

INCREASING FLEXIBILITY IN CAMBODIAN MONSOONAL RICE CROPPING SYSTEMS

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Foreword-the Technical Reference Panel

While the ACIAR Climate Adaptation Project (ACCA) research team thought that there was potential for the suggested wet season rice production interventions to contribute to increased farmer productivity, it was considered important that a peer review of technical content and systems sensibility be conducted before any recommendations were made to modify Cambodian rice production policy. A Technical Reference Panel was established to review the seasonal cropping calendars (Appendix 1) and associated response farming protocols (Appendix 2). The panel, which met in Phnom Penh on the 3rd and 4th June 2014 under the auspices of the ACCA project, consisted of rice and systems specialists from Cambodian Government agencies, locally based NGOs and Australian partners. It included representatives from DAE (Say Tom, Mao Minea), iDE (Lim Naluch, Lam Boramy), CARDI (Ung Sopheap), PDA-Svay Rieng (Sok Chanthorn), DRC-GDA (Kong Kea), SNV (Ke Sam Oeurn), Dept of Ag Engineering-GDA (Seng Tuy), Dept Land Resource Management-GDA (Koy Ra) and CSIRO (Monica van Wensveen and Neal Dalgliesh).

The panel recommended that the attached monsoon season rice production interventions be considered for promotion on medium and high lands, in provinces where the soils and environment were similar to those of Svay Rieng and Prey Veng. These included the PADEE focus provinces of Kampot, Kandal and Takeo (as well as Svay Rieng and Prey Vang), the proposed ASPIRE focus provinces of Kampong Chhnang, Pursat, Preah Vihear, Kratie and Battambang, and the provinces of Preah Sihanouk and Kampong Speu. This document aims to summarise the background research on which the systems interventions were based and the outcomes of technical panel deliberations including the specifics of the recommended response farming interventions.

Developing multi-scale adaptation strategies for Cambodian farming communities

In this project researchers and rural communities are designing farming practices to help smallholders reduce the impact of an increasingly variable climate on their livelihoods. Locally promising practices that meet the needs and capacity of different types of households have been tested and evaluated on-farm and through systems modelling. The knowledge gained through this process has then been used in the development of appropriate extension programs and their delivery to the broader farming community grappling with the challenges of producing crops in a highly variable seasonal climate.

Cambodian research focus

In Cambodia, one of 4 Asian countries participating in the project, a transdisciplinary team of social and biophysical researchers are working with the farmers of Svay Rieng and Prey Veng provinces, to investigate opportunities to improve farmer resilience to the challenges they face in growing crops in a highly variable climate. Farmers in the medium and high lands have traditionally met the requirements of family food security by producing one medium duration rice crop during the monsoon season. This differs from provincial lowlands where recession rice predominates-recession rice is not the focus of this document. Yields from the traditional growing of wet season rice have been relatively low, a result of the use of local varieties that are generally genetically inferior to modern varieties as well as low levels of nutrition and poor agronomic practice. While farmers have been able to meet their requirements in most years, research shows that this is becoming more

difficult due to the increasingly variable climate, particularly the impacts of drought and floods on production, and social and economic factors including the effect of rural migration on the agricultural labour supply.

A participatory approach has been used to investigate options to increase the flexibility of the cropping system to meet the on-going production challenges, while appreciating that it cannot be a 'one size fits all' solution, due to the differing aspirational goals and livelihood trajectories of individuals. Consequently, on-farm research has focussed on a range of potential opportunities, anticipated to meet the needs of a broad range of livelihood types. These vary from the small subsistence farmer wishing to grow sufficient rain-fed rice to meet food security requirements while utilising surplus family labour in off-farm enterprises, to those who see farming as their main enterprise and are interested in optimising production through the adoption of modern techniques including the use of genetically superior, modern, short and medium duration rice varieties, supplementary irrigation, better crop nutrition and agronomic practice and the use of mechanisation to reduce labour demands.

Increasing flexibility-responding to seasonal climatic conditions

It was theorised that the central focus of Cambodian wet season rice research be that climatic conditions varied both inter- and intra-seasonally and required that farmers have the ability and the tools to respond to seasonal changes, either in 'close to real time' in response to observed climatic conditions, or in the longer term, possibly as a result of improved seasonal climate forecasting. This led to the development of the concept described as 'response' farming.

Data from three years of on-farm research were used to test possible options developed in collaboration with the farming communities. These included the replacement of local medium duration rice with short and medium duration open-pollinated varieties developed by the Cambodian Agricultural Research and Development Institute (CARDI), mechanised establishment of the crop, supplementary irrigation, improved nutrition and better agronomic practice, particularly in regard to weed management.

While on-farm research was essential in testing the logic of particular system changes, it was not possible to undertake field-based research for a period of sufficient length to experience all potential climatic variation. Crop modelling, based on long term regional meteorological records (rainfall, temperature, radiation) and local soil information provided the longer-term link. Simulation of crop production (in this case, rice) provided an assessment of seasonal productivity over the longer-term, and an estimate of associated production risk. Comparison of on-farm data and the simulation output for the same years enabled testing for 'sensitivity' of particular interventions at relatively low cost.

Response farming interventions

Response farming assumes that there are a number of ways in which the monsoon period can be used to produce rice, with particular options better suiting particular climatic conditions. For example, whether there is an early, average or late start to the wet season and whether high, medium or low amounts of rainfall are received. The 'response' made by the farmer will depend on these conditions and the strategy they perceive to be the most appropriate to meet their livelihood

goals. The image of a ‘tool box’ which contains seasonal management options is a useful analogy, with appropriate tools taken from the box as the season progresses to meet production and livelihood demands (Figure 1). The types of tools that are stored in the box include crop duration and variety, crop sequencing and timing of establishment, availability of supplementary irrigation, availability of labour and the potential for increased mechanisation, seeding technologies (direct seeding and transplant), fertiliser (both organic and inorganic) and pest management technologies leading to aspirational seasonal production, crop return and gross margin goals.

It should be noted that the advocates of ‘response’ farming are not suggesting that all, or particular options are more important than others, or that they will be used by every farmer in every season or across an entire farm. Response farming is about having a range of tools which are all likely to contribute to reduced climate risk and to improved yields, and in many cases, will also improve financial returns, but, the final choice on whether to use particular options is the decision of the individual.

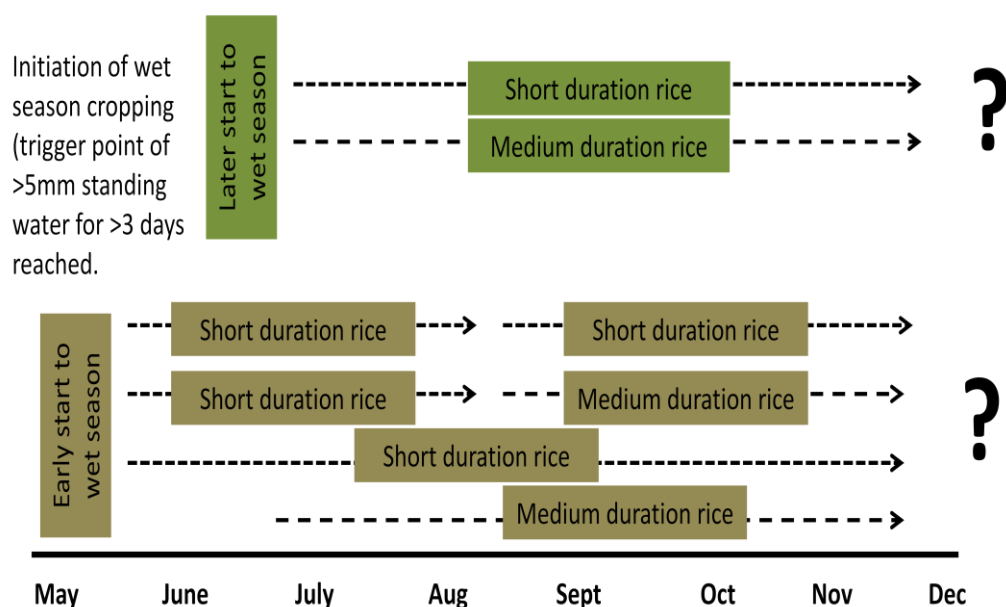


Figure 1: The way in which the farmer responds to meeting the basic soil water criteria for cropping action (>5mm of standing water in the paddy for >3 consecutive days) and their selection of tools is a personal choice. Available options are dependent on the timing of start of the wet season but are likely to include some of the following: whether to grow 2 short duration crops, a single medium duration crop, or a combination; the availability of supplementary irrigation; the availability of labour and/or mechanisation for land preparation and crop establishment; productivity and economic returns and the individuals attitude to the production and financial risk associated with particular options.

Conditions for crop establishment

It is suggested that the initial trigger point for decision making occurs when water in the paddy is >5mm in depth for >3 consecutive days. This assumes that the presence of standing water indicates that the soil has been saturated by recent rainfall and that tillage is now possible in preparation for planting. While theoretically, it would be possible to develop trigger points around the occurrence of seasonal rainfall and its impact on crop production, this is currently impractical due to the lack of regional meteorological infrastructure and expertise to measure and interpret rainfall data at a local level.

Commonly, the trigger point (water >5mm in depth for >3 consecutive days) occurs in early to mid-May, although with a late start to the monsoon, may not occur until late May or June. Its timing will dictate which response is the most logical, but could include, a) the direct seeding of an early, short duration variety as soon as the trigger point has been reached; with the potential to follow-on with a double cropped short or medium duration crop in the second half of the monsoon season, or b) depending on when the trigger point occurs, avoiding the risk of second crop failure by growing only 1 short duration crop, possibly planted a little later in the season to minimise the risk of dry conditions at establishment, or c) opting to wait until the monsoon is fully established and direct seeding or transplanting a medium duration variety in July/ August (Figure 1). Further risk mitigation may be achieved through crop ‘drought proofing’ by the use of supplementary irrigation with water supplied from a tube well, pond or canal. Irrigation enables a higher degree of seasonal flexibility in terms of timing of crop establishment, selection of crop duration type and the level of investment in fertiliser and other inputs which the farmer is willing to risk. In essence, supplementary irrigation reduces the risk of failure.

Broad details of the cropping options available to the farmer are provided in the following section, however the specifics of crop timing and agronomic management are provided in the appendices (1 and 2). It should be noted that the production and gross margin data presented for recommended treatments in the following section have all received CARDI recommended fertiliser rates of N, P and K applied as per the individual protocols in Appendix 2. ‘Farmer Practice’ undertaken in 2011 and 2012, with which the above treatments are compared, consists of the growing of a medium duration, local variety with limited amounts of inorganic fertiliser applied.

1. (a) Short duration rice-double cropped-direct seeded-supplementary irrigation

(b) Short duration rice-double cropped-direct seeded-rainfed

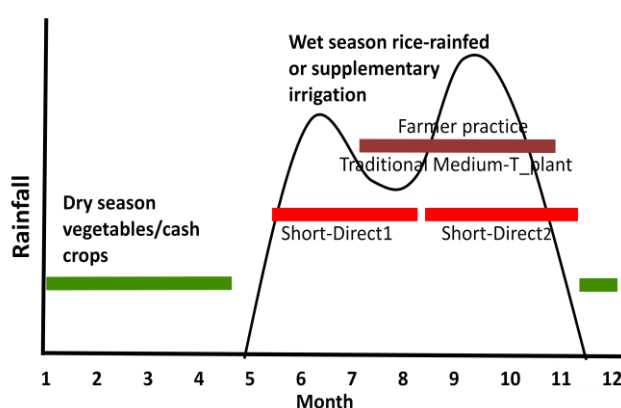


Figure 2: Replacing ‘Farmer Practice’ with the direct seeding of 2 short duration crops (both grown using CARDI fertiliser rates and good agronomic practice).

The growing of 2 short duration crops (Figure 2) requires a higher level of management than single crop production due to the need to time the establishment of the second crop so that maturity occurs before the end of the wet season. Research shows that there is a high risk of second crop failure when it is established after the first week of September, due to the high incidence of December water deficit. Keys to the success of double cropping are the early establishment of the first crop and a short transition time

between the harvest of the first, and the establishment of the second crop. This period should be no longer than 10 days. Having the capacity to apply supplementary irrigation makes this sequence a very viable option. Time lines for the growing of this sequence under rainfed and supplementary irrigated conditions are provided in Appendix 1 and 2 (Options 1(a) and 1(b)).

Table 1 shows seasonal production for the growing of 2 short duration crops and the associated gross margins, compared with farmer practice. These data show that the growing of 2 short duration

crops in sequence achieved median production between 2 and 3 times higher than farmer practice in 2011 and 2012 (for example 1927 kg/ha compared to 4923 kg/ha in 2012) (Table 1). While it is difficult to apportion this difference to a particular component of the modified system, it is considered that the use of modern varieties, improved nutrition and better agronomic management all contributed. Of particular interest, is that the maximum seasonal production achieved over the 3 years of research, for the double cropping scenario was 2.8 times (7095 kg/ha) that of the traditional medium duration variety (2535 kg/ha). What this infers is that a small number of farmers were highly successful at maximising yield using the modern varieties and associated technologies. This should set the benchmark for farmers who see the maximising of productivity as their ultimate goal.

Table 1: Seasonal production and gross margin (with and without labour) for a sequence of 2 short duration crops (grown with recommended fertiliser input) compared to farmer practice (1 medium duration traditional variety with limited inputs) in Svay Rieng (2011 to 2013) and Prey Veng (2013) provinces.

Season	2011		2012		2013	All seasons	
Establishment	Direct	Transplant	Direct	Transplant	Direct	Direct	Transplant
Duration	Short	Farmer practice	Short	Farmer practice	Short	Short	Farmer practice
No. of crops in season	2	1	2	1	2	2	1
Time of establishment	Early/Mid	Mid	Early/Mid	Mid	Early/Mid	Early/ Mid	Mid
Plot number	11	35	9	27	4	24	62
Seasonal production (kg/ha at 14% moisture)							
Lowest Yield	1792	1229	3798	1094	5658	1792	1094
Median Yield	4232	1792	4923	1927	6491	4745	1852
Highest Yield	5428	2372	6163	2535	7095	7095	2535
Middle 50% Yield	3518-4669	1621-1973	4678-5716	1621-2104	5804-7064	4015-5687	1621-2023
Gross margin-no labour (US\$/ha)							
Lowest	(261)	81	(48)	30	556	(261)	30
Median	512	296	376	283	824	545	288
Highest	805	456	736	428	987	987	456
Middle 50%	304-659	253-354	255-659	174-341	669-926	300-669	236-350
Gross margin-with labour (US\$/ha)							
Lowest	(630)	(329)	(234)	(363)	199	(630)	(363)
Median	273	(114)	9	(91)	485	227	(101)
Highest	425	46	331	160	689	689	160
Middle 50%	(39)-314	(157)-(-56)	(112)-255	(180)-(-9)	330-598	(49)-323	(157)-(-39)

As expected, comparisons of gross margin showed that the 3 year median for the 2 short duration crop sequence was almost twice as high as for farmer practice (\$545 to \$288/ha) (excluding labour costs). This disparity continued to increase when labour was considered, with a median gross margin of \$227/ha for the 2 short duration sequence compared to a loss of \$101/ha for farmer practice. This difference reflects the higher labour costs associated with transplanting and the differences in yield resulting from the lower crop inputs and management levels used in farmer practice. These data show that at least 75% of the farmers who grew the traditional medium variety did so at an economic loss. However, it should also be noted that around 30% of farmers growing the 2 short duration crops during the 3 seasons also lost financially. This resulted from, a) the inexperience of both the farmers and their advisors in growing 2 crops, b) the increased drought risk associated with the second crop when planted later than optimal, and c) the higher levels of investment required for 2 crop which, when the second crop failed, resulted in higher levels of financial loss.

2. Short duration double cropped rice followed by medium duration photo-period sensitive CARDI variety rice-rainfed, direct seeded (crop1), transplanted (Crop2)

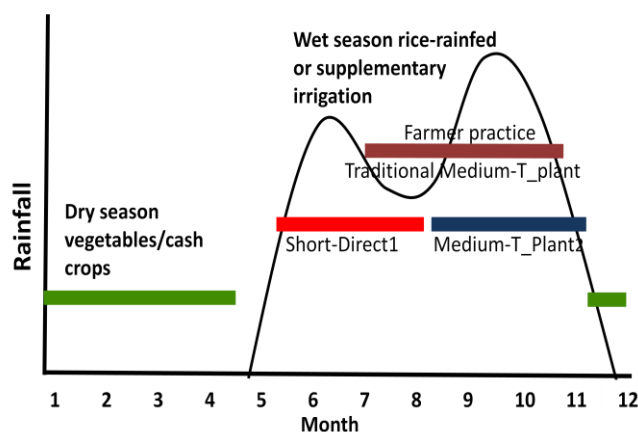


Figure 3: Replacing 'Farmer Practice' with the direct seeding of a modern, single short duration crop which is then followed by a modern, medium duration crop (both grown using CARDI fertiliser rates and good agronomic practice).

In this scenario, a short duration variety is established in the early wet season and then followed by a medium duration crop, transplanted in late August (nursery established in late July). The transplanting of a medium duration, photo-period sensitive variety, such as Phka Rumdual, provides the opportunity to produce rice which has a higher market value than short duration varieties such as Chulsa and IR66. As with the growing of 2 sequential short duration varieties, this option is reliant on the early establishment of the first crop and a quick transition between the

2 crops. While this scenario is shown as a rainfed option, supplementary irrigation would reduce the level of risk associated with timing of first crop establishment and ensure an adequate water supply for second crop completion. This option was not subject to on-farm testing but was highly recommended by the Technical Reference Panel with the time line provided in Appendix 1 and 2 (Option 2).

3. (a) Short duration rice-single cropped-direct seeded-rainfed

(b) Short duration rice-single cropped-direct seeded-supplementary irrigation

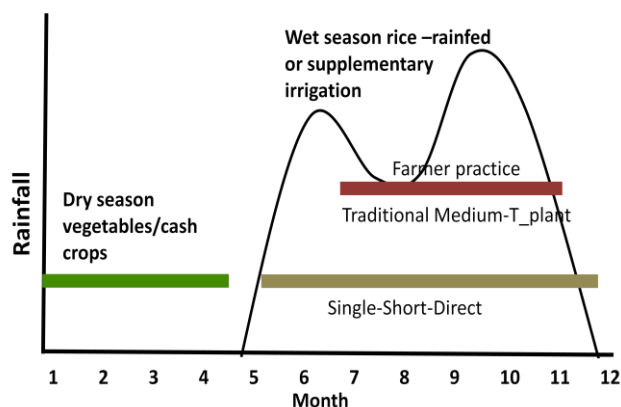


Figure 4: Replacing 'Farmer Practice' with a single, short duration, direct seeded crop grown either under rainfed conditions or with supplementary irrigation (grown using CARDI fertiliser rates and good agronomic practice).

The replacement of farmer practice, with a single, direct seeded, short duration variety is logical in terms of seasonal productivity and in ensuring flexibility in response to variable climatic conditions (Figure 4). This could be either rainfed or grown with supplementary irrigation. Therefore, a crop would be able to be established as soon as planting trigger conditions were met (>5mm standing water for >3 consecutive days), starting in early to late May for an average season, or into June for a later break. Those with irrigation access have more flexibility in establishing their crop, while

those without this luxury are more likely to opt to minimise their risk by waiting until monsoon conditions are stable before crop establishment. Given that short duration varieties (such as Chulsa and IR66) mature in <100 days, this option is the most flexible of the systems discussed, with the establishment window extending from May through until early September, although a cautious

approach should be taken from late August onwards given the risk of an early finish to the monsoon or of inadequate water supply to complete a later maturing crop.

In terms of family livelihood strategies, this option provides marked advantages. An early planted crop, grown to meet family food security requirements, or as part of a broader strategy to spread risk, could be harvested as early as mid-August. This crop would normally meet annual food security requirements and allow family members to become involved in other agricultural enterprises such as vegetable or cash crop production, or allow members to migrate to the city to access available labour markets. Also, the July/August period is often drier than the surrounding months, providing a more seasonally stable period to harvest and process crops.

Table 2: Seasonal production and gross margin (with and without labour) for 1 short duration crop (grown with CARDI recommended fertiliser inputs) compared to farmer practice (1 medium duration traditional variety with limited inputs) in Svay Rieng (2011 to 2013) and Prey Veng (2013) provinces.

Season	2011		2012		2013	All seasons	
Establishment	Direct	Transplant	Direct	Transplant	Direct	Direct	Transplant
Duration	Short	Farmer practice	Short	Farmer practice	Short	Short	Farmer practice
No. of crops in season	1	1	1	1	1	1	1
Time of establishment	Early	Mid	Early	Mid	Early/Mid	Early	Mid
Plot number	15	35	19	27	35	69	62
Seasonal production (kg/ha at 14% moisture)							
Low Yield	890	1229	1716	1094	1872	890	1094
Median Yield	2537	1792	2740	1927	3784	3080	1852
Highest Yield	3920	2372	5001	2535	6394	6394	2535
Middle 50%	1912-3062	1621- 1973	2099-3129	1621-2104	3016-4348	2514-3902	1621-2023
Gross margin-no labour (US\$/ha)							
Low	(72)	81	(83)	30	5	(83)	30
Median	442	296	193	283	486	411	288
Highest	870	456	923	428	1205	1205	456
Middle 50%	263-651	253-354	114-337	174-341	315-619	230-542	236-350
Gross margin-with labour (US\$/ha)							
Low	(279)	(329)	(295)	(363)	(175)	(295)	(363)
Median	215	(114)	(19)	(91)	272	213	(101)
Highest	653	46	711	160	1031	1031	160
Middle 50%	56-444	(157)-(56)	(98)-125	(180)-(9)	124-403	46-376	(157)-(39)

Table 2 shows seasonal production from the growing of 1 short duration crop and the associated gross margins, compared to farmer practice. These data show that with CARDI recommended rates of fertiliser and good agronomic practice, the growing of a single short duration crop achieved a median yield (over the 3 seasons) of 3080 kg/ha compared to farmer practice of 1852 kg/ha). Comparison of gross margin shows that the median for the single short duration crop was \$411/ha compared to \$288/ha for farmer practice (without labour costs). When labour was included the median gross margin for the 1 short duration crop was \$213 compared to a loss of \$101 for farmer practice. Of particular interest in this comparison is that the top farmer growing a single short duration crop achieved a gross margin, with labour of \$1031 compared to the best farmer practice of \$160, a large disparity, but one that provides optimism for the use of improved management options as farmers are challenged by the vagaries of climate and markets. Time lines for the growing of this option under rainfed and supplementary irrigated conditions are provided in Appendix 1 and 2 (Options 3(a) and 3(b).

4. (a) Medium duration rice-single crop-direct seeded or transplanted-supplementary irrigation
(b) Medium duration rice-single crop-direct seeded or transplanted-rainfed

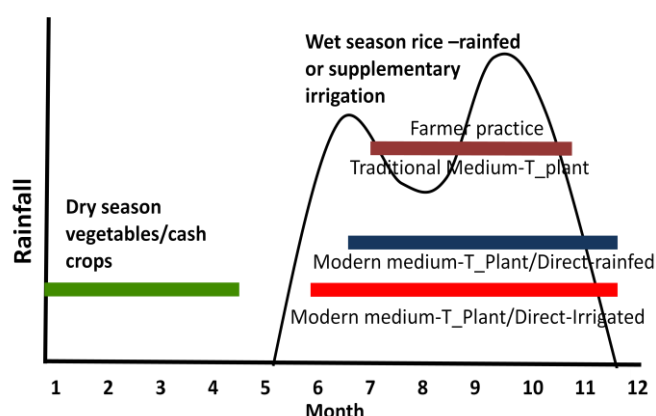


Figure 5: Replacing 'Farmer Practice' with a single, medium duration, direct seeded crop grown either under rainfed conditions or with supplementary irrigation (grown using CARDI fertiliser rates and good agronomic practice).

The use of a direct seeded, medium duration, modern variety, is the closest option to current farmer practice (Figure 5) and therefore the least risky of the suggested rainfed options in terms of current Svay Rieng and Prey Veng farmer experience. Typically farmer practice, and this option would be planted at similar times, although, where supplementary irrigation is available, the medium crop could be planted earlier to reduce the risk of late wet season water deficit. The median yield achieved over the 3 seasons from growing a medium, modern variety (typically Phka Rumdoul)

was higher than for farmer practice (2461 kg/ha compared to 1852 kg/ha for farmer practice) but was lower than those achieved with the single, short duration modern variety (Table 3). However, gross margins were not dissimilar between these 2 options, as shown in Table 4. Time lines for the growing of this option under rainfed and supplementary irrigated conditions are provided in Appendix 1 and 2 (Options 3(a) and 3(b).

Table 3: Seasonal production and gross margin (with and without labour) for 1 medium duration crop (grown with recommended fertiliser input) compared to farmer practice (1 medium duration traditional variety with limited inputs) in Svay Rieng (2011 to 2013) and Prey Veng (2013) provinces.

Season	2011		2012		2013	All seasons	
Establishment	Direct	Transplant	Direct	Transplant	Direct	Direct	Transplant
Duration	Medium	Farmer practice	Medium	Farmer practice	Medium	Medium	Farmer practice
No. of crops in season	1	1	1	1	1	1	1
Time of establishment	Mid	Mid	Mid	Mid	Mid	Mid	Mid
Plot number	14	35	15	27	19	48	62
Seasonal production (kg/ha at 14% moisture)							
Low Yield	926	1229	1291	1094	2261	926	1094
Median Yield	2017	1792	1886	1927	3404	2461	1852
Highest Yield	2641	2372	2746	2535	3884	3884	2535
Middle 50%	1754-2533	1621-1973	1633-2389	1621-2104	3091-3524	1863-3232	1621-2023
Gross margin-no labour (US\$/ha)							
Low	15	81	184	30	213	15	30
Median	460	296	343	283	469	446	288
Highest	760	456	674	428	647	760	456
Middle 50%	348-647	253-354	301-543	174-341	395-525	328-541	236-350
Gross margin-with labour (US\$/ha)							
Low	(45)	(329)	13	(363)	45	(45)	(363)
Median	387	(114)	171	(91)	292	289	(101)
Highest	664	46	502	160	477	664	160
Middle 50%	288-575	(157)-(-56)	129-371	(180)-(-9)	249-351	165-396	(157)-(-39)

Comparing the suggested systems options

To this point, this report has made comparison between the possible system options identified through on-farm research and the typical farmer practice of growing a local, transplanted, medium duration variety, however it is also important to compare the differences between the suggested system options. Table 4 provides an overview of the seasonal productivity and gross margins achieved during 3 seasons of research. As might be expected, when comparing median seasonal production, the growing of 2 short duration crops shows the best returns, however when seasonal gross margin for each system is compared the story is more complex. Where inputs costs are considered, but not labour, the highest median return is still achieved from growing 2 short duration crops, but when labour is included, the modern, medium duration option is ahead of the short duration options (\$289/ha, compared to \$213/ha and \$227/ha for the short duration cropping options). This is a result of the higher costs of pesticides required to control weed and insects in the early wet season, compared to later medium duration crops where weeds are often controlled through flooding and insects tend to be diluted across larger areas of crop.

The data also show that there is more downside financial risk associated with the growing of short duration varieties (lowest gross margin with labour for 1 short crop of -\$295 and for 2 short of -\$630/ha) than with the modern medium (-\$45), although it is suggested that as farmer and agronomist experience increases, these differences are likely to reduce, while at the same time, the number producing higher yields (and achieving higher gross margins) will increase. A very positive indication of this is the high levels of production and subsequent high gross margins being achieved by individual farmers. For example, the best seasonal productivity from a single short duration variety was 6394 kg/ha and for the sequence of 2 short varieties, 7095 kg/ha, while the highest gross margins (including labour) were \$1031/ha and \$689/ha respectively.

Table 4: Overall comparison of the 3 tested systems options compared to farmer practice (1 medium duration traditional variety with limited inputs) in Svay Rieng (2011 to 2013) and Prey Veng (2013) provinces showing seasonal production and gross margin (with, and without labour).

	All seasons			
Establishment	Direct	Direct	Direct	Transplant
Duration	Short	Short	Medium	Farmer practice
No. of crops in season	1	2	1	1
Time establishment	Early to Mid	Early & Mid	Mid	Mid
Seasonal production (kg/ha at 14% moisture)				
Low Yield	890	1792	926	1094
Median Yield	3080	4745	2461	1852
Highest Yield	6394	7095	3884	2535
Middle 50%	2514-3902	4015-5687	1863-3232	1621-2023
Gross margin-no labour (US\$/ha)				
Low	(83)	(261)	15	30
Median	411	545	446	288
Highest	1205	987	760	456
Middle 50%	230-542	300-669	328-541	236-350
Gross margin-with labour (US\$/ha)				
Low	(295)	(630)	(45)	(363)
Median	213	227	289	(101)
Highest	1031	689	664	160
Middle 50%	46 to 376	(49) to 323	165-396	(157)-(39)

The future

This research has shown that the direct, wet seeding of modern, short and medium duration rice varieties, using either a drum seeder or by hand broadcasting, and grown using higher levels of nutrition and agronomic management will increase the productivity and economics of the monsoonal, rice based cropping systems of Cambodia. However, while examples of possible technologies have been provided, these should not be considered as the only available options, or that new opportunities will not arise that better fit particular farmer preferences or environmental and seasonal conditions. For example, the use of direct seeding into dry conditions using specially developed planters is currently being researched and may provide improvements to systems flexibility and timeliness of operations compared to current options. It should also be remembered that it is very unlikely, at least in the short to medium term, that individual farmers would commit the whole of their production area to a particular cropping system. This is the case for a number of reasons including the need to, a) vary crop production timing to balance labour demand and availability, b) manage seasonal production risk, c) minimise security issues (animal and human) associated with the production of crops that are established or mature outside the accepted norms for the village, and d) meet individual household culinary preferences.

The important research message is that a flexible approach to rice production and being responsive to environmental conditions will pay dividends to the individual farmer and to overall rice productivity. However, the price for being involved in producing rice in a responsive way is the need for the farmer to be more alert to changes in seasonal conditions and to be able to respond quickly. It also requires extension workers to develop a much more dynamic ‘whole of season, hands-on’ approach to farmer engagement and support.

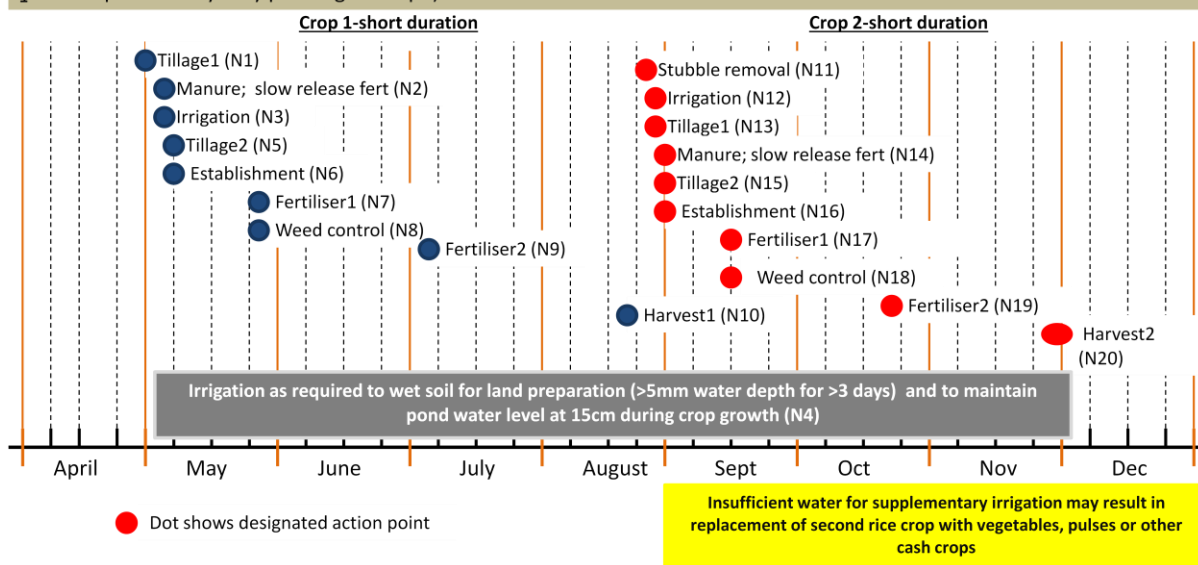
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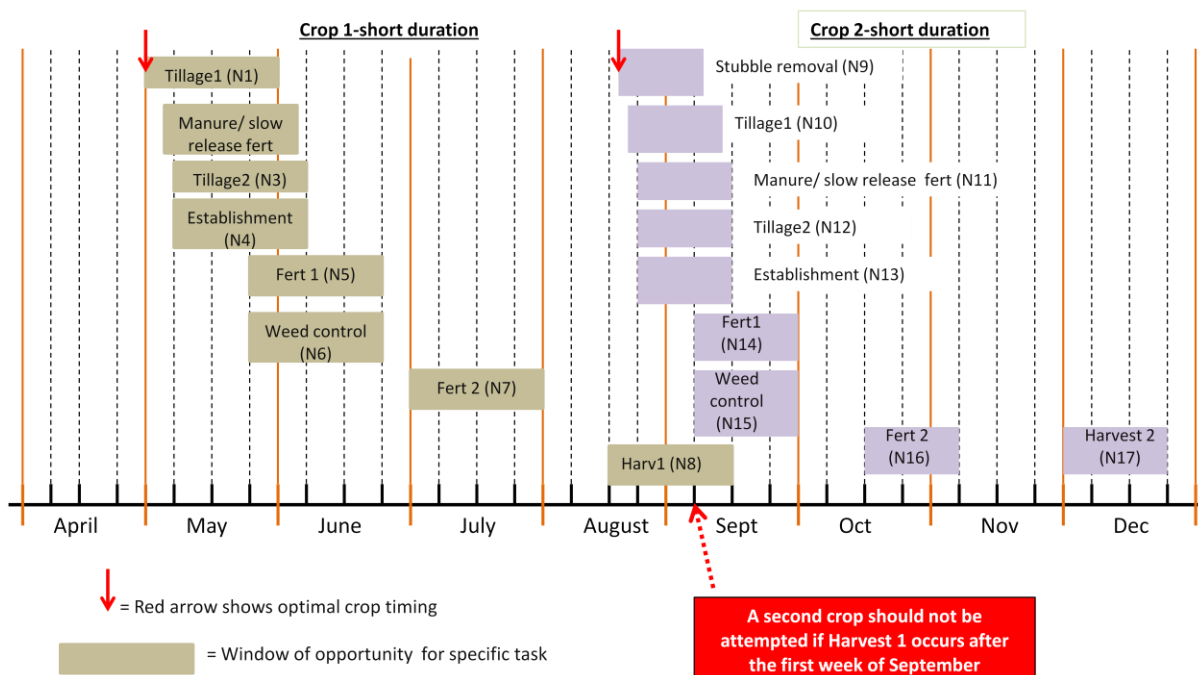
Appendix 1: Seasonal cropping calendars

1 (a) Short duration rice-double cropped-direct seeded-supplementary irrigation

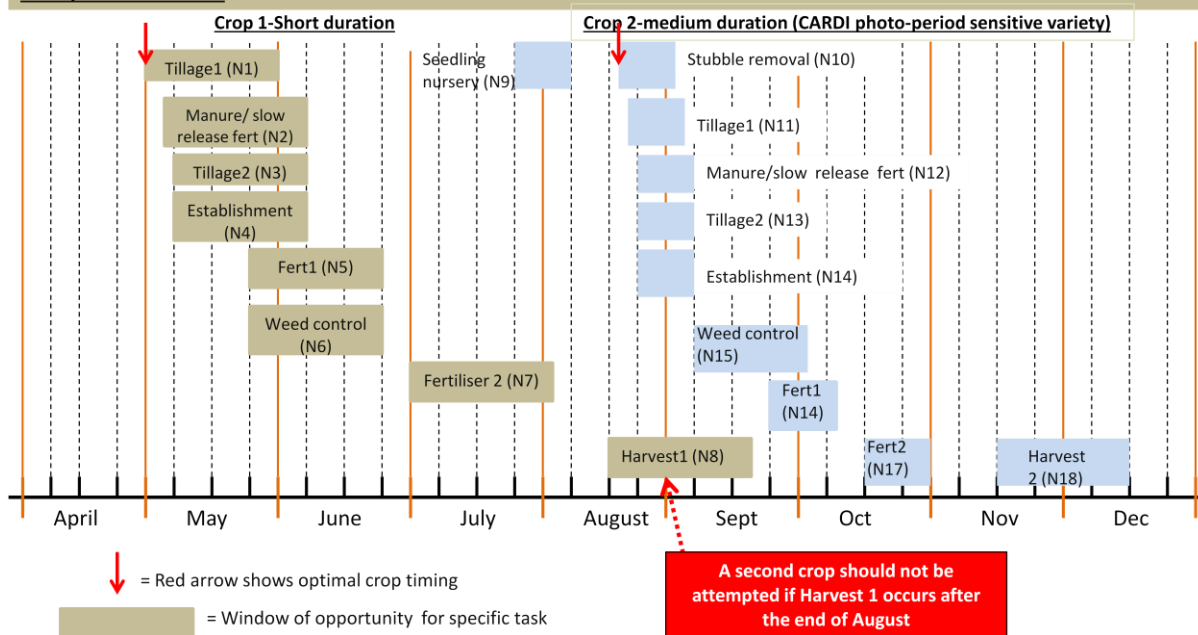
(shows optimal early May planting of Crop1)



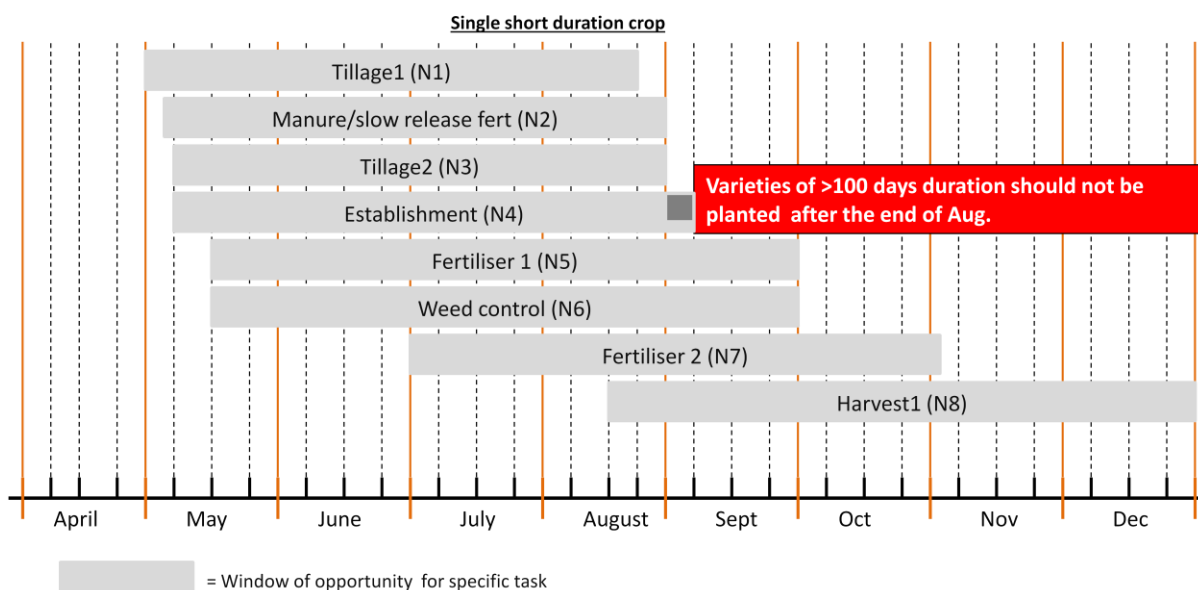
1 (b) Short duration rice-double cropped-direct seeded-rainfed



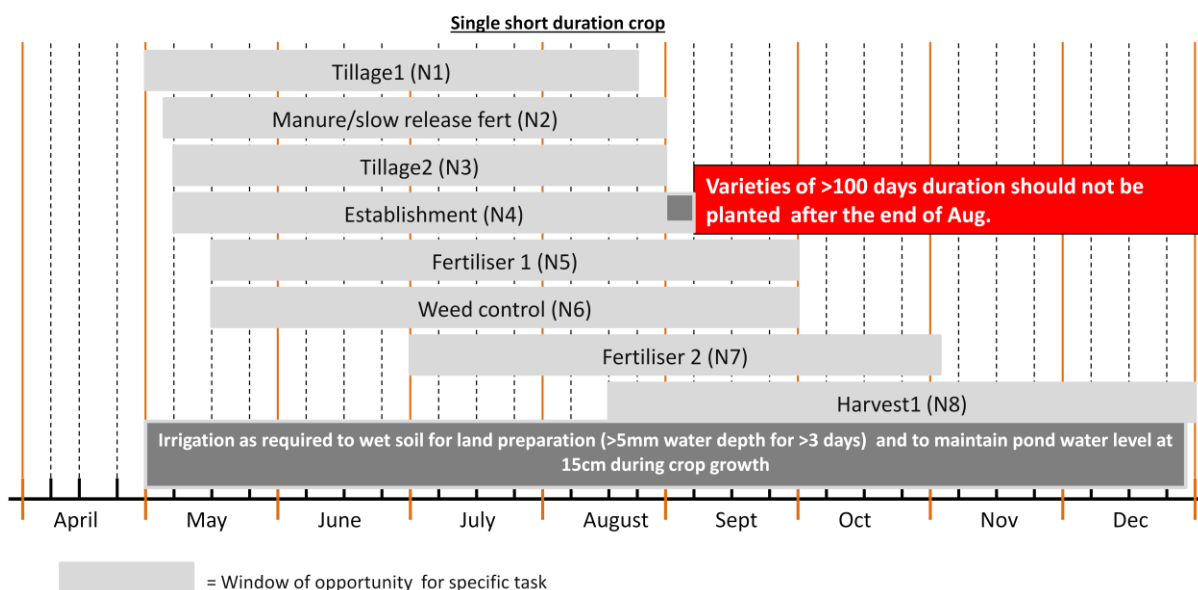
2. Short duration rice-direct seeded-rainfed, double cropped with medium duration rice (CARDI photo-period sensitive)-transplanted-rainfed



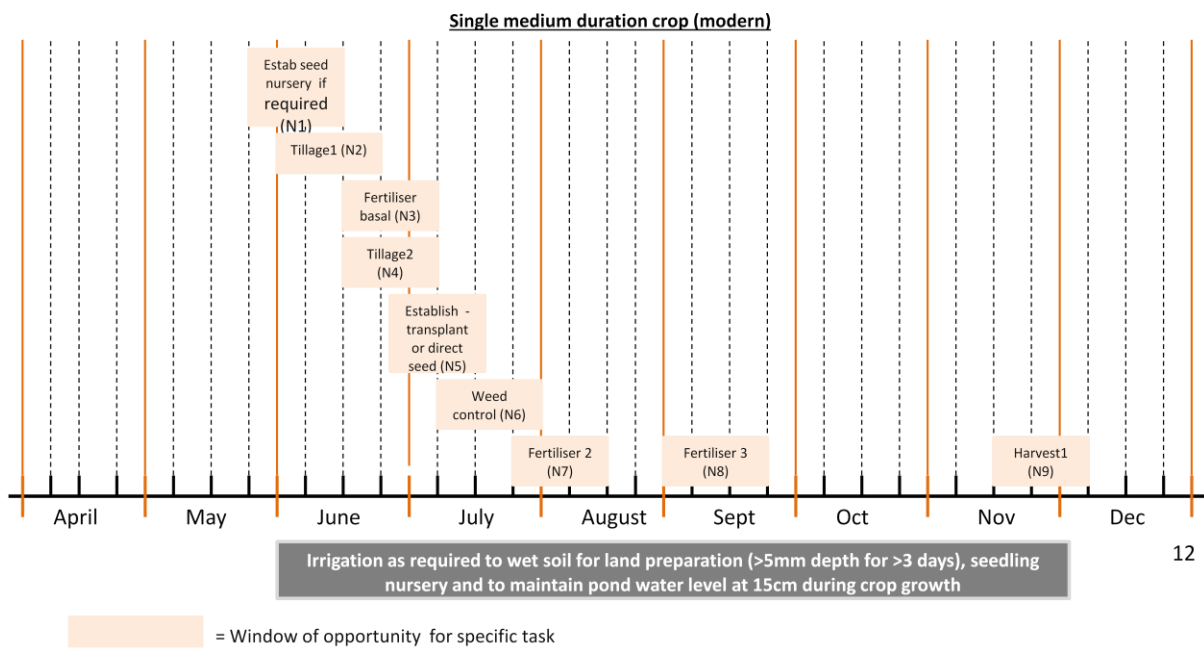
3(a) Short duration rice-single cropped-direct seeded-rainfed



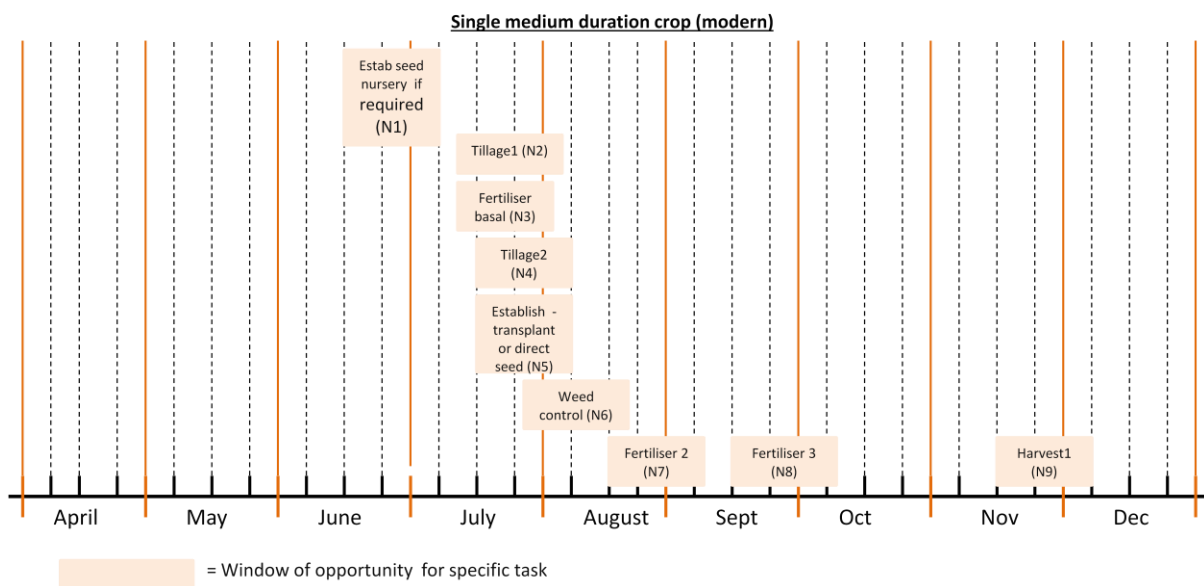
3(b) Short duration rice-single cropped-direct seeded-supplementary irrigation



4a) Medium duration rice-single crop –direct seeded or transplanted-supplementary irrigation



4b). Medium duration rice-single crop-direct seeded or transplanted-rainfed



Appendix 2: Response farming protocols (Ver 1.11_June 2014)

1 (a) Short duration rice-double cropped-direct seeded- irrigated

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
Crop 1-short duration					
1	1	Tillage 1 (T1)	1, 2	May-week1	If no rain, add sufficient water to allow tillage to be undertaken. Tillage is assumed to be done with power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
2		Manure and/or slow release fertiliser	1, 2	May-week1 5 days after T1	Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available. Slow release compressed block fertiliser (e.g. FDP) (if being used): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.
3		Irrigation at planting	1, 2	May-week1 6 days after T1	Add water, if required, to ensure soil surface is wet and suitable for drum seeding prior to T2.
4		Irrigation through season	1, 2	As required to maintain pond water level at 15cm.	Irrigations to be applied during the season to maintain water levels at 15cm, timing of this will be dependent on rainfall and availability of irrigation water.
5		Tillage 2 (T2)	1, 2	May-week1 7 days after T1	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
6		Establishment - drum seeding or hand broadcasting (P1)	1, 2	May-week1 7 days after T1	Drum seeding: Seed soaked for 12 hours and allowed to sit for 12 hours before being sown at a rate of 80 kg/ha (dry seed weight) Hand broadcast: Seed soaked for 24 hours and allowed to sit for 24 hours before being sown at a rate of 150-200 kg/ha (dry seed weight) (rate 15 to 20g/m ²) (dry seed weight)
7		Fertiliser 1	Koktrap	May-week4 15 days after T1 or as indicated in Note 2	Urea (50 kg/ha); DAP (75kg/ha); KCl (50 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although N may be required at PI.
7			Prateah Lang	May-week4 15 days after T1 or as indicated in Note 2	Urea (35 kg/ha); DAP (50kg/ha); KCl (50 kg/ha). Will be applied as a basal if manure is not available (Note 2). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					<p>application. KCl application may be split between the 15 DAS application and the PI application.</p> <p>Note: Where slow release fertiliser (e.g. FDP) is used, no additional fertiliser is applied in-crop at 15 DAS although N may be required at PI.</p>
8		Weed control	1, 2	May-week3 15 days after T1	<p>Hand weeding or Chemical weed control. Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings.</p> <p>ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what is available in local markets. Suggest including a photo of labels of locally available herbicides. Note: investigate this for fertilisers also, including FDP.</p> <p>a) Pre-emergent herbicide in rice Pretilachlor</p> <ol style="list-style-type: none"> 1. AI : Pretilachlor 300g/L+safener 2. Brand name: Sofit Syngenta 3. Used to control: Grasses, sedges and broadleaves 4. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 5. Application: Wet direct seeded 0-3 DAS <p>Butachlor</p> <ol style="list-style-type: none"> 1. Active Chemical: Butaclor 60% 2. Brand name: Taco600EC 3. Company name: Guangzhou Pesticide factory 4. Used to control: Grasses, sedges and broadleaves 5. The usage: 25ml-30ml/1000m2 (Spray volume: 200L water/ha) 6. Application: Wet direct seeded 1-4 DAS <p>B) Post emergence herbicide in rice at SVR Power</p> <ol style="list-style-type: none"> 1. Active Chemical: Quinchlorac 2. Brand name: Power 3. Company name: Agrotech 4. Used to control: Grasses, sedges and broadleaves 5. The usage: 20g/500m2(Spray volume: 300L/ha)

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					Master 1. Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl 2. Brand name: Master 3. Company name: Agrotech 4. Used to control: sedges and broadleaves 5. The usage: 10g/ha(Spray volume: 200L/ha)
9		Fertiliser 2 @ Panicle Initiation	Koktrap	July-week1 At panicle initiation	Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are: Urea (80 kg/ha). Application timing may vary with variety as this application is linked to crop phenology. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha) Urea may be applied at PI if crop colour suggests N is required.
9			Prateah Lang	July-week1 At panicle initiation	Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (55 kg/ha). Application timing may vary with variety as this application is linked to crop phenology. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha) Urea may be applied at PI if crop colour suggests N is required.
10		Crop maturity and harvest (H1)	1, 2	August-week3 85-100 days after P1	Harvest: Timing will depend on the duration of the variety being grown but will be between 85 and 110 days from planting.
Crop 2-short duration					
NOTE: If water for supplementary irrigation of the second crop is unavailable, then the production of vegetables, forages, pulses or other cash crops should be considered as alternative land-use options					
11	2	Stubble removal	1, 2	August-week4 2 days after harvest1	Stubble management: to be cut at 10-15 cm above the soil to minimise the crop transition time (facilitate ploughing, reduce N tie up) and removed from the field (animal feeding?)
13		Tillage 1	1, 2	August-week4 6 days after harvest1	Tillage undertaken after sufficient rainfall or irrigation when pond water at a depth of >5mm for >3 days. Tillage is assumed to be done with a power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
14		Manure and/or slow release fertiliser	1, 2	August-week4 7 days after harvest1	Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available.

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					Slow release compressed block fertiliser (e.g. FDP) (if being used): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.
12		Irrigation prior to T2	1, 2	August-week4 7 days after harvest1	If no rain, add water, to ensure soil surface is wet and suitable for drum seeding.
15		Tillage 2	1, 2	August-week4 7 days after harvest 1	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
16		Establishment - drum seeding or hand broadcasting (P2)	1, 2	August-week4 7 days after harvest1	Drum seeding: Seed soaked for 12 hours and allowed to sit for 12 hours before being sown at a rate of 80 kg/ha (dry seed weight) Hand broadcast: Seed soaked for 24 hours and allowed to sit for 24 hours before being sown at a rate of 150-200 kg/ha (dry seed weight) (rate 15 to 20g/m ²) (dry seed weight)
4		Irrigation through season	1, 2	As required to maintain pond water level at 15cm.	Irrigations to be applied during the season to maintain water levels at 15cm, timing of this will be dependent on rainfall and availability of irrigation water.
17		Fertiliser 1	Koktrap	September-week3 15 days after P2 or as indicated in Note 14	Urea (50 kg/ha); DAP (75kg/ha); KCl (50 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. KCl application may be split between the 15 DAS application and the PI application. Note: Where slow release fertiliser (e.g. FDP) is used as a basal, no additional fertiliser is applied in-crop at 15 DAS although a top-up of N may be required at PI.
17			Prateah Lang	September-week3 15 days after P2 or as indicated in Note 14	Urea (35 kg/ha); DAP (50kg/ha); KCl (50 kg/ha). May be applied as a basal (Note 14). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. KCl application may be split between the 15 DAS application and the PI application. Note: Where slow release fertiliser (e.g. FDP) is used as a basal, no additional fertiliser is applied in-crop at 15 DAS although a top-up of N may be required at PI.
18		Weed control	1, 2	September-week3 15 days after P2	Hand weeding or Chemical weed control. Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings. ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					<p>is available in local markets. Suggest including a photo of labels of locally available herbicides. Note: investigate this for fertilisers also, including FDP.</p> <p>a) Pre-emergent herbicide in rice Pretilachlor 1. AI : Pretilachlor 300g/L+safener 2. Brand name: Sofit Syngenta 3. Used to control: Grasses, sedges and broadleaves 4. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 5. Application: Wet direct seeded 0-3 DAS</p> <p>Butachlor 1. Active Chemical: Butaclor 60% 2. Brand name: Taco600EC 3. Company name: Guangzhou Pesticide factory 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 25ml-30ml/1000m2 (Spray volume: 200L water/ha) 6. Application: Wet direct seeded 1-4 DAS</p> <p>B) Post emergence herbicide in rice at SVR Power 1. Active Chemical: Quinchlorac 2. Brand name: Power 3. Company name: Agrotech 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 20g/500m2(Spray volume: 300L/ha)</p> <p>Master 1. Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl 2. Brand name: Master 3. Company name: Agrotech 4. Used to control: sedges and broadleaves 5. Rate: 10g/ha(Spray volume: 200L/ha)</p>
19		Fertiliser 2	Koktrap	At panicle initiation around October-week3	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (80 kg/ha). Application timing will vary with rice variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although</p>

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.
19			Prateah Lang	At panicle initiation around October-week3	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (55 kg/ha). Application timing will vary with crop variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.</p>
20		Crop maturity and harvest (H2)	1, 2	December-week1 85-100 days after P2)	Harvest: Timing will depend on the duration of the variety being grown but will be between 85 and 110 days from planting.

Koktrap¹; Prateah Lang²

1 (b). Short duration rice-double cropped-direct seeded-rainfed

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
Crop 1-short duration					
1	1	Tillage 1 (T1)	1, 2	May-week1 to May-week4	Tillage undertaken after sufficient rainfall when pond water at a depth of >5mm for >3 days. Tillage is assumed to be done with power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
2		Manure and/or slow release fertiliser	1, 2	5 days after T1 May-week1 to June-week1	<p>Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available.</p> <p>Slow release compressed block fertiliser (e.g. FDP) (if being used): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.</p>
3		Tillage 2 (T2)	1, 2	7 days after T1 May-week1 to June-week1	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
4		Establishment - drum seeding or hand broadcasting (P1)	1, 2	7 days after T1 May-week2 to June-week1	<p>Drum seeding: Seed soaked for 12 hours and allowed to sit for 12 hours before being sown at a rate of 80 kg/ha (dry seed weight)</p> <p>Hand broadcast: Seed soaked for 24 hours and allowed to sit for 24 hours before being sown at a rate of 150-200 kg/ha (dry seed weight) (rate 15 to 20g/m²) (dry seed weight)</p>
5		Fertiliser 1	Koktrap	15 days after T1 May-week4 to June-week4 or as indicated in Note 2	<p>Urea (50 kg/ha); DAP (75kg/ha); KCl (50 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm in depth but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application.</p> <p>Note: Where slow release fertiliser (e.g. FDP) is used as a basal, no additional fertiliser is applied in-crop at 15 DAS although additional N may be required at PI.</p>
5			Prateah Lang	15 days after T1 May-week4 to June-week4 or as indicated in Note 2	<p>Urea (35 kg/ha); DAP (50kg/ha); KCl (50 kg/ha). May be applied as a basal (Note 2). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. KCl application may be split between the 15 DAS application and the PI application.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although additional N may be required at PI.</p>
6		Weed control	1, 2	15 days after T1	Hand weeding

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
				May-week4 to June-week4	<p>or Chemical weed control. Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings.</p> <p>ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what is available in local markets. Suggest including a photo of labels of locally available herbicides. Note: investigate this for fertilisers also, including FDP.</p> <p>a) Pre-emergent herbicide in rice Pretilachlor 1. Al : Pretilachlor 300g/L+safener 2. Brand name: Sofit Syngenta 3. Used to control: Grasses, sedges and broadleaves 4. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 5. Application: Wet direct seeded 0-3 DAS</p> <p>Butachlor 1. Active Chemical: Butaclor 60% 2. Brand name: Taco600EC 3. Company name: Guangzhou Pesticide factory 4. Used to control: Grasses, sedges and broadleaves 5. The usage: 25ml-30ml/1000m2 (Spray volume: 200L water/ha) 6. Application: Wet direct seeded 1-4 DAS</p> <p>B) Post emergence herbicide in rice at SVR Power 1. Active Chemical: Quinchlorac 2. Brand name: Power 3. Company name: Agrotech 4. Used to control: Grasses, sedges and broadleaves 5. The usage: 20g/500m2(Spray volume: 300L/ha)</p> <p>Master 1. Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl 2. Brand name: Master 3. Company name: Agrotech 4. Used to control: sedges and broadleaves</p>

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					5. The usage: 10g/ha(Spray volume: 200L/ha)
7		Fertiliser 2 @ Panicle Initiation	Koktrap	At PI from July-week1 to July-week4	Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (80 kg/ha). Application timing will vary with rice variety as this application is linked to crop phenology. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.
7			Prateah Lang	At PI from July-week1 to July-week4	Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (55 kg/ha). Application timing will vary with crop variety as this application is linked to crop phenology. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.
8		Crop maturity and harvest (H1)	1, 2	Aug-week3 to Sept-week2	Harvest: Timing will depend on the duration of the variety being grown but will be between 85 and 110 days from planting.
Crop 2-short duration					
9		Stubble removal	1, 2	2 days after H1 Aug-week3 to Sept-week2	Stubble management: to be cut at 10-15cm above the soil to minimise the crop transition time (facilitate ploughing, reduce N tie up) and removed from the field (animal feeding?)
10	2	Tillage 1	1, 2	6 days after H1 Aug-week3 to Sept-week2	Tillage undertaken after sufficient rainfall when pond water at a depth of >5mm for >3 days. Tillage is assumed to be done with power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
11		Manure and/or slow release fertiliser	1, 2	7 days after H1 Aug-week4 to Sept-week2	Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available. Slow release compressed block fertiliser (e.g. FDP) (if being used): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.
12		Tillage 2	1, 2	7 days after H1 Aug-week4 to Sept-week2	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
13		Establishment - drum	1, 2	Aug-week4 to Sept-	Drum seeding: Seed soaked for 12 hours and allowed to sit for 12 hours before being sown at a rate of

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
		seeding or hand broadcasting (P2)		week2	80 kg/ha (dry seed weight) Hand broadcast: Seed soaked for 24 hours and allowed to sit for 24 hours before being sown at a rate of 150-200 kg/ha (dry seed weight) (rate 15 to 20g/m ²) (dry seed weight)
14		Fertiliser 1	Koktrap	Sept-week2 and week4 15 days after P2 or as indicated in Note 11	Urea (50 kg/ha); DAP (75kg/ha); KCl (50 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm in depth but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although additional N may be required at PI.
14			Prateah Lang	Sept-week2 and week4 15 days after P2 or as indicated in Note 11	Urea (35 kg/ha); DAP (50kg/ha); KCl (50 kg/ha). May be applied as a basal (Note 11). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although additional N may be required at PI.
15		Weed control	1, 2	Aug-week2 and week4	Hand weeding or Chemical weed control. Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings. ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what is available in local markets. Suggest including a photo of labels of locally available herbicides. Note: investigate this for fertilisers also, including FDP. a) Pre-emergent herbicide in rice Pretilachlor 1. AI : Pretilachlor 300g/L+safener 2. Brand name: Sofit Syngenta 3. Used to control: Grasses, sedges and broadleaves 4. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 5. Application: Wet direct seeded 0-3 DAS Butachlor 1. Active Chemical: Butaclor 60% 2. Brand name: Taco600EC 3. Company name: Guangzhou Pesticide factory

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					<p>4. Used to control: Grasses, sedges and broadleaves</p> <p>5. Rate: 25ml-30ml/1000m² (Spray volume: 200L water/ha)</p> <p>6. Application: Wet direct seeded 1-4 DAS</p> <p>B) Post emergence herbicide in rice at SVR</p> <p>Power</p> <p>1. Active Chemical: Quinchlorac</p> <p>2. Brand name: Power</p> <p>3. Company name: Agrotech</p> <p>4. Used to control: Grasses, sedges and broadleaves</p> <p>5. Rate: 20g/500m²(Spray volume: 300L/ha)</p> <p>Master</p> <p>1. Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl</p> <p>2. Brand name: Master</p> <p>3. Company name: Agrotech</p> <p>4. Used to control: sedges and broadleaves</p> <p>5. Rate: 10g/ha(Spray volume: 200L/ha)</p>
16		Fertiliser 2 @ panicle initiation	Koktrap	At PI from October-week3 to November-week1	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (80 kg/ha). Application timing will vary with rice variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.</p>
16			Prateah Lang	At PI from October-week3 to November-week1	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (55 kg/ha). Application timing will vary with crop variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.</p>
17		Crop maturity and harvest	1, 2	December-week1 to week 3 85-100 days after P2	Harvest: Timing will depend on the duration of the variety being grown but will be between 85 and 110 days from planting.

Koktrap¹; Prateah Lang²

2. Short duration double cropped rice followed by medium duration photo-period sensitive CARDI variety rice-rainfed, direct seeded (crop1), transplanted (Crop2)

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
Crop 1-short duration					
1	1	Tillage 1 (T1)	1, 2	May-week1 to May-week4	Tillage undertaken after sufficient rainfall when pond water at a depth of >5mm for >3 days. Tillage is assumed to be done with power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
2		Manure and/or slow release fertiliser	1, 2	5 days after T1 May-week1 to June-week1	<p>Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available.</p> <p>Slow release compressed block fertiliser (e.g. FDP) (if being used): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.</p>
3		Tillage 2 (T2)	1, 2	7 days after T1 May-week1 to June-week1	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
4		Establishment - drum seeding or hand broadcasting (P1)	1, 2	7 days after T1 May-week2 to June-week1	<p>Drum seeding: Seed soaked for 12 hours and allowed to sit for 12 hours before being sown at a rate of 80 kg/ha (dry seed weight)</p> <p>Hand broadcast: Seed soaked for 24 hours and allowed to sit for 24 hours before being sown at a rate of 150-200 kg/ha (dry seed weight) (rate 15 to 20g/m²) (dry seed weight)</p>
5		Fertiliser 1	Koktrap	15 days after T1 May-week4 to June-week4 or as indicated in Note 2	<p>Urea (50 kg/ha); DAP (75kg/ha); KCl (50 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. KCl application may be split between the 15 DAS application and the PI application.</p> <p>Note: Where slow release fertiliser (e.g. FDP) is used as a basal, no additional fertiliser is applied in-crop at 15 DAS although a top-up of Urea may be required at PI.</p>
5			Prateah Lang	15 days after T1 May-week4 to June-week4 or as indicated in Note 2	<p>Urea (35 kg/ha); DAP (50kg/ha); KCl (50 kg/ha). May be applied as a basal (Note 2). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although N</p>

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					may be required at PI.
6		Weed control	1, 2	15 days after T1 May-week4 to June-week4	<p>Hand weeding or Chemical weed control. Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings.</p> <p>ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what is available in local markets. Suggest including a photo of labels of locally available herbicides. Note: investigate this for fertilisers also, including FDP.</p> <p>a) Pre-emergent herbicide in rice Pretilachlor 6. AI : Pretilachlor 300g/L+safener 7. Brand name: Sofit Syngenta 8. Used to control: Grasses, sedges and broadleaves 9. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 10. Application: Wet direct seeded 0-3 DAS</p> <p>Butachlor 7. Active Chemical: Butaclor 60% 8. Brand name: Taco600EC 9. Company name: Guangzhou Pesticide factory 10. Used to control: Grasses, sedges and broadleaves 11. The usage: 25ml-30ml/1000m2 (Spray volume: 200L water/ha) 12. Application: Wet direct seeded 1-4 DAS</p> <p>B) Post emergence herbicide in rice at SVR Power 6. Active Chemical: Quinchlorac 7. Brand name: Power 8. Company name: Agrotech 9. Used to control: Grasses, sedges and broadleaves 10. The usage: 20g/500m2(Spray volume: 300L/ha)</p> <p>Master 6. Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl</p>

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					7. Brand name: Master 8. Company name: Agrotech 9. Used to control: sedges and broadleaves 10. The usage: 10g/ha(Spray volume: 200L/ha)
7		Fertiliser 2 @ Panicle Initiation	Koktrap	At PI from July-week1 to July-week4	Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (80 kg/ha). Application timing will vary with rice variety as this application is linked to crop phenology. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.
7			Prateah Lang	At PI from July-week1 to July-week4	Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (55 kg/ha). Application timing will vary with crop variety as this application is linked to crop phenology. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.
8		Crop maturity and harvest (H1)	1, 2	Aug-week3 to Sept-week2	Harvest: Timing will depend on the duration of the variety being grown but will be between 85 and 110 days from planting. Note: A second crop should not be attempted if Harvest 1 occurs after the end of August
Crop 2-medium duration					
9	1	Seedling nursery	1, 2	July-week4 to Aug-week1	Seedling nursery established for medium duration, photo period sensitive CARDI variety. This is only possible if there is sufficient rainfall at nursery establishment.
10		Stubble removal	1, 2	2 days after H1 Aug-week3 to Sept-week1	Stubble management: to be cut at 10-15cm above the soil to minimise the crop transition time (facilitate ploughing, reduce N tie up) and removed from the field (animal feeding?)
11	2	Tillage 1	1, 2	6 days after H1 Aug-week3 to Sept-week1	Tillage undertaken after sufficient rainfall when pond water at a depth of >5mm for >3 days. Tillage is assumed to be done with power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
12		Manure/ basal or slow release fertiliser	Koktrap	7 days after H1 Aug-week4 to Sept-week1	Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available.

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					<p>Slow release compressed block fertiliser (e.g. FDP) (if being used): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.</p> <p>or</p> <p>Fertiliser Basal (for transplanted crops): Basal fertiliser will be applied prior to the second tillage. Urea (50 kg/ha); DAP (75kg/ha); KCl (50 kg/ha) instead of at 30DAS (N7). Direct seeded crops will have fertiliser applied at 30DAS.</p>
			Prateah Lang	7 days after H1 Aug-week4 to Sept-week1	<p>Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available.</p> <p>Slow release compressed block fertiliser (e.g. FDP) (if being used): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.</p> <p>or</p> <p>Fertiliser Basal (for transplanted crops): Basal fertiliser will be applied prior to the second tillage. Urea (35 kg/ha); DAP (75kg/ha); KCl (50 kg/ha) instead of at 30DAS (N7). Direct seeded crops will have fertiliser applied at 30DAS.</p>
13		Tillage 2	1, 2	7 days after H1 Aug-week4 to Sept-week1	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
14		Establishment - transplanted (P2)	1, 2	Aug-week3 and week 4	<p>Transplanting: 3-4 seedlings planted in hills spaced at 20 x 20cm configuration or 2-3 seedlings planted in hills spaced at 15 x 15cm.</p> <p>Note: A second crop should not be attempted if Harvest 1 occurs after the end of August</p>
15		Weed control	1, 2	Sept-week2 to Oct-week1	<p>Hand weeding</p> <p>or</p> <p>Chemical weed control.</p> <p>Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings.</p> <p>ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what is available in local markets. Suggest including a photo of labels of locally available herbicides.</p> <p>Note: investigate this for fertilisers also, including FDP.</p>

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					<p>a) Pre-emergent herbicide in rice</p> <p>Pretilachlor</p> <ol style="list-style-type: none"> 1. AI : Pretilachlor 300g/L+safener 2. Brand name: Sofit Syngenta 3. Used to control: Grasses, sedges and broadleaves 4. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 5. Application: Wet direct seeded 0-3 DAS <p>Butachlor</p> <ol style="list-style-type: none"> 1. Active Chemical: Butaclor 60% 2. Brand name: Taco600EC 3. Company name: Guangzhou Pesticide factory 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 25ml-30ml/1000m2 (Spray volume: 200L water/ha) 6. Application: Wet direct seeded 1-4 DAS <p>B) Post emergence herbicide in rice at SVR</p> <p>Power</p> <ol style="list-style-type: none"> 1. Active Chemical: Quinchlorac 2. Brand name: Power 3. Company name: Agrotech 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 20g/500m2(Spray volume: 300L/ha) <p>Master</p> <ol style="list-style-type: none"> 1. Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl 2. Brand name: Master 3. Company name: Agrotech 4. Used to control: sedges and broadleaves 5. Rate: 10g/ha(Spray volume: 200L/ha)
16		Fertiliser 1 -30 days after transplant/ establishment	Koktrap	Sept-week4 to Oct-week1	<p>Apply Urea (63 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 30DAS application and the PI application.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although a top up of N may be required at PI.</p>

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
			Prateah Lang	Sept-week4 to Oct-week1	<p>Apply Urea (43 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 30DAS application and the PI application.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although a top up of N may be required at PI.</p>
17		Fertiliser 2 @ Panicle Initiation	Koktrap	Oct-week3 to Oct-week4	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (48 kg/ha). Application timing will vary with rice variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although 20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.</p>
			Prateah Lang	Oct-week3 to Oct-week4	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (33 kg/ha). Application timing will vary with crop variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although 20kg/ha N (44kg/ha) Urea may be required at PI if crop colour suggests N is required.</p>
18		Crop maturity and harvest (H1)	1, 2	Nov-week3 to Dec-week2	<p>Harvest: Because of the photo-period sensitivity of the variety, maturity will vary but is likely to be 100-110 days from nursery establishment.</p>

3(a). Short duration rice-single cropped-direct seeded-rainfed:

(where only 1 crop is planned or the rains start late and it is not possible to grow a sequence of 2 short duration crops - assume direct seeding (but could also be transplanted))

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
Single crop-short duration					
1	1	Tillage 1 (T1)	1, 2	June-week1 to Aug-week3	Tillage undertaken after sufficient rainfall when pond water at a depth of >5mm for >3 days. Tillage is assumed to be done with power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
2		Manure and/or slow release fertiliser	1, 2	5 days after T1 June-week1 to Aug-week4	Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available. Slow release compressed block fertiliser (e.g. FDP) (if being used): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.
3		Tillage 2	1, 2	7 days after T1 June-week2 to Aug-week4	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
4		Establishment - drum seeding or hand broadcasting (P1)	1, 2	7 days after T1 June-week2 to Sept-week1	Drum seeding: Seed soaked overnight and sown at 120 kg/ha Hand broadcast: Seed soaked overnight and spread at 120 kg/ha (rate 12g/m ²) Note: Varieties of >100 days to maturity should not be planted after August week 4, only shorter duration varieties should be planted during this period e.g. IR66 or Vn504
5		Fertiliser 1	Koktrap	15 days after T1 June-week3 to Sept-week4 or as indicated in Note 2	Urea (50 kg/ha); DAP (75kg/ha); KCl (50 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm in depth but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. Note: Where slow release fertiliser (e.g. FDP) is used as a basal, no additional fertiliser is applied in-crop at 15 DAS although a top-up of N may be required at PI.
5			Prateah Lang	15 days after T1 June-week3 to Sept-week4 or as indicated in Note 2	Urea (35 kg/ha); DAP (50kg/ha); KCl (50 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm in depth but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. Note: Where slow release fertiliser (e.g. FDP) is used as a basal, no additional fertiliser is applied in-crop at 15 DAS although a top-up of N may be required at PI.

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
6		Weed control	1, 2	15 days after T1 June-week3 to Sept-week4	<p>Hand weeding or Chemical weed control. Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings.</p> <p>ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what is available in local markets. Suggest including a photo of labels of locally available herbicides. Note: investigate this for fertilisers also, including FDP.</p> <p>a) Pre-emergent herbicide in rice Pretilachlor 1. AI : Pretilachlor 300g/L+safener 2. Brand name: Sofit Syngenta 3. Used to control: Grasses, sedges and broadleaves 4. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 5. Application: Wet direct seeded 0-3 DAS</p> <p>Butachlor 1. Active Chemical: Butaclor 60% 2. Brand name: Taco600EC 3. Company name: Guangzhou Pesticide factory 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 25ml-30ml/1000m2 (Spray volume: 200L water/ha) 6. Application: Wet direct seeded 1-4 DAS</p> <p>B) Post emergence herbicide in rice at SVR Power 1. Active Chemical: Quinchlorac 2. Brand name: Power 3. Company name: Agrotech 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 20g/500m2(Spray volume: 300L/ha)</p> <p>Master 1. Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl 2. Brand name: Master 3. Company name: Agrotech</p>

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					<p>4. Used to control: sedges and broadleaves</p> <p>5. Rate: 10g/ha(Spray volume: 200L/ha)</p> <p>** Note for ag extension workers that they need to check for BPH risk – critical stage is max tillering (booting and flowering most risky for plant growth, but water can control). Suggest that DRC may want to include advice for other pests also</p>
7		Fertiliser 2 @ Panicle Initiation	Koktrap	Aug-week1 to Oct-week4	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are: Urea (80 kg/ha). Application timing will vary with rice variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser (e.g.FDP) is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha Urea) may be required at PI if crop colour suggests N is required.</p>
7			Prateah Lang	Aug-week1 to Oct-week4	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are: Urea (55 kg/ha). Application timing will vary with crop variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser (e.g.FDP) is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha Urea) may be required at PI if crop colour suggests N is required.</p>
8		Crop maturity and harvest (H1)	1, 2	Sept-week3 to Dec-week4	<p>Harvest: Timing will depend on the short duration variety planted but will be between 85 and 110 days after P1.</p> <p>Agreement from PDA SR that end Dec is hard deadline for harvest in 'normal' years.</p>

3(b). Short duration rice-single cropped-direct seeded-supplementary irrigation

(where only 1 crop is planned or the rains start late and it is not possible to grow a sequence of 2 short duration crops - assume direct seeding (but could also be transplanted))

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
Single crop-short duration					
1	1	Tillage 1 (T1)	1, 2	May-week1 to Aug-week3	Tillage undertaken after sufficient rainfall or irrigation when pond water at a depth of >5mm for >3 days. Tillage is assumed to be done with power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
2		Manure and/or slow release fertiliser	1, 2	5 days after T1 May-week1 to Aug-week4	Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available. Slow release compressed block fertiliser (e.g. FDP) (if being used): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.
3		Tillage 2	1, 2	7 days after T1 May-week2 to Aug-week4	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
4		Establishment - drum seeding or hand broadcasting (P1)	1, 2	7 days after T1 May-week2 to Sept-week1	Drum seeding: Seed soaked overnight and sown at 120 kg/ha Hand broadcast: Seed soaked overnight and spread at 120 kg/ha (rate 12g/m ²) Note: Varieties of >100 days to maturity should not be planted after August week 4, only shorter duration varieties should be planted during this period e.g. IR66 or Vn504
5		Fertiliser 1	Koktrap	15 days after T1 May-week3 to Sept-week4 or as indicated in Note 2	Urea (50 kg/ha); DAP (75kg/ha); KCl (50 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm in depth but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application. Note: Where slow release fertiliser (e.g. FDP) is used as a basal, no additional fertiliser is applied in-crop at 15 DAS although a top-up of N may be required at PI.
5			Prateah Lang	15 days after T1 May-week3 to Sept-week4 or as indicated in Note 2	Urea (35 kg/ha); DAP (50kg/ha); KCl (50 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm in depth but when the whole soil surface is covered. KCl application may be split between the 15 DAS application and the PI application.

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					Note: Where slow release fertiliser (e.g. FDP) is used as a basal, no additional fertiliser is applied in-crop at 15 DAS although a top-up of N may be required at PI.
6		Weed control	1, 2	15 days after T1 May-week3 to Sept-week4	<p>Hand weeding or Chemical weed control. Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings.</p> <p>ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what is available in local markets. Suggest including a photo of labels of locally available herbicides. Note: investigate this for fertilisers also, including FDP.</p> <p>a) Pre-emergent herbicide in rice Pretilachlor</p> <ol style="list-style-type: none"> 1. AI : Pretilachlor 300g/L+safener 2. Brand name: Sofit Syngenta 3. Used to control: Grasses, sedges and broadleaves 4. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 5. Application: Wet direct seeded 0-3 DAS <p>Butachlor</p> <ol style="list-style-type: none"> 1. Active Chemical: Butaclor 60% 2. Brand name: Taco600EC 3. Company name: Guangzhou Pesticide factory 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 25ml-30ml/1000m2 (Spray volume: 200L water/ha) 6. Application: Wet direct seeded 1-4 DAS <p>B) Post emergence herbicide in rice at SVR Power</p> <ol style="list-style-type: none"> 1. Active Chemical: Quinchlorac 2. Brand name: Power 3. Company name: Agrotech 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 20g/500m2(Spray volume: 300L/ha) <p>Master</p>

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					<ol style="list-style-type: none"> Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl Brand name: Master Company name: Agrotech Used to control: sedges and broadleaves Rate: 10g/ha(Spray volume: 200L/ha) <p>** Note for ag extension workers that they need to check for BPH risk – critical stage is max tillering (booting and flowering most risky for plant growth, but water can control). Suggest that DRC may want to include advice for other pests also</p>
7		Fertiliser 2 @ Panicle Initiation	Koktrap	July-week1 to Nov-week1	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are: Urea (80 kg/ha). Application timing will vary with rice variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser (e.g.FDP) is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha Urea) may be required at PI if crop colour suggests N is required.</p>
7			Prateah Lang	Aug-week1 to Nov-week1	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are: Urea (55 kg/ha). Application timing will vary with crop variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser (e.g.FDP) is used, no additional fertiliser is applied in-crop at 15 DAS although 20kg/ha N (44kg/ha Urea) may be required at PI if crop colour suggests N is required.</p>
8		Crop maturity and harvest (H1)	1, 2	Aug-week3 to Dec-week4	<p>Harvest: Timing will depend on the short duration variety planted but will be between 85 and 110 days after P1.</p> <p>Agreement from PDA SR that end Dec is hard deadline for harvest in 'normal' years.</p>

4 (a). Medium duration rice-single crop –direct seeded or transplanted-supplementary irrigation

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
Single crop-medium duration					
1	1	Seedling nursery	1, 2	May-week4 to June-week2	Seedling nursery established if required
2		Tillage 1 (T1)	1, 2	June-week1 to June-week3	Tillage undertaken after sufficient rainfall when pond water at a depth of >5mm for >3 days. Tillage is assumed to be done with power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
3		Manure/ basal or slow release fertiliser	Koktrap	June-week3 to June-week1	<p>Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available.</p> <p>Fertiliser Basal: Applied before the second tillage. Urea (18 kg/ha); DAP (75kg/ha); KCl (50 kg/ha). Note that fertiliser rate varies with soil type.</p> <p>or</p> <p>Slow release compressed block fertiliser (e.g. FDP): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.</p>
			Prateah Lang	June-week3 to June-week1	<p>Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available.</p> <p>Fertiliser Basal: Fertiliser will be applied before the second tillage. Urea (13 kg/ha); DAP (50kg/ha); KCl (50 kg/ha). Note that fertiliser rate varies with soil type.</p> <p>or</p> <p>Slow release compressed block fertiliser (e.g. FDP): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.</p>
4		Tillage 2 (T2)	1, 2	June-week3 to June-week1	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
5		Establishment – transplanting, drum seeding	1, 2	June-week4 to July-week2	Transplanting: 2-3 seedlings planted in hills spaced at 20 x 20cm configuration

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
		or hand broadcasting (P1)			Drum seeding: Seed soaked for 12 hours and allowed to sit for 12 hours before being sown at a rate of 80 kg/ha (dry seed weight) Hand broadcast: Seed soaked for 24 hours and allowed to sit for 24 hours before being sown at a rate of 150-200 kg/ha (dry seed weight) (rate 15 to 20g/m ²) (dry seed weight)
6		Weed control	1, 2	July-week2 to July-week4	<p>Hand weeding or Chemical weed control. Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings.</p> <p>ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what is available in local markets. Suggest including a photo of labels of locally available herbicides. Note: investigate this for fertilisers also, including FDP.</p> <p>a) Pre-emergent herbicide in rice Pretilachlor</p> <ol style="list-style-type: none"> 1. AI : Pretilachlor 300g/L+safener 2. Brand name: Sofit Syngenta 3. Used to control: Grasses, sedges and broadleaves 4. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 5. Application: Wet direct seeded 0-3 DAS <p>Butachlor</p> <ol style="list-style-type: none"> 1. Active Chemical: Butaclor 60% 2. Brand name: Taco600EC 3. Company name: Guangzhou Pesticide factory 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 25ml-30ml/1000m² (Spray volume: 200L water/ha) 6. Application: Wet direct seeded 1-4 DAS <p>B) Post emergence herbicide in rice at SVR Power</p> <ol style="list-style-type: none"> 1. Active Chemical: Quinchlorac 2. Brand name: Power 3. Company name: Agrotech 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 20g/500m²(Spray volume: 300L/ha)

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					Master 1. Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl 2. Brand name: Master 3. Company name: Agrotech 4. Used to control: sedges and broadleaves 5. Rate: 10g/ha(Spray volume: 200L/ha)
7		Fertiliser 1 -30 days after direct seeding establishment	Koktrap	July-week4 to Aug-week2	Direct seeded crops: Urea (63 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 30DAS application and the PI application. NOTE: transplanted crops have basal application prior to T2 (see N5) Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although a top up of N may be required at PI.
			Prateah Lang	July-week4 to Aug-week2	Direct seeded crops: Urea (43 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 30DAS application and the PI application. NOTE: transplanted crops have basal application prior to T2 (see N5) Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although a top up of N may be required at PI.
8		Fertiliser 2 @ Panicle Initiation	Koktrap	Sept-week1 to Sept-week3	Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (48 kg/ha). Application timing will vary with rice variety as this application is linked to crop phenology. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although 20kg/ha N (44kg/ha Urea) may be required at PI if crop colour suggests N is required.
			Prateah Lang	Sept-week1 to Sept-week3	Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (33 kg/ha). Application timing will vary with crop variety as this application is linked to crop phenology. Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although 20kg/ha N (44kg/ha Urea) may be required at PI if crop colour suggests N is required.
9		Crop maturity and harvest (H1)	1, 2	Nov-week3 to Dec-week1	Harvest: Timing will depend on variety length but will be between 120 and 140 days from planting.

4b). Medium duration rice-single crop-direct seeded or transplanted-rainfed

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
Single crop-medium duration					
1	1	Seedling nursery	1, 2	June-week1-week2	Seedling nursery established if required
2		Tillage 1 (T1)	1, 2	June-week1-week2	Tillage undertaken after sufficient rainfall when pond water at a depth of >5mm for >3 days. Tillage is assumed to be done with power tiller. Harrowing and levelling (which are the main reasons for the second tillage) may be done as part of T1 if later access to a power tiller is likely to be difficult.
3		Manure/ basal or slow release fertiliser	Koktrap	June-week2-week3	<p>Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available.</p> <p>Fertiliser Basal: Applied before the second tillage. Urea (18 kg/ha); DAP (75kg/ha); KCl (50 kg/ha). Note that fertiliser rate varies with soil type.</p> <p>or</p> <p>Slow release compressed block fertiliser (e.g. FDP): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.</p>
			Prateah Lang	June-week2-week3	<p>Manure: it is difficult to be definitive regarding manure application due to the variability in supply. When available, manure is to be applied prior to T2. The recommended rate is 5000kg/ha (dry weight) but a more typical rate is likely to be 300 to 500 kg/ha (dry weight). Apply whatever is available.</p> <p>Fertiliser Basal: Fertiliser will be applied before the second tillage. Urea (13 kg/ha); DAP (50kg/ha); KCl (50 kg/ha). Note that fertiliser rate varies with soil type.</p> <p>or</p> <p>Slow release compressed block fertiliser (e.g. FDP): incorporate at a rate of 180kg/ha prior to tillage 2 (assuming FDP nutrient concentrations). Where a slow release fertiliser is used, no additional fertiliser is applied at 15 DAS (days after sowing) although extra N may be required at Panicle Initiation (PI), depending on crop performance.</p>
4		Tillage 2 (T2)	1, 2	July-week2-week3	Tillage undertaken. Assumed to be done with power tiller (see T1 regarding harrowing option)
5		Establishment – transplanting, drum seeding	1, 2	July-week2-week3	Transplanting: 2-3 seedlings planted in hills spaced at 20 x 20cm configuration

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
		or hand broadcasting (P1)			Drum seeding: Seed soaked for 12 hours and allowed to sit for 12 hours before being sown at a rate of 80 kg/ha (dry seed weight) Hand broadcast: Seed soaked for 24 hours and allowed to sit for 24 hours before being sown at a rate of 150-200 kg/ha (dry seed weight) (rate 15 to 20g/m ²) (dry seed weight)
6		Weed control	1, 2	Aug Week1-week2	<p>Hand weeding or Chemical weed control. Herbicide either applied in a granular form mixed with the fertiliser or as a liquid using a hand sprayer. Granular application is not recommended due to a lower chemical efficiency but is being used by farmers due to the labour savings.</p> <p>ACTION: List trade names (must be registered with Ministry Ag by active ingredients) and also check what is available in local markets. Suggest including a photo of labels of locally available herbicides. Note: investigate this for fertilisers also, including FDP.</p> <p>a) Pre-emergent herbicide in rice Pretilachlor 1. AI : Pretilachlor 300g/L+safener 2. Brand name: Sofit Syngenta 3. Used to control: Grasses, sedges and broadleaves 4. Rate : 1 to 1.5 L / ha 2) spray volume: 160 to 224 L /ha 5. Application: Wet direct seeded 0-3 DAS</p> <p>Butachlor 1. Active Chemical: Butaclor 60% 2. Brand name: Taco600EC 3. Company name: Guangzhou Pesticide factory 4. Used to control: Grasses, sedges and broadleaves 5. Rate: 25ml-30ml/1000m² (Spray volume: 200L water/ha) 6. Application: Wet direct seeded 1-4 DAS</p> <p>B) Post emergence herbicide in rice at SVR Power 1. Active Chemical: Quinchlorac 2. Brand name: Power 3. Company name: Agrotech 4. Used to control: Grasses, sedges and broadleaves</p>

Note	Crop	Action	Soil type ^{1,2}	Timing window	Rules
					<p>5. Rate: 20g/500m2(Spray volume: 300L/ha)</p> <p>Master</p> <ol style="list-style-type: none"> 1. Active Chemical: Chlorinuron Ethyl+ Metsulfuron Methyl 2. Brand name: Master 3. Company name: Agrotech 4. Used to control: sedges and broadleaves 5. Rate: 10g/ha(Spray volume: 200L/ha)
7		Fertiliser 1 -30 days after direct seeding establishment	Koktrap	Aug-week2-week3	<p>Direct seeded crops: Urea (63 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 30DAS application and the PI application. NOTE: transplanted crops have basal application prior to T2 (see N5)</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although a top up of N may be required at PI.</p>
			Prateah Lang	Aug-week2-week3	<p>Direct seeded crops: Urea (43 kg/ha). Timing of application of fertiliser should occur when the depth of water in the paddy is <20cm but when the whole soil surface is covered. KCl application may be split between the 30DAS application and the PI application. NOTE: transplanted crops have basal application prior to T2 (see N5)</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although a top up of N may be required at PI.</p>
8		Fertiliser 2 @ Panicle Initiation	Koktrap	Sept-week1 to Sept-week2	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (48 kg/ha). Application timing will vary with rice variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although 20kg/ha N (44kg/ha Urea) may be required at PI if crop colour suggests N is required.</p>
			Prateah Lang	Sept-week1 to Sept-week2	<p>Rates of fertiliser application should be based on crop performance (particularly crop colour), CARDI recommendations are Urea (33 kg/ha). Application timing will vary with crop variety as this application is linked to crop phenology.</p> <p>Note: Where slow release fertiliser is used, no additional fertiliser is applied in-crop at 30 DAS although 20kg/ha N (44kg/ha Urea) may be required at PI if crop colour suggests N is required.</p>
9		Crop maturity and harvest (H1)	1, 2	Nov-week4 to Dec-week2	<p>Harvest: Timing will depend on variety length but will be between 120 and 140 days from planting</p>