

## **APPENDIX J**

### **Colmatage System in Kandal Province**

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## **J.1 Background**

Kandal province has the most agricultural productive areas on the basis of crop productivity, higher crop intensity, larger dry season cropping areas and good transportation system. Agricultural areas is located along the roads, river, streams and colmatage canals. In the area, "Colmatage" farming is traditionally practiced by taking silt-bearing flooded water through many colmatage canals distributed along the Mekong and Bassac rivers. Most of canals, however, have been deteriorating due to unfunctional gates and insufficient canal capacity.

Under the above situations, rehabilitation of the canals has to be implemented urgently, putting high priority. Related to the implementation of canal rehabilitation, the Government of Cambodia has requested "Improvement and Development of Colmatage Systems along the Mekong, Kandal, Cambodia" to the Government of Japan. According to the request, rehabilitation of six canals and Sanda colmatage along the Mekong river is proposed.

## **J.2 Present Condition**

### **J.2.1 Agriculture in Kandal Province**

Kandal province has a land of 3,663 sq.km. Population is 855,000(1994), of which density is 238/sq.km, is the highest in the whole provinces. Most of the people engage in agriculture in the area along the Mekong and Bassac rivers.

In the agricultural area, "Colmatage" farming is practiced, which is a traditional land reclamation and cultivation methods allowing siltation on the land and recession of flooding. Provincial agriculture with colmatage farming is characterized as follows:

- Rice production is 210,200 ton(1994), about 10 percent of whole country, of which yield is 3.18 ton per ha, highest in the whole provinces with average 1.49 ton per ha, since dry season rice production is most active with favorable cropping conditions brought by colmatage canals.
- Maize is the largest production crop, among all field crops cultivating in the whole provinces. Compared with the production volume of each province, Kandal province is the top with 22,900 ton, occupying 51 percent of the whole production .
- Vegetable production is also practiced on the higher terrace land and on the slope of the natural levees behind rivers. Cultivated area of 5,560 ha is the largest in the whole provinces. Its production volume is 34,490 ton(1994). The province has many advantages for vegetable production since it has a relatively good transporting system and is closed to the large market area of Phnom Penh

Taking account of the above conditions, Kandal is considered as the most important province having high agricultural productivity associated with the periodic flooding of Mekong and Bassac rivers. The productivity, however, is stagnant at low level after civil war due to aggravation of colmatage canals.

To attain the national goals of socio-economic development, agriculture development is the most important policy. For this end, recovering and increasing agricultural productivity in Kandal province is the basic and urgent approach. From this viewpoint, high priority should be given on the rehabilitation works of colmatage canals.

### **J.2.2 Backswamp Area**

The Ministry of Environment expressed the Royal Government's intention to join the Ramsar Convention, in 1994. After affiliation, the Ministry were proposed the three sites, Lake Chhma, Koah Kapik and associated area and Middle Reaches of the Mekong river, as the convention area. Besides these areas, the Ministry is considering one site in Bassac Marshes between the Mekong and Bassac rivers, as the environmental conservation area.

The Bassac Marshes is surrounded with natural levees of both rivers as shown in Figure J.2.2.1. The natural levees slopes gently down to the in-land, swamps, streams and lakes. Agricultural lands are distributed in the narrow band along the natural levees. Intensive farming is practiced in the areas. Upland crops and vegetable in the higher land, and rice in the lower land are cropped with silt-bearing water supply through colmatage canals.

Swamp is the important area for habitat of fish which migrates from Mekong river through colmatage canals and streams. The extension area is dependent on inflow amount from canals and streams. Storage water is released toward Mekong river through the same canals and streams, as the inundation subsides. Water channel is also useful for fish migration. Present swamp areas are formed by linkage of Mekong, Bassac rivers and colmatage canals.

Department of Fisheries gives fishing lots in and around swamp area to fishermen through auction. In Kandal province, total of 19 fishing lots with the area of 178,907 ha, is counted.

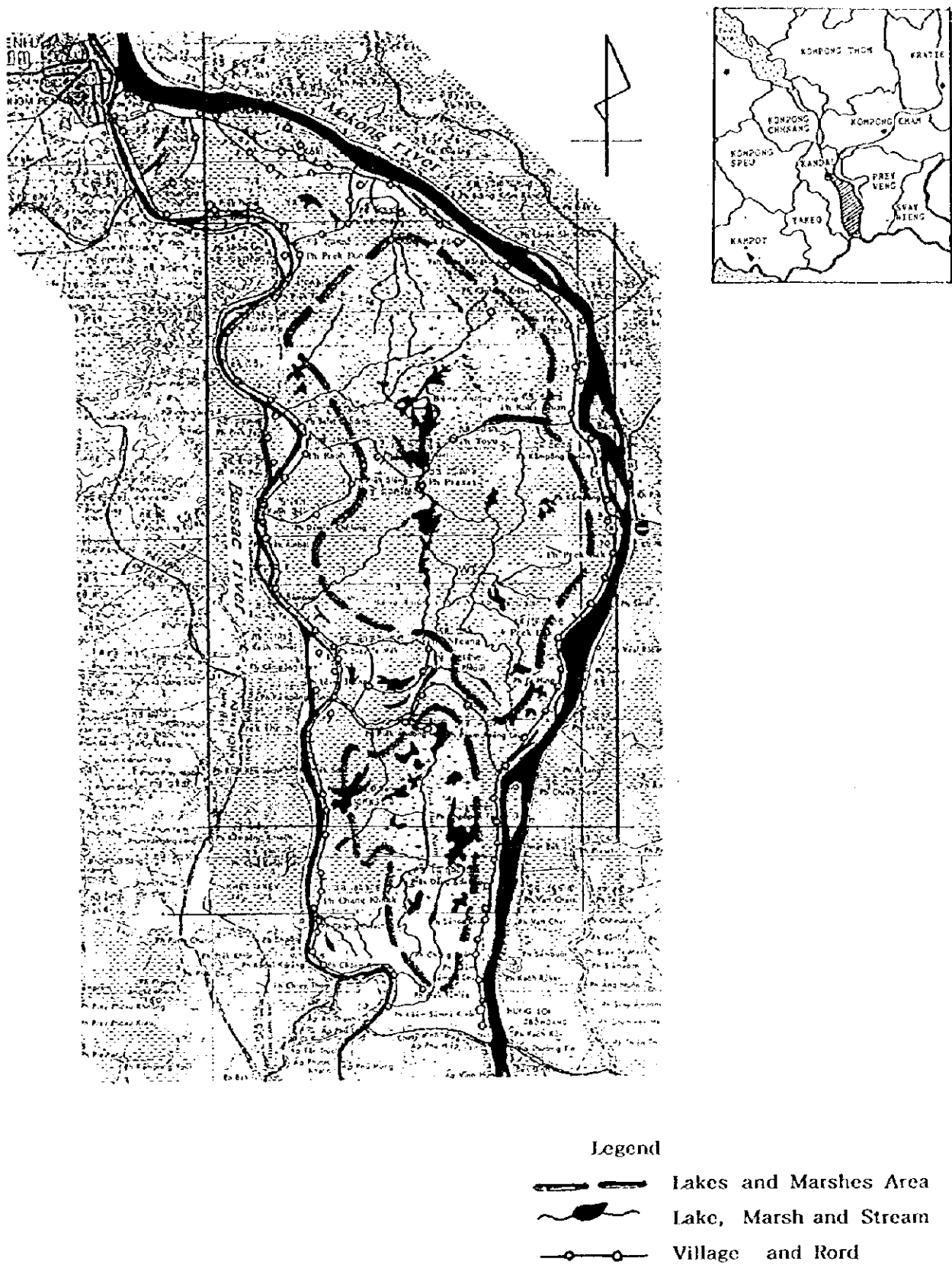


Figure J.2.2.1 Present Lakes, Flooded Forest and Freshwater Marshes Area

Sources : Lakes and Marshes area is from Land Cover Atlas in Cambodia

### **J.2.3 Role of Colmatage Canals**

Silt-bearing water intrudes into colmatage canals as water level of the Mekong and Bassac rivers is rising more than the bottom of canal. Intake water with silt is flooded into farmland and backswamp behind the natural levees, giving many favors on the agro-ecosystem of land. Silt plays an essential role in maintaining the fertility of surface soil on the land. In this flow of flooded water, colmatage canals serves as an important factor for natural environment conservation and agricultural and fishing activities. Its functions are summarized as follows.

- Supply of silt-bearing water on the farmlands
- Water resources for recession rice cultivation
- Water supply into backswamp for conservation of inundated forest and fishing resources
- Conservation of fish habitat and mitigation route
- New land reclamation through siltation
- Maintenance of soil fertility through silting on and washing off farmlands

Colmatage farming has many advantages for conducting agriculture harmonized with natural ecosystem. It is considered as sustainable and environmentally conservative farming well-balanced with annual flooding cycle.

Though the canal plays important roles to provide many benefits for maintaining agro-ecosystem of cropping land and swamp, its function has been deteriorating due to unfunctional control gates, deposited sedimentation in the canals, soil erosion on the slope of canals.

If this situation will be going on without any remedy, traditional colmatage farming and fishing production systems will be damaged by decrease of flow capacity, siltation on the land, water supply into backswamp, and blockade of fish migration routes.

### **J.2.4 Distribution of Colmatage Canals**

The number of colmatage canals in the project area is accounted for 250. Koh Thom district has the largest number, 103 or 41 % of total, and Kean Svay has the smallest number, 22 or 9 %. The scale of canals in each district is summarized as below and the distribution of the canals is shown in Figure J.2.4.1.

**Table J.2.4.1 Summary of the scale on Colmatage canal in each district**

| District Name  | Number of canals | Mean Canal Dimension (m) |              |       | Length (km) |      |
|----------------|------------------|--------------------------|--------------|-------|-------------|------|
|                |                  | Top Width                | Bottom Width | Depth | Total       | Mean |
| Kean Svay      | 22               | 13.5                     | 6.0          | 3.4   | 29.9        | 1.42 |
| Saang          | 74               | 19.5                     | 14.2         | 2.3   | 147.6       | 1.99 |
| Koh Thom       | 103              | 16.2                     | 7.0          | 3.2   | 238.0       | 2.31 |
| Leuk Dek       | 51               | 3.0                      | -            | 2.1   | 89.2        | 1.75 |
| Total/ Average | 250              | 14.2                     | 10.1         | 2.7   | 504.7       | 2.03 |

### J.2.5 Zoning of the Colmatage Farming Area

Based on the water source, farm land, farming practice, dimension and density of the canals, the colmatage farming area is divided into five zones as below. Detail is shown in Figure J.2.5.1 and Table J.2.5.2.

**Table J.2.5.1 Zoning of colmatage farming area**

| Type      | District Name | Number of Canal | Water Source | Density of Canal (km/canal) | Farm Land (ha) |          |          | Main Cropping(**) |
|-----------|---------------|-----------------|--------------|-----------------------------|----------------|----------|----------|-------------------|
|           |               |                 |              |                             | Upland Crops   | Wet Rice | Dry Rice |                   |
| Zone I    | Kean Svay     | 10              | Mekong       | 2.5                         | 1,550          | 473      | 618      | U                 |
| Zone II   | Leuk Dek      | 51              | Mekong       | 1.0                         | 0              | 0        | 3,205    | D                 |
| Zone III  | Kean Svay     | 12              | Mekong       |                             | 470            | 236      | 630      |                   |
|           | & Saang       | 10              | & Bassac     |                             | 212            | 113      | 195      |                   |
| sub total |               | 22              |              | 1.3                         | 682            | 349      | 825      | U & D             |
| Zone IV   | Saang         | 64              | Bassac       | 0.9                         | 3,108          | 2,213    | 3,420    | U,D & W           |
| Zone V    | Kho Thom      | 103             | Bassac       | 0.6                         | 2,034          | 2,761    | 5,469    | U,D & W           |
| Total     |               | 250             |              | 0.9                         | 7,374          | 5,796    | 13,537   |                   |

Note; (\*\*), U: Upland Crops, D: Dry Season Rice, W: Wet Season Rice



Table J.2.5.2 Present Condition of Colmatage System in the Project Area

| ZONE No. | District Name      | Number of Canals | Total(*) Length of Canal (km) | Number of Villages | Number of Families | Water Source    | Length (*) of River (km) | Interval of Each Colmatage (m) | Upland Crops | Farm Land (ha) Wet Season Rice | Farm Land (ha) Dry Season Rice | Total       | Mean Width of Cultivated Area (m) |             | Irrigation Type |                  | Remarks |   |
|----------|--------------------|------------------|-------------------------------|--------------------|--------------------|-----------------|--------------------------|--------------------------------|--------------|--------------------------------|--------------------------------|-------------|-----------------------------------|-------------|-----------------|------------------|---------|---|
|          |                    |                  |                               |                    |                    |                 |                          |                                |              |                                |                                |             | (4)=(5)/(2)                       | (6)=(5)/(2) | Grav. Irrig.    | Traditional Pump |         |   |
| ZONE I   | Kean Svay          | 10               | 16.70 (1.85)                  | 14                 | 4070               | Mekong          | 25                       | 2500.0                         | 1550         | 473                            | 618                            | 2641        | (5)                               | 1581        | 0               | 10               | 10      | -Dry season rice is the highest.<br>-Developmental potentiality is the highest.<br>-Large Scale Farming<br>-Access to site is good. |
| ZONE II  | Leuk Dek           | 51               | 89.00 (1.75)                  | 101                | 3221               | Mekong          | 50                       | 980.4                          | 0            | 3205                           | 0                              | 3205        | 3205                              | 360         | 0               | 0                | 51      | -Access to site is bad<br>-Dry season rice only<br>-Small Scale Farming   |
| ZONE III | Kean Svay<br>Saang | 12<br>10         | 13.20<br>13.00                | 13<br>20           | 5290<br>1680       | Mekong & Bassac | 14<br>15                 | 1166.7<br>1500.0               | 470<br>212   | 236<br>113                     | 630<br>195                     | 1336<br>520 | (5)                               | 1012<br>400 | 2<br>4          | 10<br>7          | 10<br>7 | -Access to site is good.<br>-Farming Practice is not so aggressive  |
|          | sub total          | 22               | 26.20 (1.2)                   | 33                 | 6970               |                 | 29                       | 1318.2                         | 682          | 349                            | 825                            | 1856        | 1412                              | 6           | 17              | 17               |         |   |
| ZONE IV  | Saang              | 64               | 134.58 (2.1)                  | 87                 | 15488              | Bassac          | 30 X 2<br>60             | 937.5                          | 3108         | 2213                           | 3420                           | 8741        | 650                               | 0           | 0               | 64               | 64      | -Wet & Dry season rice and upland crops<br>-Access to site is good  |
| ZONE V   | Kho Thom           | 103              | 241.80 (2.34)                 | 100                | 16451              | Bassac          | 31 X 2<br>62             | 601.9                          | 2034         | 2761                           | 5469                           | 10264       | 424                               | 10          | 0               | 88               | 88      | -Wet & Dry season rice is main<br>-Small Scale Farming<br>-Access to site is bad  |
|          | Total              | 250              | 508.3 (2.03)                  | 335                | 46200              |                 | 226                      | 904.0                          | 7374         | 5796                           | 13537                          | 26707       | 525                               | 16          | 91              | 230              |         |   |

Note : (\*) : Total length of the Mekong/Bassac river in each zone

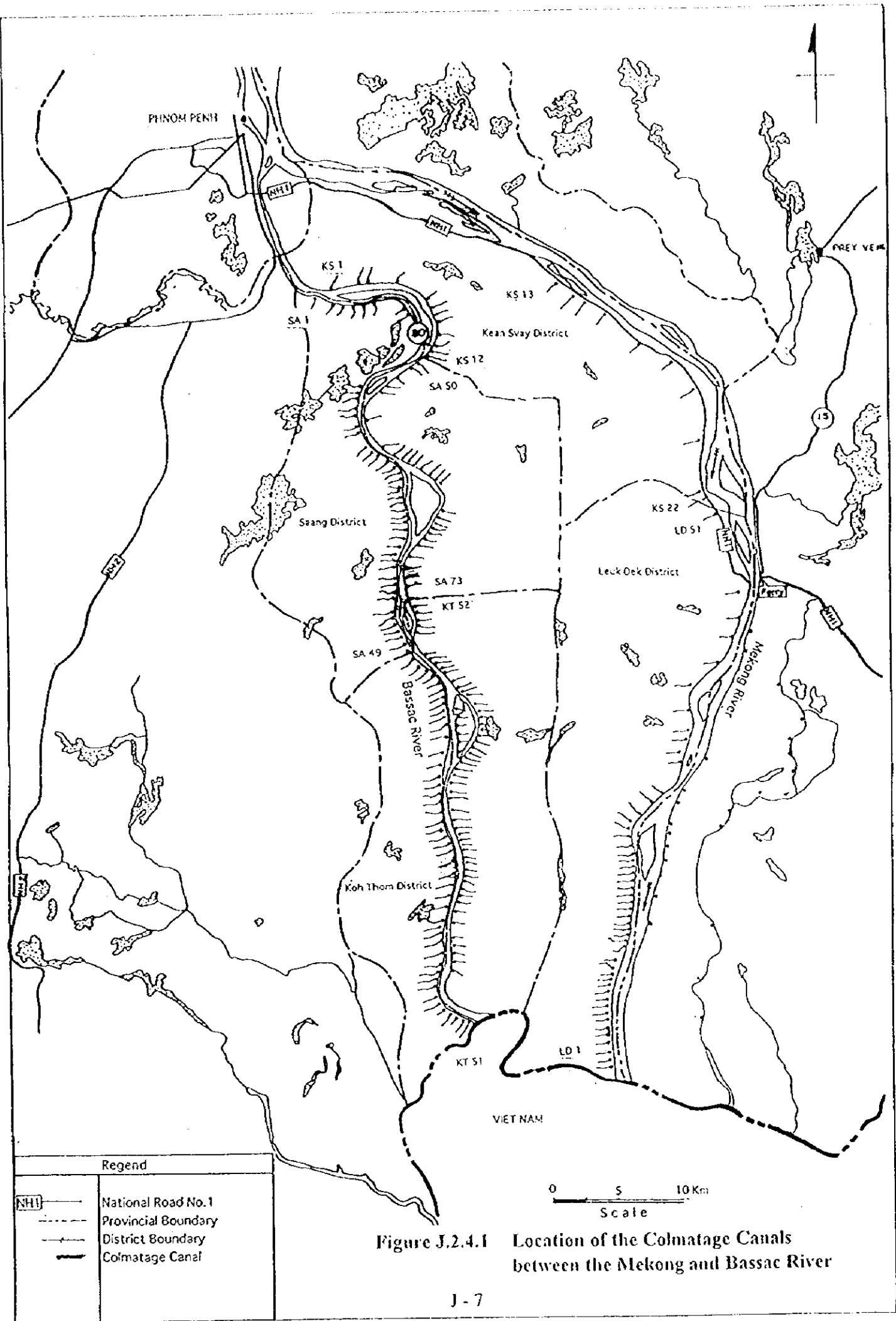


Figure J.2.4.1 Location of the Colmatage Canals between the Mekong and Bassac River

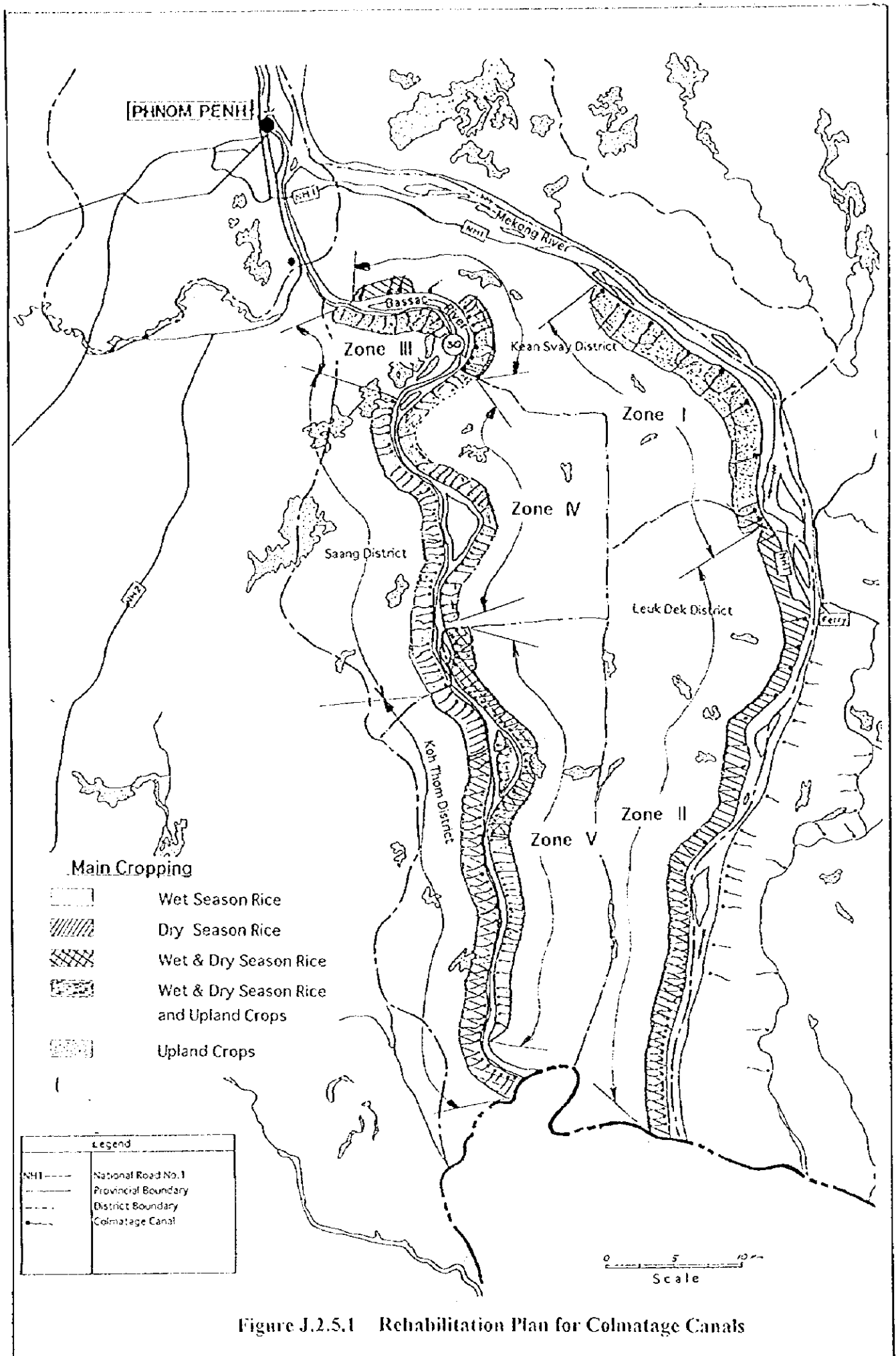


Figure J.2.5.1 Rehabilitation Plan for Colmatage Canals

### **J.3 Agricultural Development Plan**

#### **J.3.1 Cropping Pattern and Farming Practices**

Based on the regional statistics, dry season cropping area occupies half of the total cropping area and the dry season paddy area is nearly three times of the dry season field crops area. In wet season, both areas for paddy and field crops are almost same. About five percents of the whole cropping area is utilized as orchard. The double cropping area represents seven percents of the whole cropping area and are mainly distributed in Saang and Koh Thom districts. Judging from the data and field survey, double cropping is practiced on the upland fields on river banks and its back slope areas around colmatage system during dry season. (see Table J.3.1.1)

At present, the region of the four districts is one of the most productive areas. Generally, northern part of the region, namely Kean Svay and Saang districts, has a wide range of agriculture due to its geographical advantage; the capital suburbs. In particular, Saang is an important vegetable supply area for the capital demands and various kinds of vegetables; leafy, tuberous and fruit, are planted both in wet and dry seasons. On the other hand, southern part of the region, namely Koh Thom and Leuk Dek districts, is a major wet season maize cropping area. Koh Thom has also broad vegetable field, especially chili, in dry season. (see Table J.3.1.2 and J.3.1.3.)

The present cropping pattern of four districts is shown in Figure J.3.1.1. This pattern is based on the interviewing to farmers and the results of "Rural Socio-Economic Survey". The early dry season paddy which starts in October are predominantly seen in Kean Svay. The late dry season paddy which starts in December, January and February is common in other three districts. Wet season paddy usually commences in May and June. The harvesting time of wet season paddy depends on the variety. To avoid climate risks due to erratic precipitation and flooding damage, many kinds of traditional varieties are widely practiced and also some IR varieties. The dominant variety for dry season paddy is IR 66 but for wet season paddy, most farmers mentioned only traditional varieties which name could not be clarified.

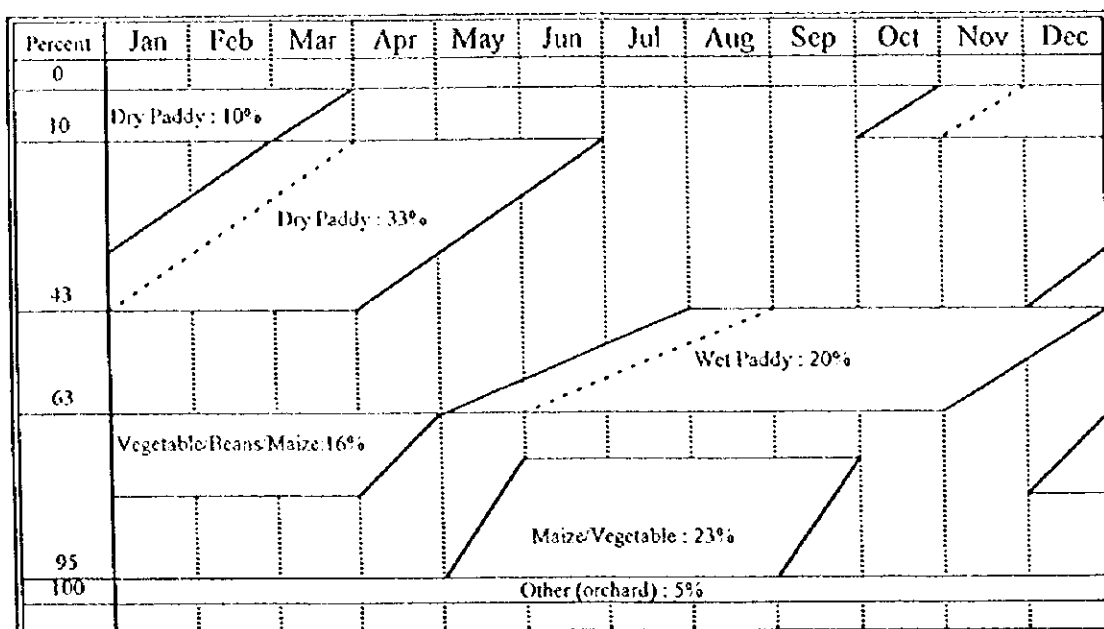
On the river banks and its back slope areas, field crops are widely practiced. In wet season, farming for field crops starts in May simultaneously with rainfall and harvesting ends before September or October when the river flood cover the area. Maize presents more than eighty percents of all field crops area in wet season. In dry season, the land which contains enough moisture for plant growing or is located near available irrigation water is cultivated and some of the farmers use mobile pumps for irrigate water from colmatage canal to upland field. Vegetables, beans (mungbean, peanut) and maize are main crops in dry season.

#### **J.3.2 Agricultural Production Plan**

The agricultural production in the region will increase by the rehabilitaion of colmatage system. If it is possible to control water level of colmatage by water control facility such as gate, dry season cropping will increase. Because more water can be retained in colmatage canal during dry season, the farmers can irrigate and cultivate upland fields which were not utilized during dry season before. At present, the half of upland fields is cultivated in dry season and it represents 16 percents of whole cropping area. The target is to increase the upland cropping ratio in dry season from 16

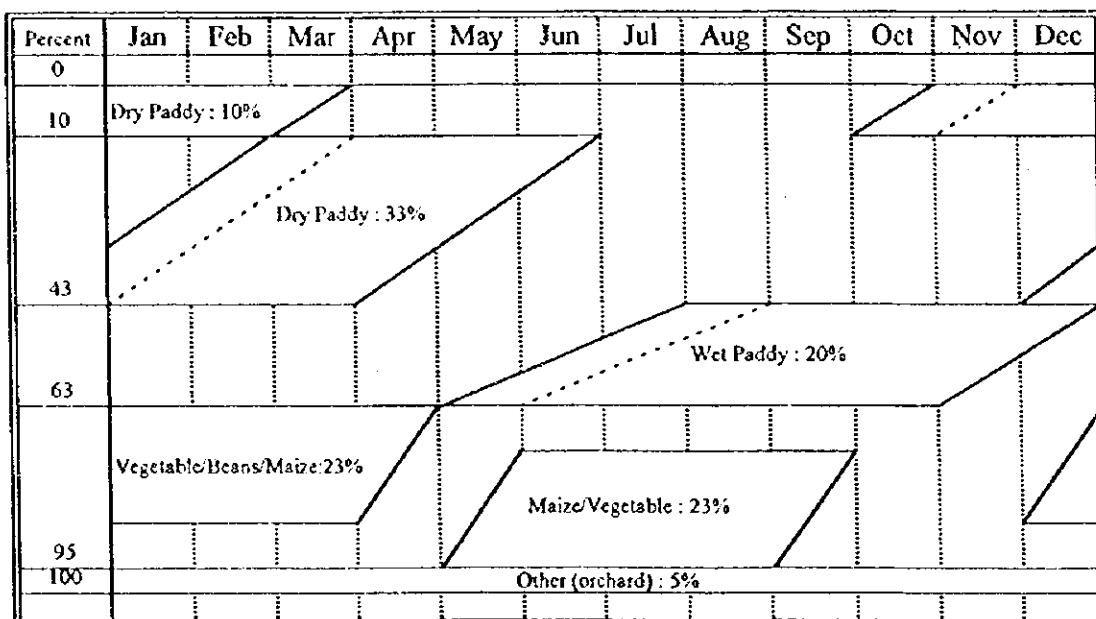
to 23 percents of whole cropping area

The proposed cropping pattern is shown in Figure J.3.2.1 and the production data with/without the project are also shown in Table J.3.2.1. The present yields are obtained from statistical data and target yields are set as the highest value among four districts.



Source: Field Survey and Rural Socio-Economic Survey

Figure J.3.1.1 Present Cropping Pattern of Colmatage System in Kandal Province



Source: Field Survey and Rural Socio-Economic Survey

Figure J.3.2.1 Proposed Cropping Pattern of Colmatage System in Kandal Province

Table J.3.1.1 Present Land Use of Related Four Districts in 1995/96

| District        | Wet Season                                |             |              |               | Dry Season                 |               |              |                | Total  | Orchard<br>(9)<br>(ha) | Total<br>(10)*<br>(8)+(9)<br>(ha) | Double<br>Cropping<br>Area<br>(11)<br>(ha) | Total<br>Cropping<br>Area<br>(12)**<br>(10)+(11)<br>(ha) | Cropping<br>Intensity<br>(13)**<br>(12)/(10)*100<br>(%) |
|-----------------|---|-------------|--------------|---------------|----------------------------|---------------|--------------|----------------|--------|------------------------|-----------------------------------|--|--|---|
|                 | Paddy                                     |             | Field Crops  |               | Paddy                      |               | Field Crops  |                |        |                        |                                   |  |  |   |
|                 | Planted                                   | Area (ha)   | (1)<br>(ha)  | (2)<br>(ha)   | planted                    | Area (ha)     | (3)<br>(ha)  | (4)<br>(ha)    |        |                        |                                   |  |  |   |
|                 | Trans-<br>seedling<br>Area<br>(5)<br>(ha) | (6)<br>(ha) | (7)*<br>(ha) | (8)**<br>(ha) | Sub Total<br>(9)**<br>(ha) | (10)*<br>(ha) | (11)<br>(ha) | (12)**<br>(ha) |        |                        |                                   |  |  |   |
| Kean Sway       | 38,211                                    | 1,468       | 1,807        | 3,275         | 4,654                      | 479           | 625          | 5,758          | 287    | 9,320                  | 853                               | 8,467                                      | 109%   |   |
| Saang           | 51,479                                    | 7,243       | 4,714        | 11,957        | 8,800                      | 1,488         | 4,812        | 15,100         | 1,864  | 28,921                 | 2,312                             | 26,609                                     | 103%   |   |
| Leuk Dek        | 37,216                                    | 281         | 4,430        | 4,711         | 3,690                      | 182           | 1,168        | 5,040          | 0      | 9,751                  | 0                                 | 9,751                                      | 100%   |   |
| Koh Thom        | 50,305                                    | 4,065       | 4,577        | 8,642         | 8,750                      | 817           | 4,283        | 13,830         | 1,492  | 23,984                 | 1,894                             | 22,090                                     | 108%   |   |
| Total           | 177,211                                   | 13,057      | 15,528       | 28,585        | 25,894                     | 2,966         | 10,888       | 39,743         | 68,333 | 3,643                  | 71,976                            | 5,059                                      | 66,917   | 107%  |
| Distribution(%) | -   | 18%         | 22%          | 40%           | 36%                        | 4%            | 15%          | 55%            | 95%    | 5%                     | 100%                              | 7%   | 93%  | -   |

Note: Data of (9) and (11) are in 1989.

Source: Provincial Agricultural Office, Kandal

Table J.3.1.2 Planted Area and Production of Wet Season Field Crops of Related Four Districts in 1995/96

| District            | Maize                |                     | Sweet Potato         |                     | Cassava              |                     | Mungbean             |                     | Vegetables           |                     | Sesame               |                     | Sugar cane           |                     | Total                |                     |        |        |
|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|--------|--------|
|                     | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) |        |        |
| Kean Sway           | 1,615                | 2,547               | -                    | -                   | 12                   | 34                  | 45                   | 13                  | 192                  | 960                 | 4                    | 1                   | 757                  | 20,439              | 51                   | 31                  | 4,714  | 29,171 |
| Saang               | 2,803                | 3,439               | 11                   | 39                  | 12                   | 34                  | 45                   | 13                  | 103                  | 5,155               | 4                    | 1                   | 757                  | 20,439              | 51                   | 31                  | 4,714  | 29,171 |
| Leuk Dek            | 4,400                | 7,505               | -                    | -                   | -                    | -                   | -                    | -                   | 25                   | 125                 | -                    | -                   | -                    | -                   | 5                    | 5                   | 4,410  | 7,635  |
| Koh Thom            | 4,434                | 6,935               | -                    | -                   | -                    | -                   | -                    | -                   | 12                   | 120                 | 4                    | 1                   | 19                   | 475                 | 4                    | 2                   | 4,577  | 7,844  |
| Total               | 13,252               | 20,426              | 11                   | 39                  | 12                   | 34                  | 45                   | 25                  | 1,368                | 6,660               | 4                    | 1                   | 776                  | 20,914              | 60                   | 38                  | 15,528 | 48,157 |
| AVG Yields (ton/ha) | 1.54                 | -                   | 3.55                 | -                   | 4.50                 | -                   | 0.56                 | -                   | 4.87                 | -                   | 0.25                 | -                   | 26.95                | -                   | 0.63                 | -                   | -      | -      |
| Distribution (%)    | 85.3%                | -                   | 0.1%                 | -                   | 0.1%                 | -                   | 0.3%                 | -                   | 8.8%                 | -                   | 0.0%                 | -                   | 5.0%                 | -                   | 0.4%                 | -                   | -      | 100.0% |

Source: Provincial Agricultural Office, Kandal

Table J.3.1.3 Planted Area and Production of Dry Season Field Crops of Related Four Districts in 1995/96

| District            | Maize                |                     | Sweet Potato         |                     | Cassava              |                     | Mungbean             |                     | Vegetables           |                     | Tobacco              |                     | Sugarcane            |                     | Castor Oil Plant     |                     | Vet grass            |                     | Total                |                     |
|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|----------------------|---------------------|
|                     | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) | Planted<br>Area (ha) | Production<br>(ton) |
| Kean Sway           | 69                   | 83                  | 14                   | 108                 | 17                   | 120                 | 65                   | 42                  | 112                  | 504                 | 67                   | 33                  | 40                   | 30                  | 34                   | 2                   | 200                  | 400                 | 2,732                |                     |
| Saang               | 637                  | 1,006               | 78                   | 279                 | 26                   | 132                 | 33                   | 229                 | 1,888                | 10,340              | 8                    | 33                  | 333                  | 18,650              | 1,187                | 1,427               | 8                    | 4,812               | 32,857               |                     |
| Leuk Dek            | 190                  | 144                 | 203                  | 1,203               | 7                    | 30                  | 54                   | 342                 | 192                  | 854                 | 19                   | 8                   | 5                    | 485                 | 127                  | 101                 | -                    | 1,168               | 2,638                |                     |
| Koh Thom            | 116                  | 139                 | 348                  | 2,088               | 7                    | 30                  | 1,470                | 1,400               | 1,960                | 7,840               | 58                   | 58                  | 139                  | 4,865               | 127                  | 101                 | 8                    | 2,901               | 16,541               |                     |
| Total               | 1,012                | 1,372               | 749                  | 4,380               | 37                   | 402                 | 2,442                | 2,013               | 4,132                | 19,578              | 210                  | 103                 | 713                  | 24,950              | 1,346                | 1,562               | 8                    | 2,901               | 10,888               | 54,728              |
| AVG Yields (ton/ha) | 1.36                 | -                   | 3.85                 | -                   | 2.05                 | -                   | 0.82                 | -                   | 4.72                 | -                   | 0.49                 | -                   | 34.79                | -                   | 1.16                 | -                   | 1.44                 | -                   | -                    |                     |
| Distribution (%)    | 9.3%                 | -                   | 6.9%                 | -                   | 0.5%                 | -                   | 22.4%                | -                   | 38.1%                | -                   | 1.9%                 | -                   | 7.5%                 | -                   | 12.4%                | -                   | 0.1%                 | -                   | 1.8%                 | -                   |

Source: Provincial Agricultural Office, Kandal

Table J.3.2.1 Comparison of Agricultural Production with/without the Project

| Location          | Project | Farmedland (ha) |            | Cropping Intensity (%) |            |            |            |            |            | Planted Area (ha) |            |            |            |       |       |        |
|-------------------|---------|-----------------|------------|------------------------|------------|------------|------------|------------|------------|-------------------|------------|------------|------------|-------|-------|--------|
|                   |         | Paddy           |            | Upland                 |            | Paddy      |            | Upland     |            | Paddy             |            | Upland     |            | Total |       |        |
|                   |         | Dry Season      | Wet Season | Dry Season             | Wet Season | Dry Season | Wet Season | Dry Season | Wet Season | Dry Season        | Wet Season | Dry Season | Wet Season |       |       |        |
|                   |         | Total           | Total      | Dry Season             | Wet Season | Dry Season | Wet Season | Dry Season | Wet Season | Dry Season        | Wet Season | Dry Season | Wet Season |       |       |        |
| Kean Svay Saang   | Without | 13,537          | 5,796      | 7,374                  | 26,707     | 43         | 20         | 16         | 23         | 5                 | 107        | 11,484     | 5,341      | 6,143 | 1,335 | 28,576 |
|                   | With    | 13,537          | 5,796      | 7,374                  | 26,707     | 43         | 20         | 23         | 23         | 5                 | 114        | 11,484     | 5,341      | 6,143 | 1,335 | 30,446 |
| Leuk Dek Koh Thom | Without | 13,537          | 5,796      | 7,374                  | 26,707     | 43         | 20         | 16         | 23         | 5                 | 107        | 11,484     | 5,341      | 6,143 | 1,335 | 28,576 |
|                   | With    | 13,537          | 5,796      | 7,374                  | 26,707     | 43         | 20         | 23         | 23         | 5                 | 114        | 11,484     | 5,341      | 6,143 | 1,335 | 30,446 |

PRODUCTION

| Location          | Project | Paddy Production (ton) |            | Field Crops Production (ton) |            | Total Production |
|-------------------|---------|------------------------|------------|------------------------------|------------|------------------|
|                   |         | Dry Season             | Wet Season | Dry Season                   | Wet Season |                  |
| Kean Svay Saang   | Without | 37,897                 | 12,819     | 11,473                       | 12,347     | 23,820           |
|                   | With    | 48,233                 | 15,490     | 19,380                       | 13,483     | 32,863           |
| Leuk Dek Koh Thom | Without | 37,897                 | 12,819     | 11,473                       | 12,347     | 23,820           |
|                   | With    | 48,233                 | 15,490     | 19,380                       | 13,483     | 32,863           |

PADDY PRODUCTION

| Location          | Project | Dry Season Paddy |                        |                   | Wet Season Paddy |                        |                   |       |
|-------------------|---------|------------------|------------------------|-------------------|------------------|------------------------|-------------------|-------|
|                   |         | Major Varieties  | Average Yield (ton/ha) | Planted Area (ha) | Major Varieties  | Average Yield (ton/ha) | Planted Area (ha) |       |
| Kean Svay Saang   | Without | IR36, IR66       | 3.3                    | 11,484            | 37,897           | Traditional, IR42      | 2.4               | 5,341 |
|                   | With    | IR66, IR72       | 4.2                    | 11,484            | 48,233           | Traditional, IR42      | 2.9               | 5,341 |
| Leuk Dek Koh Thom | Without | IR36, IR66       | 3.3                    | 11,484            | 37,897           | Traditional, IR42      | 2.4               | 5,341 |
|                   | With    | IR66, IR72       | 4.2                    | 11,484            | 48,233           | Traditional, IR42      | 2.9               | 5,341 |

FIELD CROPS PRODUCTION I

| Location          | Project | Vegetables (55%) |                  |                     | Beans (40%) |                  |                     | Maize (15%) |                  |                     |       |        |
|-------------------|---------|------------------|------------------|---------------------|-------------|------------------|---------------------|-------------|------------------|---------------------|-------|--------|
|                   |         | Area (ha)        | Production (ton) | AVG. Yield (ton/ha) | Area (ha)   | Production (ton) | AVG. Yield (ton/ha) | Area (ha)   | Production (ton) | AVG. Yield (ton/ha) |       |        |
| Kean Svay Saang   | Without | 4.7              | 1,923            | 9,038               | 0.9         | 1,703            | 1,538               | 1.4         | 641              | 897                 | 4,273 | 11,473 |
|                   | With    | 5.5              | 2,764            | 15,203              | 1.1         | 2,457            | 2,703               | 1.6         | 921              | 1,474               | 6,143 | 19,380 |
| Leuk Dek Koh Thom | Without | 4.7              | 1,923            | 9,038               | 0.9         | 1,703            | 1,538               | 1.4         | 641              | 897                 | 4,273 | 11,473 |
|                   | With    | 5.5              | 2,764            | 15,203              | 1.1         | 2,457            | 2,703               | 1.6         | 921              | 1,474               | 6,143 | 19,380 |

FIELD CROPS PRODUCTION II

| Location          | Project | Maize (85%) |                  |                     | Vegetables (15%) |                  |                     |       |        |
|-------------------|---------|-------------|------------------|---------------------|------------------|------------------|---------------------|-------|--------|
|                   |         | Area (ha)   | Production (ton) | AVG. Yield (ton/ha) | Area (ha)        | Production (ton) | AVG. Yield (ton/ha) |       |        |
| Kean Svay Saang   | Without | 1.5         | 5,221            | 7,832               | 4.9              | 921              | 4,515               | 6.143 | 12,347 |
|                   | With    | 1.7         | 5,221            | 8,876               | 5.0              | 921              | 4,607               | 6.143 | 13,483 |
| Leuk Dek Koh Thom | Without | 1.5         | 5,221            | 7,832               | 4.9              | 921              | 4,515               | 6.143 | 12,347 |
|                   | With    | 1.7         | 5,221            | 8,876               | 5.0              | 921              | 4,607               | 6.143 | 13,483 |

### J.3.3 Irrigation Development Plan

#### (1) Land use availability

According to Table J.2.5.2, the mean interval of the colmatage canals is 0.9 km. The largest interval is 2.5 km in Kean Svay and the narrowest is 0.6 km in Koh Thom. On the other hand, the average width of cultivated area in each canal is estimated at 0.5 km. The difference between the canal interval and width of cultivated area varies from 0.2 km to 1.0 km. It shows that the area between the canals still has a potential to be developed for upland crops.

Taking into consideration the environmental impacts of developing the backswamp area, to reclaim the land between the canals by the secondary canals which are perpendicular to the colmatage canal is more recommendable to develop.

#### (2) Water Resource

If gates are constructed or rehabilitated and canals are re-excavated to 1.5 m deeper, about 13.6 MCM of water can be stored in the canals at the end of the wet season. Taking into account evaporation, percolation and domestic water use, etc., 50 % (6.8 MCM) of the water could be made available for irrigation. It will increase more than 1,400 ha of upland crops in the dry season which is about 20 % of the present cultivated area.

## J.4 Project Formulation

### J.4.1 Rehabilitation Priority Area

The priority area for rehabilitation of the colmatage systems should be decided by socio-economic and infrastructural condition based on the zoning of the colmatage farming area. Table J.4.1.1 shows the ranking index used to decide the priority area. According to the table, Kean Svay area is given the first priority to rehabilitate the facilities.

### J.4.2 Type of Colmatage Canals

Based on the colmatage canals inventory, construction/rehabilitation of the colmatage system is divided into 5 types as below. Details are shown in Figure J.4.2.1

Table J.4.2.1 Type of Colmatage Canal

| Type | Bottom Width of Canal (m) | Water Control Facility |
|------|---------------------------|------------------------|
| A    | $6.0 \geq BW$             | Culvert                |
| B    | $6.0 < BW \leq 10.0$      | 2 series gate          |
| C    | $10.0 < BW \leq 15.0$     | 3 series gate          |
| D    | $15.0 < BW \leq 20.0$     | 5 series gate          |
| E    | $BW > 20.0$               | 7 series gate          |



### **J.4.3 Rehabilitation Facilities Planning and Components**

#### **(1) General**

The basic concept for the rehabilitation of the colmatage system is to restore the original capacity of the facilities and not to build new ones. At present, as a means to check flood water and to protect wet season crops, it is observed about 20 % of colmatage in the study area which are blocked by dikes embanked by farmers or gates operation. Taking into consideration the influence of water not flowing to the downstream area if all the gates are closed at the beginning of dry season and the ability of the gate operation and canal maintenance by farmers, the number of construction/reconstruction of gate is 20 % of the total. The main components for the rehabilitation of the facilities are shown as below.

#### **(2) Plan of Rehabilitation**

##### **(a) Water control facility**

A facility which is light weight and easy to operate for water control shall be considered and also bank protection around the intake is necessary. There are 33, or 13 % of total, existing gates in the project area that are almost not operative. In accordance with the above mentioned priority of rehabilitation, 1) 33 (13 %) of existing gates should be reconstructed first. 2) the remaining 17 (7%) of canals should be installed the gates.

##### **(b) Bridge**

There are three types of the bridges, the concrete, steel iron and wooden bridges in the study area. According to the inventory, almost all of the wooden bridges have become too old for use and should be reconstructed.

##### **(c) Canal**

To prevent silt sedimentation and to protect the slopes in the canal, the velocity of flow should be more than 0.6 m/sec and less than 1.5 m/sec and a side slope of 1: 1.5 is required. If the waste area is to be developed for upland crops, the secondary canal which are perpendicular to the colmatage canal should be considered. Because of the small scale of canals in type A, the farmers have the responsibility for dredging or re-shaping the slope in canals.

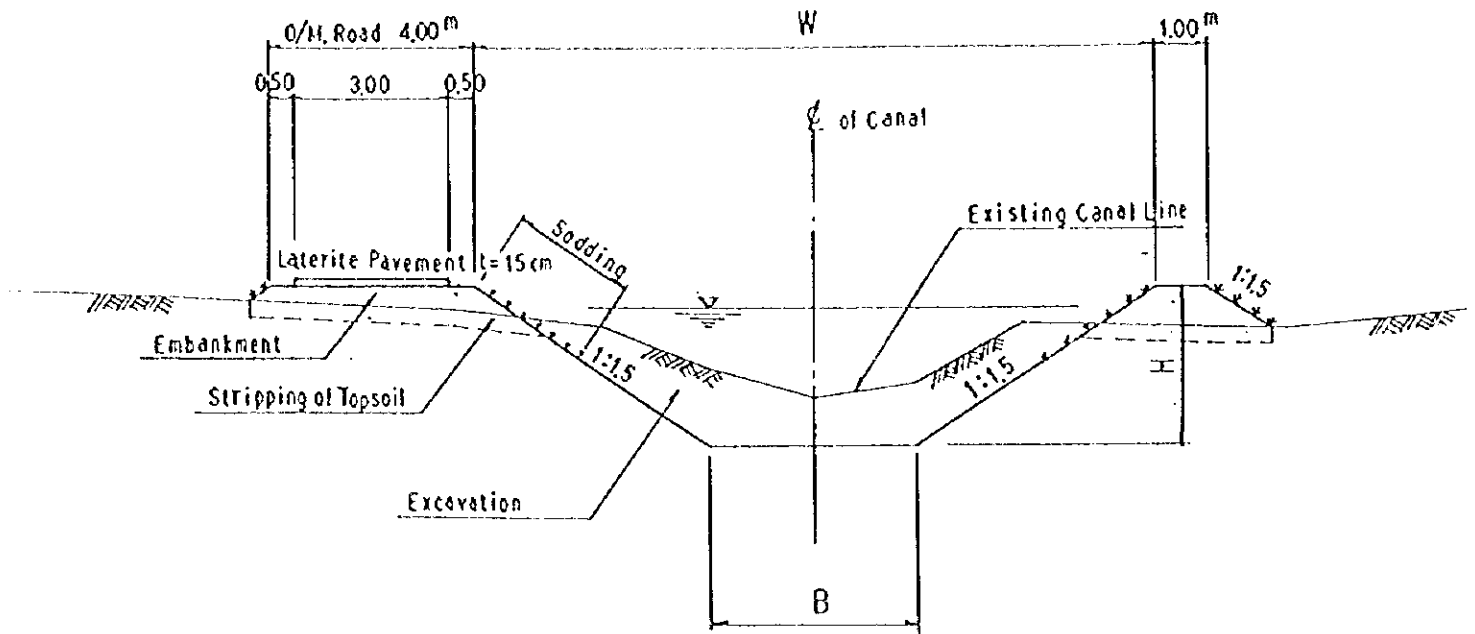
#### **(4) Maintenance Road**

The maintenance road makes a very important role not only for dredging or repairing the slope in the canal but also communication and transportation for agricultural products. The improvement of maintenance road consists of gravel pavement, banking and construction of related structures. According to the land holding system, the area from the crest of canal front slope to the toe of the dike belongs to the Governmental property but the boundary between the private and public lands at site is not clear. As for the implementation of rehabilitation/construction of the maintenance road, GDMH has the responsibility to acquire the area for maintenance road.

Table J.4.1.1 Index for Ranking of Rehabilitation Priority District

| District<br>Name | Socio-Economic Factor |         |                      |         |                              |         | Infrastructural Factor |         |              |         |  | Ranking<br>Total |         |
|------------------|-----------------------|---------|----------------------|---------|------------------------------|---------|------------------------|---------|--------------|---------|--|------------------|---------|
|                  | Population            |         | Total Farm Income    |         | Self Sufficiency<br>of Paddy |         | Annual Irrigation      |         | Road Density |         | Deterioration of Water<br>Control Facility * |                  |         |
|                  | Density<br>person/km  | Ranking | Riels/year<br>X 1000 | Ranking | ton                          | Ranking | Area<br>ha/person      | Ranking | Km/km        | Ranking | %  |                  | Ranking |
|                  |                       |         |                      |         |                              |         |                        |         |              |         |  |                  |         |
| Kean Svay        | 441                   | 1       | 1,400                | 3       | -8307                        | 1       | 0.42                   | 1       | 1.2          | 1       | 45%  | 1                | 8       |
| Saang            | 301                   | 2       | 1,100                | 1       | -331                         | 2       | 0.56                   | 2       | 0.4          | 2       | 18%  | 2                | 11      |
| Leuk Dek         | 121                   | 4       | 1,300                | 2       | 1522                         | 3       | 1                      | 4       | 0.1          | 4       | 4%   | 4                | 21      |
| Kho Thom         | 248                   | 3       | 1,800                | 4       | 5975                         | 4       | 0.62                   | 3       | 0.2          | 3       | 8%   | 3                | 20      |

Note ; Deterioration of water controle facility(%)=Number of existing/Number of colmatage canal in each District



**Typical Dimension of Designed Colmatage Canal**

\* Coefficient of roughness :  $n = 0.025$

| Type | Bottom Width (m) | Height of Canal (m) | Water Depth (m) | Freeboard (m) | Slope of Canal (1 : m) | Gradient of Canal (1 / 1) | Velocity (m/s) | Discharge Capacity (m <sup>3</sup> /s) | Remarks       |
|------|------------------|---------------------|-----------------|---------------|------------------------|---------------------------|----------------|--|---------------|
| A    | $B \leq 6$       | 2.00                | 1.60            | 0.40          | 1.5                    | 2,000                     | 0.89           | 7.7                                    | Culvert       |
| B    | $6 < B \leq 10$  | 2.50                | 2.10            | 0.40          | 1.5                    | 3,000                     | 0.96           | 22.4                                   | 2 series gate |
| C    | $10 < B \leq 15$ | 2.50                | 2.10            | 0.40          | 1.5                    | 3,000                     | 1.02           | 33.3                                   | 3 series gate |
| D    | $15 < B \leq 20$ | 3.00                | 2.60            | 0.40          | 1.5                    | 4,000                     | 1.03           | 57.2                                   | 5 series gate |
| E    | $B \geq 20$      | 3.00                | 2.60            | 0.40          | 1.5                    | 4,000                     | 1.07           | 80.0                                   | 7 series gate |

**Figure J.4.2.1 Typical Section of Colmatage Canal**

## **J.5 Operation and Maintenance of Facilities**

### **J.5.1 Operation and Maintenance Organization**

It is essential to establish a system to manage irrigation facilities well. The beneficiaries are the people to manage them, because the facilities are for them and subsequently of them. And the relevant government offices or any other organizations who are capable should help organize beneficiaries into a farmers' organization such as water users' association. In practice, the district hydrology office is responsible for it for the first hand in an irrigation project. But in case the office is not fully able to do it, it should cooperate with extension workers or NGOs who are with experiences in order to organize farmers into an organization. It is also very important to make beneficiaries feel a sense of ownership on the facilities. If they feel the ownership of the facilities, they will operate and maintain the facilities as much as possible. The organization should be with a trusted leader, regulations, its own finances and a hall to meet to keep it successfully.

There are numerous colmatage canals in Kandal Province. The canal has usually the main watergate constructed at the rivers of the Mekong, the Tonle Sap or the Bassac in order to regulate water inside. Some of them function well, but many have dilapidated and function partly or broken totally. There are many canals buried completely with the soil. Where the gates are broken, people close the canal with the soil embanked in the canal, and when water is needed, the embankment is cut open again, which is laborious and needs money every time.

There are farmers' groups in Kandal to operate and maintain the colmatages, though they are very loose on a viewpoint of organization, because the commune which is one of administrative institutions functions as a form of organization. In fact, the main gated are usually operated by an order of commune chief at present. Beneficiaries get together and work for opening or closing the gate, or embanking the soil in the canal to close and cut the embankment to open the canal, because it is a big event in a year for farmers who use the water from the colmatage. It may be understood in a sense that people are organized for the operation very loosely. But it is necessary to operate the gate and maintain the canal effectively by a farmer organization with the definite objective on water use.

It is, therefore, needed to strengthen the loose existing groups into a firm water users' association for better operation and maintenance of the colmatage system through guidance and training by the relevant officials. And the association can be a body to disseminate new agricultural techniques, new crops for diversification, higher productive varieties, etc. at the meeting hall of its own and to offer credit and other services.

### **J.5.2 Cooperation with Inland Fisheries**

There exist conflicts between farmers and fishermen whether they are light or serious as observed in this study. They have been disputing on water management, encroachment of farmers into the fishing lots in dry season and illegal fishing. Freshwater fishes are very important resources to provide people with protein. Moreover, inland fisheries give good income for fishermen with the license, employees under the fishing lot owners and the government as a tax income. Fish

production will reduce if fishermen continue intensive fishing with improved fishing gears. The fewer are fishes in the fishing lots, the more serious do the conflicts become in the future.

It is a fact that many farmers, as many as 40 % of farmers found in the socio-economic survey in this study, go fishing when they are not busy in the farm mainly for home consumption and sometimes for selling when they catch more than enough. It denotes importance to reserve the fishing lots for farmers as well, as a form of public fishing lots where anyone can fish for free.

The swamps inside the colmatage are endowed with the rich nature for farming in dry season when water recedes, the fertile soil and enough water. Average yields of rice are higher in the areas than in the non-flooded areas. Thus they are important areas to develop agriculture.

However, it is difficult to manage water in the colmatage system good for both farmers and fishermen. Because the issue lies on timing of water when farmers want water, fishermen do not want it and vice versa. In reality, nothing can be done much on it with the fishing laws existing. Therefore, in the short term plan, it is recommended to remain the fishing lots as they are, and to develop agriculture at the lands where a fishing lot does not exist. In the long term, it is recommended to demarcate clearly the area for fishing and farming with an embankment to develop farming, and water for farming shall be regulated, but water for fishing remains natural.

## **J.6 Project Cost and Implementation Program**

### **J.6.1 Project Cost**

#### **(1) General**

The preliminary costs of the implementation of the project are estimated on the basis of the following conditions:

- (a) The exchange rate is  
US\$ 1.00=Riel 2,740=Yen 115
- (b) The construction works will be carried out by the contractor(s) selected through competitive bidding.
- (c) The local unit prices are estimated based on the current market prices in June 1997 and cost data was obtained from the similar works in and around the study area. Foreign currency portion is estimated on the basis of CHF at Phnom Penh.
- (d) Contingency allowed in the cost estimate is 10 % of the construction cost.
- (e) Re-excavation of the Type A canals which is small in scale will be carried out by the farmers themselves so the construction cost is omitted in the cost estimation.
- (f) In accordance with the rehabilitation plan, 50( 20 % of total) gates shall be constructed including reconstruction of 33 existing gates.
- (g) All of the wooden bridges shall be replaced by concrete structures.

## (2) Cost Estimate

Based on the above mentioned conditions, the total cost is estimated to be US\$ 37.9 million. A summary of the cost in each zone is shown as below and the detail is shown in Table J.6.1.2.

**Table J.6.1.1 Cost Estimated for Each Zone**

| Zone No. | Cost (US \$) |             |           | Total      |
|----------|--------------|-------------|-----------|------------|
|          | Canal        | Intake Gate | Bridge    |            |
| I        | 1,234,463    | 2,716,519   | 77,967    | 4,028,948  |
| II       | 0            | 681,082     | 818,648   | 1,499,730  |
| III      | 526,869      | 1,284,477   | 444,309   | 2,255,655  |
| IV       | 9,874,640    | 3,622,417   | 2,070,579 | 15,567,636 |
| V        | 9,743,962    | 2,167,558   | 2,647,496 | 14,559,016 |
| Total    | 21,379,934   | 10,472,053  | 6,059,000 | 37,910,987 |

## J.6.2 Project Implementation Program

Based on the rehabilitation priority area and the quantity of construction works in each zone, the implementation period is determined at 5 years. The project consists of survey, detail design and construction works in each zone. The implementation schedule of the project is shown in Fig.J.6.2.1

Table J.6.1.2 Cost Estimation of Rehabilitation for Colmatage Canal between Mekong and Bassac River

(Unit : LSS)

| Zone No.                        | Name of District | EXISTING Canal |         |            |             | Cost of Implementation Works |            |             |                |         |                |               |           |                |           | Remarks |
|---------------------------------|------------------|----------------|---------|------------|-------------|------------------------------|------------|-------------|----------------|---------|----------------|---------------|-----------|----------------|-----------|---------|
|                                 |                  | Type of Canal  | Number  | Length (m) | Gate (Nos.) | Proposed canal               |            | Intake Gate |                | Bridges |                | Total (US \$) |           |                |           |         |
|                                 |                  |                |         |            |             | Amount (US \$)               | Length (m) | Number      | Amount (US \$) | Number  | Amount (US \$) |               | Number    | Amount (US \$) |           |         |
| <b>Zone-I Kean Svay</b>         |                  |                |         |            |             |                              |            |             |                |         |                |               |           |                |           |         |
| A                               |                  | 5              | 4,750   | -          | -           | -                            | -          | -           | -              | -       | -              | 4             | 77,967    | 77,967         |           |         |
| B                               |                  | -              | -       | -          | -           | -                            | -          | -           | -              | -       | -              | -             | -         | -              | -         |         |
| C                               |                  | 1              | 2,000   | 1          | 1           | 155,128                      | 2,000      | 1           | 269,274        | -       | -              | -             | -         | -              | 424,402   |         |
| D                               |                  | 2              | 4,150   | 2          | 2           | 398,448                      | 4,150      | 2           | 1,028,895      | -       | -              | -             | -         | -              | 1,427,342 |         |
| E                               |                  | 2              | 5,800   | 2          | 2           | 680,886                      | 5,800      | 2           | 1,418,351      | -       | -              | -             | -         | -              | 2,099,237 |         |
| Sub - total                     |                  | 10             | 16,700  | 5          | 5           | 1,234,463                    | 11,950     | 5           | 2,716,519      | -       | -              | 4             | 77,967    | 4,028,948      |           |         |
| <b>Zone-II Leuk Dek</b>         |                  |                |         |            |             |                              |            |             |                |         |                |               |           |                |           |         |
| A                               |                  | 51             | 89,150  | 2          | -           | -                            | -          | 10          | 681,082        | -       | -              | 42            | 818,648   | 1,499,730      |           |         |
| B                               |                  | -              | -       | -          | -           | -                            | -          | -           | -              | -       | -              | -             | -         | -              |           |         |
| C                               |                  | -              | -       | -          | -           | -                            | -          | -           | -              | -       | -              | -             | -         | -              |           |         |
| D                               |                  | -              | -       | -          | -           | -                            | -          | -           | -              | -       | -              | -             | -         | -              |           |         |
| E                               |                  | -              | -       | -          | -           | -                            | -          | -           | -              | -       | -              | -             | -         | -              |           |         |
| Sub - total                     |                  | 51             | 89,150  | 2          | -           | -                            | -          | 10          | 681,082        | -       | -              | 42            | 818,648   | 1,499,730      |           |         |
| <b>Zone-III Kean Svay Saang</b> |                  |                |         |            |             |                              |            |             |                |         |                |               |           |                |           |         |
| A                               |                  | 16             | 19,050  | 6          | -           | -                            | -          | 6           | 408,649        | -       | -              | 15            | 292,374   | 701,024        |           |         |
| B                               |                  | 4              | 4,700   | 2          | -           | 291,641                      | 4,700      | 2           | 361,381        | -       | -              | 3             | 108,699   | 761,721        |           |         |
| C                               |                  | -              | -       | -          | -           | -                            | -          | -           | -              | -       | -              | -             | -         | -              |           |         |
| D                               |                  | 2              | 2,450   | 1          | 2           | 235,229                      | 2,450      | 1           | 514,447        | -       | -              | 1             | 43,236    | 792,911        |           |         |
| E                               |                  | -              | -       | -          | -           | -                            | -          | -           | -              | -       | -              | -             | -         | -              |           |         |
| Sub - total                     |                  | 22             | 26,200  | 9          | 6           | 526,869                      | 7,150      | 9           | 1,284,477      | -       | -              | 19            | 444,309   | 2,255,655      |           |         |
| <b>Zone-IV Saang</b>            |                  |                |         |            |             |                              |            |             |                |         |                |               |           |                |           |         |
| A                               |                  | 11             | 17,015  | 1          | -           | -                            | -          | 2           | 136,216        | -       | -              | 8             | 155,933   | 292,149        |           |         |
| B                               |                  | 11             | 20,690  | 1          | 10          | 1,023,225                    | 16,490     | 1           | 180,691        | -       | -              | 9             | 326,096   | 1,530,011      |           |         |
| C                               |                  | 17             | 36,385  | 2          | 17          | 2,822,167                    | 36,385     | 2           | 538,549        | -       | -              | 16            | 627,444   | 3,988,160      |           |         |
| D                               |                  | 22             | 50,142  | 4          | 22          | 4,814,218                    | 50,142     | 4           | 2,057,786      | -       | -              | 18            | 778,248   | 7,650,252      |           |         |
| E                               |                  | 3              | 10,350  | 1          | 3           | 1,215,030                    | 10,350     | 1           | 709,176        | -       | -              | 3             | 182,858   | 2,107,064      |           |         |
| Sub - total                     |                  | 64             | 134,582 | 9          | 52          | 9,874,640                    | 113,367    | 10          | 3,622,417      | -       | -              | 54            | 2,070,579 | 15,567,636     |           |         |
| <b>Zone-V Koh Thom</b>          |                  |                |         |            |             |                              |            |             |                |         |                |               |           |                |           |         |
| A                               |                  | 55             | 91,770  | 2          | -           | -                            | -          | 8           | 544,866        | -       | -              | 50            | 974,581   | 1,519,447      |           |         |
| B                               |                  | 36             | 102,935 | 4          | 35          | 6,201,089                    | 99,935     | 6           | 1,084,144      | -       | -              | 33            | 1,195,685 | 8,480,918      |           |         |
| C                               |                  | 5              | 17,500  | 2          | 4           | 969,550                      | 12,500     | 2           | 538,549        | -       | -              | 4             | 156,861   | 1,664,960      |           |         |
| D                               |                  | 6              | 21,300  | -          | 6           | 2,045,049                    | 21,300     | -           | -              | -       | -              | 6             | 239,416   | 2,304,465      |           |         |
| E                               |                  | 1              | 4,500   | -          | 1           | 528,274                      | 4,500      | -           | -              | -       | -              | 1             | 60,953    | 589,227        |           |         |
| Sub - total                     |                  | 105            | 238,005 | 8          | 46          | 9,743,962                    | 138,235    | 16          | 2,167,558      | -       | -              | 94            | 2,647,496 | 14,559,016     |           |         |
| <b>Total</b>                    |                  |                |         |            |             |                              |            |             |                |         |                |               |           |                |           |         |
| A                               |                  | 138            | 221,735 | 11         | -           | -                            | -          | 26          | 1,770,813      | -       | -              | 119           | 2,319,504 | 4,090,317      |           |         |
| B                               |                  | 51             | 128,325 | 7          | 49          | 7,515,954                    | 121,125    | 9           | 1,626,216      | -       | -              | 45            | 1,630,480 | 10,772,649     |           |         |
| C                               |                  | 23             | 55,885  | 5          | 22          | 3,946,845                    | 50,885     | 5           | 1,346,372      | -       | -              | 20            | 784,305   | 6,077,522      |           |         |
| D                               |                  | 32             | 78,042  | 7          | 32          | 7,492,944                    | 78,042     | 7           | 3,601,126      | -       | -              | 25            | 1,080,900 | 12,174,970     |           |         |
| E                               |                  | 6              | 20,650  | 3          | 6           | 2,424,190                    | 20,650     | 3           | 2,127,527      | -       | -              | 4             | 243,811   | 4,795,528      |           |         |
| Grand - total                   |                  | 250            | 504,637 | 53         | 109         | 21,379,934                   | 270,702    | 50          | 10,472,053     | -       | -              | 213           | 6,059,000 | 37,910,987     |           |         |

**Table J.6.1.3 Summary of the Project Quantity (Colmatage Farming Area)**

| Description                        | Quantity        |                       |                    |                  |                    |               |
|------------------------------------|-----------------|-----------------------|--------------------|------------------|--------------------|---------------|
|                                    | Existing        |                       | Plan               |                  |                    |               |
|                                    | Number of canal | Number of Intake gate | Number of of canal | Canal length (m) | Intake gate (Nos.) | Bridge (Nos.) |
| <b>Zone - I</b> Kean Svay          |                 |                       |                    |                  |                    |               |
| Type - A                           | 5               | -                     | -                  | -                | -                  | 4             |
| Type - B                           | -               | -                     | -                  | -                | -                  | -             |
| Type - C                           | 1               | 1                     | 1                  | 2,000            | 1                  | -             |
| Type - D                           | 2               | 2                     | 2                  | 4,150            | 2                  | -             |
| Type - E                           | 2               | 2                     | 2                  | 5,800            | 2                  | -             |
| <b>Total</b>                       | <b>10</b>       | <b>5</b>              | <b>5</b>           | <b>11,950</b>    | <b>5</b>           | <b>4</b>      |
| <b>Zone - II</b> Leuk Dek          |                 |                       |                    |                  |                    |               |
| Type - A                           | 51              | 2                     | -                  | -                | 10                 | 42            |
| Type - B                           | -               | -                     | -                  | -                | -                  | -             |
| Type - C                           | -               | -                     | -                  | -                | -                  | -             |
| Type - D                           | -               | -                     | -                  | -                | -                  | -             |
| Type - E                           | -               | -                     | -                  | -                | -                  | -             |
| <b>Total</b>                       | <b>51</b>       | <b>2</b>              | <b>-</b>           | <b>-</b>         | <b>10</b>          | <b>42</b>     |
| <b>Zone - III</b> Kean Svay, Saang |                 |                       |                    |                  |                    |               |
| Type - A                           | 16              | 6                     | -                  | -                | 6                  | 15            |
| Type - B                           | 4               | 2                     | 4                  | 4,700            | 2                  | 3             |
| Type - C                           | -               | -                     | -                  | -                | -                  | -             |
| Type - D                           | 2               | 1                     | 2                  | 2,450            | 1                  | 1             |
| Type - E                           | -               | -                     | -                  | -                | -                  | -             |
| <b>Total</b>                       | <b>22</b>       | <b>9</b>              | <b>6</b>           | <b>7,150</b>     | <b>9</b>           | <b>19</b>     |
| <b>Zone - IV</b> Saang             |                 |                       |                    |                  |                    |               |
| Type - A                           | 11              | 1                     | -                  | -                | 2                  | 8             |
| Type - B                           | 11              | 1                     | 10                 | 16,490           | 1                  | 9             |
| Type - C                           | 17              | 2                     | 17                 | 36,385           | 2                  | 16            |
| Type - D                           | 22              | 4                     | 22                 | 50,142           | 4                  | 18            |
| Type - E                           | 3               | 1                     | 3                  | 10,350           | 1                  | 3             |
| <b>Total</b>                       | <b>64</b>       | <b>9</b>              | <b>52</b>          | <b>113,367</b>   | <b>10</b>          | <b>54</b>     |
| <b>Zone - V</b> Koh Thom           |                 |                       |                    |                  |                    |               |
| Type - A                           | 55              | 2                     | -                  | -                | 8                  | 50            |
| Type - B                           | 36              | 4                     | 35                 | 99,935           | 6                  | 33            |
| Type - C                           | 5               | 2                     | 4                  | 12,500           | 2                  | 4             |
| Type - D                           | 6               | -                     | 6                  | 21,300           | -                  | 6             |
| Type - E                           | 1               | -                     | 1                  | 4,500            | -                  | 1             |
| <b>Total</b>                       | <b>103</b>      | <b>8</b>              | <b>46</b>          | <b>138,235</b>   | <b>16</b>          | <b>94</b>     |
| <b>Total</b>                       |                 |                       |                    |                  |                    |               |
| Type - A                           | 138             | 11                    | -                  | -                | 26                 | 119           |
| Type - B                           | 51              | 7                     | 49                 | 121,125          | 9                  | 45            |
| Type - C                           | 23              | 5                     | 22                 | 50,885           | 5                  | 20            |
| Type - D                           | 32              | 7                     | 32                 | 78,042           | 7                  | 25            |
| Type - E                           | 6               | 3                     | 6                  | 20,650           | 3                  | 4             |
| <b>Grand - total</b>               | <b>250</b>      | <b>33</b>             | <b>109</b>         | <b>270,702</b>   | <b>50</b>          | <b>213</b>    |



Table J.6.1.4 (1) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No.                   | Name of Prek    | Zone | Canal Dimension (existing) |                  |           | Bridge / Culvert B/G/W or None | Gate (existing) |         |       | Cost of Implementation Works |            |                   |           | Total (U.S \$) |
|----------------------------|-----------------|------|----------------------------|------------------|-----------|--------------------------------|-----------------|---------|-------|------------------------------|------------|-------------------|-----------|----------------|
|                            |                 |      | Top Width (m)              | Bottom Width (m) | Depth (m) |                                | Length (m)      | H (m)   | W (m) | Type                         | Length (m) | Unit cost (US \$) | Nos.      |                |
| (1)                        | Koh Thom A      | V    | 5.0                        | 3.0              | 2.0       | 250                            | W               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT1                        | Prek Chen       | V    | 6.0                        | 4.0              | 2.0       | 350                            | W               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT2                        | Tumpang Roung   | V    | 4.0                        | 2.0              | 1.0       | 300                            | W               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT3                        | Prek 10 m       | V    | 4.0                        | 2.0              | 1.5       | 400                            | W               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT4                        | Prek Och        | V    | 5.0                        | 3.0              | 1.0       | 200                            | W               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT5                        | Prek Nbe        | V    | 6.0                        | 3.0              | 1.0       | 450                            | W               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT6                        | Prek Lok        | V    | (5.0)                      | (2.8)            | (1.4)     | (1,950)                        |                 |         |       |                              | 0          | 1                 | 68,108    | 68,108         |
| Sub-total of (1) (Average) |                 | 6    |                            |                  |           | (2,511)                        |                 |         |       |                              | 0          | 6                 | 116,950   | 116,950        |
| (2)                        | Koh Thom B      | V    | 17.0                       | 3.0              | 1.5       | 3,200                          | C               | No need | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT7                        | Prek Thom       | V    | 12.0                       | 2.5              | 1.0       | 3,200                          | Cul             | Need    | φ1.0  | 2.0                          | 0          | 0                 | 0         | 0              |
| KT8                        | Prek Lok        | V    | 10.0                       | 4.0              | 1.0       | 1,500                          | None            | No need | -     | -                            | 0          | 0                 | 0         | 0              |
| KT9                        | Prek Bek        | V    | 12.0                       | 2.5              | 1.0       | 2,000                          | S               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT10                       | Prek Take       | V    | 10.0                       | 2.0              | 1.0       | 2,000                          | S               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT11                       | Prek Thou       | V    | 10.0                       | 2.0              | 1.0       | 2,000                          | S               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT12                       | Prek Samrong    | V    | 7.0                        | 1.0              | 0.5       | 2,800                          | S               | Need    | -     | -                            | 0          | 1                 | 19,492    | 19,492         |
| KT13                       | Prek Tym        | V    | 15.0                       | 3.0              | 1.0       | 3,100                          | C               | Need    | 3.0   | 2.1                          | 0          | 1                 | 68,108    | 68,108         |
| KT14                       | Prek Bi         | V    | 17.0                       | 3.0              | 1.5       | 2,800                          | C               | Need    | 4.0   | 2.0                          | 0          | 1                 | 68,108    | 68,108         |
| KT15                       | Prek Tadoung    | V    | (12.2)                     | (2.6)            | (1.1)     | (2,600)                        |                 |         |       |                              | 0          | 2                 | 136,216   | 136,216        |
| Sub-total of (2) (Average) |                 | 9    |                            |                  |           | (2,511)                        |                 |         |       |                              | 0          | 7                 | 272,658   | 272,658        |
| (3)                        | Khum Prek Thmei | V    | 25.0                       | 10.0             | 6.5       | 3,300                          | C               | No need | -     | -                            | 0          | 1                 | 180,691   | 180,691        |
| KT16                       | Prek Tadoung    | V    | 25.0                       | 10.0             | 6.0       | 2,800                          | C               | Need    | 4.0   | 2.7                          | 0          | 1                 | 36,233    | 36,233         |
| KT17                       | Prek Yeay Hay   | V    | 20.0                       | 8.5              | 5.0       | 2,500                          | None            | No need | -     | -                            | 0          | 0                 | 0         | 0              |
| KT18                       | Prek Bek        | V    | 25.0                       | 11.0             | 7.0       | 2,900                          | C               | Need    | 5.0   | 2.0                          | 0          | 1                 | 39,215    | 39,215         |
| KT19                       | Kg. Sambour     | V    | 15.0                       | 8.0              | 4.5       | 2,500                          | S               | Need    | -     | -                            | 0          | 1                 | 36,233    | 36,233         |
| KT20                       | Prek Chhim      | V    | 25.0                       | 11.0             | 8.0       | 3,300                          | C               | Need    | 6.0   | 3.0                          | 0          | 1                 | 39,215    | 39,215         |
| KT21                       | Prek Thmei      | V    | 20.0                       | 9.0              | 4.5       | 3,400                          | C               | Need    | 5.0   | 2.0                          | 0          | 1                 | 36,233    | 36,233         |
| KT22                       | Prek Chham Leu  | V    | 25.0                       | 10.0             | 9.5       | 3,600                          | C               | Need    | 4.0   | 2.0                          | 0          | 1                 | 36,233    | 36,233         |
| KT23                       | Prek Fahing     | V    | 20.0                       | 10.0             | 6.0       | 4,000                          | S               | Need    | 4.0   | 2.0                          | 0          | 1                 | 36,233    | 36,233         |
| KT24                       | Prek Thounn     | V    | 25.0                       | 10.0             | 7.0       | 3,800                          | S               | Need    | -     | -                            | 0          | 1                 | 36,233    | 36,233         |
| KT25                       | Prek Chham Krom | V    | (22.5)                     | (9.8)            | (6.4)     | (3,100)                        |                 |         |       |                              | 10         | 8                 | 293,828   | 293,828        |
| Sub-total of (3) (Average) |                 | 10   |                            |                  |           | (3,210)                        |                 |         |       |                              | 10         | 8                 | 1,261,311 | 1,261,311      |
| Total of (1)-(3) (Average) |                 | 25   |                            |                  |           | (5,650)                        |                 |         |       |                              | 10         | 9                 | 1,465,636 | 1,465,636      |
| Total of (1)-(3) (Average) |                 | 25   |                            |                  |           | (2,266)                        |                 |         |       |                              | 10         | 9                 | 549,219   | 549,219        |
| Total of (1)-(3) (Average) |                 | 25   |                            |                  |           | (2,266)                        |                 |         |       |                              | 10         | 9                 | 549,219   | 549,219        |

Table J.6.1.4 (2) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No. | Name of Prek       | Zone | Canal Dimension (existing) |                  |           | Bridge / Culvert Length (m) | B/C/W or None | Rehabilitation or None | Gate (existing) |       |      | Cost of Implementation Works |            |                   |      |                   |        | Total (US \$) |                   |
|----------|--------------------|------|----------------------------|------------------|-----------|-----------------------------|---------------|------------------------|-----------------|-------|------|------------------------------|------------|-------------------|------|-------------------|--------|---------------|-------------------|
|          |                    |      | Top Width (m)              | Bottom Width (m) | Depth (m) |                             |               |                        | H (m)           | W (m) | Span | Canal                        |            | Gate              |      | Bridge            |        |               |                   |
|          |                    |      |                            |                  |           |                             |               |                        |                 |       |      | Type                         | Length (m) | Unit cost (US \$) | Nos. | Unit cost (US \$) | Nos.   |               | Unit cost (US \$) |
| (4)      | Khum Prek Sdei     |      |                            |                  |           |                             |               |                        |                 |       |      |                              |            |                   |      |                   |        |               |                   |
| KT26     | Prek Mestok        | V    | 24.0                       | 20.0             | 8.0       | 4,700                       | B             | Need                   | -               | -     | -    | 4,700                        | 96.0       | 451,255           | 0    | 1                 | 43,236 | 43,236        | 494,491           |
| KT27     | Prek Lork          | V    | 25.0                       | 20.0             | 9.0       | 4,000                       | B             | Need                   | -               | -     | -    | 4,000                        | 96.0       | 384,047           | 0    | 1                 | 43,236 | 43,236        | 427,283           |
| KT28     | Prek Pek           | V    | 25.0                       | 19.0             | 6.0       | 3,400                       | Cul           | Need                   | -               | -     | -    | 3,400                        | 96.0       | 326,440           | 0    | 1                 | 43,236 | 43,236        | 369,676           |
| KT29     | Prek Home          | V    | 25.0                       | 21.0             | 8.0       | 4,500                       | Cul           | Need                   | -               | -     | -    | 4,500                        | 117.4      | 528,274           | 0    | 1                 | 60,953 | 60,953        | 589,227           |
| KT30     | Prek Nou           | V    | 20.0                       | 16.0             | 7.0       | 3,000                       | W             | Need                   | -               | -     | -    | 3,000                        | 96.0       | 288,035           | 0    | 1                 | 43,236 | 43,236        | 331,271           |
| KT31     | Prek Khoun         | V    | 12.0                       | 9.0              | 3.0       | 2,700                       | W             | Need                   | -               | -     | -    | 2,700                        | 62.1       | 167,538           | 0    | 1                 | 36,233 | 36,233        | 203,771           |
| KT32     | Prek Chhan         | V    | 15.0                       | 10.0             | 5.0       | 2,900                       | W             | Need                   | -               | -     | -    | 2,900                        | 62.1       | 155,128           | 1    | 180,691           | 36,233 | 372,052       |                   |
| KT33     | Prek Toch          | V    | 18.0                       | 15.0             | 5.5       | 2,800                       | W             | Need                   | -               | -     | -    | 2,800                        | 77.6       | 217,179           | 0    | 1                 | 39,215 | 39,215        | 256,395           |
| KT34     | Prek Thom          | V    | 19.0                       | 16.0             | 6.0       | 3,600                       | W             | Need                   | -               | -     | -    | 3,600                        | 96.0       | 345,642           | 0    | 1                 | 43,236 | 43,236        | 388,878           |
| KT35     | Prekheat           | V    | 24.0                       | 20.0             | 6.5       | 2,600                       | W             | Need                   | -               | -     | -    | 2,600                        | 96.0       | 249,630           | 0    | 1                 | 43,236 | 43,236        | 292,866           |
|          | Sub-total of (4)   | 10   | (20.7)                     | (16.6)           | (6.4)     | 35,300                      |               |                        |                 |       |      | 33,800                       |            | 5,113,168         | 1    | 180,691           |        | 432,050       | 3,725,909         |
|          | (Average)          |      |                            |                  |           | (3,380)                     |               |                        |                 |       |      |                              |            |                   |      |                   |        |               |                   |
| (5)      | Khum Sampouvaun    |      |                            |                  |           |                             |               |                        |                 |       |      |                              |            |                   |      |                   |        |               |                   |
| KT36     | Prek Kom           | V    | 15.0                       | 4.0              | 2.0       | 3,000                       | None          | No need                | -               | -     | -    | 0                            | 0          | 0                 | 0    | 0                 | 0      | 0             | 0                 |
| KT37     | Prek Kong          | V    | 25.0                       | 5.0              | 4.0       | 4,000                       | None          | No need                | -               | -     | -    | 0                            | 0          | 0                 | 0    | 0                 | 0      | 0             | 0                 |
| KT38     | Prek Tve           | V    | 40.0                       | 10.0             | 5.0       | 4,000                       | W             | Need                   | -               | -     | -    | 4,000                        | 62.1       | 248,205           | 0    | 1                 | 36,233 | 36,233        | 284,438           |
| KT39     | Prek Wath          | V    | 20.0                       | 3.0              | 2.5       | 3,000                       | W             | Need                   | -               | -     | -    | 0                            | 0          | 0                 | 1    | 68,108            | 19,492 | 87,600        |                   |
| KT40     | Prek Seme          | V    | 25.0                       | 10.0             | 4.0       | 3,000                       | None          | No need                | -               | -     | -    | 0                            | 0          | 0                 | 0    | 0                 | 0      | 0             | 0                 |
| KT41     | Prek Nhik          | V    | 30.0                       | 10.0             | 4.0       | 4,000                       | W             | Need                   | -               | -     | -    | 4,000                        | 62.1       | 248,205           | 0    | 1                 | 36,233 | 36,233        | 284,438           |
| KT42     | Prek Ros           | V    | 20.0                       | 8.0              | 3.0       | 3,000                       | W             | Need                   | -               | -     | -    | 3,000                        | 62.1       | 186,154           | 0    | 1                 | 36,233 | 36,233        | 222,387           |
| KT43     | Prek Ampile        | V    | 20.0                       | 8.0              | 2.5       | 1,500                       | S             | Need                   | -               | -     | -    | 1,500                        | 62.1       | 93,077            | 0    | 1                 | 36,233 | 36,233        | 129,310           |
| KT44     | Prek Ngoun         | V    | 20.0                       | 8.0              | 2.5       | 2,000                       | W             | Need                   | -               | -     | -    | 2,000                        | 62.1       | 124,102           | 0    | 1                 | 36,233 | 36,233        | 160,335           |
| KT45     | Prek Thoun         | V    | 20.0                       | 8.0              | 2.5       | 2,000                       | W             | Need                   | -               | -     | -    | 2,000                        | 62.1       | 124,102           | 0    | 1                 | 36,233 | 36,233        | 160,335           |
| KT46     | Prek Amenc         | V    | 25.0                       | 10.0             | 3.5       | 3,000                       | W             | Need                   | -               | -     | -    | 3,000                        | 62.1       | 186,154           | 0    | 1                 | 36,233 | 36,233        | 222,387           |
| KT47     | Prek Soeung        | V    | 45.0                       | 15.0             | 5.0       | 5,000                       | None          | No need                | -               | -     | -    | 0                            | 77.6       | 0                 | 0    | 0                 | 0      | 0             | 0                 |
| KT48     | Prek Home          | V    | 15.0                       | 5.0              | 2.0       | 1,500                       | B             | Need                   | -               | -     | -    | 0                            | 0          | 0                 | 1    | 19,492            | 19,492 | 19,492        |                   |
| KT49     | Prek Thoun         | V    | 15.0                       | 5.0              | 2.0       | 1,500                       | W             | Need                   | -               | -     | -    | 0                            | 0          | 0                 | 1    | 19,492            | 19,492 | 19,492        |                   |
| KT50     | Prek Ong Chha      | V    | 15.0                       | 5.0              | 1.5       | 1,000                       | W             | Need                   | -               | -     | -    | 0                            | 0          | 0                 | 1    | 19,492            | 19,492 | 19,492        |                   |
| KT51     | Prek Tuen          | V    | 15.0                       | 2.5              | 1.0       | 2,000                       | B             | Need                   | -               | -     | -    | 0                            | 0          | 0                 | 1    | 19,492            | 19,492 | 19,492        |                   |
|          | Sub-total of (5)   | 16   | (22.8)                     | (7.3)            | (2.9)     | 43,500                      |               |                        |                 |       |      | 19,500                       |            | 1,209,999         | 1    | 68,108            |        | 351,068       | 1,629,195         |
|          | (Average)          |      |                            |                  |           | (2,719)                     |               |                        |                 |       |      |                              |            |                   |      |                   |        |               |                   |
|          | Total of (4) + (5) | 26   | (57.2)                     | (28.2)           | (11.0)    | 77,300                      |               |                        |                 |       |      | 53,300                       |            | 4,323,167         | 2    | 248,799           |        | 783,138       | 5,355,104         |
|          | (Average)          |      |                            |                  |           | (2,973)                     |               |                        |                 |       |      |                              |            |                   |      |                   |        |               |                   |

Table J.6.1.4 (3) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No.                     | Name of Prek     | Zone | Canal Dimension (existing) |                  |           | Bridge / Culvert or None | B/C/W Rehabil. or None | Gate (existing) |       | Cost of Implementation Works |        |            |                  | Total (US\$) |         |                  |        |                  |           |           |
|------------------------------|------------------|------|----------------------------|------------------|-----------|--------------------------|------------------------|-----------------|-------|------------------------------|--------|------------|------------------|--------------|---------|------------------|--------|------------------|-----------|-----------|
|                              |                  |      | Top Width (m)              | Bottom Width (m) | Depth (m) |                          |                        | Length (m)      | H (m) | W (m)                        | Canal  |            | Gate             |              |         |                  |        |                  |           |           |
|                              |                  |      |                            |                  |           |                          |                        |                 |       |                              | Type   | Length (m) | Unit cost (US\$) |              | Nos.    | Unit cost (US\$) | Nos.   | Unit cost (US\$) |           |           |
| <b>(6) Khum Pov Ban</b>      |                  |      |                            |                  |           |                          |                        |                 |       |                              |        |            |                  |              |         |                  |        |                  |           |           |
| KT52                         | Prek Tein        | V    | 20.0                       | 10.0             | 3.0       | 3,000                    | C                      | Need            | -     | -                            | 3,000  | 62.1       | 186,154          | 0            | 1       | 36,233           | 36,233 | 222,387          |           |           |
| KT53                         | Prek Men         | V    | 20.0                       | 9.0              | 3.0       | 2,500                    | C                      | Need            | -     | -                            | 2,500  | 62.1       | 155,128          | 0            | 1       | 36,233           | 36,233 | 191,361          |           |           |
| KT54                         | Prek Thmei       | V    | 20.0                       | 10.0             | 3.5       | 3,000                    | W                      | Need            | -     | -                            | 3,000  | 62.1       | 186,154          | 0            | 1       | 36,233           | 36,233 | 222,387          |           |           |
| KT55                         | Prek Hang        | V    | 20.0                       | 10.0             | 3.5       | 3,000                    | W                      | Need            | -     | -                            | 3,000  | 62.1       | 186,154          | 0            | 1       | 36,233           | 36,233 | 222,387          |           |           |
| KT56                         | Prek Kheak       | V    | 20.0                       | 9.0              | 2.5       | 2,500                    | W                      | Need            | -     | -                            | 2,500  | 62.1       | 155,128          | 0            | 1       | 36,233           | 36,233 | 191,361          |           |           |
| KT57                         | Prek Nam Ngav    | V    | 5.0                        | 3.0              | 2.0       | 400                      | Backfill               | Need            | -     | -                            | 0      | 0          | 0                | 0            | 1       | 19,492           | 19,492 | 222,387          |           |           |
| KT58                         | Prek Sam         | V    | 15.0                       | 10.0             | 3.0       | 3,000                    | W                      | Need            | -     | -                            | 3,000  | 62.1       | 186,154          | 0            | 1       | 36,233           | 36,233 | 222,387          |           |           |
| KT59                         | Prek Vor         | V    | 18.0                       | 9.0              | 2.5       | 3,000                    | W                      | Need            | -     | -                            | 3,000  | 62.1       | 186,154          | 0            | 1       | 36,233           | 36,233 | 222,387          |           |           |
| KT60                         | Prek Taen        | V    | 10.0                       | 9.0              | 2.5       | 4,000                    | W                      | Need            | -     | -                            | 4,000  | 62.1       | 248,205          | 0            | 1       | 36,233           | 36,233 | 284,438          |           |           |
| KT61                         | Prek Svay        | V    | 10.0                       | 8.0              | 2.5       | 3,500                    | W                      | Need            | -     | -                            | 3,500  | 62.1       | 217,179          | 0            | 1       | 36,233           | 36,233 | 253,412          |           |           |
| KT62                         | Prek Tadon       | V    | 15.0                       | 11.0             | 3.0       | 3,500                    | W                      | Need            | -     | -                            | 3,500  | 77.6       | 271,474          | 0            | 1       | 39,215           | 39,215 | 310,689          |           |           |
| KT63                         | Prek Tareth      | V    | 15.0                       | 10.0             | 3.0       | 3,500                    | W                      | Need            | -     | -                            | 3,500  | 62.1       | 217,179          | 0            | 1       | 36,233           | 36,233 | 253,412          |           |           |
| KT64                         | Prek Dem Sedi    | V    | 15.0                       | 10.0             | 3.0       | 3,000                    | W                      | Need            | -     | -                            | 3,000  | 62.1       | 186,154          | 0            | 1       | 36,233           | 36,233 | 222,387          |           |           |
| KT65                         | Prek Kouk        | V    | 15.0                       | 10.0             | 3.0       | 3,000                    | W                      | Need            | -     | -                            | 3,000  | 62.1       | 186,154          | 0            | 1       | 36,233           | 36,233 | 222,387          |           |           |
| KT66                         | Prek Chen        | V    | 8.0                        | 6.0              | 2.5       | 2,000                    | W                      | Need            | -     | -                            | 0      | 0          | 0                | 1            | 68,108  | 68,108           | 19,492 |                  |           |           |
| Sub-total of (6)             |                  |      | 15                         | (15.1)           | (8.9)     | (2.8)                    | 42,900                 |                 |       |                              | 40,500 |            | 2,567,369        |              | 1       | 68,108           | 68,108 | 15               | 512,993   | 3,148,471 |
| <b>(7) Khum Kampong Kong</b> |                  |      |                            |                  |           |                          |                        |                 |       |                              |        |            |                  |              |         |                  |        |                  |           |           |
| KT67                         | Prek Chen        | V    | 15.0                       | 4.0              | 3.0       | 1,500                    | C                      | Need            | -     | -                            | 0      | 0          | 0                | 1            | 68,108  | 68,108           | 19,492 | 19,492           | 87,600    |           |
| KT68                         | Prek Ouch        | V    | 17.0                       | 2.0              | 3.0       | 2,000                    | W                      | Need            | N/A   | -                            | 0      | 0          | 0                | 1            | 68,108  | 68,108           | 19,492 | 19,492           | 87,600    |           |
| KT69                         | Prek Kong Sroy   | V    | 20.0                       | 4.0              | 3.4       | 2,300                    | C                      | Need            | -     | -                            | 0      | 0          | 0                | 1            | 68,108  | 68,108           | 19,492 | 19,492           | 87,600    |           |
| KT70                         | Prek Thay Leup   | V    | 18.0                       | 3.0              | 2.0       | 150                      | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT71                         | Prek Thmei       | V    | 19.0                       | 3.5              | 2.0       | 250                      | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT72                         | Prek Phouv       | V    | 20.0                       | 4.5              | 3.0       | 2,500                    | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT73                         | Prek Yeay Ron    | V    | 20.0                       | 4.0              | 3.0       | 2,000                    | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT74                         | Prek Kong Sun    | V    | 20.0                       | 4.0              | 3.0       | 2,000                    | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT75                         | Prek Roun        | V    | 20.0                       | 4.0              | 3.0       | 2,500                    | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT76                         | Chrong Romas     | V    | 18.0                       | 4.5              | 3.5       | 2,000                    | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT77                         | Prek Tahang      | V    | 18.0                       | 4.5              | 3.5       | 2,000                    | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT78                         | Wath Toul Sangke | V    | 7.0                        | 2.0              | 2.0       | 500                      | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT79                         | Prek Kaeng       | V    | 9.0                        | 3.0              | 2.0       | 1,000                    | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| KT80                         | Prek Reusei Thom | V    | 9.0                        | 3.0              | 2.0       | 1,000                    | N/A                    | Need            | N/A   | -                            | 0      | 0          | 0                | 0            | 0       | 0                | 0      | 0                | 19,492    |           |
| Sub-total of (7)             |                  |      | 14                         | (16.1)           | (3.5)     | (2.6)                    | 20,450                 |                 |       |                              | 0      | 0          | 0                | 2            | 136,216 | 136,216          | 14     | 272,883          | 409,099   |           |
| <b>(Average)</b>             |                  |      |                            |                  |           | (1,461)                  |                        |                 |       |                              |        |            |                  |              |         |                  |        |                  |           |           |
| Total of (6) - (7)           |                  |      | 29                         | 419.0            | 175.5     | 75.9                     | 63,350                 |                 |       |                              | 13     | 40,500     |                  | 2,567,369    | 3       | 204,325          | 29     | 785,876          | 3,557,570 |           |
| <b>(Average)</b>             |                  |      |                            | (15.5)           | (6.5)     | (2.7)                    | (2,184)                |                 |       |                              |        |            |                  |              |         |                  |        |                  |           |           |

Table J.6.1.4 (4) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No.  | Name of Prek                                       | Zone | Canal Dimension (existing) |                  |           |                    | Bridge/Culvert |                      | Gate (existing) |       | Cost of Implementation Works |       |            |                   | Total (US \$) |           |                   |           |                   |
|---|--|------|----------------------------|------------------|-----------|--------------------|----------------|----------------------|-----------------|-------|------------------------------|-------|------------|-------------------|---------------|-----------|-------------------|-----------|-------------------|
|   |  |      | Top Width (m)              | Bottom Width (m) | Depth (m) | Length (m)         | B/C/W          | Rehabilitate or None | H (m)           | W (m) | Span                         | Canal | Gate       | Canal             |               | Gate      |                   |           |                   |
|   |  |      |                            |                  |           |                    | Length (m)     |                      |                 |       |                              | Type  | Length (m) | Unit cost (US \$) |               | Nos.      | Unit cost (US \$) | Nos.      | Unit cost (US \$) |
| <b>Koh Thom District (4/4), Kandal Province</b> |  |      |                            |                  |           |                    |                |                      |                 |       |                              |       |            |                   |               |           |                   |           |                   |
| (8)   | Khum Chhroy Taxeo                                  | V    | 16.0                       | 3.0              | 3.0       | 2,100              | N/A            | Need                 | N/A             |       |                              | 0     | 1          | 68,108            | 68,108        | 1         | 19,492            | 19,492    | 87,600            |
|   | Prek Kong Thai                                     | V    | 16.0                       | 3.0              | 3.0       | 2,000              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Chhnam  | V    | 15.0                       | 3.0              | 3.0       | 1,800              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Kong Heang                                    | V    | 11.0                       | 3.0              | 2.0       | 2,100              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Kong Ros                                      | V    | 9.0                        | 2.5              | 2.5       | 2,100              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Kong Noun                                     | V    | 9.0                        | 2.0              | 2.0       | 1,200              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Kong Keim                                     | V    | 14.0                       | 2.0              | 2.5       | 1,250              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Takot   | V    | 10.0                       | 3.0              | 2.5       | 1,250              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Kp Dor  | V    | 13.0                       | 3.0              | 2.5       | 950                | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Taseik  | V    | 9.0                        | 2.5              | 2.5       | 650                | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Tasal   | V    | 14.0                       | 3.0              | 2.0       | 1,000              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Deum Nary                                     | V    | 10.0                       | 3.0              | 3.0       | 1,500              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Taduch  | V    | 10.0                       | 3.0              | 2.5       | 1,550              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Phum  | V    | 10.0                       | 3.0              | 2.5       | 1,550              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Sub-total of (8)<br>(Average)                      | 13   | (12.0)                     | (2.8)            | (2.5)     | 19,450<br>(1,496)  |                |                      |                 |       |                              | 0     | 1          | 68,108            | 68,108        | 13        | 255,391           | 255,391   | 321,499           |
| (9)   | Khum Chheu Khmao                                   | V    | 13.0                       | 10.0             | 2.0       | 1,750              | N/A            | Need                 | N/A             |       |                              | 1,750 | 1          | 180,691           | 180,691       | 1         | 36,233            | 36,233    | 325,315           |
|   | Prek Deum Chhrey                                   | V    | 14.0                       | 10.0             | 2.0       | 1,800              | N/A            | Need                 | N/A             |       |                              | 1,800 | 1          | 111,692           | 111,692       | 1         | 36,233            | 36,233    | 147,925           |
|   | Prek Kandal  | V    | 11.0                       | 8.0              | 2.5       | 2,200              | N/A            | Need                 | N/A             |       |                              | 2,200 | 1          | 136,513           | 136,513       | 1         | 36,233            | 36,233    | 172,746           |
|   | Prek Thmei   | V    | 15.0                       | 7.0              | 1.5       | 2,000              | N/A            | Need                 | N/A             |       |                              | 2,000 | 1          | 124,102           | 124,102       | 1         | 36,233            | 36,233    | 160,335           |
|   | Prek Wash  | V    | 14.0                       | 4.0              | 2.0       | 2,300              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Tsaopeng Chhrey                               | V    | 10.0                       | 9.0              | 2.5       | 2,350              | N/A            | Need                 | N/A             |       |                              | 2,350 | 1          | 139,615           | 139,615       | 1         | 36,233            | 36,233    | 175,848           |
|   | Prek Tazang  | V    | 11.0                       | 8.0              | 3.0       | 2,335              | N/A            | Need                 | N/A             |       |                              | 2,335 | 1          | 144,890           | 144,890       | 1         | 36,233            | 36,233    | 181,122           |
|   | Prek Home  | V    | 15.0                       | 5.0              | 3.0       | 2,170              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Hai   | V    | 11.0                       | 6.0              | 2.5       | 2,150              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Lim   | V    | 10.0                       | 8.0              | 2.5       | 2,300              | N/A            | Need                 | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Prek Rolong  | V    | 10.0                       | 8.0              | 2.5       | 2,355              | N/A            | No need              | N/A             |       |                              | 0     | 0          | 0                 | 0             | 1         | 19,492            | 19,492    | 19,492            |
|   | Sub-total of (9)<br>(Average)                      | 10   | (12.0)                     | (7.5)            | (2.4)     | 21,355<br>(2,126)  |                |                      |                 |       |                              | 6     | 12,533     | 765,402           | 1             | 180,691   | 9                 | 275,872   | 1,221,965         |
|   | Total of (8) - (9)<br>(Average)                    | 23   | (12.0)                     | (4.8)            | (2.5)     | 40,705<br>(1,770)  |                |                      |                 |       |                              | 6     | 12,325     | 765,402           | 2             | 248,799   | 22                | 529,263   | 1,540,464         |
|   | Total of Koh Thom district, (1) - (9)<br>(Average) | 103  | (16.2)                     | (7.0)            | (3.2)     | 258,005<br>(2,511) |                |                      |                 |       |                              | 46    | 136,233    | 9,743,962         | 16            | 2,167,558 | 94                | 2,047,496 | 14,559,010        |

Table J.6.1.4 (5) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No. | Name of Prek                           | Zone | Canal Dimension (existing) |                  |           |            | Bridge/Culvert |             |       | Gate (existing) |      |        | Cost of Implementation Works |                   |           |                   |         | Total (US \$) |                   |           |                   |
|----------|--|------|----------------------------|------------------|-----------|------------|----------------|-------------|-------|-----------------|------|--------|------------------------------|-------------------|-----------|-------------------|---------|---------------|-------------------|-----------|-------------------|
|          |  |      | Top Width (m)              | Bottom Width (m) | Depth (m) | Length (m) | B/C/W or None  | Reliability | H (m) | W (m)           | Span | Canal  |                              | Gate              |           | Bridge            |         |               |                   |           |                   |
|          |  |      |                            |                  |           |            |                |             |       |                 |      | Type   | Length (m)                   | Unit cost (US \$) | Nos.      | Unit cost (US \$) | Nos.    |               | Unit cost (US \$) | Nos.      | Unit cost (US \$) |
| (1)      |  |      |                            |                  |           |            |                |             |       |                 |      |        |                              |                   |           |                   |         |               |                   |           |                   |
| KS1      | Spean Cheu                             | III  | 7.0                        | 4.0              | 3.0       | 1,000      | S              | Need        | -     | -               | -    | 0      | 0                            | 0                 | 0         | 1                 | 19,492  | 19,492        | 19,492            | 19,492    | 19,492            |
| KS2      | Spean Kbebung                          | III  | 2.0                        | 1.0              | 2.0       | 1,000      | S              | Need        | -     | -               | -    | 0      | 0                            | 0                 | 0         | 1                 | 19,492  | 19,492        | 19,492            | 19,492    | 19,492            |
| KS3      | Spean Kaem                             | III  | 7.0                        | 3.0              | 2.0       | 500        | C              | Need        | 1.0   | 1.8             | 2    | 0      | 0                            | 1                 | 68,108    | 68,108            | 19,492  | 19,492        | 19,492            | 37,600    |                   |
| KS4      | Spean Tavang                           | III  | 15.0                       | 5.0              | 5.0       | 1,500      | C              | Need        | 4.5   | 2.5             | 4    | 62.1   | 93,077                       | 180,691           | 1         | 36,233            | 36,233  | 36,233        | 36,233            | 310,000   |                   |
| KS5      | Spean Reusei Stok                      | III  | 5.0                        | 2.0              | 5.0       | 1,000      | C              | Need        | 4.3   | 2.0             | 5    | 0      | 0                            | 1                 | 68,108    | 68,108            | 19,492  | 19,492        | 19,492            | 87,600    |                   |
| KS6      | Spean So                               | III  | 8.0                        | 3.0              | 3.0       | 1,000      | S              | Need        | -     | -               | -    | 0      | 0                            | 0                 | 0         | 1                 | 19,492  | 19,492        | 19,492            | 19,492    |                   |
| KS7      | Ta Has                                 | III  | 13.0                       | 6.0              | 3.0       | 700        | S              | Need        | -     | -               | -    | 0      | 43,436                       | 0                 | 0         | 1                 | 36,233  | 36,233        | 36,233            | 79,669    |                   |
| KS8      | Prek Takeo                             | III  | 15.0                       | 6.0              | 3.0       | 1,000      | Cul            | No need     | -     | -               | -    | 62.1   | 62,051                       | 0                 | 0         | 0                 | 0       | 0             | 0                 | 0         | 62,051            |
| KS9      | Prek Thmar Dar                         | III  | 8.0                        | 3.0              | 2.0       | 1,000      | C              | Need        | -     | -               | -    | 0      | 0                            | 0                 | 0         | 1                 | 19,492  | 19,492        | 19,492            | 19,492    |                   |
| KS10     | Prek Doung                             | III  | 15.0                       | 9.0              | 2.0       | 1,500      | C              | Need        | 3.5   | 2.0             | 3    | 62.1   | 93,077                       | 180,691           | 1         | 36,233            | 36,233  | 36,233        | 310,000           |           |                   |
| KS11     | Kampong Sway                           | III  | 27.0                       | 13.0             | 4.0       | 1,500      | C              | Need        | -     | -               | -    | 96.0   | 144,018                      | 0                 | 0         | 1                 | 43,236  | 43,236        | 43,236            | 187,254   |                   |
| KS12     | Prek Thmei                             | III  | 5.0                        | 2.0              | 5.0       | 1,500      | C              | Need        | 4.0   | 2.0             | 5    | 0      | 0                            | 1                 | 68,108    | 68,108            | 19,492  | 19,492        | 19,492            | 87,600    |                   |
|          | Sub-total of (1)<br>(Average)          | 12   | (10.6)                     | (4.8)            | (3.3)     | 13,200     |                |             |       |                 |      | 6.200  | 433,638                      | 5                 | 563,706   | 1                 | 288,376 | 288,376       | 288,376           | 1,289,740 |                   |
| (2)      |  |      |                            |                  |           |            |                |             |       |                 |      |        |                              |                   |           |                   |         |               |                   |           |                   |
| KS13     | Prek Tan Nob                           | I    | 5.0                        | 2.0              | 1.0       | 1,000      | C              | Need        | -     | -               | -    | 0      | 0                            | 0                 | 0         | 1                 | 19,492  | 19,492        | 19,492            | 19,492    |                   |
| KS14     | Koki Thom                              | I    | 30.0                       | 15.0             | 2.0       | 2,800      | C              | No need     | 5.3   | 1.8             | 3    | 177.4  | 328,704                      | 1                 | 709,176   | 709,176           | 0       | 0             | 0                 | 1,037,879 |                   |
| KS15     | Prek Youn                              | I    | 25.0                       | 8.0              | 6.0       | 3,000      | C              | No need     | 5.0   | 2.5             | 4    | 177.4  | 352,182                      | 1                 | 709,176   | 709,176           | 0       | 0             | 0                 | 1,061,358 |                   |
| KS16     | Prek Dek                               | I    | -                          | -                | -         | 1,500      | N/A            | Need        | -     | -               | -    | 0      | 0                            | 0                 | 0         | 1                 | 19,492  | 19,492        | 19,492            | 19,492    |                   |
| KS17     | P. Samrong Kael                        | I    | 12.0                       | 5.0              | 6.0       | 1,050      | N/A            | Need        | -     | -               | -    | 0      | 0                            | 0                 | 0         | 1                 | 19,492  | 19,492        | 19,492            | 19,492    |                   |
| KS18     | Rahat Kehal                            | I    | 10.0                       | 6.0              | 2.0       | 1,200      | N/A            | Need        | -     | -               | -    | 0      | 0                            | 0                 | 0         | 1                 | 19,492  | 19,492        | 19,492            | 19,492    |                   |
| KS19     | Spean Prek Pol                         | I    | 15.0                       | 10.0             | 3.0       | 2,000      | C              | No need     | 6.4   | 1.7             | 3    | 77.6   | 153,128                      | 1                 | 269,274   | 269,274           | 0       | 0             | 0                 | 424,402   |                   |
| KS20     | Prek Chrey                             | I    | Incomplete                 | 0.0              | 0.0       | 0          | None           | No need     | -     | -               | -    | 0      | 0                            | 0                 | 0         | 0                 | 0       | 0             | 0                 | 0         |                   |
| KS21     | Samrong Thom                           | I    | 25.0                       | 7.0              | 5.0       | 2,150      | C              | No need     | 4.0   | 2.1             | 3    | 96.0   | 206,423                      | 1                 | 514,447   | 514,447           | 0       | 0             | 0                 | 720,872   |                   |
| KS22     | Prek Kompong Thom                      | I    | 20.0                       | 10.0             | 3.0       | 2,000      | C              | No need     | 4.0   | 2.3             | 3    | 96.0   | 192,023                      | 1                 | 514,447   | 514,447           | 0       | 0             | 0                 | 706,470   |                   |
|          | Sub-total of (2)<br>(Average)          | 10   | (17.8)                     | (7.9)            | (3.5)     | 16,700     |                |             |       |                 |      | 11,950 | 1,234,463                    | 5                 | 2,716,319 | 4                 | 77,967  | 77,967        | 77,967            | 4,028,948 |                   |
|          | Total of Kean Sway district, (1) + (2) | 22   | 269.0                      | 120.0            | 67.0      | 29,900     |                |             |       |                 |      | 18,150 | 1,670,121                    | 10                | 3,282,024 | 15                | 366,343 | 366,343       | 366,343           | 5,318,688 |                   |

Table J.6.1.4 (6) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No. | Name of Prek                  | Zone | Canal Dimension (existing) |                  |           |                   | Bridge/Culvert B/C/W or None | Reliability | Gate (existing) |       |      | Cost of Implementation Works |            |                   |      | Total (US \$) |         |                   |         |
|----------|-------------------------------|------|----------------------------|------------------|-----------|-------------------|------------------------------|-------------|-----------------|-------|------|------------------------------|------------|-------------------|------|---------------|---------|-------------------|---------|
|          |                               |      | Top Width (m)              | Bottom Width (m) | Depth (m) | Length (m)        |                              |             | H (m)           | W (m) | Span | Canal                        |            | Gate              |      |               | Bridge  |                   |         |
|          |                               |      |                            |                  |           |                   |                              |             |                 |       |      | Type                         | Length (m) | Unit cost (US \$) | Nos. |               |         | Unit cost (US \$) | Nos.    |
| (1)      |                               |      |                            |                  |           |                   |                              |             |                 |       |      |                              |            |                   |      |               |         |                   |         |
| SA1      | Tang Houn                     | III  | 20.0                       | 4.0              | 2.0       | 900               | C                            | No need     | 4.0             | 2.1   | 2    | A                            | 0          | 0                 | 1    | 68,108        | 68,108  | 0                 | 68,108  |
| SA2      | Svay Rolum                    | III  | 25.0                       | 14.0             | 3.0       | 950               | C                            | No need     | 3.2             | 2.1   | 3    | D                            | 950        | 96.0              | 1    | 514,447       | 514,447 | 0                 | 605,658 |
| SA3      | Ta Nang                       | III  | 8.0                        | 3.0              | 2.0       | 800               | Backfill                     | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 0       | 19,492            | 19,492  |
| SA4      | Kro Sar                       | III  | 7.0                        | 3.0              | 2.0       | 1,600             | Backfill                     | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 19,492  | 19,492            | 19,492  |
| SA5      | Trek Pas                      | III  | 6.0                        | 3.5              | 2.0       | 1,900             | Cul                          | Need        | 2.2             | 1.5   | 1    | A                            | 0          | 0                 | 1    | 68,108        | 68,108  | 19,492            | 87,600  |
| SA6      | Tacing                        | III  | 8.0                        | 3.0              | 2.0       | 2,000             | Cul                          | Need        | 2.5             | 1.2   | 1    | A                            | 0          | 0                 | 1    | 68,108        | 68,108  | 19,492            | 87,600  |
| SA7      | Ta Sok                        | III  | 7.0                        | 3.0              | 2.0       | 2,400             | Backfill                     | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 19,492  | 19,492            | 19,492  |
| SA8      | Wath Sethbo                   | III  | 8.0                        | 3.0              | 2.0       | 1,350             | Backfill                     | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 19,492  | 19,492            | 19,492  |
| SA9      | Canal 64                      | III  | 8.0                        | 4.0              | 1.5       | 700               | Backfill                     | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 19,492  | 19,492            | 19,492  |
| SA10     | Lou Roongko                   | III  | 8.0                        | 3.0              | 2.0       | 400               | Backfill                     | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 19,492  | 19,492            | 19,492  |
|          | Sub-total of (1)<br>(Average) | 10   | (10.5)                     | (4.4)            | (2.1)     | 13,000<br>(1,300) |                              |             |                 |       |      | 1                            | 950        | 91,211            | 4    | 718,771       | 155,953 | 8                 | 965,915 |
| (2)      |                               |      |                            |                  |           |                   |                              |             |                 |       |      |                              |            |                   |      |               |         |                   |         |
| SA11     | Wath Choung Leap              | IV   | 8.0                        | 4.0              | 2.0       | 1,200             | Backfill                     | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 19,492  | 19,492            | 19,492  |
| SA12     | Thei                          | IV   | 40.0                       | 20.0             | 5.0       | 2,350             | C                            | Need        | -               | -     | -    | E                            | 2,350      | 177.4             | 1    | 272,876       | 272,876 | 60,953            | 336,829 |
| SA13     | Nakta Samroung                | IV   | 25.0                       | 12.0             | 2.0       | 1,600             | S                            | No need     | -               | -     | -    | D                            | 1,000      | 96.0              | 0    | 96,012        | 96,012  | 0                 | 149,778 |
| SA14     | Long                          | IV   | 30.0                       | 13.0             | 3.0       | 1,560             | S                            | No need     | -               | -     | -    | D                            | 1,560      | 96.0              | 0    | 149,778       | 149,778 | 0                 | 155,561 |
| SA15     | Xeay                          | IV   | 20.0                       | 11.0             | 2.5       | 1,500             | S                            | Need        | -               | -     | -    | C                            | 1,500      | 77.6              | 1    | 116,346       | 116,346 | 39,215            | 155,561 |
| SA16     | Penn                          | IV   | 20.0                       | 11.0             | 2.0       | 800               | Backfill                     | Need        | -               | -     | -    | C                            | 800        | 77.6              | 1    | 62,051        | 62,051  | 39,215            | 101,266 |
| SA17     | Toch                          | IV   | 30.0                       | 16.0             | 3.0       | 5,000             | C                            | Need        | -               | -     | -    | D                            | 5,000      | 96.0              | 1    | 480,058       | 480,058 | 43,236            | 523,294 |
| SA18     | Me Srok                       | IV   | 12.0                       | 4.0              | 2.0       | 1,715             | C                            | No need     | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 0       | 0                 | 0       |
| SA19     | Peng Leng                     | IV   | 12.0                       | 4.0              | 2.0       | 1,000             | Backfill                     | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 19,492  | 19,492            | 19,492  |
| SA20     | Prek Srong                    | IV   | 12.0                       | 4.0              | 2.0       | 1,100             | S                            | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 68,108        | 68,108  | 19,492            | 87,600  |
| SA21     | Prek Svay                     | IV   | 12.0                       | 4.0              | 2.0       | 1,100             | S                            | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 19,492  | 19,492            | 19,492  |
| SA22     | Ta kok                        | IV   | 12.0                       | 3.0              | 2.0       | 1,300             | S                            | Need        | -               | -     | -    | A                            | 0          | 0                 | 0    | 0             | 19,492  | 19,492            | 19,492  |
| SA23     | Ta Chour                      | IV   | 25.0                       | 14.0             | 2.0       | 1,982             | C                            | Need        | -               | -     | -    | D                            | 1,982      | 96.0              | 1    | 190,295       | 190,295 | 43,236            | 233,531 |
| SA24     | Thmei                         | IV   | 25.0                       | 14.0             | 2.5       | 2,100             | C                            | Need        | 3.8             | 2.0   | 3    | D                            | 2,100      | 96.0              | 1    | 201,625       | 201,625 | 43,236            | 244,861 |
| SA25     | Ta Ten                        | IV   | 20.0                       | 12.0             | 2.5       | 1,490             | C                            | Need        | 3.7             | 1.7   | 3    | C                            | 1,500      | 77.6              | 1    | 116,346       | 116,346 | 39,215            | 155,561 |
| SA26     | Ta Va                         | IV   | 15.0                       | 8.0              | 1.5       | 1,490             | S                            | Need        | -               | -     | -    | B                            | 1,490      | 62.1              | 1    | 92,456        | 92,456  | 36,233            | 128,689 |
| SA27     | Wath Xbal Koh                 | IV   | 15.0                       | 4.0              | 2.0       | 1,500             | S                            | Need        | -               | -     | -    | B                            | 1,500      | 62.1              | 1    | 93,077        | 93,077  | 36,233            | 129,310 |
| SA28     | Ong Pang                      | IV   | 20.0                       | 14.0             | 1.5       | 1,885             | S                            | Need        | -               | -     | -    | C                            | 1,885      | 77.6              | 1    | 146,208       | 146,208 | 39,215            | 185,423 |
| SA29     | Wath Thmei Kandal             | IV   | 25.0                       | 14.0             | 2.0       | 2,000             | C                            | Need        | -               | -     | -    | D                            | 2,000      | 96.0              | 1    | 192,023       | 192,023 | 43,236            | 235,259 |
| SA30     | Pour                          | IV   | 30.0                       | 12.0             | 3.0       | 2,000             | S                            | Need        | -               | -     | -    | D                            | 2,000      | 96.0              | 1    | 192,023       | 192,023 | 43,236            | 235,259 |

Table J.6.1.4 (7) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No. | Name of Prek   | Zone | Canal Dimension (existing) |                  |           | Endage Culvert B/C/W Rehabili- or None | Gate (existing) H (m) | Span (m) | Cost of Implementation Works |       |            | Total (US\$) |                  |         |               |                  |         |                  |        |        |           |
|----------|----------------|------|----------------------------|------------------|-----------|--|-----------------------|----------|------------------------------|-------|------------|--------------|------------------|---------|---------------|------------------|---------|------------------|--------|--------|-----------|
|          |                |      | Top Width (m)              | Bottom Width (m) | Depth (m) |  |                       |          | Length (m)                   | Canal |            |              | Gate             |         | Bridge (US\$) |                  |         |                  |        |        |           |
|          |                |      |                            |                  |           |  |                       |          |                              | Type  | Length (m) |              | Unit cost (US\$) | Nos.    |               | Unit cost (US\$) | Nos.    | Unit cost (US\$) |        |        |           |
| SA31     | Wath Chong Kon | IV   | 25.0                       | 13.0             | 3.0       | 1,700                                  | C                     | Need     | 4.2                          | 1.8   | 3          | 1,700        | 96.0             | 162,220 | 1             | 514,447          | 514,447 | 1                | 43,236 | 43,236 | 720,902   |
| SA32     | Mea            | IV   | 25.0                       | 12.0             | 3.0       | 2,000                                  | S                     | Need     | -                            | -     | -          | 2,000        | 96.0             | 211,226 | 0             | -                | -       | 1                | 43,236 | 43,236 | 254,462   |
| SA33     | Chen           | IV   | 30.0                       | 12.0             | 3.0       | 2,500                                  | S                     | Need     | -                            | -     | -          | 2,500        | 96.0             | 240,029 | 0             | -                | -       | 1                | 43,236 | 43,236 | 283,265   |
| SA34     | Men            | IV   | 20.0                       | 8.0              | 3.0       | 2,000                                  | C                     | Need     | 4.8                          | 2.2   | 3          | 2,000        | 77.6             | 153,128 | 1             | 269,274          | 269,274 | 1                | 39,215 | 39,215 | 405,618   |
| SA35     | Ta Ok          | IV   | 25.0                       | 14.0             | 3.0       | 1,800                                  | C                     | Need     | 5.2                          | 2.8   | 3          | 1,800        | 96.0             | 172,821 | 1             | 514,447          | 514,447 | 1                | 43,236 | 43,236 | 720,504   |
| SA36     | Keo            | IV   | 25.0                       | 10.0             | 2.5       | 1,500                                  | S                     | Need     | -                            | -     | -          | 1,500        | 62.1             | 93,077  | 0             | -                | -       | 1                | 36,233 | 36,233 | 129,310   |
| SA37     | Wath Koh Kel   | IV   | 15.0                       | 9.0              | 2.0       | 1,500                                  | S                     | Need     | -                            | -     | -          | 1,500        | 62.1             | 93,077  | 0             | -                | -       | 1                | 36,233 | 36,233 | 129,310   |
| SA38     | Kreang Ang     | IV   | 15.0                       | 8.0              | 2.0       | 1,200                                  | S                     | Need     | -                            | -     | -          | 1,200        | 62.1             | 74,461  | 0             | -                | -       | 1                | 36,233 | 36,233 | 110,694   |
| SA39     | Sengly         | IV   | 20.0                       | 12.0             | 2.0       | 2,000                                  | S                     | Need     | -                            | -     | -          | 2,000        | 77.6             | 153,128 | 0             | -                | -       | 1                | 39,215 | 39,215 | 194,343   |
| SA40     | Pung           | IV   | 25.0                       | 14.0             | 2.5       | 1,500                                  | S                     | Need     | -                            | -     | -          | 1,500        | 77.6             | 116,346 | 0             | -                | -       | 1                | 39,215 | 39,215 | 155,561   |
| SA41     | Ta Lai         | IV   | 20.0                       | 10.0             | 2.5       | 1,500                                  | S                     | Need     | -                            | -     | -          | 1,500        | 62.1             | 93,077  | 0             | -                | -       | 1                | 36,233 | 36,233 | 129,310   |
| SA42     | Thmei          | IV   | 20.0                       | 11.0             | 2.0       | 2,000                                  | S                     | Need     | -                            | -     | -          | 2,000        | 77.6             | 153,128 | 0             | -                | -       | 1                | 39,215 | 39,215 | 194,343   |
| SA43     | Ta Rort        | IV   | 25.0                       | 16.0             | 2.0       | 2,000                                  | S                     | Need     | -                            | -     | -          | 2,000        | 96.0             | 192,023 | 0             | -                | -       | 1                | 43,236 | 43,236 | 235,259   |
| SA44     | Ung            | IV   | 30.0                       | 18.0             | 2.0       | 2,000                                  | C                     | Need     | 3.8                          | 2.2   | 5          | 2,000        | 96.0             | 192,023 | 1             | 514,447          | 514,447 | 1                | 43,236 | 43,236 | 749,706   |
| SA45     | Teav           | IV   | 25.0                       | 17.0             | 2.0       | 2,000                                  | S                     | Need     | -                            | -     | -          | 2,000        | 96.0             | 192,023 | 0             | -                | -       | 1                | 43,236 | 43,236 | 235,259   |
| SA46     | Sek            | IV   | 25.0                       | 13.0             | 2.0       | 2,000                                  | S                     | Need     | -                            | -     | -          | 2,000        | 77.6             | 153,128 | 0             | -                | -       | 1                | 39,215 | 39,215 | 194,343   |
| SA47     | Chuy           | IV   | 25.0                       | 14.0             | 2.0       | 3,500                                  | S                     | Need     | -                            | -     | -          | 3,500        | 77.6             | 271,474 | 0             | -                | -       | 1                | 39,215 | 39,215 | 310,689   |
| SA48     | Thom           | IV   | 25.0                       | 18.0             | 2.0       | 2,700                                  | B                     | Need     | -                            | -     | -          | 2,700        | 96.0             | 259,232 | 0             | -                | -       | 1                | 43,236 | 43,236 | 302,468   |
| SA49     | Taken          | IV   | 20.0                       | 15.0             | 1.5       | 3,000                                  | C                     | Need     | -                            | -     | -          | 3,000        | 77.6             | 232,692 | 0             | -                | -       | 1                | 39,215 | 39,215 | 271,907   |
| SA50     | Ta choir       | IV   | 25.0                       | 15.0             | 3.0       | 1,000                                  | S                     | Need     | -                            | -     | -          | 1,000        | 77.6             | 77,564  | 0             | -                | -       | 1                | 39,215 | 39,215 | 116,779   |
| SA51     | Konkay         | IV   | 10.0                       | 5.0              | 1.0       | 3,000                                  | Cul                   | Need     | -                            | -     | -          | 0            | 0                | 0       | 0             | -                | 1       | 19,492           | 19,492 | 19,492 |           |
| SA52     | Tassu          | IV   | 30.0                       | 21.0             | 3.0       | 4,000                                  | C                     | Need     | -                            | -     | -          | 4,000        | 117.4            | 469,577 | 0             | -                | -       | 1                | 60,953 | 60,953 | 530,530   |
| SA53     | Khut           | IV   | 25.0                       | 18.0             | 3.0       | 1,200                                  | S                     | Need     | -                            | -     | -          | 1,200        | 96.0             | 112,214 | 0             | -                | -       | 1                | 19,492 | 19,492 | 115,214   |
| SA54     | Hang           | IV   | 5.0                        | 1.5              | 1.5       | 2,000                                  | Cul                   | Need     | -                            | -     | -          | 0            | 0                | 0       | 0             | -                | 1       | 19,492           | 19,492 | 19,492 |           |
| SA55     | Chi            | IV   | 15.0                       | 8.0              | 1.0       | 2,000                                  | W                     | Need     | -                            | -     | -          | 2,000        | 62.1             | 124,102 | 0             | -                | -       | 1                | 36,233 | 36,233 | 160,335   |
| SA56     | Wath Pou       | IV   | 15.0                       | 9.0              | 2.0       | 1,800                                  | W                     | Need     | -                            | -     | -          | 1,800        | 62.1             | 111,692 | 0             | -                | -       | 1                | 36,233 | 36,233 | 147,925   |
| SA57     | Sohem          | IV   | 30.0                       | 9.0              | 3.0       | 4,200                                  | C                     | Need     | 3.0                          | 2.0   | 3          | 3,500        | 96.0             | 336,041 | 1             | 180,691          | 180,691 | 1                | 36,233 | 36,233 | 216,924   |
| SA58     | Taek           | IV   | 25.0                       | 17.0             | 4.0       | 3,500                                  | C                     | Need     | -                            | -     | -          | 3,500        | 96.0             | 336,041 | 0             | -                | -       | 1                | 43,236 | 43,236 | 379,277   |
| SA59     | Thmei          | IV   | 25.0                       | 14.5             | 4.0       | 4,000                                  | W                     | Need     | -                            | -     | -          | 4,000        | 77.6             | 310,256 | 0             | -                | -       | 1                | 39,215 | 39,215 | 349,471   |
| SA60     | Phum Prek      | IV   | 25.0                       | 16.0             | 2.0       | 3,600                                  | C                     | No need  | -                            | -     | -          | 3,600        | 96.0             | 345,642 | 0             | -                | -       | 1                | 39,215 | 39,215 | 384,854   |
| SA61     | Pann           | IV   | 25.0                       | 14.0             | 3.0       | 3,700                                  | W                     | Need     | -                            | -     | -          | 3,700        | 77.6             | 286,987 | 0             | -                | -       | 1                | 43,236 | 43,236 | 330,202   |
| SA62     | Balatt 6       | IV   | 25.0                       | 18.0             | 4.0       | 3,500                                  | C                     | Need     | -                            | -     | -          | 3,500        | 96.0             | 336,041 | 0             | -                | -       | 1                | 43,236 | 43,236 | 379,277   |
| SA63     | Taokok         | IV   | 30.0                       | 23.0             | 4.0       | 4,000                                  | C                     | Need     | 4.2                          | 1.8   | 10         | 4,000        | 117.4            | 469,577 | 1             | 709,176          | 709,176 | 1                | 60,953 | 60,953 | 1,229,703 |
| SA64     | Tam Lo         | IV   | 7.0                        | 3.0              | 1.5       | 3,000                                  | Cul                   | No need  | 2.0                          | 1.8   | 1          | 0            | 0                | 0       | 0             | -                | 1       | 68,108           | 68,108 | 68,108 |           |
| SA65     | Thmei          | IV   | 20.0                       | 18.0             | 2.0       | 2,000                                  | W                     | Need     | -                            | -     | -          | 2,000        | 96.0             | 192,023 | 0             | -                | -       | 1                | 43,236 | 43,236 | 235,259   |

Table J.6.1.4 (8) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No.                           | Name of Prek | Zone | Canal Dimension (existing) |                  |           |            | Bridge / Culvert<br>B/C/W<br>or None | Reliability | Gate (existing) |       |      | Cost of Implementation Works |            |                   |         |                   |      |                   |      |                   |               |            |  |
|------------------------------------|--------------|------|----------------------------|------------------|-----------|------------|--------------------------------------|-------------|-----------------|-------|------|------------------------------|------------|-------------------|---------|-------------------|------|-------------------|------|-------------------|---------------|------------|--|
|                                    |              |      | Top Width (m)              | Bottom Width (m) | Depth (m) | Length (m) |                                      |             | H (m)           | W (m) | Span | Canal                        |            |                   | Gate    |                   |      | Bridge            |      |                   | Total (US \$) |            |  |
|                                    |              |      |                            |                  |           |            |                                      |             |                 |       |      | Type                         | Length (m) | Unit cost (US \$) | Nos.    | Unit cost (US \$) | Nos. | Unit cost (US \$) | Nos. | Unit cost (US \$) |               | Nos.       |  |
| SA66                               | Ta Te        | IV   | 20.0                       | 11.0             | 2.0       | 2,000      | C                                    | Need        | -               | -     | -    | C                            | 2,000      | 77.6              | 155,128 | 0                 | 0    | 0                 | 1    | 39,215            | 39,215        | 194,343    |  |
| SA67                               | Kraoh        | IV   | 20.0                       | 17.0             | 2.0       | 2,000      | C                                    | Need        | -               | -     | -    | D                            | 2,000      | 96.0              | 192,023 | 0                 | 0    | 0                 | 1    | 43,236            | 43,236        | 225,259    |  |
| SA68                               | Wath Talong  | IV   | 20.0                       | 18.0             | 2.0       | 1,800      | Backfill                             | Need        | -               | -     | -    | D                            | 1,800      | 96.0              | 172,821 | 0                 | 0    | 0                 | 1    | 43,236            | 43,236        | 216,057    |  |
| SA69                               | Ta Prak      | IV   | 20.0                       | 12.0             | 2.0       | 2,000      | Backfill                             | Need        | -               | -     | -    | C                            | 2,000      | 77.6              | 155,128 | 0                 | 0    | 0                 | 1    | 39,215            | 39,215        | 194,343    |  |
| SA70                               | Reusseï Srok | IV   | 20.0                       | 12.0             | 2.0       | 2,000      | C                                    | No need     | -               | -     | -    | C                            | 2,000      | 77.6              | 155,128 | 0                 | 0    | 0                 | 1    | 39,215            | 39,215        | 155,128    |  |
| SA71                               | Chikakxvein  | IV   | 14.0                       | 5.0              | 2.0       | 800        | C                                    | Need        | -               | -     | -    | A                            | 0          | 0                 | 0       | 0                 | 0    | 0                 | 1    | 19,492            | 19,492        | 19,492     |  |
| SA72                               | Phon         | IV   | 10.0                       | 5.0              | 2.0       | 800        | S                                    | No need     | -               | -     | -    | A                            | 0          | 0                 | 0       | 0                 | 0    | 0                 | 0    | 0                 | 0             | 124,102    |  |
| SA73                               | Wath Khipob. | IV   | 15.0                       | 10.0             | 2.0       | 2,000      | S                                    | No need     | -               | -     | -    | B                            | 2,000      | 62.1              | 124,102 | 0                 | 0    | 0                 | 0    | 0                 | 0             | 124,102    |  |
| SA74                               | Thmei        | IV   | 12.0                       | 8.0              | 2.0       | 2,000      | S                                    | No need     | -               | -     | -    | B                            | 2,000      | 62.1              | 124,102 | 0                 | 0    | 0                 | 0    | 0                 | 0             | 124,102    |  |
| Sub-total of (2) (Average)         |              | 64   | (20.9)                     | (14.5)           | (2.4)     | (34,582)   |                                      |             |                 |       |      | 52                           | 113,367    | 9,874,640         | 10      | 3,622,417         | 54   | 2,070,379         |      |                   |               | 15,567,630 |  |
| Total of Saang districts (1) - (2) |              | 74   | (19.5)                     | (14.2)           | (2.3)     | (1,994)    |                                      |             |                 |       |      | 53                           | 114,317    | 9,965,851         | 14      | 4,341,189         | 62   | 2,226,512         |      |                   |               | 16,533,552 |  |



Table J.6.1.4 (9) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No.         | Name of Prek     | Zone | Canal Dimension (existing) |                  |           | Bridge/Culvert |               |                | Gate (existing) |       |      | Cost of Implementation Works |            |                   |        |                   |      | Total (US \$) |                   |
|------------------|------------------|------|----------------------------|------------------|-----------|----------------|---------------|----------------|-----------------|-------|------|------------------------------|------------|-------------------|--------|-------------------|------|---------------|-------------------|
|                  |                  |      | Top Width (m)              | Bottom Width (m) | Depth (m) | Length (m)     | B/C/W or None | Rehabilit- ion | H (m)           | W (m) | Span | Type                         | Length (m) | Unit cost (US \$) | Nos.   | Unit cost (US \$) | Nos. |               | Unit cost (US \$) |
|                  |                  |      | 4.0                        | -                | 3.0       | 1,200          | None          | No need        | -               | -     | -    |                              |            |                   |        |                   |      |               |                   |
| LD1              | Prek Apich       | II   | 4.0                        | -                | 3.0       | 2,000          | None          | No need        | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 0    | 0             |                   |
| LD2              | Prek Bom Kri     | II   | 3.0                        | -                | 2.0       | 2,000          | None          | No need        | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 0    | 0             |                   |
| LD3              | Prek Kong Krik   | II   | 4.0                        | -                | 3.0       | 2,000          | None          | No need        | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 0    | 0             |                   |
| LD4              | Prek Chhourb     | II   | 4.0                        | -                | 2.0       | 2,000          | None          | No need        | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 0    | 0             |                   |
| LD5              | Canal Samaki     | II   | 2.0                        | -                | 1.0       | 1,800          | None          | No need        | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 0    | 0             |                   |
| LD6              | Prek Tameau      | II   | 4.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 1                 | 68,108 | 68,108            | 1    | 19,492        |                   |
| LD7              | Canal Tachmann   | II   | 1.5                        | -                | 1.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD8              | Prek Ming Hing   | II   | 5.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD9              | Canal Ta Nilgor  | II   | 2.5                        | -                | 1.5       | 1,500          | None          | Need           | -               | -     | -    | A                            | 0          | 1                 | 68,108 | 68,108            | 1    | 19,492        |                   |
| LD10             | Prek Samaki      | II   | 3.0                        | -                | 2.0       | 1,800          | None          | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD11             | Canal Sahakur    | II   | 2.0                        | -                | 2.0       | 1,200          | None          | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD12             | Canal Tasom      | II   | 2.0                        | -                | 1.0       | 1,500          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD13             | Prek Chan        | II   | 3.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD14             | Sung Bakel       | II   | -                          | -                | -         | 2,000          | None          | Need           | -               | -     | -    | A                            | 0          | 1                 | 68,108 | 68,108            | 1    | 19,492        |                   |
| LD15             | Prek Dork        | II   | 3.0                        | -                | 2.0       | 2,000          | None          | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD16             | Prek Horn        | II   | 3.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD17             | Prek Tassy       | II   | 3.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD18             | Prek Chhmo       | II   | 4.0                        | -                | 3.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD19             | Prek Nov         | II   | 3.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD20             | Prek Leap        | II   | 3.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD21             | Prek Pakk        | II   | 3.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD22             | Prek Banhechev   | II   | 3.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD23             | Canal Tavann     | II   | 2.0                        | -                | 1.5       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 1                 | 68,108 | 68,108            | 1    | 19,492        |                   |
| LD24             | Prek Doung Kdomg | II   | 2.0                        | -                | 1.5       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD25             | Prek Chom        | II   | 2.5                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD26             | Prek Toubb       | II   | 4.5                        | -                | 3.0       | 2,000          | C             | Need           | -               | -     | -    | A                            | 0          | 1                 | 68,108 | 68,108            | 1    | 19,492        |                   |
| LD27             | Prek Kleang      | II   | 2.0                        | -                | 2.0       | 2,000          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD28             | Prek Ta Som      | II   | 4.0                        | -                | 3.0       | 1,700          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD29             | Canal            | II   | 1.5                        | -                | 1.0       | 1,500          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD30             | Prek Baek Touk   | II   | 2.5                        | -                | 2.0       | 1,900          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD31             | Prek Chsok       | II   | 2.0                        | -                | 1.5       | 1,500          | W             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD32             | Prek Tamut       | II   | 2.5                        | -                | 2.0       | 1,850          | None          | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD33             | Prek Buntay      | II   | 2.0                        | -                | 1.5       | 1,200          | None          | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD34             | Prek Samaki      | II   | 2.0                        | -                | 1.5       | 1,200          | None          | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| LD35             | Prek Thmey       | II   | 3.0                        | -                | 2.0       | 1,500          | S             | Need           | -               | -     | -    | A                            | 0          | 0                 | 0      | 0                 | 1    | 19,492        |                   |
| Sub-total of (I) |                  | 35   | (2.8)                      | (*)              | (1.9)     | 63,350         |               |                |                 |       |      | 0                            | 0          | 0                 | 7      | 476,757           | 30   | 584,749       | 1,061,506         |
| (Average)        |                  |      |                            |                  |           | (1,810)        |               |                |                 |       |      |                              |            |                   |        |                   |      |               |                   |

Table J.6.1.4 (10) Implementation Cost of each Colmatage Canals between Mekong and Bassac River

| Prek No. | Name of Prek                        | Zone | Canal Dimension (existing) |                  |           | Bridge / Culvert B/C/W or None | Reliability / Rehabilitation | Gate (existing) |       |       | Cost of Implementation Works |       |            |                   | Total (US \$) |                          |         |                   |            |
|----------|-------------------------------------|------|----------------------------|------------------|-----------|--------------------------------|------------------------------|-----------------|-------|-------|------------------------------|-------|------------|-------------------|---------------|--------------------------|---------|-------------------|------------|
|          |                                     |      | Top Width (m)              | Bottom Width (m) | Depth (m) |                                |                              | Length (m)      | H (m) | W (m) | Span                         | Canal |            | Gate              |               | Bridge Unit cost (US \$) |         |                   |            |
|          |                                     |      |                            |                  |           |                                |                              |                 |       |       |                              | Type  | Length (m) | Unit cost (US \$) |               |                          | Nos.    | Unit cost (US \$) | Nos.       |
| (2)      | C.Border Khum                       | II   | 1.5                        |                  | 1.0       | 1,800                          | None                         | No need.        | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD37     | Prek Tasork                         | II   | 3.0                        |                  | 2.0       | 2,000                          | Cul                          | No need.        | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD38     | Wath Peam Leu                       | II   | 4.0                        |                  | 3.0       | 1,500                          | Cul                          | No need.        | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD39     | Prek Tanoun                         | II   | 3.0                        |                  | 2.5       | 1,900                          | W                            | Need            | -     | -     | -                            | 0     | 0          | 0                 | 1             | 19,492                   | 19,492  |                   |            |
| LD40     | Prek Thmey                          | II   | 4.0                        |                  | 3.5       | 1,000                          | C                            | Need            | 2.5   | 2.0   | 2                            | 0     | 0          | 0                 | 1             | 68,108                   | 68,108  |                   |            |
| LD41     | Prek Chinsang                       | II   | 2.0                        |                  | 1.5       | 1,000                          | W                            | Need            | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD42     | Prek Thiang                         | II   | 4.0                        |                  | 3.0       | 1,500                          | W                            | Need            | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD43     | Prek Dach                           | II   | 4.0                        |                  | 3.0       | 2,000                          | C                            | Need            | 3.5   | 1.8   | 2                            | 0     | 0          | 0                 | 1             | 68,108                   | 68,108  |                   |            |
| LD44     | Canal Bannab                        | II   | 2.5                        |                  | 2.0       | 1,000                          | None                         | No need.        | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD45     | Prek Touk                           | II   | 2.5                        |                  | 2.0       | 1,500                          | S                            | Need            | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD46     | Canal Samaki                        | II   | 2.0                        |                  | 1.5       | 1,200                          | None                         | Need            | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD47     | Prek Tatouk                         | II   | 4.0                        |                  | 3.0       | 2,000                          | W                            | Need            | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD48     | Prek Bak                            | II   | 3.0                        |                  | 2.0       | 2,000                          | S                            | Need            | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD49     | Prek Spean Dek                      | II   | 6.0                        |                  | 4.0       | 1,000                          | W                            | Need            | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD50     | Prek Spean Thmor                    | II   | 5.0                        |                  | 4.0       | 1,900                          | W                            | Need            | -     | -     | -                            | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
| LD51     | Prek DenPour                        | II   | 3.0                        |                  | 1.5       | 2,500                          | None                         | Need            | -     | -     | -                            | 0     | 0          | 0                 | 1             | 68,108                   | 68,108  |                   |            |
|          | Sub-total of (2)                    | 16   | (3.2)                      | (-)              | (2.5)     | 25,800                         |                              |                 |       |       |                              | 0     | 0          | 0                 | 3             | 204,325                  | 204,325 |                   |            |
|          | (Average)                           |      |                            |                  |           | (1,613)                        |                              |                 |       |       |                              | 0     | 0          | 0                 | 10            | 681,082                  | 681,082 |                   |            |
|          | Total of Leuk Dek district, (1)~(2) | 51   | 149.0                      | (-)              | 105.5     | 89,150                         |                              |                 |       |       |                              | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
|          |                                     |      | (3.0)                      | (-)              | (2.1)     | (1,748)                        |                              |                 |       |       |                              | 0     | 0          | 0                 | 0             | 0                        | 0       |                   |            |
|          | Grand-Total                         | 250  | 3,491.0                    | 1,580.8          | 666.9     | 504,637                        |                              |                 |       |       |                              | 109   | 270,702    | 21,579,954        | 50            | 10,472,053               | 213     | 6,059,000         | 37,910,987 |
|          |                                     |      | (14.2)                     | (10.1)           | (2.7)     | (2,027)                        |                              |                 |       |       |                              |       |            |                   |               |                          |         |                   |            |

| Zone / District Name and<br>Construction Works Components  | Implementation Period |           |          |          |          |          |
|--|-----------------------|-----------|----------|----------|----------|----------|
|  | 1 <sup>st</sup> Year  | 2nd Year  | 3rd Year | 4th Year | 5th Year | 6th Year |
|  | Wetseason             | Dryseason |          |          |          |          |
| <b>Zone - I (Kean Svay)</b><br>- Survey Works and Detail Design<br>- Rehabilitation of Colmatage Canal L=12.0 km<br>- Construction of Intake Gate 5 Nos.<br>- Construction of Bridge 4 Nos.          | _____                 | _____     |          |          |          |          |
| <b>Zone - II (Leuk Dek)</b><br>- Survey Works and Detail Design<br>- Rehabilitation of Colmatage Canal L= - km<br>- Construction of Intake Gate 10 Nos.<br>- Construction of Bridge 42 Nos.          | _____                 | _____     |          |          |          |          |
| <b>Zone - III (Kean Svay, Saang)</b><br>- Survey Works and Detail Design<br>- Rehabilitation of Colmatage Canal L=7.2 km<br>- Construction of Intake Gate 9 Nos.<br>- Construction of Bridge 19 Nos. | _____                 | _____     |          |          |          |          |
| <b>Zone - IV (Saang)</b><br>- Survey Works and Detail Design<br>- Rehabilitation of Colmatage Canal L=113.4 km<br>- Construction of Intake Gate 10 Nos.<br>- Construction of Bridge 54 Nos.          |                       | _____     | _____    | _____    | _____    |          |
| <b>Zone - V (Koh Thom)</b><br>- Survey Works and Detail Design<br>- Rehabilitation of Colmatage Canal L= 138.2 km<br>- Construction of Intake Gate 16 Nos.<br>- Construction of Bridge 94 Nos.       |                       |           | _____    | _____    | _____    | _____    |

Figure J.6.2.1 Implementation Schedule for Colmatage System in Kandal Province

## J.7 PROJECT EVALUATION

### J.7.1 Economic Evaluation

Table J.7.1 Price of Structure of Paddy

|   | Unit     | Economic Price |
|---|----------|----------------|
| IBRD price projection in 2005 at 1990 constant price (5% broken white rice, FOB Bangkok) 1/ | US\$/ton | 233            |
| Converted to 1997 constant price 2/   | US\$/ton | 283            |
| Export price, FOB Kompong Som 3/  | US\$/ton | 255            |
| Port handling charge 4/   | US\$/ton | 9              |
| Transportation cost from mill in Province to port 5/  | US\$/ton | 10             |
| Margin of whole salers 6/   | US\$/ton | 13             |
| Rice price ex-mill  | US\$/ton | 223            |
| Paddy equivalent price(65% milling recovery)  | US\$/ton | 145            |
| Milling cost  | US\$/ton | 13             |
| Paddy price at mill   | US\$/ton | 132            |
| Average cost of transportation, farm to mill 7/   | US\$/ton | 7              |
| Farmgate price  | US\$/ton | 122            |
| Farmgate price 8/   | Riels/kg | 334            |

Note.1/World Bank's Price Forecasts, August 1995, adjusted into 1997 constant prices, and FOB price at Kompong Som was assumed to be the same as that of Bangkok port in Thailand  
 2/IBRD international price index(x1.2138)  
 3/Derived by taking 10% discount from the price of 5% broken rice FOB, Bangkok  
 4/Conversion factor of 0.85 was applied to 10\$/ton  
 5/Transportation cost was estimated at 0.055 \$/ton/km, and distance from study area to port was averaged at 205km, CF=0.85  
 6/5% of FOB price  
 7/5% of paddy price at mill was applied  
 8/Exchange rate:2,737 Riels=1US\$

Table J.7.2 Price Structure of Maize

|  | Unit     | Economic Price |
|--|----------|----------------|
| IBRD price projection in 2005 at 1990 constant price US No. 2 Yellow FOB Gulf 1/ | US\$/ton | 86             |
| Converted to 1997 constant price 2/  | US\$/ton | 104            |
| Freight and insurance  | US\$/ton | 25             |
| FOB Price at Kompong Som port  | US\$/ton | 129            |
| Transportation from wholesale to warehouse at port 3/                            | US\$/ton | 9              |
| Wholesale to warehouse at port   | US\$/ton | 9              |
| Wholesaler's price   | US\$/ton | 111            |
| Wholesaler's margin  | US\$/ton | 6              |
| Ex-warehouse price   | US\$/ton | 105            |
| Transportation and handling cost from farm to warehouse 4/                       | US\$/ton | 10             |
| Farmgate price   | US\$/ton | 95             |
| Farmgate price   | Riels/kg | 261            |

Note.1/World Bank's Price Forecasts, August 1995, adjusted into 1997 constant prices  
 2/IBRD international price index(x1.2138)  
 3/Conversion factor of 0.85 was applied  
 4/Transportation cost was estimated at 0.055\$/ton/km, and distance from study area to port was averaged at 205km, CF=0.85  
 5/5% of FOB price  
 6/Exchange rate:2,737 Riels=1US\$

**Table J.7.3 Price Structure of Fertilizer**

|  | Unit     | Urea<br>(46-0-0) | DAP<br>(16-20-0) | M. of<br>Potash |
|--|----------|------------------|------------------|-----------------|
| IFAD projection price in 2005 in 1990 constant price 1/            | US\$/ton | 137              | 153              | 99              |
| Converted to 1997 constant price(x 1.2138) 2/                      | US\$/ton | 166              | 186              | 120             |
| Ocean Freight and Insurance to Cambodian Port                      | US\$/ton | 40               | 60               | 60              |
| Import Price CIF at Kompong Som                                    | US\$/ton | 206              | 246              | 180             |
| Port handling, storage and processing charge                       | US\$/ton | 8                | 8                | 8               |
| Wholesale price  | US\$/ton | 214              | 254              | 188             |
| Wholesale margin 3/  | US\$/ton | 11               | 13               | 9               |
| Transportation Cost from Port to retail 4/                         | US\$/ton | 10               | 10               | 10              |
| Dealers Margin   | US\$/ton | 12               | 14               | 10              |
| Average Cost of Transportation from Distribution Center to Farm 5/ | US\$/ton | 2                | 2                | 2               |
| Farmgate Price   | US\$/ton | 249              | 293              | 219             |
| Farmgate Price 6/  | Riels/kg | 682              | 801              | 600             |

**Table J.7.4 Farmgate Price of Crops and Inputs**

|                     | Unit                    | Financial Economic |         |
|---------------------|-------------------------|--------------------|---------|
| <b>Crops:</b>       |                         |                    |         |
| Paddy               | Riels/kg                | 316                | 334     |
| Maize               | Riels/kg                | 257                | 261     |
| Mungbean            | Riels/kg                | 1,700              | 1,700   |
| Chinese kale        | Riels/kg                | 1,000              | 1,000   |
| Sesame              | Riels/kg                | 1,500              | 1,500   |
| Banana              | Riels/hand              | 350                | 350     |
| Piglet              | Riels/head              | 40,000             | 40,000  |
| Pig fattened        | Riels/live body weight† | 3,000              | 3,000   |
| River fishes        | Riels/kg                | 2,700              | 2,700   |
| <b>Inputs:</b>      |                         |                    |         |
| Urea                | Riels/kg                | 800                | 682     |
| 16-20-0             | Riels/kg                | 730                | 801     |
| Manure              | Riels/cart (500kg)      | 5,000              | 5,000   |
| Sumicidin           | Riels/kg                | 31,750             | 29,782  |
| Azodrine            | Riels/lit.              | 12,500             | 11,725  |
| Trifon              | Riels/lit.              | 27,900             | 26,170  |
| Rice bran           | Riels/kg                | 250                | 250     |
| Fish meal           | Riels/kg                | 900                | 900     |
| Labour              | Riels/man.day           | 3,500              | 1,750   |
| Hired animal        | Riels/animal.day        | 8,000              | 4,000   |
| <b>Seeds:</b>       |                         |                    |         |
| Paddy               | Riels/kg                | 350                | 350     |
| Mungbean            | Riels/kg                | 2,500              | 2,500   |
| Sesame              | Riels/kg                | 1,000              | 1,000   |
| Maize               | Riels/kg                | 700                | 700     |
| Chinese kale        | Riels/kg                | 20,000             | 18,760  |
| Banana nursery      | Riels/tree              | 450                | 450     |
| Motor pump (small)  | Riels/unit              | 875,000            | 820,750 |
| Motor pump (rental) | Riels/hour              | 2,500              | 2,345   |

**Table J.7.5 Calculation of Standard Conversion Factor**

|                      | (unit: million US\$) |       |         |         |         |         |
|----------------------|----------------------|-------|---------|---------|---------|---------|
|                      | 1992                 | 1993  | 1994    | 1995    | 1996    | Average |
| ① Total Imports(CIF) | 350.7                | 486.4 | 754.8   | 1,213.0 | 1,109.0 | 782.8   |
| ② Total Exports(FOB) | 264.5                | 283.0 | 462.9   | 809.0   | 659.0   | 495.7   |
| ③ Total Import Tax   | 31.7                 | 69.0  | 105.1   | 121.4   | 119.6   | 89.4    |
| ④ Total Export Tax   | 4.0                  | 4.1   | 7.3     | 6.8     | 2.9     | 5.0     |
| ⑤ Subsidy on Export: | -                    | -     | -       | -       | -       | -       |
| ⑥ = ①+②              | 615.2                | 769.4 | 1,217.7 | 2,022.0 | 1,768.0 | 1,278.5 |
| ⑦ = ①+②+③-④+⑤        | 642.9                | 834.3 | 1,315.5 | 2,136.6 | 1,884.7 | 1,362.8 |
| ⑧ SCF = ⑥/⑦          | 0.957                | 0.922 | 0.926   | 0.946   | 0.938   | 0.938   |

Source: Calculated based on the data of IMF and Ministry of Economy and Finance

**Table J.7.6 Cost and Return of Crops**

Cost and Return of Crops(financial)

Season:Dry Season  
Crop:Recession Rice

|                            | Unit  | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|-------|--------------------|-----------------|---------------|--------------|---------------|
|                            |       |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| 1. Production Cost         |       |                    |                 |               |              |               |
| a. Labor Cost              |       |                    |                 |               |              |               |
| Family labour              | MD    |                    | 65              | -             | 80           | -             |
| Hired labour               | MD    | 3,500              | 25              | 87,500        | 30           | 105,000       |
| Bullock Labor              | MAD   | 8,000              | 15              | 120,000       | 20           | 160,000       |
| Sub-total                  |       |                    |                 | 207,500       |              | 265,000       |
| b. Input Cost              |       |                    |                 |               |              |               |
| Seed                       | kg    | 350                | 60              | 21,000        | 60           | 21,000        |
| Manure                     | Cart  | 5,000              | 2               | 10,000        | 3            | 15,000        |
| Fertilizer                 |       |                    |                 |               |              |               |
| Urea                       | kg    | 800                | 40              | 32,000        | 65           | 52,000        |
| 16-20-0                    | kg    | 730                | 40              | 29,200        | 25           | 18,250        |
| Agri-Chemicals             | kg    | 31,750             | 0               | 0             | 1            | 31,750        |
| Pumping water              | Riel  | 2,500              | 12              | 30,000        | 12           | 30,000        |
| Sub-total                  |       |                    |                 | 122,200       |              | 168,000       |
| Miscellaneous(5% of total) |       |                    |                 | 17,353        |              | 22,789        |
| Total Costs                |       |                    |                 | 347,053       |              | 455,789       |
| 2. Gross Income            |       |                    |                 | 1,094,940     |              | 1,393,560     |
| a. Main Product            | kg    | 316                | 3,300           | 1,042,800     | 4,200        | 1,327,200     |
| b. By-product              | kg    | 10                 | 5,214           | 52,140        | 6,636        | 66,360        |
| 3. Net Profit              | Riels |                    |                 | 747,887       |              | 937,771       |

Cost and Return of Crops(economic)

Season:Dry Season  
Crop:Recession Rice

|                            | Unit  | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|-------|--------------------|-----------------|---------------|--------------|---------------|
|                            |       |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| 1. Production Cost         |       |                    |                 |               |              |               |
| a. Labor Cost              |       |                    |                 |               |              |               |
| Family labour              | MD    | 1,750              | 65              | 113,750       | 80           | 140,000       |
| Hired labour               | MD    | 1,750              | 25              | 43,750        | 30           | 52,500        |
| Bullock Labor              | MAD   | 4,000              | 15              | 60,000        | 20           | 80,000        |
| Sub-total                  |       |                    |                 | 103,750       |              | 132,500       |
| b. Input Cost              |       |                    |                 |               |              |               |
| Seed                       | kg    | 350                | 60              | 21,000        | 60           | 21,000        |
| Manure                     | Cart  | 5,000              | 2               | 10,000        | 3            | 15,000        |
| Fertilizer                 |       |                    |                 |               |              |               |
| Urea                       | kg    | 682                | 40              | 27,280        | 65           | 44,330        |
| 16-20-0                    | kg    | 801                | 40              | 32,040        | 25           | 20,025        |
| Agri-Chemicals             | kg    | 29,782             | 0               | 0             | 1            | 29,782        |
| Pumping water              | Riel  | 2,345              | 12              | 28,140        | 12           | 28,140        |
| Sub-total                  |       |                    |                 | 118,460       |              | 158,277       |
| Miscellaneous(5% of total) |       |                    |                 | 11,695        |              | 15,304        |
| Total Costs                |       |                    |                 | 233,905       |              | 306,081       |
| 2. Gross Income            |       |                    |                 | 1,154,340     |              | 1,469,160     |
| a. Main Product            | kg    | 334                | 3,300           | 1,102,200     | 4,200        | 1,402,800     |
| b. By-product              | kg    | 10                 | 5,214           | 52,140        | 6,636        | 66,360        |
| 3. Net Profit              | Riels |                    |                 | 920,435       |              | 1,163,079     |

Cost and Return of Crops(financial)

Season:Wet Season  
Crop:Rainfed Wet Paddy(Low Land)

|                            | Unit  | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|-------|--------------------|-----------------|---------------|--------------|---------------|
|                            |       |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| 1. Production Cost         |       |                    |                 |               |              |               |
| a. Labor Cost              |       |                    |                 |               |              |               |
| Family labour              | MD    |                    | 65              | -             | 67           | -             |
| Hired labour               | MD    | 3,500              | 20              | 70,000        | 22           | 77,000        |
| Bullock Labor              | day   | 8,000              | 15              | 120,000       | 15           | 120,000       |
| Sub-total                  |       |                    |                 | 190,000       |              | 197,000       |
| b. Input Cost              |       |                    |                 |               |              |               |
| Seed                       | kg    | 350                | 60              | 21,000        | 60           | 21,000        |
| Manure                     | Cart  | 5,000              | 1               | 5,000         | 2            | 10,000        |
| Fertilizer                 |       |                    |                 |               |              |               |
| Urea                       | kg    | 800                | 18              | 14,400        | 20           | 16,000        |
| 16-20-0                    | kg    | 730                | 18              | 13,140        | 20           | 14,600        |
| Agri-Chemicals             | kg    | 31,750             | 0               | 0             | 0            | 0             |
| Pumping water              | Riels | 2,500              | 0               | 0             | 0            | 0             |
| Sub-total                  |       |                    |                 | 53,540        |              | 61,600        |
| Miscellaneous(5% of total) |       |                    |                 | 12,818        |              | 13,611        |
| Total Costs                |       |                    |                 | 256,358       |              | 272,211       |
| 2. Gross Income            |       |                    |                 | 796,320       |              | 962,220       |
| a. Main Product            | kg    | 316                | 2,400           | 758,400       | 2,900        | 916,400       |
| b. By-product              | kg    | 10                 | 3,732           | 37,920        | 4,582        | 45,820        |
| 3. Net Profit              | Riels |                    |                 | 539,962       |              | 690,009       |

Cost and Return of Crops(economic)

Season:Wet Season  
Crop:Rainfed Wet Paddy(Low Land)

|                            | Unit  | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|-------|--------------------|-----------------|---------------|--------------|---------------|
|                            |       |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| 1. Production Cost         |       |                    |                 |               |              |               |
| a. Labor Cost              |       |                    |                 |               |              |               |
| Family labour              | MD    | 1,750              | 65              | 113,750       | 67           | 117,250       |
| Hired labour               | MD    | 1,750              | 20              | 35,000        | 22           | 38,500        |
| Bullock Labor              | day   | 4,000              | 15              | 60,000        | 15           | 60,000        |
| Sub-total                  |       |                    |                 | 95,000        |              | 98,500        |
| b. Input Cost              |       |                    |                 |               |              |               |
| Seed                       | kg    | 350                | 60              | 21,000        | 60           | 21,000        |
| Manure                     | Cart  | 5,000              | 1               | 5,000         | 2            | 10,000        |
| Fertilizer                 |       |                    |                 |               |              |               |
| Urea                       | kg    | 682                | 18              | 12,276        | 20           | 13,640        |
| 16-20-0                    | kg    | 801                | 18              | 14,418        | 20           | 16,020        |
| Agri-Chemicals             | kg    | 29,782             | 0               | 0             | 0            | 0             |
| Pumping water              | Riels | 2,345              | 0               | 0             | 0            | 0             |
| Sub-total                  |       |                    |                 | 52,694        |              | 60,660        |
| Miscellaneous(5% of total) |       |                    |                 | 7,773         |              | 8,377         |
| Total Costs                |       |                    |                 | 155,467       |              | 167,537       |
| 2. Gross Income            |       |                    |                 | 839,520       |              | 1,014,420     |
| a. Main Product            | kg    | 334                | 2,400           | 801,600       | 2,900        | 968,600       |
| b. By-product              | kg    | 10                 | 3,732           | 37,920        | 4,582        | 45,820        |
| 3. Net Profit              | Riels |                    |                 | 684,053       |              | 846,883       |

Cost and Return of Crops(financial)

Season:Dry Season

Crop:Maize

|                            | Unit | Unit Price (Riels) | Without Project |                | With Project |                |
|----------------------------|------|--------------------|-----------------|----------------|--------------|----------------|
|                            |      |                    | Quant-ity       | Value (Riels)  | Quant-ity    | Value (Riels)  |
| <b>1. Production Cost</b>  |      |                    |                 |                |              |                |
| <b>a. Labor Cost</b>       |      |                    |                 |                |              |                |
| Family labor               | MD   |                    | 45              | -              | 50           | -              |
| Hired labor                | MD   | 3,500              | 0               | 0              | 0            | 0              |
| Bullock Labor              | MAD  | 8,000              | 25              | 200,000        | 26           | 208,000        |
| Sub-total                  |      |                    |                 | 200,000        |              | 208,000        |
| <b>b. Input Cost</b>       |      |                    |                 |                |              |                |
| Seed                       | kg   | 700                | 30              | 21,000         | 30           | 21,000         |
| Manure                     | Cart | 5,000              | 1               | 5,000          | 3            | 15,000         |
| <b>Fertilizer</b>          |      |                    |                 |                |              |                |
| Urea                       | kg   | 800                | 45              | 36,000         | 50           | 40,000         |
| 16-20-0                    | kg   | 730                | 45              | 32,850         | 50           | 36,500         |
| Agri-Chemicals             | kg   | 31,750             | 1               | 31,750         | 1            | 31,750         |
| Pumping water              | MD   | 2,500              | 0               | 0              | 0            | 0              |
| Sub-total                  |      |                    |                 | 126,600        |              | 144,250        |
| Miscellaneous(5% of total) |      |                    |                 | 17,189         |              | 18,539         |
| <b>Total Costs</b>         |      |                    |                 | <b>343,789</b> |              | <b>370,789</b> |
| <b>2. Gross Income</b>     |      |                    |                 |                |              |                |
| a. Main Product            | kg   | 257                | 1,400           | 359,800        | 1,600        | 411,200        |
| b. By-product              | ton  | 0                  | 0               | 0              | 0            | 0              |
| <b>3. Net Profit</b>       |      |                    |                 |                |              |                |
|                            |      |                    |                 | <b>16,011</b>  |              | <b>40,411</b>  |

Cost and Return of Crops(economic)

Season:Dry Season

Crop:Maize

|                            | Unit | Unit Price (Riels) | Without Project |                | With Project |                |
|----------------------------|------|--------------------|-----------------|----------------|--------------|----------------|
|                            |      |                    | Quant-ity       | Value (Riels)  | Quant-ity    | Value (Riels)  |
| <b>1. Production Cost</b>  |      |                    |                 |                |              |                |
| <b>a. Labor Cost</b>       |      |                    |                 |                |              |                |
| Family labor               | MD   | 1,750              | 45              | 78,750         | 50           | 87,500         |
| Hired labor                | MD   | 1,750              | 0               | 0              | 0            | 0              |
| Bullock Labor              | MAD  | 4,000              | 25              | 100,000        | 26           | 104,000        |
| Sub-total                  |      |                    |                 | 178,750        |              | 191,500        |
| <b>b. Input Cost</b>       |      |                    |                 |                |              |                |
| Seed                       | kg   | 700                | 30              | 21,000         | 30           | 21,000         |
| Manure                     | Cart | 5,000              | 1               | 5,000          | 3            | 15,000         |
| <b>Fertilizer</b>          |      |                    |                 |                |              |                |
| Urea                       | kg   | 682                | 45              | 30,690         | 50           | 34,100         |
| 16-20-0                    | kg   | 801                | 45              | 36,045         | 50           | 40,050         |
| Agri-Chemicals             | kg   | 29,782             | 1               | 29,782         | 1            | 29,782         |
| Pumping water              | MD   | 2,345              | 0               | 0              | 0            | 0              |
| Sub-total                  |      |                    |                 | 122,517        |              | 139,932        |
| Miscellaneous(5% of total) |      |                    |                 | 15,856         |              | 17,444         |
| <b>Total Costs</b>         |      |                    |                 | <b>317,123</b> |              | <b>348,876</b> |
| <b>2. Gross Income</b>     |      |                    |                 |                |              |                |
| a. Main Product            | kg   | 261                | 1,400           | 365,400        | 1,600        | 417,600        |
| b. By-product              | ton  | 0                  | 0               | 0              | 0            | 0              |
| <b>3. Net Profit</b>       |      |                    |                 |                |              |                |
|                            |      |                    |                 | <b>48,277</b>  |              | <b>68,724</b>  |



Cost and Return of Crops(financial)

Season:Wet Season  
Crop:Maize

|                            | Unit  | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|-------|--------------------|-----------------|---------------|--------------|---------------|
|                            |       |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| 1. Production Cost         |       |                    |                 |               |              |               |
| a. Labor Cost              |       |                    |                 |               |              |               |
| Family labor               | MD    |                    | 45              | -             | 50           | -             |
| Hired labor                | MD    | 3,500              | 0               | 0             | 0            | 0             |
| Bullock Labor              | MAD   | 8,000              | 25              | 200,000       | 26           | 208,000       |
| Sub-total                  |       |                    |                 | 200,000       |              | 208,000       |
| b. Input Cost              |       |                    |                 |               |              |               |
| Seed                       | kg    | 700                | 30              | 21,000        | 30           | 21,000        |
| Manure                     | Cart  | 5,000              | 1               | 5,000         | 3            | 15,000        |
| Fertilizer                 |       |                    |                 |               |              |               |
| Urea                       | kg    | 800                | 50              | 40,000        | 60           | 48,000        |
| 16-20-0                    | kg    | 730                | 50              | 36,500        | 60           | 43,800        |
| Agri-Chemicals             | kg    | 31,750             | 1               | 31,750        | 1            | 31,750        |
| Pumping water              | MD    | 2,500              | 0               | 0             | 0            | 0             |
| Sub-total                  |       |                    |                 | 134,250       |              | 159,550       |
| Miscellaneous(5% of total) |       |                    |                 | 17,592        |              | 19,345        |
| Total Costs                |       |                    |                 | 351,842       |              | 386,895       |
| 2. Gross Income            |       |                    |                 | 385,500       |              | 436,900       |
| a. Main Product            | kg    | 257                | 1,500           | 385,500       | 1,700        | 436,900       |
| b. By-product              | ton   | 0                  | 0               | 0             | 0            | 0             |
| 3. Net Profit              | Riels |                    |                 | 33,658        |              | 50,005        |

Cost and Return of Crops(economic)

Season:Wet Season  
Crop:Maize

|                            | Unit  | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|-------|--------------------|-----------------|---------------|--------------|---------------|
|                            |       |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| 1. Production Cost         |       |                    |                 |               |              |               |
| a. Labor Cost              |       |                    |                 |               |              |               |
| Family labor               | MD    | 1,750              | 45              | 78,750        | 50           | 87,500        |
| Hired labor                | MD    | 1,750              | 0               | 0             | 0            | 0             |
| Bullock Labor              | MAD   | 4,000              | 25              | 100,000       | 26           | 104,000       |
| Sub-total                  |       |                    |                 | 178,750       |              | 191,500       |
| b. Input Cost              |       |                    |                 |               |              |               |
| Seed                       | kg    | 700                | 30              | 21,000        | 30           | 21,000        |
| Manure                     | Cart  | 5,000              | 1               | 5,000         | 3            | 15,000        |
| Fertilizer                 |       |                    |                 |               |              |               |
| Urea                       | kg    | 682                | 50              | 34,100        | 60           | 40,920        |
| 16-20-0                    | kg    | 801                | 50              | 40,050        | 60           | 48,060        |
| Agri-Chemicals             | kg    | 29,782             | 1               | 29,782        | 1            | 29,782        |
| Pumping water              | MD    | 2,345              | 0               | 0             | 0            | 0             |
| Sub-total                  |       |                    |                 | 129,932       |              | 154,762       |
| Miscellaneous(5% of total) |       |                    |                 | 16,246        |              | 18,224        |
| Total Costs                |       |                    |                 | 324,928       |              | 364,486       |
| 2. Gross Income            |       |                    |                 | 391,500       |              | 443,700       |
| a. Main Product            | kg    | 261                | 1,500           | 391,500       | 1,700        | 443,700       |
| b. By-product              | ton   | 0                  | 0               | 0             | 0            | 0             |
| 3. Net Profit              | Riels |                    |                 | 66,572        |              | 79,214        |

Cost and Return of Crops(financial)

Season:Dry Season  
Crop:Mungbean

|                            | Unit | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|------|--------------------|-----------------|---------------|--------------|---------------|
|                            |      |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| <b>1. Production Cost</b>  |      |                    |                 |               |              |               |
| <b>a. Labor Cost</b>       |      |                    |                 |               |              |               |
| Family labor               | MD   |                    | 50              | 0             | 60           | 0             |
| Hired labor                | MD   | 3500               | 0               | 0             | 0            | 0             |
| Bullock Labor              | MAD  | 8,000              | 15              | 120,000       | 20           | 160,000       |
| Sub-total                  |      |                    |                 | 120,000       |              | 160,000       |
| <b>b. Input Cost</b>       |      |                    |                 |               |              |               |
| Seed                       | kg   | 2,500              | 40              | 100,000       | 40           | 100,000       |
| Manure                     | Cart | 5,000              | 1               | 5,000         | 2            | 10,000        |
| <b>Fertilizer</b>          |      |                    |                 |               |              |               |
| Urea                       | kg   | 800                | 0               | 0             | 0            | 0             |
| 16-20-0                    | kg   | 730                | 100             | 73,000        | 120          | 87,600        |
| Agri-Chemicals             | kg   | 12,500             | 2               | 25,000        | 2            | 25,000        |
| Pumping water              | MD   | 2,500              | 2               | 5,000         | 2            | 5,000         |
| Sub-total                  |      |                    |                 | 208,000       |              | 227,600       |
| Miscellaneous(5% of total) |      |                    |                 | 17,263        |              | 20,400        |
| Total Costs                |      |                    |                 | 345,263       |              | 408,000       |
| <b>2. Gross Income</b>     |      |                    |                 |               |              |               |
| a. Main Product            | kg   | 1,700              | 900             | 1,530,000     | 1,100        | 1,870,000     |
| b. By-product              | kg   | 5                  | 2,000           | 10,000        | 3,000        | 15,000        |
| <b>3. Net Profit</b>       |      |                    |                 |               |              |               |
|                            |      |                    |                 | 1,194,737     |              | 1,477,000     |

Cost and Return of Crops(economic)

Season:Dry Season  
Crop:Mungbean

|                            | Unit | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|------|--------------------|-----------------|---------------|--------------|---------------|
|                            |      |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| <b>1. Production Cost</b>  |      |                    |                 |               |              |               |
| <b>a. Labor Cost</b>       |      |                    |                 |               |              |               |
| Family labor               | MD   | 1,750              | 50              | 87,500        | 60           | 105,000       |
| Hired labor                | MD   | 1,750              | 0               | 0             | 0            | 0             |
| Bullock Labor              | MAD  | 4,000              | 15              | 60,000        | 20           | 80,000        |
| Sub-total                  |      |                    |                 | 147,500       |              | 185,000       |
| <b>b. Input Cost</b>       |      |                    |                 |               |              |               |
| Seed                       | kg   | 2,500              | 40              | 100,000       | 40           | 100,000       |
| Manure                     | Cart | 5,000              | 1               | 5,000         | 2            | 10,000        |
| <b>Fertilizer</b>          |      |                    |                 |               |              |               |
| Urea                       | kg   | 682                | 0               | 0             | 0            | 0             |
| 16-20-0                    | kg   | 801                | 100             | 80,100        | 120          | 96,120        |
| Agri-Chemicals             | kg   | 11,725             | 2               | 23,450        | 2            | 23,450        |
| Pumping water              | MD   | 2,345              | 2               | 4,690         | 2            | 4,690         |
| Sub-total                  |      |                    |                 | 213,240       |              | 234,260       |
| Miscellaneous(5% of total) |      |                    |                 | 18,986        |              | 22,066        |
| Total Costs                |      |                    |                 | 379,726       |              | 441,326       |
| <b>2. Gross Income</b>     |      |                    |                 |               |              |               |
| a. Main Product            | kg   | 1,700              | 900             | 1,530,000     | 1,100        | 1,870,000     |
| b. By-product              | kg   | 5                  | 2,000           | 10,000        | 3,000        | 15,000        |
| <b>3. Net Profit</b>       |      |                    |                 |               |              |               |
|                            |      |                    |                 | 1,160,274     |              | 1,443,674     |

Cost and Return of Crops(financial)

Season:Dry Season  
Crop:Leafy Vegetables(Kale)

|                            | Unit | Unit Price (Riels) | Without Project |                  | With Project |                  |
|----------------------------|------|--------------------|-----------------|------------------|--------------|------------------|
|                            |      |                    | Quant-ity       | Value (Riels)    | Quant-ity    | Value (Riels)    |
| <b>1. Production Cost</b>  |      |                    |                 |                  |              |                  |
| <b>a. Labor Cost</b>       |      |                    |                 |                  |              |                  |
| Family labor               | MD   |                    | 90              | 0                | 110          | 0                |
| Hired labor                | MD   | 3,500              | 90              | 315,000          | 90           | 315,000          |
| Bullock Labor              | MAD  | 8,000              | 20              | 160,000          | 25           | 200,000          |
| Sub-total                  |      |                    |                 | 475,000          |              | 515,000          |
| <b>b. Input Cost</b>       |      |                    |                 |                  |              |                  |
| Seed                       | kg   | 20,000             | 0.5             | 10,000           | 0.5          | 10,000           |
| Manure                     | Cart | 5,000              | 1               | 5,000            | 3            | 15,000           |
| <b>Fertilizer</b>          |      |                    |                 |                  |              |                  |
| Urea                       | kg   | 800                | 100             | 80,000           | 100          | 80,000           |
| 15-15-15                   | kg   | 730                | 400             | 292,000          | 480          | 350,400          |
| Agri-Chemicals             | kg   | 31,750             | 2               | 63,500           | 3            | 95,250           |
| Pumping water              | MD   | 2,500              | 3               | 7,500            | 4            | 10,000           |
| Sub-total                  |      |                    |                 | 458,000          |              | 560,650          |
| Miscellaneous(5% of total) |      |                    |                 | 49,105           |              | 56,613           |
| <b>Total Costs</b>         |      |                    |                 | <b>982,105</b>   |              | <b>1,132,263</b> |
| <b>2. Gross Income</b>     |      |                    |                 |                  |              |                  |
| a. Main Product            | kg   | 1,000              | 4,700           | 4,700,000        | 5,500        | 5,500,000        |
| b. By-product              | ton  | 0                  | 0               | 0                | 0            | 0                |
| <b>3. Net Profit</b>       |      |                    |                 | <b>3,717,895</b> |              | <b>4,367,737</b> |

Cost and Return of Crops(economic)

Season:Dry Season  
Crop:Leafy Vegetables(Kale)

|                            | Unit | Unit Price (Riels) | Without Project |                  | With Project |                  |
|----------------------------|------|--------------------|-----------------|------------------|--------------|------------------|
|                            |      |                    | Quant-ity       | Value (Riels)    | Quant-ity    | Value (Riels)    |
| <b>1. Production Cost</b>  |      |                    |                 |                  |              |                  |
| <b>a. Labor Cost</b>       |      |                    |                 |                  |              |                  |
| Family labor               | MD   | 1,750              | 90              | 157,500          | 110          | 192,500          |
| Hired labor                | MD   | 1,750              | 90              | 157,500          | 90           | 157,500          |
| Bullock Labor              | MAD  | 4,000              | 20              | 80,000           | 25           | 100,000          |
| Sub-total                  |      |                    |                 | 395,000          |              | 450,000          |
| <b>b. Input Cost</b>       |      |                    |                 |                  |              |                  |
| Seed                       | kg   | 18,760             | 0.5             | 9,380            | 0.5          | 9,380            |
| Manure                     | Cart | 5,000              | 1               | 5,000            | 3            | 15,000           |
| <b>Fertilizer</b>          |      |                    |                 |                  |              |                  |
| Urea                       | kg   | 682                | 100             | 68,200           | 100          | 68,200           |
| 15-15-15                   | kg   | 801                | 400             | 320,400          | 480          | 384,480          |
| Agri-Chemicals             | kg   | 11,725             | 2               | 23,450           | 3            | 35,175           |
| Pumping water              | MD   | 2,345              | 3               | 7,035            | 4            | 9,380            |
| Sub-total                  |      |                    |                 | 433,465          |              | 521,615          |
| Miscellaneous(5% of total) |      |                    |                 | 43,603           |              | 51,138           |
| <b>Total Costs</b>         |      |                    |                 | <b>872,068</b>   |              | <b>1,022,753</b> |
| <b>2. Gross Income</b>     |      |                    |                 |                  |              |                  |
| a. Main Product            | kg   | 1,000              | 4,700           | 4,700,000        | 5,500        | 5,500,000        |
| b. By-product              | ton  | 0                  | 0               | 0                | 0            | 0                |
| <b>3. Net Profit</b>       |      |                    |                 | <b>3,827,932</b> |              | <b>4,477,247</b> |

Cost and Return of Crops(financial)

Season:Wet Season

Crop:Leafy Vegetables(Kale)

|                            | Unit  | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|-------|--------------------|-----------------|---------------|--------------|---------------|
|                            |       |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| 1. Production Cost         |       |                    |                 |               |              |               |
| a. Labor Cost              |       |                    |                 |               |              |               |
| Family labor               | MD    |                    | 90              | 0             | 90           | 0             |
| Hired labor                | MD    | 3,500              | 90              | 315,000       | 90           | 315,000       |
| Bullock Labor              | MAD   | 8,000              | 20              | 160,000       | 20           | 160,000       |
| Sub-total                  |       |                    |                 | 475,000       |              | 475,000       |
| b. Input Cost              |       |                    |                 |               |              |               |
| Seed                       | kg    | 20,000             | 0.5             | 10,000        | 0.5          | 10,000        |
| Manure                     | Cart  | 5,000              | 1               | 5,000         | 3            | 15,000        |
| Fertilizer                 |       |                    |                 |               |              |               |
| Urea                       | kg    | 800                | 100             | 80,000        | 100          | 80,000        |
| 15-15-15                   | kg    | 730                | 400             | 292,000       | 400          | 292,000       |
| Agri-Chemicals             | kg    | 31,750             | 2               | 63,500        | 2            | 63,500        |
| Pumping water              | MD    | 2,500              | 3               | 7,500         | 4            | 10,000        |
| Sub-total                  |       |                    |                 | 458,000       |              | 470,500       |
| Miscellaneous(5% of total) |       |                    |                 | 49,105        |              | 49,763        |
| Total Costs                |       |                    |                 | 982,105       |              | 995,263       |
| 2. Gross Income            |       |                    |                 | 4,900,000     |              | 5,400,000     |
| a. Main Product            | kg    | 1,000              | 4,900           | 4,900,000     | 5,400        | 5,400,000     |
| b. By-product              | ton   | 0                  | 0               | 0             | 0            | 0             |
| 3. Net Profit              | Riels |                    |                 | 3,917,895     |              | 4,404,737     |

Cost and Return of Crops(economic)

Season:Wet Season

Crop:Leafy Vegetables(Kale)

|                            | Unit  | Unit Price (Riels) | Without Project |               | With Project |               |
|----------------------------|-------|--------------------|-----------------|---------------|--------------|---------------|
|                            |       |                    | Quant-ity       | Value (Riels) | Quant-ity    | Value (Riels) |
| 1. Production Cost         |       |                    |                 |               |              |               |
| a. Labor Cost              |       |                    |                 |               |              |               |
| Family labor               | MD    | 1,750              | 90              | 157,500       | 90           | 157,500       |
| Hired labor                | MD    | 1,750              | 90              | 157,500       | 90           | 157,500       |
| Bullock Labor              | MAD   | 4,000              | 20              | 80,000        | 20           | 80,000        |
| Sub-total                  |       |                    |                 | 395,000       |              | 395,000       |
| b. Input Cost              |       |                    |                 |               |              |               |
| Seed                       | kg    | 18,760             | 0.5             | 9,380         | 0.5          | 9,380         |
| Manure                     | Cart  | 5,000              | 1               | 5,000         | 3            | 15,000        |
| Fertilizer                 |       |                    |                 |               |              |               |
| Urea                       | kg    | 682                | 100             | 68,200        | 100          | 68,200        |
| 15-15-15                   | kg    | 801                | 400             | 320,400       | 400          | 320,400       |
| Agri-Chemicals             | kg    | 11,725             | 2               | 23,450        | 2            | 23,450        |
| Pumping water              | MD    | 2,345              | 3               | 7,035         | 4            | 9,380         |
| Sub-total                  |       |                    |                 | 433,465       |              | 445,810       |
| Miscellaneous(5% of total) |       |                    |                 | 43,603        |              | 44,253        |
| Total Costs                |       |                    |                 | 872,068       |              | 885,063       |
| 2. Gross Income            |       |                    |                 | 4,900,000     |              | 5,400,000     |
| a. Main Product            | kg    | 1,000              | 4,900           | 4,900,000     | 5,400        | 5,400,000     |
| b. By-product              | ton   | 0                  | 0               | 0             | 0            | 0             |
| 3. Net Profit              | Riels |                    |                 | 4,027,932     |              | 4,514,937     |

Cost and Return of Unimproved Land

|                             | Unit Price (R/ha) | W. about project |              |            | W. in project |            |              |
|-----------------------------|-------------------|------------------|--------------|------------|---------------|------------|--------------|
|                             |                   | 1st year         | 2nd year     | 3rd year   | 1st year      | 2nd year   | 3rd year     |
|                             |                   | Quant- ity       | Value (R/ha) | Quant- ity | Value (R/ha)  | Quant- ity | Value (R/ha) |
| <b>1. Production Cost</b>   |                   |                  |              |            |               |            |              |
| a. Labor Cost               |                   |                  |              |            |               |            |              |
| Family labour               | 3,500             | 50               | 175,000      | 50         | 175,000       | 50         | 175,000      |
| Hired labour                | 3,500             | 40               | 140,000      | 40         | 140,000       | 40         | 140,000      |
| Bull/ox labour              | 3,000             | 6                | 18,000       | 6          | 18,000        | 6          | 18,000       |
| Sub-total                   |                   |                  | 333,000      |            | 333,000       |            | 333,000      |
| b. Inputs                   |                   |                  |              |            |               |            |              |
| Nursery                     | 450               | 1,500            | 675,000      | 1,500      | 675,000       | 1,500      | 675,000      |
| Fertilizer (15-15-15)       | 870               | 0                | 0            | 0          | 0             | 0          | 0            |
| Manure                      | 5,000             | 5                | 25,000       | 5          | 25,000        | 5          | 25,000       |
| Insecticides                | 12,500            | 0                | 0            | 0          | 0             | 0          | 0            |
| Fumigant                    | 2,500             | 0                | 0            | 0          | 0             | 0          | 0            |
| Sub-total                   |                   |                  | 700,000      |            | 700,000       |            | 700,000      |
| Miscellaneous (5% of total) |                   |                  | 42,000       |            | 42,000        |            | 42,000       |
| Total Cost                  |                   |                  | 840,000      |            | 840,000       |            | 840,000      |
| <b>2. Gross Income</b>      |                   |                  |              |            |               |            |              |
| Main Product                | 300               | 6,000            | 1,800,000    | 6,000      | 1,800,000     | 6,000      | 1,800,000    |
| Sub-product                 |                   |                  | 250,000      |            | 250,000       |            | 250,000      |
| Total                       |                   |                  | 2,050,000    |            | 2,050,000     |            | 2,050,000    |
| <b>3. Net Profit</b>        |                   |                  |              |            |               |            |              |
|                             |                   |                  | 1,210,000    |            | 1,210,000     |            | 1,210,000    |
| Average                     |                   |                  | 1,996,857    |            | 1,996,857     |            | 1,996,857    |

Average: 2,107,648

Cost and Return of Cross (economic)

|                             | Unit Price (R/ha) | W. about project |              |            | W. in project |            |              |
|-----------------------------|-------------------|------------------|--------------|------------|---------------|------------|--------------|
|                             |                   | 1st year         | 2nd year     | 3rd year   | 1st year      | 2nd year   | 3rd year     |
|                             |                   | Quant- ity       | Value (R/ha) | Quant- ity | Value (R/ha)  | Quant- ity | Value (R/ha) |
| <b>1. Production Cost</b>   |                   |                  |              |            |               |            |              |
| a. Labor Cost               |                   |                  |              |            |               |            |              |
| Family labour               | 3,500             | 50               | 175,000      | 50         | 175,000       | 50         | 175,000      |
| Hired labour                | 3,500             | 40               | 140,000      | 40         | 140,000       | 40         | 140,000      |
| Bull/ox labour              | 3,000             | 6                | 18,000       | 6          | 18,000        | 6          | 18,000       |
| Sub-total                   |                   |                  | 333,000      |            | 333,000       |            | 333,000      |
| b. Inputs                   |                   |                  |              |            |               |            |              |
| Nursery                     | 450               | 1,500            | 675,000      | 1,500      | 675,000       | 1,500      | 675,000      |
| Fertilizer (15-15-15)       | 870               | 0                | 0            | 0          | 0             | 0          | 0            |
| Manure                      | 5,000             | 5                | 25,000       | 5          | 25,000        | 5          | 25,000       |
| Insecticides                | 11,725            | 0                | 0            | 0          | 0             | 0          | 0            |
| Fumigant                    | 2,245             | 0                | 0            | 0          | 0             | 0          | 0            |
| Sub-total                   |                   |                  | 700,000      |            | 700,000       |            | 700,000      |
| Miscellaneous (5% of total) |                   |                  | 41,650       |            | 41,650        |            | 41,650       |
| Total Cost                  |                   |                  | 832,150      |            | 832,150       |            | 832,150      |
| <b>2. Gross Income</b>      |                   |                  |              |            |               |            |              |
| Main Product                | 250               | 6,000            | 1,500,000    | 6,000      | 1,500,000     | 6,000      | 1,500,000    |
| Sub-product                 |                   |                  | 196,847      |            | 196,847       |            | 196,847      |
| Total                       |                   |                  | 1,696,847    |            | 1,696,847     |            | 1,696,847    |
| <b>3. Net Profit</b>        |                   |                  |              |            |               |            |              |
|                             |                   |                  | 864,697      |            | 864,697       |            | 864,697      |
| Average                     |                   |                  | 1,907,544    |            | 1,907,544     |            | 1,907,544    |

Average: 2,095,175

**Table J.7.7 Calculation of Incremental Agricultural Benefits**

-Colmatage-

|                                    | Wet Season |         |            | Dry Season |         |           | Orchard (Banana) | Total     |
|------------------------------------|------------|---------|------------|------------|---------|-----------|------------------|-----------|
|                                    | Paddy      | Maize   | Vegetables | Paddy      | Maize   | Beans     |                  |           |
| Without Project Yield(kg/ha)       | 2,400      | 1,500   | 4,900      | 3,300      | 1,400   | 900       | 4,700            | 6,200     |
| Unit Price(Riels/kg)               | 334        | 261     | 1,000      | 334        | 261     | 1,700     | 1,000            | 350       |
| Gross Production Value(Riels/ha)   | 339,520    | 391,500 | 4,900,000  | 1,154,340  | 365,400 | 1,530,000 | 4,700,000        |           |
| Cost of Production(Riels/ha)       | 155,467    | 324,928 | 872,068    | 233,905    | 317,123 | 379,726   | 872,068          |           |
| Net Production Value(Riels/ha)     | 684,053    | 66,572  | 4,027,932  | 920,435    | 48,277  | 1,150,274 | 3,827,932        | 1,807,544 |
| Planting Area(ha)                  | 5,341      | 5,221   | 921        | 11,484     | 427     | 2,350     | 1,496            | 1,335     |
| Total NPV(Million Riels)           | 3,654      | 348     | 3,710      | 10,570     | 21      | 2,727     | 5,727            | 28,168    |
| With Project Yield(kg/ha)          | 2,900      | 1,700   | 5,400      | 4,200      | 1,600   | 1,100     | 5,500            | 7,800     |
| Unit Price(Riels/kg)               | 334        | 261     | 1,000      | 334        | 261     | 1,700     | 1,000            | 350       |
| Gross Production Value(Riels/ha)   | 1,014,420  | 443,700 | 5,400,000  | 1,469,160  | 417,600 | 1,885,000 | 5,500,000        |           |
| Cost of Production(Riels/ha)       | 167,537    | 364,456 | 885,063    | 309,061    | 348,876 | 441,928   | 1,022,753        |           |
| Net Production Value(Riels/ha)     | 846,883    | 79,214  | 4,514,937  | 1,163,079  | 68,724  | 1,443,674 | 4,477,247        | 2,085,175 |
| Planting Area(ha)                  | 5,341      | 5,221   | 921        | 11,484     | 614     | 3,379     | 2,150            | 1,335     |
| Total NPV(Million Riels)           | 4,523      | 414     | 4,158      | 13,357     | 42      | 4,878     | 9,626            | 39,782    |
| Incremental Benefit(Million Riels) | 870        | 66      | 449        | 2,787      | 22      | 2,152     | 3,899            | 10,614    |

Note: NPV per hectare includes income from by-products  
Yield of banana is in number of hands.

**Table J.7.8 Calculation of Internal Rate of Return**

(Coinbase)

(Unit: million Reels)

| Year  | Capital Cost | O & M Cost | Total   | Benefit | Return  | Present Worth Value by Discount Rate |         |             |         |             |         |
|-------|--------------|------------|---------|---------|---------|--------------------------------------|---------|-------------|---------|-------------|---------|
|       |              |            |         |         |         | Int. = 0.08                          |         | Int. = 0.10 |         | Int. = 0.12 |         |
|       |              |            |         |         |         | Cost                                 | Benefit | Cost        | Benefit | Cost        | Benefit |
| 1     | 18,697       | 60         | 18,757  | 2,120   | -16,637 | 18,757                               | 2,120   | 18,757      | 2,120   | 18,757      | 2,120   |
| 2     | 18,697       | 120        | 18,817  | 4,250   | -14,567 | 16,133                               | 3,644   | 15,551      | 3,512   | 15,001      | 3,388   |
| 3     | 18,698       | 170        | 18,868  | 6,375   | -12,493 | 14,978                               | 5,057   | 14,176      | 4,786   | 13,430      | 4,524   |
| 4     | 18,698       | 220        | 18,918  | 8,490   | -10,428 | 13,895                               | 6,240   | 12,921      | 5,739   | 12,023      | 5,396   |
| 5     | 18,698       | 280        | 18,978  | 10,614  | -8,364  | 12,916                               | 7,224   | 11,784      | 6,580   | 10,769      | 6,023   |
| 6     | 0            | 280        | 280     | 10,614  | 10,334  | 176                                  | 6,689   | 156         | 5,991   | 142         | 5,377   |
| 7     | 0            | 280        | 280     | 10,614  | 10,334  | 163                                  | 6,193   | 144         | 5,447   | 127         | 4,801   |
| 8     | 0            | 280        | 280     | 10,614  | 10,334  | 151                                  | 5,734   | 131         | 4,952   | 113         | 4,287   |
| 9     | 0            | 280        | 280     | 10,614  | 10,334  | 140                                  | 5,310   | 119         | 4,501   | 101         | 3,826   |
| 10    | 0            | 280        | 280     | 10,614  | 10,334  | 130                                  | 4,916   | 108         | 4,092   | 90          | 3,417   |
| 11    | 0            | 280        | 280     | 10,614  | 10,334  | 120                                  | 4,552   | 98          | 3,720   | 80          | 3,051   |
| 12    | 0            | 280        | 280     | 10,614  | 10,334  | 111                                  | 4,215   | 89          | 3,382   | 72          | 2,724   |
| 13    | 0            | 280        | 280     | 10,614  | 10,334  | 103                                  | 3,903   | 81          | 3,074   | 64          | 2,432   |
| 14    | 0            | 280        | 280     | 10,614  | 10,334  | 95                                   | 3,614   | 74          | 2,795   | 57          | 2,172   |
| 15    | 0            | 280        | 280     | 10,614  | 10,334  | 88                                   | 3,348   | 67          | 2,541   | 51          | 1,938   |
| 16    | 0            | 280        | 280     | 10,614  | 10,334  | 82                                   | 3,098   | 61          | 2,310   | 45          | 1,731   |
| 17    | 0            | 280        | 280     | 10,614  | 10,334  | 76                                   | 2,869   | 55          | 2,100   | 41          | 1,545   |
| 18    | 0            | 280        | 280     | 10,614  | 10,334  | 70                                   | 2,656   | 50          | 1,908   | 36          | 1,380   |
| 19    | 0            | 280        | 280     | 10,614  | 10,334  | 65                                   | 2,459   | 46          | 1,735   | 33          | 1,232   |
| 20    | 0            | 280        | 280     | 10,614  | 10,334  | 60                                   | 2,277   | 42          | 1,578   | 28          | 1,100   |
| 21    | 0            | 280        | 280     | 10,614  | 10,334  | 56                                   | 2,109   | 38          | 1,434   | 26          | 982     |
| 22    | 0            | 280        | 280     | 10,614  | 10,334  | 52                                   | 1,952   | 34          | 1,304   | 23          | 877     |
| 23    | 0            | 280        | 280     | 10,614  | 10,334  | 48                                   | 1,806   | 31          | 1,185   | 21          | 783     |
| 24    | 0            | 280        | 280     | 10,614  | 10,334  | 44                                   | 1,674   | 28          | 1,078   | 18          | 699     |
| 25    | 0            | 280        | 280     | 10,614  | 10,334  | 41                                   | 1,550   | 26          | 980     | 16          | 624     |
| 26    | 0            | 280        | 280     | 10,614  | 10,334  | 38                                   | 1,435   | 23          | 891     | 15          | 557     |
| 27    | 0            | 280        | 280     | 10,614  | 10,334  | 35                                   | 1,329   | 21          | 810     | 13          | 498     |
| 28    | 0            | 280        | 280     | 10,614  | 10,334  | 32                                   | 1,230   | 19          | 736     | 12          | 444     |
| 29    | 0            | 280        | 280     | 10,614  | 10,334  | 30                                   | 1,139   | 18          | 669     | 10          | 397     |
| 30    | 11,060       | 280        | 11,360  | 10,614  | -746    | 1,129                                | 1,055   | 651         | 608     | 379         | 354     |
| 31    | 0            | 280        | 280     | 10,614  | 10,334  | 26                                   | 977     | 15          | 553     | 8           | 316     |
| 32    | 0            | 280        | 280     | 10,614  | 10,334  | 24                                   | 904     | 13          | 503     | 7           | 282     |
| 33    | 0            | 280        | 280     | 10,614  | 10,334  | 22                                   | 837     | 12          | 457     | 7           | 252     |
| 34    | 0            | 280        | 280     | 10,614  | 10,334  | 20                                   | 775     | 11          | 415     | 6           | 225     |
| 35    | 0            | 280        | 280     | 10,614  | 10,334  | 18                                   | 718     | 10          | 378     | 5           | 201     |
| 36    | 0            | 280        | 280     | 10,614  | 10,334  | 16                                   | 665     | 9           | 343     | 5           | 178     |
| 37    | 0            | 280        | 280     | 10,614  | 10,334  | 16                                   | 615     | 8           | 312     | 4           | 156     |
| 38    | 0            | 280        | 280     | 10,614  | 10,334  | 15                                   | 570     | 7           | 284     | 4           | 143     |
| 39    | 0            | 280        | 280     | 10,614  | 10,334  | 14                                   | 528     | 7           | 258     | 3           | 128     |
| 40    | 0            | 280        | 280     | 10,614  | 10,334  | 13                                   | 489     | 6           | 235     | 3           | 114     |
| 41    | 0            | 280        | 280     | 10,614  | 10,334  | 12                                   | 452     | 6           | 213     | 3           | 102     |
| 42    | 0            | 280        | 280     | 10,614  | 10,334  | 11                                   | 419     | 5           | 194     | 2           | 91      |
| 43    | 0            | 280        | 280     | 10,614  | 10,334  | 10                                   | 388     | 5           | 176     | 2           | 81      |
| 44    | 0            | 280        | 280     | 10,614  | 10,334  | 9                                    | 359     | 4           | 160     | 2           | 72      |
| 45    | 0            | 280        | 280     | 10,614  | 10,334  | 9                                    | 333     | 4           | 145     | 2           | 65      |
| 46    | 0            | 280        | 280     | 10,614  | 10,334  | 8                                    | 308     | 3           | 132     | 2           | 58      |
| 47    | 0            | 280        | 280     | 10,614  | 10,334  | 8                                    | 285     | 3           | 120     | 1           | 52      |
| 48    | 0            | 280        | 280     | 10,614  | 10,334  | 7                                    | 264     | 3           | 109     | 1           | 46      |
| 49    | 0            | 280        | 280     | 10,614  | 10,334  | 6                                    | 244     | 3           | 99      | 1           | 41      |
| 50    | 0            | 280        | 280     | 10,614  | 10,334  | 6                                    | 226     | 2           | 90      | 1           | 37      |
| Total | 124,568      | 13,450     | 118,018 | 509,474 | 331,456 | 80,097                               | 111,752 | 75,536      | 87,806  | 71,665      | 71,343  |

EIRR = 12.3%

|           |     |      |
|-----------|-----|------|
| B/C Ratio | 8%  | 1.40 |
| B/C Ratio | 10% | 1.16 |
| B/C Ratio | 12% | 1.00 |

**Table J.7.9 Financial Analysis**

Colmatase Area(Kandal Province)

Farm Size:0.60 ha

Farm Model-Without Project

1. Crop Production

|                         | Area (ha)   | Yield (kg/ha) | Production (kg) | Unit Price (Riels/kg) | Value (Riels) | Production Cost (Riels) | Net Income (Riels) |
|-------------------------|-------------|---------------|-----------------|-----------------------|---------------|-------------------------|--------------------|
| Dry season paddy irriga | 0.57        | 3,300         | 1,881           | 316                   | 594,396       | 197,820                 | 396,576            |
| Maize                   | 0.27        | 1,400         | 378             | 257                   | 97,146        | 94,997                  | 2,149              |
| Vegetables              | 0.30        | 4,900         | 1,470           | 1,000                 | 1,470,000     | 294,632                 | 1,175,369          |
| <b>Total</b>            | <b>1.14</b> |               |                 |                       |               |                         | <b>1,574,093</b>   |

- 2. Fishery Income(Riels/year) 163,000
- 3. Off-farm Income(Riels/year) 375,000
- 4. Total Income(Riels) 2,112,093
- 5. Living Expense(Riels/year)-Family size 5.4 person/family 722,000
- 6. Disposable Income(Riels/year) 1,390,093

Farm Model-With Project

1. Crop Production

|                         | Area (ha)   | Yield (kg/ha) | Production (kg) | Unit Price (Riels/kg) | Value (Riels) | Production Cost (Riels) | Net Income (Riels) |
|-------------------------|-------------|---------------|-----------------|-----------------------|---------------|-------------------------|--------------------|
| Dry season paddy irriga | 0.57        | 4,200         | 2,394           | 316                   | 756,504       | 259,300                 | 496,704            |
| Maize                   | 0.27        | 1,700         | 459             | 257                   | 117,963       | 104,462                 | 13,501             |
| Vegetables              | 0.40        | 5,400         | 2,160           | 1,000                 | 2,160,000     | 398,105                 | 1,761,895          |
| <b>Total</b>            | <b>1.24</b> |               |                 |                       |               |                         | <b>2,272,100</b>   |

- 2. Fishery Income(Riels/year) 265,527
- 3. Off-farm Income(Riels/year) 610,875
- 4. Total Income(Riels) 3,148,502
- 5. Living Expense(Riels/year)-Family size 5.4 person/family 1,176,138
- 6. Disposable Income(Riels/year) 1,972,364



### J.7.2 Environmental Impact

The Bassac Marshes Area, in which a part of the area is proposed as a conservation area, has been maintained by periodic annual flood, coming through colmatage canals along the Mekong and Bassac both rivers. There are nine fishing lots in the area, and surrounding area is used mainly for production of rice, maize, vegetable and so on. The colmatage canals play important role on agricultural and fishing production, and ecosystem preservation, with carrying silt bearing water on agricultural lands and in swamps in the area. The activities of agriculture and fishery and the ecosystem in the area are controlled by the flood cycle under the hydrological regime of the Mekong river. The present situation scarcely changes in the area, unless the Mekong river system is drastically varied in future.

The rehabilitation project on the colmatage canals aims to recover the canal functions lost in flow. After the canals blocked and/or silted with soil are improved with the project, the canals will be able to convey water smoothly in the flooding season, and reserve water in the dry season. At the same time, the improved water gates will be able to control water flow for agricultural use, and to promote agricultural production activities. Since the project has no planning of large scale expansion and new construction of canals, the systems on the flooding water and the ecological situation in the area are reserved as present.

The framing system in the area is practiced traditionally based on the annual sedimentation, in which agricultural inputs are minimised because the silt bearing water in rich is provided as natural fertiliser and the soil fertility is maintained naturally. After the project, the canals carry a lot of water in rich sediment and organism, and deposit these on farmlands. If the farming systems like using chemical fertilisers more than at present are exploited, and some water bodies are polluted, it might cause slight impact on the ecosystem in a part of swamps in future. However, the influence is scarce at present due to enormous water flash in the flood season.

In the area, the original ecosystem has been almost alternated with the exploitation for agricultural land into the middle area so far. The forests and shrubs standing around water bodies are still a part of fuel resources for villagers. The substantial situation on the forest degradation is unclear because of no detail information to compare with the present condition. Since the project has no planning of the extension of farmlands, the present forest and shrub are reserved around water bodies, due to no spaces to develop as farmlands, unless over cutting for firewood are practiced by residents in the area. Then the ecosystem will be maintained the same as present.

For conservation of the ecosystem and natural resources around water bodies and swamps without the influence of agricultural and fishery activities, the land use concept on forest, agriculture and fishery should be built up, and moreover, the zoning for natural resources reservation should be delineated politically and technically as soon. Furthermore, it is important that the environmental change should be monitored, based on some field study to understand the present situation on plants, birds and fish for future.

The field survey was practiced on the experience of pesticide using among 200 farmers who were picked up with random sampling each 100 farmers in Saang district along the left of Bassac river and Kean Svay district along the right of the Mekong river. The results are shown in Table J.7.1 and J.7.2. Farmers are counted 92 percentage in using pesticide. The information of pesticide use has been exchanged with farmers each other and in markets in their communes. Among of them, farmers injured once are shown in 34 percentage. Most of the farmers want to know the proper application method. Eolidol, DDT and Azodrin are the best three in using pesticide. Since those are hazardous highly, those should be controlled under the proper guideline.

In the area, the flooded forests are still main fuel resources for villagers. The table J.7.3 is shown some species of trees for firewood. Most of the species are grown around water bodies in popular. Reang, in Khmer on *Barringtonia micrantha*, are used by 47 percentage of families for firewood. This tree grows easily and rapidly anywhere in throughout the year. It is noticed that *Mimosa pigra*, one of hazardous plants for farmland with its rapid growth, has been used. This are has been exploited for farmland except the central area where is shared by a lot of water bodies with forests. At least, those forests should be preserved for the fishing ground and the ecosystem, under regional maintenance groups.

The lists of plants, birds and fish identified at the study, are shown Table J.7.4, J.7.5 and J.7.6. The plants are included grass, tree and water plants. Birds are counted 31 species. Among of them, eight species are found easily, and 15 birds are difficult to find recently. No finding birds are counted eight. This lists are not counted all species in the study area. Consequently, the inventory survey are required to monitor for future. Fish is counted 35 species in the area. It is said that some large sized fish are difficult to find, and these are threatened with over catching recently.

The natural environment gets no impact from the rehabilitation project of the colmatage canal, because the project gives no impact to the Mekong river flood regime. Since the area is close located the central area, the social and economic impacts will be carried from the rapid economic growth in central area in future, more than the project.

Table J.7.1 The experience on pesticides and insecticides use among 200 farmers in Saang and Kean Svay Districts in June, 1997.

1. Have you used pesticides and insecticides ? yes=184(92.0%), no= 16(8.0%)

2. Question to "yes"

|   | from   | Friend,                 | Merchant<br>or Market, | Extension<br>worker,        | no answer,             | Total |
|---|--|-------------------------|------------------------|-----------------------------|------------------------|-------|
| (1) How did you know it ?                           | 93<br>(50.5%)  | 79<br>(42.9%)           | 11<br>( 6.0%)          | 1<br>(0.6%)                 | 184<br>(100%)          |       |
| (2) Where have you got it ?                         | 9<br>( 4.9%)   | 175<br>(95.1%)          | 0<br>( 0 %)            | 0<br>( 0 %)                 | 184<br>(100%)          |       |
| (3) Who did you teach<br>how to apply ?             | 87<br>(47.3%)  | 65<br>(35.3%)           | 10<br>( 5.4%)          | 22<br>(12.0%)               | 184<br>(100%)          |       |
| (4) How long have you used it ?                     | ~1984<br>79<br>(42.9%)   | ~1989<br>61<br>(33.2%)  | ~1994<br>37<br>(20.1%) | ~1997<br>7<br>( 3.8%)       | Total<br>184<br>(100%) |       |
| (5) If it is not effective,<br>how do you doing ?   | add,<br>101<br>(54.9%)   | change,<br>5<br>( 2.7%) | mix,<br>6<br>( 3.3%)   | effective,<br>72<br>(39.1%) | Total<br>184<br>(100%) |       |
| (6) Have you ever injured ?                         | yes= 63(34.2%), no=121(65.8%), Total=184(100%)   |                         |                        |                             |                        |       |
| (7) How did you doing that ?                        | sugar, 1( 1.6%), medicine, 17(27.0%), sugar & medicine, 0( 0 %), doctor, 5( 7.9%), rest, 19(30.2%), no answer, 21(33.3%), Total 63(100%) |                         |                        |                             |                        |       |
| (8) Do you know proper application method ?         | yes= 46(25.0%), no=138(75.0%), Total=184(100%)   |                         |                        |                             |                        |       |
| (9) Do you want to know proper application method ? | yes=173(94.0%), no= 11( 6.0%), Total=184(100%)   |                         |                        |                             |                        |       |

Table J.7.2 Cases of Pesticides and insecticides to use in Districts

| Disrict            | Kean Svay  | Saang      | Total      |
|--------------------|------------|------------|------------|
| 1) Azodrin         | 31 (27.2)  | 48 (22.4)  | 79 (24.1)  |
| 2) Cyanimid        | 19 (16.7)  | 3 ( 1.4)   | 22 ( 6.7)  |
| 3) DDT             | 6 ( 5.3)   | 79 (36.9)  | 85 (25.9)  |
| 4) Diazinon        | 1 ( 0.9)   | - -        | 1 ( 0.3)   |
| 5) Endrin          | 1 ( 0.9)   | 7 ( 3.3)   | 8 ( 2.5)   |
| 7) Folidol         | 35 (30.7)  | 70 (32.7)  | 105 (32.0) |
| 8) Mevinphos       | 4 ( 3.5)   | - -        | 4 ( 1.2)   |
| 9) Methaphos       | 7 ( 6.1)   | - -        | 7 ( 2.2)   |
| 10) Padan 95SP     | 2 ( 1.7)   | - -        | 2 ( 0.6)   |
| 11) Phosdrin       | 3 ( 2.6)   | - -        | 3 ( 0.9)   |
| 12) Visher         | 3 ( 2.6)   | 2 ( 0.9)   | 5 ( 1.5)   |
| 13) Zinc Phosphide | 1 ( 0.9)   | 5 ( 2.4)   | 6 ( 1.8)   |
| 14) Unidentified   | 1 ( 0.9)   | - -        | 1 ( 0.3)   |
| Total(%)           | 114(100.0) | 214(100.0) | 328(100.0) |

Table J.7.3 List of firewood trees and using percentage in each districts in the Bassac Marshes Area.

| District      | Name        | Kean Svay   | Saang       | Total | Scientific Name        |
|---------------|-------------|-------------|-------------|-------|------------------------|
| Local Name    | Families(%) | Families(%) | Families(%) |       |                        |
| 1 Ampil Teuk  | 1 ( 1.0)    | 1 ( 0.5)    | 2 ( 0.7)    |       | Cynometra              |
| 2 Angchang    | --          | 15 ( 8.2)   | 15 ( 5.2)   |       | Gmelina asiatica       |
| 3 Anger Dey   | 2 ( 1.9)    | --          | 2 ( 0.7)    |       |                        |
| 4 Banla Yuon  | 9 ( 8.7)    | 35 (19.1)   | 44 (15.4)   |       | Mimosa pigra           |
| 5 Kadol       | 5 ( 4.9)    | --          | 5 ( 1.8)    |       | Sarcocephalus cordatus |
| 6 Krobas Prey | 11 (10.7)   | 1 ( 0.5)    | 12 ( 4.2)   |       |                        |
| 7 Mango tree  | 4 ( 3.9)    | 3 ( 1.7)    | 7 ( 2.5)    |       |                        |
| 8 PhnomPhneng | 10 ( 9.7)   | 2 ( 1.1)    | 12 ( 4.2)   |       | Hymenocardia walichii  |
| 9 Reang       | 47 (45.6)   | 86 (47.0)   | 133 (46.5)  |       | Barringtonia micrantha |
| 10 Snor       | --          | 17 ( 9.3)   | 17 ( 5.9)   |       | Sesbania               |
| 11 Troas      | 14 (13.6)   | 23 (12.6)   | 37 (12.9)   |       | Combretum trifoliatum  |
| Total         | 103(100.0)  | 183(100.0)  | 286(100.0)  |       |                        |

Table J.7.4 List of trees in the Bassac Marshes Area.

| No | Local Name        | Scientific Name               | Finding in here | Growing place | Planting by seeds | Use for mainly |
|----|-------------------|-------------------------------|-----------------|---------------|-------------------|----------------|
| 1  | Smav bekkabal     | <i>Echinocloacrus galli</i>   | easy            | anywhere      | easy              | -              |
| 2  | Smav pukbangkang  | <i>Digitaria ciliaris</i>     | easy            | anywhere      | easy              | -              |
| 3  | Smav kravanchruk  | <i>Cyperus rodentus</i>       | easy            | anywhere      | -                 | -              |
| 4  | Smav chanchountuk | <i>Cynodon dactylon</i>       | easy            | floodplain    | easy              | -              |
| 5  | Smav tranotantung | -                             | easy            | floodplain    | no                | -              |
| 6  | Smav barang       | -                             | easy            | anywhere      | easy              | -              |
| 7  | Smav choengkras   | <i>Eleusine indica</i>        | easy            | anywhere      | easy              | -              |
| 8  | Kak chung         | <i>Cyperus irria</i>          | easy            | -             | -                 | furniture      |
| 9  | Kak moul          | <i>Cyperus difformis</i>      | easy            | floodplain    | easy              | furniture      |
| 10 | Srange            | <i>Oryza sativalvar</i>       | easy            | anywhere      | easy              | -              |
| 11 | Treng             | -                             | easy            | anywhere      | -                 | -              |
| 12 | Babos             | -                             | easy            | anywhere      | -                 | -              |
| 13 | Tapang he         | <i>Sphenochlea zeylanica</i>  | easy            | anywhere      | -                 | -              |
| 14 | Vataak            | <i>Impomoca chryscides</i>    | easy            | anywhere      | easy              | -              |
| 15 | Vaphom            | <i>Parameria glandulifura</i> | easy            | anywhere      | easy              | -              |
| 16 | Vaandat trakuot   | -                             | -               | floodplain    | no                | -              |
| 17 | Vapreng           | -                             | easy            | anywhere      | easy              | -              |
| 18 | Vaprash           | <i>Quisqualis densiflora</i>  | easy            | anywhere      | easy              | medicine       |
| 19 | Vakambor          | -                             | easy            | anywhere      | easy              | -              |
| 20 | Savob             | -                             | easy            | anywhere      | -                 | building       |
| 21 | Sanor             | <i>Sasbania aquatica</i>      | easy            | floodplain    | -                 | -              |
| 22 | Komping puoy      | <i>Jussiaea repens</i>        | easy            | floodplain    | -                 | -              |
| 23 | Saray             | -                             | easy            | floodplain    | -                 | -              |
| 24 | Rumchang          | <i>Nymphaeacastellata</i>     | easy            | floodplain    | -                 | -              |
| 25 | Chhuk             | <i>Nelumbo nucifera</i>       | dfelt           | floodplain    | easy              | -              |
| 26 | Trakuon           | <i>Impomea aquatica</i>       | -               | floodplain    | easy              | -              |
| 27 | Krachap           | <i>Pentapetes phoenicea</i>   | easy            | floodplain    | -                 | -              |
| 28 | Kamplok           | <i>Eichhomia crassipes</i>    | easy            | floodplain    | -                 | -              |
| 29 | Trakeat           | <i>Monochoria hastefolia</i>  | easy            | floodplain    | -                 | -              |
| 30 | Travprey          | -                             | easy            | floodplain    | -                 | -              |
| 31 | Chantul plinom    | -                             | easy            | anywhere      | -                 | -              |
| 32 | Reang             | <i>Barringtonia</i>           | easy            | anywhere      | easy              | firewood       |
| 33 | Trash             | <i>Combretum trifoliatum</i>  | easy            | anywhere      | easy              | firewood       |
| 34 | Ktum              | <i>Stephegyene</i>            | easy            | floodplain    | dfelt             | firewood       |
| 35 | Khnay mon         | -                             | -               | floodplain    | -                 | firewood       |

| No | Local Name    | Scientific Name         | Finding in here | Growing place | Planting by seeds | Use for mainly |
|----|---------------|-------------------------|-----------------|---------------|-------------------|----------------|
| 36 | Taour         | Terminalia              | easy            | floodplain    | -                 | -              |
| 37 | Tasek         | Petophrum ferrugineum   | -               | floodplain    | easy              | building       |
| 38 | Thmenhitrey   | Bridelia pedicellata    | easy            | anywhere      | easy              | firewood       |
| 39 | Banla yuon    | Mimosa pigra            | easy            | anywhere      | easy              | -              |
| 40 | Prabuoy       | Croton caudatus         | easy            | floodplain    | easy              | firewood       |
| 41 | Krapenh nhi   | Phyllatus               | easy            | river side    | -                 | medicine       |
| 42 | Taloem andoek | -                       | easy            | anywhere      | easy              | -              |
| 43 | Char          | Butea frondosa          | dfelt           | anywhere      | easy              | dye, rope      |
| 44 | Snay          | Grewia sinuata          | easy            | anywhere      | easy              | medicine       |
| 45 | Sandan        | Garcinia                | dfelt           | floodplain    | easy              | -              |
| 46 | Anhchanh      | Gmelina asiatica        | easy            | floodplain    | easy              | -              |
| 47 | Banla saet    | Acasia spiralis         | easy            | floodplain    | easy              | firewood       |
| 48 | Sangke        | Combretum quadrangulare | easy            | anywhere      | easy              | bld, frwd      |
| 49 | Longeang      | Cratoxylon formosum     | dfelt           | floodplain    | easy              | firewood       |
| 50 | Nhor          | Morinda citrifolia      | easy            | floodplain    | -                 | dye, mdcn      |
| 51 | Prakrab       | -                       | -               | anywhere      | easy              | medicine       |
| 52 | Lahong kanhe  | Ricinis communis        | easy            | river side    | easy              | firewood       |
| 53 | Kapeng he     | -                       | -               | floodplain    | easy              | -              |
| 54 | Slak          | -                       | easy            | river side    | easy              | medicine       |
| 55 | Kadol         | Sarcocephalus cordatus  | -               | anywhere      | easy              | blr, frwd      |
| 56 | Kandol        | Caraya                  | -               | anywhere      | easy              | firewood       |
| 57 | Chamreak      | Albizzia lebekoides     | dfelt           | anywhere      | easy              | bld, frwd      |
| 58 | Tunlear       | Cratevabuch hamvar      | dfelt           | floodplain    | easy              | mdcn, frwd     |
| 59 | Kror          | -                       | -               | floodplain    | easy              | firewood       |

Table J.7.5 List of Waterfowl in the Bassac Marshes Area.

| No | Local Name         | Scientific Name        | Finding in here | Size(cm) | Colour    | Feed   |
|----|--------------------|------------------------|-----------------|----------|-----------|--------|
| 1  | Smogn              | Anhinga melanogasier   | no              | 50       | grey      | fish   |
| 2  | Krosa prophes      | Ardea cinerea          | dfelt           | 35       | grey      | fish   |
| 3  | Krosa prophes slap | Ardea Sumatrana        | dfelt           | 35       | greywhite | fish   |
| 4  | Kok kron thom      | Egretta alda           | dfelt           | 32       | white     | fish   |
| 5  | Kok kron toch      | Egretta garzetta       | dfelt           | 30       | white     | fish   |
| 6  | Kok kor            | Bubuleus ibis          | dfelt           | 30       | white     | fish   |
| 7  | Kok krok           | Ardeola bacchus        | easy            | 29       | grey      | fish   |
| 8  | Kok roneam         | Egretta sacra          | easy            | 28       | greywhite | fish   |
| 9  | Tung prophes       | Pelecanus philippensis | dfelt           | 45       | greywhite | fish   |
| 10 | Tung thom sor      | Pelecanus onocrotalus  | dfelt           | 45       | white     | fish   |
| 11 | Kaek teuk          | Phalacrocorax carba    | no              | 32       | black     | fish   |
| 12 | Kaek teuk toch     | Phalacrocorax niga     | easy            | 30       | black     | fish   |
| 13 | Tea prey           | Anas acuta             | easy            | 35       | greywhite | fish   |
| 14 | Proveuk thom       | Dandrocugna javanica   | easy            | 30       | black     | fish   |
| 15 | Proveuk toch       | Anas crecca            | easy            | 28       | grey      | fish   |
| 16 | Proveuk            | Nettapus pulchellus    | dfelt           | 28       | greyblack | fish   |
| 17 | Klom               | Fulica atra            | dfelt           | 26       | grey      | fish   |
| 18 | Moin teuk thom     | Gallixrex cinecca      | no              | 30       | brown     | fish   |
| 19 | Moin teuk toch     | Porphyrio edwarsi      | dfelt           | 28       | grey      | fish   |
| 20 | Krodevich          | Sarcofranus indicus    | dfelt           | 28       | grey      | fish   |
| 21 | Kvaik              | Scolopax rusticola     | dfelt           | 30       | blackgrey | fish   |
| 22 | Tom                | Amauromis Phoenicurus  | no              | 45       | whitegrey | fish   |
| 23 | Aot thom           | -                      | easy            | 35       | redblack  | plant  |
| 24 | Aot sbov           | -                      | easy            | 30       | brown     | plant  |
| 25 | Roneal             | Mycteria leucocephala  | dfelt           | 35       | whitegrey | fish   |
| 26 | Kreat              | Grus antigone          | no              | 45       | grey      | fish   |
| 27 | Trodok thom        | Leptoptilos Dubius     | no              | 38       | blackgrey | fish   |
| 28 | Trodok toch        | Leptoptilos javanicus  | no              | 35       | -         | fish   |
| 29 | Tituy              | Bubobubo               | dfelt           | 35       | grey      | insect |
| 30 | Kleng srak         | Strix flammea          | dfelt           | 25       | darkbrown | insect |
| 31 | Smorng kor veng    | Oriental darter*       | no              | 45       | grey      | fish   |

Note : \* = English name, Anhinga sp.

Table J.7.6 List of Fish in the Bassac Marshes Area.

| No | Local Name          | Scientific Name               | Finding in here | Size(cm) | Habitat   | Use for   |
|----|---------------------|-------------------------------|-----------------|----------|-----------|-----------|
| 1  | Trey ros            | Channa marulius               | easy            | 70       | lk        | cm,lm     |
| 2  | Trey damrey         | Oxyeleotris marmorata         | dfelt           | 35       | anywhere  | exp,cm,lm |
| 3  | Trey sanday         | Wallago attu                  | dfelt           | 80       | rv,mkg    | cm,lm     |
| 4  | Trey chhkok         | Cyclocheilichthys enoplos     | easy            | 50       | lk,rv,mkg | cm,lm     |
| 5  | Trey kes            | Micronema apogon, M. bleekeri | easy            | 40       | lk,mkg    | exp,cm,lm |
| 6  | Trey chhlang        | Mystus nemurus                | easy            | 50       | lk,rv,mkg | cm,lm     |
| 7  | Trey kanchos        | Mystus wolffi                 | easy            | 15       | lk,rv,mkg | cm,lm     |
| 8  | Trey kromorm        | Ompokbimaculatus              | easy            | 25       | -         | cm,lm     |
| 9  | Trey andeing roeung | Clarius batrachus             | easy            | 40       | lk,swp    | exp,cm,lm |
| 10 | Trey andeing toum   | Clarius meladerma             | easy            | 35       | lk,swp    | exp,cm,lm |
| 11 | Trey pra            | Pangasius djambal             | easy            | 60       | mkg,rv    | exp,cm,lm |
| 12 | Trey pra khav       | Pangasius bocourtia           | easy            | 50       | rv,mkg    | exp,cm,lm |
| 13 | Trey chhviet        | Pangasius macronema           | easy            | 18       | lk,rv,mkg | cm,lm     |
| 14 | Trey klang hay      | Bebodonticthys dinema         | easy            | 60       | lk,mkg    | exp,cm,lm |
| 15 | Trey khman          | Hampala dispar                | easy            | 35       | lk,rv,mkg | cm,lm     |
| 16 | Trey chhpin         | Hypsibarbus lagleri rainboth  | easy            | 35       | lk,rv,mkg | cm,lm     |
| 17 | Trey chrakeing      | Puntioplites faicifer         | easy            | 30       | lk,rv,mkg | cm,lm     |
| 18 | Trey kaek           | Morulus chrysophekadion       | easy            | 60       | lk,mkg    | cm,lm     |
| 19 | Trey krum           | Osteochilus melanopleurus     | easy            | 40       | lk,rv,mkg | cm,lm     |
| 20 | Trey slat           | Notopterus                    | easy            | 30       | lk,rv     | cm,lm     |
| 21 | Trey changwa        | Opsarius koratensis           | easy            | 8        | anywhere  | cm,lm,sc  |
| 22 | Trey changwa mool   | Rasbora aurotaenia            | easy            | 15       | lk,rv,mkg | cm,lm,sc  |
| 23 | Trey linh           | Thynnichthys thynnoides       | easy            | 16       | lk,rv,mkg | cm,lm     |
| 24 | Trey riel           | Henicorhynchus siamensis      | easy            | 17       | lk,rv,mkg | exp,cm,sc |
| 25 | Trey chdaur         | Channa micropeltes            | dfelt           | 70       | lk,mkg    | exp,cm,lm |
| 26 | Trey ampiltum       | Systemus orphoides            | easy            | 20       | lk,rv     | cm,lm     |
| 27 | Trey koul reang     | Catlocarpio siemensis         | dfelt           | 250      | lk,mkg    | exp,cm,lm |
| 28 | Trey kantrab        | Pristolepis fasciata          | easy            | 20       | lk        | cm,lm,sc  |
| 29 | Trey kanthor        | Trichodaster pectoralis       | dfelt           | 20       | lk        | cm,lm     |
| 30 | Trey kanchanh chras | Pseudambasis notatus          | easy            | 5        | lk,rv,mkg | cm,lm,sc  |
| 31 | Trey kamplean phluk | Trichogaster microlepis       | easy            | 15       | lk,swp    | cm,lm,sc  |
| 32 | Trey kambot chramos | Sikukia gudgeri               | easy            | 18       | lk,mkg    | cm,lm,sc  |
| 33 | Trey kahe           | Bardodu Schwanefeldi          | dfelt           | 30       | lk,mkg    | cm,lm     |
| 34 | Trey khnong veng    | Dangila lineata               | easy            | 18       | anywhere  | cm,lm,sc  |
| 35 | Trey phtong         | Xenentodon cancila            | easy            | 20       | anywhere  | cm,lm,sc  |

Note : Habitat ; lk=lake, rv=river, mkg=Mekongriver, swp=swamp  
 Use for ; cm=central market, lm=local market, exp=export, sc=fish sauce



### **J.7.3 Overall Evaluation**

Agriculture in the backslopes of natural levees and natural condition of Bassac marsh is maintained by periodic flood intrusion through colmatage canals. The canals have many functions in the process of carrying silt-bearing water into agricultural land and backswamp.

Rehabilitation project aims to recover the deteriorated function of canals, which will bring further incentive to farming on the related farmers. Agriculture activities would become more active. Consequently, agriculture production would be expected to increase in the area along the canals. The project would also contribute to maintaining fisheries resources in backswamp areas.

Therefore, project justification should be discussed from both fields of agriculture development and environmental conservation involved in preservation of ecosystem in swamp area. Economic evaluation is based on the quantitative agriculture production expected by project implementation. But, environmental effect such as conservation of fish habitat and migration route is considered to be non-quantitative benefit. Based on the economic analysis, the project is considered to be feasible from viewpoint of quantitative agricultural increment benefit. The project implementation may not give negative impact on the agriculture and swamp areas, according to the environment impact study. Therefore, the project is concluded to be workable and is recommended to implement urgently.

This study is based on the comprehensive study for the area along the Mekong and Bassac rivers. For implementing the rehabilitation of each canal, detailed survey including farmer's consent is required by each canal.







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