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DIRECT SEEDED RICE IN MALAYSIA

A SUCCESS STORY

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FOREWORD

The APAARI has been trying to publicise various success stories experienced by its member countries in various fields of agriculture. So far about a dozen such stories have been published and circulated. Successful transformation of cultivating irrigated paddy by direct seeding in Peninsular Malaysia is yet another national achievement that the APAARI considered worth sharing among the members of the Association and other interested rice growers. This success story relates to transformation of paddy cultivation through direct-seeding in Malaysia. The Government of Malaysia has, under the new agriculture policy, decided to have self-sufficiency for rice production to the level of 65% and hence direct-seeding technology for rice production is of considerable importance. This practice is also relevant to all those countries who are facing acute shortage of labour for agricultural operations.

Traditionally, direct seeding in paddy is restricted to the cultivation of only the upland/rainfed types. A regular irrigated/wetland crop has, however, been invariably transplanted in standing water with seedlings raised in a separate nursery. Those familiar with the growth cycle of the wetland paddy crop would hardly appreciate the idea of direct seeding. Yet, a sizeable proportion of the region in the Peninsular Malaysia has already been covered under direct seeding of paddy. All this could be possible through innovative research and development efforts.

Rice is grown in 85% of the area under crop production and hence it is one of the most important staple crops in this region. Improvement in its productivity is of concern to most of the countries and new approaches such as hybrid rice technology have been followed so as to improve productivity under particular cropping situations in future. Accordingly, this success story, like the other one earlier published on hybrid rice in China, would be of considerable interest to other similarly placed countries in the Asia-Pacific region.

This publication is twelfth in the series of Success Stories being published by APAARI and it is our firm hope that readers will find it of considerable interest.

NEW DELHI
25 May, 1998

(R.S. PARODA)
Executive Secretary
APAARI

INTRODUCTION

Cultivation ofrice, once a traditional occupation for subsistence, is constantly being transformed for commercial purposes, including export oriented enterprise for rice and rice-based products. Rice production in Malaysia has witnessed several cultural changes. Initially from a rainfed single crop, it is now being cultivated under multiple cropping; the labour intensive

A vast area is covered under direct seeded irrigated rice in the Malaysian Peninsula cultivation has quite significantly changed under fully mechanized operations. The method of planting has also been affected. A practice of direct seeding has evolved rapidly and has become widespread, which could have far reaching consequences. Direct seeding, on the whole, is considered to have helped in sustained rice production which is so important for the food self-sufficiency.

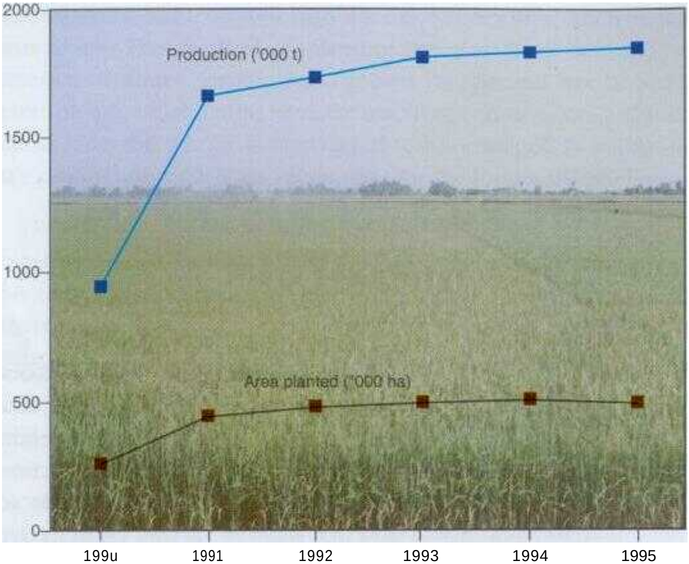
Whereas some constraints in the adoption of such a transformed cultivation practice are being resolved in some parts, this new tradition breaking alternative has been observed to be a sure success, at large, and is worth following suit under similar situations in other developing countries too.

THE RICE INDUSTRY IN MALAYSIA

Rice is cultivated throughout Malaysia and covers about 600,000 ha of area under cultivation. Two-third of this area is located in Peninsular Malaysia, half of which falls under eight major irrigation schemes. Bulk of the country's annual production of nearly two million tonnes of paddy is realized from this so called granary area. About 400 rice mills of varying capacity are located in and around the granaries as well as the other rice areas. About 10 per cent of the rice mills are in public sector, which periodically import rice in order to meet the national requirement.

The average farm holdings are small, seldom larger than 1.5 ha. Further, the holdings are fragmented, land parcels being quite irregular and miniature in size. The rice cultivation has remained restricted to small fields. Free fertilizer and price support for produce is accorded to farmers who cultivate less than 2.5 ha of land. In order to avail it, the majority of farmers have consciously contributed their *pro rata* quota of rice production.

On the other hand, efforts to extend rice farming on a larger scale through enlarged farm size are also in progress. This is being achieved through group farming, and locational land consolidation. Rice production is being corporatized into full fledged commercial venture wherever feasible although these large farms would not get the incentives targeted for small scale



Bulk of the Malaysia's annual production of paddy is realized from Peninsular granary area

farming. In order to fully exploit the rice economy to a rewarding scale and to commercialize its production efficiently, several thousand hectares are now being farmed extensively, solely by private individuals or in partnership with some state authorities or a corporatized government company, the Padiberas Nasional Berhad (BERNAS).

A CULTURAL CHANGE IN SOUTHEAST ASIA

The proportion of direct seeded land under rice cultivation is believed to be highest in Peninsular Malaysia amongst all the Asian countries. Thailand and Vietnam are fast adopting this cultural change whereas Indonesia and the Philippines are also following suit. Elsewhere in Asia, attempts to perpetuate direct seeding are witnessed in South Korea where industrialization and urbanization have affected much reduction in labour force engaged in agricultural activities. Direct seeding in other parts of southeast Asia is thus being practiced to a considerable degree although its proportion to the corresponding total rice area under cultivation is lesser as compared with the Peninsular Malaysia.

There have been several variations in the methods of planting rice. It ranged from seed dibbling, mostly in upland conditions, **to** the conventional transplanting in the low land/wet rice cultivation (WRC) or double nursery planting, wherein seeds were transferred from one nursery to another before being planted out in the main field.

Until the early eighties, some fifteen years ago, manual transplanting used to be a common way of establishing the crop in the wetland. Since then, however, direct seeding has been seasonally practiced over the years both in the main season (MS) and the off season (OS) *(Fig. 1)*. The system

An innovative mechanical broadcast of ***seeds*** *on to puddled,* ***drained*** *soil by using knapsack mounted motorized blower*

of establishing crop of paddy has almost completely changed during the decade, from 1982 to 1992 *(Fig. 2);* direct seeding has become almost an accepted way despite the assumption by certain quarters that mechanized transplanting may eventually be preferred in order to overcome the rising labour shortage. It has already been clearly observed that the agriculturally advanced and industrialized countries, like Japan, Korea and Taiwan, remained quite efficient in rice production by resorting to mechanized transplanting. Nevertheless, mechanization has been adopted to quite an extent in case of direct seeding also. The seeds could be dispersed or drilled mechanically instead of broadcasting manually. Other cropping activities, like the land preparation, application of various inputs and harvesting

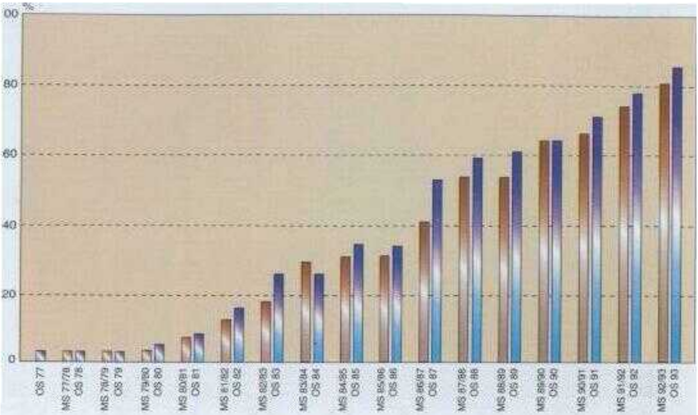


Fig. 1: Direct seeding coverage (%) in main and off seasons over years

Source: Raunkee, S.A., (1993)

Mechanisation has been adopted to quite an extent ***in*** *case of direct seeded paddy in Malaysia*

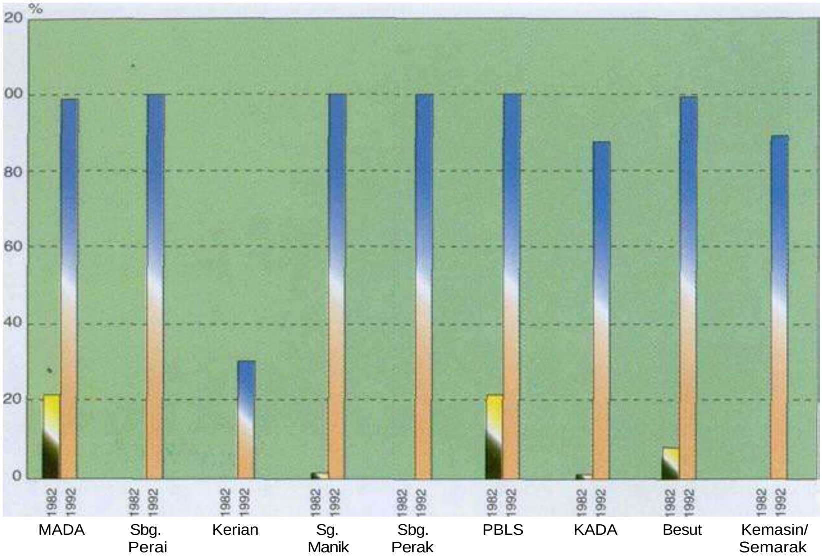


Fig. 2: Direct seeding coverage (%) 1982-1992 in major irrigation schemes

Source: Raunkee, S.A., (1993)

are also mechanized. Thus, each successive production stage is synchronized and somewhat mechanized; the level of mechanization may, however, differ from each other at different stages.

FACTORS UNDERLYING THE TRANSFORMATION

Saving of labour and other resources were among the factors that prompted the adoption of direct seeding of paddy besides, the harvesting of produce using combine harvesters that facilitated its proper management. Had it to be harvested manually, the direct seeding could not have been accepted so easily. Rather, it would have been extremely tedious to gather and sickle a haphazard crop stand, which emerged due to direct seeding by broadcast.

The innovative package of puddling, once or twice after the flooding of soil, used to be the common land preparation practice. Earlier, draught animals were used for puddling, which were replaced by pedestrian power tillers and four-wheel driven tractors. The field would be ready for transplanting after this operation. Seedlings were raised in a separate nursery. Their pulling and transfer to the field had always been a tedious operation prior to yet another back breaking task of transplanting the seedlings manually.

The puddling of flooded soil has to be thorough even for the seeding operations. Levelling of soil surface is an important pro-requisite but this could not be achieved easily under flooded conditions due to the possibilities of machineries being bogged down. Therefore, soil levelling is best done in the dry off-season when earthing work (moving of soil) is practicable. This also

Use of a pedestrian tractor for in-field soil surface smoothening

***Land** preparation, inciting rotovation and soil levelling* facilitates an efficient water management during the crop establishment and subsequent crop growth.

Dry seeding may be practiced selectively in the off season. Seeds are broadcasted and incorporated to a very shallow depth during the final pass of soil rotovation, followed by light compaction of the soil surface with a roller attached to the tractor. This lightly compacted dry soil surface helps conserve moisture from light rain or initial irrigation to trigger the seed germination. Nevertheless, crop establishment would be prompt when seeded wet. The latter could be done on drained or shallow flooded, puddled soil. When seeding is done in standing water, the drainage has to initiated within a day or two to ensure proper seedling growth and thereby good crop stand. Irrigation has to be given in the off season whereas in the main wet season drainage has to be ensured at times whenever there is heavy downpour. The tolerance to continuous submergence is limited, being 2-3 days at the most. Therefore, the young growing plants need to be safeguarded from being drowned.

A jield ready to be dry seeded

SOME COMPARISONS AND CONTRAST

The problem of grassy weeds is more associated with direct seeded paddy. In addition to the occurrence of sedges and broad-leaved weeds in the transplanted rice fields, weedy rice, like red rice, has also lately become another threat. Therefore, integrated weed and water management practices, with selective herbicide usage have to be adopted to contain these weeds.

The direct seeded crop needs more fertilizer as compared with the transplanted one. An additional split dose of fertilizer would be useful to cater to the need of a direct seeded crop which shall remain in the main field for a longer duration in contrast with the transplanted crop which grows in a separate nursery during its early, seedling stage.

The inter plant spacing in transplanted rice is very regular, particularly so when mechanically transplanted. Such spacing is not quite as uniform from the broadcasted seeds, emerging into random stands, depending on the amount of seed sown in individual patch. Bacterial diseases have been more frequently observed in direct seeded fields, probably due to denser crop stand and higher fertilizer use. However, the insect pest and rodent damage were not observed to have shown variation from the corresponding situation under transplanting.

RICE PRODUCTION AND THE NATIONAL AGRO-ECONOMY

Rice has remained the third largest crop **in** Malaysia, **next** only to oil palm and rubber. Whereas a significant amount of foreign exchange is earned through the first two ranks, rice is mainly used for domestic consumption. The country is about 70 per cent self-sufficient for this commodity.

Annual production of paddy in Malaysia is observed to be around two million metric tonnes *(Table 1)*. Most of the production is accounted for in the eight major granary areas where direct seeding has been in practice for some time now. Currently, paddy is being direct seeded almost exclusively, except for in some isolated pockets. Grain ripening in a direct seeded crop has been observed to be less uniform as compared with that under transplanting. This might be affecting quality of the grain but quantity-wise, the yield could be just as much, or even more than that under transplanting. Low yield under transplanted conditions could result particularly from a late transfer of nursery. However, extreme variation in paddy yield has been observed under direct seeding, ranging from 2 t/ha to 8 t/ha.

Production costs also range widely from less than RM 1000/ha (RM=Ringgit Malaysia) to more than RM 2000/ha *(Fig. 3,4)*. A normal yield of 4 t/ha at an average production cost of RM 1200/ha would mean that RM 0.30 have been invested to produce 1 kg of paddy. The cost of production may, however,

Table 1: *Area, Production and Yield of rice over years*

Season	Year	Peninsular Malaysia		
		Area planted ('000 ha)	Total production ('0001)	Seasonal yield (t/ha)
MS	90/91	268	936	3.5
OS	91	220	719	3.3
MS	91/92	261	1009	3.9
OS	92	223	715	3.2
MS	92/93	272	1028	3.8
OS	93	228	772	3.4
MS	93/94	271	1001	3.7
OS	94	237	818	3.5
MS	94/95	265	1012	3.8
OS	95	231	826	3.6
Mean MS		267	997	3.7
Mean OS		228	770	3.4
	1991	448	1655	3.4
	1992	484	1724	3.6
	1993	500	1800	3.6
	1994	510	1819	3.6
	1995	496	1838	3.7
Mean (Over 5 years)		495	1767	3.6

Source: Padi Production Survey Reports, Malaysia 1993 & 1995

vary considerably depending upon target yield, costs of input and location. Both fertilizer subsidy and price support are important in determining the total profit. Keeping in view the rental and management cost, the overall cost of production may be high, at RM 2000/ha. Thus at an estimated yield level of 6 t/ha, the gross returns would be around RM 3000/ha. On an average, a net return of RM 1000/ha, or 50 per cent of the investment per season is expected *(Fig.* 5,*6)*. This could be doubled with 200 per cent intensity of cropping. Efforts to enhance productivity of systems under direct seeding need to be accelerated in order to improve the rice economy and also food self sufficiency.

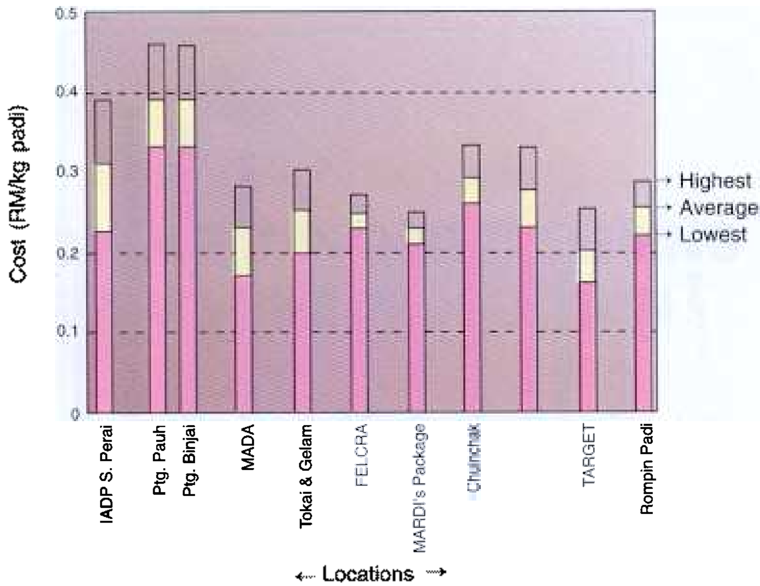


Fig. 3: Production cost (RM/kg padi) at different locations

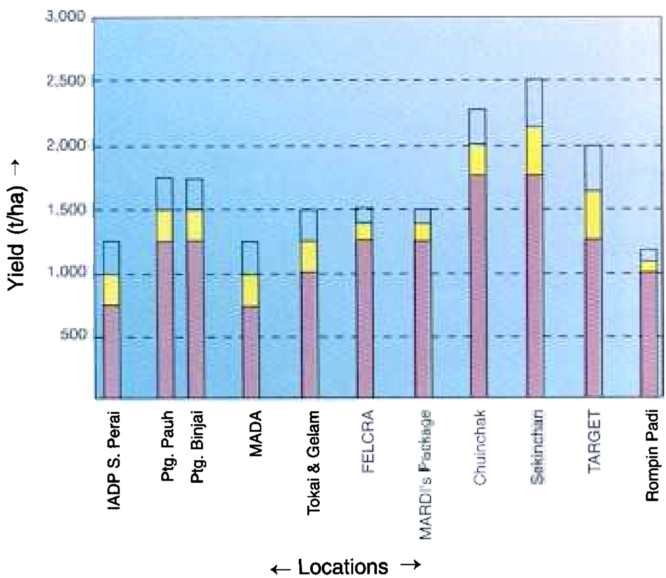


Fig. 4: Production cost of direct seeded rice (RM/ha) at various locations

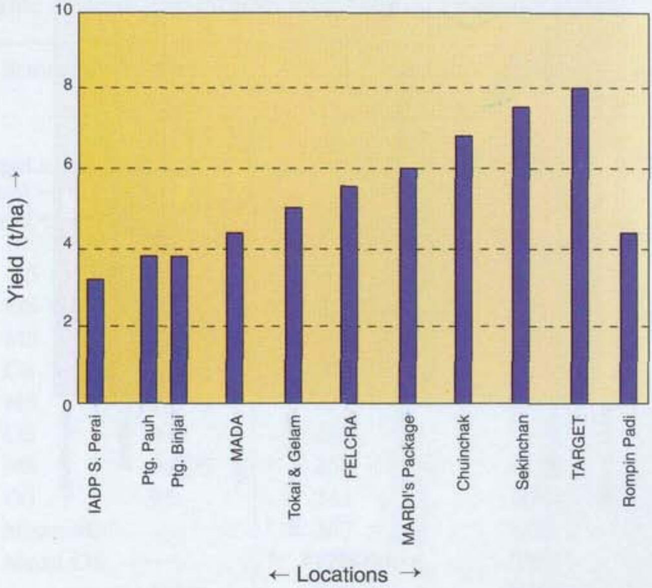


Fig. 5: Yield of direct seeded rice (t/ha) at selected locations

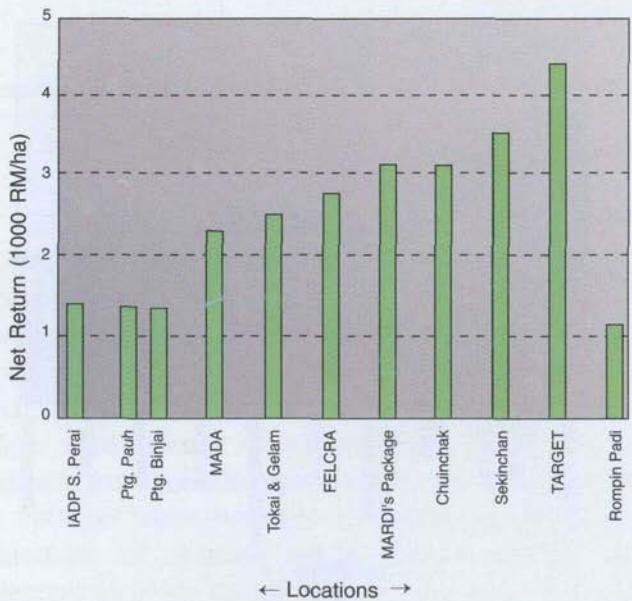


Fig. 6: Net Returns ('000RM/ha) of direct seeded rice

IMPROVEMENT IN DIRECT SEEDING VIS-A-VIS RICE PRODUCTION

The early seventies witnessed beginning of double cropping in Malaysia. This corresponded with operationalizing of the country's largest irrigation scheme, namely, the Muda Agricultural Development Authority (MADA). Seven additional schemes have also been fully operational since then, the latest being Kemasin Semarak. Infrastructural improvements catering to the special need of direct seeding situations are now receiving urgent attention in Malaysia. Increasing the canal density, separately for irrigation and drainage purposes, had received a high priority unlike in earlier planning phase when dual purpose waterways were considered appropriate for water management in a transplanted crop. Similarly plot configuration, field orientation and farm road alignments are receiving particular attention to enable perform mechanized operations in view of farm labour shortage. In-field development and on-farm roads are being expanded to allow accessibility of big farm power machineries. Resultantly, the effective planted area is being further reduced from the already diminishing total rice area. This calls for systematic attention for breeding high yielding varieties suited to direct seeded conditions to enhance overall production.

Transformation of rice cultivation practices in this era, when the rice demand is escalating with the increased population pressure, is sure to raise some relevant queries related to crop responses **to** changed **practices.** Some systematic **data have been** collected and collated to draw suitable comparisons in terms of crop efficiency and productivity under the two systems **of** cultivation *(Table 2).* The farming households accustomed **with** transplanting for ages find it quite simple and easy. There **is no** denial that they may find the direct seeded crop more difficult to manage and encounter management constraints. **Several** systematic **and** mission mode efforts and a careful **factor** analysis **between the two options** *(Table 3)* **are required for a** better

Table 2: *Comparative cost efficiency* ***and*** *crop productivity of direct seeding and transplanting in rice cultivation*

Observation from	Poduction (per ha)	Direct seeding	Transplanting	
			Mechanized	Manual
Experimentation	Total cost	M$l086	M$1328	M$l665
	Crop yield	2.8t	5.4t	4.2t
	Poductioncost (c/Kg. padi)	39c	25c	40c
	Gross income	M$ 1820	M$3510	M$2730
	Net income	M$734	M42182	M41065
	profit (%)	68	164	64
Extrapolation	Total cost	MS 1400	MS 1700	MS2000
	Cropyield	3.5t	4.5t	4.0t
	Production cost *(c/kf..* padi)	40c	38c	50c
	Gross income	M$ 2275	M$2925	M$2600
	Net income	M$875	M$ 1225	M$600
	Less fertilizer subsidy	(200)	(200)	(200)
	Less pricf support	(525)	(675)	(600)
	Real earning	M$ 150	M$ 350	MS 200
	Net profit (%)	63	72	30
	Real profit (%)	11	21	-10

Source: Embi **and Cheong, 1988**

Note: M$ (Malaysian Dollar) referred to as RM (Ringgit Malaysia). Approximately RM 3.30 is equivalent to US $ 1.00

Table 3: ***Salient features with pros and cons between direct seeding and manual or mechanical transplanting***

Features & Requirements	Manual transplanting	Direct seeding	Mechanical transplanting
i) Land preparation	– less precise	– more levelling needed	– Same as for direct seeding
ii) Seeds and seedlings	– 25-40 kg/ha seeds required – old seedlings used – more transplanting shock – outdoor field nursery	– 40-60 kg/ha – uneven seed germination – no nursery growth stage	– 40-50 kg/ha – young seedlings – faster recovery from transplanting shock – nursery anywhere, even indoors
iii) Planting	– 35-40 man days/ha – manual sometimes with 'kuku kambing' – deep into the soil, poor root growth	– less than 2 man days/ha – manual or mechanised – inadequate root anchorage as seeds germinate on/near soil surface	– about 8 man days/ha – pedestrian or riding type machines – adjustable planting depth and seeding usage
iv) Density	– haphazard and sparse planting	– uneven seed distribution with mixture of crowded and sparse patches	– adjustable to as recommended, planting in straight alignment
v) Water management	– less precise	– very precise	– intermediate requirement
vi) Crop care	– normal	– more intensive but crop is less accessible	– same as for manual transplanting
vii) Ripening	– uniform – lodging not severe	– uneven – prone to lodging due to: • shallow rooting • uneven growth	– uniform – same as for manual transplanting
viii) Harvesting	– slower maturation due to shock during transplanting – manual or machine harvest	– no transplanting shock, faster maturation – machine prefered much slower if manual	– same as for manual transplanting – manual or machine harvest
ix) Yields	– average but steady – range from: 2.5–5.5 t/ha	– inconsistent with much fluctuation – 2.0–5.0 t/ha	– above average more likely – 3.5–6.0 t/ha
x) Distinctive features	– labour intensive	– high inputs, more crop care needed	– high initial capital

follow-up of this socio-cultural transformation. The **act of directly** sowing seeds, instead of raising separate **nursery** and then tediously transplanting seedlings, is obviously the **eye** catching advantage that is so convenient and labour saving **too.** More efforts have to be made and inputs **made** available so as to fulfil **the** particular **requirements** related **to** direct seeding **which would** ensure reasonably high yield levels.

As a matter of fact, direct seeding **has** actually been practised **under** upland rice planting for **quite a long** time. Seeds **were** dibbled in the upland cultivation fields just before the onset **of** rainy season. Accordingly, wet seeding, *albeit* through broadcasting, has also become quite acceptable. Further, in a step towards mechanization, improvisation of hand drawn **drills** was done for seeding operations in the wet since the tractor **drawn** seeders **were** suitable to operate only on dry/moist soils. Modified motorized blowers are now commonly used for **seed** broadcasting on an extensive area. Sowing in rows through blowpipes attached to an extended motorized knapsack blower **has,** however, been quite cumbersome and hence not successful. **This** area **of** agricultural engineering needs particular research **input** in **order to** match **with** the required thrust to this cultural **change.**

In less **than two** decades, since **the** late **seventies,** direct seeding has become the main planting method of rice cultivation **in** many parts of Southeast Asia with several teething problems. **All** through the development of the idea *(Table 4),* enormous efforts have been made to ensure success. A systematic outlining of the research agenda has been done along with fixing priorities and approaches **for** management *(Table 5)* as well as determining necessary pre-requisites *(Table 6)* for success of direct seeded crop. On **the** whole, a considerable improvement has been made quite recently in management of direct seeding of irrigated paddy. This is clearly indicated from a **higher** yield **attained under** direct seeded **crop**

Table 4: *Chronological development of direct seeding and related practices in Peninsular Malaysian rice cultivation*

Year	Development
Pre 1970	- Single crop per year, transplanted manually. - Research emphasis on varietal development of transplanted padi.
1971-1975	- MADA and elswhere, double cropping practised regularly. - Besides varietal development, research on cultural practices intensified. - Double cropping with manual transplanting being time and labour intensive. - Research on direct seeding initiated as an alternative to manual transplanting to save time and labour.
1976-1980	- More padi land with improved infrastructures for adequate irrigation began double cropping. - Cropping intensified, hence shortage of labour increasingly felt. - Inadequate time for cropping activities to be completed, hence cropping cycle began to overlap. - Production efficiency began to drop. - Direct seeding adopted. - Facilities, infrastructures and irrigation requirements tailored for direct seeding besides transplanting needs. - Weed research in direct seeding intensified.
1981-1985	- Non-flooded soil preferred for crop establishment in direct seeding as opposed to inundated fields for transplanting. - A change in soil environment encouraged weed proliferation.

Year	Development
	- The capability of existing facilities to meet prompt water demand as was neded for proper cultural techniques to be practised in direct seeding not up to expectation, as everything designed and programmed for transplanting technology. - Technological problems encountered, such as; • technology for direct seeding incomplete • lack of appropriate material inputs • upset in rhythm of cropping and irrigation schedules - Weeds in direct seeding emerged to be a real threat to rice productivity. - Other problems that surfaced were; • sporadic pest and disease outbreak at closer intervals of time. • regular infestation by rats. • frequent water shortage or untimely excessive supply. • increase of idle (neglected or not planted at all) padi land. - Package of cultivation and management technology innovated. Integrated management began to catch on.
1986-1990	- Rice weeds remained primary threat besides rat infestation. Both problems can be minimized. - Rat damage curtailed but not weeds. Emergence of grassy weeds witnessed, such as, *Echinochloa crusgalli* (Barnyard Grass) in particular, *Leptochloa chinensis* and *Ischaemum rugosum.* - Integrated weed management adopted to provide a holistic approach in the management of the crop. - Being labour saving, direct seeding became the common method of crop establishment in the major granary areas. - Mechanising crop production gained momentum to further reduce dependence on the increasingly scarce labour resource.

Year	Development
	- The search for varieties specially bred and selected for direct seeding prioritised. - Yield decline speculated not just locally but in many rice growing countries. - Weedy rice locally known as 'padi angin' appeared as a threat to direct seeded rice yield. - Direct seeding seemed to be conducive to the spread of bacterial diseases, possibly due to its denser crop stand and higher fertilizer use.
1995-	- Productivity of direct seeded crops comparable, at times more encouraging than transplanting. - The initiation of large scale commercial rice estates. - Local efforts to isolate factors stagnating yield or causing its decline focussed on the defects of direct seeding. - Total production has been sustained despite crops being direct seeded on diminishing cropping areas. - Aerial technology considered to cope with and cater for large scale production.

as compared with the corresponding transplanted crop in the main, wet season *(Fig. 7)*.

Over the years, with the development of suitable packages for direct seeding, it is quite certain that broadcasting has emerged to be the preferred option, particularly when mechanized *(Fig. 8)* or aerially done. The prices of critical input components *(Table 7)* have remained quite unchanged during the past decade. Accordingly, the production costs *(Table 8)* were quite stable and location specific but competitive. In most instances, highly promising returns were ensured *(Fig. 3-6)*.

Table 5: ***Priortised research, development and management approaches to overcome problems of direct seeding and rice yield decline.***

Problem / Target	Approaches: Research	Development	Management
1. Weather			
i) Suitable varieties	✓		
ii) Input timing	✓		✓
iii) Soil/tillage	✓	✓	✓
iv) Water use		✓	✓
v) Harvest quality/machine		✓	✓
2. Pests			
vi) Pest resistance	✓		
vii) Pest control	✓		
viii) Soil environment		✓	✓
ix) Pest control time		✓	✓
x) Stored product pests		✓	✓
3. Management			
xi) Seed quality	✓	✓	✓
xii) Input schedule	✓	✓	✓
xiii) Soil amelioration	✓	✓	✓
xiv) Crop productivity	✓	✓	✓
xv) Water schedule	✓	✓	✓
xvi) Crop schedule/machine use	✓	✓	✓
4. Farmers			
xvii) Varietal acceptance			✓
xviii) Input discretion			✓
xix) Correct input	✓		✓
xx) Water management	✓	✓	✓
xxi) Grain handling		✓	✓
xxii) Techno-transfer	✓	✓	✓
xxiii) Subsidies	✓	✓	✓
xxiv) Quality produce			✓
5. Infrastructure			
xxv) Water stress tolerance	✓	✓	
xxvi) Enhanced input use	✓	✓	✓
xxvii) Improved infrastructure		✓	✓
xxviii) Operations		✓	✓
Involved in total of 28	17	20	24

✓ Attended to

Table 6: *Prerequisites and management requirements of various crop establishment methods in rice cultivation.*

Management requirements	Environments Methods							
	A	B	C	D	E	F	G	H
Soil/water condition								
- dry	—	—	—	@	@	@	@	@
- moist	—	@	@	@	—	@	—	—
- wet	@	@	@	@	—	@	—	—
- flooded	@	@	@	—	—	—	—	—
- deepwater	@	—	—	—	—	—	—	—
2. Land preparation								
- herbicides	@	@	@	@	@	@	@	—
- slashing	@	—	—	—	—	—	—	—
- plough	—	—	—	—	@	—	@	—
- harrow	—	—	—	—	@	—	@	—
- roto (1st pass)	—	@	@	@	@	@	@	@
- roto (2nd pass)	—	@	@	@	—	@	—	—
- level (3rd pass)	—	—	@	@	@	@	—	—
3. Crop establishment								
- nursery system	@	@	@	—	—	—	—	—
- workrate (man days/ha)	<20	20	<1	<1	<1	<1	<20	<1
4. Crop care								
- early submergence	—	—	—	@	@	@	@	@
- timely drying		@	@	@	@	@	@	@
- pest control	@	@	@	@	@	@	@	@
- disease control	@	@	@	@	@	@	@	@
- early weed control	—	—	—	@	@	@	@	@
- early fertilizer	—	—	—	@	@	@	@	@
5. Harvest								
- manual	@	@	@		@		@	
- combine	—	@	@	@	@	@		@
- lodging	@	—	—	@	—	@	—	—
- uneven ripening	@	—	—	@	@	@	@	@

Source: Embi and Cheong, 1988

@ = Areas needing attentior
A = Double nursery
B = Conventional nursery
C = Mechanical
D = Manual broadcast
E = Mechanical Drill
F = Mechanical broadcast
G = Mechanical placement
H = Volunteer

7: Currently estimated contract charges and cost of inputs for rice production in Peninsular Malaysia

Farm operation	M$/ha
Land preparation	300
Crop establishment	
– Transplanting	300
– Direct seeding	50
Crop care 300	
Harvest	
– Manual	450
– Combine	300
Transport 50	
Seeds 50	
Fertilizers 200	
Agrochemicals	200
Rental 300	
Miscellaneous	100

Source : Embi and Cheong, 1988

M$ now referred to as RM (Ringgit Malaysia). Approximately RM 3.30 is equivalent to US$ 1.00

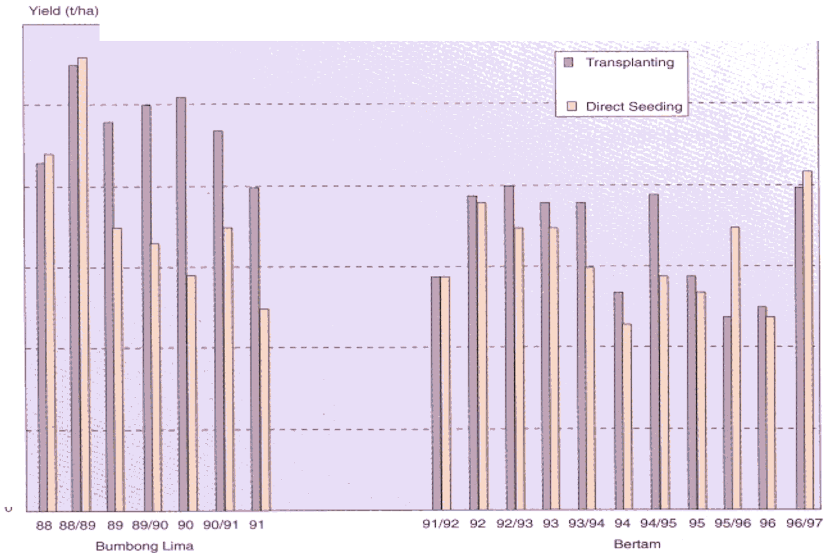


Fig. 7: Yield potential of transplanted and direct seeded rice crops monitored in two research stations over years and seasons

Table 8: *Cost of production with direct seeding in the rice granary areas*

Field Operation	Cost (RM/ha) MADA	BLS	KADA	Pulau Pinang	KETA RA	S. Perak	PERKASA
Land operation	161	193	219	199	225	150	225
Crop establishment	18	22	19	32	75	30	30
Seeds	80	101	33	73	50	100	40
Fertilizer (non-subsidised)	5	94	-	-	-	96	-
Fertilizer Application	-	-	33	-	22.5	50	20
Pesticides	3	62	33*	41	175	90	183
Pesticides Application	-	-	18*	-	50	80	70
Weedicides	30	80	-	84	187	90	40
Weedicides Application	-	-	-	-	50	50	40
Transport	82	100	48	56	50	60	90
Harvesting	248	250	250	249	300	300	350
Rental	-	127	114	178	250	-	-
Field upkeep	-	-	-	-	-	190	-
Water management	-	7	2	28	12.5	50	-
Bagging	-	-	9	-	50	-	-
Others	134	-	-	-	-	-	-
Total	761	1036	788	940	1497	1336	1088

Source: Chan *et al.* 1993

Note * Inclusive of herbicides; Approximately RM 3.30 is equivalent to US$ 1.00

MADA	: Muda Agricultural Development Authority
BLS	: Barat Laut Selangor
KADA	: Kemubu Agricultural Development Authority
KETARA	: Besut Irrigation Scheme
S. Perak	: Seberang Perak
PERAKASA	: Kemasin-Semarak Irrigation Scheme

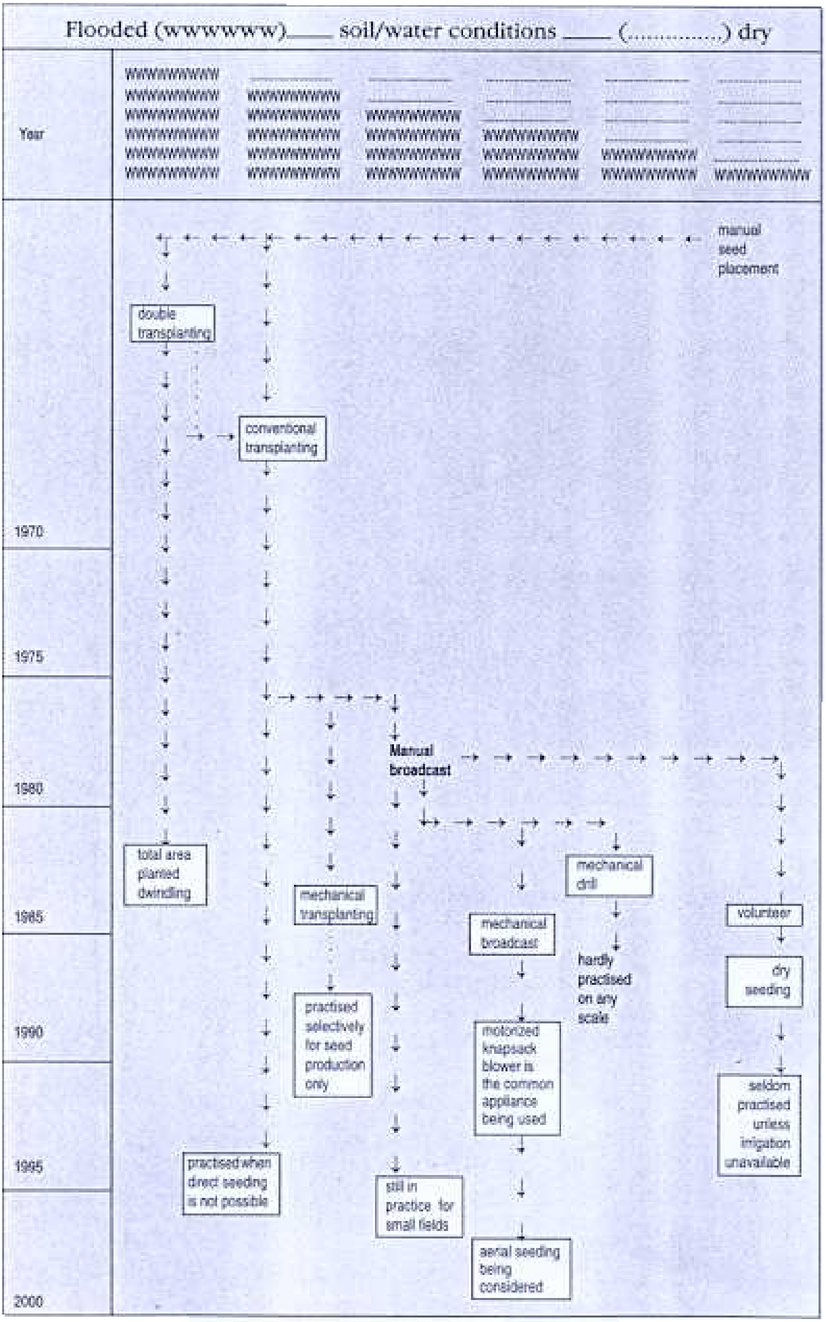


Fig. 8: Rice crop establishment trends

FACTORS UNDERLYING SUCCESS

The following underlying factors/principles give clear weightage in favour of direct seeding of irrigated rice and, accordingly, a demonstrable success has been witnessed in Peninsular Malaysia:

i) It saves a lot of time and labour of the cultivators,

ii) It is already an accepted practice in case of upland paddy cultivation,

iii) It improves probability of better crop stand, particularly when the stand in transplanted paddy fields can suffer from non-uniformity or poor establishment of crop due to delay in transplanting or poor seedlings in the nursery,

iv) It allows more effective growth period to the paddy crop within the same duration. A physiological shock to the crop due to uprooting and harmonising during re-establishment after transplanting is clearly avoided,

v) Potential yield under direct seeded crop could be higher due to a combination of factors, such as, better crop stand and more effective growth period, as also explained in paras ii) and iii) above, and

vi) Simplified, mechanized operations render this alternate crop cultivation technology more acceptable and popular.

EPILOGUE

As the practice of direct seeding is getting more and more popular, the farming operations corresponding to different crop production stages have also been mechanized quite effectively. Beginning from the land preparation, through crop establishment, crop care, input application, water management and harvesting, to the post harvest handling stages, some degree of mechanization has been duly incorporated. Thus, a successful, mechanized, direct seeded crop has paved a surer way for the sustained cultivation of rice in the Peninsular Malaysia. Its popularization on a commercial scale is being taken up steadily which is a positive signal for other countries in the sub-region in favour of adopting similar methodology suited to their specific situations. At the same time, there is a need to prioritize research areas and matching action plan that need attention so as to render the package of direct seeded cultivation of irrigated paddy a venture quite natural to the farmers and the farming practices.

Proposed target research areas to overcome problems of rice yield decline.

Problem areas		Research targets: Quality of – Variety	Research targets: Quality of – Input	Soil status suitability	Infrastructure/water management	Post harvest
1.	Weather	Shorter maturation, less prone to lodging 1	Timely usage 2	Tillage and soil improvement 3	Harness water supply, reduce wastage and improve efficient use 4	Grain quality and machine mobility 5
2.	Pests	Tolerant/resistant traits 6	Correct, discreet usage 7	Soil drying, phytosanitation 8	For expediting control measures 9	Stored product pests (if any) 10
3.	Management	Good seeds 11	Effective schedule 12	Corrective measures (if needed) 13	Crop scheduling and efficient operation & maintenance (O&M) 15	Crop scheduling and machine selection 16
			Improve and sustain crop productivity 14			
4.	Farmers	Awareness and acceptance 17	Proper usage without abuse 18	Correct fertilizer soil maintainance practices 19	Management technique to reduce water wastage 20	On farm handling and partial drying to reduce losses. 21
		Effective technology transfer through organized farming 22				
		Reduce dependence on subsidies 23				Quality produce 24
5.	Infrastructure	Tolerant to temporary water stress 25	Improve usage 26	Fertility and physical characteristics improvement 27		Facilitate operations 28

Source: MOA and Rice Research Division, MARDI) Note: Refer Table 5 for action and implementation.

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