

## CHAPTER C3 AGRICULTURAL DEVELOPMENT PLAN

This chapter presents the agricultural development plans formulated for the 21 proposed projects in the four river basins under the present Master Plan.

### C3.1 Battambang River Basin

#### C3.1.1 Present Agriculture in the Project Areas

##### (1) Land Use

The present land uses of the project areas are exclusively paddy fields under different irrigation status. Accordingly, the land uses of the areas are classified depending on current irrigation statuses into the following 5 sub-categories based on the results of the Inventory Survey and the supplemental survey conducted by the Study Team.

#### Classification of Paddy Field Based on Current Irrigation Status

Location of Paddy Field	Land Use Sub-category
Paddy Field in Current Irrigation Command Area	Normal Irrigation Paddy Field
	Supplemental Irrigation Paddy Field
	Paddy Field under Rainfed Condition
	Recession Paddy Field
Paddy Field outside of Current Irrigation Command Area	Rainfed Paddy Field

The present land use of individual project is presented in Table C3-1 and C3-2 in detail and the features of the whole project areas are summarized in the following table.

#### Present Land Use of the Project Areas in the River Basin

Land Use Sub-category	Area		
	(ha)	(%)	(%)
Paddy Field in Current Irrigation Areas			
- Normal Irrigation Paddy Field	353	2	1
- Supplemental Irrigation Paddy Field	2,953	17	11
- Paddy Field under Rainfed Condition	14,124	81	51
- Recession Paddy Field	48	-	-
Sub-total	17,478	100	63
Paddy Field outside of Current Irrigation Command Areas			
- Rainfed Paddy Field	7,373	-	27
Right-of-ways	2,815	-	10
Total	27,666	-	100

As shown in the tables, irrigation water supply conditions in the project areas are very poor and the paddy fields under rainfed conditions account for about 87% of the total paddy fields in the areas.

##### (2) Crop Production

The main cropping season is the wet season in the project areas and the cropping calendar of rice from May/June to December/January is almost exclusive calendar as shown in Table C3-3. Rice is an exclusive crop in paddy fields and an annual cropping intensity of rice is around 102%; wet season 100% and dry season 2%. Direct sowing is a prevailing rice production system in the areas. The current paddy production is estimated at some 30,400 tons/year as shown in Table C3-4 and as summarized below.

### Paddy Production Features in the Project Areas

	Cropped Area	Cropping Intensity	Paddy Production
Wet Season	24,808 ha	100 %	28,800 tons
Dry Season	581 ha	2 %	1,600 tons
Annual	25,389 ha	102 %	30,400 tons

#### C3.1.2 Agricultural Development Plan

The proposed agricultural development plan for individual projects and the overall development features of the projects in the basin are discussed in the followings.

##### C3.1.2.1 Kong Hort Rehabilitation Project: Phase I

###### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

#### Present/Without-project & With-project Land Use of the Project Area

Land Use Sub-category	Present		With-project		Increment
	(ha)	(%)	(ha)	(%)	(ha)
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			10,040	85	10,040
- Supplemental Irrigation Paddy Field	9	0			-9
- Paddy Field under Rainfed Condition	7,026	60			-7,026
Sub-total	7,035	60	10,040	85	3,005
Rainfed Paddy Field	3,525	30	-	-	-3,525
Right-of-ways	1,240	11	1,760	15	520
Total	11,800	100	11,800	100	0

As shown in the table, the development of 10,040 ha of normal irrigation paddy field is aimed at under the project by the conversion of 9 ha of supplemental irrigation fields and 10,551 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system. The decrease of paddy fields due to land use conversion to right-of-ways is estimated at 520 ha

###### (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-5 and summarized in the following table.

#### Present & With-project Crop Production of the Project Area

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		9	0	1.7	15
Rainfed Paddy Field: Wet Season Rice		10,551	100	1.1	11,448
Annual	Rice	10,560	100	1.1	11,463
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		10,040	100	2.9	29,307
Annual	Rice	10,040	100	2.9	29,307
	Upland Crops	90	1	0.5	45
Increment (II - I)					
Annual	Rice	-520	0	1.8	17,844
	Upland Crops	90	1	-	45

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.8 ton/ha from 1.1 to 2.9 ton/ha and annual paddy production increase of some 17,800 tons are expected despite the decrease of cropped area of some 520 ha. The paddy production under the project is about 260% of the current production level in the project area. Upland crops production is limited to be 45 tons, however, successful introduction of the crops in pilot bases through the proposed technology development and extension project will expand the cultivation of the same in the project area in the future.

### (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-6. Major support programs include field programs (adaptability test, demonstration plot, farm & area, seed multiplication), farmer & farmer group training programs (training course, FFS/IPM, study tour etc.), mass guidance/workshop, staff empowerment, support fund for extension staffs, provision of transportation means.

The implementation of the programs is scheduled for the period of 5 years in the project and the overall cost is estimated at US\$ 116,000.

#### C3.1.2.2 Kong Hort Rehabilitation Project: Phase II

### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	236	8	2,685	88	2,449
- Supplemental Irrigation Paddy Field	574	19			-574
- Paddy Field under Rainfed Condition	1,282	42			-1,282
- Recession Paddy Field	48	2	48	2	0
Sub-total	2,140	70	2,733	89	593
Rainfed Paddy Field	744	24			-744
Right-of-ways	182	6	333	11	151
Total	3,066	100	3,066	100	0

As shown in the table, the development of 2,685 ha of normal irrigation paddy field, increase of 2,449 ha from the present level, is aimed at under the project by the conversion of 574 ha of supplemental irrigation fields and 2,026 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system. The decrease of paddy fields due to land use conversion to right-of-ways is estimated at 151 ha

### (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the crop production under the present/with-out condition in Table C3-7 and summarized in the following table.

### Present & With-project Crop Production of the Project Area

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		477	17	2.6	1,235
Supplemental Irrigation Paddy Field: Rice		624	22	1.7	1,035
Rainfed Paddy Field: Wet Season Rice		2,076	72	1.1	2,298
Recession Paddy Field: Dry Season Rice		48	2	2.0	96
Annual	Rice	3,225	112	1.4	4,664
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		2,685	98	2.9	7,837
Recession Paddy Field: Dry Season Rice		48	2	2.5	120
Annual	Rice	2,733	100	2.9	7,957
	Upland Crops	20	1	0.5	10
Increment (II - I)					
Annual	Rice	-492	-12	1.5	3,293
	Upland Crops	20	1	-	10

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.5 ton/ha from 1.4 to 2.9 ton/ha and annual paddy production increase of some 3,300 tons are expected despite the decrease of cropped area of 492 ha. The paddy production under the project is about 170% of the current production level in the project area.

#### (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-8.

The implementation of the programs is scheduled for the period of 4 years in the project and the overall program cost is estimated at US\$ 31,000.

#### C3.1.2.3 Sala Taon Weir Rehabilitation Project

##### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as shown in the following table.

#### Present/Without-project & With-project Land Use of the Project Area

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	117	1	10,400	85	10,283
- Supplemental Irrigation Paddy Field	2,345	19			-2,345
- Paddy Field under Rainfed Condition	5,533	45			-5,533
- Recession Paddy Field					
Sub-total	7,995	66			2,405
Rainfed Paddy Field	2,818	23	10,400	85	-2,818
Right-of-ways	1,393	11	1,806	15	413
Total	12,206	100	12,206	100	0

As shown in the table, the development of 10,400 ha of normal irrigation paddy field is aimed at under the project by the conversion of 2,345 ha of supplemental irrigation fields and 8,351 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system.

**(2) Crop Production Plan**

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-9 and summarized in the following table.

**Present & With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		234	2	2.6	605
Supplemental Irrigation Paddy Field: Rice		2,385	22	1.6	3,817
Rainfed Paddy Field: Wet Season Rice		8,351	777	1.1	9,061
Recession Paddy Field: Dry Season Rice					
Annual	Rice	10,970	101	1.2	13,483
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		10,400	100	2.9	30,358
Recession Paddy Field: Dry Season Rice					
Annual	Rice	10,400	100	2.9	30,358
	Upland Crops	90	1	0.5	45
Increment (II - I)					
Annual	Rice	-570	-1	1.7	16,875
	Upland Crops	90	1	-	45

Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice

As shown in the table, the increase of overall average yield of 1.7 ton/ha from 1.2 to 2.9 ton/ha and annual paddy production increase of some 16,900 tons are expected. The paddy production under the project is about 225% of the current production level in the project area.

**(3) Agricultural Support Programs**

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-10. The implementation of the programs is scheduled for the period of 5 years in the project and the overall cost is estimated at US\$ 119,000.

**C3.1.2.4 Ratanak-Battambang Water Harvesting Rehabilitation Project**

**(1) Land Use Plan**

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use in the following table.

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			580	98	580
- Supplemental Irrigation Paddy Field	25	4			-25
- Paddy Field under Rainfed Condition	283	48			-283
Sub-total	308	52	580	98	272
Rainfed Paddy Field	286	48			-286
Right-of-ways			14	2	14
Total	594	100	594	100	0

As shown in the table, the development of 580 ha of normal irrigation paddy field is aimed at

under the project by the conversion of 25 ha of supplemental irrigation fields and 569 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system.

## (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-11 and summarized in the following table.

<b>Present &amp; With-project Crop Production of the Project Area</b>					
<b>Land Use Sub-category/Crops</b>		<b>Cropped Area (ha)</b>	<b>Intensity (%)</b>	<b>Yield (t/ha)</b>	<b>Production (t)</b>
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		50	8	2.0	102
Rainfed Paddy Field: Wet Season Rice		584	98	1.1	655
Annual	Rice	634	107	1.2	757
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		580	100	2.9	1,693
Annual	Rice	580	100	2.9	1,693
	Upland Crops	5	1	0.5	2.5
Increment (II – I)					
Annual	Rice	-54	-7	1.7	937
	Upland Crops	5	1	-	2.5

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.7 ton/ha from 1.2 to 2.9 ton/ha and annual paddy production increase of some 900 tons are expected. The paddy production under the project is about 220% of the current production level in the project area.

## (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-12. Major support programs include field programs (adaptability test, demonstration plot, farm & area, seed multiplication), farmer & farmer group training programs (training course, FFS/IPM, study tour etc.), mass guidance/workshop, staff empowerment, support fund for extension staffs, provision of transportation means.

The implementation of the programs is scheduled for the period of 3 years in the project and the overall cost is estimated at US\$ 10,000.

### C3.1.2.5 Overall Agricultural Development Plan in the Basin

The overall agricultural development plan covering the 4 projects in the river basin is summarized in the followings.

#### (1) Overall Land Use Plan

The overall land use plan under the with-project condition is presented in comparison with the present/with-out project land use as shown in the following table.

### Present/Without-project & With-project Land Use of the Project Areas

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	353	1	23,705	86	23,352
- Supplemental Irrigation Paddy Field	2,953	11			-2,953
- Paddy Field under Rainfed Condition	14,124	51			-14,124
- Recession Paddy Field	48	0.2	48	0.2	0
Sub-total	17,478	63	23,753	86	6,275
Rainfed Paddy Field	7,373	27	-	-	-7,373
Right-of-ways	2,815	10	3,913	14	1,098
Total	27,666	100	27,666	100	0

As shown in the table, the increase of normal irrigation field of 23,352 ha is planned under the projects by the conversion of supplemental irrigation field of 2,953 and rainfed paddy fields of 21,497. The decrease of paddy fields due to land use conversion to right-of-ways is 1,098 ha

#### (2) Overall Crop Production Plan

The overall crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-13 and summarized below.

#### Present & With-project Crop Production of the Project Areas

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		711	3	2.6	1,840
Supplemental Irrigation Paddy Field: Rice		3,068	12	1.6	4,969
Rainfed Paddy Field: Wet Season Rice		21,562	87	1.1	23,462
Recession Paddy Field: Dry Season Rice		48	0.2	2.0	96
Annual	Rice	25,389	102	1.2	30,367
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		23,705	100	2.9	69,195
Recession Paddy Field: Dry Season Rice		48	0.2	2.5	120
Annual	Rice	23,753	100	2.9	69,315
	Upland Crops	205	1	0.5	103
Increment (II - I)					
Annual	Rice	-1,636	-2	1.7	38,948
	Upland Crops	205	1	-	103

Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice

As shown in the table, the increase of overall average yield of 1.7 ton/ha from 1.2 to 2.9 ton/ha and annual production increase of some 39,000 tons are expected despite the decrease of cropped area of 1,636 ha due to conversion of some paddy fields into right-of-ways.

#### (3) Agricultural Support Programs

The overall costs for the agricultural support programs accommodated in the four projects are estimated at US\$ 276,000.

## C3.2 Moung Ruessei River Basin

### C3.2.1 Present Agriculture in the Project Areas

#### (1) Land Use

The present land uses of the project areas are exclusively paddy fields under different irrigation status. Accordingly, the land uses of the areas are classified depending on current irrigation statuses into the following 5 sub-categories based on the results of the Inventory Survey and the supplemental survey conducted by the Study Team.

#### Classification of Paddy Field Based on Current Irrigation Status

Location of Paddy Field	Land Use Sub-category
Paddy Field in Current Irrigation Command Area	Normal Irrigation Paddy Field
	Supplemental Irrigation Paddy Field
	Paddy Field under Rainfed Condition
	Recession Paddy Field
Paddy Field outside of Current Irrigation Command Area	Rainfed Paddy Field

The present land use of individual project is presented in Table C3-14 and C3-15 in detail and the features of the whole project areas are summarized in the following table.

#### Present Land Use of the Project Areas in the River Basin

Land Use Sub-category	Area		
	(ha)	(%)	(%)
Paddy Field in Current Irrigation Areas			
- Normal Irrigation Paddy Field	0	-	-
- Supplemental Irrigation Paddy Field	153	24	2
- Paddy Field under Rainfed Condition	487	74	5
- Recession Paddy Field	10	2	-
Sub-total	650	100	7
Paddy Field outside of Current Irrigation Command Area			
- Rainfed Paddy Field	8,180	-	92
Right-of-ways	110	-	1
Total	8,940	-	100

As shown in the tables, irrigation water supply conditions in the project areas are extremely poor and the paddy fields under rainfed conditions account for about 98% of the total paddy fields in the areas.

#### (2) Crop Production

The main cropping season is wet season in the project areas and the cropping calendar of rice from May/June to December/January is almost exclusive calendar as shown in Table C3-16. Rice is an exclusive crop in paddy fields and an annual cropping intensity of rice is around 100%; wet season 100% and dry season 0.1%. Direct sowing is prevailing rice production system in the areas. The current paddy production is estimated at some 10,300 tons/year as shown in Table C3-17 and as summarized in the following table.

#### Paddy Production Feature in the Project Areas

	Cropped Area	Cropping Intensity	Paddy Production
Wet Season	8,820 ha	100 %	10,260 tons
Dry Season	10 ha	0.1 %	20 tons
Annual	8,830 ha	100 %	10,280 tons



### C3.2.2 Agricultural Development Plan

The proposed agricultural development plan for individual projects and the overall development features of the projects in the basin are discussed in the followings.

#### C3.2.2.1 Bassac Irrigation System Rehabilitation Project

##### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			3,500	85	3,500
- Supplemental Irrigation Paddy Field					
- Paddy Field under Rainfed Condition					
- Recession Paddy Field					
Sub-total			3,500	85	3,500
Rainfed Paddy Field	4,120	100			-4,120
Right-of-ways			620	15	620
Total	4,120	100	4,120	100	0

As shown in the table, the development of 3,500 ha of normal irrigation paddy field is aimed at under the project by the conversion of 4,120 ha of rainfed paddy fields. The decrease of paddy fields due to land use conversion to right-of-ways is estimated at 620 ha

##### (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-18 and summarized in the following table.

**Present and With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice					
Rainfed Paddy Field: Wet Season Rice		4,120	100	1.2	4,759
Recession Paddy Field: Dry Season Rice					
Annual	Rice	4,120	100	1.2	4,759
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		3,500	100	3.0	10,560
Recession Paddy Field: Dry Season Rice					
Annual	Rice	3,500	100	3.0	10,500
	Upland Crops	60	2	0.5	30
Increment (II - I)					
Annual	Rice	-620	0	1.8	5,801
	Upland Crops	60	2	-	30

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.8 ton/ha from 1.2 to 3.0 ton/ha and annual paddy production increase of some 5,800 tons are expected despite the

decrease of cropped area of some 620 ha. The paddy production under the project is about 220% of the current production level in the project area. Upland crops production is limited to be 30 tons, however, successful introduction of the crops in pilot bases will expand the cultivation of the same in the project area.

### (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-19.

Major support programs include field programs (adaptability test, demonstration plot, farm & area, seed multiplication), farmer & farmer group training programs (training course, FFS/IPM, study tour etc.), mass guidance/workshop, staff empowerment, support fund for extension staffs, provision of transportation means.

The programs are scheduled for the period of 4 years in the project and the overall cost is estimated at US\$ 42,000.

#### C3.2.2.2 Ream Kon Rehabilitation Project

##### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			2,290	85	2,290
- Supplemental Irrigation Paddy Field	40	1			-40
- Paddy Field under Rainfed Condition	150	6			-150
- Recession Paddy Field	10	0.4	10	0.4	0
Sub-total	200	7	2,300	85	2,100
Rainfed Paddy Field	2,470	91			-2,470
Right-of-ways	40	1	410	14	370
Total	2,710	100	2,710	100	0

As shown in the table, the development of 2,290 ha of normal irrigation paddy field is aimed at under the project by the conversion of 40 ha of supplemental irrigation fields and 2,620 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system. The recession paddy field is assumed to be remained unchanged. The decrease of paddy fields due to land use conversion to right-of-ways is estimated at 370 ha

##### (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the estimated present/with-out crop production status in Table C3-20 and as summarized in the following table.

### Present & With-project Crop Production of the Project Area

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		40	1	1.7	66
Rainfed Paddy Field: Wet Season Rice		2,620	98	1.2	3,026
Recession Paddy Field: Dry Season Rice		10	0.4	2.0	20
Annual	Rice	2,670	100	1.2	3,112
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Recession Paddy Field: Dry Season Rice		10	0.4	2.5	25
Annual	Rice	2,300	100	3.0	6,934
	Upland Crops	40	2	0.5	20
Increment (II – I)					
Annual	Rice	-370	0	1.8	3,822
	Upland Crops	40	2	-	20

Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice

As shown in the table, the increase of overall average yield of 1.8 ton/ha from 1.2 to 3.0 ton/ha and annual paddy production increase of some 3,800 tons are expected despite the decrease of cropped area of some 370 ha. The paddy production under the project is about 220% of the current production level in the project area.

#### (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-21. The programs are scheduled for the period of 4 years in the project and the overall cost is estimated at US\$ 26,000.

#### C3.2.2.3 Por Canal Rehabilitation Project

##### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

#### Present/Without-project & With-project Land Use of the Project Area

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			1,200	85	1,200
- Supplemental Irrigation Paddy Field	100	7			-100
- Paddy Field under Rainfed Condition	300	21			-300
- Recession Paddy Field					
Sub-total	400	28	1,200	85	800
Rainfed Paddy Field	940	67			-940
Right-of-ways	70	5	210	15	140
Total	1,410	100	1,410	100	0

As shown in the table, the development of 1,200 ha of normal irrigation paddy field is aimed at under the project by the conversion of 100 ha of supplemental irrigation fields and 1,240 ha of fields under rainfed conditions in the irrigation system.

(2) **Crop Production Plan**

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-22 and summarized in the following table.

**Present and With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		100	7	1.7	166
Rainfed Paddy Field: Wet Season Rice		1,240	93	1.2	1,432
Recession Paddy Field: Dry Season Rice					
Annual	Rice	1,340	100	1.2	1,598
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Recession Paddy Field: Dry Season Rice					
Annual	Rice	1,200	100	3.0	3,620
	Upland Crops	20	2	0.5	10
Increment (II – I)					
Annual	Rice	-140	0	1.8	2,023
	Upland Crops	20	2	-	10

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.8 ton/ha from 1.2 to 3.0 ton/ha and annual paddy production increase of some 20,000 tons are expected despite the decrease of cropped area of some 140 ha. The paddy production under the project is about 230% of the current production level in the project area.

(3) **Agricultural Support Programs**

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-23. The programs are scheduled for the period of 3 years and the cost is estimated at US\$ 14,000.

**C3.2.2.4 Nikom Le/Dai Ta Chan Rehabilitation Project**

(1) **Land Use Plan**

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			600	86	600
- Supplemental Irrigation Paddy Field	13	2			-13
- Paddy Field under Rainfed Condition	37	5			-37
- Recession Paddy Field					
Sub-total	50	7	600	86	550
Rainfed Paddy Field	650	93			-650
Right-of-ways			100	14	100
Total	700	100	700	100	0

As shown in the table, the development of 600 ha of normal irrigation paddy field is aimed at under the project by the conversion of 13 ha of supplemental irrigation fields and 687 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system.

**(2) Crop Production Plan**

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-24 and summarized in the following table.

**Present and With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		13	2	1.7	22
Rainfed Paddy Field: Wet Season Rice		687	98	1.2	794
Recession Paddy Field: Dry Season Rice					
Annual	Rice	700	100	1.2	815
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		660	110	3.1	2,020
Recession Paddy Field: Dry Season Rice					
Annual	Rice	660	110	3.1	2,020
	Upland Crops	10	2	0.5	5
Increment (II - I)					
Annual	Rice	-40	10	1.9	1,205
	Upland Crops	10	2	-	5

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.9 ton/ha from 1.2 to 3.1 ton/ha and annual paddy production increase of some 1,200 tons are expected. The paddy production under the project is about 250% of the current production level in the project area.

**(3) Agricultural Support Programs**

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-25. Major support programs include field programs (adaptability test, demonstration plot, farm & area, seed multiplication), farmer & farmer group training programs (training course, FFS/IPM, study tour etc.), mass guidance/workshop, staff empowerment, support fund for extension staffs, provision of transportation means.

The programs are scheduled for the period of 3 years in the project and the overall cost is estimated at US\$ 10,000.

**C3.2.2.5 Overall Four Projects in the Basin**

The overall agricultural development plan covering the 4 projects in the river basin is summarized in the followings.

**(1) Land Use Plan**

The overall land use plan under the with-project condition is presented in comparison with the present/with-out project land use shown in the following table

### Present/Without-project and With-project Land Use of the Project Areas

Land Use Sub-category	Present		With-project		Increment
	(ha)	(%)	(ha)	(%)	(ha)
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			7,590	85	7,590
- Supplemental Irrigation Paddy Field	153	2			-153
- Paddy Field under Rainfed Condition	487	5			-487
- Recession Paddy Field	10	0.1	10	0.1	0
Sub-total	650	7	7,600	85	6,950
Rainfed Paddy Field	8,180	92			-8,180
Right-of-ways	110	1	1,340	15	1,230
Total	8,940	100	8,940	100	0

As shown in the table, the increase of normal irrigation field of 7,590 ha is planned under the projects by the conversion of supplemental irrigation field of 153 and rainfed paddy fields of 8,667 ha. The decrease of paddy fields due to land use conversion to right-of-ways is estimated at 1,230 ha

### (2) Crop Production Plan

The overall crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-26 and summarized below.

#### Present and With-project Crop Production of the Project Areas

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		153	2	1.7	253
Rainfed Paddy Field: Wet Season Rice		8,667	98	1.2	10,010
Recession Paddy Field: Dry Season Rice		10	0.1	2.0	20
Annual	Rice	8,830	100	1.2	10,283
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		7,650	101	3.0	23,109
Recession Paddy Field: Dry Season Rice		10	0.1	2.5	25
Annual	Rice	7,660	101	3.0	23,134
	Upland Crops	130	2	0.5	65
Increment (II - I)					
Annual	Rice	-1,170	1	1.8	12,851
	Upland Crops	130	2	-	65

Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice

As shown in the table, the increase of overall average yield of 1.8 ton/ha from 1.2 to 3.0 ton/ha and annual production increase of some 12,900 tons are expected despite the decrease of cropped area of 1,170 ha due to conversion of some paddy fields into right-of-ways. The overall paddy production under the projects is about 220% of the current production level.

### (3) Agricultural Support Programs

The overall costs for the agricultural support programs accommodated in the four projects are estimated at US\$ 92,000.

### C3.3 Pursat River Basin

#### C3.3.1 Present Agriculture in the Project Areas

##### (1) Land Use

The present land uses of the project areas are exclusively paddy fields under different irrigation status. Accordingly, the land uses of the areas are classified depending on current irrigation statuses into the following 5 sub-categories based on the results of the Inventory Survey and the supplemental survey conducted by the Study Team.

#### Classification of Paddy Field Based on Current Irrigation Status

Location of Paddy Field	Land Use Sub-category
Paddy Field in Current Irrigation Command Area	Normal Irrigation Paddy Field
	Supplemental Irrigation Paddy Field
	Paddy Field under Rainfed Condition
	Recession Paddy Field
Paddy Field outside of Current Irrigation Command Area	Rainfed Paddy Field

The present land use of individual project is presented in Table C3-27 and C3-28 in detail and the features of the whole project areas are summarized in the following table.

#### Present Land Use of the Project Areas in the River Basin

Land Use Sub-category	Area		
	(ha)	(%)	(%)
Paddy Field in Current Irrigation Areas			
- Normal Irrigation Paddy Field	1,265	6	4
- Supplemental Irrigation Paddy Field	3,504	17	12
- Paddy Field under Rainfed Condition	14,577	70	52
- Recession Paddy Field	1,371	7	5
Sub-total	20,717	100	73
Paddy Field outside of Current Irrigation Command Area			
- Rainfed Paddy Field	3,925	-	14
Right-of-ways	3,648	-	13
Total	28,290	-	100

As shown in the tables, irrigation water supply conditions in the target areas are poor. Paddy fields under rainfed conditions account for about 75% of the total paddy fields in the project areas. The recession paddy field of 1,371 ha in the project areas is assumed to be remained unchanged.

##### (2) Crop Production

The main cropping season is wet season in the project areas and the cropping calendar of rice is prolonged from April/June to November/January compared with other basins as shown in Table C3-29. Rice is an exclusive crop in paddy fields and an annual cropping intensity of rice is around 106%; wet season 94% and dry season 11%. Transplanting is prevailing practices for rice cultivation in the areas. The current paddy production is estimated at some 42,600 tons/year and overall average yield level is at 1.8 ton/ha as shown in Table C3-30 and as summarized in the following table.

### Paddy Production Feature in the Project Areas

	Cropped Area	Cropping Intensity	Paddy Production
Wet Season	23,270 ha	94.4 %	35,700 tons
Dry Season	2,811 ha	11.4 %	6,900 tons
Annual	26,081 ha	105.8 %	42,600 tons

#### C3.3.2 Agricultural Development Plan

The proposed agricultural development plan for individual project and the overall development features of the projects in the basin are discussed in the followings.

##### C3.3.2.1 Beoung Preah Rehabilitation Project

###### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

#### Present/Without-project & With-project Land Use of the Project Area

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	30	0.3	8,500	85	8,470
- Supplemental Irrigation Paddy Field	1,138	11			-1,138
- Paddy Field under Rainfed Condition	6,535	65			-6,535
Sub-total	7,703	77			797
Rainfed Paddy Field	940	9			-940
Right-of-ways	1,357	14	1,500	15	143
Total	10,000	100		100	0

As shown in the table, the development of 8,500 ha of normal irrigation paddy field is aimed at under the project by the conversion of 1,138 ha of supplemental irrigation fields and 7,475 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system. The decrease of paddy fields due to land use conversion to right-of-ways is estimated at 143 ha

###### (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-31 and summarized in the following table.

#### Present & With-project Crop Production of the Project Area

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		60	1	2.9	173
Supplemental Irrigation Paddy Field: Rice		1,138	13	1.9	2,145
Rainfed Paddy Field: Wet Season Rice		7,475	86	1.2	10,353
Annual	Rice	8,673	100	1.5	12,671
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		9,300	109	3.4	31,182
Annual	Rice	9,300	109	3.4	31,182
	Upland Crops	30	0.4	0.6	17
Increment (II – I)					
Annual	Rice	627	9	1.9	18,511
	Upland Crops	30	0.4	-	17

Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice



As shown in the table, the increase of overall average yield of 1.9 ton/ha from 1.5 to 3.4 ton/ha and annual paddy production increase of some 18,500 tons are expected. The paddy production under the project is about 250% of the current production level in the project area. Upland crops production is limited to be 17 tons, however, successful introduction of the crops in pilot bases will expand the cultivation of the same in the project area.

### (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-32.

Major support programs include field programs, farmer & farmer group training programs (training course, FFS/IPM, study tour etc.), mass guidance/workshop, staff empowerment, support fund for extension staffs, provision of transportation means.

The implementation of the programs is scheduled for the period of 5 years in the project and the overall cost is estimated at US\$ 96,000.

#### C3.3.2.2 Damnak Ampil Extension Project

##### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	1,170	12	8,000	85	6,830
- Supplemental Irrigation Paddy Field	1,632	17			-1,632
- Paddy Field under Rainfed Condition	4,898	52			-4,898
- Recession Paddy Field					
Sub-total	7,700	82			300
Rainfed Paddy Field	350	4			-350
Right-of-ways	1,360	14	1,410	15	50
Total	9,410	100	9,410	100	0

As shown in the table, the development of 8,000 ha of normal irrigation paddy field, increase of 6,830 ha from the present level, is aimed at under the project by the conversion of 1,632 ha of supplemental irrigation fields and 5,248 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system. The area extent of right-of ways under the with-project condition is assumed to be 15% of the project area as shown in the table.

##### (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the crop production under the present/with-out condition in Table C3-33 and summarized in the following table.

### Present & With-project Crop Production of the Project Area

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		2,340	29	2.9	6,751
Supplemental Irrigation Paddy Field: Rice		1,632	20	1.9	3,077
Rainfed Paddy Field: Wet Season Rice		5,248	65	1.4	7,269
Recession Paddy Field: Dry Season Rice					
Annual	Rice	9,220	115	1.9	17,096
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		8,755	109	3.4	29,355
Recession Paddy Field: Dry Season Rice					
Annual	Rice	8,755	109	3.4	29,355
	Upland Crops	325	4	0.5	166
Increment (II - I)					
Annual	Rice	-465	-5	1.5	12,259
	Upland Crops	325	4	-	166

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.5 ton/ha from 1.9 to 3.4 ton/ha and annual paddy production increase of some 12,300 tons are expected despite the decrease of cropped area of some 465 ha. The paddy production under the project is about 170% of the current production level in the project area.

#### (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-34.

The implementation of the programs is scheduled for the period of 5 years in the project and the overall program cost is estimated at US\$ 93,000.

#### C3.3.2.3 Wat Loung Rehabilitation Project

##### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as shown in the following table.

#### Present/Without-project & With-project Land Use of the Project Area

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	45	1	3,940	85	3,895
- Supplemental Irrigation Paddy Field	410	9			-410
- Paddy Field under Rainfed Condition	1,345	29			-1,345
- Recession Paddy Field					
Sub-total	1,800	39	3,940	85	2,140
Rainfed Paddy Field	2,535	54			-2,535
Right-of-ways	305	7	700	15	395
Total	4,640	100	4,640	100	0

As shown in the table, the development of 3,940 ha of normal irrigation paddy field is aimed at under the project by the conversion of 410 ha of supplemental irrigation fields and 3,880 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system. The decrease

of paddy fields due to land use conversion to right-of-ways is estimated at 395 ha

## (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-35 and summarized in the following table.

**Present & With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		90	2	2.9	260
Supplemental Irrigation Paddy Field: Rice		410	9	1.9	773
Rainfed Paddy Field: Wet Season Rice		3,880	90	1.4	5,374
Recession Paddy Field: Dry Season Rice					
Annual	Rice	4,380	101	1.5	6,407
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		4,190	106	3.3	14,011
Recession Paddy Field: Dry Season Rice					
Annual	Rice	4,190	106	3.3	14,011
	Upland Crops	160	4	0.5	82
Increment (II – I)					
Annual	Rice	-190	5	1.8	7,624
	Upland Crops	160	4	-	82

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.8 ton/ha from 1.5 to 3.3 ton/ha and annual paddy production increase of some 7,600 tons are expected. The paddy production under the project is about 220% of the current production level in the project area.

## (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-36. The implementation of the programs is scheduled for the period of 4 years in the project and the overall cost is estimated at US\$ 46,000.

### C3.3.2.4 Wat Chre Rehabilitation Project

#### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use in the following table.

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	20	2	1,000	85	980
- Supplemental Irrigation Paddy Field	98	8			-98
- Paddy Field under Rainfed Condition	882	75			-882
Sub-total		85			0
Right-of-ways	180	15	180	15	0
Total	1,180	100	1,180	100	0

As shown in the table, the development of 1,000 ha of normal irrigation paddy field is aimed at under the project by the conversion of 98 ha of supplemental irrigation fields and 882 ha of rainfed fields.

## (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-37 and summarized in the following table.

**Present & With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		40	4	2.9	115
Supplemental Irrigation Paddy Field: Rice		98	10	1.9	184
Rainfed Paddy Field: Wet Season Rice		882	88	1.4	1,222
Annual	Rice	1,020	102	1.5	1,521
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		1,070	107	3.3	3,584
Annual	Rice	1,070	107	3.3	3,584
	Upland Crops	40	4	0.5	20
Increment (II - I)					
Annual	Rice	50	5	1.8	2,063
	Upland Crops	40	4	-	20

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.8 ton/ha from 1.5 to 3.3 ton/ha and annual paddy production increase of some 2,000 tons are expected. The paddy production under the project is about 240% of the current production level in the project area. Upland crops production is limited to be 20 tons, however, successful introduction of the crops in pilot bases will expand the cultivation of the same in the project area.

## (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C-38.

Major support programs include field programs, farmer & farmer group training programs (training course, FFS/IPM, study tour etc.), mass guidance/workshop, staff empowerment, support fund for extension staffs, provision of transportation means.

The implementation of the programs is scheduled for the period of 3 years in the project and the overall cost is estimated at US\$ 14,000.

### C3.3.2.5 Anlong Khouch, Wat Leap, Kosh Khsach Water Harvesting & Recession Rice

#### Rehabilitation Project

## (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use in the following table.

### Present/Without-project & With-project Land Use of the Project Area

Land Use Sub-category	Present		With-project		Increment
	(ha)	(%)	(ha)	(%)	(ha)
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			1,231	40	1,231
- Supplemental Irrigation Paddy Field	226	7			-226
- Paddy Field under Rainfed Condition	917	30			-917
- Recession Paddy Field	1,371	55	1,371	45	0
Sub-total	2,514	82	2,602	85	88
Rainfed Paddy Field	100	3			-100
Right-of-ways	446	15	458	15	12
Total	3,060	100	3,060	100	0

As shown in the table, the development of 1,231 ha of normal irrigation paddy field is aimed at under the project by the conversion of 226 ha of supplemental irrigation fields and 1,017 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system.

### (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-39 and summarized in the following table.

### Present & With-project Crop Production of the Project Area

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		298	11	2.0	606
Rainfed Paddy Field: Wet Season Rice		1,120	43	1.4	1,615
Recession Paddy Field: Dry Season Rice		1,371	52	2.0	2,742
Annual	Rice	2,789	107	1.8	4,963
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		1,555	60	3.4	5,244
Recession Paddy Field: Dry Season Rice		1,371	53	2.5	3,428
Annual	Rice	2,926	112	3.0	8,672
	Upland Crops	147	6	0.6	93
Increment (II - I)					
Annual	Rice	137	6	1.2	3,709
	Upland Crops	147	6	-	93

Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice

As shown in the table, the increase of overall average yield of 1.2 ton/ha from 1.8 to 3.0 ton/ha and annual paddy production increase of some 3,700 tons are expected. The paddy production under the project is about 170% of the current production level in the project area.

### (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-40. The implementation of the programs is scheduled for the period of 4 years in the project and the overall cost is estimated at US\$ 34,000.

#### C3.3.2.6 Overall Agricultural Development Plan in the Basin

The overall agricultural development plan covering the 5 projects in the river basin is

summarized in the followings.

**(1) Overall Land Use Plan**

The overall land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Areas**

Land Use Sub-category	Present		With-project		Increment
	(ha)	(%)	(ha)	(%)	(ha)
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	1,265	4	22,671	80	21,406
- Supplemental Irrigation Paddy Field	3,504	12			-3,504
- Paddy Field under Rainfed Condition	14,577	52			-14,577
- Recession Paddy Field	1,371	5	1,371	5	0
Sub-total	20,717	73	24,042	85	3,325
Rainfed Paddy Field	3,925	14			-3,925
Right-of-ways	3,648	13	4,248	15	600
Total	28,290	100	28,290	100	0

As shown in the table, the increase of normal irrigation field of 21,406 ha is planned under the projects by the conversion of supplemental irrigation field of 3,504 and rainfed paddy fields of 18,502 ha. The decrease of paddy fields due to land use conversion to right-of-ways is 600 ha

**(2) Overall Crop Production Plan**

The overall crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-41 and summarized below.

**Present & With-project Crop Production of the Project Areas**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		2,530	10	2.9	7,299
Supplemental Irrigation Paddy Field: Rice		3,576	15	1.9	6,784
Rainfed Paddy Field: Wet Season Rice		18,605	76	1.4	25,832
Recession Paddy Field: Dry Season Rice		1,371	6	2.0	2,742
Annual	Rice	26,082	106	1.6	42,657
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		24,870	103	3.4	83,395
Recession Paddy Field: Dry Season Rice		1,371	6	2.5	3,428
Annual	Rice	26,241	109	3.3	86,823
	Upland Crops	702	3	0.5	377
Increment (II - I)					
Annual	Rice	159	3	1.7	44,166
	Upland Crops	702	3	-	377

Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice

As shown in the table, the increase of overall average yield of 1.7 ton/ha from 1.6 to 3.3 ton/ha and annual production increase of some 44,000 tons are expected. The overall paddy production under the projects is about 200% of the current production level in the project areas.

### (3) Agricultural Support Programs

The overall costs for the agricultural support programs accommodated in the four projects are estimated at US\$ 283,000.

#### C3.4 Boribo River Basin

##### C3.4.1 Present Agriculture in the Project Areas

###### (1) Land Use

The present land uses of the project areas are exclusively paddy fields under different irrigation status. Accordingly, the land uses of the areas are classified depending on current irrigation statuses into the following 5 sub-categories based on the results of the Inventory Survey and the supplemental survey conducted by the Study Team.

#### Classification of Paddy Field Based on Current Irrigation Status

Location of Paddy Field	Land Use Sub-category
Paddy Field in Current Irrigation Command Area	Normal Irrigation Paddy Field
	Supplemental Irrigation Paddy Field
	Paddy Field under Rainfed Condition
	Recession Paddy Field
Paddy Field outside of Current Irrigation Command Area	Rainfed Paddy Field

The present land use of individual project is presented in Table C3-42 and C3-43 in detail and the features of the whole project areas are summarized in the following table.

#### Present Land Use of the Project Areas in the River Basin

Land Use Sub-category	Area		
	(ha)	(%)	(%)
Paddy Field in Current Irrigation Area			
- Normal Irrigation Paddy Field	570	11	6
- Supplemental Irrigation Paddy Field	835	16	9
- Paddy Field under Rainfed Condition	3,705	73	41
- Recession Paddy Field	-	-	-
Sub-total	5,110	100	56
Paddy Field outside of Current Irrigation Command Area			
- Rainfed Paddy Field	3,170	-	35
Right-of-ways	828	-	9
Total	9,108	-	100

As shown in the tables, irrigation water supply conditions in the target areas are rather blessed compared with the other basins and normal irrigation fields account for 11% of the total paddy fields in the irrigation areas. However, paddy fields under rainfed conditions account for about 83% of the total paddy fields in the project areas.

###### (2) Crop Production

The main cropping season is wet season in the target areas and the cropping calendar from May/June to November/December is prevailing as shown in Table C3-44. Rice is an exclusive crop in paddy fields and an annual cropping intensity of rice is around 107%; wet season 100% and dry season 7%. Transplanting is almost exclusive practices for rice cultivation in the areas. The current paddy production is estimated at some 15,400 tons/year as shown in Table C3-45 and as summarized below.

### Paddy Production Feature in the Project Areas

	Cropped Area	Cropping Intensity	Paddy Production
Wet Season	8,280 ha	100 %	13,700 tons
Dry Season	570 ha	7 %	1,700 tons
Annual	8,850 ha	107 %	15,400 tons

#### C3.4.2 Agricultural Development Plan

The proposed agricultural development plan for individual projects and the overall development features of the projects in the basin are discussed in the followings.

##### C3.4.2.1 Lum Hack Rehabilitation Project

###### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

#### Present/Without-project & With-project Land Use of the Project Area

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	380	9	3,700	85	3,320
- Supplemental Irrigation Paddy Field	405	9			-405
- Paddy Field under Rainfed Condition	1,215	28			-1,215
Sub-total	2,000	46			1,700
Rainfed Paddy Field	2,000	46			-2,000
Right-of-ways	350	8	650	15	300
Total	4,350	100	4,350	100	0

As shown in the table, the development of 3,700 ha of normal irrigation paddy field is aimed at under the project by the conversion of 405 ha of supplemental irrigation fields and 3,215 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system. The decrease of paddy fields due to land use conversion to right-of-ways is estimated at 300 ha

###### (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-46 and summarized in the following table.

#### Present & With-project Crop Production of the Project Area

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		760	19	3.0	2,280
Supplemental Irrigation Paddy Field: Rice		405	10	2.0	810
Rainfed Paddy Field: Wet Season Rice		3,215	80	1.5	4,823
Annual	Rice	4,380	110	1.8	7,913
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		3,700	100	3.5	12,950
Annual	Rice	3,700	100	3.5	12,950
	Upland Crops	190	5	0.5	95
Increment (II – I)					
Annual	Rice	-680	-10	1.7	5,038
	Upland Crops	190	5	-	95

*Note: Rice figures are total of wet, early wet & dry season rice*



As shown in the table, the increase of overall average yield of 1.7 ton/ha from 1.8 to 3.5 ton/ha and annual paddy production increase of some 5,000 tons are expected despite the decrease of cropped area of some 680 ha. The paddy production under the project is about 160% of the current production level in the project area. Upland crops production is limited to be 95 tons, however, successful introduction of the crops in pilot bases through the proposed technology development and extension project will expand the cultivation of the same in the project area in the future.

**(3) Agricultural Support Programs**

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-47.

Major support programs include field programs (adaptability test, demonstration plot, farm & area, seed multiplication), farmer & farmer group training programs (training course, FFS/IPM, study tour etc.), mass guidance/workshop, staff empowerment, support fund for extension staffs, provision of transportation means.

The implementation of the programs is scheduled for the period of 4 years in the project and the overall cost is estimated at US\$ 44,000.

**C3.4.2.2 7th January Canal Rehabilitation Project**

**(1) Land Use Plan**

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment
	(ha)	(%)	(ha)	(%)	(ha)
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	190	8	2,000	85	1,810
- Supplemental Irrigation Paddy Field	203	9			-203
- Paddy Field under Rainfed Condition	607	26			-607
Sub-total	1,000	43	2,000	85	1,000
Rainfed Paddy Field	1,170	50			-1,170
Right-of-ways	180	8	350	15	170
Total	2,350	100	2,350	100	0

As shown in the table, the development of 2,000 ha of normal irrigation paddy field is aimed at under the project by the conversion of 203 ha of supplemental irrigation fields and 1,777 ha of rainfed fields and paddy fields under rainfed condition in the irrigation system. The decrease of paddy fields due to land use conversion to right-of-ways is estimated at 170 ha

**(2) Crop Production Plan**

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-48 and summarized in the following table.

### Present & With-project Crop Production of the Project Area

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		380	18	3.0	1,140
Supplemental Irrigation Paddy Field: Rice		203	9	2.0	406
Rainfed Paddy Field: Wet Season Rice		1,777	82	1.5	2,666
Annual	Rice	2,360	109	1.8	4,212
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		2,000	100	3.5	7,000
Annual	Rice	2,000	100	3.5	7,000
	Upland Crops	100	5	0.5	50
Increment (II - I)					
Annual	Rice	-360	-9	1.7	2,789
	Upland Crops	100	5	-	50

*Note: Rice figures are total of wet, early wet & dry season rice*

As shown in the table, the increase of overall average yield of 1.7 ton/ha from 1.8 to 3.5 ton/ha and annual paddy production increase of some 2,800 tons are expected despite the decrease of cropped area of some 360 ha. The paddy production under the project is about 170% of the current production level in the project area. Upland crops production is limited to be 50 tons, however, successful introduction of the crops in pilot bases through the proposed technology development and extension project will expand the cultivation in the future.

#### (3) Agricultural Support Programs

The agricultural support programs accommodated as a project component in the project and the implementation and cost schedule of the programs is presented in Table C3-49. The implementation of the programs is scheduled for the period of 4 years in the project and the overall cost is estimated at US\$ 24,000.

#### C3.4.2.3 Khvet Rehabilitation Project

##### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

#### Present/Without-project & With-project Land Use of the Project Area

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			250	86	250
- Supplemental Irrigation Paddy Field	25	9			-25
- Paddy Field under Rainfed Condition	225	78			-225
Sub-total	250	86	250	86	0
Rainfed Paddy Field					
Right-of-ways	40	14	40	14	0
Total	290	100	290	100	0

As shown in the table, the development of 250 ha of normal irrigation paddy field is aimed at under the project by the conversion of 25 ha of supplemental irrigation fields and 225 ha of paddy fields under rainfed condition in the irrigation system.

**(2) Crop Production Plan**

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-50 and summarized in the following table.

**Present & With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		25	10	2.0	50
Rainfed Paddy Field: Wet Season Rice		225	90	1.5	338
Annual	Rice	250	100	1.6	383
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Annual Rice		250	100	3.5	875
Annual	Upland Crops	10	4	0.5	5
Increment (II - I)					
Annual	Rice	0	0	1.9	488
	Upland Crops	10	4	-	5

*Note: Rice figures are total of wet, early wet & dry season rice*

As shown in the table, the increase of overall average yield of 1.9 ton/ha from 1.6 to 3.5 ton/ha and annual paddy production increase of some 500 tons are expected. The paddy production under the project is about 230% of the current production level in the project area.

**(3) Agricultural Support Programs**

The agricultural support programs accommodated in the project and the cost schedule of the programs is presented in Table C3-51. The implementation of the programs is scheduled for the period of 3 years and the overall cost is estimated at US\$ 7,000.

**C3.4.2.4 Ta Ram Rehabilitation Project**

**(1) Land Use Plan**

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			180	95	180
- Supplemental Irrigation Paddy Field	18	10			-18
- Paddy Field under Rainfed Condition	162	86			-162
Sub-total	180	95	180	95	0
Rainfed Paddy Field					
Right-of-ways	9	5	9	5	0
Total	189	100	189	100	0

As shown in the table, the development of 180 ha of normal irrigation paddy field is aimed at under the project by the conversion of 18 ha of supplemental irrigation fields and 162 ha of paddy fields under rainfed condition in the irrigation system.

(2) **Crop Production Plan**

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-52 and summarized in the following table.

**Present & With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		18	10	2.0	36
Rainfed Paddy Field: Wet Season Rice		162	90	1.5	243
Annual	Rice	180	100	1.6	279
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Annual Rice		180	100	3.5	630
Annual	Upland Crops	10	6	0.5	5
Increment (II - I)					
Annual	Rice	0	0	1.9	351
	Upland Crops	10	6	-	5

*Note: Rice figures are total of wet, early wet & dry season rice*

As shown in the table, the increase of overall average yield of 1.9 ton/ha from 1.6 to 3.5 ton/ha and annual paddy production increase of some 350 tons are expected. The paddy production under the project is about 230% of the current production level in the project area.

(3) **Agricultural Support Programs**

The agricultural support programs accommodated in the project and the cost schedule of the programs is presented in Table C3-53. The implementation of the programs is scheduled for the period of 3 years and the overall cost is estimated at US\$ 7,000.

**C3.4.2.5 Chak Teum, Trapeang Khong, Don Pov Rehabilitation Project**

(1) **Land Use Plan**

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas			980	85	980
- Normal Irrigation Paddy Field	98	9			-98
- Supplemental Irrigation Paddy Field	882	77			-882
- Paddy Field under Rainfed Condition					
Sub-total	980	85	980	85	0
Rainfed Paddy Field					
Right-of-ways	170	15	170	15	0
Total	1,150	100	1,150	100	0

As shown in the table, the development of 980 ha of normal irrigation paddy field is aimed at under the project by the conversion of 882 ha of supplemental irrigation fields.

## (2) Crop Production Plan

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-54 and summarized in the following table.

**Present & With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		98	10	2.0	196
Rainfed Paddy Field: Wet Season Rice		882	90	1.5	1,323
Annual	Rice	980	100	1.6	1,519
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Annual	Rice	980	100	3.5	3,430
	Upland Crops	50	5	0.5	25
Increment (II - I)					
Annual	Rice	0	0	1.9	1,911
	Upland Crops	50	5	-	25

*Note: Rice figures are total of wet, early wet & dry season rice*

As shown in the table, the increase of overall average yield of 1.9 ton/ha from 1.6 to 3.5 ton/ha and annual paddy production increase of some 1,900 tons are expected. The paddy production under the project is about 230% of the current production level in the project area.

## (3) Agricultural Support Programs

The agricultural support programs accommodated in the project and the cost schedule of the programs is presented in Table C3-55. The implementation of the programs is scheduled for the period of 3 years and the overall cost is estimated at US\$ 13,000.

### C3.4.2.6 Teuk Laak and Trapeang Thlan Rehabilitation Project

#### (1) Land Use Plan

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field			230	95	230
- Supplemental Irrigation Paddy Field	23	9			-23
- Paddy Field under Rainfed Condition	207	85			-207
Sub-total	230	95	230	95	0
Rainfed Paddy Field					
Right-of-ways	13	5	13	5	0
Total	243	100	243	100	0

As shown in the table, the development of 230 ha of normal irrigation paddy field is aimed at under the project by the conversion of 23 ha of supplemental irrigation fields and 207 ha of paddy fields under rainfed condition in the irrigation system.

**(2) Crop Production Plan**

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-56 and summarized in the following table.

**Present & With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		23	10	2.0	46
Rainfed Paddy Field: Wet Season Rice		207	90	1.5	311
Annual	Rice	230	100	1.6	357
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Annual Rice		230	100	3.5	805
Annual	Upland Crops	10	4	0.5	5
Increment (II - I)					
Annual	Rice	0	0	1.9	449
	Upland Crops	10	4	0.5	5

*Note: Rice figures are total of wet, early wet & dry season rice*

As shown in the table, the increase of overall average yield of 1.9 ton/ha from 1.6 to 3.5 ton/ha and annual paddy production increase of some 450 tons are expected. The paddy production under the project is about 230% of the current production level in the project area.

**(3) Agricultural Support Programs**

The agricultural support programs accommodated in the project and the cost schedule of the programs is presented in Table C3-57. The implementation of the programs is scheduled for the period of 3 years and the overall cost is estimated at US\$ 7,000.

**C3.4.2.7 Toul Chamney Rehabilitation Project**

**(1) Land Use Plan**

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas			360	86	360
- Normal Irrigation Paddy Field	36	9			-36
- Supplemental Irrigation Paddy Field	324	77			-324
- Paddy Field under Rainfed Condition					
Sub-total	360	86	360	86	0
Rainfed Paddy Field					
Right-of-ways	60	14	60	14	0
Total	420	100	420	100	0

As shown in the table, the development of 360 ha of normal irrigation paddy field is aimed at under the project by the conversion of 36 ha of supplemental irrigation fields and 324 ha of paddy fields under rainfed condition in the irrigation system.

**(2) Crop Production Plan**

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-58 and summarized in the following table.

**Present & With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		36	10	2.0	72
Rainfed Paddy Field: Wet Season Rice		324	90	1.5	486
Annual	Rice	360	100	1.6	558
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Annual Rice		360	100	3.5	1,260
Annual	Upland Crops	20	6	0.5	10
Increment (II - I)					
Annual	Rice	0	0	1.9	702
	Upland Crops	20	6	-	10

*Note: Rice figures are total of wet, early wet & dry season rice*

As shown in the table, the increase of overall average yield of 1.9 ton/ha from 1.6 to 3.5 ton/ha and annual paddy production increase of some 700 tons are expected. The paddy production under the project is about 230% of the current production level in the project area.

**(3) Agricultural Support Programs**

The agricultural support programs accommodated in the project and the cost schedule of the programs is presented in Table C3-59. The implementation of the programs is scheduled for the period of 3 years and the overall cost is estimated at US\$ 8,000.

**C3.4.2.8 Chan Keak Rehabilitation Project**

**(1) Land Use Plan**

The land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Area**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas			110	95	110
- Normal Irrigation Paddy Field	27	23			-27
- Supplemental Irrigation Paddy Field	83	72			-83
- Paddy Field under Rainfed Condition					
Sub-total	110	95	110	95	0
Rainfed Paddy Field					
Right-of-ways	6	5	6	5	0
Total	116	100	116	100	0

As shown in the table, the development of 110 ha of normal irrigation paddy field is aimed at under the project by the conversion of 27 ha of supplemental irrigation fields and 83 ha of paddy fields under rainfed condition in the irrigation system.

**(2) Crop Production Plan**

The crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-60 and summarized in the following table.

**Present & With-project Crop Production of the Project Area**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Supplemental Irrigation Paddy Field: Rice		28	25	2.0	56
Rainfed Paddy Field: Wet Season Rice		82	75	1.5	123
Annual	Rice	110	100	1.6	179
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice					
Annual Rice		110	100	3.5	385
Upland Crops		10	9	0.5	5
Increment (II – I)					
Annual Rice		0	0	1.9	206
Upland Crops		10	9	0.5	5

*Note: Rice figures are total of wet, early wet & dry season rice*

As shown in the table, the increase of overall average yield of 1.9 ton/ha from 1.6 to 3.5 ton/ha and annual paddy production increase of some 200 tons are expected. The paddy production under the project is about 220% of the current production level in the project area.

**(3) Agricultural Support Programs**

The agricultural support programs accommodated in the project and the cost schedule of the programs is presented in Table C3-61. The implementation of the programs is scheduled for the period of 3 years and the overall cost is estimated at US\$ 6,000.

**C3.4.2.9 Overall Agricultural Development Plan in the Basin**

The overall agricultural development plan covering the 8 projects in the river basin is summarized in the followings.

**(1) Overall Land Use Plan**

The overall land use plan under the with-project condition is presented in comparison with the present/with-out project land use as follows;

**Present/Without-project & With-project Land Use of the Project Areas**

Land Use Sub-category	Present		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	570	6	7,810	86	7,240
- Supplemental Irrigation Paddy Field	835	9			-835
- Paddy Field under Rainfed Condition	3,705	41			-3,705
- Recession Paddy Field					
Sub-total	5,110	56	7,810	86	2,700
Rainfed Paddy Field	3,170	35			-3,170
Right-of-ways	828	9	1,298	14	470
Total	9,108	100	9,108	100	0



As shown in the table, the increase of normal irrigation field of 7,240 ha is planned under the projects by the conversion of supplemental irrigation field of 835 and 6,875 ha of rainfed fields and paddy fields under rainfed condition in irrigation systems. The decrease of paddy fields due to land use conversion to right-of-ways is 470 ha

**(2) Overall Crop Production Plan**

The overall crop production plan under the with-project condition is presented in comparison with the present/with-out crop production in Table C3-62 and summarized below.

**Present & With-project Crop Production of the Project Areas**

Land Use Sub-category/Crops		Cropped Area (ha)	Intensity (%)	Yield (t/ha)	Production (t)
I. Present/Without-project Crop Production					
Normal Irrigation Paddy Field: Rice		1,140	14	3.0	3,420
Supplemental Irrigation Paddy Field: Rice		836	10	2.0	1,672
Rainfed Paddy Field: Wet Season Rice		6,874	83	1.5	10,311
Recession Paddy Field: Dry Season Rice					
Annual	Rice	8,850	107	1.7	15,403
II. With-project Crop Production					
Normal Irrigation Paddy Field: Rice		7,810	100	3.5	27,335
Recession Paddy Field: Dry Season Rice					
Annual	Rice	7,810	100	3.5	27,335
	Upland Crops	400	5	0.5	200
Increment (II - I)					
Annual	Rice	-1,040	-7	1.8	11,932
	Upland Crops	400	5	-	200

*Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice*

As shown in the table, the increase of overall average yield of 1.8 ton/ha from 1.7 to 3.5 ton/ha and annual production increase of some 11,900 tons are expected despite the decrease of cropped area of 1,040 ha due to conversion of paddy fields into right-of-ways. The paddy production under the projects is about 180% of the current production level in the project areas. Upland crops production is limited to be 200 tons, however, successful introduction of the crops in pilot bases through the proposed technology development and extension project will expand the cultivation of the same in the project areas in the future.

**(3) Agricultural Support Programs**

The overall costs for the agricultural support programs accommodated in the four projects are estimated at US\$ 116,000.

**C3.5 Overall Agricultural Development Plan under the Master Plan**

The overall agricultural development plan covering the 21 irrigation projects proposed in the present Master Plan in the four river basins is summarized in the following.

**(1) Overall Land Use Plan**

The overall land use plan under the with-project condition is presented in comparison with the present/with-out project land use as shown in the following table.

### Present/With-out and With-project Land Use: Overall Master Plan

Land Use Sub-category	Present/With-out		With-project		Increment (ha)
	(ha)	(%)	(ha)	(%)	
Paddy Field in Current Irrigation Areas					
- Normal Irrigation Paddy Field	2,188	3	61,776	83	59,588
- Supplemental Irrigation Paddy Field	7,445	10			-7,445
- Paddy Field under Rainfed Condition	32,893	44			-32,893
Recession Paddy Field: Dry Season Rice	1,429	2	1,429	2	0
Sub-total	43,955	59	63,205	85	19,250
Rainfed Paddy Field	22,648	31			-22,648
Right-of-ways	7,401	10	10,799	15	3,398
Total	74,004	100	74,004	100	0

As shown in the table, the development of some 61,776 ha of normal irrigation paddy field is aimed at under the Master Plan. The increase of normal irrigation field is planned to be 59,588 ha by the conversion of 7,445 ha of supplemental irrigation fields and 55,541 ha of rainfed fields and paddy fields under rainfed condition in irrigation systems. The decrease of paddy fields due to land use conversion to right-of-ways is estimated at 3,398 ha

#### (2) Crop Production Plan

The overall crop production plan under the with-project condition is presented in comparison with the present/with-out crop production as shown in the following table.

### Present/With-out and With-project Crop Production: Overall Master Plan

Land Use Sub-category/Crops	Cropped Area (ha)	Intensity (%) 1/	Yield (t/ha)	Production (t)
I. Present Crop Production				
Normal Irrigation Paddy Field: Rice	4,381	7	2.9	12,559
Supplemental Irrigation Paddy Field: Rice	7,633	11	1.8	13,678
Rainfed Paddy Field: Wet Season Rice	55,708	84	1.2	69,615
Recession Paddy Field: Dry Season Rice	1,429	2	2.0	2,858
Annual Rice	69,151	104	1.4	98,710
II. With-project Crop Production				
Normal Irrigation Paddy Field: Rice	64,035	101	3.2	203,034
Recession Paddy Field: Dry Season Rice	1,429	2	2.5	3,573
Annual Rice	65,464	104	3.2	206,607
Upland Crops	1,437	2	0.5	745
Increment (II - I)				
Annual Rice	-3,687	0	1.8	107,897
Upland Crops	1,437	2		745

1/: Cropping intensity to total paddy fields

Note: Rice figures are total of wet, early wet & dry season rice and direct sowing & transplanting rice

As shown in the table, the increase of overall average yield of 1.8 ton/ha from 1.4 to 3.2 ton/ha and annual paddy production increase of some 108,000 tons are expected despite the decrease of cropped area of some 3,690 ha. The paddy production under the Master Plan is about 210% of the current production level in the overall project areas. Upland crops production is limited to be some 750 tons, however, successful introduction of the crops in pilot bases through the proposed technology development and extension project will expand the cultivation of the same in the project areas.

**(3) Agricultural Support Programs**

The overall costs for the agricultural support programs accommodated in the 21 projects under the Master Plan are estimated at US\$ 767,000.

## CHAPTER C4 MARKET STUDY

This chapter presents the results of the studies made within the scope of the market study under the present Study.

### C4.1 Food Balance and Food Security in Cambodia

#### C4.1.1 National Food Balance

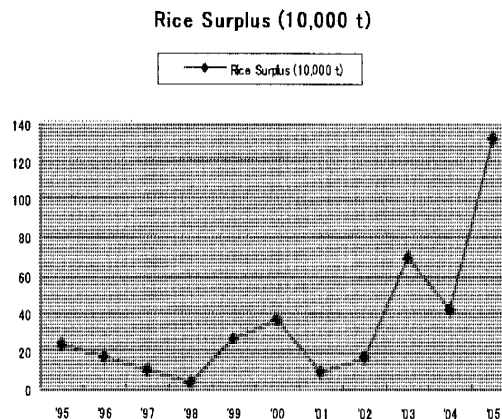
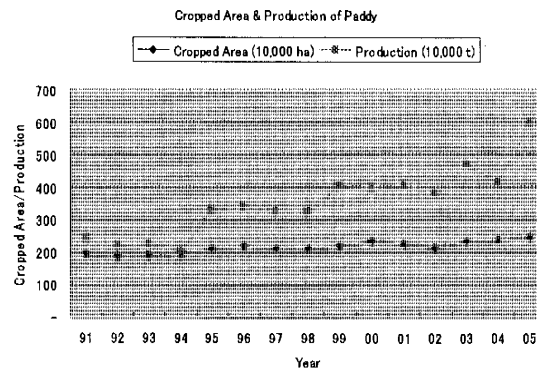
The paddy production trend shows substantial annual fluctuation in Cambodia. The drastic production increases from 1995 are attributed to the progress of land allocation to individual families in 1994 ~ 1995. The increases of cultivated areas and production increases from 1994 to 1995 in all the provinces are reported.

Especially, the expansion of rice cultivated areas from 147,900 ha to 238,000 ha in Takeo and from 144,000 ha to 286,000 ha in Prey Veng largely contributed to the production increase of the year in the country. The production decreases in 2002 is attributed to drought and flood and the same in 2004 is to drought. The production in 2005 increased drastically blessed with favorable climatic conditions. Rainfall was a primary reason for the extra-ordinary high production of paddy according to an unpublished report by a joint field investigation of staff of the World Bank, Ministry of Economy and Finance and MAFF<sup>1</sup>.

The country achieved self sufficiency of rice in 1995 and the substantial volume of rice surpluses have been reported by MAFF. However, directly affected by the fluctuation of production volumes, the national food balances estimated by MAFF indicate unstable features as shown in the figure. In the MAFF estimation from 2000, the largest surplus of 1.3 million tons of milled rice attained in 2005 and the smallest surplus of 30,000 tons was reported in 1998.

#### C4.1.2 Current Food Security Status

In the estimation of the food balance of rice in the country, the basic figures for the estimation were altered from the 2001 estimation; per capita consumption of milled rice from 151.2 kg/person to 143 kg/person, seed requirement & post harvest losses



<sup>1</sup> Cambodian Economic Review, Issue 3, June 2007, CIA

from 17% to 13% and milled rice recovery rate from 62% to 64%. The alternation is positively affecting the food balance status of the country to a certain extent. While the per capita consumption of milled rice in 1999-2001 in Cambodia, Viet Nam and Thailand is estimated at 155, 167 and 109 kg per capita by FAO <sup>2</sup>, respectively.

For the assessment of food security status and its stability, the food balances from 2000 to 2005 were examined by applying various basic figures discussed above as shown in Table C4-1. Assumptions applied for individual cases are as follows;

#### **Assumptions Applied for Estimating Food Balance of Rice**

Case 1	Seed/post harvest losses: 13%; milling recovery rate: 64%; per capita consumption: 143 kg
Case 2	ditto; ditto; per capita consumption: 155 kg (FAO estimate)
Case 3	ditto; ditto; per capita consumption: 167 kg (consumption in Viet Nam, FAO estimate)
Case 4	Seed/post harvest losses: 17%; milling recovery rate: 62%; per capita consumption: 143 kg
Case 5	ditto; ditto; per capita consumption: 155 kg (FAO estimate)
Case 6	ditto; ditto; per capita consumption: 167 kg (consumption in Viet Nam, FAO estimate)

In the cases, the highest rice requirements are estimated in Case 6 followed by Case 5 and 3. The lowest requirement is estimated in Case 1.

As shown in the table, some rice deficiencies are estimated in all cases except Case 1 (MAFF estimate) in 2002 when production decrease of paddy brought about by drought and flood. In other years, no deficits are estimated except for Case 6 and 5, in which the highest and 2nd highest rice requirement is assumed.

#### **C4.1.3 Nutritional Status of the Nation**

The national nutritional statuses of Cambodia, Thailand and Viet Nam are estimated by FAO as shown below.

#### **Some Essential Indicators on Food Security & GDP per Capita**

Indicator	Cambodia	Thailand	Viet Nam
Dietary Energy Consumption in 2004 (Cal/person/day)	2,060	2,410	2,580
Protein Consumption in 2004 (g/person/day)	51	57	63
Proportion of Undernourished Population to Total (1990-1992)	43%	30%	31%
Proportion of Undernourished Population to Total (2001-2003)	33%	21%	17%
Child Mortality Rate in 2003 (per 1000 live birth)	140	26	23
Per Capita GDP (2004)	309 US\$	2,359 US\$	499 US\$

*Source: FAO Statistical Year Book, 2005-2006*

As shown in the table, the per capita consumptions of dietary energy and protein of Cambodia are substantially lower than the other countries. In case of dietary energy, the per capita consumption in Cambodia is estimated at 85% and 80% of that of Thailand and Viet Nam, respectively. Similarly, the same of protein is respectively 89% and 81% of the two countries. These figures indicate limited consumption of carbohydrate (rice, cereals) and protein (crops especially beans, fish & meat) in Cambodia. Further, the FAO estimate indicates 33% of the undernourished population to the total population in 2001-2003 in Cambodia.

In nutritional intake in Cambodia, rice is by far the most important calorie and protein

<sup>2</sup> Proceedings of the FAO Rice Conference 2004, FAO

source accounting respectively for 76% and 70% of total intake as shown in the following table.

#### Contribution of Rice for Nutrition Intake in Cambodia

Indicator	Cambodia	Thailand	Viet Nam
% Calories from Rice in 1999	76	42	65
% Protein from Rice in 1999	70	34	57

Source: *Rice Today* September 2002

The importance of rice for the improvement of nutritional status of the nation in the future should not be overlooked. When assuming that the dietary energy consumption in the country attains the current consumption level of Viet Nam (2,580 Cal/person/day) and 50% of calorie is taken from rice, the potential incremental demand for rice consumption in the country is roughly estimated as follows;

Additional dietary energy to be taken	$2,580 - 2,060 = 520$ (Cal/person/day)
Additional annual rice consumption when 50% of calorie is taken from rice	$(520/2 \text{ Cal} \times 365 \text{ days}) / 3.378 \text{ Cal/g rice} = 28 \text{ kg rice/year}$

Note: Estimated based on information presented in *Rice Today* September 2002

As shown in the calculation, the consumption of 28 kg rice/person/year is the additional volume required to attain the national nutritional status (dietary energy consumption) equivalent to the same of Viet Nam. The figure is about 20% of annual per capita rice consumption (143 kg) adopted for the estimation of rice food balance by MAFF and the estimated rice consumption of 171 kg/capita (143 kg + 28 kg) is almost equal to the current consumption level of 167 kg/capita in Viet Nam.

Although the income elasticity of demand for rice is not so high, with the increase of GDP per capita, there might be some expansion of demand for rice in the country toward reducing the nutritional gap with the level of Viet Nam. It appears that there exists the possibility of some increase of per capita rice consumption in the country.

#### C4.1.4 Future Food Balance Estimation

For the projection of the future production level, the production level attained in 2005 could not be taken into account because the production in the year was extra-ordinary high blessed with favorable climatic conditions as stated earlier. In the present Study, therefore, several possible production cases are applied for examining food balance statuses in 2010, 2015 and 2020 to avoid presenting controversial issues. The assumptions applied in the case study are as follows;

#### Assumptions Applied for Estimating Food Balance of Rice (1/2)

Case A	Paddy production in the future remain at present level (average of 2000 to 2004) National Production Assumed: 2010, 2015 & 2020: 4,469,000 tons
Case B	Production Volume Estimated by MAFF 1/ 2010: 6,000,000 ton; 2015: 6,125,000 tons; 2020: 7,500,000 tons
Case C	Production Volume Estimated Based on Production of 2000 to 2004 2010: 4,745,000 ton; 2015: 5,159,000 tons; 2020: 5,572,000 tons
Case D	Production Volume Estimated Based on Production of 1995 to 2004 2010: 5,074,000 ton; 2015: 5,647,000 tons; 2020: 6,220,000 tons

1/: 3rd Draft, *Development Scenario for Agriculture Sector in Cambodia, 2007, MAFF*

### Assumptions Applied for Estimating Food Balance of Rice (2/2)

Sub-case	
1	Seed/post harvest losses: 13%; milling recovery rate: 64%; per capita consumption: 143 kg
2	ditto; ditto; per capita consumption: 155 kg (FAO estimate)
3	ditto; ditto; per capita consumption: 167 kg (consumption in Viet Nam, FAO estimate)
4	Seed/post harvest losses: 17%; milling recovery rate: 62%; per capita consumption: 143 kg
5	ditto; ditto; per capita consumption: 155 kg (FAO estimate)
6	ditto; ditto; per capita consumption: 167 kg (consumption in Viet Nam, FAO estimate)

The results of the case study are presented in Table C4-2 and the same expressed by proportion (%) of surplus or deficit to the paddy requirement volume in 2010, 2015 and 2020 are shown in the following table:

#### Surplus or Deficit Volume of Paddy Expressed by Proportion to Requirement (%)

Case	Sub-case	2010	2015	2020	Case	Sub-case	2010	2015	2020
Case A	1	4	-7	-17	Case C	1	10	7	3
	2	0.4	-10	-20		2	7	3	0
	3	-7	-17	-26		3	-1	-4	-7
	4	-5	-15	-24		4	1	-2	-6
	5	-7	-17	-26		5	-1	-4	-8
	6	-14	-23	-31		6	-9	-11	-15
Case B	1	39	27	39	Case D	1	18	17	15
	2	35	23	34		2	14	13	11
	3	25	14	25		3	6	5	3
	4	28	16	27		4	8	7	5
	5	25	14	24		5	5	5	3
	6	16	5	15		6	-2	-3	-5

The major findings of the case study are enumerated in the followings.

- When production volume remains at current level (Case A), the country will face rice deficit in all sub-cases except Case A-1 and A-2 in 2010 and in any assumptions and sub-cases in 2015 and 2020. These results indicate that production increase is essential for the national food security in the future.
- When per capita consumption of current consumption level of Viet Nam is attained through the improvement of nutrition status of the nation and per capita consumption of 167 kg is assumed, production deficits are brought about from 2010 in some sub-cases in Case C and Case D.
- In Case B (production volume estimated by MAFF), in which substantial production increases are assumed, no rice deficit will occur up to 2020 in any assumptions and sub-cases.

#### C4.1.5 Contributions of the Four River Basins for Food Security: Present & Future

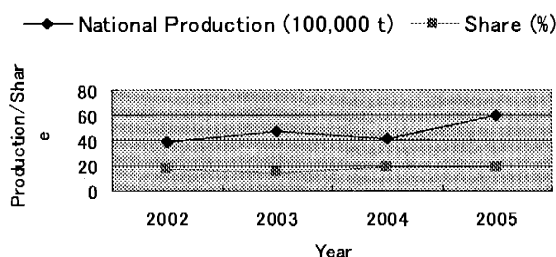
The contributions of the target four river basins (figures of all districts located in the basins) to the national food security have been examined by their paddy production share to the national production from 2002 to 2005 as shown in Table C4-3 and in the following figure.

As shown in the table, the production shares of the river basins as a whole are in the range of 15 to 17% and 17% on an average. In terms of paddy, average production

surpluses account for 25% and 29% of the production volume in the country and the river basins, respectively.

By assuming that the current production contributions of the river basins to the country are to be maintained in the future, the expected production volumes of the basins for the future paddy requirements for consumption level of 143 kg/person (MAFF estimate), FAO estimate of 155 kg/person and consumption level of Viet Nam, 167 kg/person, are estimated as follows;

Production Share of River Basins



Results of Case Study (Unit: 1,000 tons)

Assumptions/ Consumption	Paddy Requirements 1/			Contribution 2/			Balance 3/		
	2010	2015	2020	2010	2015	2020	2010	2015	2020
Assumption 1 (seed & post-harvest losses 13% & milling recovery rate 64%)									
143 kg/person	4,302	4,821	5,406	731	820	919	71	-18	-117
155 kg/person	4,449	4,985	5,591	756	847	950	46	-45	-148
167 kg/person	4,793	5,371	6,023	815	913	1,023	-13	-111	-222
Assumption 2 (seed & post-harvest losses 17% & milling recovery rate 62%)									
143 kg/person	4,696	5,261	5,901	798	894	1,003	4	-92	-201
155 kg/person	4,814	5,394	6,049	818	917	1,028	-16	-115	-226
167 kg/person	5,187	5,811	6,517	882	988	1,108	-80	-186	-306

1/: Estimated national paddy requirements for self-sufficiency

2/: 17% to the national requirements; expected contribution of the river basins to national production

3/: Paddy production increases required from the present level (802,000 tons) in the river basins for suffice the contributions

As shown in the table, to maintain the present level of contribution of the river basins to the national food security of rice in the country, substantial production increases by 2015 are necessary. In case of rice consumption level equivalent to the current consumption level in Viet Nam assumed, production increases of 14 to 23% of the current production volume by the year are to be achieved to suffice the contribution of the basins.

In case of the minimum requirement level assumed by the MAFF (Food Balance Sheet), the production increase required for the basins is **117,000 tons/year in 2020**. The production increase expected at the full development under the agricultural development plans of the present Master Plan is estimated at **108,000 tons/year**, nearly equal to the said production increase required in the year.

## C4.2 Rice Trade

### C4.2.1 Trade of Agricultural Products in Cambodia

The current main export destinations of agricultural products of Cambodia are Thailand and Viet Nam as shown in the following table.



### Cambodia's Export of Agricultural Products by Destination in 2005

Commodity Cluster	Thailand	Viet Nam	China	World
Agricultural Products (US\$ million)	11.7	1.7	1.3	66.6
(%)	22.2	2.6	1.9	100

*Source: Cambodian Economic Review, June 2007, Cambodian Economic Association*

Thailand has been the Cambodia's largest export destination in GMS for agricultural products due to the fact that the western provinces, which are relatively productive in agriculture production especially crops, share borders with the country and the country has greater demands for agricultural products for animal feeds and industrial inputs.

Cambodia's agricultural exports to Thailand have been carried out under various preferential trade schemes including AFTA/CEPT, a regional free trade agreement, and ASEAN Integration System of Preference (AISP), by which Thailand unilaterally agreed to allow imports of 310 items from Cambodia at preferential tariff rates.

Viet Nam appeared to the second largest export market for Cambodia agricultural products in GMS with trade value of US\$ 1.72 m., followed by China. Export of agricultural products to Viet Nam takes place either through exporters themselves transporting directly to Viet Nam or through middlemen from Viet Nam coming to Cambodia's nearby province to collect products from Cambodia such as cassava, cashew nuts, live animals and rubber and bringing those into Viet Nam.

It is also important to note that the trade statistics between the two countries could be much less than the actual trade value. This implies that Viet Nam is also a Cambodia's key trade partner in agricultural products.

#### C4.2.2 Current Rice Trade of Cambodia

The official statistic information indicates import surplus of rice at some 70,000 tons, export 5,200 tons & import 75,700 tons in 2004 as shown below.

#### Rice Trade of Cambodia from 2000 to 2004

Trade	2000	2001	2002	2003	2004
Export (1000 ton)	6.4	8.6	3.9	2.3	5.2
(US\$ million)	0.95	2.84	1.69	0.64	1.92
Import (1000 ton)	52.7	46.0	68.8	62.3	75.7
(US\$ million)	8.63	5.88	11.03	8.01	12.75

*Source: World Rice Statistics (WRS), IRRI*

However, volume nearer to the paddy surplus estimated in the food balance sheet might have been exported to the world market. The Cambodian Economic Review, 2007 reports the status of the informal trade of rice by saying that; "Data of official rice export is not available, however, according to the data form NIS, unrecorded rice export in 2005 was as much as US\$ 43 million (roughly estimated at 116,000 tons).<sup>3</sup> The rice export has drastically increased since the last couple of years due to production increase. Rice export is directed mostly to Viet Nam and Thailand, most in an informal manner. Two countries import rice for **re-exporting** to the world market

<sup>3</sup> Cambodian Economic Review, Issue 3, June 2007

rather than for their own consumption”.

An increasing **re-exporting** demand from Viet Nam and Thailand can be a stimulus of rice market as rice surplus is increasing. Cambodia needs, however, to establish a direct access to the world market in order to fully utilize its surplus.

There are several transactions involved before rice is exported to Viet Nam and Thailand as follows,<sup>3</sup>

- At the first level, farmers sell rice to the local collectors who himself are quite often farmers who do that kind of business as side activities.
- The local collectors sell rice to the wholesalers or to the rice millers.
- Wholesalers sell rice further to the traders who sell rice to Viet Nam or Thai buyers.
- Some report said “low to medium grade rice is exported to Viet Nam and high grade rice to Thailand.
- Sometimes, products in provinces bordering Thailand are also transported to Viet Nam across Phnom Penh.

### C4.2.3 Global Rice Trade

The world production volumes of milled rice from 2000 to 2005 are estimated as shown in the following table.

**World Milled Rice Production from 2000 to 2005**

Region	2000	2001	2002	2003	2004	2005	Average
World (million ton) 1/	401.4	400.7	381.3	391.5	406.2	414.4	399.2
Asia (million ton) 1/	365.4	364.9	345.2	355.6	366.4	374.8	362.1

1/: Estimated by: paddy production x 67%

Source: World Rice Statistics (WRS), IRRI

The rice production in Asia accounts for over 90% of the world production as shown in the table and the major producing countries of rice are Asian countries as shown below.

**Major Rice Producing Countries and Their Production of Milled Rice**

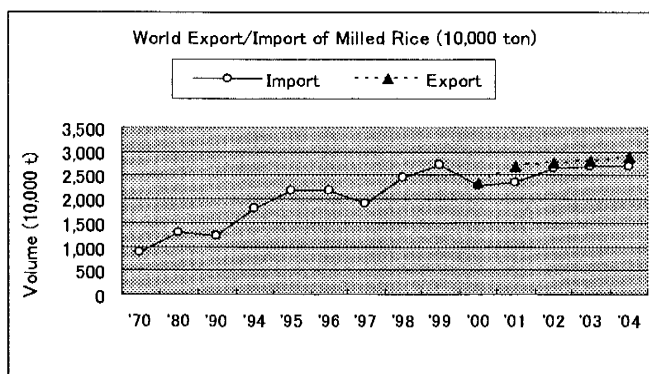
	China	India	Indonesia	Bangladesh	Viet Nam
Production (million ton) 1/	119.7	85.5	35.1	25.5	22.9
Proportion (%) 2/	30	21	9	6	6

1/: Estimated by: paddy production x 67%; average production volume of 2000 to 2005

2/: Proportion to world average production volume of 2000 to 2005

Source: WRS, IRRI

The global trade volume of milled rice exceeded 20 million tons in 1995 and the volume reached 27 million tons level in 2004 as shown in the figure. The trade volume is about 7% of the global production volumes in recent years (2000 to 2004). The



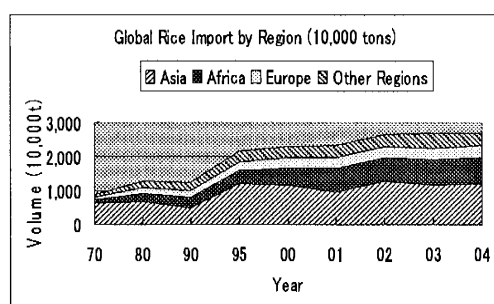
volume is, however, limited compared with the recent grain trade volumes (average of 2002 to 2004): i) corn 87 million tons, ii) wheat 116 million tons and iii) soybeans 60 million tons.

Major rice exporters include Thailand, India, Viet Nam, USA and Pakistan. The share of Asia in the global rice export trade accounts for 76% in 2004 and major contributing countries are Thailand, India and Viet Nam as shown in the following table.

#### Major Rice Exporting Countries in 2004

Item	Thailand	Viet Nam	India	Asia	USA	World
Volume (1000 ton)	9,990	4,087	4,794	22,114	3,067	28,990
Proportion to World (%)	34	14	17	76	11	100

Source: of Rice & World Rice Statistics, IRRI



The regional distributions of rice import from 1970 to 2004 are illustrated in the left figure. The Asia is continuously the largest importers of rice as shown in the figure. However, the increase of rice import in Africa from 1995 is noticeable and the region is the 2<sup>nd</sup> largest region of rice import after Asia in recent years.

Major importers are African countries of Nigeria, Cote d'Voire and Senegal and Saudi Arabia, Bangladesh and Brazil. Their import volumes in 2004 are as follows;

#### Major Rice Importing Countries in 2004

Item	Nigeria	Cote d'Voire	Senegal	Africa	Bangladesh	World
Volume (1000 ton)	1,398	868	823	7,572	992	26,914
Proportion to World (%)	5.2	3.2	3.1	28.1	3.7	100

Source: of Rice & World Rice Statistics, IRRI

The concentration of production and trade in Asia is an outstanding characteristic of the rice production and trade in the history of the same. In the global trade features, it should be noted that the rice export of China drastically decrease in 2004, from an average of 2.4 million tons from 2000 to 2003 to 0.9 million tons in 2004.

The other characteristic of rice trade is the annual variation of trade volume as shown in the following tables.

#### Annual Variations of Rice Export from 2000 to 2004

Item	World	Thailand	Viet Nam	India	China	Asia
Range ('00 to '04) 1/	87 ~ 108	78 ~ 126	88 ~ 111	45 ~ 149	42 ~ 144	84 ~ 111

1/: Proportion (%) to an average volume from 2000 to 2004

Source: WRS, IRRI

#### Annual Variations of Rice Import from 2000 to 2004

Item	World	Indonesia	Bangladesh	Asia	Africa
Range ('00 to '04) 1/	90 ~ 106	34 ~ 155	20 ~ 165	84 ~ 111	74 ~ 113

1/: Proportion (%) to an average volume from 2000 to 2004

Source: WRS, IRRI

The noticeable features in the global trade are large annual variations of export and import volumes of major exporters and importers and as a whole of major regions as

shown in the tables.

#### C4.2.4 Bibliographic Study on Long Term Projections for Global Rice Demands

The long term projections for the global demand for rice are made by many institutions. However, the results of projections vary among the institutions attributed to the different assumptions and simulation models adopted. Some of such projections made by various institutions are presented in the followings.

##### (1) USDA (Rice: Market Outlook (2005 -14), USDA Economic Research Service)

USDA estimates that global rice trade is projected to grow 2.4 % per year from 2007 to 2016 and by 2016 global rice trade reaches nearly 35 million tons, about 25% above the record set in 2002. The increased global rice trade is projected to be primarily driven by rising import demand from Indonesia and Bangladesh, the two largest rice import markets. Combined, these two markets account for 28 percent of the increase in global rice imports projected over the baseline (2005).

Sub-Saharan Africa and the Middle East, major destinations for internationally traded rice, are also projected to substantially increase rice imports over the baseline, exhibiting annual import growth of 2.3 and 3 percent, respectively. In both regions, strong demand growth driven by rapidly expanding populations and rising incomes confronts limited opportunities to expand production

Further, the Report indicates that long-grain varieties currently account for around three-fourth of global rice trade and are expected to account for the bulk of trade growth over the next decade. The statistic data on the volume of trade by variety is shown below.

**Changes in Quality of Traded Rice 1/**

Year	Variety				Total
	Indica	Japonica	Aromatic	Glutinous	
1992-1994	76 %	14 %	9 %	1 %	100 %
2001-2003	75 %	12 %	12 %	1 %	100 %
Annual Growth Rate	6 %	4 %	9 %	8 %	6 %

1/: Share (%) to an average annual trade volume

Source: F. Lancon, *World Rice Commerce*, 2006

##### (2) FAO Projections (Prospects by Major Sector)

In the FAO document, the global rice production and consumption is projected that “this crop is overwhelmingly used for direct human consumption, and made up 21 percent of the world's cereal consumption by weight in 1997-99. Average consumption per person in developing countries has been leveling off since the mid-1980s, reflecting economic development and income growth in major East Asian countries. It has, however, been growing in some regions, including South Asia, where it is still low. Consumption is expected to grow more slowly in the future than in the past. Indeed, average consumption per person in developing countries may well start to decline during the period 2015 to 2030. This will ease pressures on production, but given the slow yield growth of recent years, maintaining even modest increases in production will be a challenge to research and irrigation policy.”

### (3) **FAO: Medium-term Projections for Agricultural Commodities**

The report presents medium-term projections for major agricultural commodities over the period to 2010. According to the report, the medium-term production and consumption of rice is projected as follows;

- Global production of cereals is projected to grow 1.1 percent annually over the projection period, continuing a decline in per capita terms from the previous decade. For rice, high production growth is anticipated in Latin America and in Africa.
- Prices in real terms have been considerably below their long term trend lines. They are projected to move back to trend levels, and perhaps in the cases of maize and rice, to move somewhat above trend as yield growth slows and demand remains steady.
- For rice, imports into Africa are projected to grow and several developed markets are set to increase imports as a result of new preference access programs such as EU's Everything But Arms initiative.

### (4) **Global Food Projections to 2020, IFPRI, 2001**

The Projections by IFPRI (International Food Policy Research Institute) indicate the world production, demand and trade of rice in 2020 as shown in the following table.

**Rice Production, Demand & Trade in 1997 & 2020 (Unit: 1,000t)**

Region	Production	Demand	Net Trade
1997			
World	380,827	380,827	0
2020			
World	503,212	503,212	0
Developed World	18,124	18,790	-666
S.E. Asia & East Asia	282,732	269,251	13,481
West Asia/North Africa	8,275	13,418	-5,143
Sub-Saharan Africa	15,185	20,943	-5,758
Other Regions	178,896	180,810	-1,914

As shown in the table, IFRI projects the demand increase for rice of about 32% from 1997 to 2020 or an annual growth rate of 1.2%. It also projects the 1 % decline of per capita demand for rice in the world and the 1.8% increase of the same in Asia from 1997 to 2020.

### (5) **Long-term Prospects for the Global Rice Economy, IRRI**

The recent projections of IFPRI presented at the FAO Rice Conference, 2004 by Mr. Mahabub Hossain, Lead Economist of IRRI indicate that the demand for rice will increase by 1.1% per year over the next three decade (2000 - 2030). This is only a fraction of the actual increase in rice consumption over the last three decades (2.4%). This increase in demand will vary considerably across the regions. It will increase only marginally in East Asia (0.4%) but quite substantially in the low income countries of South Asia (1.6%) and Sub-Saharan Africa (2.0%). In the projection, the world demand for rice is estimated at some 560 million tons in 2030, which is about 147% of the

projection made for 2020 in 2001 by the institute.

## (6) Implications of the Complete Rice Trade Liberalization

The Uruguay Round Agreement on Agriculture represented a turning point in the history of the multilateral trading system by subjecting agricultural trade to essentially the same rules that discipline trade in industrial goods. With the signing of the Doha Ministerial Declaration in 2001, objectives and deadlines for the current round of multilateral negotiations were set. However, little compromise has been reached on core issues regarding commitments to further expand market access, reduce or eliminate export subsidies and lower trade-distorting domestic supports. Rice remains as one of the most protected food commodities in world trade.

Dr. Eric J. Wailes of University of Arkansas, USA analyzed the impact of the complete liberalization of rice trade; the elimination of import tariffs, export subsidies and domestic supports; on the global rice trade by applying the simulation models called RICE FLOW and AGRAM (Arakansas Global Rice Model). The results of the analyses were presented in the FAO Rice Conference, 2004 as follows;

- Complete rice trade liberalization in 2000 would have resulted in an expansion in global rice trade of nearly 3.3 million tons, a 15% increase in trade compared to actual 2000 rice trade. Trade weighted average export prices would be 32.8% higher and trade weighted import prices would be 13.5% lower.

### Impact of Trade Liberalization on Rice Trade in 2000

Indicator	Baseline 1/	Free Trade 2/	Change (%)
Trade Volume (1000 tons)	22,892	26,428	15.4
Export Price (US\$/ton)	225.7	299.7	32.8
Import Price (US\$/ton)	373.5	323.0	-13.5

1/: Actual figure in 2000; 2/: Results of simulations under free trade on 2000 status

- Trade in medium/short grain with trade liberalization would increase by 73% in volume, while trade of long grain would increase only 7%.
- With global complete policy reform, total rice trade is estimated to increase by 10 to 15% and rice trade volume will increase from the current 6.5% of global consumption to 8.4% by 2012.

### C4.2.5 Specific Features of Rice Consumption and Trade

Rice has been consumed as a staple food more than any other grain in the world and its consumption and trade has specific features in many aspects. Dr. F. Lancon of CIRAD<sup>4</sup> clearly defined such features as enumerated in the followings.<sup>5</sup>

#### Rice remains a strategic commodity:

- Public specific status of rice in the agricultural development and food policy translate into recurrent public interventions affecting rice trade, and
- Rice trade is considered as a tool to pursue policy objectives.

<sup>4</sup> The Centre de Cooperation Internationale en Recherche Agronomique pour le Development, France

<sup>5</sup> The Rice Market Trends , The Long and Short Term Perspectives, World Rice Commerce 2006

#### Potential impact of rice trade liberalization:

- Many simulations show a positive impact of trade liberalization of rice on traded volumes and prices,
- Magnitude of the impact differs according to the type of rice grains (i.e. short, long grains),
- Impact varies across countries depending on their position (net exporters or net importers), and
- Current & forthcoming trade agreements still recognize strategic nature of rice.

#### Change of driving forces in demand shift:

- Traditional driving forces: urbanization and higher opportunity costs for time allocated to food preparation, income level and food policies.
- New driving forces: changes in life style, diet diversification, migration & globalization of food habits.

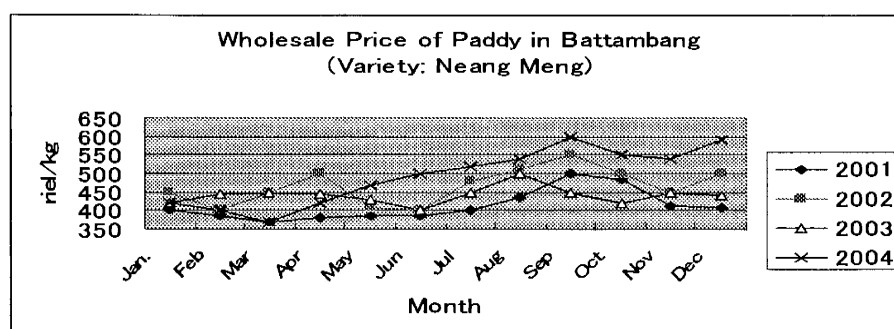
#### Increasing segmentation of the rice market:

- New markets' consumers are becoming more sensitive to rice quality (appearance, taste, safety),
- Traditional markets' consumers are becoming more selective in rice quality,
- New determinants of segmentation: ethnic market, "cultural" protection, and
- Segmentation along the supply chain with increasing added value in rice processing (packaging, pre-cooked, etc.).

### **C4.3 Miscellaneous Issues on Rice Marketing**

#### **C4.3.1 Marketing Prices of Paddy**

The past trends of wholesale paddy prices from 2001 to 2004 in Battambang are illustrated as follows;



Source: Agricultural Market Information Bulletin, 2004, MAFF

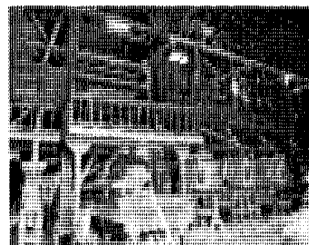
The general trend of the wholesale paddy prices in Battambang is its hike from July/August to October as shown in the figure.

#### **C4.3.2 Rice Millers Associations and Rice Millers in Battambang**

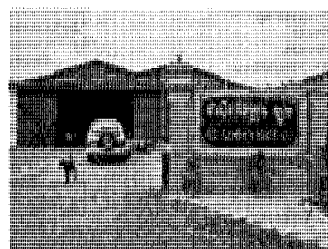
Currently, there formed 9 province level rice miller associations in Cambodia; in Battambang, Banteay Meanchey, Kandal, Prey Veng, Pursat, Siem Reap, Svey Reng, Kampong Cam and Takeo. The apex organization of the rice miller associations, Federation of National Rice Miller Association, was established in May 2000 in Phnom

Penh under the support of UN' Cambodia Rehabilitation and Regeneration Project (CARERE). The main envisaged activities of the Federation include: i) low interest loan for member associations and ii) exporting rice in a group by associations or Federation (not yet realized). The Federation received US\$ 5.0 million loan from Rural Development Bank in 2006 and US\$ 4.0 million of the loan are provided to the association in Battambang.

The rice miller association in Battambang was first established in 1994 and current membership is 112 rice millers out of the total millers of 274 in the province. The main planned activities are similar to the same of the Federation and the association is planning to make trial shipment to Africa under the contract with WFP.



According to the rice miller association in Battambang, there are 274 rice millers in the province. Among them, 36 millers are classified as large ones and about 50% are having operation capital of over US\$ 0.2 to 0.3 million. The number of modern mills is only 4 in the province and most of the mills are old plant types. However, the construction of several new rice mills are on-going or planned equipped with modern machinery and expansion of warehouse are on-going in plural mills.



### **C4.3.3 Constraints for Milled Rice Export**

An increasing re-exporting demand from Viet Nam and Thailand can be a stimulus of rice market as rice surplus is increasing in Cambodia as stated earlier. However, Cambodia needs to establish a direct access to the global market in order to be fully benefited from its surplus.

The constraints for the expansion of milled rice export encountered by rice traders are numerous from production issue, marketing issue and institutional and trade facilitation issue. Such constraints raised by various stake holders such as rice traders, associations and MAFF are discussed in the followings.

#### **(1) Problem Tree Analysis of MAFF**

The problem tree analysis for crop marketing and commercialization presented in "Report on Agricultural Marketing System and Market Potential, Agricultural Marketing Office, MAFF, 2006" is presented in Table C4-5.

#### **(2) Constraints for Milled Rice Export**

Constraints for milled rice export reported by rice traders/millers in Phnom Penh and Battambang, the Federation of National Rice Millers Association and Rice Millers Association in Battambang and MAFF are as enumerated below.

##### Products

- Low quality; failed to meet quality standard set by importers: mixture of grains



- of different varieties (caused by impurity of seeds grown),
- Seed quality {cultivation of self-multiplied seeds prevailing (impurity of seed) & use of certified seeds still limited},
- Unstable production under rainfed rice cultivation, and
- Marketing volume of individual farmers limited & containing immature grains and grains of high moisture content (especially harvest of October/November).

#### Milling Facilities

- Poor milling facilities compared with those of Thailand & Viet Nam (outdated facilities, limited milling capacity, insufficient storage capacity, foreign materials and broken rice content etc.),
- Lack of drying facilities,
- Lacking systematic knowledge of milling technology, and
- Limited access to loan for capital investment.

#### Trading

- High costs incurred in export (transportation, export clearance costs),
- Shortage of capital for procurement of paddy and limited access to /credit for operation fund,
- High cost to get quality certification by MOC,
- Handling volume of individual rice millers/traders limited,
- No to limited experiences in rice export & no access to export market, and
- Huge volume of informal trading of paddy (paddy trade statistics not available).

#### Government Policy

- Government paddy free trade policy (farmers/collectors sell paddy to buyers from Thailand & Viet Nam offering higher price) & paddy export through traders from Thailand & Viet Nam prevailing,
- Lack of government support for export, and
- No standardization of milled rice in Cambodia.