effort) for owner-operators and tenants should be observed.

By farm size, large farms would clearly depend more on paddy production as these farms earn more than 50% of their total household incomes from this source alone. This, significantly, is more than three times the corresponding proportion of small farms and twice that of the medium size farms. Reference should, in this context, also be made to their relative labour inputs in paddy cultivation. The relative importance of agricultural and non-agricultural incomes are clearly related to the size of paddy production units. Where large farms generated only 33% of their total household income from non-agricultural pursuits, the proportions are markedly greater for small farms (75%) and medium farms (64%). In the involvement and dependence on non- agricultural employment, the relative contributions of the operating couple and other household members deserve attention. The role of other household members was largest for the small farms and least for

*Table 13. Structure of household income by source and tenure status, off-season of 1982 (M$)*

| | Owner-operator | Owner-tenant | Tenant | Total |
|---|---|---|---|---|
| Net paddy income[1] | | | | |
| total | 14 193 (30%) | 15 888 (27%) | 1 255 (39%) | 31 336 (29%) |
| per farm | 887 | 588 | 628 | 696 |
| per farm/month | 117 | 117 | 125 | 139 |
| Other agricultural income[2] | | | | |
| total | 3 310 ( 7%) | 8 562 (15%) | 295 ( 9%) | 12 167 (11%) |
| per farm | 207 | 317 | 148 | 270 |
| Total agricultural income | | | | |
| total | 17 503 (37%) | 24 451 (42%) | 1 550 (48%) | 43.504 (40%) |
| per farm | 1 094 | 906 | 775 | 967 |
| Non-agricultural income (operator)[3] | | | | |
| total | 13 980 (30%) | 16 118 (27%) | 1 646 (52%) | 31 744 (30%) |
| per farm | 874 | 597 | 823 | 705 |
| Non-agricultural income (non-operator)[4] | | | | |
| total | 15 360 (33%) | 17 960 (31%) | 0 ( 0%) | 33 320 (31%) |
| per farm | 960 | 665 | 0 | 740 |
| Total household income | | | | |
| total | 46 843 | 58 529 | 3 196 | 108 568 |
| per farm | 2 928 | 2 168 | 1 598 | 2 413 |
| per farm/month | 586 | 434 | 320 | 482 |

[1] *Total value of paddy output less production costs and rentals plus rents for paddy land rented out*

[2] *Agricultural labour income and income from crops and livestock*

[3] *Wage labour outside agriculture for operator and spouse only*

[4] *Wage labour outside agriculture for other household members*

*Table 14. Structure of household income by source and farm size, off-season of 1982 (M$)*

| | 0-0.6 ha | 0.6-1.0 ha | over 1.0 ha | total ha |
|---|---|---|---|---|
| Net paddy income[1] | | | | |
| total | 7 024 (15%) | 7 692 (25%) | 16 621 (51%) | 31 336 (29%) |
| per farm | 413 | 513 | 1 356 | 696 |
| per farm/month | 83 | 102 | 271 | 139 |
| Other agricultural income[2] | | | | |
| total | 4 320 ( 9%) | 3 646 (12%) | 4 201 (16%) | 12 167 (11%) |
| per farm | 254 | 243 | 323 | 270 |
| Total agricultural income | | | | |
| total | 11.343 (25%) | 11 338 (36%) | 21 822 (67%) | 43 504 (40%) |
| per farm | 667 | 756 | 1 679 | 966 |
| Non-agricultural inccme (operator)[3] | | | | |
| total | 13 442 (30%) | 11 528 (37%) | 6 774 (21%) | 31 744 (29%) |
| per farm | 791 | 769 | 521 | 705 |
| Non-agricultural income (non-operator)[4] | | | | |
| total | 20 870 (46%) | 8 450 (27%) | 4 000 (12%) | 33 320 (31%) |
| per farm | 1 228 | 563 | 308 | 740 |
| Total household income | | | | |
| total | 45 655 | 31 316 | 32 596 | 108 568 |
| per farm | 2 686 | 2 088 | 2 507 | 2 413 |
| per farm/month | 537 | 418 | 501 | 482 |

*1 Total value of paddy output less production costs and rentals plus rents for paddy land rented out*

*2 Agricultural labour income and income from crops and livestock*

*3 Wage labour outside agriculture for operator and spouse only*

*4 Wage labour outside agriculture for other household members* the large farms. The size of households, especially the income-contributing members, the availability of non-agricultural employment opportunities and the inclination of individuals to work then come into play in this equation.

It would not be reasonable, however, to state categorically that tenurial status or farm size determine or influence the size of the total household income. As noted in Tables 13 and 14, despite of the implicit differences in farm size operated by owner-operators, owner-tenants and tenants, the average household income per household per month was highest among the owner-operators and lowest among the tenants. In like manner, the smallest farmers more than compensated for their low income dependence on paddy cultivation (and, significantly, highest per acre labour inputs) by availing themselves (and their household members) of non- agricultural employment opportunities to generate $537 per farm per month. In comparison, the large farmers earned $501 while medium size operators generate only $418.

From a policy perspective, and assuming the official poverty line at $286 per household per month in 1980, it has been noted that the net paddy income of all farm households, irrespective of tenure status or farm size falls below this minimum (average $139). Once again, the peripheral nature of paddy production in the area is underscored. By tenure, the owner-operators having the smallest farms were best off ($177), while, by farm size, it is not unexpected that the largest paddy farms generate the highest incomes although marginally below the poverty line level ($271). Two points deserve consideration in this connection: one, no account has been made of the imputed cost of family labour involved in paddy production. This would serve to reduce greatly the per farm incomes generated from the paddy enterprise, affecting the small and owner-operated farms most; secondly, the productivity per acre of paddy cultivated during the off-season has been higher than normally experienced in the region.

Taking total household incomes on a monthly basis pushes all tenure/farm size categories above the minimum poverty income line. The owner-operators and the smallest paddy farmers were better placed than the other categories. The relative significance of non-agricultural employment opportunities and the opportunity cost of remaining in paddy farming become factors to be weighed heavily.

The small-scale character of paddy production

The foregoing analysis of land and labour, and the costs and returns of paddy production, makes it possible to analyse the socio-economic nature of paddy production in more detail. As indicated above, the paddy acreages operated by households in Kemubu fall within a relatively limited range.[9] This is because productivity levels in paddy production and prevailing (opportunity) costs of land and labour make that farmers limit their operated paddy acreage to an area that can be managed almost completely by the available family labour stock, with at the most a small supplement of hired labour. Thus, large landowners rent-out (*pawah*) the surplus land which they cannot operate with the available family labour capacity. On the other hand, small landowners do not rent-in more land than corresponds with the excess labour capacity of the household.

The logic of these choices will be demonstrated for both small and large landowners below. Suppose a small landowner (or landless) with excess labour capacity rents-in land on a share crop basis: in case the only input which the tenant provides is labour, he can expect a return for his labour input of 50% of the gross production value, i.e. between $625 and $850 per ha in an average season. Given a labour input of an average 500-600 hours per ha the per hour net return for the tenant's family labour is only $1.04 - $1.70,[10] which is very near to the market wage rate for unschooled irregular non-agricultural labour ($1.50 per hour) and for agricultural labour ($1.50 - $2.00 for threshing and $1.00 for other work).[11] If the gross yields fall below 2.5 ton/ha (which happened to 5 (11%) of the sample farmers, even in the favourable conditions of the 1982 off-season) tenants earn a per hour net return below the opportunity cost of their household labour.

It follows that operation of a share cropped field with 100% dependence on wage labour gives a near zero return to the tenant. Therefore operation of share cropped fields is only attractive in so far as this provides employment to household members whose labour has little or no opportunity cost, i.e. women and elderly people: although some women do hire themselves out as wage labourers in paddy production, or as share tappers, most of them are unwilling to do so. Other jobs than agricultural wage labour are seldom performed by women. Thus, although male operators (whose labour has a high opportunity cost) do work on share cropped fields, - in fact the sexual distribution of labour on share cropped fields does not differ from that on owner-operated fields - share cropping is only attractive because a part of the labour input comes from household members who otherwise could not be gainfully employed and now obtain a labour income. In good years (high yields) these household members earn slightly more per hour in this way than a wage labourer, but in bad years they earn less than the market wage rate.

Under these circumstances, and given the limited labour capacity available in most households which was seldom enough to cope with more than 1.5 ha, it is not surprising that these were no small land owners who extended their paddy acreage beyond this limit, by renting in more land. Any larger acreage would require the use of wage labourers who are scarce in periods of high demand and often are elderly people with a lower productivity than household labour; it is likely that these labourers produce less than they cost when all the work is left to them.

In case a large land owner owns more paddy land than he can operate with available labour capacity, he has the choice between renting out the surplus land on a 50-50 share crop basis or operating it with 100% wage labour. In te latter case the household earns a gross production value of \$1250-\$1700 per ha depending on the yield. The costs are those for land preparation (\$160 per ha) and labour (\$600-\$700 per ha).[12] This leaves a net return of \$390-\$940 per ha, whereas in case the land is rented out the net return is 50% of the gross production value minus the land preparation cost, i.e. \$465-\$690 per ha. Again it should be added that the net returns of operation with wage labour are flattered, because the labour cost might actually be higher than the estimated $600-$700 per ha due to the low productivity of wage labourers. Under these conditions many land owners prefer to rent out their surplus land on a share crop basis. It is, however, often not economically attractive to rent out more than the surplus land. By retaining part of the land to be owner-operated with family labour, the household increases its income from this land by 50% of the gross production value, compared to the return that would be obtained by renting out this land on a share crop basis, i.e. by $625-$850 per ha. This marginal income is obtained at a marginal cost of 500-600 labour hours. As part of the labour stock of most households has a low opportunity cost it pays to employ this labour stock and, thus, many large landowners retain part of their land to be operated with family labour.

These various calculations explain why practically all operated paddy acreages converge within a limited size-range. Although this explanation was inferred from the researchers' observations in the first instance it was later confirmed by various farmers that such considerations lay at the basis of their "size strategy" concerning the operated paddy acreage.

It appears that the remaining variation in operated paddy acreage is dependent on the variation of available household labour stock, but still more on the degree to which the household wishes to exploit this labour stock. The latter factor is mainly determined by the household's access to more remunerative non-agricultural employment: the easier the access, the less the household exploits its own labour resources for paddy production. Therefore, those with off-farm employment either farm a small or a medium, but seldom a large acreage; and in case they farm a medium acreage they are more prepared to reduce the labour burden of the household by hiring in some additional labour when the family gets tired during peak periods of labour input. However, those with no access to off-farm employment are forced to exploit their household labour stock to a much larger extent. They have to operate a larger acreage, but unlike the medium farms with off-farm employment, they cannot reduce the labour burden by hiring in wage labourers. Thus the sample operators of large acreages made substantially less use of wage labour (on a per ha basis) than farmers with medium acreages. Of the 3 sample farmers who operated paddy acreages above 2.0 ha, two made no use of wage labour at all and staggered their transplanting and harvesting operations over a period of more than a month. When all other farmers had long finished their paddy work one could still see these families at work on their fields. From personal acquaintance with these farmers we know that they operated these large acreages because they did not want or could not get more remunerative non- agricultural employment and were therefore primarily dependent on paddy. The survey results show that the higher the dependence of an operating couple or a household on paddy (as measured by the share of net paddy income in total net income) the lower the per ha expenditure on wage labour. This relationship is statistically significant at a 1% level.

It can be concluded that in Kemubu, paddy production is a competitive economic activity *only* when it is undertaken with household labour, i.e. on a small scale. Farmers consider it mainly as a cheap way to provide for the subsistence needs of the family, i.e. cheaper than having to buy *beras*.[13] In addition, in seasons with a good yield the scale of the surplus provides a substantial amount of cash income obtained at a low opportunity cost. Furthermore, most people consider that the growing of enough paddy for subsistence is necessary to secure the livelihood of their family. Even those factory workers who earned much higher daily wages than they could earn with paddy production, left the factory for three weeks or a month in the transplanting and harvesting periods to be able to grow paddy for home consumption. They were aware of the relatively low returns, but pointed out that they had to grow paddy to make sure that they had enough to eat in case they could not do factory work for some time, because of sickness or a desire for leisure. Money could never provide this security, because they were unable to control their cash expenditures sufficiently, whereas the speed of depleting a paddy stock was constrained by the capacity of the mouths which they had to feed.

Labour allocation on the structure of household income

The structure of household income reflects decisions about the allocation of family labour resources across different agricultural and non-agricultural activities. In making such a statement, one assumes that the farm household operates a single decision-making unit in so far as labour allocation among competing enterprises and opportunities is concerned. This is a simplifying (and simplistic assumption) which, in all probability, as discussed earlier in this chapter, may not reflect the real situation of the farm household. One also makes the assumption that family labour units behave rationally in allocating their labour resources among competing occupations. In effect, the implicit understanding is that household members compare their returns to labour in different occupations. Related to this assumption is the notion that paddy growing is a "core" cultural activity for the Kemubu farmers but not necessarily one with predominant economic significance. One adopts another assumption in defining rational behaviour on the part of family labour units - that those persons able to work and knowledgeable about the opportunities for gainful employment whether in the farm vicinity, in the environs of Kota Bharu and provincial towns or further afield - have an equal inclination and psychological predisposition to undertake gainful employment.

The problem that is central to the pattern and motivations underlying the allocation of household labour resources among competing employment oppurtunities is not made less complex by the fact that other variables can be postulated to have deterministic force. Among these are the size of the potential family labour force, size of paddy land and other land resources owned/operated and returns to labour in different enterprises.

In the earlier discussion on labour supply characteristics, data on the household size, different notions of potential labour supply and full/partial involvement in paddy cultivation were presented, together with estimates of labour use intensities. To simplify the analysis below, the labour allocation patterns related to total household income structure are limited to the size distribution of paddy farms operated by the sample farmers.

It is important to recount that although household size varies by farm size, there is a clear relationship between operated paddy acreage and available labour capacity. However, research data suggest a higher intensity of labour use per ha of paddy cultivated in the small farms compared to the large farms. This is reflected in an additional fact that can be derived from Tables 5 and 6. On a per ha basis, the full/partial involvement of household members in small farms is 2.7/3.5 persons compared to 1.0/1.5 persons for the large farms. Also, the small farms are more dependent on family labour resources than the large farms, hence, the latter category employs more hired labour than the former. It has also been shown that the intensive nature of small-scale farming leads to higher productivity per ha cultivated in the small farm category than the large farms. However, the lowest productivity per ha is shown by the medium size farms.

Although in percentage terms, paddy income accounts for only 15% of total household incomes of the small farmers, the higher intensity of family labour use (despite of similarly higher intensities in paddy cultivation) in non-agricultural work generates a level of total household income exceeding that attained by the large farmers. If one assumes that the higher labour intensities in small-scale farming are off-set by the scale of operation of the large farms, it is difficult to explain why in percentage terms, the small farms are able to exploit off-farm employment opportunities to the extent that they earn twice what the large farms generate. In absolute dollar terms, the difference is even wider. Even if imputed family labour costs are taken into account, the large farms, on average, only earn marginally higher incomes than the small farms. The differences in total household income can, then, only be hypothesized to relate to access to and knowledge of the labour market especially of off-farm jobs, willingness to work and nature of off-farm work which can facilitate occasional labour inputs in paddy and other agricultural pursuits, if necessary. It could also be postulated that large farms have a target income, but this is less plausible.

The medium size farms have a greater intensity of labour use in paddy agriculture than the large farms. Moreover, they are more dependent on hired labour inputs in paddy activities; in fact, among the three size classes, medium size farms are dependent on hired labour for 35% of all labour inputs. Despite of this situation and an average paddy acreage less than half the large farms, medium size farmers are able to generate twice the income, in percentage terms, from non-agricultural pursuits. It is true that their total household incomes are the least among the three farm size categories related primarily to their low paddy yields.

Tables 15 and 16 present data on the acreages of paddy land rented out and rubber/other crop land operated or leased out by tenure category and farm size. Table 3 has shown that all farm size classes rent-in paddy land which constitutes 70% of the total operated paddy acreage. The smallest farms rent-in only 20% of the total acreage operated in that category, while the other two classes rent-in about 45% each. In sharp contrast, all farm size groups rent out paddy land; the small farms rent out close to 72% of the total acreage leased out compared to smaller corresponding percentages for the remaining farm size groups.

*Some exploratory hypotheses*

In bringing together the factors presented above related to household size, labour involvement in paddy operations, land resources managed, and the structure of total household income, the following hypotheses appear to be relevant:

1. The pattern of renting-in and renting-out paddy land, especially by the small farms, appears to indicate that a minimum acreage of land is preferred for paddy cultivation in order, apparently, to ensure security of a staple food crop. This subsistence food security goal is reflective of the cultural affinities that Malay paddy cultivators still exhibit for paddy growing. Such a predisposition is, naturally, hard to justify in the Malaysian environment where rice supplies are abundant, whether domestically produced or imported. The renting-in and leasing-out of paddy land also rationalizes the management of paddy lots constituting the farm as distance, physical elevation, etc., are factors that require consideration in minimizing the uncertainties facing paddy cultivation in the Kemubu area.

*Table 15. Area (ha) of paddy land rented-out, and rubber/other crops operated or rented-out by tenure status of paddy farm, off-season of 1982*

| Tenure status | Paddy land | | | | Rubber land | | Other crops | |
|---|---|---|---|---|---|---|---|---|
| | *pawah* | | *sewa* | | | | | |
| | total | per farm | total | per farm | total | per farm | total | per farm |
| owner-operated | 4.7 | 0.30 | 0.8 | 0.05 | 7.1 | 0.71 | 0.73 | 0.14 |
| owner-tenant | 0.3 | 1.01 | 0.0 | 0.00 | 20.3 | 1.13 | 5.7 | 0.52 |
| tenant | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 | 0.0 | 0.00 |
| total | 5.1 | 0.11 | 0.8 | 0.05 | 27.5 | 0.98 | 6.4 | 0.40 |

*Table 16. Area of paddy land rented-out, and rubber/other crops operated or rented-out by farm size of paddy farm, off-season of 1982*

| Farm size | Paddy land | | | | Rubber land | | Other crops | |
|---|---|---|---|---|---|---|---|---|
| | *pawah* | | *sewa* | | | | | |
| | total | per farm | total | per farm | total | per farm | total | per farm |
| 0 - 0.6 ha | 3.4 | 0.20 | 0.00 | 0.00 | 6.5 | 0.59 | 1.8 | 0.26 |
| 0.6 - 1.0 ha | 1.6 | 0.11 | 0.00 | 0.00 | 13.0 | 1.45 | 3.2 | 0.54 |
| over 1.0 ha | 0.0 | 0.00 | 0.8 | 0.06 | 7.9 | 1.00 | 1.4 | 0.47 |
| total ha | 5.1 | 0.11 | 0.8 | 0.06 | 27.5 | 6.98 | 6.4 | 0.40 |

2. The returns to paddy production are clearly very low and can be adduced by the levels of net paddy income 'B' in Table 11. Returns are low despite of the extensive support provided for rice prices and subsidies on fertilizer inputs. The fact that labour is retained in paddy production despite of high opportunity costs can be explained by the subsistence security nature of the crop and the difficulties of obtaining gainful employment elsewhere. This is a especially the case for women and the aged. Also the opportunity costs of land resources in paddy cultivation are low.
   It would seem that the large farms do not behave rationally in renting-in fairly substantial acreages of paddy land especially when returns are low, labour-use intensities in paddy cultivation are also low, and the problems faced in obtaining hired labour during peak periods of the paddy cultivation regime. The large average household size of the large farms may well be a motivation to rent-in land resources for paddy cultivation so as to ensure subsistence security but is not fully acceptable because the difference in family size is disproportionate to the acreage of land rented-in.

3. It would be convenient to assume that the large farmers as contrasted to the small and medium farmers are less motivated to seek and exploit off-farm employment. This assumption has been confirmed in personal interviews with some of the larger farmers. However, it needs to be investigated in a more methodical fashion than in this project together with the operation of the off-farm labour market as a whole, in the research area within the region, and in other parts of Peninsular Malaysia.

4. Among the three farm size classes, the small farmers appear to have the best (but not necessarily the optimum) strategy of labour allocation among different enterprises. The medium size farmers rank second best while the large farmers would benefit economically if they were to reduce their operated paddy acreage and exploit the off-farm employment market more assiduously than they appear to do currently.

# III. SUPPLY OF IRRIGATION WATER

## The need for irrigation in the Kemubu scheme

In the Kelantan plain the growing of two paddy crops a year is only possible with a reliable supply of irrigation water. Although annual rainfall at the north-east coast of Peninsular Malaysia is very high, averaging 3000 mm, its distribution is very uneven. Almost 60% falls during the north-east monsoon from October to February, concentrated in two very wet months, November and December, when the average amount is more than 1100 mm. During the drier months rainfall is very unreliable with a pronounced dry period occurring during February, March and April. In that period, dry spells can last for more than a month; in 1982 only five days with rainfall of more than 5 mm in January, February and March were experienced.

The rain falls in short and heavy localized showers resulting in great differences in daily and monthly amounts for nearby areas. Intensities are high, especially during the rainy season and maximum values of more than 400 mm in 24 hours (once in 10 years) have been measured (Minco, 1982). The average, maximum and minimum rainfall for the area within the Kemubu scheme is presented in Table 17.

*Table 17. Monthly average, maximum and minimum rainfall in mm over a period of 24 years (1956 - 1979)*

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 167 | 76 | 88 | 74 | 121 | 157 | 190 | 220 | 260 | 301 | 597 | 544 | 2794 | mean |
| 13 | 5 | 9 | 0 | 36 | 88 | 110 | 112 | 124 | 134 | 196 | 113 | 2105 | min |
| 631 | 315 | 268 | 237 | 242 | 283 | 304 | 358 | 416 | 498 | 1365 | 1026 | 3608 | max |

*Source: Minco, 1982*

Water requirements for lowland paddy are those for evapotranspiration (ET), percolation and land preparation. The water which is required in the flooded fields during the growing period is mainly governed by ET. Monthly average values of ET are calculated for a paddy crop in the mid-season period based on pan-evaporation data and given in Table 18.

*Table 18. Monthly average evapotranspiration of a paddy crop in the mid-season period*

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 135 | 144 | 169 | 166 | 161 | 143 | 144 | 141 | 142 | 135 | 100 | 99 | 1679 |

*(From pan-evaporation data in Pasir Mas, 1969 - 1979)*

Average evapotranspiration during the dry months is 5.5 mm per day and maximum daily values can reach 9 mm. A comparison of the average rainfall (R) and ET from Table 17 and 18 is illustrated in Figure 2. It shows that in the dry period from January until June the average rainfall conditions are insufficient to meet the crop water requirements.

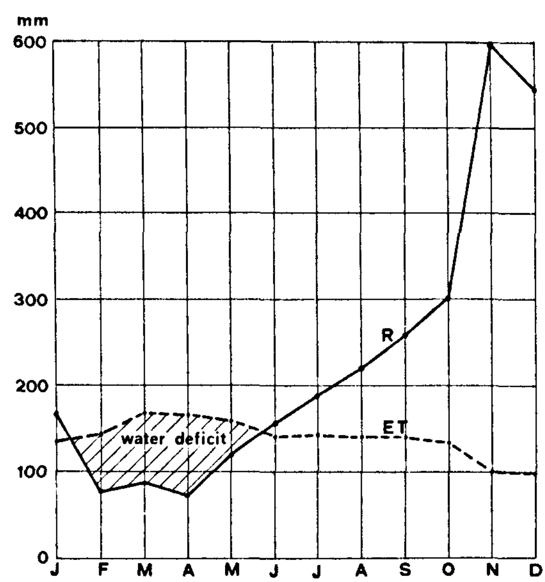



*Fig. 2. Comparison of monthly precipitation (R) and evapotranspiration of a paddy crop (ET) in the Kemubu area*

The amount of water required for percolation is considered by others (Van de Goor and Zijlstra, 1968; Minco, 1982) as negligible or very small (1 mm/day) in the period after transplanting. This can well be the case for the major part of the scheme; however, indications of high percolation losses (9 mm/day) were found on the high grounds of the area under study.

Land preparation requires an additional amount of 200 - 300 mm of water which is needed to saturate the topsoil and to provide a water layer in the field. The highest water deficiency occurs during the land preparation period for the off-season crop which has to take place during the driest months (March, April) of the year. Rainfall is then so unreliable that the irrigation system must be capable of supplying all the water needed. As land preparation in the whole scheme has to be completed within an acceptable period of 30-40 days, a constant supply of 10 - 14 mm per day is required, not taking into account any losses. Part of the supply is used for presaturating new land and another part for maintaining the water in the already flooded fields (evaporation).

After the presaturation period, less water is required but the irrigation supply has to be much more than would be expected from dependence on the rainfall. This arises as only a small percentage of the rain can be stored in the fields and eventually be used by the crop when at the time of rainfall a continuous flow of irrigation water passes over the fields.

With double cropping, a rigid planting schedule is necessary and delays caused by water cannot be permitted. Presaturation for the main season crop has to take place in September and October, so that transplanting is finished before the heavy rainfall starts. Although there will be years when presaturation of the fields can take place without irrigation, dependable rainfall in September is not more than 200 mm for four out of five years. This is not sufficient to finish presaturation within the required period.

*Rainfall in 1982*

As rainfall is an important aspect in reviewing irrigation performance in a specific year, the monthly rainfall in 1982 for the Kemubu scheme and the off-season rainfall in the research area are given in Table 19.

The off-season in the area under study started in early May and harvesting was completed by the end of October. During this season no serious water limitations occurred, partly the result of the favourable rainfall and partly because adequate supplies were

*Table 19. Monthly average rainfall in Kemubu in 1982 and monthly rainfall in the research area in mm*

| month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kemubu mean[1] | 27 | 19 | 57 | 42 | 120 | 171 | 349 | 225 | 212 | 221 | 274 | 703 | 2420 |
| standard deviation | 11 | 8 | 26 | 18 | 60 | 64 | 58 | 66 | 74 | 78 | 48 | 88 | |
| research area | (not available) | | | | 139 | 263 | 356 | 229 | 277 | 212 | 286 | 819 | |

[1] *Arithmetic mean of 13 rainstations*

pumped into the irrigation system. In total 1489 mm of rain fell in the period between 20 April and 15 September during which rain-water could have contributed to the water supply for the paddy fields. The amount that was effectively used was highly variable and dependent on the time when the rain fell, the irrigation conditions of each field and the water conservation practices of the farmer. Rainfall in the presaturation period enabled to prepare those fields which had not yet received irrigation water. However, for those fields already flooded, most of the rainwater was drained away. During the growing period the contribution of rainwater was only substantial for those fields suffering shortages in the irrigation supply. In the majority of the other fields, the considerable rainfall did not lead to much saving of irrigation water. This was owing to the fact that when the supply was stopped after heavy rainfall, most of the rain was already spilled away and the fields ran dry soon afterwards because gaps in the fieldbunds were left open.

*Basic requirements of the irrigation system*

As irrigation water plays an essential role in creating favour-able water conditions for paddy cultivation, the system to deliver this water to the fields should meet the following criteria:

1. Deliver water to all fields at the beginning of the season in such a time span that all farmers can follow the planting schedule within an acceptable period. For the local farming

method it means that all the plots in a paddy area in which a nursery (seedbed) has been planned, must receive water within a period of a week. The rest of the plots should receive sufficient water for presaturation within the following three weeks in order to be ready for transplanting.

2. Provide sufficient control over the depth of water in every individual plot during the growing period. A continuous water layer of a depth of 5-15 cm must be available to reduce effectively weed growth as no other weed control measures are practised by farmers. To meet this condition a guaranteed supply to all plots is required.

3. Keep distribution losses at an acceptable level and divide equally scarce water among the users in periods of limited supplies. Complicated and time consuming distribution proce dures must be avoided for the water users as well as for the operational staff.

As drainage is as important as irrigation, it is necessary that drainage facilities are available for avoiding prolonged submerging of the crop and for removing all the water from the fields at harvest time. These criteria have been used for analysing the actual water conditions in the field and the performance of the irrigation system. Furthermore, the irrigation system has been divided into three interrelated factors determining the supply for the paddy fields under study:

(i) The water supply from the major system, influenced by its infrastructure and water management.

(ii) The infrastructure of the minor system; the irrigation units, including water distribution network, drainage system, topography and field arrangements.

(iii) The water management practices of the farmers within the units.

## The major irrigation system

*The supply of the scheme*

The canal network of the Kemubu scheme is supplied by one pumping station situated on the right bank of the Kelantan river, the main river in the state. The station is equipped with five diesel - engine driven pumps, each with a design capacity of 7.08 $m^3/s$ (250 cusecs) to lift the water 9.6 m high (max). Next to the pumpping station, a number of private pumps were installed during the off-season, to give additional capacity of 7 $m^3/s$.
Furthermore, there are five booster pumps to supply areas from the canal system, which are too high to be irrigated by gravity (500 ha). Some additional water from small rivers is collected by 9 gravity flow weirs and added into the canal system but in the dry season the whole Kemubu area depends on the pumping station.

*The limited supply by the pumping station*

During several periods in the past, farmers have faced an insufficient, interrupted supply at times when irrigation water was needed the most, the major reason being the lack of adequate pumping capacity aggrevated by an uneven distribution in the network.

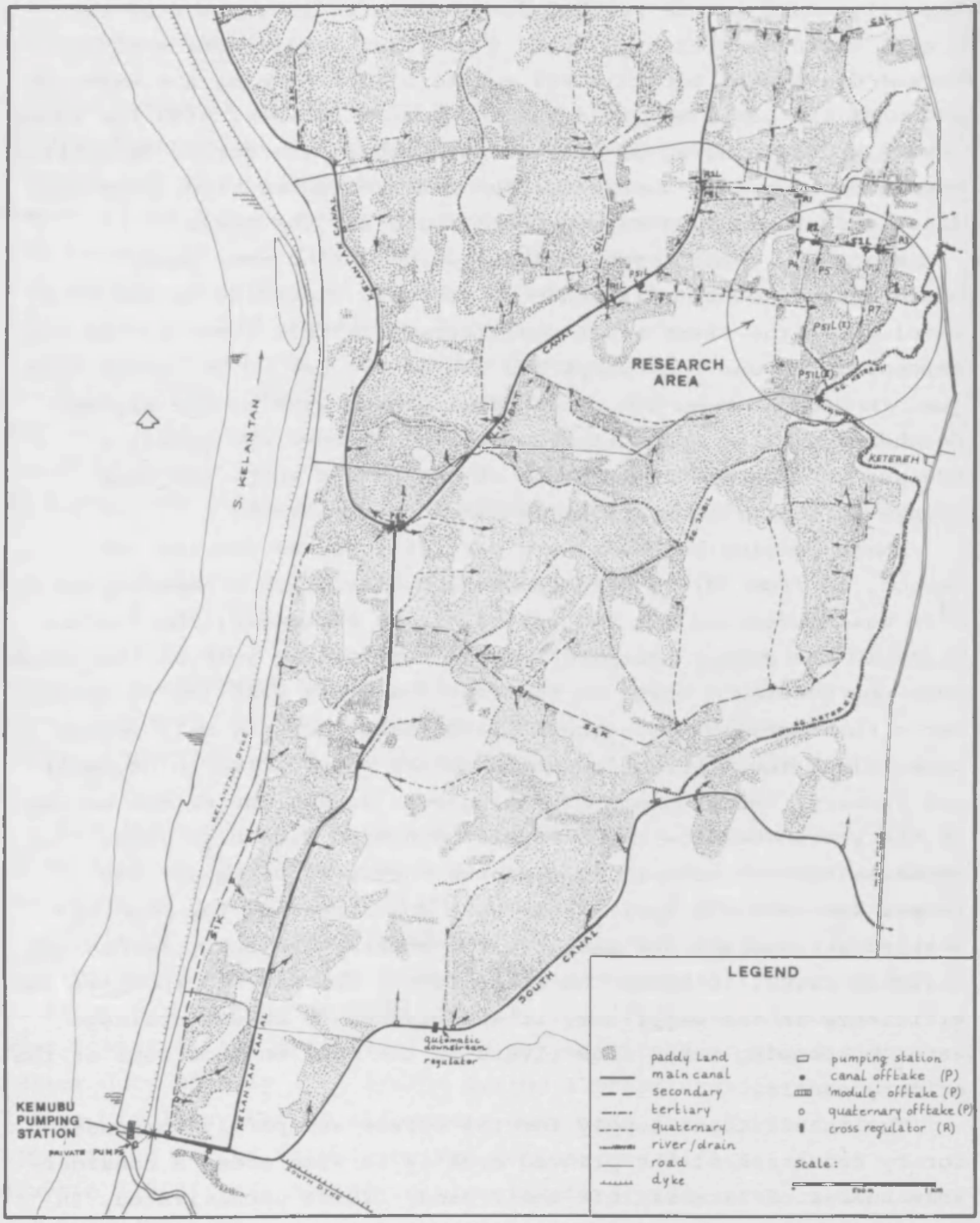
The designed pumping capacity of 28.3 $m^3/s$ (1000 cusecs) [14] for an area of 20,600 ha, which gives a supply of 1.37 l/s/ha, has been based on a water duty at unit level of 1.17 l/s/ha, implying an efficiency in the major canal network of 85%. As this water duty is considered too low to meet the requirements in the units, the resulting pumping capacity is also insufficient. Although water losses at the unit level were not specified in the design, a water duty of only 1.17 l/s/ha during a presaturation period of 30 days, implies that no allowances were made for any loss of water. Based on the formula by Van de Goor and Zijlstra for Malaysia (1968), the demand to presaturate a paddy area in 30 days is 1.5 l/s/ha, not including any operational loss at unit level. A water duty at unit level of 2-3 l/s/ha would have been more appropriate for calculating the design capacity of the scheme.

The situation worsened when after installation the designed capacity could not be reached due to insufficient power of the diesel engines. With high heads (low river levels) the engines became overloaded but this was solved by diminishing the empellor pitch of the pumps and reducing the speed. Besides, with low river levels and silting up of the entrance canal, the stream velocities became so high that turbulence and cavitation occurred. Also the inlet structure appeared to be too small for the pumps.

Altogether, the total capacity when running four pumps diminished to 20-23 $m^3/s$ (700-800 cusecs), depending on the river level. When the river level came below a certain level it was even impossible to use four pumps and one or two had to be closed down, just in periods when the water requirements were at the highest. Furthermore, also operational problems affected the capacity because of frequent brake-downs of one of the pumps and long delays in repair as spare parts were not available.

These pumping problems were partially solved for the off-season, as from 1977 a private pumping plant with a capacity of 7 $m^3/s$ was contracted for the period May to September. The limitations in the supply remained for the rest of the year as the pumps were not available then. In the last few years this led to serious water shortages and consequent yield losses for the main season crop. Since the start of the main season was shifted to December and January, the crop was at full growth during the driest months of the year, when low river levels coincided with high water demands. Another measure to overcome supply problems for the scheme was taken in April 1982, when downstream of the pumping station a temporary dam made of iron sheets, was built across the Kelantan river, to raise the water-level. Thirdly, to increase the efficiency in the water use, it was planned to re-use drainage water by pumping water from rivers in the tail ends of some of the primary canals.

The insufficient supply for the scheme was partly compensated for by reduction of the planted area as in some areas a considerable number of farmers left their paddy fields uncultivated. In the main seasons of 1980/81 and 1981/82, the planted area was reduced to 84 and 65% respectively and in the off-seasons of 1981 and 1982, only 65 and 59% were planted. A decrease of peak




Map 2. Detail of Kemubu scheme

requirements was also caused by a shift of the presaturation period for the off-season to more rainy months together with an extension of more than a month for the total presaturation period in the scheme.

*General lay-out of the irrigation network*

Water is pumped into the head of a primary canal (South canal) and distributed through a network of primary, secondary and tertiary canals, to the various paddy areas (see Map 2). The South canal, which supplies the other 7 primary canals, is equipped with automatic downstream regulators and therefore serves as a reservoir from which each canal can draw water independent from the others; a change in demand is automatically transmitted to the head where the pumps keep the water at a constant level. All the other canals have upstream control and are therefore provided with an intake structure (primary, secondary and tertiary offtakes) for manual regulating and measuring the discharge. From the canals, the water is diverted to the paddy fields through outlets, locally called quaternary offtakes, which are equipped with a gate and a measuring weir. The paddy fields which receive water from a quaternary offtake are grouped together in a so-called "Irrigation Unit". Water is supplied either directly from the offtake into the unit or first conveyed in a quaternary canal which connects the offtake with the unit. A combination of both forms also exists.

The design of the canal network does not incorporate a systematic lay-out. Primary canals branch from other primaries and the tertiary canals, which belong to the major system, can branch from primary canals.[15] Operation of the system is complicated especially by the fact that quaternary offtakes are located along each type of canal, implying that a unit can receive water not only from a tertiary canal but also from secondary and primary canals (see Fig.3).

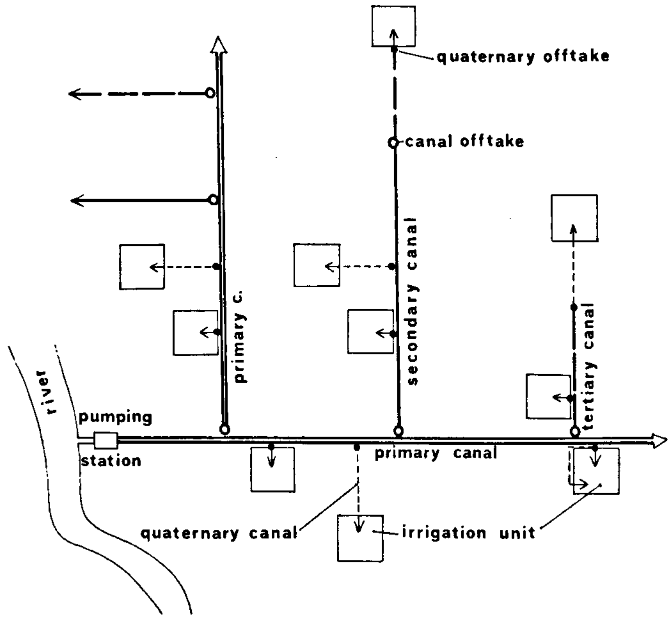



*Fig. 3. Basic features of the irrigation network in the Kemubu Scheme*

The total irrigation area, which is estimated by KADA on 19.200 ha, consists of about a 1000 irrigation units with highly variable sizes. In the design the scheme was divided into three major areas:

- the western part, area I (5.700 ha), which is supplied by the Kelantan and Limbat canals;
- the southern part, area II (8.600 ha), supplied by the South canal and the Gunong system;
- the north-eastern part, area III (4.900 ha), which is supplied from the Ketereh river at the dam site. This river has a double function: it collects run-off water from an irrigated area and functions as a main canal, supplied from the South canal.

The complete irrigation network has been designed for continuous supply to all irrigation units. Rotational supply is only possible in the smallest tertiary canals and among the quaternary offtakes on the same canal, as these standardized offtakes have been designed to supply more than twice the maximum discharge for a standard unit of 19.4 ha.

The scheme has been provided with a drainage network which consists mainly of improved natural rivers and old waterways. Three main rivers collect the water and discharge it into the South China Sea. Flooding in the low-lying areas (4,450 ha) along the Kemasin and Semarak rivers remained a problem and was probably aggrevated by the irrigation scheme. Two dikes were constructed to protect the scheme against floods from the Kelantan river.

*Details on the irrigation system to the research area*

The research area comprised five of the 134 irrigation units in the area served by the Limbat canal. Water to this primary canal is directly diverted from the storage canal of the pumping station in which the water-level is kept within close limits by the pumps (see Map 2). The intake structure, called primary offtake, of the Limbat canal consists of a number of gated modules (Neyrpic, type with two baffles), each module representing a fixed discharge.

The desired discharge can be obtained by opening a certain number of modules, and remains constant independent from minor variations of the upstream water-level. The structure allows an intake of 5.66 $m^3/s$ (200 cusecs) and the designed canal capacity is 5.10 $m^3/s$ (180 cusecs) for an area of 2,246 ha, differing only slightly from the actual gross area of 2,223 ha.[15] The designed capacity of 2.27 l/s/ha is 60% higher than one could expect from the discharge calculations for the scheme (1.4 l/s/ha).

The primary and secondary canals are divided into sections by cross regulators, consisting of a long concrete weir (duck bill type), with in the middle two orifices equipped with manually operated slide gates (see Fig.4). With the gates, the discharge has to be regulated so that the depth of overflow over the weir is maintained at 0.09 m, the full supply level. The long weir (26 m in the main canal) makes the upstream water-level more or less constant, independent from small variations in the discharge.

The quaternary offtake of one of the units under study (P51L) is positioned along the second section of the Limbat canal, in which the water level is regulated by the cross regulator R2L (see Map 2).

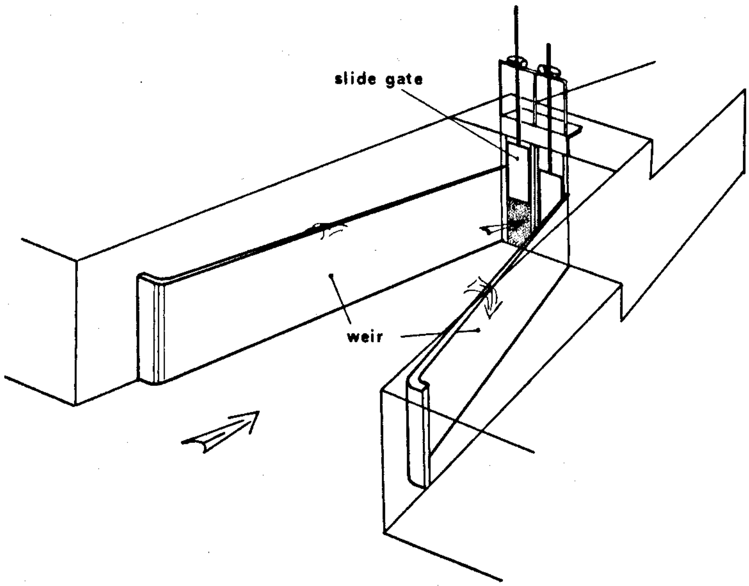



*Fig. 4. Cross regulator in main and secondary canals*

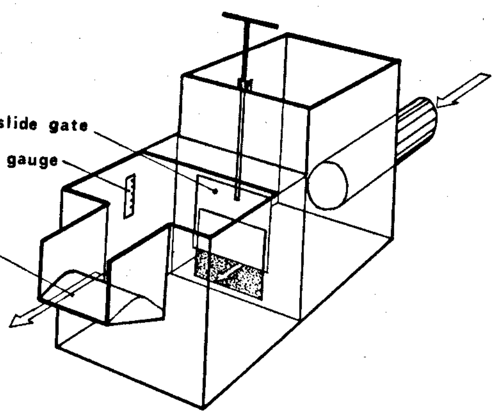



*Fig. 5. Quaternary offtake*

Quaternary offtakes (see Fig.4) were designed for a maximum capacity of 57 l/s (2 cusecs), that is 2.5 times higher than the designed demand of 23 l/s (0.8 cusecs) for a standard unit of 19.4 ha.[16] The quaternary offtake P51L is one of the several additional offtakes included later when it appeared impossible to irrigate the paddy area by the original designed offtakes. According to the manual, the area served by an additional offtake remained a part of the original unit and therefore the supply should rotate with the original offtake. In this case, rotational supply was not feasible, but all service areas supplied by these additional offtakes were considered as independent units and received a continuous supply of water. The service area for P51L is located about 1 km away from the main canal and is connected by a quaternary canal (see Map 2).

The secondary canal S2L, which serves the other four units, branches from the Limbat canal in the same canal section as the quaternary offtake P51L. At its head this canal is equipped with an intake structure consisting of a movable weir with a staff gauge attached to the weir which makes it possible to read directly the set discharge. In this offtake (P8L) the gauge was broken which made direct measurement impossible. For the actual command area of S2L, an estimated 291 ha, the designed capacity of 0.76 $m^3/s$ (27 cusecs) gives a supply of 2.6 l/s/ha, which is 86% higher than the designed project capacity of 1.4 l/s/ha. Two quaternary offtakes (P4- and P5S2L) serving the area under study, are located in the second canal section of S2L and the other two in the third one. In the four offtakes there were no gates to regulate the discharge, and measurement could not be done as the downstream water-levels were so high that the weir was completely submerged.

*The insufficient head at the quaternary offtakes of the research area*

At all four offtakes, the designed water-levels in the secondary canal (S2L) were insufficient to supply the highest fields at the head of the units except when measures creating distributional problems were taken. Regulating the flow according to the size of the units with the gate under semi-module conditions for measurement was impossible, because it would have meant that the water-level downstream of the offtake (in the quaternary canal) would be 0.3 - 0.5 m below the highest field levels (see Table 20).

*Table 20. Comparison of the highest ground-levels in the units with water-levels (in m above sea level)*

| Offtake/ unit | Planted area (ha) | FSL in S2L[1] at offtake | Actual w.l. (max) | Highest ground-l. in unit | Sill-level of offtake | W.l. down stream of offtake[2] | Difference[3] |
|---|---|---|---|---|---|---|---|
| P4S2L | 8.25 | 11.84 | 11.84 | 11.8 | 11.45 | 11.50 | -0.3 |
| P5S2L | 9.32 | 11.82 | 11.84 | 11.8 | 11.45 | 11.50 | -0.3 |
| P7S2L | 11.12 | 11.62 | 11.78 | 11.7 | 11.20 | 11.26 | -0.44 |
| P8S2L | 3.82 | 11.57 | 11.78 | 11.75 | 11.20 | 11.23 | -0.47 |

1 *FSL is full supply-level and is designed at 0.09 m above sill-level of the canal cross regulator*

2 *Calculated for semi-module conditions with a discharge of 1.5 l/s/ha*

3 *Difference between ground-level and calculated water-level downstream of offtake*

The only possibility for farmers to supply the high fields was to block the flow in the quaternary canal in order to get practically the same water-level as in the secondary canal. For two units even the full supply level in the secondary canal was not sufficient and the farmers therefore raised it by placing boards on top of the weir of the cross regulator and obstructed the orifice flows with stones, boards and earth lumps. They managed to raise the water-level in the upstream section of the secondary canal by another 16 cm. The improperly controlled discharge into the irrigation units could lead to water shortage and water wastage, depending on the individual actions taken by farmers. This situation was not at all exceptional as many of the quaternary offtakes were situated too low with regard to ground elevations in the upper end of the irrigation units.

*Uneven supply conditions of the irrigation units*

One of the complications in the water distribution was that, under equal supply levels in the major canals, the supply to the units could differ considerable. Some units had a consistent over-supply of water while other units suffered from a scarcity. This resulted from a combination of two major design features.

First, the quaternary offtakes servicing the units were designed for a capacity of twice the peak demand for a standard unit of 19.4 ha. However, actual sizes of the units were highly variable: a unit could be as small as only one ha or as large as 40 ha. For regulating the supply according to actual size and water requirements of the units, the offtakes were provided with a gate. However, practically all these gates were removed by the farmers thus taken away their utility in regulating the water supply to the units.

The second factor relates to the topographical variations relative to the water-level in the canals. Offtakes were placed on an elevation according to a water-level in the canals, but with the variable ground levels this meant for low units an unlimited supply, even with low water-levels whereas the supply to higher units was restricted as soon as the water in the canal dropped. Under unfavourable supply conditions, the lower units may still obtain an excessive supply of water to the detriment of the higher units along the same canal.

*Pipe outlets*

In several places ungated pipes have been placed in the canal banks by KADA and the farmers to supply water to paddy areas which could not or were difficult to irrigate with the offtakes provided by the project. The pipes were laid at various heights, depending on the elevation of the paddy fields. Sometimes, they were placed so high that the water level in the canal had to be raised by obstructing the flow, and sometimes so low that the uncontrolled discharge was far in excess of demand, leading to wastage and water logging. The pipes were not only placed for topographical reasons but also for social and political reasons when farmers upstream did not permit the water to flow to the area further downstream.

*Control and measuring structures*

In general, the design has provided the distribution system with adequate control structures. One of the exceptions was that the

South Canal, which diverted all the water from the pumping station to the scheme, was equipped with automatic downstream regulators (Avis-Neyrpic type). These structures gave operational problems as soon as the supply by the pumps decreased. When the discharges from the lower reaches of the canal were not adjusted, the water-level in the upper reaches dropped, diminishing the discharges from the offtakes and eventually stopped altogether. Also, rotational supply to the various areas was not possible unless the gate was jammed in order to close off the downstream area.

Some inaccuracies of the measuring facilities were found in evaluating discharges from different canal offtakes. An inaccurate standard discharge formula was used for calibrating the scale on the measuring gauge, which did not take into account the various shapes of the measuring weirs. For secondary offtakes of the modified Butcher type, discharges were under-estimated at full supply by more than 18% and the round-shaped weir of the tertiary offtakes discharged more than 28% of what was read on the stick gauge.

## Water management in the major irrigation system

Water management of the Kemubu scheme is the responsibility of the operational staff of the Engineering Division of KADA. The scheme is divided into three districts, Kota Bharu, Pasir Puteh and Bachok, each headed by a district engineer, assisted at head-quarters by a chief irrigation inspector. The field staff stationed in the various Farmers' Organizations, consists of 8 irrigation inspectors (I.I.), 19 irrigation overseers (I.O.) and 68 linesmen, who actually operate the distribution structures. Besides, every irrigation inspector has a group of 10 - 13 labourers for maintenance purposes.

The staffing for the area served by the Limbat canal, the main canal supplying the research area, is shown below.

Ketereh area (2230 ha): 1 I.I.

| | | |
|---|---|---|
| Ketereh I | (660 ha) | : 1 I.O. and 2 linesmen |
| Ketereh II | (850 ha) | : 1 I.O. and 3 linesmen |
| Ketereh III | (720 ha) | : 1 I.O. and 2 linesmen |

For the operation and maintenance of the whole KADA area, consisting of five irrigation schemes, the Engineering Division in 1981 spent $10.4 million for an area of 33,200 ha (two seasons) amounting to $313 per ha per year (KADA).[17] A substantial part of the expenses consisted of energy costs to pump the water into the schemes. For the Kemubu scheme alone these costs arrived at $160 and $120 per ha (planted) for the off-seasons 1981 and 1982 respectively.[18]

Irregular and insufficient supply of irrigation water faced by the farmers was partly result of the water management by the authority. Some of them, related to the distribution of water in the major system, follow below. It should be mentioned that the responsibility of KADA was not limited to the major system. As quaternary canals, which form a part of the distribution network inside the irrigation units, were provided by the project, KADA is also responsible for their operation and maintenance. However, in daily practice, water distribution was left to the farmers, whose unaccordinated actions led to an unequal water distribution through these canals. With the exception of technical improvements, such as concrete lining, no actions were undertaken by the irrigation staff to solve the distributional problems in the quaternary canals by more structural measures.

*Interruptions in the water supply*

The irrigular water supply from the major system was mainly due to limitations in the pumping capacity, but the supply was also stopped on several occasions for other reasons discussed later. The results were immediately observed in the fields, even when the supply stopped after rainfall. At times when the water level in the canals could not be maintained anymore to serve adequately all units with a continuous supply, a rotational supply was performed in the primary canals to ration the water. This however, hardly improved the uneven distribution of the scarce water among the units.

*Regulation of the control structures*

In the studied part of the irrigation network, the operational activities of the linesmen were limited to the gate settings of the regulators and canal offtakes in the main canal. The regulators in the secondary canal (S2L) were not operated during the irrigation period and the canal ran completely dry when the supply was interrupted. The discharges in these regulators were controlled by the farmers who obstructed the flow through the orifices, in this way improving the supply to their units upstream of the control structures.

Regulating the quaternary offtakes to adjust the discharges to size and actual requirements of the units, appeared to be impossible for the linesmen since practically all the locked gates had been removed by the farmers. The field staff was powerless to change this situation; trials to reinstall the gates were unsuccesful. Uneven distribution among the units was the result, as the supply conditions and command areas of these offtakes were highly variable. In some of the offtakes the supply was controlled by a farmers' block in the quaternary canal downstream of the structure. However, this method of supply control did not work effectively and in times of water scarcity KADA could not prevent the farmers from removing the block and from supplying their unit with much more water than available for other units. Observations indicated that after rainfall the intake discharge for the main canal (see Fig. 6) was reduced for a certain period. However, these effects on saving water were limited.[19]

*The irrigation schedule*

With the introduction of irrigated double cropping, all farmers within the scheme had to plant their paddy crop according to a common irrigation schedule. This schedule determined the water supply periods for both seasons as well as the start of the major events in the production cycle: sowing, transplanting and harvesting. A rigid and uniform schedule for the whole scheme is necessary since the nature of the climate and the design features of the scheme do not allow much flexibility in the cropping cycle.

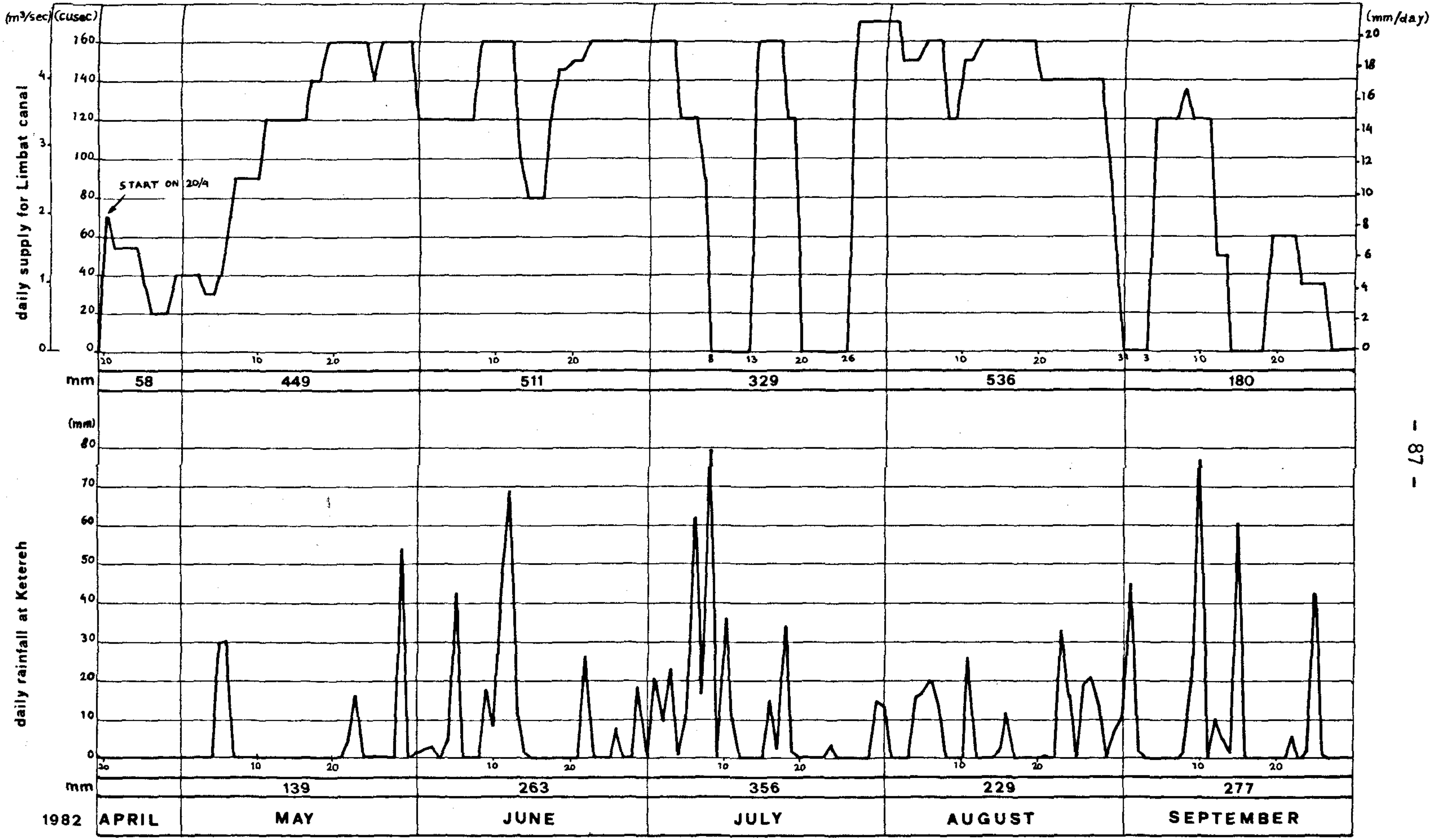



*Fig. 6. Relation between supply of irrigation water and rainfall during the off-season 1982. Supply for Limbat Canal area (1.990 ha) and rainfall at Ketereh*

Only a well-developed crop can withstand the heavy monsoon rainfall in November and December, and transplanting and harvesting cannot take place during this period without risks of loosing the crop. Consequently, only one suitable crop cycle remains: the main season from September to February and the off-season from February to September. The design of the scheme does not permit a permanent supply with staggered irrigation seasons, since the project has only one pumping plant which has to be closed down periodically for maintenance. Besides, the irrigation system is designed for simultaneous supply to all areas of the scheme and independent water delivery to certain parts of the network is not possible.

Furthermore, there are agronomic and economic reasons why farmers should adhere to a common planting schedule. The designed irrigation periods (125 days) ran from 15 March to 15 July for the off-season and from 15 September to 15 January for the main season. However, KADA had implemented an irrigation schedule which started later: irrigation for the main season from 1 October to 15 February (138 days) and for the off-season from 1 April to 15 August. In an 'ideal' situation, the periods of water supply and requirements in the field should coincide and moreover, they should follow the planned schedule. However, in practice it turned out that none of these conditions could be met: the irrigation periods - especially for the main season - extended considerable, and in recent years they shifted to unfavourable times.

In spite of these changes the demands from the field could not be fulfilled. The main cause was that most farmers did not follow the scheduled cropping cycle because they were unable to realize the production of a crop within the planned time limit. Every year they lagged behind more and more and needed therefore water, later and later. As the delay increased, also the differences among the farmers became gradually bigger. The shifting of the irrigation seasons after 1979 did not improve this situation. Even the delayed start of the main season of one month (1980) was followed by only a few farmers and the majority started two months later. This was also caused by the fact that the start of the irrigation season coincided with the monsoon and the farmers therefore were delayed until January, after the heavy rains stopped. Ten years after the start of the project, synchronization of the cropping cycle was lost and a suitable irrigation schedule was difficult to establish.

Decisions of starting the irrigation periods had to be changed several times and in the field, both farmers and field staff were not certain when the supply would start again. Trials to re-establish a coordinated cropping programme according to plan by skipping an irrigation season failed because KADA resumed delivering water at the farmers' request.

> For the new season of 1982/83, it was first decided not to deliver water to the western part of the scheme, and to wait until February to start the new off-season early. However, the farmers who had completed harvesting in October and were ready for the coming main season were not informed about this decision. As pumping continued for a rehabilitation project in the southern part of the scheme and for a pilot project located close to the areas in which harvesting was completed, KADA had to come back to the original decision to start the supply in November.

The decision-making process to establish the irrigation periods was complicated and not dependent on KADA alone. Political factors played an important role and could force KADA to continue the supply, as was the case for the main season 1981/82 when elections expected. This fact implies that KADA could not use the supply period as a means of forcing farmers to adhere better to the gazetted cropping schedule, or to re-install a schedule as planned.

The omission of one season does not only provoke farmers' resistance, it also does not resolve the problem as the situation will repeat. Only by removing the constraints which farmers have in completing the cropping cycle within the required time span, it is possible to follow a suitable irrigation schedule.

An overview of the cropping cycle in the Kemubu scheme for the last five seasons is given in Fig. 7, for which the main activities of transplanting and harvesting have been used. Besides the delays of more than two months, it shows that in the majority of the area transplanting of the main season crop was done after the monsoon in January, about three months later than originally planned.

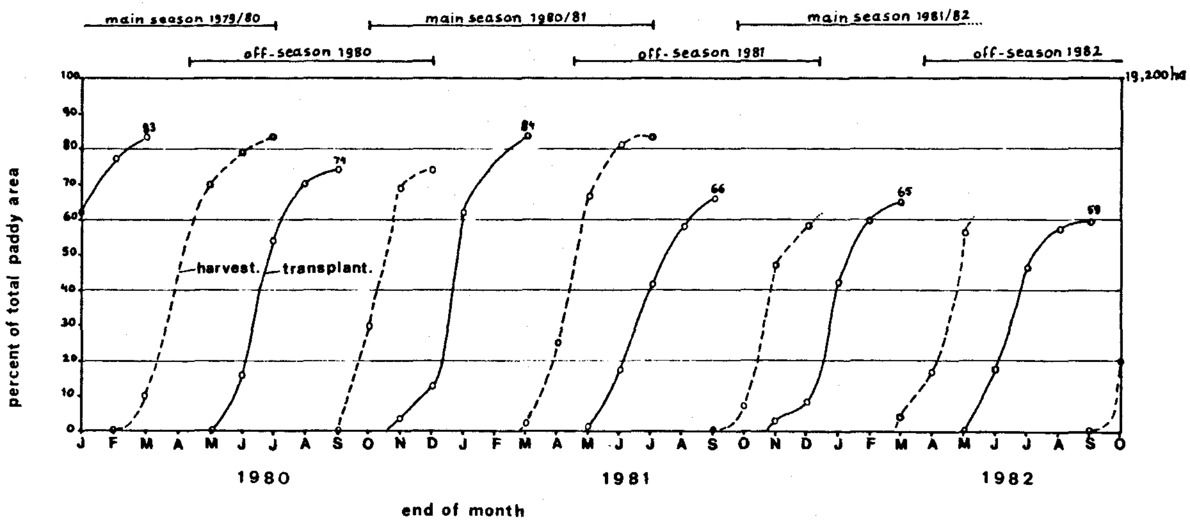



*Fig. 7. Paddy production cycle in Kemubu Scheme, Jan. 1980 - Oct. 1982. Transplanted or harvested area at end of month as a percentage of total paddy area (from KADA statistics).*

*Maintenance*

Clearing of the irrigation canals, the main maintenance activity, was carried out partly by the labourers of the Irrigation Inspectors and partly by private contractors. This work could not be performed effectively on account of insufficient funds and manpower. The lack of regular clearing did not show ill effects on the condition of the main and secondary canals, but in the tertiary canals. Particularly, in the quaternary canals the results of insufficient maintenance were noticeable. Heavy weed growth and silting up obstructed the flow in these quaternary canals and water was lost due to neglected embankments. An even more serious consequence of the budget constraints was that drainage canals could not be cleaned at all. Beside cleaning activities, the labourers were also involved in improving small stretches of quaternary canals by concrete lining, the material of which was paid for by maintenance money.

## Infrastructure of the irrigation units

The water for the irrigation units in the research area was supplied from the major canal system through five offtakes. From the offtake, the water flowed through an earthen canal, the quaternary canal into the paddy fields along the canal or into field ditches which distributed the water to fields located further down. Through openings made in the banks of the quaternary canal or field ditch, the water was released into the head of a number of adjacent plots from which it flowed from one plot into the next successively, arriving finally at the lowest plot or into a drain (see Map 4).

*Imperfections of the system and the consequences*

The actual infrastructure and the resulting distribution process was far from ideal and led to many water problems in the paddy fields. A dominant factor involved in the complex water distribution system behind the quaternary offtakes was the irregular topography. The paddy fields were located in small isolated patches in between rubber land and kampong areas; only 50-60% of the total area in the scheme was used as paddy land. These small paddy areas were further broken up into topographical units by the many micro depressions and elevations, formed by numerous old riverbeds. As the major canal network did not service all these areas, sometimes consisting of only a few fields, with an independent water supply, a complicated network of quaternary canals and field ditches was necessary to connect all the fields to the major canals.

On paper, the paddy field which received water from one quaternary offtake were grouped together into an irrigation unit. In the actual field situation, however, this was hardly observable. Boundaries between units were vague and changed frequently as fields could receive water from different offtakes, while water could be diverted into several units from one quaternary canal. The sometimes ingeniously constructed network of field ditches by the farmers was, however, not a guarantee for a sufficient supply to all fields. Uneven water distribution among the fields remained a major problem because farmers had not been able to overcome effectively the micro-topographical problems by constructing field ditches.

*Quaternary canals*

In the research area, each irrigation unit was provided with an earthen canal, called a quaternary canal, with length variances between 91 and 1256 m.

*Table 21. Lengths of quaternary canals in the research area*

| Unit | Number | Length (m) |
|---|---|---|
| P4S2L | Q1S2L | 91 |
| P5S2L | Q2S2L | 137 |
| P7S2L | Q5S2L | 549 |
| P8S2L | Q6S2L | 274 |
| P51L(I) | Q17L | 1256 |
| P51L(II) | Q17aL | 366 (branch of Q17L) |

The quaternary canals were the only irrigation facility in the units provided by the project to convey water from the offtakes along the major canal system to several isolated paddy areas. The construction of the quaternary canals took place when the major canal system had already been completed, because the original intention for the farmers to construct these facilities, turned out to be unfeasible.

Landowners of the land through which the quaternary canals were planned were not willing to give up the land without compensation and communal construction could not be organized. The project had to acquire the required land and to pay for the construction (an additional 11 million M$). Only 40% of the irrigation units in the scheme were provided with this facility (World Bank, 1975); the intensity in the project was only 3 m/ha (Minco, 1981), concentrated in the western part of the scheme.[20]

The longest quaternary canal serving P51L carried the water over about 1 km before arriving at the first fields in the unit. On its way, the water was tapped from the canal at five places and diverted into paddy fields situated in two other units (see Map 2). Close to the offtake, the canal passed some fields which were difficult to irrigate from their own offtake. Farmers blocked the quaternary canal by closing a pipe culvert to raise the water level above their high fields. Further along the canal, the water was diverted into field ditches to irrigate the major part (7 ha) of another unit (P5L). In this unit, the slopes were not suitable for plot-to-plot irrigation from the offtake, and the necessary field ditch from the offtake was not constructed. About one third of the flow in the quaternary canal was tapped; far in excess of requirements, but with the high supply in the quaternary canal during the season studied, sufficient water was left over for the downstream area (P51L). In more critical periods, however, obstructions were placed in the quaternary canal causing serious water shortages downstream.

Not all the water in the quaternary canal arrived in the paddy fields, as in the last stretch of the canal, water was lost into the drain by seepage through its banks. Under conditions of high water supply, an even greater quantity of water was spilled by overflowing the canal banks. For the highest plots in the unit, this high water-level, which was about 10-20 cm above the designed one, was, however, necessary for their supply.

In the beginning of the irrigation period hardly any water entered the paddy area served by the far end of this quaternary canal (P51L(I)), this was caused by broken inverted syphon through which most of the water was spilled from the quaternary canal into the drain. Later on the syphon was replaced by a pipe.

From design drawings of the four other quaternary canals serving the area under study, it appeared that even with the design capacity of 57 l/s, which was much more than the requirements of the small units, the corresponding water-level was too


*Map 3. The research area*

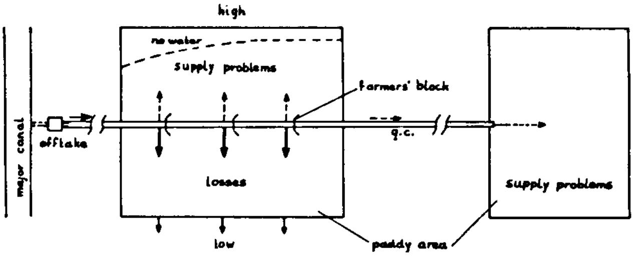
low to supply the high fields along the upper end of these canals. In one unit (P7S2L), the upper 2/3 of the quaternary canal showed a designed water-level lower than the paddy fields. Even with full supply level in the major canal a continuous supply was not secured for these fields. The farmers had always to block the flow in the quaternary canal to obtain water in their plots. The higher their fields the more their actions affected the supply to other farmers. For the highest fields, the discharge in the quaternary canal had to be blocked off completely resulting in only a small supply into the plot. As this situation was not acceptable for the downstream farmers, the blocks were removed again. The result was that both the high fields close to the offtake and the fields in the tail-end of the unit did not get a sufficient water supply.

The length of a quaternary canal did not create unacceptable delays for the unit at the end. In less than half a day, water reached the end of the longest quaternary canal (1256 m) and in two to three days the maximum supply level was reached. This could have been attained even faster by proper cleaning of the quaternary canal and by preventing the water losses. The long quaternary canal led more to an operational problem as the uncontrolled interference of the supply by farmers in the upper reaches made regular checking by downstream farmers difficult.

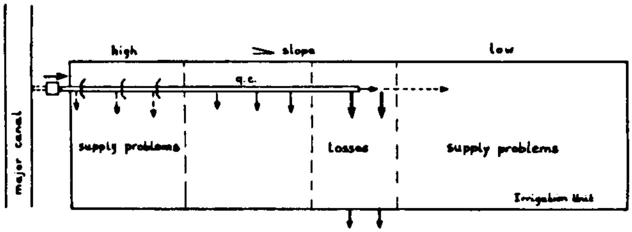
In Fig. 8 some of the typical constraints in the distribution of the water through quaternary canals are shown. It is not possible to seperate technical contraints from the water management problems as both lead to unequal distribution along the canals, causing an irregular supply and water shortages for some fields and water losses in others.

*Field ditches*

Together with the quaternary canals, the field ditches (*parit gila*) formed the distribution canals within the units. Field ditches were much smaller than the quaternary canals and were constructed by farmers who were dependent on them for the water supply to their fields. They supplied those paddy plots which were difficult to irrigate or were not at all irrigated by the plot-to-plot method. All the major field ditches formed an extension of the




*a. Separate paddy areas served by a long quaternary canal*




*b. Example of uneven waterdistribution in an irrigation unit*

*Fig. 8. Schematic view of typical problems in water distribution by quaternary canals*

quaternary canals to distribute the water further into the unit (see Map 3). They differed in importance based on the topographical features of each unit and the presence of a quaternary canal. In P51L(I), the long field ditch (450 m) supplied every field, because from the quaternary canal plot-to-plot irrigation was impossible, whereas in other units the ditches connected only a few paddy fields with the quaternary canal. In the middle of the units, some smaller ditches joined one plot to another, cutting through high ground.

The irregular patterns of the ditches resulted from the fact that they were constructed along bunds which existed before irrigation was established in the area. The total density of the field ditches was high; for the 51 ha, a total length of 2350 m was constructed, giving a density of 46 m/ha. Together with the parts of the quaternary canals which had a distribution function in the units, the density for the research area became 67m/ha.[21]

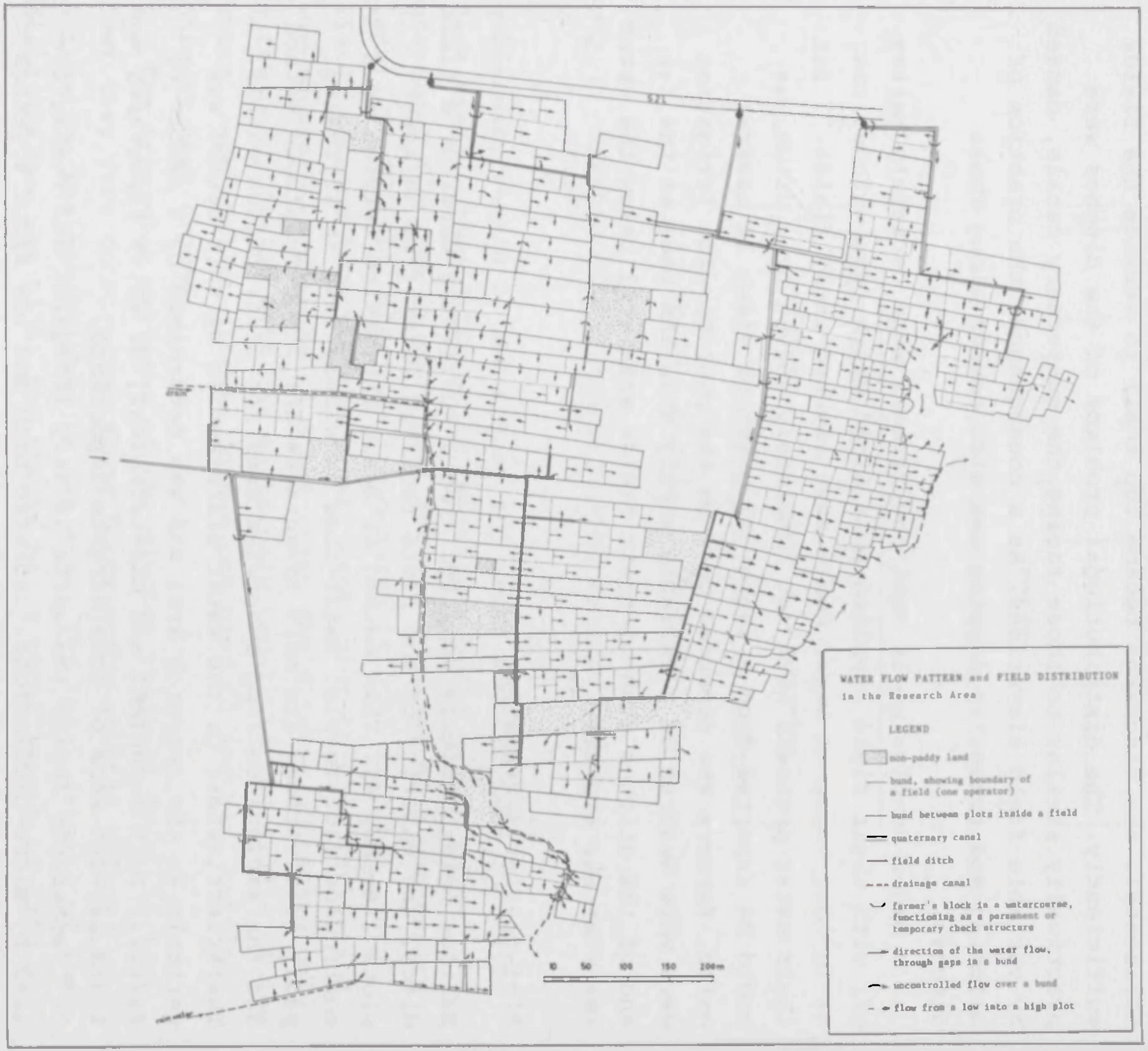
Inadequacies in the distribution of water through the field ditches were dominated by operational problems. The lay-out did not show technical imperfections but their cross sections were too limited in relation to the quaternary canal when they transported the complete discharge from the quaternary canal into the unit, as was the case in P51L(I). Where the canal bottom was more or less horizontal, the discharge became too small to service the fields sufficiently. The distributional problems of the ditches were practically similar to those facing the quaternary canals, caused by variable field elevations. As a consequence, the practice of blocking and excessive tapping was also common along these ditches.

A major conclusion is that the farmers were certainly better off with their field supplied by a field ditch than without one, as in most cases no water would have reached their fields.[22] But their water problems were not completely solved by a ditch, as could be expected from a technical point of view. In several units, farmers who depended only on the plot-to-plot irrigation were more assured of a reliable supply than the ones at the far end of the ditches even if their fields were well below the water level at the offtake.

*Plot-to-plot irrigation*

Besides being directly supplied from a quaternary canal or a field ditch, the majority of the plots received water from adjacent plots (see Map 4). This method of basin irrigation relying on a continuous plot-to-plot water-flow is widely used in irrigated paddy cultivation. Its main advantages are the very simple method and the savings on land otherwise used for distribution canals. The effectiveness of the water distribution by this method was variable in the research area and was determined by a number of factors, both technical and non-technical, of which topography and field lay-out were of considerable importance.

Topography inside the units is very irregular and characterized by micro-undulations: isolated high and low spots together with steep slopes next to flat pockets of elevated land. The major variation of the natural ground level was formed by two former river beds now in use as drain outlets, sloping towards the Ketereh River.




Map 4. Water flow pattern and field distribution

The highest paddy grounds were found in the north, next to the secondary canal and the lowest ones in the depressions close to the Ketereh River, with a difference in elevation of about 3 meters over 1 km. Over short distances maximum slopes could be found of 1%.

Independent from the lay-out of the fields, the topography generally resulted in variable water conditions in the plots. Plots with slightly higher elevations situated on the edges of the irrigation units could only receive water from other plots located on a lower level and had only a little water on the ground when the others were deeply inundated.[23]

For virtually flat areas, the plot-to-plot irrigation induced time lags in filling the plots. When only a small head was available for the first plot, the inflow into this plot decreased to a negligible amount because of the influence of the rising water level inside the plot. In only a few cases farmers constructed a small ditch to fill the downstream plots directly. The plot-to-plot irrigation was unfavourably affected by man-made micro-depressions. Several farmers solved their supply problems by having their high plots excavated by a bulldozer. Although this improved water conditions inside these plots, it could affect the supply to other plots. Where these lower plots were part of a chain of plots through which the water had to flow, it created uneven water conditions and delays in supply to plots further down.

*Land use and lay-out of fields*

In the 51 ha of cultivated paddy land, there were 170 fields,[24] operated by 109 farmers. The division of the research area into fields is depicted in Map 4. The average field was 0.3 ha in size, ranging from 0.04 to 1.09 ha. Each field was further sub-divided into small rectangular basins, the paddy plots. The number of plots within a field varied between 1 and 13 plots, averaging 3.6, and the average size was 828 $m^2$. Table 22 shows the number of fields, plots and operators in each of the units.

*Table 22. Land use in the research area*

| Unit | Paddy area[1] | Planted in off-season '82 | Idle land high (ha) | Idle land low (ha) | Planted area[2] field | Planted area[2] plot | Planted area[2] nr. of operators | Numbers of operators in survey |
|---|---|---|---|---|---|---|---|---|
| P4S2L | 9.8 | 8.3 | 1.1 | 0.4 | 42 | 96 | 32 | 8 |
| P5S2L | 12.1 | 9.3 | 2.3 | 0.5 | 29 | 75 | 22 | 8 |
| P7S2L | 14.3 | 11.1 | 3.2 | - | 33 | 181 | 34 | 17 |
| P8S2L | 5.5 | 3.8 | 1.7 | - | 12 | 56 | 11 | 7 |
| P51L(I) | 12.4 | 10.0 | 2.0 | 0.4 | 27 | 105 | 22 | 14 |
| P51L(II) | 9.3 | 8.4 | 0.6 | 0.3 | 40 | 108 | 29 | 16 |
| Total | 63.4 | 50.9 | 10.9 | 1.6 | 170 | 615 | 109 | 45 |

1 *Included in the area is the land occupied by field ditches and bunds. The land occupied by the crop is about 4% smaller*

2 *The total number is less than the sum because one item can be found in more than one unit*

The existing lay-out of the paddy plots dated back prior to the time irrigation was established and largely it has remained unchanged. The basic arrangement was determined by the limits of the different land-holdings demarcated by bunds for the paddy fields. These demarcation bunds had no relation to topography and divided the area into artificial rectangular compartments. A major part of the holdings were formed in a long oblong shape which could be 750 m long and only 18 m wide in extreme cases. The ground level inside a holding was highly variable with slopes running in different directions. The effect was that farmers were facing highly variable supply conditions for their fields (Fig. 9 and 10).

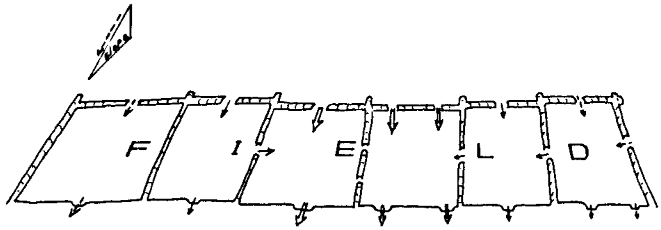



*Fig. 9. Schematic view of water distribution pattern in a field (one operator) perpendicular to the main slope*

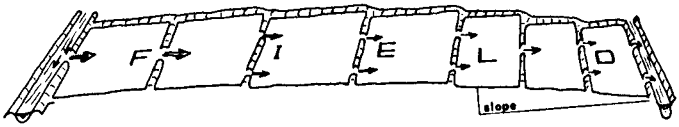



*Fig. 10. Schematic view of water distribution pattern in a field (one operator) parallel to the main slope*

Compacted field bunds sufficiently high above the ground level are essential to proper basin irrigation in sloping terrain. Beside their vital function for water conservation, they are also used as pathways when on-farm roads are absent. In the units where the water supply was abundant, bunds were so low and weak that their water control function was lost.

*Drainage facilities*

The only drainage facility provided by the project was a communal drainage canal for three units upstream of the research area and three inside. Its capacity was not sufficient to cope with excess rainwater from heavy showers. In the research area, water overflowed the banks of the drain and the discharge occurred partly in the inundated plots alongside. After the rain stopped, this situation kept on for several days. In the off-season, the damage to the crop was limited, while in the main season, farmers could lose their crop or waited until the monsoon rains were over. For the units upstream of the research area, the drain was totally inadequate as in the lower fields the crop remained submerged for about two weeks. The drainage capacity was affected by a lack of maintenance and several obstructions made by the farmers supplying their plots in the old riverbed from the drain.

In two depressions (in P4S2L and P5S2L) without any drainage, deep water conditions remained throughout the year. Here paddy cultivation was so difficult that parts of the fields were left uncultivated and covered with sedges. Over-irrigation was one of the causes, but this in turn was necessary to supply the higher plots nearby. For the major part of the research area drainage was not a problem. The natural drains, formed by the old riverbeds were large and deep enough to drain all the excess water towards the river without problems. In higher fields without any drainage facility, (part of P51L(I)) inundation of the crop never occurred according to the farmers and they could transplant even with heavy rainfall.

## Water supply during the off-season of 1982

### *The start of the irrigation period*

In 1982 the pumping for the off-season started on 16 April, 25 days after the water supply for the previous season was stopped. On the one hand this was much too early for the majority of the farmers in the scheme since the harvesting of the previous crop was still in progress or had not yet even started. On the other hand, the starting date was later than originally intended by KADA as also the pumping for the main season of 81/82 had to be extended by 25 days.

In the research area, the farmers were still harvesting until the end of April; no water entered the offtakes because either the water level in the canal remained too low for supply or the inflow was blocked by the farmers. In the first week of May, the water entered the units. Fig. 11 indicates the timetable for the water supply and planting schedule in three irrigation units.[9]

The main concern of the farmers, then, was to get water in the plots where the nurseries were to be prepared. As farmers had several options for their location, they selected the nursery in that plot which was the first to receive water. Where it was necessary, these plots were located along the quaternary canals and field ditches, as close as possible to the water source. Only in a few cases a farmer who had no suitable plot, shared one with a more fortunate farmer. To get the water in the nursery plots, farmers made gaps in the bunds and individually cleared some stretches of the field ditches. The abundant weed growth in some of the quaternary canals which blocked water passage was not removed.

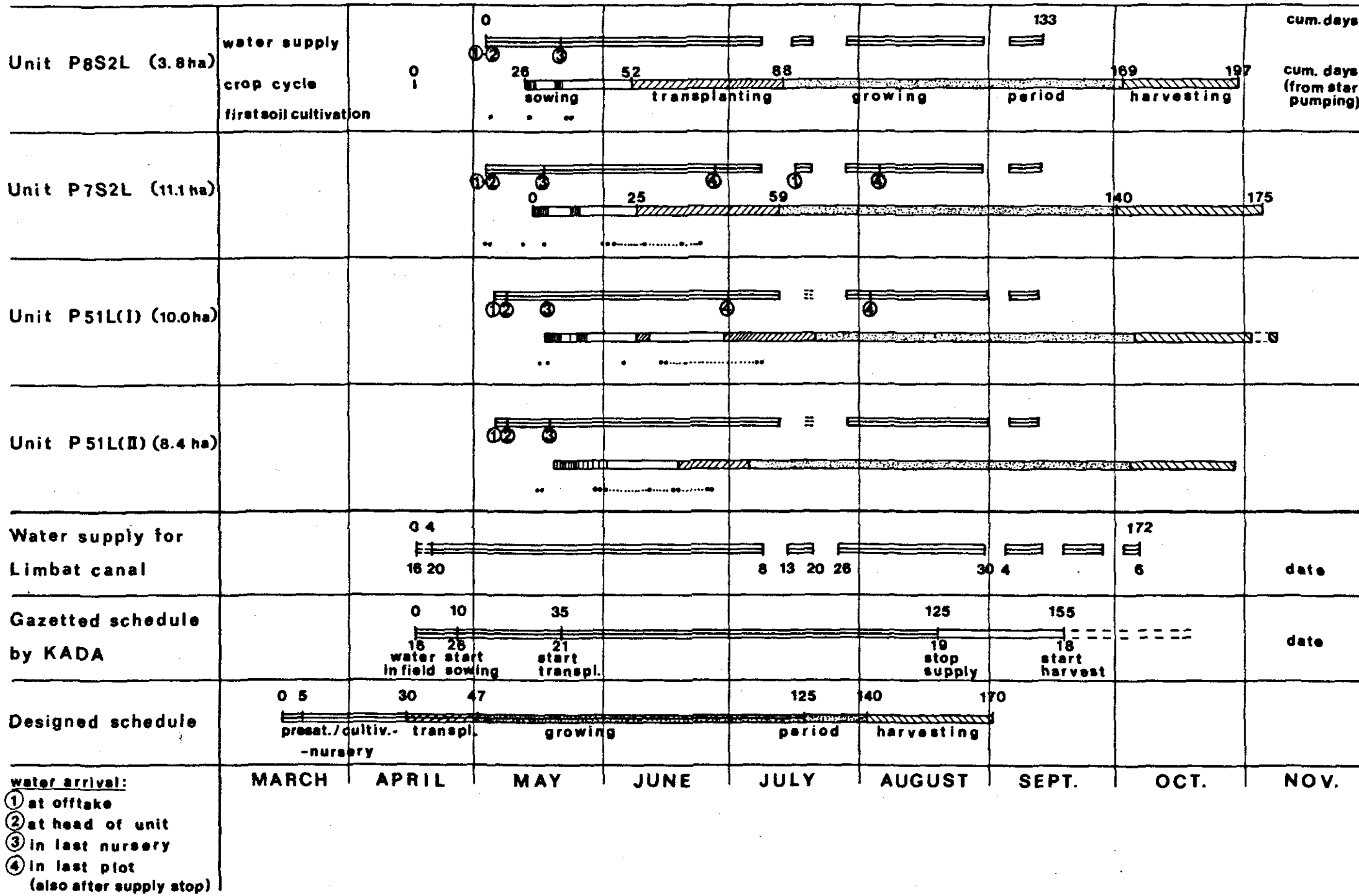



*Fig. 11. Time table for irrigation and crop production schedule in three irrigation units of the Kemubu scheme during the off-season 1982*

An important aspect in the research area was the land preparation by tractor as soon as the water arrived in the nursery plots. The rest of the paddy fields remained untouched for at least two weeks.

*Supply conditions during the growing period*

In general it can be stated that the expected variation in water conditions among the irrigation units in the research area did not occur in the off-season. The large contrasts observed in the previous season when the area was selected, did not arise because ample rainfall and sufficient supply prevented any serious water shortage. Only during short periods fields ran dry when the water supply for the whole scheme was temporarily interrupted (for details see Appendix 3).

Under normal (unrestricted) conditions of water supply a large portion of the irrigation water was not effectively used for purposes of crop production. One estimation showed an irrigation efficiency of only 14-17% on unit level, while for a main and secondary canal the efficiencies varied between 20-30%. These efficiencies are further discussed in Appendix 3.

*Percolation losses*

After a supply stop it was noticeable that several plots ran dry very fast, although the fiels bunds were closed. As no surface water could leave the plots, the water must have been lost by percolation to the subsoil. In six plots from where no water was drained, the decreasing water-level indicated very high percolation rates, which are considered too high for irrigated wet paddy cultivation. In a period of 9 days when 49 mm rainfall was measured, the water level in these plots dropped by an average of 90 mm. If an evapotranspiration of 6 mm per day is estimated, 9 mm per day could not have been lost but by percolation. In two other periods without a supply of irrigation water, the average percolation rate was estimated at 9 and 11 mm per day. The six plots were all located in P51L(I), which is situated on the higher grounds of the area.

The high percolation losses can be ascribed to the absence of an impermeable layer at shallow depth, which reduces the percolation effectively on these soils permeable by nature. This impermeable layer was found by others (Van de Goor and Zijlstra, 1968) as a result of the traditional harrowing and puddling practiced in wet land paddy cultivation. On the high grounds of the area, however, only dry land paddy was cultivated with the absence of this traditional practice. Along with the introduction of irrigation, the land-use changed into wet land paddy cultivation but the traditional land preparation was replaced by mechanized tillage at the same time.

*Effect of water conditions on crop production*

The 51 crop cutting tests in the plots in which the water level was measured (twice a week) throughout the growing season permitted an analysis of effects of water conditions on yields. Two indicators of 'water conditions' were used in the analysis: (1) the number of days a plot was dry and (2) the average water-depth in the plot.

It was found that neither of these factors has a statistically significant effect on yield, even when other factors like pests and diseases were eliminated. In judging these negative findings, it should be noted that moisture stress probably did not occur even when some plots had no standing water for some time. Rainfall distribution was favourable during the growing season, so that the soil always remained moist and did not dry out.

Some special tests were performed in certain plots with large differences in elevation within the plots. In three out of four plots measured the differences in yield were evident. Where deep water conditions existed (20-30 cm), the crop yield was 40% lower (poor tillering) than that of the higher part. In two other plots with uneven ground-level where heavy weed growth had overgrown the paddy, the crop reduction was 40 and 60% in comparison with the lower part received adequate water.

Water management at unit level

Inequalities in water distribution were not only a result of the prevailing physical conditions and technical aspects of the irrigation and drainage system, but also a result of human actions. These actions had a negative impact on the success of the Kemubu project, both from KADA's viewpoint because they affected the productivity per ha and increased the water costs, and from the viewpoint of some farmers, who benefitted less from the scheme.

*The social and economic composition of the operator population*

The 109 farmers who operated paddy fields in the irrigation units under study did not form a group with common interest. As will be discussed in more detail below, the advantages and disadvantages of the present water distribution practices weighed differently on different farmers, depending on the location of their fields. Furthermore, the operators differed greatly in economic dependence on paddy production, in the paddy acreages they operated, the degree of fragmentation of their paddy area and in tenure conditions. Almost all farmers operated more than one paddy field, often including some fields outside the research area.

The operators came from more than 10 different villages, some of them at a distance of several miles from the research area. However, the majority came from the four villages and hamlets surrounding the irrigation units, creating a considerable geographical variety in the operator population. Operators of the various villages were scattered all over the irrigation units studied.

Some fields within the units were operated by the same farmer from season to season. These included owner-operated fields and share-cropped or rented fields operated by tenants with secure tenure. Some fields, however, regularly changed from one tenant or share-cropper to another, because either the tenant or the landowner was dissatisfied with the results and preferred a change. Through this process each season some operators left the research units and others came in. Apart from these regular changes in the operator population, there was also a seasonal reshuffling of fields between the remaining operators, as when both the former and the new tenant of a field already operated one or more other fields in the unit on a more permanent basis.

An indication of the size of this phenomenon is given by the fact that 10 of the 45 sample farmers experienced a change in the operated acreage from the off- to the main season of 1982. The reshuffle involved 9% of the total acreage operated by the 45 operators and 23% of the rented and share-cropped land. The ultimate reshuffle might have been still more extensive; during the last round of the survey, a few weeks before the start of transplanting for the main season 1982/83, several farmers were still not sure if they could rent certain fields on which they had an option. As a precaution some farmers had sown extra seed in case some additional land would come available.

Finally, the operator population changed during the season, because several farmers transferred their fields to other operators in the middle of the growing season, because they moved to another place, fell ill, or found a job which could not be combined with paddy farming.

*The social organization of field neighbours*

The variety of village origins and the regular changes within the operator population meant that the collection of operators of neighbouring fields did not form part of any of the existing social structural units, however, 'loose' they might be.[25] Field neighbours formed an accidental collection of persons and no group with a structure, functions and clear boundaries which could mark it off from other similar groups. In fact the social structure of this accidental grouping of operators could only be defined from the ego-centered viewpoint of the individual farmer. An occasional tenant or share-cropper from another village operating a nearby field was often not known by name. In this case one could hardly speak of a relationship at all. With other field neighbours, a farmer could have only limited interaction in the form of small-talk when they met each other accidentally in the field. Finally, only with some of the neighbouring operators a relationship was maintained which had a wider basis than the nearness of fields and occasional interaction in the form of small-talk.

Before the introduction of the irrigation scheme, the absence of a group structure and prevalence of dyadic relationships among neighbouring operators posed hardly any problems to paddy growers. The peasants of neighbouring fields carried out their farming operations without the need for cooperation in the field of water control. Water conservation was an individual activity and confined itself to the maintenance of bunds to prevent the water from flowing to the neighbours' fields. No activities were undertaken by the peasants, individually or collectively to divert water from the water-ways to their fields (Craig, 1935).

The construction of the irrigation scheme meant a profound change in this situation. Irrigation water is now supplied by KADA and delivered at the offtake for distribution by the farmers on their own responsibility. This has made farmers very dependent on each other: in periods of low rainfall they could only get enough water on their field if farmers upstream let it pass through the quaternary canal, field ditch or across field boundaries.

KADA used the term 'irrigation unit' to indicate the area irrigated from each offtake, but this concept existed only in the minds of irrigation personnel.[26] The area of the irrigation units had never been pointed out to the farmers and, except for some recent experiments in a few irrigation units with improved lay-out, KADA had not given the concept of irrigation unit a social and organizational connotation. Also the operators in a unit had not received assistance in working out procedures for water distribution among themselves.

The farmers then were not aware of the existence of irrigation units. They did see that they were dependent on the same water source as field neighbours and others both up and downstream, but this did not make them see themselves as a group with a collective task and common problems and interests. They rather felt their interests as opposed, having become competitors for a scarce resource to which they had unequal access, depending on the location of their fields. In this way, the introduction of the irrigation scheme brought potentials for new antagonisms among the water-users in times of scarcity. As long as KADA supplied large quantities of water scarcities did not arise, and the uneven distribution could be relatively easily solved.

Given a relatively abundant supply of water, and during high rainfall, the distribution tasks inside most irrigation units could be managed with reasonable success and without the help of complicated organizational procedures. When all the farmers in a unit had relatively easy access to irrigation water their dependence on each other was not strongly felt. They could continue their individual activities that existed before the scheme, supplemented with occasional cooperative actions for which participants were mobilized on an *ad hoc* basis. An example in this respect was the construction of the field ditches (*parit gila)* in the research units during the period following the completion of the irrigation scheme. These ditches were constructed by small groups of 3-5 farmers who operated paddy fields at some distance from the offtake or quaternary canal. Although only a few farmers did the work, the cooperation of others was often required as they had to give up a small amount of paddy land for the construction of the ditch.

*Problems of unorganized water distribution*

In periods when demand was higher than supply, such *ad hoc* forms of cooperation were not sufficient to solve the water distribution problems that arose in certain sections of units with a more complicated distribution system. These problems have been recognized by the irrigation authorities. The Drainage and Irrigation Department, for instance, had taken the initiative to construct a long straight field ditch to alleviate the problems of irrigating the unit P51L(I). However, in none of these cases the authorities tried to provide an organizational solution to the problems, e.g. by establishing water-users groups and helping the farmers to work out rules and procedures for water distribution among themselves.

During periods of relative water scarcity, farmers with relatively high fields half a mile upstream along the canal or field ditch that supplied the end sections of these units, blocked the water flow in order to increase the water level in the canals so that it could flow on to their fields. Some of them preferred to leave their blocks in the canal indefinitely, even if they had enough water on their fields, whereas some farmers with low fields along the same waterway left a permanent gap in the bund to flood their fields. In both cases water was wasted into the drain at the far end of these fields, while fields further down the field ditch did not get enough water or none at all.

These farmers' excessive use of irrigation water was partly caused by their uncertainty about the water supply. As stops of the supply could not be predicted and farmers were uncertain as to when the supply would be resumed by KADA, they preferred the water level in their fields to be as high as possible at all times.

There were some ways by which individual farmers in the problem sections at the end of the unit tried to improve their situation. One way was by meeting with each of the farmers upstream and asking them politely to let the water pass to the fields further down for a while. This was usually not very effective; although in most cases the farmer who had blocked the water or let it run off, took out the block or closed the bund, or allowed the complainant to do so, he restored the old situation as soon as the complainant had disappeared out of sight. When a farmer downstream desparately needed water, he had to ask others upstream to let the water pass through two to three times a day. It was of no use to become angry with people who persistently blocked the water, since this would only make them still less cooperative. Despite of considerable tensions and quarrels among farmers, cases of fighting about water were rare.

Another way in which individual farmers tried to deal with water problems was by removing blocks at night and closing all gaps in the bunds along a canal, so that the water would not flow into other fields than their own. Farmers whose fields only received water via another farmer's field sometimes let in more water than their neighbour would allow by making gaps in the bunds at night. Since several farmers were out by that time, each to solve his or her own water problems, water-flows were frequently changed during the night. Only when a farmer stayed up all night he could make sure that the water kept flowing to his field.

Still another way to try to solve water shortages by farmers in problem sections of the irrigation units was to appeal to what they saw as the relevant authorities. These were not the traditional local authorities, such as the *penghulu*, *imam* and members of the village committee, who were considered as powerless by the affected farmers in solving problems, of such a crucial issue as irrigation water. These leaders conceded in interviews that it was beyond their power to solve these situations. They also pointed out that their personal identification with a political party made it impossible for them to act as mediators, since their political opponents simply would not accept them as such.

Complaints by disadvantaged farmers were therefore directed to the linesmen and other irrigation personnel whom the farmers expected to control the water supply. However, KADA considered itself only responsible for delivering water to the offtakes and not for the distribution of water within the units. In response to complaints the irrigation personnel always told the disadvantaged farmers to solve the matter themselves. Furthermore, the Irrigation Inspectors considered that, even to control blocking in the quaternary canals which was their official duty, they would need more powers than they had at the time and should receive stronger backing from KADA in the execution of these powers.[27] As these conditions were not fulfilled, they said, they avoided confrontations with blocking farmers which would only expose their powerlessness and would not solve the problems at all.

### *Absence of organizational procedures and its consequences*

The absence of organizational procedures for an efficient and equitable water distribution had a number of serious consequences. Firstly, it led to considerable wastage of irrigation water. Secondly, it made paddy production on fields at some distance from the offtake or quaternary canal a very unreliable enterprise. These fields suffered from droughts as soon as there was a shortfall in the supply of irrigation water. With intermittant irrigation, as in January - March 1982, crop failure was almost certain. Therefore, farmers who did not have the time to pay continuous attention to the water situation in their fields, left the more difficult fields uncultivated.

Despite of these negative results and even through some of the disadvantaged farmers saw a need for organizational procedures, it is understandable that, in the absence of any initiative by KADA, such procedures did not evolve spontaneously. These regulations should achieve that farmers with relatively easy access to irrigation water would cut down on their excessive use and, in periods of scarcity, would share the scarce resource. However, they can only be expected to participate in water sharing agreements, i.e. act against their own interests, if they (1) are effectively forced to do so; or, (2) are compensated materially; or, (3) feel so much solidarity with the rest of the farmers in the unit that they consider that they should sacrifice some of their own advantages for the benefit of the others (Galjart, 1976).

Actually none of these conditions was or could be fulfilled by the farmers themselves. Firstly, as outlined above, there was no authority at the local level that could force farmers to participate in and comply with possible water sharing procedures. Secondly, material compensation had never been considered by any of the disadvantaged farmers. They were of the opinion that they had just as much right to receive water as the others and that KADA had to see to it that they received what was rightly theirs. The idea of compensating other farmers was obviously seen as unfair as they received water free of charge anyway. Thirdly, it was clear from our observations that, where irrigation water was concerned, feelings of solidarity among farmers were weak, and that there was little willingness to sacrifice the advantage of easy access to irrigation water for the benefit of others in the unit. A feeling of group identity among the farmers in an irrigation unit, which is a necessary precondition for solidarity among them, was lacking completely.

Not surprisingly, disadvantaged farmers saw a more active role of KADA as the only solution to their irrigation problems. However, these farmers tended to expect too much from an agency like KADA; they wanted it to take over the responsibility and the actual operation of water distribution in the units, either through stricter control by the linesmen, or by nominating an 'irrigator' who should be the only one who was allowed to interfere with the water-flow. Both cases would involve a strong 'policing' role by the irrigation authorities.

This task seems both beyond the organizational capacity of an agency like KADA and also as undesirable. If KADA were to assume responsibility for the water distribution within the units, it would come under pressure from dissatisfied farmers whose complaints could never be settled satisfactorily. Even if it would achieve a more equitable distribution of irrigation water and higher average yields per ha, the number of complaints could well be larger than at present. In this case KADA's new role would probably do more harm than good to its relationship with the farmers. At least it would have to take sides in conflicts among farmers and accept the blame of those who felt injured.

Furthermore, the agency would be obliged to look into these complaints and could even be held responsible to some extent for the consequences of failures in the distribution process. If this were not enough to deter KADA from accepting a mediating role, there was the further danger that certain dissatisfied farmers would be able, as often happened in other cases, to mobilize high level political support for their requests. In that case it would be still more difficult for the agency to maintain the uncompromising and firm attitude that would be required for its task in the water distribution process.

# IV. FARMERS' ORGANIZATIONS, SERVICES AND FARMERS' PERCEPTIONS

In an irrigation project such as the Kemubu scheme, which aims at a change in technology from single to double cropping, a number of services are necessary to support and facilitate this change. These include the multiplication and distribution of seed of improved paddy varieties, provision of fertilizers and crop protection chemicals, credit facilities, extension advice about new cultivation techniques, introduction of farming machinery and, last but not least, market outlet for the increased crop output. In this chapter the way in which these tasks were carried out at the level of the interface between agencies and farmers and their effect on paddy production will be analysed.

## Farmers' Organizations

These tasks were carried out by several agencies and organizations, some of them under KADA's Agricultural Division, others more or less independent from KADA. An important part of the service task was assigned to the eight Farmers' Organizations (FOs), operating under the jurisdiction of KADA. FOs are formal rural institutions created by the government to perform 'multipurpose' duties within the overall context of rural development. The FOs in the Kemubu scheme specifically provide services associated with and designed to stimulate paddy farming.

FOs are government-supported associations of farmer members represented by an assembly and a board of directors. The official objective is that FOs would gradually develop into self-supporting business organizations. In practice FOs, which are staffed by several government officers, project an image of being KADA's field units and are primarily used to administer and channel agricultural services to farmers. The most important services are the distribution of subsidized paddy fertilizer, provision of seeds of the improved paddy varieties, tractor services and buying paddy on behalf of the National Padi and Rice Authority.

Short-term production credit was previously the FO's major function but this was discontinued in 1981 because of the low repayment rates to the Bank Pertanian Malaysia. At any rate, such credit had become less important with the introduction of the paddy fertilizer subsidy scheme in 1979. At present, only few farmers need credit to pay the tractor and hired labour. Tractor owners, including the FO, provide informal credit by collecting their money some time after ploughing, sometimes even after harvest. Additional credit needs are covered by borrowing from relatives, friends and neighbours, or, in some cases from pawn shops, paddy buyers and shopkeepers. Loans are relatively small and there are no discernable indications of exploitative practices in the informal credit market.

The services provided by the FOs are all of non-commercial nature. To make the FOs survive financially, the government pays the salaries of FO personnel and, in addition, a commission for services which the FO provides on behalf of other government agencies, such as the distribution of subsidized fertilizer for the Department of Agriculture and the purchase of paddy on behalf of LPN. The research area was covered by the FO in Ketereh which had a membership of 2800 spread over 17 local branches called Small Agricultural Units and an area of 93 $km^2$, half of which was used for paddy cultivation.

*Affiliation of farmers to FOs*

During 1971-78, only some farmers with relatively large paddy acreages in the research area joined the FO, attracted by the credit facilities. The others found it cheaper or easier to deal with shopkeepers in Ketereh. Share croppers often obtained inputs from the landowners and, hence, generally did not join the FO. However, after the start of the paddy fertilizer subsidy scheme in 1979, the FO membership grew considerably covering some 75% of the paddy farmers in the research area. There were few female FO members, most of whom are divorcees or widows. Even where the female was the paddy field operator, it was usually the husband who joined the FO (Rodenburg, 1983).

The distribution of free fertilizer is a federal policy to increase paddy production and support the incomes of small-scale producers. Each farmer is entitled to 200 kg of compound fertilizer (17:20:10) and 100 kg of urea (46%N) per ha, up to a maximum of 2.4 ha (6 acres). The fertilizer is distributed via the FOs, and officially all paddy farmers, whether FO members or non-members, are entitled to the subsidy. Nevertheless the board members asked the non-members to join the FO as a sign of their appreciation of the government's generosity. Many non-members heeded this advice as otherwise they would have felt embarrassed (*malu*) to apply for the subsidy. Also, in order to obtain the subsidy, they needed the approval of the Village Security and Development Committee members and the *penghulu* (headman), who were often also important leaders in the local FO branch. Officially, this arrangement was to ensure that farmers did not receive fertilizer for land they did not operate; in reality, it had far reaching political consequences.

*Farmers' perception of the FO and their role as members*

Farmers generally had virtually no idea about the role of the FO as defined under the Farmers' Organization Act 1973 and its by-laws. The FOs were perceived as government-assisted agencies supplying inputs and other services to farmers and as a communication link between them and government agencies. Few farmers took seriously official statements that FOs should gradually develop into viable business associations, financially independent of the government. Moreover, neither farmers nor KADA grasped how this objective was to be achieved. In fact, as one of its senior officers put it, the agency was "groping in the dark as to the actual government policy concerning the direction of the development of FOs".

From the farmers' viewpoint, financial independence of the FO was not possible, as they expected that the FOs could not survive without continued financial assistance. They also did not regard their representatives in the FO board and assembly as capable of assuming an independent role in planning and implementing development projects, which they see in terms of providing yield-increasing technology, improved irrigation infrastructure and better educational facilities for their children. All these tasks were beyond the scope of the farmers in terms of technical and organizational complexity and in terms of the financial resources required. Instead, the farmers understood their representatives' role as that of an intermediary through whom some influence could be excercised on the development activities affecting them.

The FO membership reflected a patron-client relationship between the farmer and a benevolent government, represented by KADA, with the latter making the larger contribution. The fact that the government asked the farmers to become members and pay annual dues and buy shares, before obtaining FO services, was regarded as a slight inconvenience. At the same time, the farmers considered that it was only fair that they should make this small sacrifice of $13 and as a token of appreciation for the large material benefits given to them. Their affiliation to the FOs did not mean that they accepted full responsibility for the organization, neither individually nor as a group. It only meant that they showed their good intentions by doing what the government asked them; in return they expected that the government would continue to provide them with assistance through the FO. A striking similarity in farmers' attitudes was found in the Muda and Krian areas in an earlier study (Daane, 1982).

The farmers' view that FO membership was a kind of patron-client relationship, was clearly expressed in their reactions to the unequal distribution of the fertilizer subsidy that followed the 1982 elections. Both PAS and UMNO supporters referred to rights and obligations of a patron-client type when they protested against or defended the distribution of fertilizer only to UMNO members. The PAS voters defended their rights to the subsidy by pointing out that they had joined the FO, as requested by the government. In their eyes, the government had not fulfilled its obligation to them. In private, several of them threatened to give up their FO membership and withdraw their capital shares, as this sacrifice was no longer reciprocated. The UMNO voters, on the other hand, considered that the PAS supporters themselves were the ones who had violated the patron-client relationship by not supporting the UMNO government that introduced the subsidies. In both arguments, the right to material benefits in exchange for immaterial support, so typical of patron-client relationships, is a central element.

The political changes brought the development of factions which were divided between the two major Malay political parties the United Malays National Organisation (UMNO) and the *Partai Islam* (usually called PAS). Both parties are of urban nature, but actively woo the rural vote. In this respect, the PAS has been most successful in Kelantan where it controlled the state government between 1959 and 1978. In that year its fortunes changed and the reins of the state government were taken over by the UMNO which had always controlled the federal government and most of the state governments since independence through its confederation with the principal parties of the non-Malay minorities.

In establishing party branches in Kelantan, both parties worked through the existing intermediaries between village and state. UMNO directed itself to local school teachers and other government servants with a popular local reputation, village headmen and educated wealthier farmers, whereas PAS, while also directing itself to village headmen and prominent farmers, focused on traditionalist Islamic teachers and rural *imam*.

*Role of the FO board and assembly*

On consequence of the farmers' continued reliance on the government was that the administration of the FO, as practised by KADA and its FO staff, was much too complex for the administrative capabilities and insights of the FO board and assembly members. As a result, the latter were not able to exercise their formal policy making functions.[28] Instead, they assumed only a consultative status or function as a discussion platform to channel requests or complaints about the scheme's infrastructure and the provision of services. Another important function of the FO leaders was to explain the policies of KADA to the members (cf. Husin Ali, 1975 and Daane, 1982).

Uncertain about the actual range of their authority, the farmers' representatives left much of the policy making and implementation to the FO staff. When, as sometimes happened, the FO staff and KADA took a long time to respond to the requests of the board and assembly, the latter showed great tolerance. In exceptionally pressing cases, however, the FO members' representatives did not wait for KADA's decision, but operated via the local *Wakil Rakyat* (state assembly member) who sits on the KADA board and has direct access to the *Menteri Besar*. In these cases, the slow administrative process between FO and KADA could be bypassed and overruled via these political connections.

Many of the assembly and board members were not farmers, but local teachers and other educated members of the salariat to whom farmers had easy access. These people had never grown paddy themselves and knew very little about agriculture in general. They were nevertheless elected, because they were a stronger partner vis-à-vis the FO staff and KADA than ordinary farmers, who did not understand the complex formal procedures of the bureaucracy.

In many instances, these non-farmer board members were also politically influential people in the FO-area, who could get things 'pushed through' if necessary. However, their actions to assist the farmers were limited to *ad hoc* solving of particular problems and to helping individual members of their clientele. They did not form long term views of the development of paddy farming or stimulate the active participation of their clientele in the development of such views. In this way, farmers remained a silent and recipient category who only heard about new projects affecting their future after KADA had finished the planning and reached the implementation stage.

*Communication between farmers and KADA*

The communication between farmers and KADA was constrained by a number of problems. Firstly, the FO board and assembly were controlled by UMNO supporters who - in the heated political situation of Kelantan after the fall of PAS in 1978 - avoided any form of contact or communication with PAS supporters. In some cases, the FO board made exclusive use of the communication channels of the UMNO party organization to spread information to the members, to make sure that PAS supporters could not intercept the message. In fact, farmers who were sympathetic to PAS had little access to KADA.

Secondly, there was a lack of communication between members and their assembly or board representatives even when no political differences existed among them. The representatives did not keep the members in their village informed of the issues discussed in board and assembly meetings, nor did they convene the membership on a village basis to consult them when certain issues arose. Rather than representing the views of the ordinary members in their village, in most cases the representatives appeared to articulate their private opinion in assembly or board meetings or discussions with KADA.

Thirdly, there was the problem that the suggestions of the ordinary members in the annual meetings at village level, as passed on to KADA via the FO board and assembly, were required to be formalized in a letter in which detail was discouraged. Most of the requests pertained to the need for additional quaternary canals, maintenance work, feeder roads and more tractor services. After some time, the letter was screened by KADA and directed to the relevant divisions for action. In fact, little decisive action was actually undertaken because of the lack of detail and the view that the suggestions were already provided for in the current work programme of the division concerned.

## Service delivery

### *The paddy fertilizer subsidy*

The distribution of the paddy fertilizer subsidy after the 1982 elections underscored the exceptionally close links in Kelantan between the ruling political party and the government agency involved with the subsidy. As indicated above, the FOs register the applications for the subsidy; approving powers, however, are not vested in these associations, but in the headmen and the members of the Village Security and Development Committees, i.e. the lowest level in the administrative structure of the state. In the years that followed UMNO's 1978 election victory these offices, that had gradually become dominated by PAS supporters in the previous decades, were suddenly transferred to UMNO followers. This caused an acute awareness that these offices had become politicised, which undermined their traditional authority and credibility.

Initially, the new headmen in the research area approved all applications independent of the applicant's political allegiance, in the vain hope that it would earn them a certain recognition if they gave the PAS minority no reason to complain about unfair treatment. However, the hope that this would help the PAS minority to be complacent and accept the new political situation did not materialize. When the April 1982 elections approached and there were signs that some of the voters who had crossed over the UMNO in 1978 had returned to the PAS fold, the PAS put more vigour into its campaign that in 1978. As they had traditionally done, the PAS speakers, none of them farmers themselves, accused the UMNO of "money politics", inducing pious Muslims with material advantages, such as free fertilizer, in the ultimate interest of the elite, not of the farmers. The farmers who accepted these offers were compromising their religious purity, because they were partly paid from taxes on liquor sales, gambling and other vices forbidden by Islam.

The PAS attempt to regain influence threatened the UMNO supporters' newly won status, material advantages and easy access to the state government via the close relationship between the headmen and the state assembly members. The antagonistic feelings between the supporters of the two parties ran high in many villages and the state UMNO decided to counter the PAS threat by warning all PAS voters that - since their party was opposed to the UMNO's material inducements - they would not get free fertilizer any more. After the elections which returned the UMNO to power, it stuck to this policy. In the three administrative sub-districts (*mukim*) covered by the research area, 115 out of 516 applicants found their fertilizer applications for the 1982 off-season rejected. In the following main season, i.e. 7 months after the general elections, almost all of these 115 farmers were again penalized.

Many of these farmers faced a dilemma. Whatever their party cadres had said in the election campaign about the impure nature of the fertilizer subsidy, the PAS supporters wanted it. They viewed the biased distribution as an injustice, but could not appeal to the headman and inquire about their share of fertilizer without a substantial loss of face. The headman would embarrass them with their inconsequent attitude while their fellow PAS voters would regard them as defectors, having put material advantages above Islamic solidarity.

The PAS supporters tried to solve this dilemma in various ways but very few openly surrendered by approaching the headman. Some tried physical threats and our village headman was beaten up. Others tried to get around the headman by asking higher authorities to intervene, but were referred back to the headman as the ultimate authority in this matter. Finally, there was a demonstration in a nearby township which was defused by the authorities with the promise to appoint a complaints committee. By the time the committee started work, the fertilizer was already long overdue and none of the farmers in the research area used this course of action.

The unsolved dilemma of the PAS supporters generated tensions, not only between them and the new headman, but also between them and the UMNO rank and file who considered the unequal distribution of fertilizer as a just punishment for the PAS voters. However, except for some minor incidents, people avoided open confrontation by completely ignoring each other socially and turning off their heads when they passed each other on the road.

Since neither the FO nor private shops sold any paddy fertilizer, the non-recipient farmers had to rely on friends or relatives having a surplus of subsidized fertilizer, and usually living in other villages, sometimes at tens of miles distance. Such fertilizer was bought at greatly reduced prices ($4-$5 per 20 kg bag). The difficulty in obtaining fertilizers resulted in a 30% reduction in average fertilizer use per ha by non-recipients compared to recipients and 12% below the recommended level. In some instances, non-recipients left part of their land uncultivated.

Another consequence, with perhaps a longer term influence, is that KADA, FO and DOA officers were constrained from carrying out their duties in the villages to avoid the embarrassment of being blamed by the non-recipients for not being able to achieve an equitable distribution of the subsidy. Extension activities were completely stopped. Furthermore, the biased distribution of the subsidy kept the villagers permanently divided, thereby aggravating the already formidable problems involved in achieving some form of cooperation among the farmers in such crucial areas as water management and pest control at unit level.

*Seed supply*

Each season, one third of all villages in an FO area were supplied with improved paddy seeds developed by MARDI and multiplied by KADA. Thus, each village received seeds once every three seasons. In 1982, four different locally improved MARDI varieties were distributed with KADA determining the variety to be provided to a particular area on the basis of growth duration. Areas that were far behind on the irrigation schedule received the shortest term variety.

Farmers normally apply for new seeds through the headman of their sub-district (*mukim*) or obtain supplies from those who apply. Of the 45 farmers interviewed, 26 received new seeds of *Padi Kadaria* in the off-season of 1982. As applications were processed before the general elections, the political problems that circumscribed the distribution of the fertilizer subsidy were not encountered. Those who received seeds included non-members of the FO and supporters of both political parties. Each applicant was allocated 15-20 kg of free seeds, distributed at a well advertised hour and place in the village. Field observations indicate widespread use of the new seeds in the research area. The programme has a strong positive impact on the use of modern varieties, as farmers who received seeds planted a significantly larger proportion of their paddy area with modern varieties ($p = 0.001$). This indicates, however, also the use of seeds do not spread easily among the non-applicants. The latter continue to use the seeds of various semi-traditional varieties.

*Tractor services*

The FO in Ketereh uses ten 4-wheel tractors to help overcome a tractor shortage. Detailed estimates of the FO's market share indicate that its tractors plough about 10% of the total paddy fields in its area during each season. This is much lower than the estimated 36% by KADA and 45% by the FO. These latter estimates were derived from the total number of work hours of the tractors divided by an unrealistically low estimate of the work hours required per ha. The FO tractor capacity was underutilized by 40% annually, due to lack of work in between the peak periods. The rest of the area was ploughed by private 4-wheel tractors owned by local and non-local busenissmen. The charges for private tractors were slightly higher than those of the FO and amounted to about $26-$30 per hour, but payment conditions differed.

Although the use of 4-wheel tractors is not advisable from an agronomic point of view - they till too deep, completely destroy the soil structure and damage bunds - there are compelling economic pressures on the farmers to use 4-wheel rather than pedestrian tractors. The capital overhead cost per ha of ploughing with 4-wheelers is lower than for power tillers. However, similar economic forces also operate in the Muda and Tanjung Karang areas, but there the use of power tillers is widespread. Further research is necessary to identify the reasons for the prevalence of 4-wheelers in the KADA area.

Of the purchasing value of the FO tractors, only 36% is been provided by the FO itself while the balance is a subvention from KADA. On paper the tractor service makes a small profit after taking into account depreciation. However, because of the slow recovery of tractor service charges, the actual cash inflow is just enough to compensate for the operating costs (not including depreciation). Even then, temporary cash flow problems have to be overcome occasionally by short term loans from KADA ($100,000 - $150,000).

Both the FO and private tractor owners try to distribute their services via what are locally called "brokers". The broker is a local intermediary between the tractor owner or FO, and the farmers in his village of residence and immediate surroundings. Each tractor owner has his own broker in a particular locality who is to be contacted when a farmer needs a tractor. In reality, however, most farmers book with the tractor driver who has started work near his fields. The main function of the broker is then to collect the tractor charges from the farmers after ploughing. The broker is fully responsible to the owner for all debts of the farmers in his area and receives a commission of 10% of the charge payable after all outstanding payments have been recovered.

The reason why farmers do not book with the brokers is that bookings have to be done relatively long in advance (at least 4-5 days, but often longer). Given the prevailing water distribution pattern, the farmer is uncertain about the time of arrival of water to his field and cannot book a tractor in advance, unless he is prepared to pay the higher costs of dry ploughing. Once the water has arrived, a tractor soon arrives and it is easy for the farmer to contact the driver and point out the fields that are to be ploughed. As a consequence of this practice, a farmer often uses different tractors for different fields.

Even on the same field, such operations as nursery preparation and the first and second field preparation are often completed by different tractors. The driver hardly knows his clientele and, unless the broker is vigilant, it is impossible to prevent drivers from ploughing the fields of farmers who have not paid old debts.

The FO tractor services are used by both members and non-members, irrespective of political affiliation. The fact that tractor drivers are usually outsiders and not involved with the local political controversies, is advantageous. The local political strongmen make no objection to this practice.

*Recovery of tractor debts*

The recovery of tractor debts which have been increasing every season was one of the main problems of the FO. Although farmers had to pay within 45 days after ploughing, few farmers did so, with the majority making payments after harvest. By allowing this practice, the FO was actually providing credit to the farmers.

The repayment problems were due to a number of reasons. The FO staff and KADA did not fully recognize that debt recovery requires continuous monitoring of the brokers, so as to pressure them to pay regular visits to each debtor. Private tractor owners, who showed better repayment records, indicated that they could only get their money back if they paid weekly visits to their brokers, starting immediately after ploughing and continuing throughout the season.[29] As the FO had appointed 65 brokers throughout its area of operations, the FO officer concerned could not pay them visits on a weekly basis.

The monitoring of the brokers and debt recovery was further complicated by poor and unsupervised debt records. The FO had no records of the tractor debts of each farmer; only the broker knew the debts of his clientele. When a broker quitted, as happened in many cases, neither the FO nor the new broker knew how much was owed by each farmer. Furthermore, with the current records it was impossible to know how long the debts of each broker were overdue. Finally, the system allowed some brokers to use collected repayments for private purposes, at least on a temporary basis. Accusations to this effect were frequently heard from various sources.

The debt recovery problem of the FO was also due to factors beyond its control. Firstly, the farmers considered that since it was government policy to help them, repayment of debts was not as urgent as a debt to a private individual. Secondly, brokers were often local FO leaders, headmen, and other politically influential persons whose political survival depended on their ability to show their clientele that the government was generous to them, and who did not want to antagonize their supporters by putting pressure on them to repay debts. This lenient attitude was endorsed by the ruling party, which made it double difficult for the FO staff to pressure the brokers to do their job effectively.

Extension advice on paddy cultivation

The provision of agricultural extension advice to the farmers in the research area was the responsibility of the branch office of the Department of Agriculture (DOA) in Ketereh, which considered paddy to be a priority crop in its activities. Since 1980, the formal structure for the extension work was based on the Training and Visit System, as propagated by the World Bank (Benor and Harrison, 1977). This system, locally known as 2L (*Latihan dan Lawatan*), involves a combination of bi-weekly training of extension officers by specialists and bi-weekly visits of extension workers to groups of farmers. In the villages covered by the research project, groups of some 50 farmers were formed in 1980-81 in a village level meeting at which the 2L concept was explained. The groups were formed on a co-residential rather than a field neighbourship basis.

However, it appeared that only one third of the farmers were involved in the system. Of the farmers interviewed 38% had never attended an extension activity of the DOA, whereas 31% had only attended the demonstrations organized at the start of double cropping. Only 31% had a somewhat more intensive contact with the DOA through occasional visits to the office or attendance at the inaugural meeting of a 2L group. However, even these contacts were irregular and infrequent.

For individual farmers, the frequency of extension contacts appeared positively correlated with the operated paddy acreage. This does not mean, however, that it were the richer farmers, or the farmers without a non-agricultural job who had most contacts with the DOA. Household income and non-agricultural jobs showed no correlation at all with these contacts. Despite of the fact that one third of the operators were women, the extension activities were clearly aimed at men, and few women operators had attended any of the DOA's activities (Rodenburg, 1983).

Although extension workers have attended bi-weekly staff training sessions, it has been impossible to organize subsequent group meetings with the farmers. The extension officers mentioned such reasons as: (1) lack of interest of the farmers who are older and more experienced paddy growers than the officers,

(2) differences in political outlook among the farmers, and (3) lack of time because many farmers undertook non-paddy activities. There were also no visits to individual farmers appointed as contact persons for their group, as officers avoided to go to the village for reasons outlined above.

It appeared that farmers in the research area did not see much use in receiving bi-weekly information that would most probably be impracticable. The farmers considered that they already used an adapted package of cultivation techniques incorporating the useful and leaving out the unrealistic elements of the extension message. Although individual variations in techniques were found, they remained within the limits of a relatively uniform technological level. There was no group of technically more advanced farmers as the acceptable elements of the new technology had been diffused to all farmers. The frequency of extension contacts was not correlated with the use of modern varieties, quantities of fertilizer used per ha and the use of crop protection chemicals.

The more sophisticated techniques that were recommended required greater control of the environment than was possible on the farmers' fields or that could only be carried out in very close cooperation with field neighbours, an unrealistic proposition. Extension efforts were not tailored to achieve this control or cooperation.

In the farmers's eyes, the 2L system was only useful to obtain assistance from the DOA in cases of paddy disease and pest attacks affecting large areas of contiguous paddy fields. If the damage was sufficiently large, the group leader or one of the affected farmers would contact the DOA and mobilize the others in a joint attempt to control the pest. If pests only affected individual farmers scattered over the irrigation unit, as happened during the off-season of 1982, no joint action was undertaken, despite of considerable damage from the black stalk bug (*kesing kura-kura*) and the danger that the pest would spread to other fields. Only few farmers took any action at all and those who did, obtained pesticides through their own individual channels, without contacting the group leader.[30]

In fact, the farmers had no idea about the potential damage of this pest. Some of them were aware of the presence of the black stalk bug in their fields from the time of transplanting, but did not regard this as a serious threat, until a few days before the harvest, when they found that parts of their crop had been completely destroyed. Some others mistook the symptoms of the damage by the black stalk bug for lack of urea and added more of this fertilizer.

In general, farmers had little knowledge of the life cycle of these new pests and of how and in which growth-stage various pests lay the groundwork for latter damage. Hence, the farmers often did not identify a pest as a problem, until they observed serious damage, i.e. when it was usually too late for any remedial action by the DOA.

# V. PRACTICES OF PADDY CULTIVATION*

General cultivation conditions in the research area could be considered as favourable as compared to other cultivated areas in the Kemubu scheme. On closer inspection, however, a number of problems occurred which had a definite impact on cultural practices and production levels in the area.

## Cultivation conditions

Main problems in paddy cultivation were related to (1) irrigation, drainage and physical infrastructure, and (2) the cropping calendar.

### *Irrigation, drainage and physical infrastructure*

The lack of an efficient water distribution system at the unit level, and the absence of adequate drainage facilities were among the major factors hampering sound and effective cultural practices. The irregular topography had resulted in a complicated water distribution system and the same factor posed problems for proper water management of the paddy fields. In various cases farmers interfered with the flow of irrigation water, thereby disrupting the water distribution to other fields. The absence of tertiary drains, the neglect of maintenance of existing drains and the poor condition of the field bunds gave rise to excessive amounts of drainage water, even during harvesting periods. Lack of sufficient farm roads and the usually poor maintenance of the field bunds hampered transportation, and protection measures of the crop.

### *The cropping calendar*

The extremely high rainfall in November and December makes it difficult to adopt an efficient cropping calendar for the scheme with suitable periods for growing two rice crops per year (see Fig. 12). In practice it has not been possible for the farmers to

* This chapter is based on the report "Rice cultivation in the Kemubu irrigation scheme" by H. ten Have (1982), and on a report by E.C.M. Gies, entitled "Agronomic aspects of paddy farming in the Kemubu Irrigation Scheme" (1982).

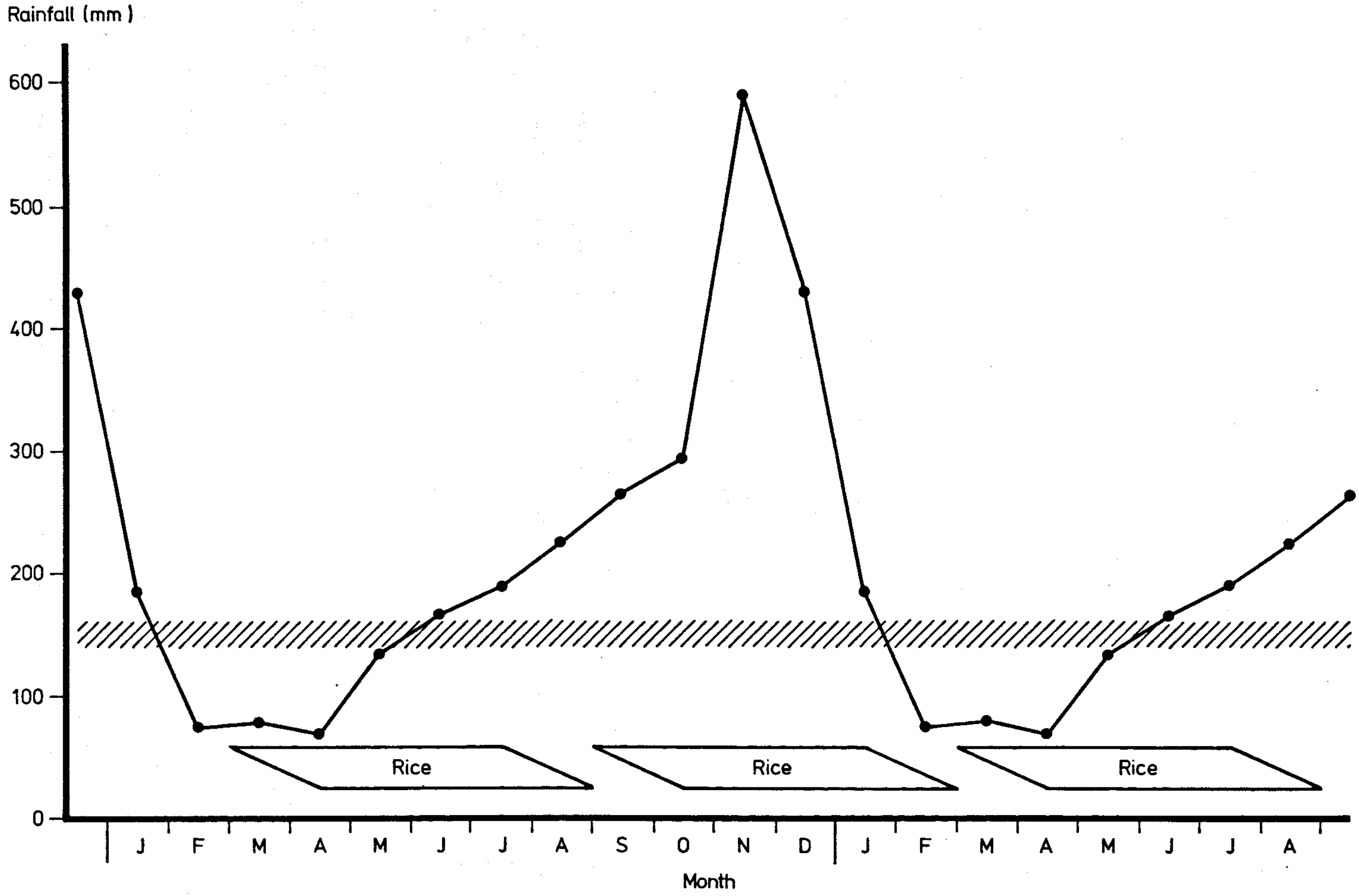



*Fig. 12. Average rainfall distribution for the Kemubu scheme and the optimum periods for growing two rice crops per year. The hatched band indicates the transition between a dry and a wet month*

follow a strict cropping calendar, as intended by KADA. Sowings have been delayed so that in 1982 a critical situation had arisen, whereby the calendar was about two months behind the official schedule.

Nursery sowings for the off-season crop were staggered over a six-week period from May 7 to about June 22. All transplanting operations were carried out within a two-month period, from June 7 until August 7. With a timelag of six months between the off-season crop and the next main season crop the periods for the various operations were then as follows (Table 23).

*Table 23. Cultivation operations and periods*

| Activity | Dates for 1982-1983 | |
|---|---|---|
| | off-season crop | main season crop |
| nursery sowing | May 7 to June 22 | November 7 to December 22 |
| transplanting | June 7 to August 7 | December 7 to February 7 |
| harvesting | October 1 to November 22 | April 1 to May 22 |

As can be seen from this table real problems were ahead with the sowings for the main season crop of 1983 as heavy rains in November and December could inflict serious damage on nurseries and recently planted fields. Postponing nursery sowings until early January 1983 became risky as not enough irrigation water might be delivered for timely and successful transplanting and weed control. It was also apparent that the harvest operations for the off-season crop (1982) would already continue until the end of November, thereby inviting high risks for heavy rainfall during harvesting activities.

*Division of labour*

In the cultivation of paddy a division of labour could be observed between men and women. Women were involved in the more tedious tasks such as pulling and bundling of seedlings, and winnowing and drying of paddy. The men carried out activities which require more physical strength, such as land preparation, transporting and threshing of paddy. An equal number of men and women were involved in planting and cutting the paddy during harvest. Marketing activities were performed mostly by men, they assisted with the loading and unloading of paddy and received the paddy subsidy.

Observed cases of child labour in paddy cultivation were rare. In general, most boys and girls considered themselves as unskilled for work in the paddy fields, or they disapproved of this work as being too dirty. Also they were seldom encouraged by their parents to learn farming practices (Rodenburg, 1983).

## Cultural practices

In this section a description will be given of the various stages in the paddy growing cycle, observed during the off-season of 1982.

### *Rice varieties*

Rice varieties used by the farmers in the research area can be divided in two groups:
- short-strawed, modern varieties (*Kadaria/MR 27*) and
- semi-tall, semi-traditional varieties (*Mahsuri, Padi Merah* and *Padi Pauh*).

Semi-traditional varieties were planted in low-lying paches, where the crop suffered from an excess of standing water. On fields with a higher elevation, short varieties were grown. These short varieties had a length of 90-100 cm while the semi-tall varieties varied between 120 and 130 cm length. The growing period for the short varieties was 130-135 days, and 140-150 days for the semi-tall ones.

Farmers often used more than one paddy variety because of the following reasons:
- Their fields were of different elevation. Tall varieties were planted on fields of lower elevation, while short varieties were planted on the higher fields.
- Many farmers experimented with a number of varieties.
- By planting varieties with different growth durations it was possible to extend the transplanting and harvesting times, thereby diminishing labour shortages.

It appeared that farmers often changed varieties from one season to another. New seeds were obtained from the Farmers' Organization or through exchange with other farmers. New varieties were always tried out on a small plot and if proven satisfactory, larger areas would be planted in the next season

*Nurseries*

As the availability and control of irrigation water in nurseries is important, most farmers located their nurseries as close as possible to a water source. Land preparation commonly was done twice with a tractor, only two farmers used a *kerbau* (water buffalo) for the second round of cultivation. Mechanical land preparation was done with a rotavator. Usually only those fields were rotavated on which the nurseries were planned. This meant that the tractor went from nursery to nursery, leaving fields in between uncultivated. It caused serious damage to the bunds.

After this mechanical operation farmers leveled their nurseries with a hoe. The soil surface was flattened as smooth as possible, and ditches of about 30 cm wide were dug between the seedbeds. The seedbeds had an average size of 10-15 m long and 2.3 m wide. For each paddy variety a separate seedbed was prepared, to prevent the seed from mixing with other varieties.

Germinated seed was commonly used. Most seed came from the farmers' own supply; once in three years KADA distributes free paddy seeds to farmers, up to 8 *gantang* per acre paddy land. As an average, farmers used 5.5 *gantang* of seed to transplant one hectare (30 kg/ha).

The fertilizer for the nurseries, also supplied free of charge by KADA, was Ammophos. This off-season the supply of fertilizers arrived very late, but most farmers could use some fertilizer from the main season wich they had stored near their houses.

All nurseries were affected by pests, the most important being *kesing kura-kura*, or black stalk bug (*Scotinophora coarctata*). From the 35 nurseries observed, 6 showed severe damage, 18 medium damage, and 11 suffered little or no damage. Some of the farmers reported the use of pesticides against these pests, but the effect was minimal. Very little damage by rats was observed in the research area.

*Land preparation*

In the research area, land preparation was carried out one or two weeks before the seedlings were transplanted. The first round of land preparation was always carried out by rotavating with a tractor.

There were two possibilities for hiring a tractor: one was to hire a tractor from KADA, the other was to obtain the services of a private individual. It appeared that only 20% of the farmers made full use of tractors provided by KADA, the majority preferred privately-owned tractors. Although services under the latter category were slightly more expensive ($28/hr against $26 under KADA) preference was given to private tractors because of the following reasons:

- Most farmers found it easier to obtain private tractor services at the time when the water arrived in their fields.
- The tractors under KADA had a long waiting list.
- It was easier to make an appointment with private owners, as many of them had a shop nearby.

The second working was commonly also done with a tractor and seldom by making use of a water buffalo. In the latter case, the soil was puddled by dragging a log with nails around the field, whereby some levelling was obtained. Although animal traction had some advantages over tractor use, land preparation by the former method was becoming an exception rather than a rule. The preference given to tractors caused a number of problems to proper water management and cultural practices. The existence of small sized plots and the lack of sufficient farm roads lowered tractor efficiency, and the heavy fourwheelers partially destroyed the bunds as they moved from field to field.

*Transplanting*

When the seedlings reached a height of 35-40 cm they were pulled out of the nurseries. The roots were then slapped against a wooden block to remove soil and insects. Some farmers cut about 15 cm from the top of the seedlings, giving as reasons that this facilitated transplanting and that it might decrease lodging.

There upon the seedlings were packed in bundles and carried to the fields by means of a *cagak* (bamboo yoke).

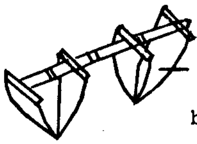



*Fig. 13. A 'cagak', or bamboo yoke for carrying paddy seedlings*

No special planting techniques were observed in the fields. A rather wide spacing of about 30 x 30 cm was a fairly common practice, which increased weed problems and decreased grain yields. In many low lying fields, planting was done 4 to 6 cm too deep, retarding crop growth. On the other hand, this practice better safeguarded young crops against uprooting and floating under conditions of heavy floods. Nursery and transplanting operations were estimated to require about 35 working days per hectare. Transplanting took a long time as the Islamic fasting month (*Ramadan*) coincided with this labour consuming activity. The labour capacity was greatly reduced as farmers worked in their fields only during morning time.

*Fertilization*

Compound fertilizer (17-20-10) was applied between three and five weeks after transplanting. The second topdressing was usually applied three to four weeks after the first application. In some cases compound fertilizer and urea were mixed in the field and applied simultaneously, in the ratio 2:1. The application was then carried out only once, normally three weeks after transplanting. Reasons for this practice were the time factor and a shortage of fertilizer.

Depending on rainfall and drainage conditions, fertilizers were broadcasted into varying depths of standing water. Farmers who had obtained their share of fertilizers applied sufficient amounts; those who had not received subsidized fertilizers had to buy them elsewhere or had to obtain them from relatives. In those cases less fertilizer was applied than was recommended.

*Water-management and weed control*

As discussed in chapter 3 adequate water management was virtually absent as a result of problems in the delivery of irrigation water, the loss of water through neglected field bunds and the poor condition of the drainage system.

In the research area, lack of water appeared to be less serious during the off-season as compared to the last main season, when severe water shortages were experienced in the Kemubu scheme. On the other hand, excess of water was now appeared to be one of the main reasons for crop damage as some areas remained water-logged for long periods of time.

Too shallow depths of water in the field contributed to weed growth and rat damage. Weed infestation was furthermore encouraged by wide spacing, the use of overaged seedlings, and semidwarf varieties. Different kinds of weeds were noted: grasses, sedges, broadleaf weeds and waterplants. Some farmers cut grass from the bunds but they did not attempt to control weed growth in their fields. In fact, no weeding operation was observed in the research area. Weed problems were predominantly caused by inadequate water control rather than by poor tillage operations.

*Pest and disease control*

Diseases are generally not considered as a major factor in limiting grain yield. The major diseases occurring in the area were bacterial sheath blight, rice blast, tungro virus and false smut. The most important pests were black stalk bugs, stemborers, seedbugs and plant and leaf hoppers. Many nurseries suffered seriously from the black stalk bugs, and also after transplanting the crop was infested with these bugs in many locations. Effective control measures were not undertaken by farmers.

A similar situation was found with rats. In many plots, scattered patches of rat damage were visible, where shallow depths of water occurred. Baiting, however, was not undertaken.

Climatic conditions, double cropping, staggered planting over a long period, and the presence of abandoned and unplanted paddy fields add to the problems of insects and other pests attacking the rice crop. Their relative significance may vary from season to season, but they continue to be a real menace to the productivity of paddy cultivation in the area.

At the regional level, KADA and DOA had organized a surveillance team to monitor pest attacks. Within the research area, however, no case of control measures was observed during the off-season, and farmers were not aware of assistance by the agencies.

*Harvesting*

In the research area, harvesting operations began in the first week of October 1982 and lasted until the first week of November. Rainfall conditions were relatively favourable for this time of the year and the majority of farmers could start their harvesting operations in dry fields.

The cutting of the paddy was carried out with a sickle (*sadat*). Some of the harvested paddy was threshed immediately by beating the stalks in a bin (*tong*). Also, bundles of paddy were heaped in the field, where they remained for approximately one week before being threshed. Under dry weather conditions, the paddy was always winnowed in or near the field, after which it was taken home and dried at the roadside or near the house. Harvesting and threshing operations required about 35 to 40 working days per hectare. Although labour shortages were apparent, no use was made of light threshing machinery.

Fields situated in depressions without adequate drainage facilities remained inundated. There, the tall paddy crop lodged, and where the fascicles remained under water for some time, grains started to sprout. Harvesting paddy in these flooded plots was a laborious and time-consuming process, causing delay and extra costs if the work was done with hired labour. Drying of the paddy and threshing took place on the field bunds or outside the flooded fields.

At the end of October, the monsoon started. This meant that the remainder of the harvesting operations had to be carried out under wet conditions. The average moisture content of the grains, measured in crop cutting tests, was 21%, which made additional drying necessary. Quality losses due to rain were observed when wet paddy was piled up in stacks, waiting for threshing.

Results from the crop cutting test showed an average yield of 3.45 t/ha (560 gtg/acre), with 0.94 t/ha as the lowest and 5.08 t/ha as the highest yield, at a moisture content of 14%.

# VI. MARKETING OF PADDY

In this chapter, the marketing system for paddy grown in the research area will be analysed mainly from the point of view of the farmers. Paddy farmers are often, in one way or another, dependent on the marketing behaviour of middlemen or rice mills. Consequently, existing marketing channels for paddy and the marketing behaviour of both farmers and middlemen are examined.

## The paddy marketing system and its environment

Paddy farmers and paddy traders usually operate in a market where they are more price takers than price setters. Consequently, their scope for an own market approach is limited. For example, the market approach of paddy traders is often limited to the traditional marketing functions like grading,[31] providing market information, storage, transport and giving credit. Large rice mills may have more scope for an own market approach because they often operate in a less competitive environment than farmers or middlemen and because they can adapt better to changes in consumption patterns than farmers or paddy traders.

### *Government intervention*

The policy of the government of Malaysia is to reach a high degree of self-sufficiency in rice.[32] It created the paddy and rice marketing board *Lembaga Padi dan Beras Negara* (LPN) in 1971 to take over the task of other authorities responsible for the stabilization of rice price by government trading or marketing schemes in which it had a monopoly to buy paddy (Vokes, 1978). In response to the rice crisis of 1973 and 1974, LPN implemented a policy of fixed prices for rice throughout the year in the wholesale and retail stages of marketing. Inventory costs could not longer be met by seasonal variation in the rice price. LPN was also empowered to regulate almost every aspect of paddy marketing and processing. A system of government support prices for paddy was introduced in 1974; these prices could be adjusted to market conditions. The government support price for paddy payable at licensed rice mills, increased considerably between 1974 and 1979, whereas the ex-mill price for rice remained the same, resulting in a corresponding decrease in the gross profitability of commercial rice mills. In 1980 because the government support price for paddy could not be further increased, a subsidy for farmers was introduced payable at licensed mills or agents of LPN. For paddy of medium or small grain size, the price of $28 per *pikul* (60.5 kg) has been supplemented with a subsidy of $10 per *pikul*.

In 1974, LPN became the sole importer of ricee. Several (former) wholesalers in Kota Bharu reported that they imported rice before this measure was taken and could earn a profit by selling the rice at higher prices in between harvests. After the introduction of the fixed prices for paddy and rice in 1974, the profitability of wholesaling in rice decreased considerably and large wholesalers in Kota Bharu reduced their activities in the rice trade and shifted to other trades.

As rice is much cheaper in Thailand than in Malaysia, rice has been smuggled into the border states (Narendran, 1979). Inhabitants of the state capital, Kota Bharu, and those of large villages outside the rice producing areas seem to have a strong preference for Thai rice. Consequently, a considerable part of the local market was served by smuggled rice, thus forcing local rice mills to sell a larger part of their output to other states.

### *Changes in the paddy marketing system*

*Rice mills*. Before 1980, LPN had already decided to restrict the number of licensed cooperative rice mills in Kelantan to ensure a high rate of capacity utilization and to encourage a limited number engaged in commercial milling. However, these objectives were not attained as no action was taken against unlicensed mills. In fact, several private mills - owned by Malays - invested in new milling equipment shortly before the subsidy scheme was introduced. With the introduction of this subsidy, LPN's policy of restricting the number of mills became effective, as farmers could not receive the subsidy at unlicensed mills. Consequently, the unlicensed commercial mills had to reduce their milling activities to service milling only. Licensed rice mills were confronted with large deliveries of paddy to their mills. Whereas before the subsidy on the paddy price, large cooperative rice mills had serious difficulties in buying sufficient paddy to break-even, after the introduction of the subsidy the limiting factor became the availability of working capital to purchase the increased volume of paddy supplied.

*Middlemen*. Although paddy buying by middlemen has been considered as an illegal activity by the government, the majority of middlemen interviewed began buying paddy after the introduction of the subsidy scheme. As licensed mills were often not conveniently located, middlemen provided transport facilities and helped farmers to obtain subsidies and payments. Also, these middlemen devised a profitable way to provide farmers with rice for home consumption by exchanging paddy for rice: farmers brought their paddy stored for home consumption to a middleman, who would sell the paddy to a rice mill, obtain the subsidy and purchase rice to deliver to the farmers.

*Farmers*. Before the introduction of the subsidy, farmers brought periodically a part of the paddy[33] stored for home consumption to a service mill which charged $1 per *pikul* in 1975, while retaining the by-products. After the introduction of the subsidy, farmers could choose among three methods to obtain rice for home consumption: sell all paddy after harvest and purchase rice when needed, periodically exchange paddy for rice through a middleman, or deliver paddy to a service mill. As a result of the subsidy, it was most profitable for the farmer to sell all paddy and buy rice resulting in a gain of between $2.40 and $5.40 per *pikul*. No gain accrued to the farmer in exchanging paddy for rice, while service milling cost between $1.20 and $2.00 per *pikul*. About two-third of the quantity of paddy stored by the farmers interviewed was exchanged for rice and the rest delivered to service mills. Farmers explained that they did not want to dispose of the paddy stored for home consumption as they would spend the income obtained.

The question can be raised as to which factors affected the farmers' decision to continue with service milling after the introduction of the subsidy scheme. In one village in the research area, an operator of a service mill became a middleman after the subsidy was introduced. He ceased service milling and began exchanging paddy for rice. Twenty-four out of twenty-nine farmers interviewed in that village exchanged paddy through this middleman, three farmers exchanged paddy through a middleman in another village, whereas two farmers continued patronizing a service mill.

In another village in the research area, a service mill was still operating after the introduction of the subsidy scheme. Fourteen out of nineteen farmers interviewed in that village brought their paddy stored for home consumption to this mill, three farmers went to another service mill and two farmers exchanged paddy through a middleman in another village. It can be concluded that the type of service offered to farmers was the main factor in the choice of a particular method of obtaining rice for home consumption.

### *Marketing channels for paddy*

The paddy marketing system in the research area consisted of farmers, middlemen and rice mills or their agents. The farmers included all categories of paddy producers including owner-operators, tenants and owner-tenants, while all middlemen were private entrepreneurs. Mills processing rice for the market were owned either by cooperatives or by the marketing board, LPN. Some Farmers' Organizations operated as buying agents for LPN. In the Kemubu scheme, the paddy market was serviced by four large rice mills, two operated by the marketing board, and two operated by cooperatives, and by some 15 small cooperative rice mills. In Kelantan, rice milling licencies are only issued to cooperative rice mills and to LPN. There are four types of marketing channels in the movement of paddy (Fig. 14).

Marketing channels for paddy in the research area for both main (May/June) and off-season harvest (October/November) of 1982 are given in Fig. 15 and 16, respectively. The market situation varied considerably between the two seasons. During the main season, Kelantan was struck by a severe drought resulting in low

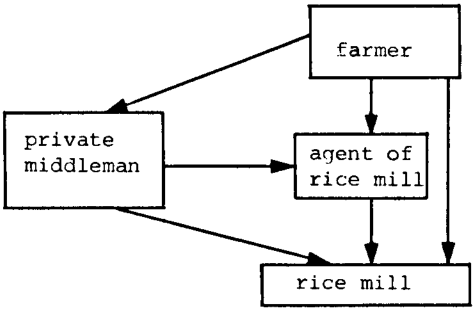



*Fig. 14. Different types of marketing channels in the paddy marketing systems in the research area*

paddy yields. As there was a ready market for dry, main season paddy, this resulted in a smooth buying season. During the off-season, good growing conditions for paddy resulted in high yields. As off-season paddy was not really wanted by the cooperative rice mills, because of the risks of quality deterioration of wet paddy, the supply was mainly concentrated on LPN mills, creating delays for the vans delivering paddy.

The Farmers' Organization (FO) began operations as an LPN agent in 1981. It missed the first paddy-buying season in 1982, because of a disagreement between FO and LPN on the rate of commission and losses on the difference in weight of paddy, but began paddy buying again at the beginning of the off-season harvest after the problem was solved. The paddy that the small cooperative rice mills (SCRM) purchased during the off season was sold to LPN as soon as possible because of the risk of quality deterioration. The large cooperative rice mills (LCRM) were in contrast to the SCRM's, obliged to pay the farmers the government support price and, consequently, could not trade in paddy with LPN. As many non-members offered paddy to these mills, they decided to buy paddy from members only during the off-season in 1982 to limit the risk of buying wet paddy.

After the main season harvest, about three quarters of the quantity sold were purchased by the LCRM in transactions averaging 20 pikul (1210 kg), purchases by middlemen averaged 7.5 pikul per transaction being about one quarter of the quantity sold while a small volume was sold to SCRM's.

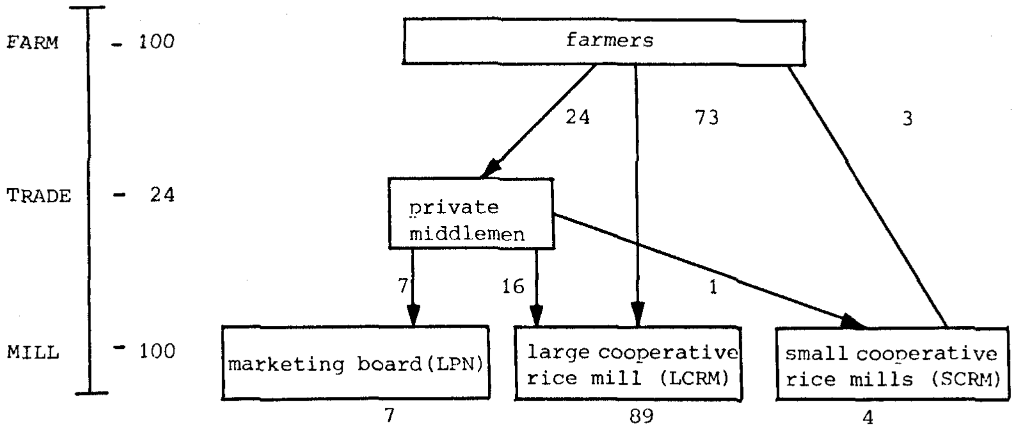



*Fig. 15. Marketing channels for paddy after the main season harvest of 1982*

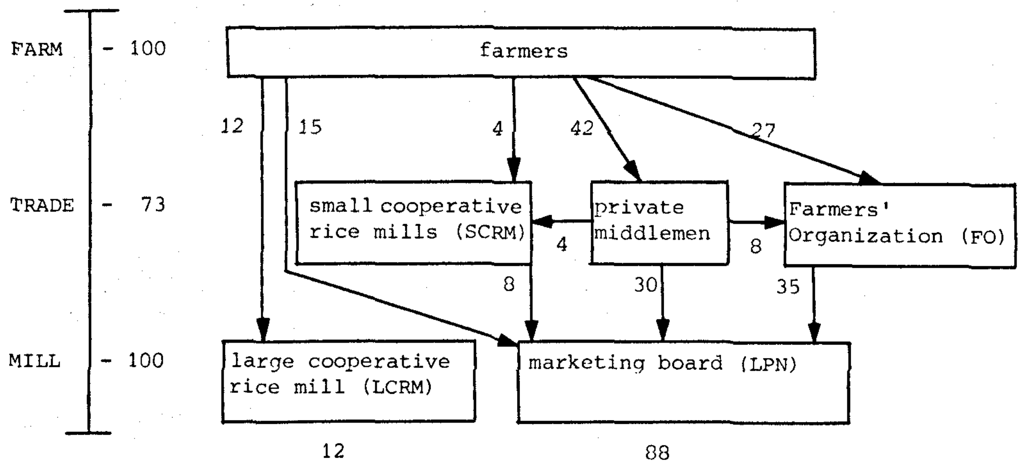



*Fig. 16. Marketing channels for paddy after the off-season harvest of 1982*

Transactions with the LCRM were 2.5 times larger than those with middlemen for reasons to be explained below.

After the off-season harvest, about forty per cent of the total quantity sold was purchased by middlemen in transactions averaging 1150 kg; purchases by the FO averaged 1390 kg per transaction being about a quarter of the quantity sold; 15% was sold directly to LPN, 12% to the LCRM and 4% to SCRM's. Transactions with large rice mills, LCRM or LPN, were 1.5 times larger than those with middlemen. The main differences between the two seasons can be summarized as follows: the marketing channels in the off-season were longer than those in the main season, because of structural changes in the market; the FO started buying paddy whereas the large cooperative rice mill hardly bought any paddy.

The small cooperative rice mills purchased paddy for commercial milling during the main season, but acted as paddy traders during the off-season. The large cooperative rice mills attempted to buy the paddy needed for one year during the main season harvest. Consequently, there was a large difference between the volume of paddy offered to LPN during the main and off-season of 1982. The middlemen, although illegal, played an important role in the marketing of paddy in both seasons. Their market share in the research area in the off-season was 1.75 times that of the off-season because of the buying policy of the LCRM nearby.

Marketing behaviour of paddy farmers

At the end of the off-season of 1982, the farmers interviewed harvested on average 1410 kg of paddy from their own fields and 1170 kg from fields rented in. They received, on average, 170 kg from tenants and they had to pay 590 kg to their landlords. After deduction of the average quantity given to harvest labourers or creditors, an average quantity of about 2.150 kg remained for home consumption and sale.

*Degree of commercialization*

The degree of commercialization of farmers or a crop can be measured in several ways (e.g. Van Lindert, 1978). In this study, it is defined as the proportion of the paddy sold after deductions for rent in kind, etc. The marketable surplus depended upon the acreage of paddy fields operated, productivity of the fields, conditions of the share cropping agreement, and whether credit or hired labour were paid in cash or kind. All operators interviewed wanted to retain sufficient paddy for their own consumption, but this depended on their financial situation at harvest time.

For example, after the poor harvest of the main season, on average, 300 kg was stored by the farmers compared to 875 kg after the relatively good off-season harvest. As an average family of 5.8 persons needed about 450 kg in one paddy season, 14 out of 45 farmers had to purchase or borrow paddy or rice before the off-season harvest.

The degree of commercialization varied greatly among farmers (Table 24): five farmers did not sell any paddy at all, whereas another five farmers sold more than 80% of the paddy produced. The weighted average of sales was 60% of total production. It can be expected that the degree of commercialization was positively associated with farm size and negatively associated with household size, but variation in yields may have disturbed these patterns. On average, farmers selling 60 to 100% of their harvest operated an acreage 1.7 times as large as those selling less than 60% of their harvest; on average, the family size was 6.2 for the first category and 5.7 for the second.

*Table 24. Percentage of sale of paddy harvested by farmers (n=45) in the off-season of 1982*

| % of harvest sold | number of farmers |
|---|---|
| 0 | 5 |
| 1-39 | 8 |
| 40-59 | 13 |
| 60-79 | 14 |
| >80 | 5 |

*Sales transactions*

If a farmer wanted to sell paddy to a middleman, the middleman provided sacks before the harvest. He would then come to the farmer's house of his field to collect the paddy and deliver it to his store for inspection and weighing. Two percent of the gross weight was deducted for the sack, while 5 to 10% was deducted for extremely wet or dirty paddy. The trader sold the paddy to a rice mill and the farmer would be paid after two to fourteen days. The transport costs and other costs were included in the price offered by the middleman. If a farmer wanted to sell paddy directly to a rice mill, he had to fetch the sacks at the mill and pay a refundable deposit for them. If he had to sell a van-load of paddy (about 900 kg or more), then it was worthwhile to contact a van-operator. If he had less to sell, he could attempt to combine his paddy together with that of neighbours provided they were prepared to sell to the same mill. On arrival at the mill, the paddy would be weighed (gross weight) and inspected.

Deductions on the weight would be made for moisture content exceeding 14%, impurities and unripe or damaged grains. A subsidy of $10 was paid for each *pikul* (net weight) of paddy delivered. This subsidy could be cashed immediately at the LPN desk in the rice mill on presentation of the sales coupon and the farmer's identity card. The paddy sold was paid for one or two weeks after delivery.

*Choices of a paddy buyer*

The motivating factor of farmers' choices between middlemen and rice mills after the main season harvest of 1982 is given in Table 25. The farmer's motivation for their choice between middleman and rice mill was most clear for the main season harvest because the FO did not buy during this season and because often small quantities had to be sold due to the poor harvest. Transport facilities and quick payment were mentioned as reasons to sell to a middleman, whereas a high price or the receipt of the subsidy on the paddy price were mentioned as reasons to sell to a rice mill. Also location of the buyer appeared to be an important factor in

*Table 25. Major reason given by farmers for their choice of paddy buyer after the main season harvest of 1982*

| Reason | Paddy buyer | |
|---|---|---|
| | middleman | rice mill |
| location of buyer nearby | 7 | 5 |
| sold less than a van-load | 4 | 1 |
| transport provided by buyer | 5 | 1 |
| quick payment | 6 | - |
| higher price/subsidy | - | 17 |
| other reasons | 1 | 3 |

the choice between middleman and rice mill. The farmer's village appeared to be significantly related to this choice (P <10%): in Kampong Pasir, many farmers chose the middlemen living in that kampong, whereas in Kampong Binjal, most farmers chose the large cooperative rice mill nearby (main season) or the Farmers' Organization (off-season) both at about the same distance, to sell their paddy. The question can be raised to what extent prices paid to farmers differed between paddy buyers. The weighted average price per *pikul* of paddy, net of quality deductions and transport costs, received by the farmers interviewed in the research area are given in Table 26.

*Table 26. Weighted average price per pikul of paddy, net of quality deductions and transport costs, through the main marketing outlets*

| | main season | off-season |
|---|---|---|
| Large cooperative mill nearby | \$ 36.10 | - |
| Middleman: | | |
| less than 10 *pikul* (605 kg ) | \$ 33.60 | \$ 35.60 |
| at least 10 *pikul* (605 kg) | \$ 34.70 | \$ 35.60 |
| Farmer's Organization as agent of LPN | - | \$ 36.50 |

The quality deductions applied by the large cooperative mill averaged 11.6% in the main season harvest. This appears excessive compared to 11.5% deductions by the FO in the off-season harvest when wetter conditions prevailed. It can be concluded that in the main season the large cooperative rice mill near-by offered the best prices to paddy farmers, while in the off-season, the FO appeared the best marketing outlet.

*Why not the most profitable outlet?*

An analysis of the behaviour of farmers who patronized other than the most profitable marketing channels is necessary as the middlemen appeared to have a rather strong position in the paddy market. A farmer was not always free in his choice between middleman and rice mill. Constraints on his choice were the quantity of paddy available for sale, credit obtained and having a job outside the agriculture.

*Quantity available for sale.* A full load of paddy (900 kg or more) was necessary to make the hire of a van economical. Often farmers were unable to provide this full load, either alone or together with other farmers, and hence were inclined to sell to the nearest middlemen. This can be illustrated by the choice of paddy buyer during the off-season harvest (Table 27).

*Table 27. Choice of paddy buyer and quantity of paddy sold in the first sales transaction of the off-season harvest*

| | Quantity sold[a] | |
|---|---|---|
| Paddy buyer | less than 910 kg | at least 910 kg |
| middleman | 9 | 9 |
| FO | 4 | 7 |
| rice mill | 1 | 10 |

[a] *5 farmers did not sell any paddy at all*

Middlemen were more often chosen than other outlets for the sale of small quantities of paddy (P <10%).

*Credit obtained.* Although many farmers or their family members had a job outside agriculture or also cultivated a cash crop (rubber), after a bad harvest such as in May/June 1982, several farmers needed credit to buy consumer goods, to plough paddy fields or hire labour for the next harvest. Small amounts of cash, \$10 to \$50, could be borrowed from relatives or neighbours without providing security or paying interest. For larger amounts, \$50 to \$300, farmers could borrow under the same conditions from shopkeepers, tractor brokers or private paddy traders. The debt had to be repaid during the next harvest period. If a famer could not avail himself of these sources, he could borrow money from a pawn-shop or a moneylender, provided he could offer a security and bear a higher interest rate (Van Wassenaer, 1982).

Farmers reported that they preferred to borrow from paddy middlemen because the amount that could be borrowed was sufficient to cover the need for cash in one crop cycle. The farmer could not borrow more than what he could repay with the sale of his harvest. No interest or security was required and there was no risk that the money had to be paid back sooner than agreed upon as sometimes happened with relatives. Rice mills near the research area did not lend money to farmers.

If the farmer did not sell his harvest to the middleman from whom he borrowed money, then further borrowing from this middleman was impossible. Farmers reported that middlemen did not exploit them because of their debt; sale conditions were the same for both debtors and non-debtors. All middlemen were Malay and belonged often to the same community as the farmers. If a middleman abused his power, he would certainly lose his clients to another middleman. About 30% of the farmers interviewed borrowed money, paddy or rice shortly before the off-season harvest began; 20% borrowed from middlemen and some 10% borrowed from neighbours.

*Job outside agriculture*. It was assumed that having a job outside agriculture would increase the possibility of choosing a middleman to save the time needed to sell paddy at a rice mill. It appeared (Table 28) that if one of the spouses had such a job, often a middleman instead of a rice mill or FO was chosen as a paddy buyer during the off-season harvest ($P < 5\%$).

*Table 28. Choice of paddy buyer (random selection of first or second buyer) in the off-season and having a job outside agriculture by the operator or his/her spouse*

| | Paddy buyer | | |
|---|---|---|---|
| | middleman | FO | rice mill |
| Job outside agriculture | 18 | 7 | 6 |
| No job outside agriculture | 1 | 7 | 5 |

If a farmer had a small quantity of paddy to sell, borrowed money from a middleman or had a job outside the agriculture - factors which may be interrelated - then he/she chose a middleman rather than a rice mill.

*Choice between two middlemen or between two rice mills*

In choosing between middlemen, the factors considered were distance between paddy field and house of the middleman, duration of trade relationship, whether or not the middleman was a relative, and the price offered. This can be illustrated by the following example.

> In one village, two middlemen lived near each other (at a distance of 100 m). One of them explained that they had each their 'own' area in which they operated. One farmer sold to each of these middlemen after the main season harvest; the yield of one field was disposed of to one and that of another field to the other middleman. One middleman was a nephew to whom he always sold paddy and from whom he sometimes borrowed money. The other middleman was a relative of his wife.
>
> Some farmers who had a large quantity to sell gathered information about the prices paid and deductions applied at various large rice mills. During the off-season 1982, two farmers sold their paddy directly to LPN Peringat located about 12 km and two farmers sold directly to LPN Pasir Putih located about 20 km away. Other farmers preferred to sell their paddy to the FO Ketereh (agent of LPN), because the FO paid the farmers on delivery in 1981.

*Marketing functions performed by farmers*

The marketing functions farmers performed in the research area were related to product policy (quality, grading) and distribution policy (physical distribution and trade credit). The grades of paddy distinguished were long grains ($30), medium sized grains ($28) and short grains ($28). Long grains were produced by traditional varieties of paddy. These varieties were more highly valued by consumers, especially in the towns. Farmers harvested paddy with long grains separately to prevent mixing with other grades.

A premium was paid for paddy with a low (14%) moisture content, for clean paddy and for paddy with few unripe or damaged grains. Almost all farmers cleaned their paddy by winnowing but unripe or damaged grains could not be removed. The percentage of unripe grains depended on the timing of the harvest, whereas the percentage of damaged grains was related to both weather conditions during the harvest and the extent to which the grains were dried. A large majority of farmers did not dry the paddy during the off-season harvest when relatively wet weather conditions prevailed. The average moisture content of a sample of 51 was 20.6%, ranging between 17 and 25%. The question why only a few farmers dried the paddy to be sold may be related to the long tradition before 1975 of harvesting one crop a year for which there was no need for paddy drying, the idea that the costs of drying paddy were not sufficiently compensated, lack of time during harvest, or the fact that no simple technology was available for farmers to dry paddy. Drying yards near rice mills or the FO were hardly used.

Only relatively large farmers hired transport to sell their paddy to a mill. Often they hired a van and driver from a middleman who also gave information on deductions applied at various mills. Farmers gave trade credit to middlemen and rice mills, because they were only paid after a period of two days to two weeks. In the past, only the FO paid the farmers immediately on delivery.

## Marketing behaviour of middlemen

The types of middlemen who operated in and around the research area included the farmer/broker, commission agent and paddy buyer. A farmer/broker bought small quantities of paddy from neighbours in order to accumulate enough volume to hire a van. A commission agent brought together seller and buyer and charged a commission for his services based on a fixed charge per *pikul* or load. The most common type of middleman was the paddy buyer who offered a price per *pikul* of paddy in which the subsidy and deductions were already included. The buying price could vary with season and quantity offered.

A detailed investigation of 8 middlemen operating in and around the research area showed that apart from the paddy trade, they were involved in exchanging paddy for rice (3 middlemen), transporting paddy or other products with private vans (6 middlemen), providing credit to farmers (4 middlemen), selling consumer items (1 middleman) and trade in other agriculture products (2 middlemen) or in non-agricultural products (1 middleman). Four of these middlemen purchased more than 60.5 ton every harvest period, three purchased between 15 and 60 ton and one middleman purchased less than 15 ton.

In the paddy trade, the main marketing functions performed by middlemen were giving credit to farmers and providing transport. The farmer's need for credit was highest just before the harvest. Middlemen gave credit to commit the farmers to sell paddy to them. Credit was given in kind (rice or other groceries) or in cash. Farmers could borrow $50 to $300. At most, 30 to 40% of the clientele of a middleman borrowed money. To transport paddy, 6 middlemen operated a van with an official loading capacity of about one ton, although it was often loaded with two tons of paddy. They attempted to operate the van throughout the year for all kinds of purposes: paddy trade, exchange of paddy for rice with farmers, transport of rice, transport of fruit or vegetables, building materials, etc.

When the middlemen bought a van of a value of about $15.000, they often had to finance it with a hire-purchase contract. If a hire-purchase contract was concluded, a down payment of $5000 to $7000 was required, with monthly installments amounting to $300. One middleman borrowed $6000 from relatives to be able to pay the down payment, for which he gave a piece of land as security. The monthly installment had to be financed from his operational profits.

### *Choice of a rice mill*

A middleman's choice of a rice mill (or its agent) depended on a multitude of factors: the relationship between middleman and rice mill, the mill's list-price, the deductions applied for the moisture content, impurities and unripe or broken grains, the number of days between delivery of the paddy and the payment for the purchase, the distance between trader and rice mill, the possibility of being fined by the police for overloading the van and the waiting time at the mill.

The list-price for paddy was two dollars per *pikul* higher at large rice mills than at small rice mills. Consequently, middlemen who did not have a strong relationship with a small rice mill preferred to sell to a large rice mill or its agent. Deductions applied on the gross weight of paddy might vary among mills, because one mill varied the size of the deductions with its need for paddy, or attempted to increase its gross margin by applying higher deductions than allowed.

The transport costs were affected by the distance to a rice mill, the possibility of being fined for overloading the van and the waiting time at the rice mill. The profitability of the transport function depended upon making at least two trips per day to the rice mill; this generated a profit of $0.32 per *pikul* to $0.36 per *pikul* depending on the outlet used. Losses of $0.12 to $0.08 per *pikul* were made if only one trip was made and this happened quite often when large rice mills were congested with waiting vans, as was the case in the off-season of 1982.

Middlemen reported that they switched from one large rice mill to another when circumstances changed. It was observed, however, that almost all middlemen sold most often to a particular mill, because they knew people and procedures there very well.

*Sales transactions between middlemen and rice mills*

Officially, the paddy trade by private middlemen was considered as an illegal activity because only licensed rice mills were allowed to buy paddy from farmers. In practice, it appeared to be very difficult for rice mill personnel or LPN staff to distinguish middlemen from farmers. Often middlemen themselves owned some paddy land and, consequently, could be considered as farmers too. As, however, LPN verified whether middlemen sold large quantities of paddy to rice mills under their own name, middlemen asked one or two relatives or farmers to accompany them to the mill to act as the person selling paddy. The middleman paid the farmer $5 each time for this service. The paddy was examined at the mill by taking samples. The percentage of deductions was assessed by visual inspection. If a paddy seller complained that the deductions were too high, then a moisture meter was used. At a LPN mill also the percentage of rice obtainable from paddy could be assessed with a special apparatus. After inspection, the paddy seller recieved a coupon with which the subdsidy on the paddy sold could be cashed immediately at the LPN desk at the mill and with which payment for the paddy could be obtained after a few days to two weeks.

*A case of middleman living in the research area*

The fact that middlemen often combine several functions can be illustrated with the following example.

> About 50% of the sales transactions of paddy farmers included in the survey were between farmers and middleman Abdullah and more than two third of the farmers exchanged paddy for rice with him. He reported that he bought paddy of some 45 farmers and that the total quantity bought was about 1200 *pikul* every harvest season. Abdullah lived in one of the two villages in the research area. He also owned a small rice mill, ran a van and operated a grocery shop. Before introduction of the paddy price subsidy, he was engaged in service milling and probably also in commercial milling. As he did not have a milling licence, he could not longer mill paddy commercially after the introduction of the subsidy. He continued service milling for farmers until he discovered that the exchange of paddy for rice with farmers was a more profitable business. The mill was not longer used at the time of the research. Abdullah's contact with retailers in rice was continued after introduction of the licensing system by cooperating with a wholesaler in the selling of rice.
>
> Abdullah ran his business with his wife and a relative. The assortment of products and services he offered can be considered rather complete from the point of view of paddy farmers: paddy could be both sold and exchanged for rice, credit in cash or in kind (groceries) could be obtained when farmers sold their paddy to Abdullah. Farmers who wished to sell their own paddy could rent his van together with a driver and could consult him at which mill the best price could be obtained. If Abdullah did not have sufficient working capital to finance his paddy trade, farmers were paid later than agreed upon. The price he asked for his services was competitive with that of other traders. Abdullah said that he attempted to keep a good relationship with the paddy farmers.

*Margins in the paddy trade*

Two aspects of the paddy trade are considered: buying and selling paddy and the exchange of paddy for rice with farmers. The paddy trade was competitive in nature. Several middlemen in or around the research area attempted to increase their turnover and to improve the utilization of their van. Consequently, the prices middlemen paid for paddy did hardly differ among the farmers. The margins which middlemen operating in the research area earned from the paddy trade are given in Table 29. The middlemen's labour costs were not substracted from the net margin.

*Table 29. Gross and net margin middlemen earned with the paddy trade*

| | Main season 1982 | | Off-season 1982 | |
|---|---|---|---|---|
| Paddy sold to | LCRM | | FO | LPN |
| Distance | 2 km | | 2 km | 12 or 20 km |
| Quantity purchased from farmers | less than 605 kg | at least 605 kg | all quantities | all quantities |
| Sales value at the mill | 100 % | 100 % | 100 % | 100 % |
| Paid to farmers | 91 % | 94 % | 94 % | 94 % |
| Gross margin | 9 % | 6 % | 6 % | 6 % |
| Transport costs | 2.5 % | 2.5 % | 4 % | 3.5 % |
| Net margin | 6.5 % | 3.5 % | 2 % | 2.5 % |

It can be concluded from Table 29 that middlemen received a relatively low net margin if they bought about 600 kg paddy or more from a farmer. For these quantities, competition is higher than for small quantities. If the quantity a farmer had to sell was small, then there was an opportunity for middlemen to pay a price lower than the ruling market price, because middlemen living further away were not interested. As a middleman's profit is the product of net margin and turnover, its size depends also on the quantity of paddy traded. Net margins middlemen earned from exchanging paddy for rice with farmers varied between 9 to 13% of the sale value of paddy to a rice mill. As the degree of commercialization in the research area was about 60%, it is estimated that middlemen who also exchanged paddy for rice earned more from the exchange of paddy than from the sale of paddy.

The net margins obtained by buying and selling paddy correspond with those found by Purcal (1971) in a case study in four villages on the West Coast. He found a dealer's margin of 2.1% for the main season and 3% for the off-season.

Marketing conduct of rice mills and their agents

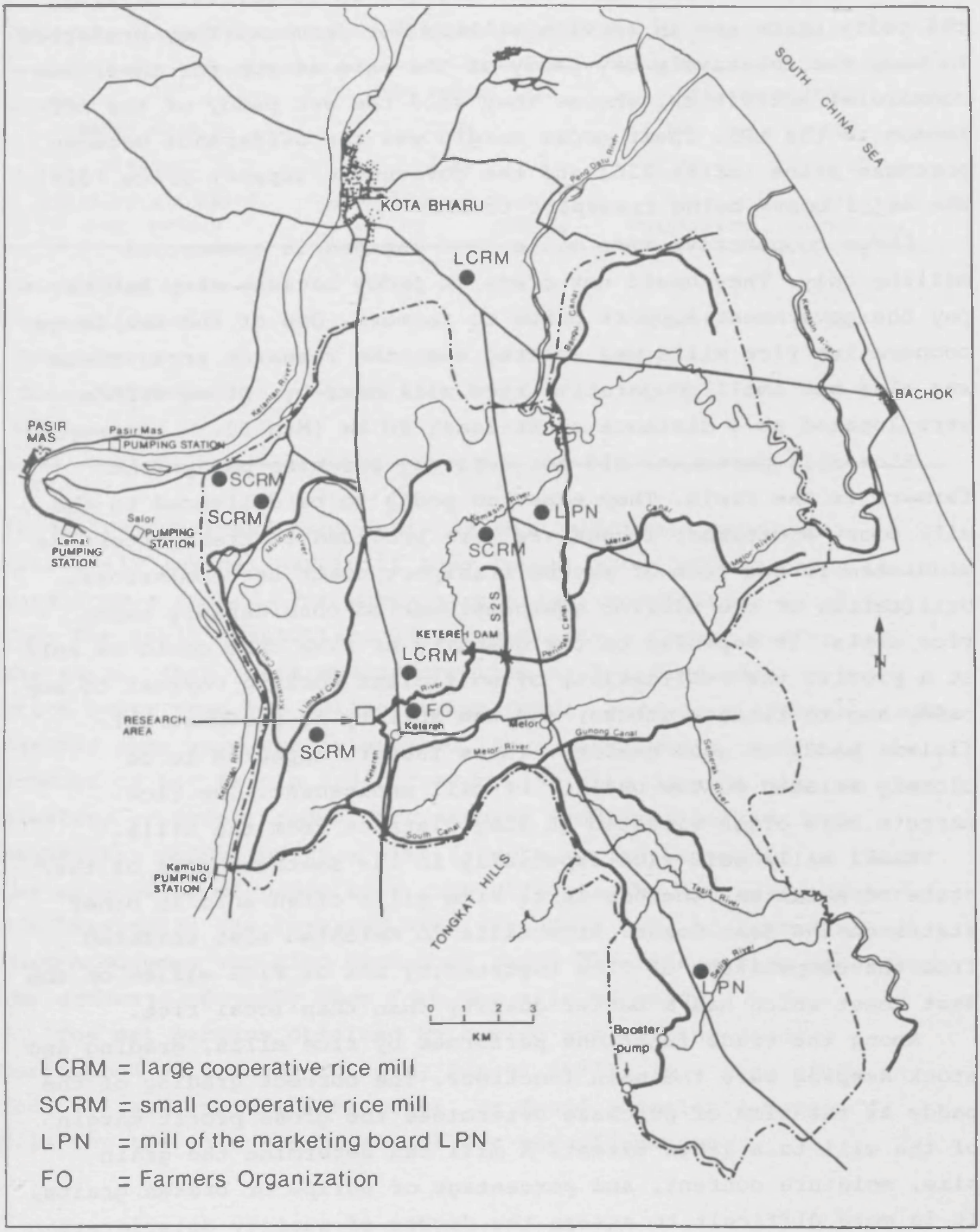
Small cooperative rice mills were engaged in commercial milling, the paddy trade and in service milling for farmers. They preferred to keep the relatively dry paddy of the main season for their own commercial activities, wheras they sold the wet paddy of the off-season to the LPN. Their gross margin was the difference between purchase price (often $26) and the government support price ($28), the major costs being transport to LPN.

Large cooperative rice mills were engaged in commercial milling only. They could not trade in paddy because they had to pay the government support price to farmers. One of the two large cooperative rice mills was located near the research area. There was also one small cooperative rice mill near-by. Other SCRM's were located at a distance of at least 10 km (Map 5).

Rice mill personnel did not actively purchase paddy from farmers in the field. They expected paddy to be delivered to the mill door. Sometimes, incentives were provided to transporters or middlemen in the form of paying transport costs or commissions. Utilization of the milling equipment varied considerably among rice mills. It depended on the quantity of rice that could be sold at a profit, the availability of sufficient working capital to buy paddy and to finance stocks, and the ability to purchase sufficient paddy of good quality. These factors appeared to be closely related to the quality of mill management. The rice markets were often situated at long distance from the mills.

Small mills sold rice especially in the southern part of the state of Kelantan, whereas large rice mills often sold in other states on the East Coast. Rice mills in Kelantan also suffered from the competition of rice imported by LPN or rice milled on the West Coast which had a better quality than than local rice.

Among the trade functions performed by rice mills, grading and stock keeping were the main functions. The correct grading of the paddy at the time of purchase determines the gross profit margin of the mill to a large extent. A mill can determine the grain size, moisture content, and percentage of unripe or broken grains. It is more difficult to assess the degree of quality deterioration of relatively wet paddy offered to the mill. The greater the




*Map 5. Location of rice mills*

deterioration of paddy the more yellow or brown grains of rice are obtained and the lower the grade of rice is. The gross milling margin is highly dependent on the grade of rice after milling. Consequently, the viability of a mill also depends on the extent to which the quality of the paddy purchased is assessed correctly. This is why cooperative rice mills in and around the research area increased the quantity of paddy bought after the dry main season at the expense of the quantity purchased after the wet off-season.

Another instrument to adapt the quality of the rice produced to the needs in the market is a rice grader which separates whole grains and broken grains after the milling process. If the grade of rice produced depends on the percentage of brokens only, then those grades of rice can be mixed to maximize profits. Only one LPN rice mill in the Kemubu scheme had a rice grader. A wholesaler in Kota Bharu reported that he would not buy from a mill which did not have a rice grader because grading by visual means lead to varying results.

*A case study of a large cooperative mill*

About 90% of the quantity of paddy sold after the main season harvest of 1982 directly or indirectly reached the large cooperative rice mill near the research area. Compared to only some 10% after the off-season harvest. More details of this important outlet for paddy farmers are given in the following case study.

The cooperative '*Seribu Gantang*' was founded in 1951. It operated five small rice mills which were engaged in service milling or commercial milling. In the late sixties and early seventies, the government attempted to persuade financial institutions to invest in the agricultural sector. The *Bank Rakyat* decided to invest in two large cooperative rice mills in or around the Kemubu scheme because double cropping of paddy became feasible after the construction of irrigation facilities.In Kelantan the Bank selected the cooperatives *Baya Lalang* near Kota Bharu and *Seribu Gantang* near the research area to run the new mills.

The *Baya Lalang* mill started operations at the end of 1971, but failed to purchase sufficient paddy to reach the mill's break-even capacity because of competition by many unlicensed mills. The Bank invested $1,000,000 in the *Seribu Gantang* mill. After it was completed in 1974, it appeared that no electricity could be obtained. By the end of 1974 the Bank decided to close *Baya Lalang* temporarily and the plans for opening the new *Seribu Gantang* mill were shelved *Seribu Gantang* eventually started operations in 1978. By then, the accumulated interest had grown to $400,000 and an additional $500,000 was needed as working capital resulting in a debt of about $2,000,000. In 1978, the share capital of the members of the cooperative amounted to about $18,000. Consequently, the cooperative was almost fully financed with borrowed money. The bank had the right to appoint the general manager of the mill to make sure that installments and interest would be paid back on schedule.

*Members and board of the cooperative.* In 1982, the cooperative had about 400 members, each having a share of $100 which was partly or fully paid up. Only a few farmers in the research area were members of the cooperative. Farmers mentioned 'membership is too expensive' or 'never invited to become a member' as the main reasons for not becoming a member. The Board, having 12 members, consisted of 5 full time farmers and 7 teachers who rented out their paddy land. Board members should be local farmers according to the regulations of the cooperative. The cooperative is a unit member of the local Farmers' Organization.

*Paddy buying.* In 1982, the cooperative preferred to buy dry paddy during the main season harvest, because it had serious difficulties in the past in selling the low-quality rice obtained from the paddy of the wet off-season. Consequently, the cooperative instituted a policy of buying only from members during the off-season harvest and buying from everybody during the main season harvest. After introduction of the paddy price subsidy in 1980, payable at licensed mills only, the supply of paddy to the mill improved considerably.

*Paddy drying and milling.* In 1982, the equipment of the mill consisted of two rice mills one of local make (3.5 ton per hour) and a Japanese one (2 T.P.H.); two paddy driers, a continuous one (5 T.P.H.) and a batch drier (35 ton per day); and two godowns, one for paddy (4000 ton) and the other for rice (1000 ton).

The mill operated at 40 to 50% of its capacity in 1981 and 1982. For the computation of the capacity a working day of 8 hours was chosen. The drying equipment was used to a lesser extent because of the mill's policy to buy mainly dry season paddy.

*Marketing of rice.* The cooperative experienced serious marketing problems caused by the preference of town dwellers for (smuggled) Thai rice instead of the local rice; the relatively low quality of the rice produced in the Kemubu scheme; the severe competition in other states on the East coast by rice of better quality imported from the West coast; the marketing policy of the marketing board LPN in releasing rice from the national stock-pile (the timing of the release was unknown by rice mills); and the regular break-downs of the rice mills, which prevented the mill from entering into contracts for the delivery of rice to government agencies.

The mill *'Seribu Gantang'* produced mainly rice of grade $B_2$ with a gross margin of about $60 per ton, but also rice of grade $B_3$ with a gross margin of about $15 per ton. In 1982, the mill had to reduce paddy buying because of a lack of sufficient working capital. The cooperative reported a small profit both in 1981 and 1982 . It seemed very difficult for the cooperative to fulfil its large loan commitments.

### *The marketing board LPN and its buying agents*

In the Kemubu scheme, LPN operated two large drying and milling complexes. During the off-season harvest of 1982, the LPN complex at Peringat purchased between 3500-5500 bags per day compared to only 2000 bags in the corresponding period in the previous year. This situation created delays for the vans delivering paddy to the mill - often 40 or 50 vans were still waiting around five o'clock in the afternoon - despite of efforts by the management to reduce the waiting time as much as possible. This problem became worse towards the end of October when only a part of the contract labour force turned up for work, resulting in quality deterioration of paddy which could not be dried in time. The system of tendering out contract work to labour contractors required re-examination, especially as labourers demanded payments from van-operators.

The FO near the research area (Ketereh) began its operations as an LPN agent in 1981 but did not buy any paddy during the main season of 1982. In the off-season, because LPN agreed to raise the rate of commission from $0.50 to $0.75 per *pikul* paddy (net weight) and to pay for losses on the difference in paddy weight at FO and LPN, FO Ketereh began to buy paddy again. During several days, the FO delivered more than 10% of the paddy purchased by LPN Peringat. The FO, being an agent of LPN, received preferential treatment at the LPN mill in unloading its vans. The profit margin of the FO varied between 0.75% and 1.5% of the turnover depending on whether FO and LPN labour costs were included or not.

*Margins and turnover of cooperative rice mills*

The return on investment of a business is affected by the profit margin, the asset turnover and the degree of leverage between own capital and debt capital (e.g. Stern and El-Ansary, 1982). These first two components are relevant for this study and will be discussed for cooperative rice mills in or around the research area.

*The gross margin.* The gross margin of rice milling depends mainly on the quality of the rice produced and the buying price for paddy. The gross margin for a number of relevant combinations of grade of rice produced and the paddy buying price are given in Table 30. These gross margins can be derived from the prices fixed by the government. It was reported that some rice mills attempted to enlarge their gross margin by applying larger deductions on the paddy price than allowed or by asking wholesalers to pay a part of their margin to the rice mill because of the delivery of rice that was in short supply.

*Table 30. Gross margin per pikul of milled paddy for combinations of buying price and grade or rice produced*

| Buying price for paddy | Grade or rice produced $B_2$ | $B_3$ |
|---|---|---|
| $26 | $5.50 | $2.75 |
| $28 | $3.50 | $0.75 |

Small cooperative rice mills often purchased paddy at a price of $26, whereas large cooperative rice mills had to follow the government support price of $28. It can be derived from the table that small rice mills producing a relatively high grade of rice, had relatively good opportunities to survive. On the other hand, large cooperative rice mills which, as in 1981, bought wet paddy and thus produced a large proportion of rice of grade $B_3$, had a rather difficult time to survive. Operating costs were considerable, because of high labour costs and because almost all rice mills and drying equipment were powered by diesel engines, resulting in high fuel costs.

*Asset turnover.* The degree of asset turnover depends on the size of the investment, the utilization of the equipment and the turnover of the inventories. The size of the investment in small cooperative rice mills with a capacity varying between 0.25 and 0.8 ton per hour was relatively small, because they bought land, building and local equipment some twenty or thirty years ago. Usually the milling equipment was well maintained and could still be used for a long time. The large rice mills with a capacity varying from 2.5 to 5 ton per hour were established in the early seventies when investments were high because large plots were bought and modern equipment, often of foreign make, was installed.

In theory, the rice produced with modern equipment (e.g. continuous driers, rubber rollers for separating the grain and the husk, more than one polishing cone) should have better characteristics than that produced with traditional equipment (e.g. sundrying or using batch driers, stones for separating grain and husk, one polishing cone). However, better performance by the modern mills depended on several conditions including the timely drying of paddy and the availability of skilled personnel to maintain or repair the drying and milling equipment. In practice, these conditions were not always fulfilled.

It was observed that many rice mills were under-utilized. Even for a working day of one shift of 8 hours, two out of four small cooperative rice mills reported a utilization of less than 40% whereas the other two reported a 70% utilization rate. The large rice mill described in the case study reported a utilization rate of only 40%-50% given a working day of 8 hours. The LPN mill in Peringat with about half the capacity of this LCRM processed about two times as much paddy by processing paddy continuously during harvest time and working with two shifts a day outside the harvest period.

The decision of cooperative rice mills not to buy paddy from non-members during the off-season harvest affected the degree of asset turnover, because the average stock of paddy had to be about two times as large as that when a policy of buying paddy two times a year was followed. The question is whether the advantages of the new policy of producing a better quality of rice outweighed the disadvantages of higher inventory costs. A break-even analysis showed that a policy of buying dry paddy during the main season only was slightly better than buying during the two harvest seasons, assuming that 80% of the rice produced had grade $B_2$ and 20% had grade $B_3$ if paddy was bought during the main season harvest only, and that only 50% of the rice produced had grade $B_2$ if paddy was bought during both harvests.

## Performance of the marketing system

A popular framework for the evaluation of a marketing system is market structure analysis (e.g. Clodius and Mueller, 1961). Market structure analysis requires an 'ideal' marketing system with which the existing system can be compared. An existing system was often compared with a system of perfect competition. It was recognized, however, that perfect competition may not result in the most efficient system, because it is difficult to reap the advantages of the economies of scale with many small enterprises. Consequently, perfect competition as an ideal was replaced by workable competition, which was characterized as follows (Kohls and Uhl, 1980). There must be an appreciable number of buyers and sellers, no trader must be so powerful as to be able to coerce effectively his rivals, traders must be responsive to incentives of profits and loss, there must be no agreements on commercial policy among rivals, entry must be free from handicap and there must be no substantial preferential treatment of any particular trader or group.

Three elements can be distinguished in market structure analysis: market structure, market conduct and market performance which are assumed to be interrelated. Market structure refers to the organizational characteristics in a market which seem to influence competition and pricing. Market conduct refers to the patterns which participants in the market follow in adjusting to changes resulting from customers, competitors or the environment. Market performance refers to the economic results and the equity that are derived from the system.

In the following, an attempt to evaluate the performance of the paddy marketing system in a part of the Kemubu irrigation scheme is made.

*Structure of the market*

The structure of the market is related to the degree of concentration of buyers or sellers, the degree of horizontal or vertical integration in the market, the conditions of entry and the availability of market information.

*Degree of competition.* At least 8 middlemen were operating in the research area. Farmers could also deliver their paddy to the Farmers' Organization, a large cooperative rice mill or a small cooperative rice mill near-by (Map 5). Factors that limited farmers in their choice of paddy buyer were debts to a middleman or the sale of a small quantity of paddy. About 20% of the farmers interviewed borrowed money, paddy or rice from a middleman during the off-season of 1982, whereas about 25% of the farmers reported selling quantities of less than 900 kg to the middleman (Table 27). Nevertheless, farmers reported that they could be hardly exploited because of the competition among middlemen, mutual interests and social relationships. Horizontal and vertical integration in the marketing system took place with the formation of small cooperative rice mills in the fifties and sixties which were stimulated by the government and with the formation of two large cooperative rice mills in the seventies by a bank. However, the rather inactive role farmers played and the low profitability of these cooperatives prevented the members from improving their competitive position in the paddy market.

*Entry into the market.* Entry into the paddy trade by middlemen existed as little working capital was required to trade in paddy. However, the purchase of a van to facilitate operations involved a relatively great capital outlay. Several middlemen operating in the research area started their business after introduction of the price subsidy. Involvement of rice mills in the paddy and rice trade was controlled by LPN. No subsidies were paid to farmers patronizing unlicensed mills. Although entry of rice mills appear restricted, not many entrepreneurs preferred to enter the market because of low and uncertain returns to investment.

*Market information.* Farmers knew the size of the government support price and subsidy for paddy, but it appeared to be difficult to compare the amount of price plus subsidy minus deductions with the net price paid by middlemen. The price paid by a particular middleman usually was the same for all farmers. Consequently, it did not motivate farmers to sell a better quality or another variety of paddy. The farmers in the research area were well serviced by middlemen, rice mills and an agent of LPN. Thus, it can be expected that it was easier for them to acquire market information than for other farmers living further away from a large rice mill or FO.

*Conduct in the market*

Market conduct is understood as the marketing policy of or the collusive tactics among participants in the market or the willingness of these participants to adapt to changes in the market. No evidence of collusive tactics could be found.

*Marketing policy.* It was stated in the beginning of this chapter that the marketing policy of farmers and middlemen was limited to the marketing functions, whereas rice mills were supposed to have more scope for their own marketing policy. A weak point in the marketing of paddy was the quality deterioration of off-season paddy caused by the late drying of paddy. Farmers can be blamed for this if the compensation for drying wet paddy is high enough and if a relatively simple and cheap drying technology were available. Additional investments by rice mills in drying equipment does not seem to be the solution to this problem, because it takes many days for the wet paddy to reach the mill. Buying good quality paddy and using a rice grader to adapt the grade of rice produced to the needs in the rice market seemed the best policy for rice mills to survive in the short run. This policy assumes that rice mills know their rice market very well, which was not true for several cooperative mills in the Kemubu scheme.

The government was the most active change agent in the paddy market. However, "the very act of the central planner in initiating change may reduce the initiative of the individual entrepreneur" (Cundiff, 1982, p. 17). The paddy farmers might expect the government to solve their problems instead of finding solutions themselves. The government operated through LPN and KADA in an attempt to improve the marketing and milling of paddy. For example, KADA was also involved in a programme begun in 1981 to rehabilitate small cooperative rice mills, which became units of the Farmers' Organizations. This programme provided aid in kind by the installation of drying or milling equipment. It could be justified on the grounds that rice of higher quality might be produced. There was a need, however, to look into the quality of the management of small cooperative mills as well.

*Performance of the marketing system*

The performance of the paddy marketing system is measured by the following criteria: the paddy price received by farmers, size of marketing margins in relation to turnover and the degree of equity resulting from the operation of the system.

*Economic results*. Farmers who could sell their paddy to a large rice mill or its agent could receive the highest price for their produce (Table 26). However, about 25% of the farmers had to sell to middlemen, because of small quantities available or credit relationships. Middlemen received a low margin when trading in paddy, whereas exchanging paddy for rice with farmers generated high margins (Table 29). Evaluating the profitability of rice mills on profit margin and turnover, the conclusion can be drawn that for small cooperative rice mills the degree of asset turnover (capacity utilization) rather than the profit margin was a weak point. Two out of the four small cooperative rice mills reported generating a profit because of a relatively high profit margin and a relatively high rate of utilization of the equipment. It appeared that middlemen rented these mills and, consequently, the cooperative received a compensation for renting out the mill. The other two small mills with a utilization of less than 40% hardly made a profit, one since 1974 and the other since 1980. For the large cooperative rice mill near the research area, the profit margin improved after instituting a policy of buying paddy mainly during the main season harvest. However, the degree of asset turnover (utilization) was still low, resulting in very small profits. A real constraint for the rice milling industry was that the gross margin was relatively low and fixed by the government.

*Equity*. Apart from the exchange of paddy for rice, no excessive profit taking seemed to have taken place. The weakest links in terms of economic power in the marketing channel seemed to be the farmers and the cooperative rice mills, whereas the middlemen and the marketing board, LPN, seemed to be the strongest links.

### *Concluding remark*

It was found that the main marketing channels for paddy (Fig. 15 and 16) were rather competitive: many paddy buyers operated in the research area, no trader complained of being coerced by other traders, no agreements between traders on commercial policy were reported, entry by middleman (although illegal) was free and preferential treatment of one group by another was limited to exclusive buying from members by large cooperative rice mills and preferential treatment of FO (as agent of LPN) -deliveries to the LPN mill. A lack of responsiveness to incentives of profits and loss might be assumed for LPN because it guaranteed to buy all paddy farmers offered irrespective of the potential losses. However, this measure was taken in the interest of the farmers.

Middlemen appeared to perform a useful function in facilitating the disposal of paddy by farmers. They provided transport, credit and market information to farmers who wished to sell their paddy themselves. They seemed to be better equipped to perform these functions than cooperative rice mills.

# VII. CONCLUSIONS AND RECOMMENDATIONS

As will be recalled, the primary goal of the research effort was to undertake an interdisciplinary study to describe and analyse conditions and processes of development within a specific area of irrigated paddy farming. As the research team was also conscious of the possible value of its findings to the implementing agency (KADA), they formulated a number of practical recommendations, based on the major problems identified or perceived. These recommendations were incorporated in the preliminary field report.[34]

A word of caution is relevant: the conclusions and recommendations have reference to the research area and cannot, therefore, be extrapolated for the Kemubu scheme as a whole. However, they apply to similar conditions as found in the research area, which was considered as fairly representative of the cultivated part of the Kemubu scheme.

The recommendations fall under the following groupings:

1. Irrigation facilities
2. Water management
3. Farmers' organizations and agricultural services
4. Cultivation practices
5. Marketing facilities

In addition, based on this project, some suggestions are offered for future research directions in the Kemubu scheme. This chapter also incorporates some reflections and lessons arising from the interdisciplinary nature of the study.

## Major findings and recommendations

### *1. Irrigation facilities*

The main findings related to the supply of irrigation water can be summarized as follows.

- During the dry part of 1982, the main pumping station (at Kemubu) was not capable to deliver sufficient irrigation water for the scheme. The resulting water problems were further aggravated by an unequal water distribution; in the major system because of insufficient canal water-levels for elevated areas and no regulation of quaternary offtakes, and in the units because of imperfections of the distribution system and current practices by farmers. The result was an excessive water use in lower parts close to the offtakes and shortages in elevated or in distant fields. With ample rainfall and high supply of irrigation water during the offseason of 1982, the farmers in the research area did not experience problems in irrigating their fields.

- The major canal system to the units in the research area did not show significant weaknesses except for the low level of quaternary offtakes and an insufficient water-level in part of the secondary canal.
- The physical problems of water distribution in the irrigation units were related to micro-variations in topography, the lay-out of the quaternary canals, the lay-out of the fields, in-field water control facilities, and a lack of proper drainage facilities.

*Recommendations*

A dependable water supply from the major system is a prerequisite for efficient water use at the irrigation level. This implies adequate pumping facilities and sufficiently high water-levels in the canals. To achieve a more even water distribution among the units, quaternary offtakes should then be modified and adjusted to provide each unit with a discharge independent from the downstream water-level and in accordance with its area and requirements. At the same time, the water management of the major system should be improved, with particular attention to the regulation of quaternary offtakes, so as to avoid interferences by farmers.

At the irrigation unit level, a more efficient water use and a more equitable water access for the farmers can be realized by improving the existing infrastructure. However, it is predicted that without adequate cooperation and proper water management by the farmers, the results will be disappointing (see section 2). Physical improvements include the following:

(i) The quaternary canal Q 17L should be improved, so that the water-level will become sufficiently high to irrigate all fields. Concrete lining of the last stretch is advisable, together with an extension into the unit P51L(I). Uncontrolled tapping from the upper reach into other units should be prevented. The blocks in all quaternary canals, used by the farmers to raise upstream water-levels, should be replaced by fixed drop structures (e.g. wooden weirs).

(ii) It should be considered to re-arrange those fields which are unsuitable for proper in-field water distribution. Each field should be supplied either directly from a field ditch or from a higher plot; backing-up of water from lower plots must be avoided. Water flowing from plot to plot should follow well-defined routes. A simple method to improve in-field water control is to place wooden drop planks in the bunds. Unit boundaries need to be well demarcated; water should not cross boundary bunds. Minor land levelling could solve many of the distribution and drainage problems currently faced by the farmers.

(iii) Improvements in the existing drainage system include the following measures:

- increasing the capacity of the main drain and maintaining its capacity by regular cleaning;
- providing additional drains to those parts which are now permanently or temporarily waterlogged.

(iv) All fields now left idle because of supply problems should be incorporated in improvement plans for the irrigation scheme as a whole.

(v) It is recommended to investigate in more detail the excessive percolation losses, found on the higher grounds. These soils might be better suited for other crops.

## 2. *Water management*

The farmers and not KADA, were held responsible for the distribution of water among their fields in an irrigation unit. Water distribution was a largely anarchical process, leading to wastage of water in the upstream sections of units and difficulties in obtaining water in the high fields. This caused considerable delays in the planting of paddy on these fields and crop failures in periods of water scarcity. The current cropping schedule created many risks for the farmers, such as harvesting of the off-season crop and transplanting of the main crop undertaken under rainy conditions. While farmers recognized the need for an organized way of water distribution, they were unable to form some kind of water users' group, as there was no authority in the local community to enforce equitable water sharing in periods of shortages. In fact, farmers expected KADA to assume responsibility for water distribution inside the irrigation units.

*Recommendations*

To cut down the wastage of irrigation water, reduce the continuous delays in the planting schedule and increase the reliability of yields, KADA will have to develop procedures which quarantee a more equitable sharing of water within the irrigation units. This necessity will remain ever after the implementation of the plans for improving the physical infrastructure of the Kemubu scheme. As a first step, KADA irrigation personnel must be trained and authorized to take immediate and effective action against any farmer who persists in taking more than his share of irrigation water to the detriment of his neighbours. If this condition is fulfilled, the following options are available:

(i) To have more frequent field contacts between farmers and irrigation linesmen. Complaints about water supply should be investigated immediately and, if well-founded, a warning should be issued by the linesman the same day.

If this option proves insufficient in itself, the following alternatives deserve attention:

(ii) Prohibit farmers to interfere with water flows and assign the task of distributing water equally to all fields to an "irrigator" responsible for one or two irrigation units, working under KADA's authority;

(iii) Organize farmers in water users' groups at unit level. These groups should work out procedures for water sharing themselves, but will ultimately depend on KADA to enforce them.

Any of the latter two alternatives should only be carried out in combination with the first option. Before being put into practice, the options need to be thoroughly tested out in a small number of irrigation units. These experiments will also have to show whether the expected advantages, such as reduced wastage of irrigation water, more reliable yields and increased cropping uniformity can really be achieved, and compensate the increased personnel costs.

### *3. Farmers' Organizations and agricultural services*

#### *The role of Farmers' Organizations*

In 1982, eight Farmers' Organizations (FOs) had been established within the Kemubu scheme; five additional FOs functioned in the other irrigation schemes under KADA's jurisdiction. These organizations were mainly used as service points, from where goods (agricultural inputs) and services (tractor and marketing services) were distributed to FO members and non-members. The FO approximated a type of area office in which administrative duties were performed by government personnel, and not a business-like or cooperative organization of the farmers.

FOs are essentially government-sponsored and supported institutions, whose members only participate as recipients of services. Policy-making and resource allocation were mainly left to KADA and the FO manager. The role played by the members' board of directors was that of a consultative committee. Ordinary members were seldom consulted and their comments and suggestions were communicated to KADA in a very general form, which did not evoke much action. In this respect, upward communication appeared to be far more effective when informally channelled through the network of *Penghulu* and *Wakil Rakyat*, who are in a position to get things done.

#### *Recommendations*

Three alternatives can be considered in regard to the future role of FOs:

(i) Leave FOs as they are, use them mainly as delivery units for inputs and services, and as local bases for KADA representation.

(ii) Re-name and re-model FOs so that they become mere service units only. In this case, they may well be less costly in operation and more administratively efficient.

(iii) Allow them to become real farmers' organizations, in the sense that farmers and their respective leaders are prepared to take over responsibilities and manage these centres themselves, with the support of KADA operating as regional centre.

For the third option, guidelines from policy-makers at the federal level are required to make tangible the creation of farmers' organizations which are the responsibility of and responsible to the farming community.

*Provision of services*

The most important services provided by the FO were the distribution of the paddy fertilizer subsidy, provision of seed of improved paddy varieties, tractor services and the purchase of paddy on behalf of LPN. The distribution of the fertilizer subsidy via the FOs was controlled by the *penghulu* and village committee members who withhold it from their local opponents. This led to under-utilization of fertilizer and made the agricultural officers reluctant to execute their duties at village level, for fear of getting involved in local politics.

Although it was found that the FO only ploughed 10% of the paddy acreage, its tractors operated all over the FO area in an un-coordinated manner. The recovery of tractor charges was one of the main problems of this service. The provision of seeds of improved paddy varieties was well organized.

*Recommendations*

(i) A more equitable distribution of the paddy fertilizer subsidy would require that decision-makers at the state and federal level provide firm quidelines to this effect.

(ii) In order to improve the operation of the tractor service, the following options are offered:

- Liquidate the service and stimulate the private sector to fill the gap. If constraints in the institutional credit market are eliminated, more people will purchase tractors, and
- Focus the provision of FO tractor services in a sub-section of the FO area in order to improve debt recovery by limiting the number of brokers.

The later option may lead to greater certainty of obtaining tractor services by the farmers, more efficient use of the FO and private-owned tractors and less damage to field bunds.

*Agricultural extension*

During the research period, no particular advice on paddy cultivation reached paddy farmers in the research area. Although there was a regular training programme for extension workers, the vital link between extension workers and farmers was still missing. This was due to a number of reasons:

- There was limited scope for general information about paddy farming practices, as paddy farmers were already much aware of the use of modern rice varieties and cultivation methods.
- Paddy cultivation was and still is of an extensive nature: farmers were more interested in non-agricultural activities and job opportunities outside paddy farming.
- The formation of farmers groups, an important feature of the T&V system, was very difficult to achieve, because of little interest by paddy farmers, absence of local leaders, and differences in political outlook.

From field observations, it appeared that much advice and action was needed in one particular aspect of paddy farming, i.e. pest control. During the off-season many nurseries and paddy fields suffered seriously from the attack of insect pests, primarily the black stalk bugs. No control measures were undertaken by the farmers or by extension personnel. The need for such measures was often not realized until after the damage had been done.

*Recommendations*

(i) It is recommended that organizational measures should, in the first place, be directed towards generating practical knowledge on the various aspects of paddy farming, based on the farmers' needs and their experiences.[35] Field personnel are advised to become more information-seekers than information-suppliers, and work closely with farmers to identify the nature of current problems in paddy cultivation and irrigation. Training given to extension officers should be tuned to the needs and problems thus identified. It is recommended to form a strong and well-equipped team of field personnel to fight and control insect pests on the spot, in collaboration with farmers.

(ii) The issue of where to locate Agricultural Extension, whether under DOA and KADA, is considered of secondary importance. However, from the logic of integrated rural development and organizational structure, preference should be given to the location of Agricultural Extension under KADA.[35] A better linkage system with the farmers could then be established and the interrelated nature of the provision of irrigation water, input supply and agricultural advice could be emphasized.

*4. Cultivation practices*

It can be stated that rice cultivation in Kemubu is of an extensive nature. This is mainly caused by inadequate irrigation and drainage facilities, labour constraints, part-time farming and off-farm employment, and by considerable delays in the cropping calendar. This limits the scope for obtaining higher yields through more careful and labour-consuming practices. Improvements in yield and quality are possible through chemical weeding, better pest control, and mechanical threshing.

*Recommendations*

(i) Although poor water management limits the possibilities of chemical weed control, KADA is advised to introduce and demonstrate the use of safe and effective herbicides for increasing paddy yields.

(ii) To diminish the workload at harvest time and to reduce losses in yield and quality, there is scope for simple, mechanical threshing machinery and - to a lesser extent - for cleaning equipment.[36]

*5. Marketing facilities*

It was found that the main marketing channels for paddy were rather competitive: many paddy buyers operated in the research area, no trader complained of coercion by other traders, no agreements between traders on commercial policy were reported, and entry by middlemen (although illegal) was free. Preferential treatment of one group by another was limited to exclusive buying from members by large cooperative rice mills and preferential treatment of FO (as an agent of LPN) deliveries to the LPN mill. A lack of responsiveness to incentives of profit and loss might be assumed for LPN because it quaranteed to buy all paddy offered by farmers.

Middlemen appeared to perform a useful function in facilitating the disposal of paddy by farmers. They provided transport, and offered credit and market information to farmers who wished to sell their paddy themselves. Middlemen were better equipped to perform these functions than cooperative rice mills.

*Recommendations*

To improve the performance of the marketing channels for paddy, the following measures are advised:

(i) Improve product quality by:

- an increase in the premium paid by rice mills to farmers for selling dry paddy harvested in the off-season (LPN);
- introducing a drying technology for paddy that can be easily applied by farmers (KADA);
- adding a rice grader to the equipment of large cooperative or public rice mills (LPN/KADA);
- formulating a crop schedule in which the risk of harvesting paddy in wet periods is minimal (KADA).

(ii) Improve the pricing system by:

- varying paddy prices by variety dependent on preferences in the consumer rice market (LPN);
- requiring all rice mills to pay the government minimum price to farmers (LPN).

(iii) Improve the profitability of cooperative rice mills by:

- renting idle drying and milling capacity from cooperative rice mills during the off-season, instead of considering the opening of new public mills by LPN;
- experimenting with a marketing bureau representing the cooperative rice mills to bring together their knowledge of the Malaysian rice market;
- organizing a training course in marketing management and market research for cooperative mill managers.

(iv) Improve the modernization of paddy milling and drying capacity in the Kemubu scheme by:

- requiring that LPN, cooperative rice mills and KADA discuss their investment plans annually, to prevent overcapacity of milling and drying facilities.

## Further research

In the early phase of this research project, the General Manager of KADA suggested that a similar study be undertaken on the West Bank, facing problems in paddy farming similar to those occurring around Ketereh. KADA agreed to undertake such a study, with the assistance of the Dutch research team, which provided all the relevant research material, including questionnaires.

In the event, because of the shortage of research staff, the project was postponed. It suggested, then, that KADA's Evaluation Unit be strengthened by recruiting competent researchers, having field experience and interested in field research, and not encumbered with administrative tasks. In addition, assistance and cooperation of the local universities and research institutes should be sought to undertake well-defined research projects within the scheme. As a matter of interest, such assistance is already being given, but could be more focused on problems encountered by farmers and field staff.

In the following paragraphs various topics for future studies are suggested, based on the research results discussed in this monograph:[38]

1. A socio-economic field study on the West Bank, e.g. Pasir Mas, to identify problems related to water supply and the use of farm services in paddy farming. The role of the FO and the level of farmers' interest in FO affairs could be highlighted. If it is intended to undertake a policy-directed research project such study should generate specific recommendations and quidelines for KADA's consideration and action.

2. A number of experiments of new procedures for water distribution and maintenance work at the unit level, to test out various practical approaches to an equitable system of water supply within the scheme. Next to the infrastructural design, attention should be given to the interaction between water users and irrigation personnel in the allocation of irrigation water and the maintenance of quaternary canals.

3. A study on the occurrence of labour shortages in paddy areas, related to the scope for mechanized paddy farming and the potential for light machinery, such as pedestrian tractors and portable threshers. Such study could also lead to an investigation into the preference by farmers for 4-wheel tractors in the Kemubu area compared to the widespread use of pedestrian tractors in irrigation schemes at the West Coast.

4. An experimental study to test the viability of an integrated approach to paddy farming development. This experiment should validate a combination of specific agricultural research under MARDI and the input supply and extension advice under KADA. This experiment could be well undertaken within the research area near Ketereh, using the information base already available. If successful, the experiment could be replicated on a larger scale, and be supplemented by action-directed research.

5. An evaluation study to keep track of a number of pilot projects within the scheme, especially those with moderate budget allocations, so as to assess the impact of such projects on the distribution of irrigation water, cultivation techniques and paddy yields.

6. A study of the managerial and entrepreneurial characteristics of small paddy milling cooperatives and their members. Such study could identify those aspects which contribute to their effective management and those which hamper such development.
7. An in-depth study on farm households composition and the role of members in paddy production. Various types of households could be compared, reflecting several phases of orientation to paddy farming and off-farm activities.

Reflections on the interdisciplinary research project

As a concluding observation, it seems relevant to make some evaluative comments on the interdisciplinary approach used in this study. Such comments, it is hoped, will have some utility to other researchers, as there is little evidence of the problems and risks connected with this type of research (Ricksons, 1982). The following topics are given attention: depth and coverage of the research activity, research components that are suitable for this type of approach, research methods used, and interactions among the researchers.

The basic assumption underlying the research project was that an interdisciplinary research effort would yield a more comprehensive understanding of the complex processes involved in irrigated paddy farming than could a simple, disciplinary orientation or even a multidisciplinary approach. The main focus of this research undertaking was an integrated study of the various activities of paddy farmers and the environmental conditions under which they cultivate and market their produce. As double cropping is much dependant on the supply of water, the distribution network and water management practices received considerable emphasis in the study.

Furthermore, the intervening role of the government through its various agencies in promoting paddy production and the wide range of inputs and services formed an important area of interest to the researchers. In the effort to unravel some of the complex and interacting processes of paddy production, a fairly broad range of topics was covered and analysed.

One limitation that has been felt during our interdisciplinary study has been the difficulty in maintaining both an extensive range and intensive depth of the various aspects of irrigated paddy farming investigated. In other words, to permit the interdisciplinary focus of the study, detailed analysis by any one particular specialization - rural sociology, irrigation engineering, farm economics or marketing - could not be easily pursued and had to be sacrificed to some extent. One reason for this state of affairs was the need to maintain, or to attempt to maintain, a broad perspective of the various topics dealt with, in order to generate an interdisciplinary focus. Thus, the engineering aspects of this study probably incorporate more preliminary detail than needed by other members in the team. These have been included, nevertheless, to provide a broad framework for the technical and social aspects of water distribution. In this way, it is hoped, a more meaningful picture of the social or institutional problems has been obtained that coincides with the technical weaknesses of the irrigation infrastructure of the Kemubu scheme. It may well be that breadth and depth of analysis in a study such as ours can be achieved given a longer period of post-field research analysis.

Somewhat related to the point above is our finding that it appears far easier to undertake a combined field research project in a specific agricultural area than contribute to a theory of rural development. In the preliminary phases of this project, the compilation and close reading of the literature proved valuable in defining a common direction for this study. It also introduced the concept of "integrated rural development" as a promising approach because of its conceptually comprehensive scope. At an early stage, however, this conceptual base had to be abandoned as it was too vague and diffuse and centered much more on the roles and performance of agencies outside the farming community.

The focus of the study, then, became the activities of paddy growers within a setting where many essential agricultural services and inputs were supplied by government agencies. The absence of a common conceptual base for this study may well constitute a serious limitation; to future researchers interested in interdisciplinary pursuits is left the challenge of building a viable conceptual basis and methodology. The trend in this interdisciplinary research undertaking has thus not been towards theoretical explorations or developments. Rather, the area of study has been investigated to analyse and describe farming conditions and practices within a specific setting, and to generate a set of practical guidelines for improving paddy cultivation and the supply of agricultural services to the farming community.

The disciplines represented in this study included both the social, natural and technical sciences, a combination that would provide a major challenge under most circumstances. One component of the study, however, appeared a most promising area of interdisciplinary research, i.e., the supply and management of irrigation water to small-scale paddy cultivators. Despite, or perhaps, because of the crucial nature of irrigation to paddy double-cropping, many problems of intimate relevance to paddy cultivation were generated; this proved to be a rich ground for studying the various implications of water supply and management at the field level. Irrigation personnel referred to the late arrival of irrigation water into the irrigation units as a 'social problem' thus attracting the attention of the researchers, who focused upon its engineering and social dimensions. Informal interviews and discussions with water users enlightened the researchers on the complex problems of achieving an equitable water supply for farmers in one irrigation unit; it also provided some insights into the barriers to achieving cooperative patterns of behaviour in water distribution.

An important aspect of the field study was the identification and selection of the research area, a task undertaken immediately after the researchers were settled in Kota Bharu. It was quite natural to expect each participating researcher, guided by his disciplinary orientation and training, to identify an area for study that best suited his subject. It thus took a considerable time before an area was selected that could satisfy all the disciplines involved. This well illustrates the pressures and tensions of interdisciplinary research which calls for a good degree of mutual understanding, compromise and agreement on the scope and nature of such an enterprise. The eventual choice of the research area comprising the five irrigation units reflected its suitability from the perspective of irrigation, agronomy, economics, sociology and marketing. Doubtless, if the research project was based on one discipline only, less time would have been needed to select the research area.

Another example of interdisciplinary effort was the socio-economic survey undertaken. In the initial stages, the original questionnaire posed in purely farm management terms, was reformulated covering social, technical and marketing aspects. In the actual survey and data gathering stage, several members were involved, and assisted by a student researcher and field interviewers. Despite these efforts, the survey method raised many difficulties in terms of the validity and reliability of the data collected. In many instances, recorded data appeared inconsistent with field observations, as for example, the intensity of family and hired labour inputs into paddy cultivation, operated acreages of paddy land and their associated tenurial status. Survey data had to be revised several times by the application of more informal data gathering methods than the standardized survey procedure used. This combination of formal and informal research methods for a relatively small sample of farmers highlights the weaknesses of the survey method commonly applied in farm management research. If unnoted or unchecked, consistent errors may be built into the data collection and subsequent analysis.

The above stated example makes it clear how the willingness to cooperate in this field study influenced the intensity of the researchers' interaction, as not only the methodology and the research setting had to be acceptable to all but also the general findings and interpretations. A definite advantage was that two members of the team already had cooperated in an earlier field research on paddy farming in Malaysia. This facilitated formulating the research problem in the early stages of the study, in acquiring financial support, and in establishing a sound field base for the research.

During the several stages of the research there was ample opportunity for team members to discuss and learn from each other experiences; a great advantage was that individual observations could be validated and supplemented. This publication has also benefitted much by the continuation of the interdisciplinary approach into the report writing stage. Before publication, drafts of the various chapters, some of which were jointly authored, were circulated among all the researchers for critical comments and observations. On some occasions, too, several researchers discussed the drafts either informally or formally with selected participants at the Agricultural University in Wageningen. In order to attain some degree of unity and consistancy in style and presentation, two of the researchers undertook the task of editing the manuscript.

As a final point, interdisciplinary research approaches are promising for research particularly having an applied perspective. It probably is easier also to undertake interdisciplinary research only among social scientists or among natural or technical scientists. The interdisciplinary framework is a compromise that implies potential conflict between group goals and individual objectives of researchers. Its major advantage lies in its suitability in clarifying complex processes from several angles and in particular, in identifying social and technical key factors involved in the process of agricultural change. Although the combined study approach proved profitable in gaining a better understanding of irrigated paddy farming, it was also found that the complex nature of these social, economic and technical components decreased the potential for generalization. In our view, interdisciplinary research may not be able to generate the depth of analysis normally associated with research undertaken within a disciplinary context. However, an interdisciplinary research undertaking inculcates among its participants the relevance of other disciplinary perspectives and its utility in exploring major issues in such vital fields as irrigation, food production and rural development.

ABBREVIATIONS

| | |
|---|---|
| DID | Drainage and Irrigation Department |
| DOA | Department of Agriculture |
| FO | Farmers' Organization |
| KADA | Kemubu Agricultural Development Authority |
| LCRM | Large cooperative rice mill |
| LPN | Lembaga Padi dan Beras Negara (National Paddy and Rice Marketing Board) |
| MARDI | Malaysian Agricultural Research and Development Institute |
| PAS | Partai Islam |
| SCRM | Small cooperative rice mill |
| UMNO | United Malays National Organisation |

NOTES

1. Freeman and Lowdermilk (1979) discuss the uses and limitations of survey methods for the analysis of irrigation systems.

2. Irrigation techniques using brushwood and earthen dams to block mountain streams have been used in the narrow valleys adjoining the plain for at least 150 years. An example of this type of irrigation was brought to our attention by Mr. Kenzo Horii.

3. All amounts in the text are given in Malaysian dollars. Rates of exchange on 1 January 1982 were as follows:
   1 M$ = US$ 0.44
   1 M$ = Hfl 1.13

4. Ownership *(sendiri)*, *sewa*, *pawah*, lease *(pajak)*, usufructuary loan *(gadai)* and conditional sale *(jual janji)*.

5. Only 2 cases of *bagi tiga* were reported.

6. Fujimoto (1980) also notes other variations of the *pawah* system reflecting differences in production cost sharing arrangements between landlord and tenant. These differences were also found by us, and were related to the share *(bagi dua or tiga)* and the form of the share *(padi bersih or pohon padi)*.

7. Especially now that landowners often pay for land preparation, and fertilizer is fully subsidized, many tenants do not pay any cash production costs except for the labour they hire and, in a few cases, crop protection chemicals.

8. KADA recommends two rounds of rotavation of the soil, the first under dry field conditions and the second two weeks later under wet field conditions. In the research area, however, most fields were rotovated under wet conditions one or two weeks before transplanting.

9. Especially compared to the much larger differentiation on the West Coast irrigation schemes.

10. In this case we assumed that all labour inputs are provided by the tenant and all cash costs (except wages) borne by the landowner. Other types of share crop contracts result in similar returns to the tenant's labour.

11. The average net return per labour hour to the operators in the sample (both owner-operators, owner-tenants and tenants) was $1.48, the median $1.36.

12. We have assumed that, as it is in most cases, fertilizer is fully subsidized.

13. Various researchers, such as G.J. Tempelman and K. Horii, have remarked that the limited interest in paddy production on the West Bank of the Kelantan river is due to the low price of *beras* smuggled from Thailand. In the research area, on the East Bank, smuggle is much more difficult and costly, and *beras* prices are higher.

14. Only four pumps were used simultaneously, the fifth served as stand-by.

15. The nomenclature is more related to size and capacity of the canals, although secondary canals can have a larger capacity than the smallest primaries.

16. With full supply level in the canals, even much higher discharges could be realized: for P51L maximum amounts were measured of 110 l/s (3.9 cusecs).

17. No separate data for the Kemubu scheme were available.

18. Including the expenses for water delivered by the private pumps.

19. In August 1982 for instance, the total reduction in the supply for the main canal was not more than 16% of the rainfall in that month.

20. In the Limbat canal area, 87 of the 134 units (65%) had a quaternary canal; the intensity was four times higher than for the whole scheme (12.4 m/ha).

21. This is even higher than the most intensive type of on-farm development (62 m/ha), proposed in the improvement plan for the Kemubu scheme (Minco, 1982).

22. Thavaraj (1975) came to a similar conclusion as to the provision of terminal facilities in the Muda scheme.

23. This practice of 'back filling' is wasteful and does not guarantee an adequate water supply for the higher plots.

24. A field is a part of the paddy land, operated by one farmer.

25. In contrast to the situation prevailing for instance on Bali (Geertz, 1967) there were no irrigation associations cutting through village organization and uniting farmers from various villages on a new basis.

26. Its boundaries were seldom clearly defined and frequently official boundaries did not tally with the real situation.

27. The Irrigation Inspectors recalled such powers as defined by The Irrigation Areas Ordinance 1953 and Ordinan Kerja2 Pemaritan 1954 for gazetted irrigation areas.

28. This fact was candidly observed by several board members, who nevertheless regarded it as unalterable.

29. Observation by Alexander van Wassenaer, one of the students involved in the research project.

30. Similar critical comments on the performance of the T&V system in other countries were made by Lin Compton during the Regional Seminar on Extension and Rural Development Strategies at Universiti Pertanian Malaysia in May 1983 (Seminar's report, pp. 13-14).

31. Grading is defined as the sorting of unlike lots of products into uniform categories, according to quality standards.

32. The actual rate of self-sufficiency varies between 80 and 90%.

33. Paddy can be stored longer than rice.

34. The main findings and recommendations have been presented and discussed with KADA and during a seminar organized by the Socio Economic Research Unit in Kuala Lumpur.

35. As women are actively involved in paddy farming , their experiences and knowledge should also be determined. Such knowledge could be used in new approaches to agricultural extension.

36. In April 1983 a ministerial decree on this issue was expected to be implemented in the Kemubu scheme.

37. During the study specific information on the Votex ricefan thresher was given to KADA.

38. For brevity's sake, only topics are indicated; they should be spelled out in a greater detail if and when studies are undertaken. New research projects can make full use of the hypotheses formulated at the end of chapter II.

REFERENCES

Afifuddin, Hj. Omar (1972), A study on leadership pattern, activities and behaviour among leaders of farmers' associations within the Muda scheme. Alor Setar: Mada Monograph no. 17

Beaglehole, J.H. (1976), The district: A study in decentralization in West Malaysia. (London: Oxford Universiry Press)

Benor, B. and J.Q. Harrison (1977), Agricultural extension: The training and visit system. (Washington: World Bank)

Bos, M.G. and J. Nugteren (1974), On irrigation efficiencies. Wageningen: ILRI publication no. 19.

Bray, F.A. and A.F. Robertson (1980), Share cropping in Kelantan, Malaysia. Research in Economic Anthropology, vol. 3, pp. 209-244

Chambers, R. (1981), In search of a water revolution. Water supply and Management vol. 5, no. 1, pp. 5-18

Clodius, R.L. and W.F. Mueller (1961), Market structure analysis as an orientation for research in agricultural economics. Journal of Farm Economics, vol. 43, no. 3, pp. 513-553

Cohen, J.M. (1980), Integrated rural development. Sociologia Ruralis vol. 20, no. 3, pp. 195-212

Coward, E.W. (ed.) (1980), Irrigation and agricultural development in Asia. (Ithaca: Cornell University Press)

Craig, J.A. (1935), Agriculture in Kelantan. Malayan Agricultural Journal, Aug. 1935, pp. 369-374

Cundiff, E.W. (1982), A macromarketing approach to economic development. Journal of Macromarketing, vol. 2, no. 1, pp. 14-19

Daane, J.R.V. (1982), Responses of peasant growers to farmers' organizations in West Malaysia. (Ph.D. thesis, Agricultural University, Wageningen)

Daane, J.R.V. et al. (1983), Irrigated padi farming in Kemubu. (Provisional report, Kota Bharu)

Dixon, J.A. (1979), Diversity in the diet and staple food consumption patterns in Indonesia. Kajian Ekonomi Malaysia, vol. 16, nos. 1 and 2, pp. 137-152

Dobby, E.H.G. (1951), The Kelantan delta. The Geographical Review vol. XLI, pp. 226-255

Fredericks, L.J., G. Kalshoven and J.R.V. Daane (1980), The role of farmers' organizations in two paddy farming areas in West Malaysia. Wageningen: Afd. Sociale Wetenschappen Landbouwhogeschool, Bulletin no. 40

Freeman, D.M. and M.K. Lowdermilk (1979), Survey research methodologies for the analysis of irrigation systems. Cornell Rural Sociology Bulletin Series no. 98

Fujimoto, Akami (1980), Land tenure, rice production and income-sharing among Malay peasants: A study of four villages. (Ph.D. thesis Flinders University of South Australia)

Galjart, B.F. (1976), Peasant mobilization and solidarity. (Assen: Van Gorcum)

Geertz, C. (1967), Tihingan: A Balinese village. In Koentjaraningrat (ed.), Villages in Indonesia. (Ithaca: Cornell University Press)

Geertz, C. (1967), Tihingan: A Balinese village. In Koentjaraningrat (ed.), Villages in Indonesia. (Ithaca: Cornell University Press)

Gies, E.C.M. (1982), Agronomic aspects of paddy farming in the Kemubu irrigation scheme. (Field report, Kota Bharu)

Goor, G.A.W. van de and G. Zijlstra (1968), Irrigation requirements for double cropping of lowland rice in Malaya. Wageningen: ILRI publication no. 14

Graham, W.A. (1911), Kelantan, Trengganu, Kedah, Perlis. (Encycl. Britannica 11th edn. 17, pp. 482-483)

Gullick, J.M. (1965), Indigenous political systems of Western Malaya. London School of Economics Monographs on Social Anthropology no. 17

Hassani, Nik Mohammed (1979), Agricultural development implementation; The Kemubu rice project in Malaysia. (Ph.D thesis, Ann Arbor/London: University Microfilms)

Have, H. ten (1982), Rice cultivation in the Kemubu scheme. (Report)

Hill, R.D. (1977), Rice in Malaya: A study in historical geography. (Kuala Lumpur: Oxford University Press)

Horii, K. (1982), Some socio-economic changes of paddy planting village in Kelantan - A case study of Kampong Gajah Mati. (Seminar paper, University of Malaya)

Husin Ali, S. (1975), Malay peasant society and leadership. (Kuala Lumpur): Oxford University Press)

IRRI (1975), Changes in rice farming in selected areas of Asia. (Los Banos: IRRI)

Jackson, J.C. (1972), Rice cultivation in West Malaysia: Relationships between culture, history, customary practices and recent development. Journal of the Malaysian Branch of the Royal Asiatic Society, vol. 45, pp. 76-96

Jegatheesan, S. (1977), The green revolution and the Muda Irrigation Scheme: Analysis of its impact on the size, structure and distribution of rice farmer incomes. Alor Setar: MADA Monograph no. 30

KADA (1976), Kajian sosio ekonomi petani-petani dalam kawasan KADA. (Draft report, Kota Bharu)

Kawaguchi, K. and K. Kyuma (1969), Lowland rice soils in Malaysia. Reports on research in Southeast Asia. (Kyoto: National Science Series, no. 5

Kessler, C.S. (1978), Islam and politics in a Malay state, Kelantan 1838-1969. (Ithaca: Cornell University Press)

Kohls, R.L. and J.N. Uhl (1980), Marketing of agricultural products (5th ed.). (London: Collier MacMillan)

Kuchiba, M., J. Tsubouchi and N. Meada (eds.) (1979), Three Malay villages: A sociology of paddy growers in West Malaysia. (Honolulu: University Press of Hawaii)

Lindert, P. van (1978). Agrarische kommercialisatie. Geografisch Tijdschrift, vol. 12, no. 5, pp. 442-451

Minconsult Sdn.Bhd. and Sanyu Consultants (1982), KADA II Improvement project Kelantan. Feasibility Study. (Draft final report for the Ministry of Agriculture, Government of Malaysia)

Moormann, F.R. and N. van Breemen (1978), Rice: Soil, Water, Land. (Los Banos: IRRI)

Narendran, V.M. (1979), The market as an articulator of the integrated economy: The anthropological case of Pasir Mas, Malaysia. (Ph.D. thesis Cornell University: University Microfilms)

Nash, M. (1974), Peasant citizens: Politics, religion and modernization in Kelantan, Malaysia. (Ohio: Ohio University)

Olson, M., Jr. (1969), The logic of collective action: Public goods and the theory of groups. (New York: Schocken)

Purcal, J.T. (1971), Rice Economy. A case study of four villages in West Malaysia. (Kuala Lumpur: University of Malaya Press)

Rickson, R.E. and S.T. Rickson (1982), Problems and prospects of cross-disciplinary research. The Rural Sociologist, vol. 2, no. 2, pp. 95-103

Rodenburg, J. (1983), Women and padi farming - a sociological study of a village in the Kemubu Scheme. (M.Sc. thesis, University of Amsterdam)

Selvadurai, S. (1972), Padi farming in West Malaysia. (Kuala Lumpur: Ministry of Agriculture and Fisheries, Bulletin no. 127)

Selvadurai, S. (1979), Agriculture in Peninsular Malaysia. (Kuala Lumpur: Ministry of Agriculture, Development and Planning Division Bulletin no.148)

Selvadurai, S., Ani Arope and Nik Hassani Mohammed (1969), Socio-economic study of paddy farms in the Kemubu area of Kelantan, 1968. (Kuala Lumpur: Ministry of Agriculture)

Shand, T., Mohammed Ariff Hussein and Mohammed Abdul Rahman (1982), A socio-economic study of the impact of the Kemubu irrigation scheme in Kelantan, Malaysia. (Serdang: University Pertanian Malaysia)

Short, D.E. and J.C. Jackson (1971), The origins of an irrigation policy in Malaya. Journal of the Malay Branch of the Royal Asiatic Society, Part 2, 1971

Soo Swee Weng (1975), Semi-detailed soil survey of the Kelantan Plain. (Kuala Lumpur: Ministry of Agriculture and Rural Development)

Stern, L.W. and A.I. El-Ansary (1982), Marketing channels. (Englewood Cliffs: Prentice Hall)

Taylor, D.C. (1981), The economics of Malaysian paddy production and irrigation. (Bangkok: Agricultural Development Council)

Thavaraj, S.H. (1975), The necessity of terminal facilities for water management at the farm level. In: Proceedings of the national seminar on water management and control at farm level. (Ministry of Agriculture and Rural Development, Kuala Lumpur, Bulletin no. 139)

Vokes, R.W.A. (1978), State marketing in a private enterprise economy: The paddy and rice market of West Malaysia 1966-1975. (Unpublished Ph.D. thesis, University of Hull)

Wassenaer, A. van (1982), Marketing behaviour of paddy farmers in Malaysia. (Field report, Kota Bharu)

World Bank (1975), Completion report of Kemubu irrigation project. (Report no. 796-MA)

World Bank (1981), Impact evaluation report Malaysia: Muda and Kemubu irrigation projects. (Report no. 3587)

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# PADDY FARMERS, IRRIGATION AND AGRICULTURAL SERVICES IN MALAYSIA: a case study in the Kemubu Scheme


## SUMMARY

An interdisciplinary field research project was conducted in an irrigated paddy farming area within the Kemubu Scheme on the east coast of Peninsular Malaysia during the off-season of 1982. The study focused on the activities of farming families as prime producers of paddy, and on the conditions under which they cultivated and marketed their produce. The study was also concerned with how agricultural services were provided by government agencies within the irrigation scheme. The main components of the research project were the supply of irrigation water, cultivation practices, distribution of farm services and marketing behaviour of paddy farmers.

The construction of a large irrigation scheme and the introduction of double-cropping have initiated many changes in the farm economy. Topographic conditions and inadequate distribution of water result in wastage during normal weather and in scarcity during dry periods. Poor performance of the irrigation system was attributed to flaws in design and to deficiencies in management, including supply of water to the irrigation units and in its use by the farmers within the units. In their uncertainty about supply, farmers look for individual solutions, including blockage of quaternary channels, and are not motivated to take collective action to cope with distribution problems.

Paddy farming within the research area is extensive, as farmers are more interested in off-farm jobs than in undertaking time-consuming cultivation. Sowing is often delayed, resulting in shifts in the official schedule of farming operations. Both short-strawed modern paddy varieties and semi-tall semi-traditional varieties are planted. Harvesting and threshing operations are carried out by hand; paddy yields vary greatly from season to season and over the years.

Agricultural services to the farmers are channelled through farmers' organizations, which can be typified as area offices operating under the Kemubu Agricultural Development Authority (KADA). Farmers' commitments to these organizations are low, as they only participate as recipients of services. Fertilizers provided under the subsidy scheme are withhold from certain categories of farmers because of local political implications. Agricultural advice does not reach farmers, as the formation of farmers' groups, a salient feature of the Training and Visit System, is difficult to achieve. Upward communication appears to be effective when informally channelled through the network of village headmen and members of the state assembly.

In selling their produce, the farmers make considerable use of middlemen, who provide cheap transport to the rice mills. The paddy subsidy scheme, introduced by the government, resulted in a sharp decrease in commercial milling by unlicensed mills. Large cooperative rice mills in the scheme are under-utilized during the off-season, when it becomes more profitable to deliver wet paddy to the rice mills of the marketing board. Small cooperative mills provide mainly commercial and service milling.

We recommend the following as possible ways in which KADA could improve irrigated paddy farming in the scheme.

(1) To extend and improve existing field ditches, to regulate discharges to the irrigation units for an even and effective distribution, to increase the capacity of the main drain and to maintain its capacity by regular clearing of weeds, and to develop procedures and control measures that guarantee a more equitable sharing of water within the units.

(2) To further explore alternatives for clarifying the role and position of Farmers' Organizations. One obvious way is to leave these institutions as they are, and use them mainly as delivery points for inputs and services, and as local bases for KADA representation. To obtain a more equitable distribution of the subsidy on fertilizer, decision-makers at the state and federal level should provide firm guidelines.

(3) Agricultural extension on paddy farming should be directed towards generating practical knowledge of paddy farming, based on the farmers' needs and their experience. To diminish the work load of farmers at harvest time and to reduce losses in yield and quality, there is scope for simple mechanical threshing machinery.

(4) To improve the performance of marketing channels for paddy and to improve product quality, the premium paid by rice mills to farmers should be increased for selling dry paddy harvested in the off-season. The profitability of cooperative rice mills could be improved by using idle drying and milling capacity of cooperative rice mills during the off-season.

The publication also contains a listing of new research topics on irrigated paddy farming in the Kemubu Scheme, and an evaluation of the interdisciplinary approach used in this study.

Appendix 1. THE INTERRELATIONSHIP OF RESEARCH COMPONENTS AND DISCIPLINES

| | Economics | Marketing | Irrigation | Agronomy |
|---|---|---|---|---|
| Rural sociology | farmers' use of FO services; division of labour | relations farmers-middlemen | relations between water users | use of improved varieties; role of rural extension |
| Economics | | profitability of paddy sales | costs and benefits of irrigation | risks of new technologies |
| Marketing | | | influence of irrigation facilities on paddy yiels | milling quality grades of paddy |
| Irrigation | | | | water requirements and the cropping calendar |

## Appendix 2. RESEARCH METHODS

### Selection of paddy operators

1) Paddy and non-paddy areas within the irrigation units were demarcated on a cadastral map with the help of irrigation staff. This was followed-up by extensive field checks. The cadastral lot numbers of all lots which were partly or wholely planted with paddy were listed.
2) With the aid of the lot numbers, the names and addresses of the owners or tenant-operators of these lots could be obtained from a file in the FO office containing application forms for the paddy fertilizer subsidy. It was later found, however, that many tenants had not registered at all, since they received the fertilizer subsidy through their landlord. Operators who lived at some distance from the selected irrigation units often applied through another FO and were also difficult to identify.
3) The identified applicants were visited by research assistants and asked for the names of all operators on the lots in the selected units that they had applied for. This was necessary because in many cases the applicant was not the operator of the lot or not the only operator (in case the lot had been subdivided unofficially).
4) Each operator who could be identified was visited and asked for additional information concerning FO-membership and tenure of paddy land both in and outside the selected irrigation units.

   At the start of the off-season of 1982 sixty paddy operators had been identified. Ultimately only 45 of these 60 operators could be interviewed. Some dropped out because they moved to another village or land settlement scheme during the season and either left their land in somebody else's care or continued to farm it by returning there once a month. Others were never at home or lived too far from the research units which made it impractical to include them. Finally there were some farmers who initially claimed that they farmed a particular lot in the research units, but later on appeared to have rented the land to tenants.

   To compensate farmers for their time and willingness to cooperate in the study, a large *kenduri* (meal served at festive occasions) was given for all farm households.

### Questionnaires

The weekly questionnaire covered the following topics:
- labour utilization for the various economic activities of the household members,
- sales of farm procedure,
- production costs,
- gross income obtained,
- water conditions and water control on one selected paddy field per farmer,
- details of paddy growing practices on this field, such as varieties grown, dates of operations, quantities and costs of inputs, methods of application, mobilization of labour and other inputs,
- yields on the selected fields.

Information on the conduct and performance of persons engaged in paddy marketing was obtained from surveys among farmers both after main season and off-season harvests of 1982, and from case studies among seven middlemen, four small cooperative rice mills and one large cooperative rice mill in the Kemubu scheme.

*Training of interviewers*

Three interviewers were recruited from the research area itself with the aid of the FO and the local *penghulu*. The fact that the interviewers came from the same area as the respondents had a number of advantages:
- it improved the respondents' cooperation,
- it reduced the possibility of respondents to withhold information,
- it limited transport costs.

The obvious disadvantage was that these interviewers were not professionals and required much training and supervision. All interviewers had at least passed their SPM examinations. They were the best of a group of ten research assistants used to obtain the original list of operators in the research area.

All interviewers were closely supervised and all finished interviews were checked for mistakes, inconsistencies and deleted answers. Furthermore each of the researchers went through the information obtained to identify particular problems for a more detailed analysis in the form of a case study. Each researcher also checked independently obtained information with the answers given by the respondents.

Reliability of data

The combination of qualitative case studies with quantitative information obtained by the survey method was a major step towards satisfactory reliability. The reality of peasant economic activities is so complex that it often does not fit or only seemingly fits into the neat categories of a survey designed without a preceding detailed qualitative analysis of the subject matter. Even the closest possible supervision of interviewers could not have brought this to light, if the researchers had not had a detailed knowledge of their survey respondents obtained by less formal methods, such as observations and intensive informal interviews.

Apart from non-agricultural income which was frequently not reported or under-reported, it proved a major problem to find out the respondents' actual operated acreage of paddy and other crops and the tenure conditions relating to this land. Time and again these data had to be revised in the light of new observations and information obtained in an informal way which proved the survey outcome wrong. Several farmers operated more land than they had admitted. Others were found to operate other plots than they had originally told the interviewers or to operate no fields at all. If respondents had good reasons to provide incorrect answers in these cases, they were not much more precise either in cases where there was no reason to conceal the truth.

## Appendix 3. CASE STUDIES ON WATER SUPPLY AND WATER USE EFFICIENCIES

### Three case studies on water supply

*Case 1*

In P8S2L, a very small unit with only a planted area of 3.8 ha, the water arrived in two nursery plots the same day as supply started and by the next day, land preparation took place with seeding starting one week later.
It took two weeks before the third nursery in this unit, situated at the far end of the field ditch received water. Most of the water entering this unit flooded the banks of the field ditch and flowed through some plots into the natural drain because a farmer blocked the ditch just behind the intake of his nursery plot. The losses from the field ditch continued when farmers did not close their plot intakes. The late arrival of water in the nursery at the end of the ditch as well as an irregular supply during the season was the result.

In this unit transplanting began on 7 June and continued until 15 July. Delays in transplanting due to late water arrival were considered of minor importance compared to the slow progress in planting in some of the fields. Variations in planting time between fields were high: one field of 0.2 ha was finished in 4 days but in another field of the same size, the transplanting took about one month.

*Case 2*

In P7S2L, with the furthest nursery plot situated along the main field ditch at a distance of 1 km from the offtake, it took about two weeks before the water arrival. In the first nursery plots water arrived one day after the supply started and a day later they were rotavated.

For one week, no water entered the field ditch at the end of the quaternary canal, because farmers blocked the quaternary canal in several places in order to raise the water level sufficiently to supply their nurseries. The supply level in the secondary canal and therefore in the quaternary canal remained low because the boards on top of the weir in the regulator had not been properly installed and did not raise the water effectively.

On 11 May, the farmers closed the remaining openings in this additional weir and managed to raise the water-level in the secondary canal by another 20 cm, increasing the supply in the quaternary canal to its maximum of 40-50 l/s (1.4-1.8 cusecs). This situation went on for a week until one of the boards on top of the weir was removed again. During this period, great variations in the water distribution were observed. All the plots along the last 100 m of the quaternary canal were deeply flooded because water overflowed the banks of the quaternary canal. Water passed over the bunds of several plots and splilled into a drain. Also, in the upper reaches of the field ditch, water rushed through a cut in the bund towards the drain.

On 18 May, two weeks after water had entered the unit, the last nursery received sufficient water and was cultivated. Seeding of the nurseries was undertaken between 14 and 23 May.

The insufficient and irregular supply towards the tail end of the unit was the result of the water management practices by other farmers. Firstly, the supply to the unit dropped frequently when the boards on top of the weir in the secondary canal were removed by farmers from the area downstream of the blocked regulator. Secondly, most of the water in the quaternary canal and field ditch was diverted into the fields and eventually spilled into the drain. At the end of May when the water in the field ditch finally reached the last plot, sufficient rainfall had made land preparation already possible.

Transplanting started on 7 June and the last plot was finished on 13 July. The delay of two weeks in the supply to the last nursery had no noticeable effect on the start of transplanting. Several farmers who were the first to receive water in their nurseries started transplanting at the same time as the farmers who were the last.

*Case 3*

In the area of P51L(I) supplied by the field ditch connecting the fields with the end of the quaternary canal (see Map 3), it took ten days after the water arrived at the head of this area, to reach the last nursery which was situated not more than 250 m along the field ditch. In the beginning almost all the water was lost into the drain through a broken siphon which connected the quaternary canal with the field ditch.

The water front remained in the field ditch at the last nursery plot up to 19 June and no farmer made any attempt to move the water further southwards. In the mean time, at the initiative of the researchers, KADA maintenance personnel replaced the broken siphon by a temporary pipe-connection across the drain.

It took until the end of June, 50 days after the water had arrived at the head of the field ditch, before water was finally channeled through the last reach of the field ditch into the plots. Still several plots higher up along the field ditch had not received water because farmers left the bunds closed and no land preparation had taken place there. By this time several of the then transplanted plots were dry again, indicating that even without supply limitations from the quaternary canal, the water requirements in the fields could not be met effectively.

The transplanting period started ten days later than in the other described units, excluding one farmer with a nursery elsewhere, who started much earlier. In this off-season the water supply hardly affected the planting time, also because of the favourable rainfall in the presaturation period.

## Supply interruptions

Three times, the water supply to the area was interrupted because pumping for the scheme was stopped. The first interruption to the supply lasted from 8-14 July when the gates of the main canal were closed because of heavy rainfall in the two previous days (62 mm). From 6-12 July, 204 mm rain was registered and most of the plots remained ponded without the supply. However, next to the ponded plots, several plots did not have any water because farmers did not close the openings in field bunds to prevent the water from flowing away. The plots that lost water soon after rainfall were found in the upper reaches of the units and in fields with good irrigation and drainage conditions. In the paddy fields with less secure water supply, the plots remained covered with water at an average depth of 15-20 cm. Here, farmers were more conscious of preventing water from leaving their plots.

The supply was interrupted the second time (21-26 July) to celebrate the end of the fasting month. Moreover, the supply period of a week between the two interruptions had been too short to supply most of the plots affecting them adversely. At the end of the second interruption, all the plots on the higher grounds were dry and weed developed inside. In P51L(I) which had relatively uniform field conditions 80% of the plots were dry. In the lowest parts of other units, plots were still covered with more than 20 cm of water. Rain which fell before the supply stop (50 mm) prevented the plots from completely drying out. On 26 July, the supply to the main canal started with the highest discharge in the season. The next morning, the secondary canal was at full supply level and one day later, the supply to the unit P51L at the end of the long quaternary canal was almost at its maximum.

On 28 July, the water reached the far end of the field ditch in P51L(I), and three days later all plots were flooded again. In P7S2L, the water did not arrive in the last plots before 4 August but due to good water conservation and some rain, they remained wet. It took ten days from the start of the supply to reach the end-plots (here) because of blocking in the quaternary canal and excessive tapping from quaternary canal and field ditch.

The third time that pumping stopped was for Independence Day and from 31 August to 5 September, no water was supplied. With high rainfall, this interruption did not create any difficulties in the fields. On 13 September, the main canal was closed again; for the research area it meant the end of the irrigation period which lasted 136 days. A low water supply in the main canal was re-established for the tail end up to 6 October, when it was finally closed for the off-season.

## Water use efficiencies

An estimate has been made of the water use efficiency in a few components of the supply system to the fields in the research area. For the supply, measured or recorded discharges in offtakes were used and for the requirement, the calculated evapotranspiration of the paddy crop.
Percolation in the field has not been included in the water requirement and is therefore in the calculations part of the losses. As percolation losses are often considered as part of the requirements, the efficiency will be higher with a daily rate of 1 mm, an amount used by others (Minco, 1982), the efficiency will rise 3-5%. Only irrigation periods have been taken into account when there were no apparent supply limitations causing possible water shortages in the field.

### *Efficiency on unit level*

The supply in the growing season during August was fairly constant and for more than 21 days discharges in the offtake P51L were higher than 80 l/s (2.8 cusecs), with maximum values of 90-100 l/s (3.5 cusecs). For the total planted area of 23.7 ha served by this offtake, it meant a supply level of 3.4 l/s/ha. With an estimated crop water use of 5 mm/day or 0.6 l/s/ha, the efficiency was only 14-17%, depending on the significance of the rainfall.

### *Efficiency of a secondary canal (S2L)*

Without rainfall, the discharge in the secondary offtake was fairly constant and was estimated at 800-900 l/s (28-32 cusecs) for a total area of 290 ha. With a crop water use of 0.6 l/s/ha and actual supply of 2.8-3.1 l/s/ha, the efficiency was 19-21%.

### *Efficiency of a main canal (Limbat Canal)*

From daily records spread over several years, the supply during the growing season in periods without rainfall was always more than 4.0 $m^3/s$ (140 cusecs) when pumping for the scheme was not limited. For a total planted area of 2000 ha, this meant an overall efficiency of not more than 30%.

In the off-season of 1982, the total quantity supplied to the Limbat canal has been evaluated on a monthly basis. Evapo(transpi)ration data are based on average values, derived from pan-evaporation data. An additional quantity of 300 mm has been assumed for presaturation, of which 150 mm is for establishing the water layer in the field and 150 mm is for soil saturation.

*Table 31. Supply, rainfall and evapo(transpi)ration for Limbat canal area (Ketereh) during the off-season of 1982*

| Month | supply | | Rainfall | Total | evapo (transpi)ration |
|---|---|---|---|---|---|
| | $m^3.10^6$ | mm | mm | mm | mm |
| April | 1.138 | 58 | 42 | 100 | - |
| May | 8.881 | 449 | 120 | 569 | 148 |
| June | 10.104 | 511 | 171 | 682 | 137 |
| July | 6.508 | 329 | 349 | 678 | 144 |
| August | 10.594 | 536 | 225 | 761 | 141 |
| September | 3.560 | 180 | 212 | 392 | 130 |
| Total | 40.785 | 2.063 | 1.119 | 3.182 | 700 + 300 presat. =1000 mm |

From Table 31 can be concluded that for the whole period, the efficiency was about 40%, the exact value depending on the effective use of rainfall, which falls between 31 and 48%. Although water requirements are lower during the growing season than in the presaturation period, the supply was not reduced. In August, even the highest supply was carried out consequently giving the lowest irrigation efficiency. With an effective rainfall of 0 or 100%, the efficiency was 26 or 18%. It should be noted that water which is drained from a part of the service area of the Limbat canal, was re-used for irrigation and therefore cannot be considered as lost to the scheme.

The estimated actual efficiencies of 20-30% during the growing season contrasted sharply with the designed efficiencies for the scheme. Distributional losses on unit level which are normally the highest in continuous basin irrigation were not taken into account, as the requirements in the irrigation units were estimated on 0.8 l/s/ha (7 mm/day) during the growing period. Only conveyance losses in the major canal system of 12% have been used in calculating the design discharges.

In an evaluation report on irrigation efficiencies (Bos and Nugteren, 1974), the average project efficiency for 11 schemes with continuous basin irrigation for paddy was estimated at 27%, with an efficiency at unit level of 29%. This shows that our estimates for a part of the Kemubu scheme were not exceptionally low or unique with the exception of the very low water use efficiency at unit level.

# Appendix 4. SOILS

In the paddy fields of the research area a limited soil survey was carried out to assess the major physical and chemical characteristics of the soils, with particular emphasis on soil limitations for the paddy production.

The soils developed from recent riverine alluvium on the upper and free-draining terraces of the Kelantan plain. In examining the soil profiles, distinct differences were found in present soil morphology as a result of different soil moisture regimes under the irrigated conditions for double-cropping. In the fields which are almost continuously waterlogged due to over-irrigation and insufficient drainage, the soil is characterized by a strongly reduced superficial horizon to a depth of 50 cm, indicated by a uniform light grey colour. Downwards, the colour of this horizon gradually changes to light brown with dark brown concretions. On the higher elevations, the fields dry up regularly, have a good internal drainage and an irregular supply of irrigation water. The soil has a uniform yellow brownish unsaturated horizon below the plow layer up to a depth of 80 cm and contains only sporadically some light grey spots. The other soils show a morphology varying between these extremes, clearly influenced by the local irrigation and drainage conditions and to a lesser extent by their elevation.

For laboratory analysis, a total of 10 air-dried samples of the surface plow layer was prepared; each one consisted of 20-30 sub-samples, collected in the fields of a part of the area with specific topographical and/or hydrological conditions. The sampling was carried out at the end of December 1982 when the saturated topsoil (10-30 cm) was thoroughly mixed by the mechanical land preparation before transplanting and when fertilizing had not yet taken place. The results of the soil analysis for the 10 samples can be found in Table 32. A summary of the main soil properties affecting the suitability of the soils for paddy cultivation, follows below.

## Soil properties

### *Texture*

All samples have a clayey topsoil with a clay content of 36-48%, which is considered as an optimum content for paddy production (Moormann and van Breemen, 1978). The sand fraction (0.05-2.0 mm) is not uniform and varies between 2 and 30%. The hypothesis that the high percolation found on the higher grounds (sample 2 and 6) coincides with lighter, sandier soils was not confirmed by the textural analysis.

### *Mineralogy*

According to Soo (1975) and Kawaguchi (1969) the soils on the Kelantan plain have a clay fraction dominated by kaolinite (80-90%). In general, kaolinitic soils are considered as having a lower inherent production capacity than soils with a 2:1 type of clay because of its lower nutrient absorption capacity, lower water-holding capacity and less favourable conditions for preparing the puddled mud layer.

### *Acidity*

As can be seen from the pH value, which is rather low for all samples, the soils have an average acidity degree of 5.3 (determined in water suspension of air-dried soils). As pH normally rises under submerged conditions, no adverse effects for paddy growth are expected.

*Table 32. Results of the soil analysis of 10 air-dried soil samples*

| soil sample nr. | pH ($H_2O$) | total $P_2O_5$ | avail. $P_2O_5$ | total N | CEC ($NH_4$+) | exchangeable cations | | | | texture in % of oven-dried samples (1) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | $Ca^{2+}$ | $Mg^{2+}$ | $K^+$ | sum | sand | silt | clay | total |
| | | mg/ 100g | mg/ 100g | % | mg/ 100g | meq/ 100g | meq/ 100g | meq/ 100g | meq/ 100g | 50 | 2-50 | 2 | |
| 1 | 5.2 | 97 | 1.1 | 0.13 | 5.7 | 1.50 | 0.44 | 0.25 | 2.19 | 19 | 34 | 43 | 96 |
| 2 | 5.3 | 93 | 1.4 | 0.13 | 5.4 | 1.45 | 0.45 | 0.16 | 2.06 | 19 | 36 | 43 | 98 |
| 3 | 5.1 | 102 | 1.3 | 0.15 | 5.7 | 0.88 | 0.35 | 0.14 | 1.37 | 22 | 33 | 42 | 97 |
| 4 | 5.1 | 62 | 0.5 | 0.14 | 4.8 | 0.46 | 0.28 | 0.10 | 0.84 | 16 | 43 | 40 | 99 |
| 5 | 5.4 | 75 | 1.3 | 0.13 | 4.1 | 1.06 | 0.30 | 0.12 | 1.48 | 30 | 31 | 36 | 97 |
| 6 | 5.3 | 104 | 1.4 | 0.13 | 5.9 | 1.39 | 0.50 | 0.27 | 2.16 | 9 | 48 | 39 | 96 |
| 7 | 5.2 | 102 | 1.2 | 0.14 | 5.9 | 1.52 | 0.38 | 0.20 | 2.10 | 4 | 42 | 44 | 90 |
| 8 | 5.3 | 98 | 1.1 | 0.15 | 6.4 | 1.61 | 0.40 | 0.15 | 2.16 | 5 | 50 | 43 | 98 |
| 9 | 5.3 | 92 | 1.1 | 0.14 | 5.5 | 1.32 | 0.31 | 0.20 | 1.83 | 14 | 41 | 40 | 95 |
| 10 | 5.4 | 101 | 1.1 | 0.16 | 6.4 | 1.78 | 0.44 | 0.17 | 2.39 | 2 | 44 | 48 | 94 |
| average | 5.3 | 93 | 1.1 | 0.14 | 5.6 | 1.30 | 0.39 | 0.18 | 1.87 | 14 | 40 | 42 | |
| minimum | 5.1 | 62 | 0.5 | 0.13 | 4.1 | 0.88 | 0.28 | 0.10 | 0.84 | | | | |
| maximum | 5.4 | 104 | 1.4 | 0.16 | 6.4 | 1.78 | 0.50 | 0.25 | 2.39 | | | | |

*Notes:*

*(1) Average moisture content in air-dried samples is 5%*

*(2) Soil textural classes (USDA 1975): clay, silty clay (8 samples) and silty clay loam, clay loam (2 samples)*

*(3) Average base saturation of Ca, Mg and K is 33%*

*(4) Organic matter content is 2-2.5%; estimated from total N with C/N = 8-10 and carbon content in organic matter is 58%*

*Cation exchange capacity*

The CEC (determined with ammonium acetate, pH=7) of all samples is low, averaging 5.6 meq/100 g, what is an unfavourable characteristic of soils with a high content of kaolinic clay minerals. In the CEC test there is also included the retention of cations by the soil's organic matter. However, the low CEC indicates that the contribution of organic matter is probably negligible as a CEC of 5.6 can be deduced from the kaolinic fraction (40%) only. This low CEC value is a soil constraint on maintaining adequate fertility, since retention and therefore supply of nutrient cations such as K, Ca and Mg is very limited.

*Exchangeable cations*

The total amount of the exchangeable cations, Ca, Mg and K is low, averaging 1.87 meq/100 g, and very low (0.84) in the waterlogged fields. The exchange complex is only for 33% saturated with these basic cations. The reserve in the soils of these nutrient bases, essential for the plant, is therefore low, but at present low critical values that can limit the paddy production have not yet been reached.

Most of the samples have an exchangeable *potassium* content which is lower than the adequate level of 0.2 meq/100 g and these soils can be considered as deficient in potassium. The value of 0.1 meq/100 g K, which can be compared with about 50-90 kg K per ha, (10-20 cm soil depth), found in sample 4, is critical and without adequate fertilization, the paddy production will be affected by a lack of this nutrient. According to Kawaguchi and Kyuma (1969) the soils are deficient in both of the other elements *calcium* and *magnesium*, who took 2 for Ca and 1 meq/100 g for Mg as critical low levels, but the contents are not so low that danger for the plant growth will be expected.

*Phosphorus*

The ready available phosphorus is very low, averaging 1.1 mg/100 g $P_5O_5$ (determined by Olsen's method), while the total content in the soil is 93 mg/100 g. The soils have therefore a high phosphorus fixation capacity which is considered as a limiting soil characteristic. The low availability of soil phosphorus makes the application of fertilizer indispensable.

*Organic matter content*

The plow layer has an estimated content of organic matter of 2-2.5%, which percentage was derived from the total content of nitrogen. Most of the organic matter consists probably of non-decomposed plant material and therefore its role in retaining cations as well as in supplying organic nitrogen is limited.

## Conclusions

The soil analysis did not show great differences in soil characteristics between the selected parts of the research area. All samples indicated a low fertility status of the soil, which was very low in a poorly drained part (sample 4). Although the soils have certain limitations which make them less suitable for intensive paddy production, these constraints are not all stable as a low nutrient status can be changed by the use of fertilizers and permanent waterlogging can be solved by improved water management. The low capacity to retain cations (CEC), however, remains a limiting factor on maintaining adequate soil fertility. Improvement can be obtained from raising the humus content and pH of the soil.

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