UNIVERSITI PUTRA MALAYSIA

PADDY DOUBLE CROPPING IN KETARA IRRIGATION SCHEME: AN ANALYSIS OF CROPPING SCHEDULE

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PADDY DOUBLE CROPPING IN KETARA IRRIGATION SCHEME: AN ANALYSIS OF CROPPING SCHEDULE

BY

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Specially dedicated to

Tan Hui Yong

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Faculty : Engineering

Water availability is the main criterion considered in the fixation of a planting schedule. As water plays a central role in crop establishment, and that water availability is dependent on rainfall pattern and irrigation system characteristics, the recommendation of a cropping schedule largely revolves around long term rainfall pattern.

In the KETARA Irrigation Scheme, the irrigation water supply is tapped directly from the Sungai Besut river system at Besut Barrage. The town water supply is also dependent on the same water source, which lends competition to the irrigation authority in the use of water.

The KETARA authority has experienced irrigation water shortages in the scheme. To fix a cropping schedule to capitalize on direct rainfall within the irrigation command area will help to relieve the water deficient situation.

In the process of recommending the best cropping schedule based on long term rainfall pattern, analysis is also carried out to ascertain the status of irrigation performance in the KETARA Irrigation Scheme.

It is found that the overall irrigation efficiency of the KETARA Irrigation Scheme during the main season 1995/96 and off-season 1996 was 38.1%. Available stream flow in the Sungai Besut River System was not to be able to meet the peak water supply requirement of the scheme during the pre-saturation period during the off-season 1996. Contribution of direct rainfall towards total seasonal irrigation supply was in the region of 27% to 33%.

As for cropping schedule, starting of a planting season near the North East monsoon has been proven to be undesirable. Taking the long term rainfall pattern as the criteria, the most suitable cropping schedule is that the main-season crop shall be between week number 36 to week number 6 of the following year. The off-season crop shall be between week number 10 to week number 32 of the same year.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia untuk memenuhi syarat untuk mendapatkan Ijazah Sarjana Sains.

PADDY DOUBLE CROPPING IN KETARA IRRIGATION SCHEME: AN ANALYSIS OF CROPPING SCHEDULE

Oleh

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Dalam menentukan satu jadual tanaman padi, sumber air pengairan merupakan satu faktor yang amat mustahak. Tanpa air penanaman padi tidak mungkin dilaksanakan. Maka dalam menentukan satu jadual tanaman, taburan hujan jangka panjang merupakan satu faktor yang sangat mustahak.

Di Skim Pengairan KETARA, air pengairan diperolehi daripada sistem Sungai Besut. Air dari sungai ini juga dibekalan untuk kegunaan domestik oleh pihak berkenaan.

Pihak KETARA pernah menhadapi kekurangan air pengairan di Skim Pengairan KETARA. Hujan yang turun keatas bendang boleh menjimatkan air pengairan. Usaha untuk menetapkan satu jadual tanaman supaya dapat mengunakan air hujan yang tutun terus kebendang akan mengurangkan masalah kekurangan air pengairan. Di sini analisa juga dibuat keatas kecekapan pengairan di Skim Pengairan KETARA untuk memahami status Skim Pengairan ini.

Adalah didapati bahawa kecekapan pengairan keseluruhan pada dua musim utama 1995/96 dan luar musim 1996 adalah 38.1%. Kajian ini juga mendapati jumlah aliran air dalam Sungai Besut tidak mencukupi untuk memenuhi keperluan pratepuan pada luar musim 1996. Dari segi air hujan yang turun terus keatas bendang, sumbangannya kepada jumlah besar air pengairan yang dibekalkan dalam satu musim hanya 27% ke 33%.

Untuk jadual tanaman pula, didapati bahawa memulakan penanaman dalam musim tengkujuh adalah tidak wajar. Dengan mengambil kira taburan hujan hitung panjang, maka jadual penanamaan yang paling sesuai ialah dari minggu ke 36 hingga ke 6 pada tahun berikutan bagi musim utama; dan dari minggu ke 10 hingga minggu ke 32 bagi luar musim.

CHAPTER I

INTRODUCTION

General

Rice cultivation has traditionally been given much attention by the Government. To date, the Government has provided irrigation facilities to a total of 340,500 ha of paddy land, mainly for the purpose of cultivating rice crops two times a year, or commonly known as double cropping.

The Government policies that affect rice production industry are the Second Outline Perspective Plan 1991 - 2000 (OPP2); and the National Agriculture Policy 1992 - 2010 (NAP). The OPP2 has stated, among other pertinent issues, that the agriculture sector will have to compete for various resources with other higher growth sectors like manufacturing and services industries. "Resources" here includes water, a very important ingredient in rice cultivation.

The NAP has targeted rice production in the country to achieve a self-sufficiency level of 65 %. It further states that this level of production shall be met from the 8 Granary Areas with a combined paddy area of 210,500 ha, and the 74 Mini Granary Areas totaling 28,500 ha of paddy land. Granary areas refer to major rice growing areas in the country. The 8 granary areas are Muda Agricultural Development Authority (MADA) in Kedah, Kelantan Agricultural Development Authority (KADA) in Kelantan, Integrated Agricultural Development Project (IADP) Kerian/Sungai Manik in Perak, IADP Barat Laut Selangor in Selangor, IADP Pulau Pinang in Penang, Seberang Perak in Perak, IADP Kemasin-Semerak in Kelantan, and Project Pembangunan Pertanian Trengganu Utara (KETARA) in Terengganu. Among them, MADA has the largest area of 97,000 ha and KETARA has the smallest area of 5,100 ha.

Irrigation for Rice Cultivation

Rice cultivation in Malaysia is concentrated in the Granary Areas as described above. Irrigation facilities, including water resources, water distribution systems, a series of regulating and control structures, and a network of farm roads have been provided to enable double cropping of rice. The two crops are referred to as main-season crop, which is planted during the wet season of the year; and off-season crop, which is planted in the drier part of the year.

In rice cultivation practices, water is supplied to the fields in two stages. The first stage is termed pre-saturation supply where water is supplied at a relatively high rate and short duration, followed by the second stage termed as the supplementary supply for the rest of the season. The rate of supplementary supply is usually half that of pre-saturation supply. In terms of duration, pre-saturation supply usually takes about 2 to 4 weeks, and the supplementary supply shall last the entire growth duration of the crop. For the present short-term variety suitable for double cropping, the growth period is between 126 to 145 days (Tan Jin Tun, 1987).

Generally, water supplied during pre-saturation period is not consumed by the paddy plants. This pre-saturation supply is meant for land preparation prior to planting activity (Thavaraj, 1975).

Once the crop is in place, supplementary supply is applied to the paddy fields to meet the water demand by the plants and other losses in the fields. Irrigation water is continuously supplied for about four months until 20 days before the expected harvesting date. Rainfall during period is taken into account in determining the quantum of irrigation supply required (Yashima, 1987).

Irrigated agriculture sector is currently the largest consumer of water, amounting to about 75% of total fresh water withdrawal in the country. Compounded to this magnitude of water consumption, the overall irrigation efficiencies in Malaysia is at best around 35% to 40% (Sharizaila, 1991). Although this figure is not very encouraging, it is comparable to that in the region. Studies have shown that irrigation efficiencies in the South and Southeast Asia is in the region of 30% to 40% (Sharizaila, 1991).

Statement of the Problems

The primary role of irrigation in agriculture is to avoid crop failure and/or yield reduction due to water stress. Subsequently the benefits of other agronomic inputs could be maximized with the incorporation of proper water management.

A prerequisite to be able to supply irrigation water is the development of irrigation infrastructure. They may include development of water resources and water delivery and control systems. After the often high investment cost in providing such infrastructure, it calls for the management and utilization of the entire infra-structural facilities to its most cost-effective and efficient manner possible. The management aspect is further stretched under the present scenario where further investment in developing additional water resources is hard to come by. A strong indication to this effect is that the Paya Peda dam, which was to supply water to meet all needs in Setiu and Besut districts, within the Projek Pembangunan Pertanian Terengganu Utara (KETARA), was not approved by the Government for construction under the Seventh Malaysian Plan.

On the other hand, water demand from the domestic and industrial sectors is continuously mounting. Emphasis on manufacturing and services industries is expected to continue as the country strides towards Vision 2020. The rapid growth in the industrial sector means rapid increase in water demand by this sector. The competing use of water from other sectors will certainly exert much pressure on the agricultural sector to be more efficient in utilization of water resources (NAP, 1992). In the KETARA area, the town water supply authority has been extracting water from the Sungai Besut system at the Besut Barrage pool.

At the same time, the KETARA authority has experienced some sort of water related problem. It has been reported that out of the total 5169 ha of paddy land in KETARA scheme, only 58.1% of it enjoys adequate irrigation supply. A further 19.7% of the area is categorized as having fair irrigation supply, and the remaining 22.2% faces water shortages (Mohd Yusof, 1996). As the KETARA system has no water storage facility, management intervention to solve the water supply problem is inevitable. In this context, to capitalise on direct rainfall within the irrigation command area represents a very tangible option in relieving water stress situation. It also optimises the use of natural resources, i.e. water, and at the same time does not induce additional interference on the environment.

This research discusses the options available in the fixation of planting schedule in the KETARA irrigation scheme in particular reference to rainfall.

As cropping schedule cannot be determined by water availability alone, there exists possibilities that the recommended irrigation schedule might not be adhered to. In which case, the proposed cropping schedule shall be made flexible to allow the scheme operators to vary the schedule to suit the next best possibility based on rainfall prediction alone.

Research Objectives

The objectives of this research are:

1. To develop an irrigation schedule (thus cropping schedule) to suit the long term rainfall pattern in the area so as to minimize the input of water supply from the Sungai Besut river system.

2. To develop an alternative cropping schedule in the event that the above recommended schedule cannot be adhered to.

The probable problems associated with the cropping schedules above will be presented along with other schedules that may be considered. This presentation will assist the personnel involved in practicing the recommended schedule.

Research Approach

Three important factors to be considered in fixation of planting schedules are:

1. Pre-saturation of land to coincide with raining season,
2. Avoid flowering of rice plants in the wet,
3. Target harvesting of the crop in the dry season, and
4. Avoid planting in the months of November and December.

Based on the above consideration, the Designer's Operation and Maintenance Manual (DID, 1994) has suggested a planting schedule as follows:

1. **Off-season:** Pre-saturation supply to begin on 1st of March to 14th of March, and supplementary supply shall commence on 15th of March to about 31st of July, the same year, for Phase 1 Irrigation Block. Phase 2 Irrigation Block is scheduled to start 2 weeks later than Phase 1.

2. **Main season:** Pre-saturation supply to begin on the 1st of September for two weeks, and supplementary supply takes over from 15th of September to 31st January the following year for Phase 1 Irrigation Block, and Phase 2 Irrigation Block is staggered two weeks later

A mean monthly rainfall table is also presented in the said Manual. In this research, to develop a planting schedule for the project area, the following approach will be adopted:

1. A study on the written literature on the related issues.
2. Interviewing field experts on the water demand and supply situations.
3. Analyse the long- term rainfall patterns within the command areas.
4. Analyse various planting schedules and compare with practices to ascertain their practicability.

Expected Outcome

From this research, a new irrigation schedule to capitalise on the direct rainfall within the command areas will be formulated. The irrigation schedule will serve as a useful guide in the seasonal planning to be undertaken by the field operators.

CHAPTER II

LITERATURE REVIEW

Irrigation Development in Malaysia

Rice is the staple food of Malaysians. Besides the main meals of the day, there are many other types of food consumed by Malaysians which are rice based. Fittingly, rice cultivation began with early settlement in Malaysia.

Hill (1977) reported that way back in 1303, there was evidence of rice cultivation in the state of Terengganu. Rice cultivation could have started much earlier, especially in Kedah.

The Muda region in Kedah is traditionally the rice bowl of Malaysia. Reclamation of the swampy land was carried out way back in 1664, where a channel was dug in the Mukim of Anak Bukit (Afifudin Omar, 1978). More channels were constructed in the years that followed. The famous Wan Mat Saman canal, connecting Alor Setar to Guar Chempedak in the south for a stretch of 20 miles, was built in 1885. It opened up vast areas of land for cultivation of rice (Hill, 1977). It also acted as a catalyst of growth in rice cultivation in the region

The rice industry was given special attention after the severe rice shortage experienced by the country between 1918 and 1920. Recognizing the danger of being over dependent on other countries for basic food requirement, the Colonial Government set up the Drainage and Irrigation Department (DID) in 1932. The primary function of the DID was to design and construct physical infra-structural facilities to provide water for cultivation of rice (Pang Leong Hoon, 1979).

Irrigation in Malaysia centers around the provision of water supplemental to that of rain for rice cultivation. Until 1969, the irrigation schemes constructed by DID were mainly to ensure adequate supply of water to safeguard against variability of rainfall. The schemes were only designed to cater for the supply of irrigation water for cultivation of rice one crop per year in the wet season (Pang Leong Hoon, 1979), a relatively simple job to accomplish compared with the demand and complexity of present days.

Double cropping of rice in Malaysia started only in 1942 with the introduction of Japonica paddy varieties. However, it was not until the 1960's that the idea of double cropping became popular (Tan Jin Tun, 1987)

Since then, the double cropping of rice has been the key factor in the development of irrigation infrastructure and facilities. Investment in irrigation can be approved only when the adequate water resources is available for double cropping of rice. Further changes in the rice industry environment has led the National Agriculture Policy to place much emphasis on the 8 Granary Acres in achieving the desired rice production targets.

Irrigation Water Demand

Rainfall plays a very important role in agricultural production. Crop water requirement is met entirely from rain in the early days when irrigation was not available. With the introduction of irrigation facilities, farmers are able to plant rice at a time when raising of a crop was relatively uncertain previously due to inadequate or unpredictable and unreliable rainfall.

However, with the presence of irrigation facilities, rainfall still plays a major role in the cultivation of rice crop as far as meeting crop water requirement is concerned. The need to irrigate arises out of natural weather and other conditions which are not ideal for the growing of crops. Irrigation in Malaysia has been devoted mainly to the provision of supplemental water for cultivation of wet paddy. The facilities provided are intended to supplement rainfall to the extent of providing a reliable irrigation water supply throughout the growing season (Pang Leong Hoon, 1979).

Irrigation is not new in Malaysia. Prior to the 1880's, some Kelantanese had already practised irrigation for their rice crops (Hill, 1977). The irrigation methods were rudimentary and not as sophisticated as it is now. It invariably served its purpose at that time.

Irrigation is primarily required to avoid undesirable water stress in rice plants. Reyes (1975) carried out some experiments and showed that yields are extremely sensitive to low levels of water input. De Datta, Abillay and Kalwar (1972) reported that yields are reduced when crops are faced with water stress, the degree of yield reduction depends on the extent of moisture stress experienced by the plants.

To avoid undesirable moisture stress, adequate irrigation water has to be supplied to the right place at the right time.

Evapotranspiration is the single most important factor in estimating water demand from the rice fields during the entire duration of plant growth. Generally, evapotranspiration is higher during the off-season crop compared to the main-season crop, because of prevailing weather conditions. Sugimoto (1970) found the value of evapotranspiration to be 6.4 mm/day and 4.9 mm/day for off-season and main-season crops respectively (reported by Murakami, 1975).

Another important consideration in irrigation supply is to replenish the water lost through percolation and seepage. Both percolation and seepage losses are due to movement of water through soil media. Soil permeability and hydraulic gradient caused by the height of groundwater and drainage water levels affect the rate of water loss.