10 female fries ovulate about 320,000 eggs which is equivalent to 1kg.

20% of the 1kg, that is 200g, shall be the standard weight of fries.

| Fish Category | Breeding (days) | Feed Distribution (days) | Unit price of Feed for 1 period (Kip) |
|---|---|---|---|
| Fry | 90 | 38 | 1,080 |
| Bred Fish | 365 | 90 | 16,750 |
| Bred Fish (1) | 365 | 30 | 2,790 |

Source. M. P. State Fisherles Development Corporation 1985

The feed provision standard for bred fishes is 9 months in the spawning period and 3 months when they're not incubated.

| | Total Number of Fish Eggs ① | Number of Natural Inclused Fry ② | Total River with Fry ③ | Total Number of Living Fry ④ | Number of Adult Fish ⑤ | Total Number of Adult Fish ⑥ | Total Catch Fish (kg/year) ⑦ |
|---|---|---|---|---|---|---|---|
| 1st Year | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2nd Year | 75,900 | 15,180 (20%) | 64,515 | 51,802 | 46,622 (90%) | 98,423 | 2.953 (10%) |
| 3rd Year | 75,900 | 26,565 (35%) | 64,515 | 59,202 | 47,362 (80%) | 106,564 | 6.394 (20%) |
| 4th Year | 75,900 | 45,540 (60%) | 64,515 | 71,536 | 53,652 (75%) | 125,188 | 9,389 (25%) |
| 5th Year | 75,900 | 53,130 (70%) | 64,515 | 76,469 | 57,352 (75%) | 133,821 | 10,037 (25%) |
| 6th Year | 75,900 | 53,130 (70%) | 64,515 | 76,469 | 57,352 (75%) | 133,821 | 10,037 (25%) |

Note : ②=①×%, ③=①×85%
④ : Total Number of Living Fry in the pond is 65% from Total river with Fry.
④ = (②+③)×65%
⑤ : Number of Adult Fish is from ④.
⑤=④×90%, ⑥=④+⑤, ⑦=⑥×30%

Increase in the number of naturally propagated fries
second year: 20%; third year: 35%; fourth year: 60%. The maximum increase rate of naturally propagated fries was estimated during the 5th year at 70%.

Catch fish transition ratio
second year: 10%; third year: 20%; fifth year: 25%. Generally, the transition ratio of catch fish from the total number of fish in the pond is 25%

The growth and number of living fish is 65% in rivers with fry.

## Table V - 1 Present Cropping Situation

| Name of Village | Number of Farm family | Cultivate Paddy (ha) | Cultivate Rice (ha) | Cultivate Vegeta-bles | Average of Paddy (ha) | Average of Total field |
|---|---|---|---|---|---|---|
| B, Sitong | 89 | 170 | 28 | 12 | 1.91 | 2.36 |
| B, Kho | 103 | 178 | 30 | 9 | 1.73 | 2.11 |
| B, Nongveng | 58 | 81 | 16 | 6 | 1.40 | 1.78 |
| B, Dongdokmai | 88 | 112 | 22 | 7 | 1.27 | 1.60 |
| B, Nanokkien | 89 | 110 | 8 | 13 | 1.24 | 1.47 |
| B, Dongkhankhou | 155 | 172 | 0 | 10 | 1.11 | 1.17 |
| B, Nongkalong | 114 | 123 | 0 | 10 | 1.08 | 1.17 |
| B, Gnangsoung | 74 | 133 | 5 | 10 | 1.80 | 2.00 |
| B, Dongkhamkhen | 68 | 68 | 0 | 11 | 1.00 | 1.16 |
| B, Nonnadi | 45 | 32 | 2 | 2 | 0.71 | 0.80 |
| B, Vatthana | 129 | 136 | 2 | 11 | 1.05 | 1.16 |
| B, Phailom | 67 | 96 | 3 | 2 | 1.43 | 1.51 |
| B, Phonthan | 48 | 47 | 6 | 2 | 0.98 | 1.15 |
| B, Mouangkhai Nua | 175 | 194 | 0 | 34 | 1.11 | 1.30 |
| B, Mouangkhai Tai | 235 | 205 | 0 | 47 | 0.87 | 1.07 |
| B, Dontoum | 99 | 145 | 0 | 30 | 1.46 | 1.77 |
| B, Dongmakfai | 240 | 228 | 0 | 25 | 0.95 | 1.05 |
| B, Donghouakham | 42 | 43 | 33 | 8 | 1.02 | 2.00 |
| B, Namphou Nua | 112 | 108 | 4 | 2 | 0.96 | 1.02 |
| B, Namphou Tai | 92 | 59 | 3 | 5 | 0.64 | 0.73 |
| B, Dongphosi | 134 | 111 | 0 | 45 | 0.83 | 1.16 |
| B, Phoxai | 50 | 41 | 0 | 15 | 0.82 | 1.12 |
| B, Xianban | 104 | 87 | 0 | 6 | 0.84 | 0.89 |
| B, Nonghong | 75 | 67 | 0 | 3 | 0.89 | 0.93 |
| Total | 2,485 | 2,746 | 162 | 325 | 1.11 | 1.30 |

Source: Agriculture Data Office in the sub District 1991.

Table V - 2 Result of Paddy Damge by Flood and Drought in the Study Area

| Number of sub District | Planting Area (ha) | Harvest Area (ha) | Flood Damage (ha) | Drought Damage (ha) | Amount of Damage (kip) |
|---|---|---|---|---|---|
| Khamthao | | | | | |
| 1986 | 1,687 | 1,210 | 0 | 477 | 26,712 |
| 1987 | 1,688 | 1,688 | 0 | 0 | 0 |
| 1988 | 1,691 | 1,691 | 0 | 0 | 0 |
| 1989 | 1,694 | 1,694 | 0 | 0 | 0 |
| 1990 | 1,999 | 1,420 | 579 | 0 | 109,336 |
| 1991 | 1,699 | 968 | 731 | 0 | 163,744 |
| Nanokkhian | | | | | |
| 1986 | 772 | 770 | 0 | 104 | 11,921 |
| 1987 | 787 | 788 | 0 | 87 | 3,869,214 |
| 1988 | 827 | 827 | 2 | 44 | 1,550,247 |
| 1989 | 699 | 698 | 0 | 175 | 23,880,482 |
| 1990 | 742 | 742 | 0 | 131 | 18,218,078 |
| 1991 | 733 | 734 | 0 | 139 | 18,801,400 |
| Vatthana | | | | | |
| 1986 | 609 | 602 | 4 | 4 | 864,240 |
| 1987 | 609 | 592 | 1 | 15 | 2,070,600 |
| 1988 | 605 | 591 | 5 | 9 | 1,427,800 |
| 1989 | 601 | 599 | 5 | 1 | 427,200 |
| 1990 | 601 | 600 | 5 | 0 | 164,000 |
| 1991 | 600 | 440 | 2 | 164 | 22,702,480 |
| Mouangkhai | | | | | |
| 1986 | 1,378 | 964 | 0 | 413 | 6,204,396 |
| 1987 | 1,378 | 1,034 | 0 | 344 | 5,165,328 |
| 1988 | 1,378 | 1,102 | 0 | 275 | 4,129,259 |
| 1989 | 1,378 | 1,239 | 0 | 138 | 2,072,137 |
| 1990 | 1,378 | 1,308 | 0 | 69 | 1,036,068 |
| 1991 | 1,378 | 1,175 | 0 | 203 | 3,048,144 |
| Nateuy | | | | | |
| 1986 | 701 | 686 | 0 | 15 | 2,900,000 |
| 1987 | 669 | 659 | 0 | 10 | 1,058,400 |
| 1988 | 725 | 716 | 0 | 9 | 1,315,650 |
| 1989 | 734 | 724 | 0 | 10 | 1,488,200 |
| 1990 | 744 | 739 | 0 | 5 | 805,600 |
| 1991 | 922 | 911 | 0 | 11 | 1,460,992 |
| Nakham | | | | | |
| 1986 | 1,240 | 703 | 0 | 537 | 8,063,318 |
| 1987 | 1,240 | 885 | 0 | 355 | 5,345,514 |
| 1988 | 1,240 | 956 | 0 | 284 | 4,264,398 |
| 1989 | 1,239 | 0 | 0 | 0 | 0 |
| 1990 | 1,240 | 0 | 0 | 0 | 0 |
| 1991 | 1,240 | 803 | 10 | 427 | 6,561,768 |
| Phone, Sog | | | | | |
| 1986 | 1,734 | 1,277 | 0 | 457 | 685,470 |
| 1987 | 1,734 | 1,499 | 0 | 235 | 3,533,595 |
| 1988 | 1,734 | 1,687 | 47 | 0 | 698,220 |
| 1989 | 1,734 | 1,681 | 53 | 0 | 798,824 |
| 1990 | 1,734 | 1,658 | 76 | 0 | 1,133,669 |
| 1991 | 1,734 | 1,405 | 217 | 112 | 4,931,837 |

Source : Agricultural Data Office in the Sub District 1991.

## Table V - 3 Fruit Tree Species and Cultivation Quantity

| Name of sub District | Non Tree | 1 to 2 Tree | 3 to 4 Tree | 5 to 6 Tree | 7 to 8 Tree | 9 to 10 Tree | 11 Up Tree | Household |
|---|---|---|---|---|---|---|---|---|
| Khamthao | | | | | | | | |
| Banana | No | 17 | 108 | 73 | 65 | 25 | 3 | |
| Mango | Data | 0 | 0 | 0 | 0 | 0 | 0 | |
| Coconut | ' | 33 | 24 | 18 | 7 | 14 | 0 | |
| Orange | ' | 0 | 0 | 0 | 0 | 0 | 0 | |
| Nut | ' | 0 | 0 | 0 | 0 | 0 | 0 | |
| Other | ' | 0 | 0 | 0 | 0 | 0 | 0 | |
| Nanokkhian | | | | | | | | |
| Banana | 507 | 108 | 73 | 36 | 0 | 0 | 0 | |
| Mango | 580 | 109 | 37 | 0 | 0 | 0 | 0 | |
| Coconut | 435 | 145 | 73 | 51 | 21 | 0 | 0 | |
| Orange | 580 | 109 | 36 | 0 | 0 | 0 | 0 | |
| Nut | 652 | 43 | 30 | 0 | 0 | 0 | 0 | |
| Other | 507 | 145 | 73 | 0 | 0 | 0 | 0 | |
| Vatthana | | | | | | | | |
| Banana | 150 | 95 | 71 | 127 | 15 | 10 | 8 | |
| Mango | 43 | 290 | 95 | 48 | 0 | 0 | 0 | |
| Coconut | 71 | 238 | 143 | 24 | 0 | 0 | 0 | |
| Orange | 238 | 95 | 95 | 48 | 0 | 0 | 0 | |
| Nut | 286 | 143 | 38 | 9 | 0 | 0 | 0 | |
| Other | 286 | 119 | 48 | 23 | 0 | 0 | 0 | |
| Mouangkhai | | | | | | | | |
| Banana | 917 | 3 | 100 | 224 | 0 | 276 | 67 | |
| Mango | 210 | 427 | 327 | 111 | 97 | 195 | 226 | |
| Coconut | 510 | 376 | 225 | 129 | 191 | 75 | 98 | |
| Orange | 1,425 | 275 | 134 | 97 | 30 | 3 | 0 | |
| Nut | 1,053 | 100 | 71 | 0 | 0 | 0 | 0 | |
| Other | 1,413 | 127 | 32 | 0 | 0 | 0 | 0 | |
| Nateuy | | | | | | | | |
| Banana | 150 | 177 | 165 | 170 | 204 | 200 | 0 | |
| Mango | 165 | 170 | 150 | 204 | 200 | 177 | 0 | |
| Coconut | 177 | 200 | 204 | 170 | 165 | 150 | 0 | |
| Orange | 170 | 165 | 177 | 150 | 204 | 200 | 0 | |
| Nut | 165 | 177 | 150 | 200 | 170 | 204 | 0 | |
| Other | 204 | 150 | 200 | 165 | 177 | 170 | 0 | |
| Nakham | | | | | | | | |
| Banana | 459 | 253 | 102 | 134 | 135 | 135 | 0 | |
| Mango | 174 | 348 | 232 | 232 | 110 | 122 | 0 | |
| Coconut | 152 | 355 | 237 | 158 | 105 | 200 | 11 | |
| Orange | 609 | 340 | 134 | 135 | 0 | 0 | 0 | |
| Nut | 812 | 203 | 101 | 102 | 0 | 0 | 0 | |
| Other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Phone, Sog | | | | | | | | |
| Banana | 126 | 130 | 156 | 98 | 99 | 166 | 401 | |
| Mango | 584 | 158 | 76 | 136 | 70 | 78 | 74 | |
| Coconut | 608 | 164 | 189 | 115 | 33 | 34 | 33 | |
| Orange | 489 | 209 | 215 | 100 | 106 | 60 | 0 | |
| Nut | 986 | 190 | 0 | 0 | 0 | 0 | 0 | |
| Other | | | | | | | | |

Unit Nunber of Household

Source : Agricultural Data Office in the Sub District 1991.

Present Number of Livestock and Poultry in the Study Area

| Name of Village | Number of Total Household | Rear Buffalo Household | Rear Cattle Household | Buffalo Rear % | Cattle Rear % | Total Buffalo | Tota Cattlel | Total Pig | Total Poultry | Total Duck |
|---|---|---|---|---|---|---|---|---|---|---|
| B, Sithong | 89 | 84 | 86 | 1.429 | 2.791 | 120 | 240 | 305 | 4,605 | 2,065 |
| B, Kho | 103 | 90 | 93 | 1.422 | 2.581 | 128 | 240 | 305 | 500 | 2,008 |
| B, Nongveng | 58 | 50 | 55 | 1.220 | 1.964 | 61 | 108 | 45 | 388 | 120 |
| B, Dongdokmai | 88 | 82 | 86 | 1.037 | 2.384 | 85 | 205 | 358 | 408 | 400 |
| B, Nanokkhian | 89 | 85 | 89 | 1.235 | 2.360 | 105 | 210 | 34 | 541 | 63 |
| B, Dongkhankhou | 155 | 140 | 145 | 1.157 | 2.400 | 162 | 348 | 105 | 820 | 61 |
| B, Nongkalong | 114 | 78 | 83 | 1.179 | 3.169 | 92 | 263 | 132 | 931 | 86 |
| B, Gnangsoung | 74 | 45 | 55 | 1.622 | 2.655 | 73 | 146 | 72 | 251 | 85 |
| B, Dongkhamkhen | 68 | 56 | 68 | 2.464 | 2.706 | 138 | 184 | 97 | 679 | 67 |
| B, Nonnadi | 45 | 32 | 44 | 2.313 | 2.091 | 74 | 92 | 30 | 12 | 13 |
| B, Vatthana | 129 | 83 | 93 | 1.157 | 1.430 | 96 | 133 | 75 | 1,050 | 118 |
| B, Phailom | 67 | 65 | 60 | 0.985 | 1.733 | 64 | 104 | 17 | 300 | 30 |
| B, Phonthan | 48 | 40 | 40 | 1.300 | 1.275 | 52 | 51 | 38 | 460 | 50 |
| B, Mouangkhai Nua | 175 | 170 | 172 | 1.347 | 1.831 | 229 | 315 | 110 | 1,100 | 99 |
| B, Mouangkhai Tai | 235 | 227 | 231 | 0.907 | 1.515 | 206 | 350 | 105 | 1,200 | 150 |
| B, Dontoum | 99 | 50 | 85 | 1.720 | 4.118 | 86 | 350 | 170 | 1,325 | 900 |
| B, Dongmakfai | 240 | 210 | 238 | 1.524 | 2.462 | 320 | 586 | 218 | 1,005 | 302 |
| B, Donghouakham | 42 | 40 | 40 | 2.125 | 5.125 | 85 | 205 | 358 | 408 | 132 |
| B, Namphou Nua | 112 | 100 | 112 | 1.380 | 1.473 | 138 | 165 | 92 | 362 | 68 |
| B, Namphou Tai | 92 | 90 | 92 | 1.644 | 2.076 | 148 | 191 | 43 | 694 | 267 |
| B, Dongphosi | 134 | 126 | 128 | 0.833 | 4.375 | 105 | 560 | 200 | 684 | 168 |
| B, Phoxai | 50 | 48 | 50 | 1.833 | 2.000 | 88 | 100 | 12 | 500 | 50 |
| B, Xianban | 104 | 100 | 103 | 1.030 | 1.922 | 103 | 198 | 79 | 1,650 | 350 |
| B, Nonghong | 75 | 70 | 75 | 1.457 | 2.057 | 102 | 188 | 84 | 1,654 | 560 |
| | 2,485 | 2,161 | 2,323 | 1.323 | 2.381 | 2,860 | 5,532 | 3,084 | 21,527 | 8,212 |

## Table V - 4 Total Number of Livestock Every 5 Years

| Name of Village | Buffalo | UP % | Cattle | UP % | Pig | UP % | Fowl | UP % | Duck | UP % |
|---|---|---|---|---|---|---|---|---|---|---|
| B, Xianban | | | | | | | | | | |
| 1986 | 85 | 106 | 178 | | 59 | | 1,600 | | 200 | |
| 1987 | 90 | 112 | 185 | 104 | 60 | 102 | 1,630 | 102 | 249 | 125 |
| 1988 | 95 | 118 | 190 | 107 | 65 | 110 | 1,638 | 102 | 250 | 125 |
| 1989 | 100 | 121 | 192 | 108 | 70 | 119 | 1,649 | 103 | 300 | 150 |
| 1990 | 103 | | 198 | 111 | 79 | 134 | 1,650 | 103 | 350 | 175 |
| B, Nonghong | | | | | | | | | | |
| 1986 | 85 | | 150 | | 60 | | 1,335 | | 450 | |
| 1987 | 90 | 106 | 160 | 107 | 65 | 108 | 1,400 | 105 | 460 | 102 |
| 1988 | 95 | 112 | 170 | 113 | 70 | 117 | 1,500 | 112 | 490 | 109 |
| 1989 | 100 | 118 | 178 | 119 | 74 | 123 | 1,554 | 116 | 500 | 111 |
| 1990 | 102 | 120 | 188 | 125 | 84 | 140 | 1,654 | 124 | 560 | 124 |
| B, Sithong | | | | | | | | | | |
| 1986 | 82 | | 150 | | 200 | | 3,000 | | 900 | |
| 1987 | 90 | 110 | 200 | 133 | 240 | 120 | 4,008 | 134 | 1,085 | 121 |
| 1988 | 99 | 121 | 230 | 153 | 280 | 140 | 4,089 | 136 | 1,090 | 121 |
| 1989 | 105 | 128 | 232 | 155 | 300 | 150 | 4,450 | 148 | 1,107 | 123 |
| 1990 | 120 | 146 | 240 | 160 | 305 | 153 | 4,605 | 154 | 2,065 | 229 |
| B, Kho | | | | | | | | | | |
| 1986 | 92 | | 207 | | 269 | | 3,909 | | 997 | |
| 1987 | 99 | 108 | 220 | 106 | 270 | 100 | 4,027 | 103 | 1,007 | 101 |
| 1988 | 102 | 111 | 230 | 111 | 298 | 111 | 4,801 | 123 | 1,098 | 110 |
| 1989 | 110 | 120 | 231 | 112 | 300 | 112 | 4,957 | 127 | 1,992 | 200 |
| 1990 | 128 | 139 | 240 | 116 | 305 | 113 | 5,000 | 128 | 2,008 | 201 |
| B, Nongveng | | | | | | | | | | |
| 1986 | 46 | | 84 | | 32 | | 215 | | 88 | |
| 1987 | 48 | 104 | 98 | 117 | 39 | 122 | 218 | 101 | 77 | 88 |
| 1988 | 56 | 122 | 101 | 120 | 41 | 128 | 325 | 151 | 106 | 120 |
| 1989 | 58 | 126 | 106 | 126 | 44 | 138 | 361 | 168 | 119 | 135 |
| 1990 | 61 | 133 | 108 | 129 | 45 | 141 | 388 | 180 | 120 | 136 |
| B, Dongdokmai | | | | | | | | | | |
| 1986 | 58 | | 90 | | 270 | | 357 | | 304 | |
| 1987 | 67 | 116 | 101 | 112 | 282 | 104 | 378 | 106 | 315 | 104 |
| 1988 | 70 | 121 | 118 | 131 | 318 | 118 | 400 | 112 | 350 | 115 |
| 1989 | 73 | 126 | 129 | 143 | 337 | 125 | 401 | 112 | 387 | 127 |
| 1990 | 85 | 147 | 205 | 228 | 358 | 133 | 408 | 114 | 400 | 132 |
| B, Vatthana | | | | | | | | | | |
| 1986 | 93 | | 129 | | 80 | | 1,100 | | 70 | |
| 1987 | 91 | 98 | 127 | 98 | 76 | 95 | 1,100 | 100 | 60 | 86 |
| 1988 | 90 | 97 | 131 | 102 | 70 | 88 | 1,200 | 109 | 85 | 121 |
| 1989 | 95 | 102 | 130 | 101 | 81 | 101 | 1,000 | 91 | 80 | 114 |
| 1990 | 96 | 103 | 133 | 103 | 75 | 94 | 1,050 | 95 | 118 | 169 |
| B, Phailom | | | | | | | | | | |
| 1986 | 51 | | 84 | | 16 | | 150 | | 18 | |
| 1987 | 53 | 104 | 86 | 102 | 21 | 131 | 200 | 133 | 24 | 133 |
| 1988 | 53 | 104 | 90 | 107 | 20 | 125 | 250 | 167 | 28 | 156 |
| 1989 | 60 | 118 | 98 | 117 | 23 | 144 | 200 | 133 | 20 | 111 |
| 1990 | 64 | 125 | 104 | 124 | 17 | 106 | 300 | 200 | 30 | 167 |

## Total Number of Livestock in the Study Area Every 5. Years.

| Name of Village | Buffalo | UP % | Cattle | UP % | Pig | UP % | Fowl | UP % | Duck | UP % |
|---|---|---|---|---|---|---|---|---|---|---|
| B, Phonthan | | | | | | | | | | |
| 1986 | 44 | | 47 | | 30 | | 210 | | 30 | |
| 1987 | 46 | 105 | 49 | 104 | 28 | 93 | 300 | 143 | 36 | 120 |
| 1988 | 50 | 114 | 50 | 106 | 35 | 117 | 370 | 176 | 40 | 133 |
| 1989 | 52 | 118 | 54 | 115 | 40 | 133 | 400 | 190 | 43 | 143 |
| 1990 | 52 | 118 | 51 | 109 | 38 | 127 | 460 | 219 | 50 | 167 |
| B, Nanokkhian | | | | | | | | | | |
| 1986 | 161 | | 240 | | 90 | | 801 | | 15 | |
| 1987 | 171 | 106 | 201 | 84 | 84 | 93 | 900 | 112 | 14 | 93 |
| 1988 | 160 | 99 | 200 | 83 | 50 | 56 | 341 | 43 | 24 | 160 |
| 1989 | 100 | 62 | 210 | 88 | 40 | 44 | 230 | 29 | 50 | 333 |
| 1990 | 105 | 65 | 210 | 88 | 34 | 38 | 541 | 68 | 63 | 420 |
| B, Dongkhankhou | | | | | | | | | | |
| 1986 | 159 | | 298 | | 111 | | 650 | | 52 | |
| 1987 | 154 | 97 | 292 | 98 | 100 | 90 | 720 | 111 | 96 | 185 |
| 1988 | 152 | 96 | 311 | 104 | 98 | 88 | 690 | 106 | 47 | 90 |
| 1989 | 156 | 98 | 342 | 115 | 101 | 91 | 701 | 108 | 58 | 112 |
| 1990 | 162 | 102 | 348 | 117 | 105 | 95 | 820 | 126 | 61 | 117 |
| B, Nongkalong | | | | | | | | | | |
| 1986 | 82 | | 212 | | 91 | | 610 | | 98 | |
| 1987 | 85 | 104 | 230 | 108 | 102 | 112 | 720 | 118 | 62 | 63 |
| 1988 | 85 | 104 | 237 | 112 | 81 | 89 | 513 | 84 | 52 | 53 |
| 1989 | 89 | 109 | 250 | 118 | 99 | 109 | 693 | 114 | 75 | 77 |
| 1990 | 92 | 112 | 263 | 124 | 132 | 145 | 931 | 153 | 86 | 88 |
| B, Gnangsoung | | | | | | | | | | |
| 1986 | 72 | | 145 | | 65 | | 248 | | 150 | |
| 1987 | 71 | 99 | 142 | 98 | 67 | 103 | 242 | 98 | 131 | 87 |
| 1988 | 71 | 99 | 141 | 97 | 64 | 98 | 245 | 99 | 129 | 86 |
| 1989 | 73 | 101 | 143 | 99 | 68 | 105 | 238 | 96 | 132 | 88 |
| 1990 | 73 | 101 | 146 | 101 | 72 | 111 | 251 | 101 | 127 | 85 |
| B, Dongkhamkhen | | | | | | | | | | |
| 1986 | 135 | | 150 | | 80 | | 720 | | 50 | |
| 1987 | 139 | 103 | 175 | 117 | 73 | 91 | 760 | 106 | 45 | 90 |
| 1988 | 137 | 101 | 142 | 95 | 83 | 104 | 640 | 89 | 58 | 116 |
| 1989 | 142 | 105 | 181 | 121 | 96 | 120 | 792 | 110 | 65 | 130 |
| 1990 | 138 | 102 | 184 | 123 | 97 | 121 | 679 | 94 | 67 | 134 |
| B, Nonnadi | | | | | | | | | | |
| 1986 | 60 | | 67 | | 20 | | 70 | | 60 | |
| 1987 | 63 | 105 | 70 | 104 | 35 | 175 | 100 | 143 | 93 | 155 |
| 1988 | 70 | 117 | 80 | 119 | 49 | 245 | 40 | 57 | 36 | 60 |
| 1989 | 70 | 117 | 85 | 127 | 60 | 300 | 230 | 329 | 151 | 252 |
| 1990 | 74 | 123 | 92 | 137 | 30 | 150 | 12 | 17 | 13 | 22 |
| B, MouangkhaiNua | | | | | | | | | | |
| 1986 | 223 | | 270 | | 150 | | 1,200 | | 100 | |
| 1987 | 207 | 93 | 300 | 111 | 137 | 91 | 1,115 | 93 | 120 | 120 |
| 1988 | 269 | 121 | 208 | 77 | 105 | 70 | 1,320 | 110 | 117 | 117 |
| 1989 | 204 | 91 | 250 | 93 | 160 | 107 | 1,008 | 84 | 105 | 105 |
| 1990 | 229 | 103 | 315 | 117 | 110 | 73 | 1,100 | 92 | 99 | 99 |
| B, MouangkhaiTai | | | | | | | | | | |
| 1986 | 207 | | 290 | | 187 | | 1,300 | | 160 | |
| 1987 | 204 | 99 | 304 | 105 | 162 | 87 | 1,200 | 92 | 140 | 88 |
| 1988 | 230 | 111 | 280 | 97 | 156 | 83 | 1,400 | 108 | 130 | 81 |
| 1989 | 210 | 101 | 345 | 119 | 110 | 59 | 1,100 | 85 | 120 | 75 |
| 1990 | 206 | 100 | 350 | 121 | 105 | 56 | 1,200 | 92 | 150 | 94 |

## Total Number of Livestock in the Study Area Every 5. Years.

| Name of Village | Buffalo | UP % | Cattle | UP % | Pig | UP % | Fowl | UP % | Duck | UP % |
|---|---|---|---|---|---|---|---|---|---|---|
| B, Dontoum | | | | | | | | | | |
| 1986 | 76 | | 200 | | 102 | | 578 | | 400 | |
| 1987 | 79 | 104 | 230 | 115 | 120 | 118 | 642 | 111 | 500 | 125 |
| 1988 | 80 | 105 | 275 | 138 | 143 | 140 | 798 | 138 | 600 | 150 |
| 1989 | 84 | 111 | 300 | 150 | 150 | 147 | 872 | 151 | 760 | 190 |
| 1990 | 86 | 113 | 350 | 175 | 170 | 167 | 1,325 | 229 | 900 | 225 |
| B, Dongmakfai | | | | | | | | | | |
| 1986 | 304 | | 433 | | 400 | | 1,540 | | 214 | |
| 1987 | 290 | 95 | 340 | 79 | 324 | 81 | 2,300 | 149 | 256 | 120 |
| 1988 | 275 | 90 | 462 | 107 | 465 | 116 | 2,456 | 159 | 325 | 152 |
| 1989 | 317 | 104 | 427 | 99 | 327 | 82 | 948 | 62 | 222 | 104 |
| 1990 | 320 | 105 | 586 | 135 | 218 | 55 | 1,005 | 65 | 302 | 141 |
| B, NamphouNua | | | | | | | | | | |
| 1986 | 110 | | 130 | | 65 | | 216 | | 54 | |
| 1987 | 112 | 102 | 138 | 106 | 79 | 122 | 322 | 102 | 55 | 102 |
| 1988 | 120 | 109 | 148 | 114 | 82 | 126 | 342 | 108 | 59 | 109 |
| 1989 | 127 | 115 | 154 | 118 | 85 | 131 | 358 | 113 | 65 | 120 |
| 1990 | 138 | 125 | 165 | 127 | 92 | 142 | 362 | 115 | 68 | 126 |
| B, NamphouTai | | | | | | | | | | |
| 1986 | 95 | | 121 | | 38 | | 825 | | 276 | |
| 1987 | 113 | 119 | 134 | 111 | 46 | 121 | 716 | 87 | 314 | 114 |
| 1988 | 122 | 128 | 152 | 126 | 36 | 95 | 709 | 86 | 283 | 103 |
| 1989 | 138 | 145 | 178 | 147 | 40 | 105 | 690 | 84 | 305 | 111 |
| 1990 | 148 | 156 | 191 | 158 | 43 | 113 | 694 | 84 | 267 | 97 |
| B, Dongphosi | | | | | | | | | | |
| 1986 | 97 | | 475 | | 100 | | 428 | | 124 | |
| 1987 | 100 | 103 | 490 | 103 | 118 | 118 | 635 | 148 | 127 | 102 |
| 1988 | 112 | 115 | 511 | 108 | 120 | 120 | 700 | 164 | 319 | 257 |
| 1989 | 103 | 106 | 543 | 114 | 119 | 119 | 540 | 126 | 201 | 162 |
| 1990 | 105 | 108 | 560 | 118 | 200 | 200 | 684 | 160 | 168 | 135 |
| B, Phoxai | | | | | | | | | | |
| 1986 | 60 | | 79 | | 18 | | 420 | | 26 | |
| 1987 | 65 | 108 | 84 | 106 | 24 | 133 | 450 | 107 | 34 | 131 |
| 1988 | 73 | 122 | 93 | 118 | 25 | 139 | 370 | 88 | 31 | 119 |
| 1989 | 76 | 127 | 95 | 120 | 15 | 83 | 480 | 114 | 22 | 85 |
| 1990 | 88 | 147 | 100 | 127 | 12 | 67 | 500 | 119 | 50 | 192 |

Source : Agriculture Data Office in the Sub District, 1991.

## Table V - 5 Market Price in the Study Area

| Sell Item (kg/kip) | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Average 87.Pric | Average 88.Pric | Average 90.Pric |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cack Paddy | | | | | | | | | | | | | | | |
| (Grade. 1) | 85 | 85 | 85 | 90 | 90 | 95 | 95 | 100 | 110 | 85 | 85 | 85 | 75 | 80 | 95 |
| (Grade. 2) | 70 | 70 | 70 | 75 | 75 | 80 | 95 | 95 | 80 | 75 | 70 | 70 | 65 | 70 | 70 |
| Rice | | | | | | | | | | | | | | | |
| (Grade. 1) | 190 | 195 | 200 | 250 | 280 | 280 | 280 | 280 | 250 | 200 | 190 | 190 | 220 | 250 | 250 |
| (Grade. 2) | 180 | 180 | 185 | 185 | 200 | 200 | 250 | 200 | 190 | 185 | 185 | 180 | 190 | 200 | 220 |
| Onion | | | | | | | | | | | | | | | |
| (Grade. 2) | 400 | 400 | 400 | 450 | 400 | 400 | 400 | 400 | 350 | 350 | 350 | 350 | 350 | 380 | 400 |
| Garlic | 350 | 350 | 350 | 350 | 400 | 400 | 400 | 350 | 350 | 350 | 350 | 350 | 350 | 400 | 430 |
| Chili | 350 | 400 | 450 | 450 | 450 | 450 | 350 | 350 | 250 | 250 | 250 | 250 | 300 | 350 | 400 |
| Chili (dry) | 1000 | 900 | 900 | 1000 | 900 | 900 | 800 | 850 | 850 | 900 | 1000 | 1000 | 850 | 900 | 1000 |
| Tomato | 450 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 450 | 500 | 450 | 450 | 450 | 450 | 450 |
| Hull, Pranut | 200 | 250 | 250 | 250 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 150 | 150 | 200 |
| Bean | 500 | 450 | 450 | 450 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 350 | 400 | 420 |
| Banana | 150 | 200 | 200 | 200 | 200 | 200 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 180 | 200 |
| MEAT | | | | | | | | | | | | | | | |
| Buffalo | 500 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 400 | 400 | 400 | 400 | 350 | 400 | 430 |
| Cattle | 550 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 550 | 550 | 550 | 550 | 450 | 500 | 550 |
| Pig | 450 | 450 | 450 | 450 | 450 | 450 | 400 | 400 | 400 | 400 | 400 | 400 | 330 | 400 | 450 |
| Chicken | 500 | 600 | 350 | 350 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 350 | 400 | 450 |
| Fish | 550 | 600 | 600 | 600 | 500 | 500 | 500 | 500 | 500 | 500 | 450 | 450 | 350 | 450 | 500 |
| Sugar | 180 | 180 | 180 | 200 | 200 | 200 | 200 | 200 | 200 | 180 | 180 | 180 | 180 | 200 | 200 |
| Milk | 190 | 200 | 200 | 200 | 210 | 210 | 210 | 210 | 210 | 210 | 200 | 200 | 150 | 180 | 200 |
| Salt | 35 | 35 | 35 | 40 | 45 | 45 | 45 | 45 | 45 | 45 | 35 | 35 | 25 | 35 | 45 |

Source: Interview survey at Kenckok markets in 1991. By the study team

# Table V - 6 Total Labber and Water Buffaloes Demand

## Labber

| Sanonal Item | Growing Area (ha) | Total Labber Budget Withe Project Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainy Paddy | 155 | 0 | 0 | 0 | 0 | 4,340 | 5,425 | 2,325 | 620 | 775 | 2,015 | 4,650 | 2,325 |
| Irrigated Paddy | 1,655 | 0 | 0 | 0 | 0 | 41,375 | 57,925 | 33,100 | 6,620 | 6,620 | 33,100 | 49,650 | 24,825 |
| Dry Season Paddy | 490 | 4,900 | 25,480 | 4,900 | 17,150 | 12,250 | 0 | 0 | 0 | 0 | 0 | 0 | 12,250 |
| Rainy Season Crop | 15 | 0 | 0 | 0 | 0 | 375 | 135 | 75 | 75 | 375 | 375 | 0 | 0 |
| Dry Sason Crop | 495 | 11,880 | 6,435 | 4,950 | 2,475 | 2,970 | 12,375 | 0 | 0 | 0 | 0 | 0 | 10,890 |
| Sub-Total | 1,810 | 16,780 | 31,915 | 9,850 | 19,625 | 61,310 | 75,860 | 35,500 | 7,315 | 7,770 | 35,490 | 54,300 | 50,290 |
| Available Family ① | 4,426 | 137,206 | 128,354 | 137,206 | 132,780 | 137,206 | 132,780 | 137,206 | 132,780 | 132,780 | 137,206 | 132,780 | 137,206 |
| Employee ② | | -120,426 | -96,439 | -127,356 | -113,155 | -75,896 | -56,920 | -101,706 | -125,465 | -125,010 | -101,716 | -78,480 | -86,916 |
| Employee, 20dy/mth | | 88,520 | 88,520 | 88,520 | 88,520 | 88,520 | 88,520 | 88,520 | 88,520 | 88,520 | 88,520 | 88,520 | 88,520 |
| Net Emply | | 71,740 | 56,605 | 78,670 | 68,895 | 27,210 | 12,660 | 53,020 | 81,205 | 80,750 | 53,030 | 34,220 | 38,230 |

Note : ① Total number of manpower in the study area
② Number of Possibility Employee

## Water Buffalo

| Sanonal Item | Growing Area (ha) | Jan. | Feb. | Mar. | Apr. | May. | June. | July. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainy Paddy | 155 | 0 | 0 | 0 | 0 | 4,340 | 5,425 | 2,325 | 620 | 775 | 2,015 | 4,650 | 2,325 |
| Irrigated Paddy | 1,655 | 0 | 0 | 0 | 0 | 41,375 | 57,925 | 33,100 | 6,620 | 6,620 | 33,100 | 49,650 | 24,825 |
| Dry Sason Paddy | 490 | 4,900 | 25,480 | 4,900 | 17,150 | 12,250 | 0 | 0 | 0 | 0 | 0 | 0 | 12,250 |
| Rainy Sason Crop | 15 | 0 | 0 | 0 | 0 | 375 | 135 | 75 | 75 | 375 | 375 | 0 | 0 |
| Dry Sason Crop | 495 | 11,880 | 6,435 | 4,950 | 2,475 | 2,970 | 12,375 | 0 | 0 | 0 | 0 | 0 | 10,890 |
| Sub-Total | | 16,780 | 31,915 | 9,850 | 19,625 | 61,310 | 75,860 | 35,500 | 7,315 | 7,770 | 35,490 | 54,300 | 50,290 |
| Demand of Animal, day/month | | 1,678 | 3,192 | 985 | 1,963 | 6,131 | 7,586 | 3,550 | 732 | 777 | 3,549 | 5,430 | 5,029 |
| Average of Work day/month | | 27,450 | 27,450 | 27,450 | 27,450 | 27,450 | 27,450 | 27,450 | 27,450 | 27,450 | 27,450 | 27,450 | 27,450 |
| Balance | | 25,772 | 24,259 | 26,465 | 25,488 | 21,319 | 19,864 | 23,900 | 26,719 | 26,673 | 23,901 | 22,020 | 22,421 |

Note : Total Number of Water Buffalo 2.860 head
Number of Buffalo in the Project Area 2.8 head
Number of Adult Buffalo 1.830 head
Average of Working day 15 day/month,
Demand of Animal Wark, Total man-day 10%

Table V - 7 Balance of Rice Consumption

| Name of Village | ① Population | ② Rice Production | ③ Seed & Tax | ④ Rice Consumption | ⑤ Balance |
|---|---|---|---|---|---|
| B.Xianban | 532 | 243,000 | 24,300 | 175,560 | 43,140 |
| B.Nonghong | 457 | 188,000 | 18,800 | 150,810 | 18,390 |
| B.Sithong | 560 | 477,000 | 47,700 | 184,800 | 244,500 |
| B.Kho | 712 | 499,000 | 49,900 | 234,960 | 214,140 |
| B.Nongveng | 392 | 227,000 | 22,700 | 129,360 | 74,940 |
| B.Dongdokmai | 515 | 314,000 | 31,400 | 169,950 | 112,650 |
| B.Vatthana | 650 | 260,000 | 26,000 | 214,500 | 19,500 |
| B.Phailon | 317 | 173,000 | 17,300 | 104,610 | 51,090 |
| B.Nanokkian | 455 | 121,000 | 12,100 | 150,150 | -41,250 |
| B.Dongkhankhou | 913 | 194,000 | 19,400 | 301,290 | -126,690 |
| B.Nongkalong | 640 | 136,000 | 13,600 | 211,200 | -88,800 |
| B.Gnangsong | 479 | 146,000 | 14,600 | 158,070 | -26,670 |
| B.Dongkhamkhen | 426 | 75,000 | 7,500 | 140,580 | -73,080 |
| B.Phonthan | 225 | 85,000 | 8,500 | 74,250 | 2,250 |
| Sub-Total | 7,273 | 3,138,000 | 313,800 | 2,400,090 | 424,110 |
| B.Mouangkhai Nua | 965 | 213,000 | 21,300 | 318,450 | -126,750 |
| B.Mouangkhai Tai | 1,316 | 247,000 | 24,700 | 434,280 | -211,980 |
| B.Dontoum | 616 | 291,000 | 29,100 | 203,280 | 58,620 |
| B.Dongmakfai | 1,551 | 274,000 | 27,400 | 379,830 | -133,230 |
| B.Donghouakham | 227 | 51,000 | 5,100 | 74,910 | -29,010 |
| B.Namphou Nua | 630 | 130,000 | 13,000 | 207,900 | -90,900 |
| B.Namphou Tai | 568 | 71,000 | 7,100 | 187,440 | -123,540 |
| B.Dongphosi | 740 | 134,000 | 13,400 | 244,200 | -123,600 |
| B.Phoxai | 267 | 50,000 | 5,000 | 88,110 | -43,110 |
| Sub-Total | 6,880 | 1,461,000 | 146,100 | 2,138,400 | -823,500 |
| TOTAL | 14.063 | | 459,90 | 2,212,650 | |

(unit. kg)

Note ① – ② Data from Agricultural office in Sub District
③ Seed and Tax ratio of 10% from ②
④ Average of rice Consumption 330Kg/man/year
⑤ ② – (③ + ④)

Table V-8 Present Farm Input and Labof Requirement for Rice of Rice

| Item | Rainy Season Paddy | Farm, Cost (kip) | Up Land Rice | Farm, Cost (kip) |
|---|---|---|---|---|
| Farm Inputs | | | | |
| Seed | 55kg/ha | 3,850 | 80kg/ha | 5,600 |
| Fertilizer | | | | |
| Urea | 5kg/ha | 550 | 0 | 0 |
| 16-20-0 | 25kg/ha | 3,000 | 0 | 0 |
| Compost | 5kg/ha | 100 | 0 | 0 |
| Insecticide | | | | |
| Diazinon | 0 | | | |
| Seven | 5kg/ha | 4,650 | 0 | 0 |
| Foridol | 0 | | | |
| Tax | Houshold | 7,875 | 0 | 0 |
| Labor | | | | |
| Land Preparation | 25day/man/ha | 12,500 | 25day/man/ha | 12,500 |
| Nursery | 7day/man/ha | 3,500 | | |
| Transplanting | | | (seeding) | |
| Family labor. | 40day/man/ha | 20,000 | 25day/man/ha | 12,500 |
| Hired labor. | (5man/ha) | 2,500 | | |
| Othe Work | 16day/manhha | 8,000 | 5day/man/ha | |
| | | | | 2,500 |
| Harvesting | | | | |
| Family labor. | 30day/man/ha | 15,000 | 30day/man/ha | 15,000 |
| Hired labor. | (5man/ha) | 2,500 | | |
| Threshing | 17day/man/ha | 8,500 | 17day/man/ha | 8,500 |
| Total | 145 | 92,525 | 102 | 54,100 |

Source : Farm interview Survey in the Study Area 1991.

Note, Cause of Farme Saize 1 > 1.5ha in Rainy Season Paddy.
Cause of Tax Paddy Yield 1.5t/ha Tax Rate 5% Price 70kip/kg.
Cause of Labor 500kip/day.

Table V-9 Proposed Farm Input and Labor Requirement for Rice

| Item | | Rainy Season Paddy | Dry Season Paddy |
|---|---|---|---|
| Farm Inputs | | | |
| Seed | (kg/ha) | 40 | 40 |
| Fertilizer | | | |
| Urea | (kg/ha) | 100 | 100 |
| Ammopos | (kg/ha) | 150 | 200 |
| Compost | (kg/ha) | 1,000 | 500 |
| Insecticide | | | |
| Diazinon13% | (kg/ha) | 10 | 5 |
| Labor (man-day/ha) | | | |
| Land preparation | | 25 | 30 |
| Nursery growing | | 3 | 5 |
| Transplanting | | | |
| Family labor | | 40 | 40 |
| Hired labor | | 10 | 7 |
| Irrigation | | 5 | 10 |
| Manuring | | 5 | 5 |
| Harvesting | | | |
| Family labor | | 30 | 30 |
| Hired labor | | 20 | 10 |
| Total | | 153 | 157 |

Table V-10 Present Farm Input and Labor Requirement for Peanut

| Item | Rainy Season Peanut | Farm Cost (kip) |
|---|---|---|
| Farm Inputs (kg/ha) | | |
| Seed (grain, 250/kip/kg) | 75 | 18,750 |
| Fertilizer | | |
| Urea | 0 | 3,000 |
| 16-20-0 | 25 | |
| Compost | 0 | |
| Insecticide | | |
| Diazinon | 0 | |
| Seven | 5 | 4,650 |
| Foridol | 0 | |
| Tax | 0 | |
| Labor (day/man/ha) | | |
| Land Peparation | 22 | 11,000 |
| Seeding | 12 | 6,000 |
| Pest Control | 3 | 1,5000 |
| Weeding | 10 | 5,000 |
| Harvesting | | |
| Family labor. | 25 | 12,500 |
| Hired labor. | 10 | 5,000 |
| Threshing (Dry up) | 12 | 6,000 |
| Total | 94 | 86,900 |

Table V-11 Proposed Farm Input and Labor Requirement for Peanut

| Item | | Dry Season Peanut | Cost |
|---|---|---|---|
| Farm Inputs (kg/ha) | | | |
| Seed | (grain 250k/kg) | 60 | 15,000 |
| Fertilizer | | | |
| Urea | (11200k/50kg) | 50 | 11,200 |
| 16-20-0 | (10200k/50kg) | 150 | 30,600 |
| Compost | (3500k/1000kg) | 1,000 | 3,500 |
| Insecticide | | | |
| Diazinon | | | |
| Seven | | | |
| Foridol | | 10 | 8,000 |
| Tax | | 0 | 0 |
| Labor (day/man/ha) | | | |
| Land Preparation | | 22 | 11,000 |
| Seeding | | 12 | 6,000 |
| Pest Control | | 5 | 2,500 |
| Weeding | | 10 | 5,000 |
| Harvesting | | | |
| Family labor. | | 30 | 15,000 |
| Hired labor. | | 10 | 5,000 |
| Threshing (Dry up) | | 10 | 5,000 |
| Irrigation | | 5 | 2,500 |
| Total | | 104 | 120,300 |

# V - 12 Facilities and Summarized for Fish

| Item | Start | Second | 3.th | 4.th | 5.th | 6.th | 7.th | 8.th | 9.th | 10.th |
|---|---|---|---|---|---|---|---|---|---|---|
| Expenses | 312,000 | 569,400 | 569,400 | 569,400 | 569,400 | 569,400 | 569,400 | 569,400 | 569,400 | 569,400 |
| Maintenance | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 | 50,000 |
| Feed cost | 43,200 | 43,200 | 43,200 | 43,200 | 43,200 | 43,200 | 43,200 | 43,200 | 43,200 | 43,200 |
| Feed (1) | 58,620 | 58,620 | 58,620 | 58,620 | 58,620 | 58,620 | 58,620 | 58,620 | 58,620 | 58,620 |
| Netting | 50,000 | 450,000 | 0 | 0 | 50,000 | 450,000 | 0 | 0 | 0 | 450,000 |
| Buy fish | 11,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 524,820 | 10171,220 | 721,220 | 721,220 | 771,220 | 1,171,220 | 721,220 | 721,220 | 721,220 | 1,171,220 |
| | | | | | | | | | | |
| Fish Income | 0 | 0 | 374,600 | 766,500 | 238,100 | 4,415,000 | 4,861,400 | 4,861,400 | 4,861,400 | 4,861,400 |
| Fry Income | 0 | 134,540 | 210,700 | 210,700 | 21,0700 | 210,700 | 210,700 | 210,700 | 210,700 | 210,700 |
| Total Income | 0 | 134,540 | 585,300 | 977,200 | 448,800 | 4,625,700 | 5,072,100 | 5,072,100 | 5,072,100 | 5,072,100 |
| Total Input | 524,820 | 1,171,200 | 721,200 | 721,200 | 771,200 | 10171,200 | 721,200 | 721,200 | 721,200 | 1,171,200 |
| | | | | | | | | | | |
| Balance | -524,820 | -902,120 | 449,400 | 1,233,200 | 126,400 | 8,080,200 | 9,423,000 | 9,423,000 | 9,423,000 | 8,973,000 |
| Accumulate Balance | -524,820 | -1,426,940 | -977,540 | 255,660 | 382,060 | 8,462,260 | 17,885,260 | 27,308,260 | 36,731,260 | 45,704,260 |

(Unit kip)

Note:

| | | |
|---|---|---|
| Expenses | 234000 | (1300*15*12) |
| | 312000 | (1300*20day*12month) |
| Feed Cost | 19530 | (90day*2kg) = 180kg/year*93kip = 16740kip/year |
| | | (30day*1kg) = 30kg/year*93kip = 2790 |
| Fry Feed | 26000 | (0.2kg*38day*142kip) = 1080kip*8ponds*3time/year = 26000kip |
| Netting | 663000 | (net10m*5th) = 75000kip*2set = 150000kip |
| | | Miscellaneous expenses = 500000kip |
| | | Pong maintenance 13000kip |
| Breeding Fis | 8500 | (Tilapia 30kip*200fl, Carf25kip*100fl) |
| Maintenance | 35000 | (fuel 350kip*100) = 35000kip/year |

## Characteristics of Rice Varieties

| Variety | Photo-period (×/-) | Growth duration (days) | Fertilizer doses (N-P-K) | Expect-ed yield (ton/ha) | Insect and Disease | Taste | Remarks |
|---|---|---|---|---|---|---|---|
| Rainy Season | | | | | | | |
| - Glutionous rice | | | | | | | |
| Sampaton | + | 150 | 20-30-0 | 3 | Susceptible to Blast, BLB and SB | Good | |
| RD-8 | + | 145 | 50-30-0 | 4-5 | - ditto - | Good | Foundation seed released since 1985, Back cross of Banpaton |
| RD-16 | - | 130 | 50-30-0 | 4-5 | - ditto - | Fairly good | |
| IR-848 | - | 140 | 50-30-0 | 4-5 | Susceptible to BPH | Fiarly good | Low milling quality |
| - Non-glutinous rice | | | | | | | |
| Hom Mali | + | 150 | 20-30-0 | 3 | Susceptible to Blast, BLB and SB | Good | |
| CR-203 | - | 125 | 50-30-0 | 4-5 | Moderately resistant to BPH and SB | Farily good | |
| IR-42 | - | 150 | 50-30-0 | 4-5 | - ditto - | Fairly good | |
| Dry Season | | | | | | | |
| - Glutinous rice | | | | | | | |
| RD-16 | - | 125 | 60-30-0 | 4-5 | Susceptible to Blast, BLB and SB | Fairly good | |
| IR-848 | - | 140 | 60-30-0 | 4-5 | Susceptible to BPH | Fiarly good | Low milling quality |
| IR-253 | - | 150 | 60-30-0 | 4-5 | Resistant to SB | Fiarly good | |
| - Non-glutionous rice | | | | | | | |
| CR-203 | - | 120 | 90-60-0 | 5-6 | Moderately resistant to BPH and SB | Fiarly good | |
| IR-42 | - | 145 | 90-60-0 | 5-6 | - ditto - | Fiarly good | |

Remark : BLB - Bacterial Leaf Bright, BPH - Brown Plant Hopper, SB - Stemborer
Source : Salakham Rice Research Station

## Present Planting Paddy Variety in the Sub District

| Number of sub District | Early Variety Paddy (ha) | Planting Percent | Medium Variety Paddy (ha) | Planting Percent | Late Variety Paddy (ha) | Planting Percent | Total Planting (ha) |
|---|---|---|---|---|---|---|---|
| Khamthao | | | | | | | |
| 1986 | 597 | 35 | 253 | 15 | 837 | 50 | 1,687 |
| 1987 | 599 | 35 | 254 | 15 | 835 | 49 | 1,688 |
| 1988 | 265 | 16 | 725 | 43 | 701 | 41 | 1,691 |
| 1989 | 321 | 19 | 245 | 14 | 1,128 | 67 | 1,694 |
| 1990 | 788 | 39 | 708 | 35 | 503 | 25 | 1,999 |
| 1991 | 488 | 29 | 708 | 42 | 503 | 30 | 1,699 |
| Nanokkhian | | | | | | | |
| 1986 | 194 | 25 | 289 | 37 | 289 | 37 | 772 |
| 1987 | 197 | 25 | 295 | 37 | 295 | 37 | 787 |
| 1988 | 207 | 25 | 310 | 37 | 310 | 37 | 827 |
| 1989 | 175 | 25 | 262 | 37 | 262 | 37 | 699 |
| 1990 | 186 | 25 | 278 | 37 | 278 | 37 | 742 |
| 1991 | 183 | 25 | 275 | 38 | 275 | 38 | 733 |
| Vatthana | | | | | | | |
| 1986 | 114 | 19 | 309 | 51 | 186 | 31 | 609 |
| 1987 | 114 | 19 | 309 | 51 | 186 | 31 | 609 |
| 1988 | 114 | 19 | 305 | 50 | 186 | 31 | 605 |
| 1989 | 113 | 19 | 305 | 51 | 183 | 30 | 601 |
| 1990 | 113 | 19 | 305 | 51 | 183 | 30 | 601 |
| 1991 | 112 | 19 | 305 | 51 | 183 | 31 | 600 |
| Mouangkhai | | | | | | | |
| 1986 | 278 | 20 | 450 | 33 | 650 | 47 | 1,378 |
| 1987 | 300 | 22 | 555 | 40 | 523 | 38 | 1,378 |
| 1988 | 246 | 18 | 500 | 36 | 632 | 46 | 1,378 |
| 1989 | 340 | 25 | 625 | 45 | 413 | 30 | 1,378 |
| 1990 | 273 | 20 | 549 | 40 | 556 | 40 | 1,378 |
| 1991 | 305 | 22 | 496 | 36 | 577 | 42 | 1,378 |
| Nateuy | | | | | | | |
| 1986 | 106 | 15 | 361 | 51 | 234 | 33 | 701 |
| 1987 | 105 | 16 | 238 | 36 | 326 | 49 | 669 |
| 1988 | 221 | 30 | 241 | 33 | 263 | 36 | 725 |
| 1989 | 191 | 26 | 245 | 33 | 298 | 41 | 734 |
| 1990 | 160 | 22 | 248 | 33 | 336 | 45 | 744 |
| 1991 | 211 | 23 | 250 | 27 | 461 | 50 | 922 |
| Nakham | | | | | | | |
| 1986 | 248 | 20 | 248 | 20 | 744 | 60 | 1,240 |
| 1987 | 348 | 28 | 448 | 36 | 444 | 36 | 1,240 |
| 1988 | 251 | 20 | 375 | 30 | 614 | 50 | 1,240 |
| 1989 | 240 | 19 | 380 | 31 | 619 | 50 | 1,239 |
| 1990 | 240 | 19 | 500 | 40 | 500 | 40 | 1,240 |
| 1991 | 240 | 19 | 500 | 40 | 500 | 40 | 1,240 |
| Phone, Sog | | | | | | | |
| 1986 | 347 | 20 | 520 | 30 | 867 | 50 | 1,734 |
| 1987 | 347 | 20 | 520 | 30 | 867 | 50 | 1,734 |
| 1988 | 347 | 20 | 520 | 30 | 867 | 50 | 1,734 |
| 1989 | 347 | 20 | 520 | 30 | 867 | 50 | 1,734 |
| 1990 | 347 | 20 | 520 | 30 | 867 | 50 | 1,734 |
| 1991 | 347 | 20 | 520 | 30 | 867 | 50 | 1,734 |

Source : Sub District Agriculture Office 1991.

Result of Paddy Yield Srvey

| Sampling Place | Variety of | Hills per $m^2$ | Panicles per Hill | Grains per $m^2$ | % of Ripend | 1.000 Grain Weight (g) | Yield (ton/ha) |
|---|---|---|---|---|---|---|---|
| Phoxai | Dokmay | 17.2 | 51 | 3,412 | 88 | 34.37 | 1.173 |
| Namphou | Dokmay | 15.5 | 46 | 3,346 | 85 | 34.32 | 1.148 |
| Namphou | Kaset | 15.4 | 55 | 4,098 | 89 | 33.83 | 1.386 |
| Namphou | Kokho | 16.0 | 51 | 3,635 | 75 | 34.15 | 1.241 |
| Dongphosi | Kokho | 15.7 | 81 | 5,978 | 70 | 37.27 | 2.228 |
| Dongphosi | Dokmay | 16.4 | 82 | 7,019 | 75 | 36.31 | 2.549 |
| Namphou | Dokmay | 16.7 | 79 | 8,180 | 80 | 36.46 | 2.982 |
| Dongphosi | Kaset | 16.2 | 81 | 7,027 | 80 | 36.65 | 2.575 |
| Nanokkian | Dokmay | 20.6 | 111 | 6,564 | 88 | 31.72 | 2.082 |
| Nonnady | Kaset | 26.0 | 78 | 6,385 | 65 | 30.91 | 1.974 |
| Nongkhalong | Dokmay | 26.2 | 110 | 8,786 | 88 | 32.13 | 2.823 |
| Nanokkian | Doktiou | 24.3 | 102 | 7,267 | 88 | 31.65 | 2.300 |
| dongkhamkhen | Ko Kho | 23.8 | 85 | 5,600 | 75 | 37.84 | 2.119 |
| Nongkhalong | Dokmay | 22.3 | 62 | 4,924 | 80 | 39.80 | 1.960 |
| Dongkhamkhen | Phokha | 23.0 | 73 | 6,248 | 78 | 33.20 | 2.074 |
| Nanokkian | Kaset | 23.0 | 73 | 5,587 | 85 | 36.71 | 2.051 |

Note: Result of Paddy Yield at 1991. Surveyed by the Study Team

Result of Peanut Quality Survey

| Sampling Place | Sample Total (g) | Single Grain | Dorble Grain | Triple Grain | Sample Weight (g) | Grain (g) | % of Grain (g) | No. High Quality | No. Low Quality |
|---|---|---|---|---|---|---|---|---|---|
| Namphou | 4,490 | 2,000 | 1,691 | 464 | 4,155 | 2,660 | 64 | 460 | 768 |
| Namphou | 4,500 | 1,800 | 2,300 | 150 | 4,250 | 2,600 | 61 | 380 | 690 |
| Dongphosi | 4,200 | 1,550 | 2,880 | 120 | 4,550 | 2,800 | 62 | 430 | 780 |
| Dongphosi | 4,050 | 1,860 | 1,750 | 382 | 3,982 | 2,600 | 65 | 450 | 680 |

Note: Result of Peanut Quality at 1991. Surveyed by the Study Team

Table Future Demand Paddy and Peanut

| Item | Without Project | | | With Project | | |
|---|---|---|---|---|---|---|
| | Area (ha) | Yield (t/ha) | Production (t) | Area (ha) | Yield (t/ha) | Production (t) |
| Rainfed Paddy | 1,655 | 1.5 | 2,483 | 0 | | |
| Irrigation Paddy | 0 | | | 1,655 | 4 | 5,793 |
| Irrigated Dry Season Paddy | 0 | | | 490 | 4.5 | 2,205 |
| Paddy Total | 1,655 | | 2,483 | 2,145 | | 7,998 |
| Peanut | 15 | 0.5 | 8 | 495 | 2.5 | 1,238 |

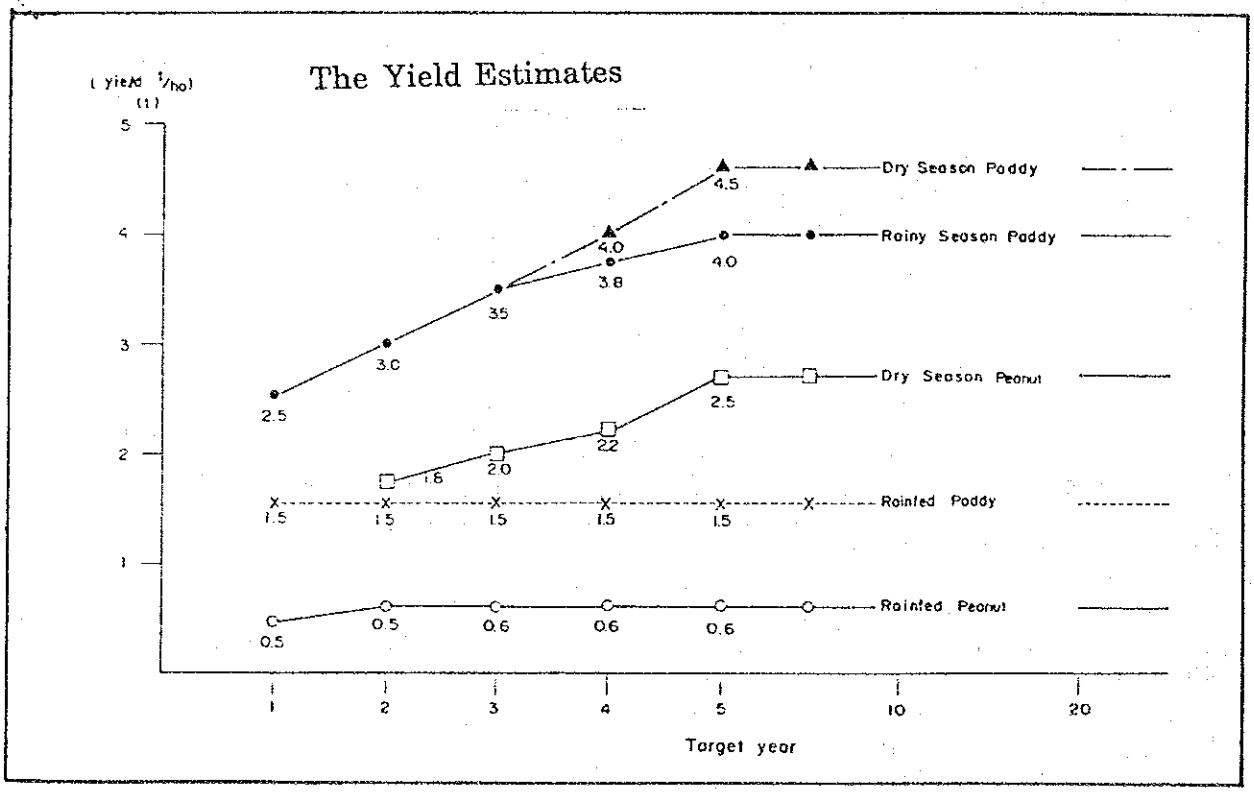



Fig. V - 1 The Yield Estimates

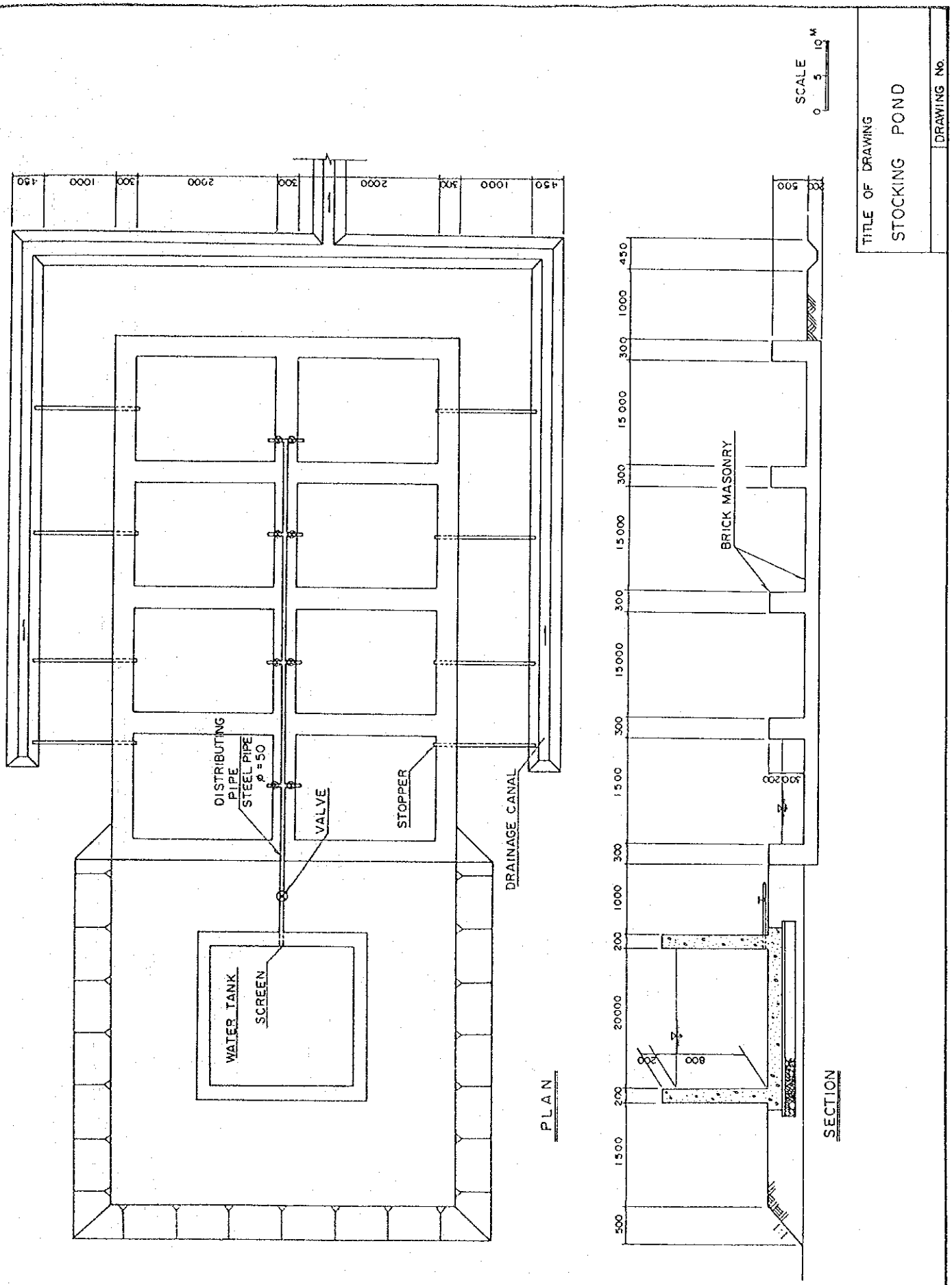
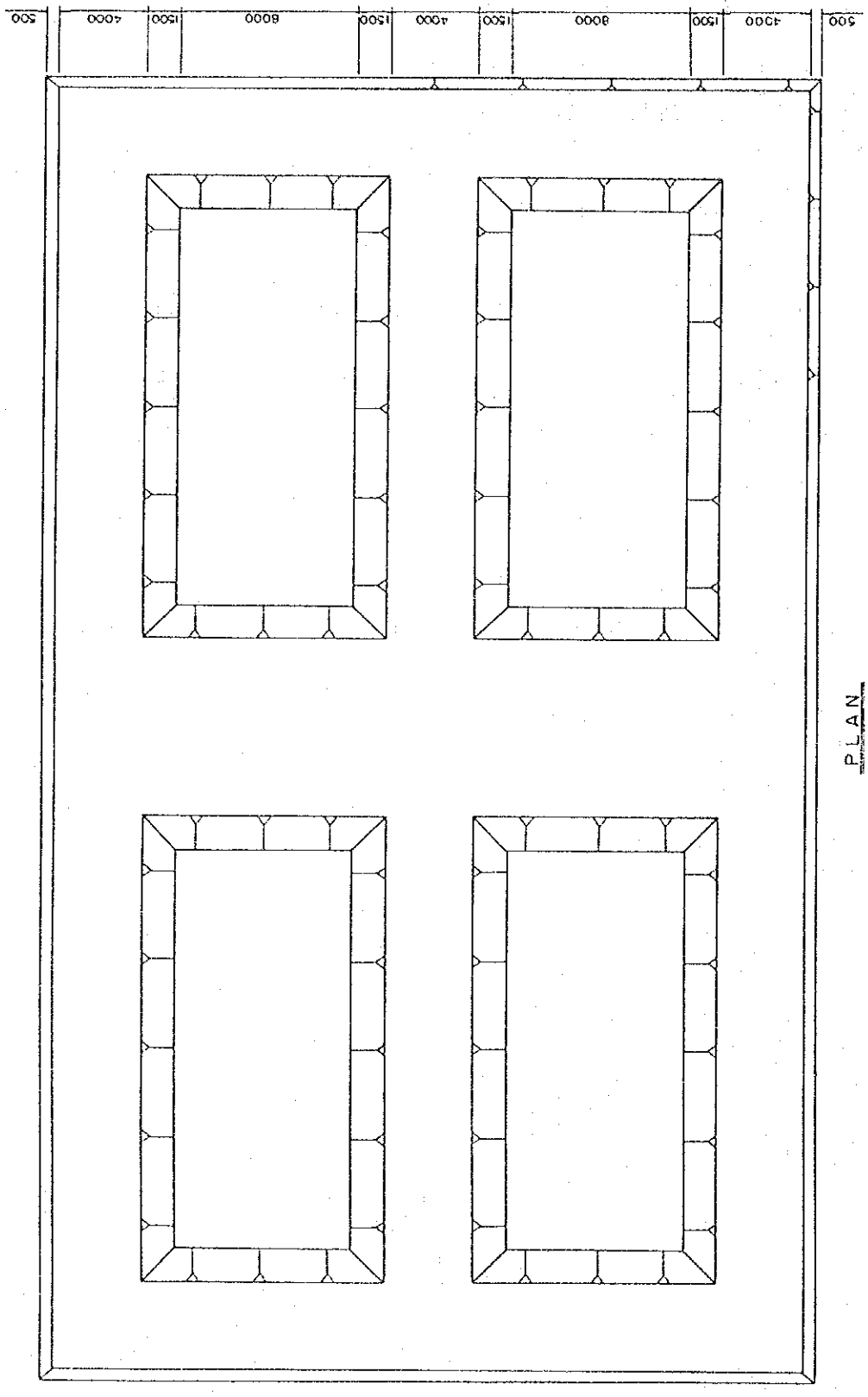
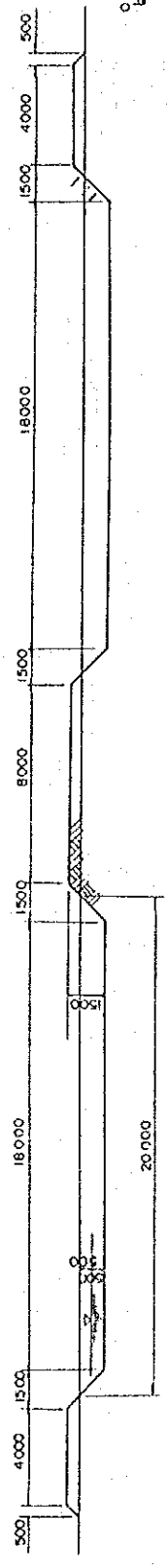



Fig. V - 2 Fry Production in the Hatchery




SCALE
0 1 2 3 4 5 10M

TITLE OF DRAWING
BREEDING POND

DRAWING NO.

Fig. V - 2 Breeding Pond

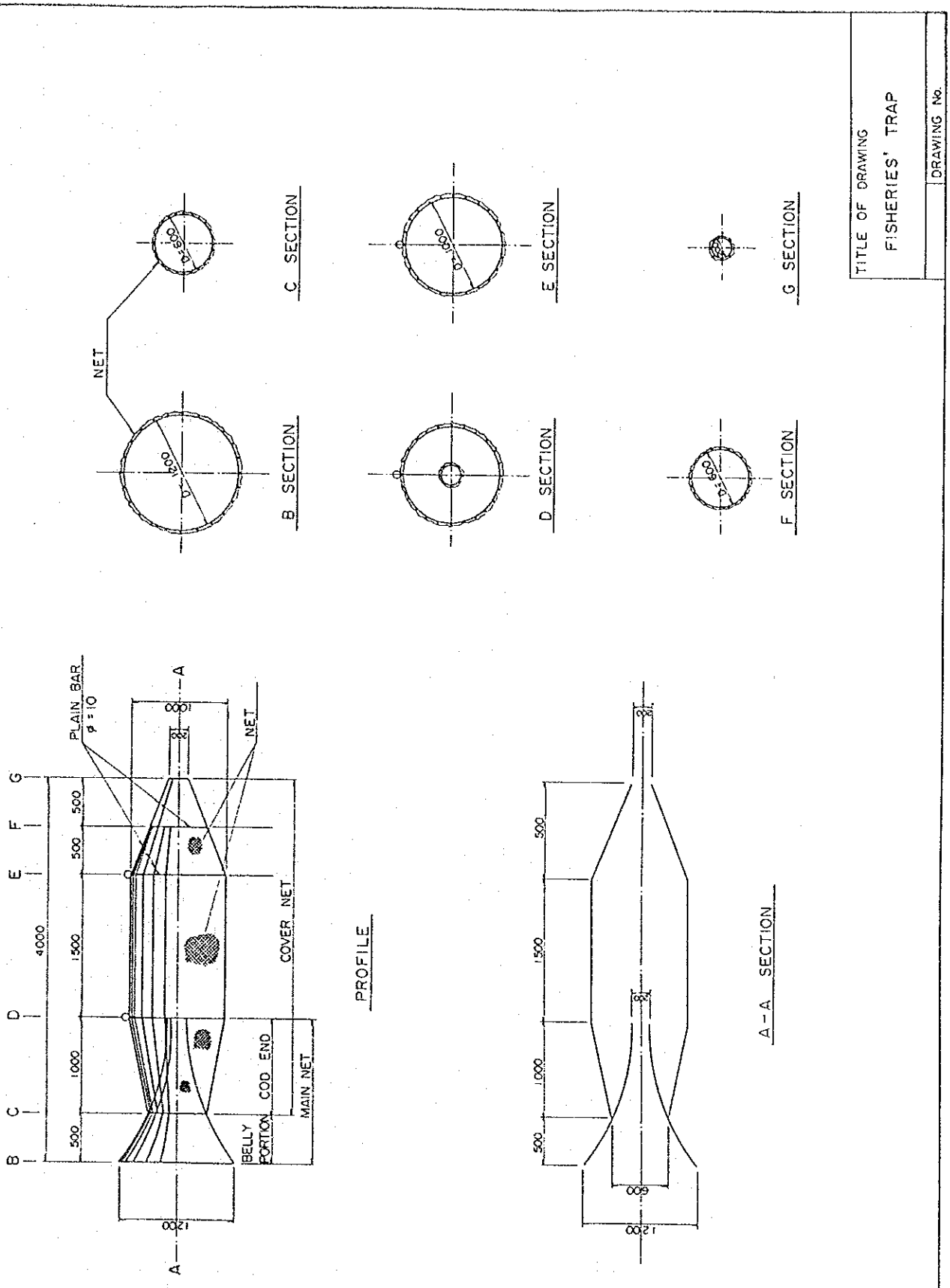



Fig. V - 3 Model of Fish Trap

# ANNEX VI

# AGROECONOMY

ANNEX VI

# AGROECONOMY

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## List of Tables

## 1. General

The present study on agroeconomy is designed to clarify the present condition of the rural economy and forecast the future economy after the implementation of the project.

Parallel to such data collection, and interview with 100 farm households was carried out in the study are from October 1991.

The farm budget analysis was mostly based on these survey results.

Approximately 80% of the population of Laos is into agriculture and forestry, and 60% of the GDP is covered by these industries.

Rice crops cover 85% of the cultivated land. cultivation in Laos depends largely on rain water and this dependence on weather conditions unstabilizes production. Accordingly, the economic policy implemented since 1975 concerning the establishment of self-sufficiency in food production was not achieved.

The causal factors behind the delay in the establishment of self-sufficiency in food production are as follows:

(1) Low Agricultural Productivity (due to the use of old techniques)

(2) Delayed transition to a market economy

(3) Unimproved roads conditions and shortage in transportation for delivery work around the area.

(4) Population Increase

Conclusively, self-sufficiency in food production can only be achieved through the stable increase in crop yield.

## 2. The Farmers Economic Conditions in the Study Area

Agriculture is the main industry in the area. According to the results of the survey on farmers' income, profits from paddy cultivation cover approximately 50% of the income.

The present agricultural conditions indicate extremely unstable yield. Further, in times of crisis, i.e., sickness in the family, accidents, decrease in yield, food shortage, etc., livestocks are sold to cover the expenses.

Most of the farmers have no savings, and the few who have, have only but a little.

The results of the interview conducted to the farmers are as summarized below.

- gross profits increase as the number of cultivated areas increase.

- the net profit of small scale farmers is bigger as their work load is smaller thus giving them chances to work in other fields and gain extra income.

- large scale farmers have large families and, therefore, need large food provisions.

The Laos Government established a new economic policy which aims to fully achieve self-sufficiency in food and rice production, improve farmers' income and set income disparity right. The policy also states the gist of the development plan.

## 3. Agriculture Developing Plan in New Economic Policy

### 3-1 Targets

In the future, the agricultural sector will remain the most important sector in the Lao Economy. In the past, the target of the "Central Planning" economy system of the agricultural sector was to be self-sufficient in rice production. Under the "New Economic Mechanism" or MEN, agriculture development will depend largely on the policy environment for private sector. The allocation of the means of production and the infrastructure of the agriculture development will be determined by the market and the decisions of the farmers' families.

This will lead to a basic change in the rice production policy to open up the production of the others crops as well, aiming at increasing the income and improving internal trades as well as external trades by ensuring good communications and information systems.

As indicated in Table VI - 1, in order to achieve the targets as planned, the agricultural production as a whole must be increased by 6.5% per year.

Table VI - 1 : The increases/year of the agricultural production planned for 1990-1995.

| | |
|---|---|
| Agriculture | 7.5% |
| Livestock and fishery | 6.6% |
| Forestry | 2.0% |
| | 6.5% |
| GDP(year 1989) Lao PDR | |

Remarks : Figures shown are based on potential average seasonal production and on the assumption that the NEM is implemented as planned.

Even though the GDP of the country depends quite considerably on the export of timber, the increase in forestry production is limited to a suitable level for environmental purposes.

Some targets as planned by the Bureau of Agriculture are summarized in Table VI - 2 below. We can already imagine that there are some increase in other crops while rice is still regarded as the principal crop.

Table VI - 2 : Estimation of crop production (1990-1995)

| Crops | 1990 Production 3 (× 10 tons) | Percentage increase Per year % |
|---|---|---|
| Paddy (Total) | 1407.5 | 2.3 |
| in which: | | |
| - Wet season rice | 1068.0 | 2.9 |
| - dry season rice | 45.5 | 8.8 |
| - upland rice | 294.0 | (-1.0) |
| - Vegetables | 72.8 | 10.9 |
| · Mous | 51.4 | 12.2 |
| · Cotton | 4.8 | 8.7 |
| · Coffee | 5.3 | 14.9 |
| · Tobacco | 38.7 | 13.0 |
| · Rootcrops | 176.1 | 20.0 |
| · Peanut | 6.9 | 15.9 |
| · Mungbean | 3.1 | 4.9 |
| · Soybean | 5.5 | 15.0 |
| · Tea | 0.8 | 33.5 |
| · Sugarcane | 144.7 | 15.0 |

In Table VI - 3, the target in livestock production is summarized. All production increased except buffaloes. This is explained by the slow increase in rice production which needs less buffaloes for assistance in land preparation.

Table VI - 3 : Animal production plan (1990-1995)

| Items | 1990 Production (× 1000 heads) | Percentage of increase/year % |
|---|---|---|
| - Buffaloes | 997.0 | (-1.6) |
| - Cattle | 830.0 | 8.8 |
| - Pig | 1351.0 | 9.7 |
| - Sheep and goat | 116.0 | 8.9 |
| - Poultry | 8039.0 | 5.9 |

Table VI - 2 summarizes some regional targets. The table is based on the increase in agriculture production and livestock production multiplied by the respective prices in 1989. As we can see, in general, production will increase steadily in other regions except in the central region where it will be a little lower.

Table VI - 4: Agriculture and livestock production targets in different regions

| | Percentage increase per year % from 1990-1995 | | |
|---|---|---|---|
| | Agriculture | Livestock | All |
| Northern region | 7.9 | 7.0 | 7.8 |
| Central region | 6.0 | 6.1 | 6.0 |
| Southern region | 8.0 | 6.2 | 7.7 |
| Total (Average) | 7.5 | 6.6 | 7.3 |

As mentioned earlier, the possibility of the National economy to achieve a high percentage increase and ensure public investments in the infrastructures of the country as planned, will depend on the export income and without any pressures or problems from outside. Agricultural sector will significantly contribute to this. The government has to negotiate with all the countries surrounding Lao P.D.R. in order to facilitate trade transactions. The improved export conditions in the forestry sector will be an important factor to success. This will include :

- The export trade will be increasingly responsible for the forestry sectors itself.

- Reduction of local consumption and increase in export, and

- Improve the price by improving the quality of the products and market management.

The basic strategies and specific recommendations in the following paragraph are aimed at switching the role of the government from controlling directly the investments and production, to supporting and providing services which are more

technical and important. This will create all the facilities needed and incentives for farmers to be more active and professional.

The most important concern is to provide all the information regarding marketing. All the planned projects within or outside the agricultural sector will be more or less useful to agricultural production.

In the initial phase of the plan, the expansion of the state enterprises activities will limit the infrastructural prospects of production, the supply of inputs for agro-industries and marketing. State intervention will be reduced, for example Vaccine production or seed production which can be established only where necessary and where private sectors can be promoted.

### 3-2 General recommendations for agricultural adjustment and reforms

The key issues in the development of agricultural adjustment are to strengthen the government institutions in order to provide efficiently good services to farmers' business. Some intermediate institutions will be reduced; and the remaining will be strengthened by clarifying their roles regarding the National Plan, in providing good reliable services. In the initial stage of the programs, the number of departments of the Ministry of Agriculture-Forestry will be reduced from 11 to 7 (Planning and Finance, Personnel, Cabinet, Research and extension, livestock and veterinary services, Irrigation and forestry and Environment). This will insure good monitoring of projects and efficacity in carrying out national programs.

### 3-3 Agriculture activities

In the past, the main strategy for agriculture was self-sufficiency in rice production in each region. From the introduction of NEM in 1986, changes are geared to produce crops other than rice.

In order to achieve the above mentioned targets, it is necessary to cultivate suitable crops according to the suitability of the lands. Some lands are suitable for growing rice. Rice are planted and excess of the rice product can be exchanged with others crops produced by other areas where lands are suitable for crops other than

rice. Government policies will be issued in order to facilitate trade and commerce and the use of suitable land-crops. This refers to land right reforms, the freedom of labor mobility and the promotion of private investments from within and abroad. The producers will have the right to decide where to sell their products, an incentive for them to have more income from their products. This will mean that the agro-industry has to buy the farmers' products according to the market price. During the implementation of the new programs aiming at increasing production, many state enterprises have to be more efficient in their management to cope with more competitive conditions or otherwise they have to shut down or sell their business.

As stated earlier, taxes will be increased. During the 3rd five year plan, agricultural taxes will be reviewed, therefore, changes in taxes will hamper some necessary crops. Land taxes will also be reviewed based on the value or quality of the land instead of the production of the land and export taxes.

## 3-4 Irrigated agriculture

One sector which the government had invested a lot of money in is irrigation. During the last fifteen years, significant investments have been made in public sectors where medium and large scale irrigation schemes are managed.

During the 3rd five year plan, the core strategy will be to consolidate and strengthen the role of farmer groups in ownership and in controlling their small and medium scale weir and pump irrigation schemes. The functions of the public agencies will be redirected from investment financing of support services to farmers associations. The overall management of the schemes will be under the farmers associations. Cost recovery will be introduced during this program. External lenders and donors will have to fit in with this new strategy by transforming the money through the bank system and provide as credit to farmers for their irrigation scheme development.

## 3-5 Livestock

In the case of agriculture, many reforms in accordance with strategies under the 3rd five year plan, were partly implemented from the onset of the NEM. But for

the case of livestock, export taxes and marketing barriers still remain and threaten the prices of the products.

Studies made recently indicate that the prices of cattle and meat throughout the country, except in the Vientiane areas, are lower by half of the prices nearby Thailand, though the quality of the products are almost the same. In 1990, export taxes were $35/head for cattle and $40/head for buffalo; and this caused the decrease in the farmers' income by 25 to 30%. While these taxes are lowered to some extent, present statistics show that lowering a little bit taxes, means higher price the farmers can get.

In order to promote the sector increased production as planned, the government has to :

- Remove all export taxes on livestock trade and impose income taxes instead.

- Remove all restrictions made upon the quotas of the livestock, and

- Allow for free trade if needs aroused from business are satisfactory.

In the past the government intervened in the livestock industry through livestock state enterprises and livestock projects under grant aids or loans from outside. In fact they are not very successful. One problem is that, the government was trying to adopt new technologies and production systems from abroad which are not suitable for the local conditions. However, the main problem is the lack of support and bad management by state enterprises which are not aware of the needs of the market. Many state enterprises still rely on the government investment heavily, though others sectors also need the money. During the implementation of this program, all of the livestock enterprises should be sold to private sectors.

So the budget saved can be spent for the control and prevention of disease for livestock exports. The lack of proper control and prevention of disease in livestock production causes a lot of loss and a risk in the sector investment as well as a big threat to the export industry. The first step in controlling livestock disease is to improve the institutions concerned. This will need to reorganize the livestock and

veterinary department in order to carry out such tasks and provide more important support services.

## 3-6 Forestry

The contribution in export income by the forestry sector is related to the rules and regulations suitable for export promotion very strictly. The policy aims at balancing the needs for sustainable or rational economic use of the forest resources with the need to preserve watershed areas and environmentally sensitive areas. During the 2nd five year plan, the danger of devastating the forest was protected by increasing taxes, export ban and strict guard of the cutting of the logs. However the threat to the resource is still in bad situations. This can be by 3 causes :

First, the economic reforms have eliminated some of the state controls on some basic income resources, at the same time the new tax policies have not been successful, so some provinces had to rely heavily on the forest exploitation.

Second, the ban on the forest exploitation in the region, specially in Thailand, that made the exploitation of the Lao forest more attractive.

Third, the drawbacks in governmental regulations and the contradictions between the law maker and the exploiter happening to be the same : the government agencies.

Annual production of logs are estimated at 250,000 $m^3$ and mainly for the export directly and indirectly. This volume of official production can not be tolerated any more if illegal log cutting are still at the present level ie. 100.000 to 150.000 $m^3$ and the exploitation by the provincial authorities can not be reduced significantly, the figure is about 100,000-120,000 $m^3$.

At present, the log cutting business is under the authorized central and provincial state enterprises. Even though the large amount of log exploitation are executed, these state enterprises still have low financial status. After all the selling price of the production made by the enterprises is regarded very low. (According to

the analysis of prices obtained for the private log traders, the prices offered by the state log enterprises are very low indeed.)

During the implementation of this program, the role of the government will change from production to the establishment of regulations to control the private production. Some of the state log enterprises will be eliminated, the skills and knowledges about log trading will be improved. The government will play the role of owner of the forest and the resource manager; only through endorceable contracts and regulations, the forest exploitation can be allowed. The government has to be very strict to the regulations in managing the forests resource, specially with the exploitation. This means the need for more budget to implement this program successfully. The government has to introduce a system of taxation which can allow the use of part of taxes of monitoring this program. Taxes should come from the volume of production and not from export so as to promote more export.

Budget controlling procedures between the central and provincial governments should be reviewed in order not to put a lot of pressure on the provincial authorities which have to rely heavily on the exploitation of logs. At the initial stage of the program, the regulations must be developed along with the reorganization of the Department of Forestry and Environment. Legal and regulatory system should facilitate to private sector to invest in this economic sector and meanwhile it will allow the government to improve their regulatory role and the efficiency and returns from the exploitation of the resource.
Measures in preserving the environmental conditions are of important concerns of the government during this program. Good measures may be allowing the population to be responsible for protecting the forestry and issuing sales in looking after the national forest.

## 3-7 Summary of important strategies and actions

- Reorganize the Ministry of Agriculture Forestry and reduce the number of departments form 11 to 7 only.

- Property rights reforms. (Land reforms)

- Increase the free flow of labor.

- Privatize some state owned enterprises.

- Develop trade transactions acts.

- Let the market determine the production.

- Change from agricultural tax to the land tax based on the quality and value of the land.

- Stop the public investment in medium and large scale irrigation projects and support the small and medium farmers' irrigation schemes.

- Eliminate all export taxes and remove all barriers for livestock trade.

- Establish the health care and control centers for livestock trade (internal and external).

- Research and extension program to promote upland crops and introduce appropriate technologies to be applied by farmers.

- The change from direct involvement of the government in the forest exploitation to management and control through rules and regulations.

- Reorganize the forestry industry and management of the forest resource by adopting tax system which is based on the production cost and not on the exported volume.

- Review all the present plans of the government in order to ensure the accordance with new policies.

## 3-8 Public investment plan

Due to lack of budget and in order to be able to manage extended aid projects, the public funding for agriculture sector must be curtailed to about 10% of the total internal budget and about 9% of the external budget. That is to say that the total internal budget for the program is $10 \times 10^9$ kips and about 55 million Dollars of external aid to be used for agriculture sector. However, the expenditure will be mainly for supporting programs. The great benefits from public investment in communication systems covering 41% of the total national budget are for agriculture development. This will also facilitate the electricity line extension.

The national investment plan which is regarded very important will need $3.6 \times 10^9$ kips and 19.2 millions Dollars. This includes the livestock disease control program, the research and extension program, the small scale farmers' irrigation scheme support program and the forestry management, regulation system and support services program.

The committed and under implementation projects will need $6.4 \times 10$ kips and external aid of $100{,}4 \times 10^6$ Dollars for the implementation duration. Some of these projects are not in line with the new strategies set out for the 3rd five year plan, specially the irrigation sector. The use of local budget a little bit over may be possible but the use of external budget for this purpose is not possible. It may be necessary to save some money up to 65 millions kips in rearranging the committed and under implementation projects by delaying the original plans.

In order to achieve the saving above, the review of big projects as national projects can be proceeded. The present review of all the committed projects under the guide lines of the NEM will ensure the saving to become real. Before committing any budget to the agriculture sector, careful studies should be made by the Ministry of Planning and Finance and the role of the department to foreign relations should be reduced.

Table VI - 5 : Budget plan for agriculture sector

| New projects | local (× 109 kips) | external (× 106 Dollars) |
|---|---|---|
| Livestock | | |
| - Disease control (export) | 0.02 | 0.16 |
| - Disease control (internal) | 1.10 | 0.50 |
| Research and extension | | |
| - Program development | 0.17 | 0.55 |
| - Farm radio development | 0.33 | 0.40 |
| - Upland agro-forestry program | 0.21 | 5.00 |
| Irrigation | | |
| - Farmers' schemes support project | 0.18 | 1.20 |
| - Privatization of big scheme | 0.01 | 0.60 |
| - Support services program | 0.21 | 0.20 |
| Forestry projects | 1.43 | 10.60 |
| - National program | 3.56 | 19.21 |
| - Present projects | 6.42 | 100.37 |
| - Saving after review | - | (-65.00) |
| Total | 9.98 | 54.58 |

3-9 Effects from unsuccessful reforms

The success of the program will depend on the agriculture sector reform. Major effects from unsuccessful reforms or no reforms are that there would be more delays in the development of the country, reduction in export incomes and production and more budget required in the agricultural sector.

The slow increase in the agriculture sector will also slow down the percentage increase in others sectors. The G.D.P. will also have the effect of low increase from 6.8% to 5.7%. The unsuccessful reform will mean the loss of 5 × $10^9$ kips per year.

Table VI - 6 : Percentages increase in the cases of major reform and without reform in the agriculture sector, and effects to others sectors.

| | Percentage increase % | |
|---|---|---|
| | with reform | without reform |
| Agriculture | 6.5 | 4.9 |
| Industry | 6.0 | 6.0 |
| Services | 6.8 | 5.7 |
| G.D.P. | 6.6 | 5.4 |

Table VI - 7 summarizes the effects within the agricultural sector and to others sectors as well as budget and aids if the reform is not successful within the agricultural sector.

Table VI - 7 : Summarized Reforms

| Items of activities | Effects due to unsuccessful reforms |
|---|---|
| Rice production | Not much changes |
| Agriculture | The production in 1995 will be decreased by 16.2% |
| Livestock | The production in 1995 will be reduced by 14.2% |
| Export trade | The export earnings will be reduced by 28.2% in the year 1995. (mainly forestry products) |
| Import trade | Imports in 1995 will be increased by 1.1% |
| National budget | Balance deficit in 1995 will be increased by 22.8% |

The percentage increase of others crops (other than rice) and the livestock production will not be achieved according to plans estimated in the case reforms will be successfully taken place. At the end of the program, if there is no successful reform, the production of others crops will be decreased by 16% of the planned targets. Similarly for livestock production, it will be reduced by 14%.

Export trades will be reduced by 20% at the end of the program, mainly due to the reduction in forestry products which are related to world market prices and low production outputs by state enterprises. The illegal log cuttings will remain unsolved if there is no change in the policies mentioned.

The import trades are estimated more or less to be quite stable if there is no successful reform. This can be explained by 2 reasons. Imports by the private sector will be reduced because of low incomes. However, the need to import of the government will be increased because of unsuccessful reform in trade policies.

In the year 1995, the balance deficit of the government budget will arrive at 23% higher if there is no reform. There are 2 reasons also: one, income taxes will be reduced because of the low income of the private sectors. Second, the investment costs to big projects will be increased and in order to support the state enterprises.

# Table VI - 8 Present Farm Budget in the Study Area

| Item | Farm Size | Farm Size 1 | Farm Size 2ha | Farm Size 3ha |
|---|---|---|---|---|
| Income | Yield 1200k/ha (Paddy 0.8ha) | Yield 1600k/ha (Paddy 1ha) | Yield 1600k/ha (Paddy 1.5ha) | Yield 1500k/ha (Paddy 2ha) |
| Nut Seed. 30 kg/ha 350 kip/kg (ha*Yield*70kip) | 67,200 | 105,000 | 168,000 | 210,000 |
| Up Land rice (ha*800kg/ha*70kip/kg) | 11,200 | 0 | 0 | 28,000 |
| Up Land Peanut (ha*500kg/ha*175k/kg) | 0 | 43,750 | 43,750 | 43,750 |
| Irrigation Paddy | 0 | 0 | 0 | 0 |
| *Irrigation Up Land Crop* | *0* | *0* | *0* | *0* |
| Buffalo rent 1500kip/day | 0 | 7,500 | 3,000 | 0 |
| Livestock & Fowl Seeling | | | | |
| 1) Buffalo. head*65000 | 0 | 0 | 0 | 0 |
| 2) Cattal. head*55000 | 0 | 0 | 0 | 55,000 |
| 2) Pig. head*15000 | 15,000 | 15,000 | 15,000 | 15,000 |
| 4) fowl 400* fowl | 2,000 | 2,000 | 8,000 | 0 |
| Hirde Labor. 800kip/day | | 8,000 | 1,600 | 0 |
| Other Income | | | | |
| 1) remittance Money | 0 | 0 | 0 | 0 |
| 2) Handcraft | 0 | 0 | 0 | 0 |
| Total Income | 115,400 | 181,250 | 239,350 | 351,750 |
| Production Cost | 2,240 | 2,800 | 4,200 | 7,000 |
| Rainfed Paddy Seed. 40kg/ha | 1,120 | 0 | 0 | 0 |
| Nut seed. 30 kg/ha 350 kip/kg | 0 | 5,250 | 5,250 | 5,250 |
| Livestock Control (1500kip/head/year) | 0 | 1,500 | 3,000 | 4,500 |
| *Fertilizer. 11200kip/50kg* | 0 | 11,200 | 11,200 | 22,400 |
| Compost (cost 1000kg/3500kip) | 0 | 1,750 | 3,500 | 3,500 |
| Insect Control 1kg/800kip | 0 | 0 | 0 | 0 |
| Hirde Labor. 800kip/day | 0 | 1,600 | 5,600 | 16,000 |
| Buffalo Rental fee | 15,000 | 0 | 0 | 0 |
| Tax for Paddy (5%) | 4,200 | 5,250 | 11,200 | 10,500 |
| Livelihood Cost | 18,250 | 21,900 | 25,550 | 29,200 |
| Education | 4,500 | 4,000 | 5,000 | 5,000 |
| *Charge for Medicine* | 3,000 | 5,000 | 5,000 | 5,000 |
| Consumption for rice (360kg/man/year) | 126,000 (2, A 6, C) | 126,000 (3, A 4, C) | 138,600 (4, A 3, C) | 151,200 (4, A 4, C) |
| Miscellaneous Expenses | 2,000 | 4,000 | 3,500 | 4,000 |
| Total Expenses | 176,310 | 190,25 | 221,600 | 263,550 |

(Unit Kip)

Source: Farm interview Survey Namphou, Dongphosi Project Area 1991.
Note, consumption A, number of Adult 360kg. C, number of Child 180kg

# ANNEX VII

# RURAL INFRASTRUCTURES

ANNEX Ⅶ

# RURAL INFRASTRUCTURES

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# Ⅶ. RURAL INFRASTRUCTURES

## Agro-infrastructural Improvement and Development

### 1. Rural Road Improvement Plan

#### 1.1 Routes of Rural Road to be Improved

The B. Lak 35 zone covers the middle Champhone river plain and Phoummachedy plain. The Agricultural Supporting Center will be established at B. Lak 35, located at the intersection of route No. 13 and route No. 11, the routes connecting Savannakhet city and Kengkok. The objective of the rural road improvement Plan will be formulated for the existing lateral roads which connect the Nyhod H. Bak irrigation area (950 ha), the Namphou irrigation area (705 ha) and the Agricultural Supporting Center. The main target of the rural road improvement routes will be to support the B. Lak 35 zone development (see Drawing No. R-1)

The existing road networks and the distance of road improvement are as follows:

| Road Section | Distance | Distance of road Improvement |
|---|---|---|
| - Savannakhet ~ B. Lak 35 (National Road Route No. 11) | 35 km | 0 |
| - B. Lak 35 ~ Kengkok (Route No. 11) | 20 km | 0 |
| - B. Lak 35 ~ Namphou intersection National road No. 13 (Route No. 13) | 15 km | 0 |
| - B. Lak 35 ~ Xeno (Route No. 13) | 22 km | 0 |
| - B. Nakhou ~ route No. 9 intersection(East side of Nyhod H. Bak irrigation area) | 26 km | 0 |
| - B. Mai ~ B. kokleng (Wilhin the Nyhod H. Bak irrigation area) | 11 km | Route-A 10.4 km |
| - B. Phonkho ~ National Road No. 13 intersection (west side of the Namphou Irrigation Area) | 14 km | Route-B 14.2 km |
| - B. Phonkho ~ Namphou intersection National road No. 13 (Southside of the Namphou Irrigation Area) | 14 km | Route-C 5.0 km |
| Total | 157 km | 29.6 km |

## 1.2 Improvement Routes and Beneficiary Villages

About 29.6 km of rural roads will be improved in order to make traffic possible. The improvement of rural roads will greatly contribute, not only to support irrigation development, but also to the prosperity of the village.

The beneficiary villages will be as follows:

| Improvement Route | Bridge Improvement | Village | | Population |
|---|---|---|---|---|
| Route - A 10,426m | 1 place | B.Mai | B.Nongboua | 5,894 |
| | | B. Khamnoy | B. Nonghong | |
| | | B. Donggne | B. Dongkhakhou | |
| | | B. Nanokkhian | B. Dongmakyang | |
| | | B. Nongkalong | B. Kokleng | |
| | | Phailom | B.Dongkhamkhen | |
| Route - B 14,164m | 3 places (improvement) | B. Phoxai Mai | B. Dongphosi | 6,480 |
| | | B. Namphou Nua | B. Namphou Tai | |
| | | B. Donghouakham | B. Dongmakfai | |
| | | B. Dontoum | B. Mouangkhai | |
| Route - C 5,018m | 5 places (2:improvement) (3:new construction) | B. Phonkho | B. Natai | 5,630 |
| | | B. Tan | B . Phonthat | |
| | | B. Deng | B. Namakka | |
| | | B. Takdet | B. Phosomhong | |
| | | B. Nakhum | | |
| Total 29,608 m | 9 places | 29 villages | | 18,004 |

## 1.3 Rural Road Improvement Process and Standards

The improvement of the rural roads which is particularly way behind, as well as irrigation, became an essential component for development in the present Agricultural Development Project.

This is the reason why the repair of existing routes related to the Irrigation Development Area and to the Agricultural Supporting Center shall be given importance.

The most suitable standards for rural road improvement will be formulated giving full consideration to the range of other areas, to the future management of maintenance and to economically feasible construction.

The rural roads which are not seriously damaged will be improved by stripping (10 cm), subbase grading and laterite soil pavement.

Moreover, the roads where surface damages are progressing and where even roadbeds are seriously damaged, thus making traffic difficult, will be improved by substantial strengthening of roadbeds, by subbase course stabilization, and laterite soil pavement.

The design plan for the improvement of rural roads is shown below (see Drawing No. R-1, 2, 9, 18).

| | | |
|---|---|---|
| - Road surface width | : | 6m |
| - Road surface stripping | : | 10cm thick |
| - Laterite pavement | : | 15cm thick |
| - road height | : | 30~50cm height from adjoining land |
| - road cross fall | : | 3% transverse slope |
| - Road cross drain | : | $\phi$600mm concrete pipe $\times$ lines |
| - Shoulder slope gradient | : | 1:2 embankment |
| - California bearing ratio (CBR) | : | More than 6 |

The design plan for bridge improvement is shown below (see Drawing No. R-21, 22, 23).

| | | |
|---|---|---|
| - Superstructure | : | Floor slab type, RC. bridge<br>Floor width 3.6m |
| - Substructure | : | RC. abutment and pier,<br>Single column footing direct<br>Foundation |

- Design load : T-10t

## 2. Agricultural Supporting Center Plan

### 2.1 Rice Processing and Storage Facilities

In consideration of the rural conditions, the facilities will be designed under the rural standards in force in Lao. The design of facilities will be carried out in consideration of capacity of equipment, durability, cost and economical efficiency in operation and maintenance, easy checking of preservation and method of construction. The scale of facilities, based on rice mill and storage in the Project Area, will be determined in due consideration of rural conditions and customs as well as the Project Area's paddy production and rice processing capacity. Storage facilities are as follows:

- Storage floor area : 475m$^2$ single story, wooden building
- Rice storing volume : Paddy storing 40m$^3$ × 7 places = 150t, and bag storing 200t, total capacity is about 350t.
- Ventilation : Natural louver ventilation (prevention from dusty draining, humidity, hear)

Rice mill facilities are as follows:

- Floor area : 100m$^2$, Wooden building
- rice processing capacity : 1,000 kg/hr in paddy

2.2 Truck Terminal Market

The function of the truck terminal market is to develop trading relations outside of the zones and provinces, as well as to support intermediate trading. Facilities will be designed for the truck terminal and the trading area.

2.3 Description of the Center Facilities (See Drawing No. C-1)

- Total area : 2.25 ha (150×150m)
- Office : 250m wooden building
- Garage : 150m$^2$ wooden building
- Storage : 475m$^2$ wooden building, Ventilation
- Market : 875m$^2$ slate roof only
- Rice mill : 100m$^2$ wooden building, ventilation
- Live stock shed : 300m$^2$ wooden building
- Fish farm : 120m$^2$ wooden building, water pipe and drain
- Water supply : Well, water supply facilities
- Truck terminal and drying space : 4,000m$^2$ concrete pavement t=10cm
- Farm land and Nursery bed : 2,100m$^2$
- Truck : 8t - 3 Units
- Tractor : 65HP - 1 Unit
- O and M cars : pick up - 2 Unit, Motor bike - 2 cars
- Generator : 150kw - 1 Unit

3. Village Water Supply Plan

The well discharge and well depth will be checked through the drilling tests. By observation of rural water supply conditions, the supply discharge will be designed for a 60ℓ/person/day consumption in the dry season. Optimum scale and sizing of the facilities are as follows: (See Drawing No. C-2)

- Well type : Shallow well; excavation surface will be protected by a 1.0 diameter concrete pipe; depth 10~15m. The well will be constructed by manual excavation; shall be 1.6m in diameter.

- Pumping : Line shaft hand pump (manual type)

- Wells siting : Facilities for villages with dense population and serious water shortage in the dry season. A total of 8 wells shall be planned.

<Namphou area>
B. Dongmakfai, B. Namphou - Nuia

<Nyhod H. Bak area>
B. Nongboua, B. Khamnoy
B. Khemthao, B. Phomasavang
B. Kokleng, B. Dongmakyang

4. Rural Road O/M Equipment

The following O/M equipment will be required for the operation and maintenance of the rural roads.

| | | | |
|---|---|---|---|
| - Bulldozer | D6 type | 130 HP | 1 Unit |
| - Wheel loader | | 110 HP | 1 Unit |
| - Backhoe | 0.4m$^3$ | | 1 Unit |
| - Motor grader | | 135 HP | 1 Unit |
| - Road roller | Vibrating type | 70 HP | 1 Unit |
| - Dump truck | 8t | | 1 Unit |
| - Water tank | Sprinkler truck 10t | | 1 Unit |
| - Spare parts | | | 1 Sum |

These supplementary O/M equipment will be used for the rural improvement routes (Route A, B, C total distance : about 30 km) as well as the reparation of the rural roads required for the Savannkhet Province Agriculture Development (total distance : about 520 km) and will be supervised by DCTPC. Therefore, all rural road improvement and road O/M works will be conducted according to the personal budget and the improvement plan of the executive agency (DCTPC).

5. Irrigation O/M Equipment

The following irrigation O/M equipment will be required for drainways and on-farm roads (total distance : 36.7 km) in the irrigation area.

| | | | | |
|---|---|---|---|---|
| - | Backhoe | 0.4 $m^3$ | | 1 Unit |
| - | Motor grader | | 135 HP | 1 Unit |
| - | Dump truck | 8t | | 1 Unit |

These O/M equipment will be managed by the B. Lak 35 Agricultural Supporting Center along with the truck terminal center equipment (trucks, tractor and pick-up cars).

# ANNEX VIII

# ENGINEERING DESIGN

ANNEX Ⅷ

# ENGINEERING DESIGN

## Table of Contents

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## List of Figures

# 1. General

## 1.1 Nhyod H. Bak Irrigation Plan

### (1) Basic concept

Basic concept of irrigation and drainage plan for this area is as follows:

- Maximum utilization of the water resource
- Maximum storage of available water for both supplementary irrigation and dry season irrigation

The result of water resource investigation says that from the topographical, technical and economical points of view, the construction of a dam to store the water of 8.0 to 10 million $m^3$ is possible at Nhyod H. Bak area. Therefore, irrigation by gravity, through the Nhyod H. Bak reservoir, is proposed in this area.

### (2) Selection of irrigation area

To select the irrigation area, the topographical, soil, technical and economical conditions were considered. The proposed areas to be irrigated are some parts of the existing paddy field mainly taken up based on the topographical conditions.

### (3) Irrigable area

As mentioned above, the amount of available water is estimated at . . . . . million $m^3$ per annum. Based on the result of the simulation of water balance and by considering the cropping patterns, proposed irrigation plan is as below. The calculation of water balance for the proposed irrigation plan is shown in Table Ⅷ-1.

| Crop | Irrigable Area (ha) |
|---|---|
| Rainy season paddy | 950 |
| Dry season paddy | 400 |
| Dry season field crops | 400 |

## 1.2 Namphou Irrigation Plan

### (1) Basic concept

The amount of available water is estimated at 7 million $m^3$ at the proposed site for a reservoir near B. Phoxai, though the development of the reservoir big enough to utilize the whole amount of water above is very difficult because of topographical conditions. Therefore the irrigable area for the dry season is limited and the main method used in the area is supplementary irrigation in the rainy season.

Further, the objective area for irrigation is demarcated to some of the northern areas of B. Phoummachedy because other irrigation projects are planned for the southern part of Phoummachedy basin where the priority is high.

### (2) Irrigable area

The selected irrigation area amounts to 705 ha considering the topographical conditions, and 185 ha of which will be irrigated in the dry season utilizing the discharged water from H. Xay reservoir and annual regular H. Namphou and H. Namphou Noy. The calculation of water balance for the proposed cropping pattern is shown in Table Ⅷ-2 and proposed irrigation plan is summarized below.

| Crops | Irrigation Area (ha) |
|---|---|
| Rainy season paddy | 705 |
| Dry season paddy | 90 |
| Dry season field crops | 95 |

## 2. Nhyod H. Bak Irrigation Facilities

### 2.1 Irrigation System

The irrigation facilities to supply the water to fields will consist of Nhyod H. Bak reservoir, and main, secondary, tertiary and field canals with related structures.

The water for an entire irrigation area of 950 ha will be stored in the reservoir and will be taken through the intake gates and conveyed through 10.7 Km-long main canals, 10.9 Km-long secondary canals and 31.8 Km-Long tertiary canals off to the fields.

The intake facilities of the reservoir is located on the right bank of the H. bak river. The right bank main canal (RMC) branches off just after the outlet to the left bank, starting at the left main canal (LMC) which is 5.7 Km-Long. From the end of the LMC, a 4.1 Km-long left bank secondary canal (LSC) follows covering 357 ha of total left bank irrigation area.

As for the right bank, 5.0 Km-long RMC branches out into two (2) secondary canals, namely the 2.6 Km-long right bank secondary canal-1 (RSC-1), and the 2.4 Km-long right bank secondary canal-2 (RSC-2). RSC-2 further branches off at the turnout No. 2 of RSC-2, starting at the right bank secondary canal-2-1 (RSC-2-1) which is 1.8 Km-long. These main and secondary canals cover a total of 593 ha right bank irrigation area. All the canals are located in areas with elevations ranging from 152.0 to 160.0 m to make gravity irrigation possible.

The general layout of irrigation and drainage facilities is shown in Fig. Ⅷ-1.

### 2.2 Nhyod H. Bak Reservoir

(1) Dam site selection

In order to select the suitable dam site, considerations about the capacity, irrigation efficiency, construction difficulties, construction cost, eviction,

submergence, 9existing paddy field, forest area, climate, meteorology, catchment area, topography, geology, and flood countermeasures, etc. were considered and No. 2 site was determined to be the most suitable one. The comparison of three (3) alternatives is summarized in Table Ⅷ-3 and Fig. Ⅷ-2.

(2) Type of Dam

Dam type should be determined based on the availability of materials, purpose of dam, volume of dam, similar projects, topographical, economical and technical conditions, etc. Taking into account the information above, homogeneous type dam is proposed for this project.

(3) Height of Dam

The height of the dam is determined according to the total irrigation capacity, design of flood, spillway and free board. H-V, H-A curves are shown in Fig. Ⅷ-3, describing 12.0 × 10^6 $m^3$ of total capacity with an EL of 168.0 m, and 5.3 × 10^6 $m^3$ capacity with an EL of 166.0 m. On the other hand, as there are 950 ha of rainy season paddy, 400 ha of dry season paddy and 400 ha of dry season field crops, the water balance requires a total capacity of 17 million $m^3$.

Considering the information above and other conditions such as sedimentation, intake water level, etc., the elevations of the proposed dam, the water and crest length are determined below:

| | | |
|---|---|---|
| Dam Crest Elevation | : | EL 171.0 m |
| Design Flood Level | : | EL 169.10m |
| Normal Full Water Level | : | EL 167.10m |
| Lowest Water Level | : | EL 161.00m |
| Dam Crest Length | : | 965 m |

(4) Boring and Soil Testing

In order to design the proposed dam, boring and soil testing were carried out during the period of September 19 to October 10, 1991. Four (4) boring holes were drilled along the dam axis to take boring logs, and soil samplings were carried out from four (4) borrow pits, as shown in Fig. Ⅷ-4.

According to the result of the boring tests, Sandy Loam, Loam and Loamy Sand are the predominant soils in the area, showing more than 70 of N-value with depths between 4.8 m and 10.2 m. The boring logs of four (4) sites are shown in Fig. Ⅷ-5, 6, 7 and 8.

For the samples from the four (4) pits, laboratory tests about natural moisture content, atterberg limit, sieve analysis, specific gravity, classification and permeability, and compaction and unconfined compression tests were carried out. Type of material is mostly sandy clay loam with laterite gravel and the results are summarized in Table Ⅷ-4.

(5) Design of Dam

Based on the results of boring and soil testing and other local conditions, the design for the Nhyod Bak Dam was made. Considering the condition of surface soil depth, about 3.0 to 4.0 m depth of surface soil in the center of both rivers should be replaced with embankment materials. Therefore the height from the excavated base of the river center, i.e. foundation to the dam crest, will be 21.0 m. The slopes of the dam shall be 1:3.0 upstream and 1:2.5 downstream. For slope protection, the upper slope will be covered with 0.4 m thick riprap stones and sodfacing shall be made downstream.

The dimension of Nhyod H. Bak Dam is summarized below and its plan and longitudinal section are shown in Fig. Ⅷ-9 and 10.

Dimension of Nhyod H. Bak

| | |
|---|---|
| Catchment Area | 31.0 $Km^2$ |
| Total Capacity | 11.9 × 10^6 $m^3$ |
| Effective Capacity | 8.9 × 10^6 $m^3$ |
| Reservoir Area | 430 ha |
| Dam Crest Level | EL 171.0 m |
| Design Flood Level | EL 169.1 m |
| Normal Full Water Level | EL 167.1 m |
| Lowest Water Level | EL 161.0 m |
| Dam Type | Homogeneous Type |
| Dam Height | 21 m |
| Dam Crest Length | 965 m |
| Dam Crest Width | 6 m |
| Upstream Slope | 1 : 3.0 |
| Downstream Slope | 1 : 2.5 |
| Dam Volume | 320 × 10^3 $m^3$ |

(6) Stability

Safety factor was computed using the slip surface method with the following values and the results of the material test. The computation showed adequate stability as safety factors of 2.790 and 3.497 for the upper stream side and downstream side were respectively achieved.

| Physical Value | Material | | |
|---|---|---|---|
| | Embankment 1) | Riprap 2) | Drain 2) |
| $\gamma^t$ (t/$m^3$) | 1.83 | 2.0 | 2.0 |
| $\gamma^{sat}$ (t/$m^3$) | 2.00 | 2.2 | 2.2 |
| C (t/$m^3$) | 3.3 | 0 | 0 |
| $\phi$ ( ° ) | 30 | 40 | 35 |

Note : 1) Average of five (5) samples
2) Assumption

(7) Sedimentation

The volume of sediment was calculated as follows, showing the adequate capacity of the proposed dam for the sedimentation.

Based on the topography, erosion, river slope and catchment area, the sedimentation volume per catchment area ($Km^2$) per year is estimated at 250 $m^2$.

Sedimentation for 50 years is 250 $m^2 \times 31$ $km^2 \times 50$ years $= 387{,}500$ $m^3$

(8) Spillway

Flood discharges at the dam site with 50-year, 100-year and 200-year return period were estimated and are shown below:

| Return Period | Flood Discharge ($m^3/s$) |
|---|---|
| 50-year | 174 |
| 100-year | 193 |
| 200-year | 211 |

Generally, 1.2 times of 200-year return period flood discharge is considered as the design flood discharge, however, the value of 211 $m^3/s$ (200-year return period flood discharge) is directly applied as the design flood discharge considering the local conditions. The type of spillway is an overflow type and the layout of designed spillway is shown in Fig. Ⅷ-11.

(9) Outlet Works

The intake tower is located on the right bank of H. Tat river with two (2) intake gates of 1.0 m long and 1.0 m width being installed in areas 161.0 m EL and 165.5 m EL, respectively. The two slide gates are operated in the operating room depending on the water level of the reservoir. The operating room can be reached through the footpath bridge which is 1.2 m wide and 32 m long from the dam crest. The intake tower upstream and

the outlet basin at downstream are connected with a concrete pipe which is 1.5 m in diameter and 65 m long. The outlet works' layout is shown in Fig. Ⅷ-9.

## 3. Namphou Irrigation Facilities

### 3.1 Irrigation System

The irrigation facilities that will supply water to the fields will consist of six (6) diversion facilities, namely No. 1 (H. Xay reservoir), No.2 (H. Banhang Weir), No. 3 (H. Phou Noy reservoir), No. 4 (H. Phou reservoir), No.5 (H. Xay weir) and No. 6 (H. Pangha weir), and main, secondary, tertiary and field canals with related structures.

Each of the irrigable area in these six (6) diversion facilities vary from 25 ha to 410 ha for the rainy season, and 0 ha to 80 ha for the dry season cultivation. Irrigable areas for both rainy and dry seasons are summarized below:

| Diversion Facilities | No.1 | No.2 | No.3 | No.4 | No.5 | No.6 |
|---|---|---|---|---|---|---|
| Irrigable Area (ha) | | | | | | |
| Rainy season paddy | 140 | 45 | 35 | 25 | 410 | 50 |
| Dry season paddy | 30 | 0 | 10 | 10 | 40 | 0 |
| Dry season field crops | 30 | 0 | 10 | 5 | 40 | 10 |

The water reserved in No. 1 (H. Xay reservoir) will be used for an entire irrigation area (No. 1 command area) of 140 ha in the rainy season and some 60 ha in the dry season. Further, some of the water shall be discharged for dry season irrigation downstream.

With No. 2 (H. Banhang weir), only 45 ha of supplementary irrigation in the rainy season is proposed because reserved water or return flow is expectable.

No. 3 (H. Phoun Noy reservoir) is a small existing reservoir, with some regular flow even in the dry season. And No. 4 (H. Phou reservoir) is a small reservoir with some regular flow which is expectable even in the dry season. Both regular

flows will enable the possible irrigation of 20 ha for No. 3 and 15 ha for No. 4 in the dry season. The reservoir water of both No. 3 and No. 4, about 1.0 to 2.0 ha of reservoir area each, will be also used for domestic livestock and any other use or emergency. The regular flow joins together at about 1.0 Km downstream of both reservoirs and 2.0 Km further downstream, it joins with H. Xay river.

About 1.0 Km downstream from the junction of H. Phou and H. Xay, No. 5 (H. Xay weir) construction is proposed for the effective use of return flow from H. Xay reservoir (No. 1), H. PhouNoy reservoir (No. 3) and H. Phou reservoir (No. 4). Aside from a 410 ha of supplementary irrigation in the rainy season, 80 ha of dry season irrigation is possible in the No. 5 command area with the above return flow.

With No. 6 (H. Pangha) weir, 50 ha of supplementary irrigation in the rainy season and only 10 ha of dry season irrigation is expectable due to a small regular flow.

The general layout of Namphou Irrigation Area is shown in Fig. Ⅷ-12.

## 3.2 H. Xay Reservoir

### (1) Dam Site Selection

Only one (1) site is determined through a 1/5000 scale map and site investigation considering the most effective capacity and minimum dam volume as shown in Fig. Ⅷ-12.

### (2) Type of Dam

Homogeneous type is also proposed for the Nhyod H. Bak Dam according to local conditions.

(3) Height of Dam

The height of the dam was determined to acquire a maximum capacity with due consideration to the local condition. H-V, H-A curves are shown in Fig. Ⅷ-13 describing 390 × 10^3 m3 of total capacity for 168.0 m EL and 1,600 × 0^3 m3 of total capacity for 170 m EL. Considering the design of the flood spillway, the freeboard and other necessary conditions, the dimensions of EL and crest length are determined below:

| | | | |
|---|---|---|---|
| Dam Crest | EL | 172.5 | m |
| Dam Crest Length | | 730 | m |
| Design Flood Level | EL | 170.8 | m |
| Normal Full Water Level | EL | 169.3 | m |
| Lowest Water Level | EL | 167.0 | m |

(4) Boring and Soil Testing

Two (2) boring holes were drilled and soil samplings from two (2) borrow pits were carried out as shown in Fig. Ⅷ-14. According to the results of the boring tests, the dominant soils are sandy loams to sand stone, showing more than 70 of N-Value with a depth ranging between 1.8 m and 2.3 m. The boring logs of the two (2) sites are shown in Fig. Ⅷ-15 and 16. Laboratory tests for the samples from the two (2) pits on soil mechanical nature were carried out. The type of material is Sandy Clay Gravel and Laterite and the results are summarized in Table Ⅷ-5.

(5) Design of Dam

Based on the result of the boring and soil tests and other local conditions, the design of the H. Xay Dam was made. Considering the condition of surface soil depth, about 1.5 m depth of the surface soil in the center of both rivers should be replaced with embankment materials. Therefore, the height from the excavated base of the river center to the dam crest will be 10.5 m. The slopes of the dam shall be 1:2.5 for both sides. For slope

protection, the upstream slope will be covered with 0.3 m thick riprap stones, and sodfacing will be carried out.

The dimension of H. Xay Dam are summarized below and its plan and longitudinal section are shown in Fig. Ⅷ-17 and 18.

Dimensions of H. Xay Dam

| | |
|---|---|
| Catchment Area | 15.8 $Km^2$ |
| Total Capacity | 1.6 × 10^6 $m^3$ |
| Effective Capacity | 0.98 × 10^6 $m^3$ |
| Reservoir Area | 95 ha |
| Dam Crest Level | EL 172.5 m |
| Design Flood Level | EL 170.8 m |
| Normal Full Water Level | EL 169.3 m |
| Lowest Water Level | EL 167.0 m |
| Dam Type | Homogeneous Type |
| Dam Height | 10. 5 m |
| Dam Crest Length | 730 m |
| Dam Crest Width | 5. 0 m |
| Upstream Slope | 1 : 2.5 |
| Downstream Slope | 1 : 2.5 |
| Dam Volume | 83 × 10^3 $m^3$ |

(6) Spillway

Flood discharges at the dam site with 50-year, 100-year and 200-year return periods were estimated and are shown below:

| Return Period | Flood Discharge ($m^3/s$) |
|---|---|
| 50-year | 73 |
| 100-year | 80 |
| 200-year | 88 |

The value of 88 $m^3/s$ (200-year return period flood discharge) is directly applied for the design flood discharge. The type of spillway is an overflow type and the layout of the designed spillway is shown in Fig. Ⅷ-17.

(7) Outlet Works

An intake gate of 1.0 m long and 1.0 m wide is installed at an area of 167.0 m EL, that is, on the right bank of the river. The gate will be operated at the operation deck, which can be reached through a 1.2 m wide and 13 m long foot bridge of from the dam crest. The water passing through the intake gate, will go through a 0.6 m diameter and 35 m long concrete pipe to reach the outlet basin. The outlet basin has two (2) slide gates, one is a turnout gate for the main canal No. 1 and the other is a flood way gate for the downstream irrigation areas of No. 5 H. Xay weir. The layout of the outlet works is shown in Fig. Ⅷ-19.

(8) Canals, drains and irrigable area

Canals, drains and irrigable area commanded by H. Xay reservoir are listed below:

| | | |
|---|---|---|
| Main Canal | : | 3,740 m |
| Secondary canal | : | 660 m |
| Tertiary canals | : | 4,490 m |
| Field canals | : | 8,650 m |
| Field drains | : | 5,420 m |
| Rainy season paddy | : | |

3.3 H. Banhang Weir

(1) Irrigation Plan

Because there are no suitable sites for the reservoir and the small catchment area (4.3 $Km^3$), only supplementary irrigation by weir is recommended for this area. The proposed weir site is in H. Banhang river, one of the tributaries of H. Xay river, located at 1.6 Kmupper stream from

the junction of both rivers, (see Fig. Ⅷ-12). Considering the topographical and hydrological conditions in this area, supplementary irrigation for 45 ha of rainy season paddy is proposed.

(2) Design

A 10-year return period of load discharge (15 $m^3/s$) is considered as the design flood discharge for the gated weir. As manual and easy operation and maintenance are required for the farmers, more simple structures are necessary. Two (2) 1.0 m long and 1.5 m wide slide gates and one (1) 1.5 m wide stop log gate are proposed. The total width of the weir is 9.4 m and the height (from the apron to the top of the operation deck) is 3.5 m, as shown in Fig. Ⅷ-20.

(3) Canals and drains

Canals and drains commanded by H. Banhang weir are as follows:

| | | |
|---|---|---|
| Main Canal | : | 1,010 m |
| Tertiary canals | : | 1,930 m |
| Field canals | : | 3,190 m |
| Field drains | : | 1,970 m |

3.4 H. Phou Noy Reservoir

(1) Irrigation plan

A regular flow is expectable in H. Phou Noy river and an existing small reservoir (1.0 ha) is observed upstream. This reservoir was constructed by the farmers aiming at both irrigation for 2 to 3 ha of dry season paddy and domestic use. (See Fig. Ⅷ-12, General layout). The proposed plan is mostly to use a regular flow for both rainy and dry season irrigations by rehabilitation and by raising the existing dike and installation of intake facilities. By raising the dike, the effective capacity of the reservoir will be

increased and which will be a reassurance for dry season irrigation when the regular flow decreases. The irrigable areas are estimated as follows:

| | | |
|---|---|---|
| Rainy season paddy | : | 35 ha |
| Dry season paddy | : | 10 ha |
| Dry season field crops | : | 10 ha |

(2) Design

The height of the existing dam crest is 1.0 m on average with an EL of 162.5 m of the raising dam crest level and 142 m of the dam crest length. The type of spillway is an overflow type, and 10 m in width. In both sides of the spillway 1.0 m wide stoplog intakes are installed. The layout of Namphou Noy reservoir, intakes and spillway is shown in Fig. Ⅶ-21.

(3) Canals and drains

Canals and drains commanded by H. Phou Noy reservoir are as follows:

| | | |
|---|---|---|
| Main Canal | : | 160 m |
| Tertiary canals | : | 1,780 m |
| Field canals | : | 2,260 m |
| Field drains | : | 2,910 m |

3.5 H. Phou Reservoir

(1) Irrigation plan

The proposed plan is mostly to use the regular flow, which is also expectable in H. Phou river, for both rainy and dry season irrigations. Besides, to reassure dry season irrigation and domesticity of livestock, a reservoir construction is proposed upstream 1.0 Km from the junction of H. Phou and H. Phou Noy.

The irrigable areas are estimated as follows:

| | | |
|---|---|---|
| Rainy season paddy | : | 25 ha |
| Dry season paddy | : | 10 ha |
| Dry season field crops | : | 5 ha |

(2) Design

Considering the condition of surface soil depth, about 1.0 m depth of the surface soil in the center of the river should be replaced with embankment materials. Therefore, the height from the excavated base of the river center to the dam crest will be 5.8 m.

The slopes of the dams are 1:2 for both sides. The elevation of the dam crest 163.5 m and the crest length is 307 m and the width is 4.0 m. The type of spillway is an over flow type with a width of 18 m. An intake gate is installed at 160.0 m EL, and it is connected with an outlet basin by a 0.3 m in diameter and 31 m long concrete pipe. The dimensions of H. Phou Dam are summarized below and its typical cross and longitudinal sections are shown in Fig. Ⅷ-22.

Dimensions of H. Phou Dam

| | |
|---|---|
| Reservoir Area | 2.0 ha |
| Dam Crest Level | EL 163.5 m |
| Design Flood Level | EL 162.5 m |
| Normal Full Water Level | EL 161.5 m |
| Lowest Water Level | EL 161.0 m |
| Dam Type | Homogeneous Type |
| Dam Height | 5.8 m |
| Crest Length | 307 m |
| Crest Width | 4.0 m |
| Slope | 1 : 2.0 |
| Dam Volume | 9.3 × 10^3 $m^3$ |

## 3.6 H. Xay Weir

The proposed site is located at H. Xay river about 300 m downstream from the junction of H. Xay and H. Phou rivers. (See Fig. Ⅶ-12 General Layout). A reservoir is not suitable in this site but a weir aiming to utilize a return flow for dry season irrigation from H. Phou and H. Pho Noy rivers and discharged water from H. Xay reservoir is okay. Supplementary irrigation for 410 ha of rainy season paddy is possible, though it is estimated that 40 ha of paddy and 40 ha of field crops in the dry season are possible using the discharged water and return flow from upstream. The irrigable areas are summarized below:

| | | |
|---|---|---|
| Rainy season paddy | : | 410 ha |
| Dry season paddy | : | 40 ha |
| Dry season field crops | : | 40 ha |

(2) Design

The value of 135 $m^3/s$ is considered as the design flood discharge. The design policy states that the easier the operation and maintenance of all structures in this project, the better. Twelve (12) 1.5 m long and 1.5 m wide slide gates and a total width of 24.6 m are required, though two (2) of the gates near both banks will be replaced with stop logs to minimize the construction cost. On both sides of the gated weir, fixed 4.0 m wide weirs are proposed, making the total width of the weir amount to 32.6 m. The height of the gated weir (from the apron to the top of the operation deck) is 4.8 m. Detailed dimension is shown in Fig. Ⅶ-23 and 24.

(3) Canals and drains

Canals and drains commanded by H. Xay weir are listed below:

| | | |
|---|---|---|
| Main canal | : | 8,200 m |
| Tertiary drains | : | 10,080 m |
| Field canals | : | 25,130 m |
| Tertiary drains | : | 4,350 m |
| Field drains | : | 18,730 m |

## 3.7 H. Pangha Weir

(1) Irrigation Plan

Because there are no suitable site for a reservoir, supplementary irrigation by weir is mostly proposed and only 10 ha for field crop irrigation in the dry season is expectable with a small regular flow. The proposed weir site is located in H. Pangha river, which runs parallel with H. Xay river joining at B. Phonsomhong at the southern end of the Phoummachedy basin (See Fig. Ⅷ-12 General Layout).

(2) Design

The value of 53.6 $m^3/s$ is considered as the design flood discharge. Six (6) 12.5 m long and 1.0 m wide slide gates with a total width of 9.0 m are required, though two (2) gates near the left bank will be replaced with stop logs to minimize the construction cost. On both sides of the gated weir, 2 m wide concrete weirs are proposed on the left bank side and 30 m wide on the right bank side. In addition to the concrete fixed weirs on the left side, 11 m wide fixed weir composed of gabion is required, making the total width of the weir amount to 52 m. The height of the gated weir is 5.4 m. Detailed dimension is shown in Fig. 25, 26 and 27.

(3) Canals and drains

Canals and drains commanded by H. Pangha weir are listed bellow:

| | | |
|---|---|---|
| Main canal | : | 740 m |
| Tertiary drains | : | 1,910 m |
| Field canals | : | 2,490 m |
| Field drains | : | 2,900 m |

4. Irrigation Canals and Related Structures
(Nhyod H. Bak and Namphou Irrigation)

(1) Irrigation Canals

The irrigation canals of the Project include main canals, secondary canals, tertiary canals and field canals. Main canals will convey the water from the reservoir/weir to secondary or tertiary canals. Secondary canals will convey the water to tertiary and field canals. All the canals will be trapezoidal earthen channels. Approximate command areas of these canals are as follows:

| Canals | Command Area (ha) | |
|---|---|---|
| | Nhyod H. Bak | Namphou |
| Main Canals | 350 to 950 | 25 to 245 |
| Secondary Canals | 220 to 300 | 50 |
| Tertiary Canals | 10 to 100 | 2 to 70 |
| Field Canals | < 5 | < 5 |

A list of canals is shown in Table Ⅷ-6. and summarized below:

| Canals | Length (m) | |
|---|---|---|
| | Nhyod H. Bak | Namphou |
| Main Canals | 10,690 | 14,440 |
| Secondary Canals | 10,920 | 660 |
| Tertiary Canals | 31,830 | 20,930 |
| Field Canals | 76,000 | 43,510 |

(2) Canal Structures

A number of canal structures such as turnout, check, siphon and culvert will be provided. All of them will be of reinforced concrete construction. A list of structures is shown in Table Ⅷ-7, and is summarized below:

| Structures | Nhyod H. Bak | Namphou |
|---|---|---|
| Turnout | 30 | 31 |
| Check | 15 | 13 |
| Siphon | 5 | 2 |
| Culvert | 10 | 1 |
| Drop | 15 | 6 |
| Spillway/waterway | 3 | 3 |
| Cross drain | 36 | 36 |
| Footpath bridge | 40 | 25 |
| Division Box on tertiary canal | 267 | 80 |
| On-farm culvert | 110 | 65 |
| On-farm syphon | 4 | 1 |
| On-farm cross drain | 57 | 55 |
| Division box on field canal | 951 | 577 |

(3) Design criteria

The basic design criteria for irrigation canals and related structures are as follows:

i) Design discharge

Nhyod H. Bak

- Main canal and related structures = 1.43 lit/s/ha
  $(1.87+1.53)/2\times800/950=1.43$
- Secondary canal/turnout = 1.87 lit/s/ha
  (Water requirement for dry season paddy)

Namphou

- Main canal and related structures = 1.1 lit/s/ha
  (Water requirement for dry season paddy)
- Secondary canal/turnout = 1.87 lit/s/ha

ii) Hydraulic formula : Manning's formula

iii) Allowable velocity

| | Max. | Min. |
|---|---|---|
| - Canal | 0.6m/s | 0.3m/3 |
| - Concrete structure | 2m/s | 0.3m/3 |

iv) Roughness coefficient

- Concrete structure : 0.015
- Unlined canal : 0.025

v) Freeboard

- Main and secondary canals : 0. 3 m
- Tertiary and field canals : 0. 15 m

vi) Cross section of canals

Canal base width (B) -water depth (H) ratio and crest width of bank (W) are determined. Internal and external side slopes of canals are determined based on the soil mechanical test. Factors necessary for determination of cross section of canal are as follows:

| Structures | B / H | Internal Side Slope (1 : Z) | Crest Width of Bank (W) (m) | Free-board (m) |
|---|---|---|---|---|
| Main/Secondary | Around 0.6 | 1.5 - 1.0 | 4.5 - 3.0 | 0.3 |
| Tertiary | Less than 1 | 1.0 | 0.6 - 0.8 | 0.2 |
| Field | Less than 1 | 1.0 | 0.3 | 0.1 |

| Filling Height or Cutting Depth D (m) | External Side Slope for Filling Portion of Canal | Internal Side Slope for Cutting Portion of Canal |
|---|---|---|
| D < 2.5 | 1 : 1.5 | 1 : 1.5 |
| 2.5 < D < 4 | 1 : 2 | 1 : 2 |

Note : In case of D > 4 m, a berm of 1.5 m of 1.5 m wide will be provided to internal side slope of canals.

Irrigation flow diagram is shown in Fig. Ⅷ-28, 29 and 30. Typical cross section of canals and farm roads are shown in Fig. Ⅷ-31.

5. Drainage Facilities

(1) Drainage system

The Project area does not likely get inundated and has a lot of natural drains (streams or rivers), therefore, minimum drainage facilities are proposed for the fast draining of excess water aiming at the betterment of crop growth and soil conservation. The drainage facilities of the Project

will consist of tertiary and field drains and related structures. Only one (1) secondary drain is required for the Nhyod H. Bak Area, though, no main drains are proposed for both areas. All the water coming from the Project area will be drained by gravity. All excess water collected through field drains will be directly conveyed to the natural streams or rivers. Some excess water collected through field drains will be conveyed through tertiary and secondary drains to the natural drains.

(2) Drains and related structures

All the drains will be trapezoidal and unlined channels. Approximate catchment areas of secondary, tertiary and field drains are shown below:

| Drains | Catchment Area (ha) | |
|---|---|---|
| | Nhyod H. Bak | Namphou |
| Secondary drains | 400 | - |
| Tertiary drains | 10 to 390 | 10 to 80 |
| Field Drains | < 60 | < 15 |

In drains, drainage culverts will be provided. All these structures will be reinforced concrete construction. A list of drains and that of drainage structures are shown in Table Ⅷ-6 and 7, respectively and are summarized below:

| Drains | Nhyod H. Bak | Nhyod H. Bak |
|---|---|---|
| Secondary drains | 2,100 m | - |
| Tertiary drains | 15,760 m | 4,350 m |
| Field Drains | 62,00 m | 33,350 m |
| Drainage culvert | 16 Nos. | 31 Nos. |

(3) Design criteria

The basic design criteria for drains and drainage structures are as follows:

i) Design discharge
- For paddy field : 6.1 lit/s /ha
- For upland field : by Rational formula

ii) Hydraulic formula : manning's formula

iii) Allowable velocity

| | Max. | Min. |
|---|---|---|
| - Drain | 0.9m/s | 0.3m/3 |
| - Concrete structure | 2.5m/s | 0.8m/3 |

iv) Roughness coefficient

- Drain : 0.03
- Concrete structure : 0.015

v) Side slope of drain : 1 : 1.5

vi) Freeboard (F) : $F > 0$

Drainage flow diagram is shown in Fig. Ⅷ-32, 33 and 34. Typical cross sections of drains are shown in Fig. Ⅷ-35.

6. On-farm Development Work

The on-farm development work is necessary for irrigation and drainage development of the Project. This work will consist of the following:

i) Construction of tertiary and field canals with related structures such as division box, and on-farm culvert, syphon and cross drain;

ii) Construction of tertiary and field drains with related structures such as on-farm drainage culvert;

iii) Construction of farm footpaths with a width of 0.6 to 0.8 m for tertiary and 0.3 m for field canals.

7. Farm Road

Village roads connecting the national road Route 13 or Route 11 run through both Project areas, though, roads in the Project area are considerably poor in density and quality. In order to strengthen the road network in the Project area with the purpose of (i) efficient transportation of agricultural input and output to and/or from village and market, and (ii) smooth operation and maintenance work of canals and structures, farm roads will be provided alongside the main canals, secondary canals, tertiary canals and field canals. The farm road will be earthen road with a width of 3.0 to 4.5 m for main and secondary canals, 0.6 to 0.8 m for tertiary canals, and 0.3 m for field canals. The surface will be paved with laterite of 3.5 m wide and 15 m thick only for some farm roads to be provided alongside the main and secondary canals with a width of 4.5 m according to the importance of the roads.

The typical cross sections of the roads are shown in Fig. Ⅷ-31.

8. Demonstration Farm

Introduction and extension of the improved farming practice and water management practice are very necessary for an optimum agricultural production in the Project area. In addition, such practices have be improved through field trials to meet the local requirement in the area. In order to promote such extension and execute such field trials, construction of demonstration farm (58 ha in net) is proposed under the Project.

The proposed site is located near B. Donghnkhou, almost at the center of the Nhyod H. Bak Irrigation area, as shown in Fig. Ⅷ-1. This location is very effective for demonstration and is very convenient for the implementation of technical guidance by the Project office.

The proposed area is all existing rainfed paddy field, mostly privately owned by the farmers of B. Dongkhankhou. In order to produce the demonstration effect, the following considerations are given to the demonstration farm:

i) Land consolidation is not proposed for irrigation area of the Project but only for the demonstration farm.

ii) The use of buffaloes is proposed in the agricultural development plan as draft animal, but the use of small farm tractors is proposed instead for land preparation of the demonstration farm.

The future use of the farm machineries was considered to determine the size of the plot of the farm. Three (3) farm plot sizes are conceived, namely 1.0 ha (200 m × 50 m), 0.5 ha (100 m× 50 m) and 0.3 ha (100 m × 30 m). However, since the farm plot size of 1.0 ha is considerably large for paddy cultivation, a comparative study was made on areas of 0.5 ha and 0.3 ha. The study is made with due regard to cost, namely earth-moving volume per hectare. As the result of the study, farm plot size of 0.3 ha is adopted as the appropriate standard size.

The demonstration farm will consist of one tertiary block. Irrigation water will be supplied from turnout No.4 through Right Bank Secondary Canal-1 (RSC-1). Further, drainage water will be collected through field drains (TD-RS1-4 and 5), which is connected to the natural stream of H. Don. General layout of the proposed demonstration farm is shown in Fig. Ⅷ-36.

The operation and maintenance of the farm will be made by the farmers under the technical guidance of the Project office. For the demonstration farm, three (3) units of tractors (35 HP) will be provided by the Project office. The operation and maintenance of such tractors will be made by the Project office.

## Table Ⅷ-1 Water Blance (Nhyod H. Bak)

| No. | R (mm) | Q ($m^3$/D) | W.R ($m^3$/D) | Balance ($m^3$/D) | Capacity ($m^3$) | ($m^3$) |
|---|---|---|---|---|---|---|
| 1/1/85 | 0 | 12,096 | 90,548 | -78,452 | -392,260 | 542,238 |
| 1/2/85 | 0 | 12,096 | 90,548 | -78,452 | -392,260 | 934,498 |
| 1/3/85 | 0 | 12,096 | 90,548 | -78,452 | -392,260 | 1,326,758 |
| 1/4/85 | 0 | 12,096 | 90,548 | -78,452 | -392,260 | 1,719,018 |
| 1/5/85 | 1.9 | 30,906 | 90,548 | -59,642 | -298,210 | 2,017,228 |
| 1/6/85 | 1.3 | 24,966 | 90,548 | -65,582 | -393,492 | 2,410,720 |
| 2/1/85 | 0.6 | 18,036 | 104,717 | -86,681 | -433,405 | 2,844,125 |
| 2/2/85 | 0.7 | 19,026 | 104,717 | -85,691 | -428,455 | 3,272,580 |
| 2/3/85 | 0 | 12,096 | 104,717 | -92,621 | -463,105 | 3,735,685 |
| 2/4/85 | 0 | 12,096 | 104,717 | -92,621 | -463,105 | 4,198,790 |
| 2/5/85 | 0 | 12,096 | 104,717 | -92,621 | -463,105 | 4,661,895 |
| 2/6/85 | 0.7 | 19,026 | 104,717 | -85,691 | -257,073 | 4,918,968 |
| 3/1/85 | 2.9 | 40,806 | 117,504 | -76,698 | -387,490 | 5,306,458 |
| 3/2/85 | 0 | 12,096 | 117,504 | -105,408 | -527,040 | 5,833,498 |
| 3/3/85 | 0 | 12,096 | 117,504 | -105,408 | -527,040 | 6,360,538 |
| 3/4/85 | 0 | 12,096 | 117,504 | -105,408 | -527,040 | 6,887,578 |
| 3/5/85 | 0 | 12,096 | 117,504 | -105,408 | -527,040 | 7,414,618 |
| 3/6/85 | 0 | 12,096 | 117,504 | -105,408 | -632,448 | 8,047,066 |
| 4/1/85 | 0 | 12,096 | 32,486 | -20,390 | -101,950 | 8,149,016 |
| 4/2/85 | 0 | 12,096 | 32,486 | -20,390 | -101,950 | 8,250,966 |
| 4/3/85 | 0 | 12,096 | 32,486 | -20,390 | -101,950 | 8,352,916 |
| 4/4/85 | 0.9 | 21,006 | 32,486 | -11,480 | -57,400 | 8,410,316 |
| 4/5/85 | 7.3 | 84,366 | 32,486 | 51,880 | 259,400 | 8,150,916 |
| 4/6/85 | 1.7 | 28,926 | 32,486 | -3,560 | -17,800 | 8,168,716 |
| 5/1/85 | 8.4 | 95,256 | 2,074 | 93,182 | 465,910 | 7,702,806 |
| 5/2/85 | 3.3 | 44,766 | 2,074 | 42,692 | 213,460 | 7,489,346 |
| 5/3/85 | 5.1 | 62,586 | 2,074 | 60,512 | 302,560 | 7,186,786 |
| 5/4/85 | 4.4 | 55,656 | 2,074 | 53,582 | 267,910 | 6,918,876 |
| 5/5/85 | 0.4 | 16,056 | 2,074 | 13,982 | 69,910 | 6,848,966 |
| 5/6/85 | 1.3 | 24,966 | 2,074 | 22,892 | 137,352 | 6,711,614 |
| 6/1/85 | 5.0 | 61,596 | 22,982 | 38,614 | 193,070 | 6,518,544 |
| 6/2/85 | 1.2 | 23,976 | 22,982 | 994 | 4,970 | 6,513,574 |
| 6/3/85 | 14.6 | 156,636 | 22,982 | 133,654 | 668,270 | 5,845,304 |
| 6/4/85 | 29.8 | 307,116 | 22,982 | 284,134 | 1,420,670 | 4,424,634 |
| 6/5/85 | 12.2 | 132,876 | 22,982 | 109,894 | 549,470 | 3,875,164 |
| 6/6/85 | 2.2 | 33,876 | 22,982 | 10,894 | 54,470 | 3,820,694 |
| 7/1/85 | 2.6 | 37,836 | 90,288 | -52,452 | -262,260 | 4,082,954 |
| 7/2/85 | 15.0 | 160,596 | 90,288 | 70,308 | 351,540 | 3,731,414 |
| 7/3/85 | 2.8 | 39,816 | 90,288 | -50,472 | -252,360 | 3,983,774 |
| 7/4/85 | 2.4 | 35,856 | 90,288 | -54,432 | -272,160 | 4,255,934 |
| 7/5/85 | 2.9 | 40,806 | 90,288 | -49,482 | -247,410 | 4,503,344 |
| 7/6/85 | 12.7 | 137,826 | 90,288 | 47,538 | 285,228 | 4,218,116 |
| 8/1/85 | 18.9 | 199,206 | 0 | 199,206 | 996,030 | 3,222,086 |
| 8/2/85 | 27.3 | 285,773 | 0 | 285,773 | 1,428,865 | 1793,221 |
| 8/3/85 | 4.1 | 52,686 | 0 | 52,686 | 263,430 | 1,529,791 |
| 8/4/85 | 7.1 | 82,386 | 0 | 82,386 | 411,930 | 1,117,861 |
| 8/5/85 | 7.6 | 87,336 | 0 | 87,336 | 436,680 | 681,181 |
| 8/6/85 | 1.4 | 25,956 | 0 | 25,956 | 155,736 | 525,445 |
| 9/1/85 | 15.0 | 160,596 | 54,994 | 105,602 | 528,010 | 0 |
| 9/2/85 | 2.0 | 31,896 | 54,994 | -23,098 | -115,490 | 115,490 |
| 9/3/85 | 3.4 | 45,756 | 54,994 | -9,238 | -46,190 | 161,680 |
| 9/4/85 | 2.8 | 39,816 | 54,994 | -15,178 | -75,890 | 237,570 |
| 9/5/85 | 1.5 | 26,946 | 54,994 | -28,048 | -140,240 | 377,810 |
| 9/6/85 | 0.2 | 14,076 | 54,994 | -40,918 | -204,590 | 582,400 |
| 10/1/85 | 4.5 | 56,646 | 42,682 | 13,964 | 69,820 | 512,580 |
| 10/2/85 | 2.2 | 33,876 | 42,682 | -8,806 | -44,030 | 556,610 |
| 10/3/85 | 2.4 | 35,856 | 42,682 | -6,826 | -34,130 | 590,740 |
| 10/4/85 | 8.9 | 100,206 | 42,682 | 57,524 | 287,620 | 303,120 |
| 10/5/85 | 2.2 | 33,876 | 42,682 | -8,806 | -44,030 | 347,150 |
| 10/6/85 | 2.3 | 34,868 | 42,682 | -7,816 | -46,896 | 394,046 |
| 11/1/85 | 0 | 12,096 | 5,746 | 6,350 | 31,750 | 362,296 |
| 11/2/85 | 0 | 12,096 | 5,746 | 6,350 | 31,750 | 330,546 |
| 11/3/85 | 0 | 12,096 | 5,746 | 6,350 | 31,750 | 298,796 |
| 11/4/85 | 0 | 12,096 | 5,746 | 6,350 | 31,750 | 267,046 |
| 11/5/85 | 0 | 12,096 | 5,746 | 6,350 | 31,750 | 235,296 |
| 11/6/85 | 0 | 12,096 | 5,746 | 6,350 | 31,750 | 203,546 |
| 12/1/85 | 0 | 12,096 | 10,368 | 1,728 | 8,640 | 194,906 |
| 12/2/85 | 0 | 12,096 | 10,368 | 1,728 | 8,640 | 196,266 |
| 12/3/85 | 0 | 12,096 | 10,368 | 1,728 | 8,640 | 177,626 |
| 12/4/85 | 0 | 12,096 | 10,368 | 1,728 | 8,640 | 168,986 |
| 12/5/85 | 0 | 12,096 | 10,368 | 1,728 | 8,640 | 160,346 |
| 12/6/85 | 0 | 12,096 | 10,368 | 1,728 | 10,368 | 149,978 |

## Table Ⅷ-2 Water Balance Namphu(cont.)

| No. | Water Balance (m³/D) No.1 | No.2 | No.3+4 | No.5 | No.6 | H. Xay Dam Balance (m³/d) | m³ | No. 3+4 Balance m³ | m³ | m³ |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/1/85 | -6,791 | 0 | 410 | -5,295 | 1,332 | -12,086 | -60,430 | 84,548 | 2,050 | 0 |
| 1/2/85 | -6,791 | 0 | 410 | -5,295 | 1,332 | -12,086 | -60,430 | 144,978 | 2,050 | 0 |
| 1/3/85 | -6,791 | 0 | 410 | -5,295 | 1,332 | -12,086 | -60,430 | 205,408 | 2,050 | 0 |
| 1/4/85 | -6,791 | 0 | 410 | -5,295 | 1,332 | -12,086 | -60,430 | 265,838 | 2,050 | 0 |
| 1/5/85 | 3,716 | 2,860 | 9,017 | 18,603 | 10,110 | 3,716 | 18,580 | 247,258 | 45,085 | 0 |
| 1/6/85 | 398 | 1,957 | 6,299 | 8,912 | 7,338 | 398 | 2,388 | 244,870 | 37,794 | 0 |
| 2/1/85 | -4,536 | 903 | 2,640 | -579 | 3,663 | -5,115 | -25,575 | 270,445 | 13,200 | 0 |
| 2/2/85 | -3,983 | 1,054 | 3,093 | 483 | 4,125 | -3,983 | -19,915 | 290,360 | 15,465 | 0 |
| 2/3/85 | -7,854 | 0 | -78 | -6,874 | 891 | -14,728 | -73,640 | 364,000 | -390 | 390 |
| 2/4/85 | -7,854 | 0 | -78 | -6,874 | 891 | -14,728 | -73,640 | 437,640 | -390 | 780 |
| 2/5/85 | -7,854 | 0 | -78 | -6,874 | 891 | -14,728 | -73,640 | 511,280 | -390 | 1,170 |
| 2/6/85 | -3,983 | 1,054 | 3,093 | 483 | 4,125 | -3,983 | -11,949 | 523,229 | 9,279 | 0 |
| 3/1/85 | 7,224 | 4,365 | 12,489 | 29,473 | 14,151 | 7,224 | 36,120 | 487,109 | 62,445 | 0 |
| 3/2/85 | -8,813 | 0 | -648 | -7,908 | 753 | -16,721 | -83,605 | 570,714 | -3,240 | 3,240 |
| 3/3/85 | -8,813 | 0 | -648 | -7,908 | 753 | -16,721 | -83,605 | 654,319 | -3,240 | 6,480 |
| 3/4/85 | -8,813 | 0 | -648 | -7,908 | 753 | -16,721 | -83,605 | 737,924 | -3,240 | 9,720 |
| 3/5/85 | -8,813 | 0 | -648 | -7,908 | 753 | -16,721 | -83,605 | 821,529 | -3,240 | 12,960 |
| 3/6/85 | -8,813 | 0 | -648 | -7,908 | 753 | -16,721 | -100,326 | 921,855 | -3,888 | 16,848 |
| 4/1/85 | -2,436 | 0 | 3,188 | 2,147 | 1,583 | -2,436 | -12,180 | 934,035 | 15,940 | 908 |
| 4/2/85 | -2,436 | 0 | 3,188 | 2,147 | 1,583 | -2,436 | -12,180 | 946,215 | 15,940 | 0 |
| 4/3/85 | -2,436 | 0 | 3,188 | 2,147 | 1,583 | 2,436 | -12,180 | 958,395 | 15,940 | 0 |
| 4/4/85 | 2,541 | 1,355 | 7,265 | 14,248 | 5,741 | 2,541 | 12,705 | 945,690 | 36,325 | 0 |
| 4/5/85 | 37,933 | 10,987 | 36,257 | 117,624 | 35,309 | 37,933 | 189,665 | 756,025 | 181,285 | 0 |
| 4/6/85 | 6,965 | 2,559 | 10,889 | 27,170 | 9,437 | 6,965 | 34,825 | 721,200 | 54,445 | 0 |
| 5/1/85 | 46,296 | 12,642 | 42,540 | 141,441 | 40,831 | 46,296 | 231,840 | 489,720 | 212,700 | 0 |
| 5/2/85 | 18,093 | 4,967 | 19,437 | 59,063 | 17,269 | 18,093 | 90,465 | 399,255 | 97,185 | 0 |
| 5/3/85 | 28,047 | 7,676 | 27,591 | 88,137 | 25,585 | 28,047 | 140,235 | 259,020 | 137,955 | 0 |
| 5/4/85 | 24,176 | 6,622 | 24,420 | 76,831 | 22,351 | 24,176 | 120,880 | 138,140 | 122,100 | 0 |
| 5/5/85 | 2,056 | 602 | 6,300 | 12,221 | 3,871 | 2,056 | 10,280 | 127,860 | 31,500 | 0 |
| 5/6/85 | 7,033 | 1,957 | 10,377 | 26,758 | 8,029 | 7,033 | 42,198 | 85,662 | 62,262 | 0 |
| 6/1/85 | 24,263 | 6,436 | 25,764 | 72,897 | 23,965 | 24,263 | 121,315 | 0 | 128,820 | 0 |
| 6/2/85 | 3,249 | 717 | 8,550 | 11,518 | 6,409 | 3,249 | 13,245 | 0 | 42,750 | 0 |
| 6/3/85 | 77,351 | 20,884 | 69,252 | 227,961 | 68,317 | 77,351 | 386,755 | 0 | 346,260 | 0 |
| 6/4/85 | 161,407 | 43,760 | 138,108 | 473,479 | 138,541 | 161,407 | 807,035 | 0 | 690,540 | 0 |
| 6/5/85 | 64,079 | 17,272 | 58,380 | 189,195 | 57,229 | 64,079 | 320,395 | 0 | 291,900 | 0 |
| 6/6/85 | 8,779 | 2,222 | 13,080 | 27,670 | 11,029 | 8,779 | 43,895 | 0 | 65,400 | 0 |
| 7/1/85 | 0 | 0 | 10,642 | -9,131 | 9,335 | -9,131 | -45,655 | 45,655 | 53,210 | 0 |
| 7/2/85 | 69,644 | 18,298 | 66,814 | 190,796 | 66,623 | 69,644 | 348,220 | 0 | 334,070 | 0 |
| 7/3/85 | 0 | 0 | 11,548 | -3,201 | 10,259 | -6,201 | -31,005 | 31,005 | 57,740 | 0 |
| 7/4/85 | -34 | 0 | 9,736 | -12,026 | 8,411 | -12,060 | -60,300 | 91,305 | 48,680 | 0 |
| 7/5/85 | 0 | 88 | 12,001 | -4,649 | 10,721 | -4,649 | -23,245 | 114,550 | 60,005 | 0 |
| 7/6/85 | 56,925 | 14,837 | 56,395 | 153,645 | 55,997 | 56,925 | 341,550 | 0 | 338,370 | 0 |
| 8/1/85 | 104,517 | 28,445 | 90,183 | 312,316 | 89,393 | 104,517 | 522,585 | 0 | 450,915 | 0 |
| 8/2/85 | 150,969 | 41,087 | 129,521 | 449,564 | 128,786 | 150,969 | 754,845 | 0 | 647,605 | 0 |
| 8/3/85 | 22,673 | 6,171 | 23,139 | 73,259 | 21,017 | 22,673 | 113,365 | 0 | 115,695 | 0 |
| 8/4/85 | 39,263 | 10,686 | 36,729 | 121,716 | 34,877 | 39,263 | 196,315 | 0 | 183,645 | 0 |
| 8/5/85 | 42,028 | 11,438 | 38,994 | 129,793 | 37,187 | 42,028 | 210,140 | 0 | 194,970 | 0 |
| 8/6/85 | 7,742 | 2,107 | 10,908 | 29,647 | 8,543 | 7,742 | 46,452 | 0 | 65,448 | 0 |
| 9/1/85 | 74,846 | 19,970 | 69,043 | 213,674 | 68,481 | 74,846 | 374,230 | 0 | 345,215 | 0 |
| 9/2/85 | 2,956 | 405 | 10,153 | 3,692 | 8,421 | 2,956 | 14,780 | 0 | 50,765 | 0 |
| 9/3/85 | 10,698 | 2,512 | 16,495 | 26,305 | 14,889 | 10,698 | 53,490 | 0 | 82,475 | 0 |
| 9/4/85 | 7,380 | 1,609 | 13,777 | 16,614 | 12,117 | 7,380 | 36,900 | 0 | 68,885 | 0 |
| 9/5/85 | 0 | 0 | 7,888 | -4,038 | 6,111 | -4,038 | -20,190 | 20,190 | 39,440 | 0 |
| 9/6/85 | -6,998 | 0 | 1,999 | -16,081 | 105 | -23,079 | -115,395 | 135,585 | 9,995 | 0 |
| 10/1/85 | 18,595 | 4,751 | 22,255 | 52,053 | 20,619 | 18,595 | 92,975 | 42,610 | 111,275 | 0 |
| 10/2/85 | 5,876 | 1,289 | 11,836 | 14,902 | 9,993 | 5,876 | 29,380 | 13,230 | 59,180 | 0 |
| 10/3/85 | 6,982 | 1,590 | 12,742 | 18,133 | 10,917 | 6,982 | 34,910 | 0 | 63,710 | 0 |
| 10/4/85 | 42,927 | 11,373 | 42,187 | 123,124 | 40,947 | 42,927 | 214,635 | 0 | 210,935 | 0 |
| 10/5/85 | 5,876 | 1,289 | 11,836 | 14,902 | 9,993 | 5,876 | 29,380 | 0 | 71,016 | 0 |
| 10/6/85 | 6,429 | 1,440 | 12,289 | 16,517 | 10,455 | 6,429 | 38,574 | 0 | 61,445 | 0 |
| 11/1/85 | 259 | 29 | 5,109 | 6,539 | 2,697 | 259 | 1,295 | 0 | 25,545 | 0 |
| 11/2/85 | 259 | 29 | 5,109 | 6,539 | 2,697 | 259 | 1,295 | 0 | 25,545 | 0 |
| 11/3/85 | 259 | 29 | 5,109 | 6,539 | 2,697 | 259 | 1,295 | 0 | 25,545 | 0 |
| 11/4/85 | 259 | 29 | 5,109 | 6,539 | 2,697 | 259 | 1,295 | 0 | 25,545 | 0 |
| 11/5/85 | 259 | 29 | 5,109 | 6,539 | 2,697 | 259 | 1,295 | 0 | 25,545 | 0 |
| 11/6/85 | 259 | 29 | 5,109 | 6,539 | 2,697 | 259 | 1,295 | 0 | 25,545 | 0 |
| 12/1/85 | -778 | 0 | 4,060 | 4,826 | 2,049 | -778 | -3,890 | 3,890 | 20,300 | 0 |
| 12/2/85 | -778 | 0 | 4,060 | 4,826 | 2,049 | -778 | -3,890 | 7,780 | 20,300 | 0 |
| 12/3/85 | -778 | 0 | 4,060 | 4,826 | 2,049 | -778 | -3,890 | 11,670 | 20,300 | 0 |
| 12/4/85 | -778 | 0 | 4,060 | 4,826 | 2,049 | -778 | -3,890 | 15,560 | 20,300 | 0 |
| 12/5/85 | -778 | 0 | 4,060 | 4,826 | 2,049 | -778 | -3,890 | 19,450 | 20,300 | 0 |
| 12/6/85 | -778 | 0 | 4,060 | 4,826 | 2,049 | -778 | -4,668 | 24,118 | 24,360 | 0 |

Table Ⅷ-2 Water Balance Namphu(cont.)

| No. | No.1 Q ($m^3$/D) | No.2 Q ($m^3$/D) | No.3+4 Q ($m^3$/D) | No.5 Q ($m^3$/D) | No.6 Q ($m^3$/D) | No.1 W.R. ($m^3$/D) | No.2 W.R. ($m^3$/D) | No.3+4 W.R. ($m^3$/D) | No.5 W.R. ($m^3$/D) | No.6 W.R. ($m^3$/D) | Return Flow ($m^3$/D) No.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/1/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 6,791 | 0 | 4,156 | 9,055 | 743 | 2,352 |
| 1/2/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 6,791 | 0 | 4,156 | 9,055 | 743 | 2,352 |
| 1/3/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 6,791 | 0 | 4,156 | 9,055 | 743 | 2,352 |
| 1/4/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 6,791 | 0 | 4,156 | 9,055 | 743 | 2,352 |
| 1/5/85 | 10,507 | 2,860 | 13,173 | 36,253 | 10,853 | 6,791 | 0 | 4,156 | 9,055 | 743 | 2,352 |
| 1/6/85 | 7,189 | 1,957 | 10,455 | 25,562 | 8,081 | 6,791 | 0 | 4,156 | 9,055 | 743 | 2,352 |
| 2/1/85 | 3,318 | 903 | 7,284 | 15,255 | 4,847 | 7,854 | 0 | 4,644 | 10,472 | 1,184 | 2,600 |
| 2/2/85 | 3,871 | 1,054 | 7,737 | 16,870 | 5,309 | 7,854 | 0 | 4,644 | 10,472 | 1,184 | 2,600 |
| 2/3/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 7,854 | 0 | 4,644 | 10,472 | 1,184 | 2,600 |
| 2/4/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 7,854 | 0 | 4,644 | 10,472 | 1,184 | 2,600 |
| 2/5/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 7,854 | 0 | 4,644 | 10,472 | 1,184 | 2,600 |
| 2/6/85 | 3,871 | 1,054 | 7,737 | 16,870 | 5,309 | 7,854 | 0 | 4,644 | 10,472 | 1,184 | 2,600 |
| 3/1/85 | 13,037 | 4,365 | 17,703 | 52,406 | 15,473 | 8,813 | 0 | 5,214 | 11,750 | 1,322 | 2,844 |
| 3/2/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 8,813 | 0 | 5,214 | 11,750 | 1,322 | 2,844 |
| 3/3/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 8,813 | 0 | 5,214 | 11,750 | 1,322 | 2,844 |
| 3/4/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 8,813 | 0 | 5,214 | 11,750 | 1,322 | 2,844 |
| 3/5/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 8,813 | 0 | 5,214 | 11,750 | 1,322 | 2,844 |
| 3/6/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 8,813 | 0 | 5,214 | 11,750 | 1,322 | 2,844 |
| 4/1/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 2,436 | 0 | 1,378 | 3,249 | 492 | 1,210 |
| 4/2/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 2,436 | 0 | 1,378 | 3,249 | 492 | 1,210 |
| 4/3/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 2,436 | 0 | 1,378 | 3,249 | 492 | 1,210 |
| 4/4/85 | 4,977 | 1,355 | 8,643 | 20,101 | 6,233 | 2,436 | 0 | 1,378 | 3,249 | 492 | 1,210 |
| 4/5/85 | 40,369 | 10,987 | 37,635 | 123,477 | 35,801 | 2,436 | 0 | 1,378 | 3,249 | 492 | 1,210 |
| 4/6/85 | 9,401 | 2,559 | 12,267 | 33,023 | 9,929 | 2,436 | 0 | 1,378 | 3,249 | 492 | 637 |
| 5/1/85 | 46,452 | 12,642 | 42,618 | 141,245 | 40,883 | 156 | 0 | 78 | 207 | 52 | 637 |
| 5/2/85 | 18,249 | 4,967 | 19,515 | 58,867 | 17,321 | 156 | 0 | 78 | 207 | 52 | 637 |
| 5/3/85 | 28,203 | 7,676 | 27,669 | 87,941 | 25,637 | 156 | 0 | 78 | 207 | 52 | 637 |
| 5/4/85 | 24,332 | 6,622 | 24,498 | 76,635 | 22,403 | 156 | 0 | 78 | 207 | 52 | 637 |
| 5/5/85 | 2,212 | 602 | 6,378 | 12,025 | 3,923 | 156 | 0 | 78 | 207 | 52 | 637 |
| 5/6/85 | 7,189 | 1,957 | 10,455 | 26,562 | 8,081 | 156 | 0 | 78 | 207 | 52 | 637 |
| 6/1/85 | 27,650 | 7,525 | 27,216 | 86,326 | 25,175 | 3,387 | 1,089 | 1,452 | 9,919 | 1,210 | 2,418 |
| 6/2/85 | 6,636 | 1,806 | 10,002 | 24,947 | 7,619 | 3,387 | 1,089 | 1,452 | 9,919 | 1,210 | 2,418 |
| 6/3/85 | 80,738 | 21,973 | 70,704 | 241,390 | 69,527 | 3,387 | 1,089 | 1,452 | 9,919 | 1,210 | 2,418 |
| 6/4/85 | 164,794 | 44,849 | 139,560 | 486,908 | 139,751 | 3,387 | 1,089 | 1,452 | 9,919 | 1,210 | 2,418 |
| 6/5/85 | 67,466 | 18,361 | 59,832 | 202,624 | 58,439 | 3,387 | 1,089 | 1,452 | 9,919 | 1,210 | 2,418 |
| 6/6/85 | 12,166 | 3,311 | 14,532 | 41,099 | 12,239 | 3,387 | 1,089 | 1,452 | 9,919 | 1,210 | 2,418 |
| 7/1/85 | 14,378 | 3,913 | 16,344 | 47,560 | 14,087 | 13,306 | 4,277 | 5,702 | 38,966 | 4,752 | 5,196 |
| 7/2/85 | 82,950 | 22,575 | 72,516 | 247,851 | 71,375 | 13,306 | 4,277 | 5,702 | 38,966 | 4,752 | 5,196 |
| 7/3/85 | 15,484 | 4,214 | 17,250 | 50,791 | 15,011 | 13,306 | 4,277 | 5,702 | 38,966 | 4,752 | 5,196 |
| 7/4/85 | 13,272 | 3,612 | 15,438 | 44,330 | 13,163 | 13,306 | 4,277 | 5,702 | 38,966 | 4,752 | 5,196 |
| 7/5/85 | 16,037 | 4,365 | 17,703 | 52,406 | 15,473 | 13,306 | 4,277 | 5,702 | 38,966 | 4,752 | 5,196 |
| 7/6/85 | 70,231 | 19,114 | 62,097 | 210,700 | 60,749 | 13,306 | 4,277 | 5,702 | 38,966 | 4,752 | 5,196 |
| 8/1/85 | 104,517 | 28,445 | 90,183 | 310,846 | 89,393 | 0 | 0 | 0 | 0 | 0 | 1,470 |
| 8/2/85 | 150,969 | 41,087 | 129,521 | 448,094 | 128,786 | 0 | 0 | 0 | 0 | 0 | 1,470 |
| 8/3/85 | 22,673 | 6,171 | 23,139 | 71,789 | 21,017 | 0 | 0 | 0 | 0 | 0 | 1,470 |
| 8/4/85 | 39,263 | 10,686 | 36,729 | 120,246 | 34,877 | 0 | 0 | 0 | 0 | 0 | 1,470 |
| 8/5/85 | 42,028 | 11,438 | 38,994 | 128,323 | 37,187 | 0 | 0 | 0 | 0 | 0 | 1,470 |
| 8/6/85 | 7,742 | 2,107 | 10,908 | 28,177 | 8,543 | 0 | 0 | 0 | 0 | 0 | 1,470 |
| 9/1/85 | 82,950 | 22,575 | 72,516 | 247,851 | 71,375 | 8,104 | 2,605 | 3,473 | 23,734 | 2,894 | 3,739 |
| 9/2/85 | 11,060 | 3,010 | 13,626 | 37,869 | 11,315 | 8,104 | 2,605 | 3,473 | 23,734 | 2,894 | 3,739 |
| 9/3/85 | 18,802 | 5,117 | 19,968 | 60,482 | 17,783 | 8,104 | 2,605 | 3,473 | 23,734 | 2,894 | 3,739 |
| 9/4/85 | 15,484 | 4,214 | 17,250 | 50,791 | 15,011 | 8,104 | 2,605 | 3,473 | 23,734 | 2,894 | 3,739 |
| 9/5/85 | 8,295 | 2,258 | 11,361 | 29,792 | 9,005 | 8,104 | 2,605 | 3,473 | 23,734 | 2,894 | 3,739 |
| 9/6/85 | 1,106 | 301 | 5,472 | 8,794 | 2,999 | 8,104 | 2,605 | 3,473 | 23,734 | 2,894 | 3,739 |
| 10/1/85 | 24,885 | 6,773 | 24,951 | 78,250 | 22,865 | 6,290 | 2,022 | 2,696 | 18,420 | 2,246 | 3,231 |
| 10/2/85 | 12,166 | 3,311 | 14,532 | 51,099 | 12,239 | 6,290 | 2,022 | 2,696 | 18,420 | 2,246 | 3,231 |
| 10/3/85 | 13,272 | 3,612 | 15,438 | 44,330 | 13,163 | 6,290 | 2,022 | 2,696 | 18,420 | 2,246 | 3,231 |
| 10/4/85 | 49,217 | 13,395 | 44,883 | 149,321 | 43,193 | 6,290 | 2,022 | 2,696 | 18,420 | 2,246 | 3,231 |
| 10/5/85 | 12,166 | 3,311 | 14,532 | 41,099 | 12,239 | 6,290 | 2,022 | 2,696 | 18,420 | 2,246 | 3,231 |
| 10/6/85 | 12,719 | 3,462 | 14,985 | 42,714 | 12,701 | 6,290 | 2,022 | 2,696 | 18,420 | 2,246 | 3,231 |
| 11/1/85 | 1,106 | 301 | 5,472 | 8,794 | 2,999 | 847 | 272 | 363 | 2,480 | 302 | 1,707 |
| 11/2/85 | 1,106 | 301 | 5,472 | 8,794 | 2,999 | 847 | 272 | 363 | 2,480 | 302 | 1,707 |
| 11/3/85 | 1,106 | 301 | 5,472 | 8,794 | 2,999 | 847 | 272 | 363 | 2,480 | 302 | 1,707 |
| 11/4/85 | 1,106 | 301 | 5,472 | 8,794 | 2,999 | 847 | 272 | 363 | 2,480 | 302 | 1,707 |
| 11/5/85 | 1,106 | 301 | 5,472 | 8,794 | 2,999 | 847 | 272 | 363 | 2,480 | 302 | 1,707 |
| 11/6/85 | 1,106 | 301 | 5,472 | 8,794 | 2,999 | 847 | 272 | 363 | 2,480 | 302 | 1,707 |
| 12/1/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 778 | 0 | 506 | 1,037 | 26 | 805 |
| 12/2/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 778 | 0 | 506 | 1,037 | 26 | 805 |
| 12/3/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 778 | 0 | 506 | 1,037 | 26 | 805 |
| 12/4/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 778 | 0 | 506 | 1,037 | 26 | 805 |
| 12/5/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 778 | 0 | 506 | 1,037 | 26 | 805 |
| 12/6/85 | 0 | 0 | 4,566 | 5,564 | 2,075 | 778 | 0 | 506 | 1,037 | 26 | 805 |

Table Ⅷ-3 Comparison of Dam Site Alternatives

| Dam Site Alternative | No.1 | No.2 | No.3 |
|---|---|---|---|
| Catchment Area | 38 $Km^2$ | 31 $Km^2$ | 20 $Km^2$ |
| Crest Length (Crest Level = El 171 m) | 1,460 m | 965 m | 650 m |
| Dam Volume | 930,000 $m^3$ | 320,000 $m^3$ | 320,000 $m^3$ |
| Submerged Area (Water Level = 168 m) | 6.19 $Km^2$ | 4.28 $Km^2$ | 2.54 $Km^2$ |
| Total Capacity | 19.9 mil. $m^3$ | 11.9 mil. $m^3$ | 6.3 mil. $m^3$ |
| Irrigable Area (Rainy season) | 890 ha | 950 ha | 680 ha |
| Difficult for Construction | Good access downstream | Good access downstream and upstream | Fair access upstream Long head race and Syphon are required |
| Construction Cost | Highest | Lower than No. 1 Higher than No. 3 | Lower than No. 2 |
| Evaluation | Submerged 60 ha of existing paddy field | Most economical reservoir and low difficulty for construction showing the most suitability | Low efficiency because of long head race and low total capacity showing low irrigable area |
| Ranking | 2 | 1 | 3 |

Table Ⅷ-4 Material Test for Nhyod H. Bak Dam

| Sample No. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Pit No. | 1 | 1 | 2 | 2 | 3 | 4 |
| Depth (m) | 1.2-2.2 | 2.2-3.0 | 1.1-1.8 | 1.8-3.0 | 1.7-3.0 | 1.0-1.3 |
| Type of Material | Sandy Clay Loam | Sandy Clay Gravel | Sandy Clay Loam | Sandy Clay Loam+ Gravel | Sandy Clay Loam+ Laterite | Sandy Clay Loam+ Laterite |
| Moisture Content (%) | 12.62 | - | 11.32 | - | - | - |
| Liquid limit | 31.19 | 39.48 | 33.98 | 32.48 | 34.00 | 33.89 |
| Plastic Limit | 20.13 | 24.40 | 21.43 | 21.43 | 22.26 | 21.89 |
| Plastic Index | 11.06 | 15.08 | 12.55 | 11.05 | 11.74 | 12.09 |
| Specific Gravity ($g/cm^3$) | 2.70 | 2.72 | 2.70 | 2.71 | 2.69 | 2.69 |
| Classification AASHTO- | A-6 | A-2-6 | A-6 | A-2-6 | A-6 | A-2-6 |
| Max. Dry Density (LB/FT3) | 126.30 | 130.20 | 124.56 | 131.19 | 126.80 | 131.00 |
| ($g/cm^3$) | 2.02 | 2.08 | 1.99 | 2.10 | 2.03 | 2.10 |
| Optimum Moisture Content (%) | 9.50 | 8.70 | 10.97 | 9.74 | 12.50 | 8.10 |
| Permeability (K) (mm/day) | 757×10^-4 | - | 221×10^-4 | - | - | - |

Source : Ministry of Communication T.P.C
Enterprise for Survey and Construction
Material Laboratory, Vientiane, Lao PDR

Table Ⅷ-5 Material Test for H.Xay Dam

| Sample No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Pit No. | 1 | 1 | 1 | 2 |
| Depth (m) | 0.0-1.0 | 1.0-1.8 | 1.8-2.7 | 0.8-2.8 |
| Type of Material | Sandy Clay Gravel | Clay Gravel and Laterite | Clay | Sandy Clay Loam + Laterite |
| Moisture Content (%) | 20.47 | 15.20 | 18.80 | 21.05 |
| Liquid limit | 27.70 | 41.80 | 41.60 | 38.20 |
| Plastic Limit | 17.69 | 24.40 | 24.77 | 25.22 |
| Plastic Index | 10.01 | 17.40 | 16.83 | 12.98 |
| Specific Gravity ($g/cm^3$) | 2.71 | 2.73 | 2.73 | 2.70 |
| Classification AASHTO- | A-2-4 | A-7-5 | A-7-5 | A-6 |
| Max. Dry Density (LB/FT3) | 133.0 | 121.5 | 119.0 | 125.0 |
| ($g/cm^3$) | 2.13 | 1.99 | 1.90 | 2.00 |
| Optimum Moisture Content (%) | 8.50 | 13.10 | 13.50 | 14.00 |
| Permeability (K) (mm/day) | - | 60×10^-5 | 111×10^-4 | 129×10^-5 |

Source : Ministry of Communication T.P.C
Enterprise for Survey and Construction
Material Laboratory, Vientiane, Lao PDR

Table Ⅷ-6 List of Canal & Drain (1/3)

(I) N. H. Bak Irrigation

| Canal/Drain | Name | Length (m) | Canal Type |
|---|---|---|---|
| 1. Main Canal | LMC | 5,710 | C-C |
| | RMC | 4,980 | C-A, B |
| | (Sub-total) | 10,690 | |
| 2. Secondary Canal | LSC | 4,130 | C-C, D, E |
| | RSC-1 | 2,570 | C-C, D |
| | RSC-2 | 2,410 | C-B, D |
| | RSC-2-1 | 1,810 | C-D |
| | (Sub-total) | 10,690 | |
| 3. Tertiary Canal | TC-LM1 | 400 | C-H |
| | TC-LM2-1 | 520 | C-H |
| | TC-LM2-2 | 710 | C-H |
| | TC-LM3-1 | 190 | C-H |
| | TC-LM3-2 | 950 | C-H |
| | TC-LM4-1 | 1,040 | C-H |
| | TC-LM4-2 | 300 | C-H |
| | TC-LM4-2-1 | 820 | C-H |
| | TC-LM4-2-2 | 400 | C-H |
| | TC-LS1 | 560 | C-H |
| | TC-LS2 | 490 | C-H |
| | TC-LS3 | 550 | C-H |
| | TC-LS4 | 1,010 | C-H |
| | TC-LS5 | 1,090 | C-H |
| | TC-LS6 | 1,290 | C-H |
| | TC-LS7 | 840 | C-H |
| | TC-LS8 | 670 | C-H |
| | TC-LS9 | 500 | C-H |
| | TC-LS9-1 | 320 | C-H |
| | TC-LS9-1-1 | 940 | C-H |
| | TC-LS9-1-2 | 440 | C-H |
| | TC-LS9-2 | 470 | C-H |
| | TC-RM2-1 | 180 | C-H |
| | TC-RM2-2 | 270 | C-H |
| | TC-RM3-1 | 180 | C-H |
| | TC-RM3-2 | 820 | C-H |
| | TC-RM4-1 | 730 | C-H |
| | TC-RS1-1 | 780 | C-H |
| | TC-RS1-2-1 | 450 | C-H |
| | TC-RS1-2-2 | 400 | C-H |
| | TC-RS1-3 | 510 | C-H |
| | TC-RS1-4-1 | 2,310 | C-H |
| | TC-RS1-4-2 | 250 | C-H |
| | TC-RS1-5-1 | 2,180 | C-H |
| | TC-RS1-5-2 | 150 | C-H |
| | TC-RS1-6 | 860 | C-H |

Table Ⅷ-6 List of Canal & Drain (2/3)

(I) N. H. Bak Irrigation

| Canal/Drain | Name | Length (m) | Canal Type |
|---|---|---|---|
| 3. Tertiary Canal | TC-RS2-1 | 1,220 | C-H |
| | TC-RS2-3 | 90 | C-H |
| | TC-RS2-3-1 | 150 | C-H |
| | TC-RS2-3-2 | 370 | C-H |
| | TC-RS2-4-1 | 250 | C-H |
| | TC-RS2-4-2 | 100 | C-H |
| | TC-RS2-5 | 480 | C-H |
| | TC-RS2-5-1 | 170 | C-H |
| | TC-RS2-5-2 | 300 | C-H |
| | TC-RS2-1-1 | 310 | C-H |
| | TC-RS2-1-2 | 910 | C-H |
| | TC-RS2-1-3 | 520 | C-H |
| | TC-RS2-1-4 | 340 | C-H |
| | TC-RS2-1-5 | 2,050 | C-H |
| | (Sub-total) | 31,830 | |
| 4. Field Canal | | 76,000 | C-J |
| 5. Secondary Drain | SD-LS-1 | 2,110 | D-A |
| 6. Tertiary Drain | TD-LM-2-1 | 810 | D-B |
| | TD-LM2-2 | 690 | D-B |
| | TD-LM4 | 500 | D-B |
| | TD-LS2 | 620 | D-B |
| | TD-LS3 | 620 | D-B |
| | TD-LS4 | 970 | D-B |
| | TD-LS5 | 710 | D-B |
| | TD-LS6-1 | 1,100 | D-B |
| | TD-LS6-2 | 670 | D-B |
| | TD-LS7 | 300 | D-B |
| | TD-LS8 | 630 | D-B |
| | TD-LS9 | 1,250 | D-B |
| | TD-RS1-4 | 1,820 | D-B |
| | TD-RS1-5 | 2,240 | D-B |
| | TD-RS2-1 | 700 | D-B |
| | TD-RS2-1-2 | 450 | D-B |
| | TD-RS2-1-5 | 1,130 | D-B |
| | TD-RS2-4 | 550 | D-B |
| | (Sub-total) | 15,760 | |
| 7. Field Drain | | 62,000 | D-D |

Table Ⅷ-6 List of Canal & Drain (3/3)

(Ⅱ) Namphou Irrigation

| Canal/Drain | Name | Length (m) | Canal Type |
|---|---|---|---|
| 1. Main Canal | RMC No. 1 | 3,740 | CF |
| | LMC No. 2 | 1,010 | C-G |
| | LMC No. 3 | 160 | C-G |
| | RMC No. 4 | 590 | C-G |
| | LMC No. 5 | 3,860 | C-D, E |
| | RMC No. 5 | 4,340 | C-E, F |
| | LMC No. 6 | 740 | C-G |
| | (Sub-total) | 14,440 | |
| 2. Secondary Canal | SC No. 1 | 660 | C-G |
| 3. Tertiary Canal | TC-RM1-2 | 400 | C-I |
| | TC-RM1-3 | 200 | C-I |
| | TC-RM1-4 | 220 | C-I |
| | TC-RM1-5 | 420 | C-I |
| | TC-RM1-6 | 370 | C-I |
| | TC-RM1-7 | 390 | C-I |
| | TC-RM1-8 | 1,370 | C-I |
| | TC-SC1-2 | 240 | C-I |
| | TC-SC1-3 | 880 | C-I |
| | TC-LM2-1 | 420 | C-I |
| | TC-LM2-2 | 450 | C-I |
| | TC-LM2-4 | 1,860 | C-I |
| | TC-LM3-1 | 620 | C-I |
| | TC-LM3-2 | 620 | C-I |
| | TC-RT3 | 540 | C-I |
| | TC-RM4-1 | 160 | C-I |
| | TC-RM4-2 | 230 | C-I |
| | TC-RM4-3 | 950 | C-I |
| | TC-RM5-1 | 670 | C-I |
| | TC-RM5-2 | 660 | C-I |
| | TC-RM5-4 | 410 | C-I |
| | TC-RM5-5 | 1,000 | C-I |
| | TC-RM5-6 | 650 | C-I |
| | TC-LM5-1 | 700 | C-I |
| | TC-LM5-2 | 180 | C-I |
| | TC-LM5-4 | 440 | C-I |
| | TC-LM5-5 | 410 | C-I |
| | TC-LM5-7 | 590 | C-I |
| | TC-LM5-8 | 660 | C-I |
| | TC-LM5-9 | 1,850 | C-I |
| | TC-LM5-10 | 1,860 | C-I |
| | TC-LM6-1 | 1,070 | C-I |
| | TC-LM6-2 | 300 | C-I |
| | TC-LM6-3 | 540 | C-I |
| 4. Field Canal | | 43,510 | C-J |
| 5. Tertiary Drain | TD-LM5-4 | 500 | C-C |
| | TD-LM5-5 | 600 | C-C |
| | TD-LM5-7 | 850 | C-C |
| | TD-LM5-8 | 800 | C-C |
| | TD-LM5-9 | 1600 | C-C |
| 6. Field Drain | (Sub-total) | 4,350 | |
| | | 33,350 | C-D |

Table Ⅷ-7 List of Canal/Drain Structure

(I) N. H. Bak Irrigation

| Canal/Drain | length (m) | Structure | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | TO | CK | SY | CU | DR | SW | CD | FP | DB |
| (Ⅰ)N. H. Bak | | | | | | | | | | |
| 1. Main Canal | | | | | | | | | | |
| LMC | 5,710 | 4 | 4 | 4 | 0 | 0 | 1 | 7 | 8 | - |
| RMC | 4,980 | 5 | 3 | 0 | 2 | 0 | 1 | 8 | 8 | - |
| (Sub-total) | 10,690 | 9 | 7 | 4 | 2 | 0 | 2 | 15 | 16 | 0 |
| 2. Secondary Canal | | | | | | | | | | |
| LSC | 4,130 | 8 | 3 | 1 | 1 | 3 | 1 | 6 | 5 | - |
| RSC-1 | 2,570 | 5 | 2 | 0 | 6 | 5 | 0 | 7 | 6 | - |
| RSC-2 | 2,410 | 4 | 2 | 0 | 1 | 0 | 0 | 6 | 7 | - |
| RSC-2-1 | 1,810 | 4 | 1 | 0 | 0 | 7 | 0 | 2 | 6 | - |
| (Sub-total) | 10,920 | 21 | 8 | 1 | 8 | 15 | 1 | 21 | 24 | 0 |
| 3. Tertiary Canal | 31,830 | - | - | 4 | 110 | 0 | - | 57 | - | 267 |
| 4. Field Canal | 76,000 | - | - | 0 | - | 0 | - | 0 | - | 951 |
| 5. Secondary Drain | 2,110 | - | - | 0 | 13 | 0 | - | 0 | - | - |
| 6. Tertiary Drain | 15,760 | - | - | 0 | 3 | 0 | - | 0 | - | - |
| 7. Field Drain | 62,000 | - | - | 0 | 0 | 0 | - | 0 | - | - |
| (Ⅱ)Namphou | | | | | | | | | | |
| 1. Main Canal | | | | | | | | | | |
| RMC No. 1 | 3,740 | 7 | 3 | 0 | 1 | 0 | 1 | 11 | 14 | - |
| LMC No. 2 | 1,010 | 3 | 1 | 0 | 0 | 0 | 0 | 3 | 2 | - |
| LMC No. 3 | 160 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| RMC No. 4 | 590 | 2 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | - |
| LMC No. 5 | 3,860 | 9 | 3 | 1 | 0 | 4 | 1 | 3 | 4 | - |
| RMC No. 5 | 4,340 | 5 | 3 | 1 | 0 | 1 | 1 | 14 | 1 | |
| LMC No. 6 | 740 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | |
| (Sub-total) | 14,440 | 29 | 13 | 2 | 1 | 5 | 3 | 34 | 22 | 0 |
| 2. Secondary Canal | | | | | | | | | | |
| SC NO. 1 | 660 | 2 | 0 | 0 | 0 | 1 | 0 | 2 | 3 | - |
| 3. Tertiary Canal | 20,930 | - | - | 1 | 65 | 0 | 0 | 55 | - | 80 |
| 4. Field Canal | 43,510 | - | - | 0 | - | 0 | 0 | 0 | - | 577 |
| 5. Tertiary Drain | 4,350 | - | - | 0 | 31 | 0 | 0 | 0 | - | - |
| 6. Field Drain | 33,350 | - | - | 0 | 0 | 0 | 0 | 0 | - | - |

Note : To-Turnout, CK = Check, SY = Syphon, CU = Culvert, DR = Drop,
SW = Spillway, Westeway, CD = Cross Drain, FP = Footpath, DB = Division Box

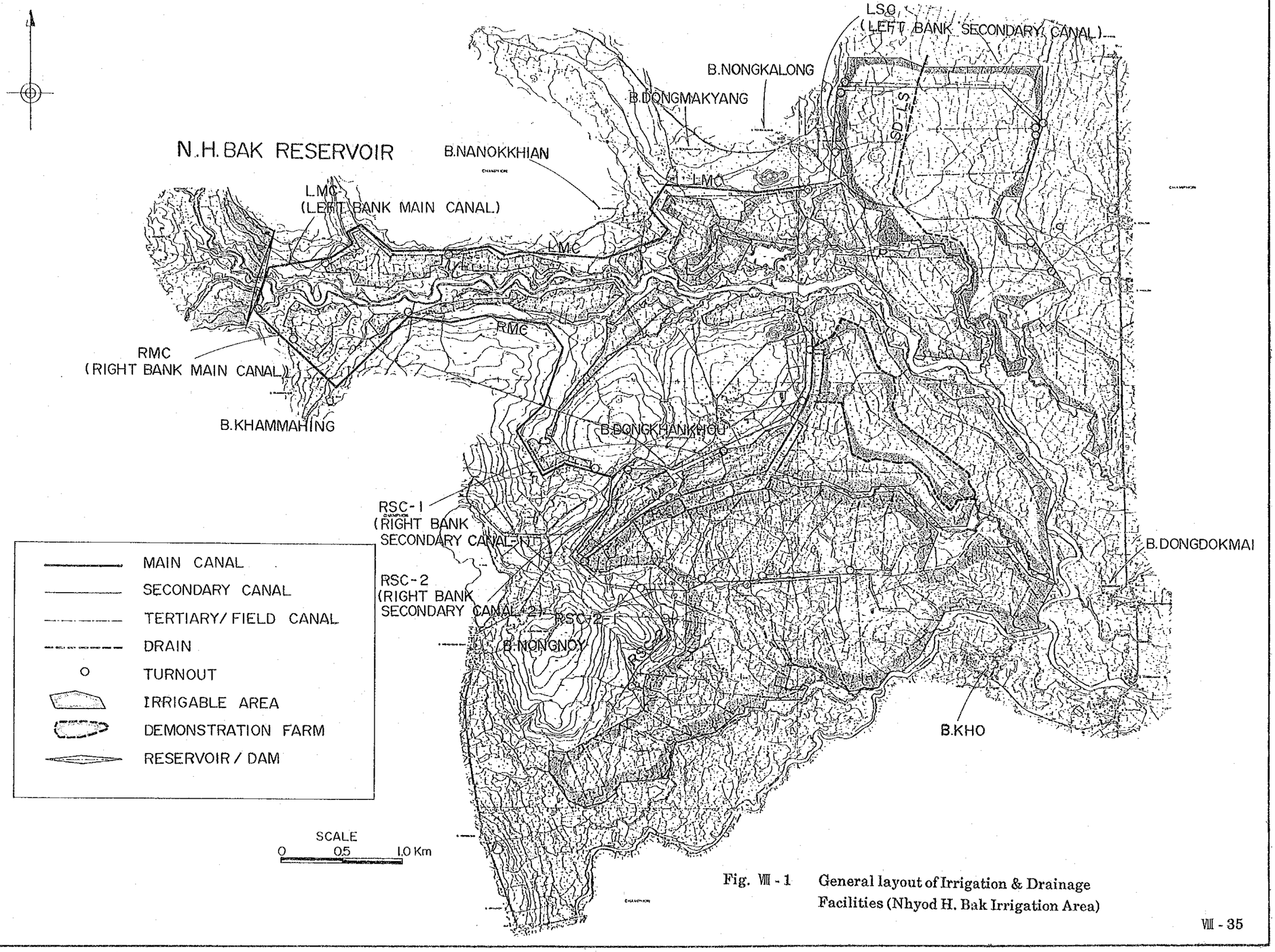


Fig. Ⅷ - 1 General layout of Irrigation & Drainage Facilities (Nhyod H. Bak Irrigation Area)