

Figure 2.9 Distribution of Land Reform Projects in the NBR

(3) Irrigation Area

The NBR has two irrigation dams, namely, Lam Pao dam and Nam Un dam, and 77 medium-scale irrigation dams and 580 small-scale irrigation dams. Total capacity of water reservoir is approximately 2,280 MCM and total irrigated area is approximately 1,171 thousand rai, which is approximately 7.1% of the total area of the NBR. Due to topographical characteristics, irrigation projects are limited to Phu Phan Mountain and its surrounding area, so that there are few places to develop irrigation dams. Irrigation projects in the NBR are shown in Figure 2.10.

Table 2.7 Irrigation Projects in the NBR

	Large-scale Dam	Medium-scale Dam	Small-scale Dam	Total Capacity (MCM)	Total Irrigated Area (rai)
Nakhon Phanom	0	14	139	76.39	116,751
Sakon Nakhon	1 (Lam Pao)	38	166	679.09	523,530
Mukdahan	0	8	90	83.7	81,795
Kalasin	1 (Nam Un)	17	185	1,441.58	449,307
Total	2	77	580	2,280.76	1,171,383

Source: Royal Irrigation Department

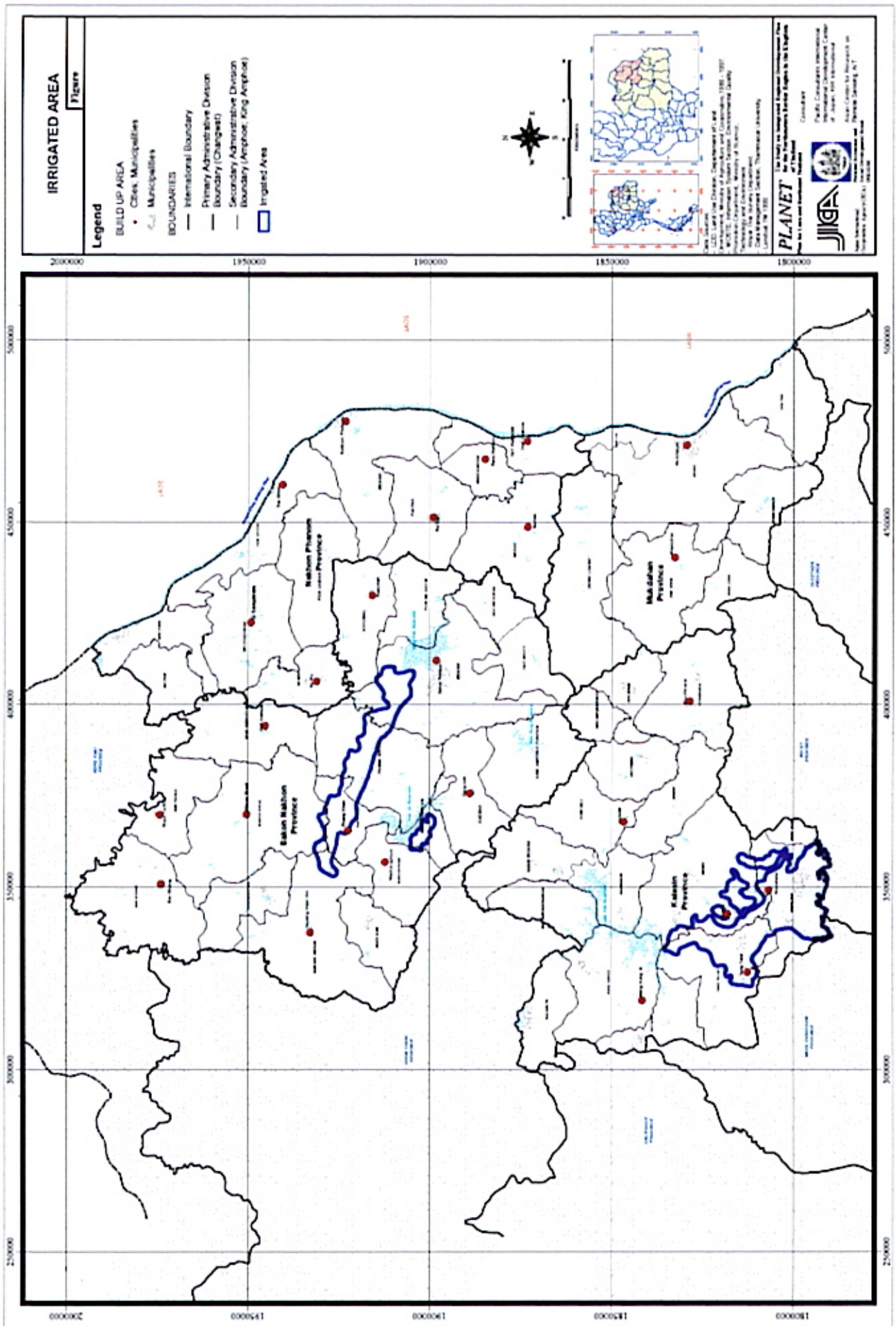


Figure 2.10 Location of Irrigation Projects in the NBR

(4) Farm Holding Size

Farm holding size has not decreased much in Thailand. As shown in Table 2.8, there is not much difference of holding size between 1980 and 1995, which are 22.9 rai/farm and 22.5 rai/farm, respectively. However, the proportion of owned land in the farmland has gradually decreased during the same period. In the NBR, 94% of farmland had been classified as owned land in 1980, while it was only 87% in 1995. Comparing the composition of farm holding in 1980 and 1995, the difference is the increasing proportion of rented land. It implies that necessity to rent land for farming is increasing.

In general, the farmers in the NBR principally divide their property equally for bequest, so that the owned farmland is gradually reduced along with the change of generation. To obtain necessary land for cultivation, the farmers need to rent land.

According to an interview survey conducted, farm-holding size has been reduced at the higher agricultural potential area like large irrigation areas. Currently, high value-added agriculture is applied in such high potential area, so that there is no apparent problem caused by bequests.

Table 2.8 Farm Holding Size

		1980	1985	1991	1995	1980-95
		(rai)				
Whole Country	Farm land	118,998,940	128,603,472	133,076,188	132,478,570	0.7%
	No. of Farm	4,467,547	4,878,004	5,130,531	5,248,815	1.1%
	Farm size	26.6	26.4	25.9	25.2	-0.4%
Northeastern region	Farm land	50,092,989	55,363,790	5,718,517	57,859,173	1.0%
	No. of Farm	1,786,465	2,044,520	2,183,557	2,273,549	1.6%
	Farm size	28.0	27.1	2.6	25.4	-0.6%
NBR	Farm land	6,092,546	6,931,172	7,581,055	7,814,186	1.7%
	No. of Farm	265,572	297,570	315,765	347,983	1.8%
	Farm size	22.9	23.3	24.0	22.5	-0.1%

Source: Agricultural Statistics of Thailand, MOTC

Table 2.9 Proportion of Owned Farmland

		1980	1985	1991	1994	1980-95
		(rai)				
Whole Country	Owned	100,537,613	104,627,195	108,057,531	109,318,442	0.6%
	%	84.5%	81.4%	81.2%	82.5%	-0.2%
Northeastern region	Owned	46,258,764	49,236,198	50,464,612	51,310,467	0.7%
	%	92.3%	88.9%	88.5%	88.7%	-0.3%
NBR	Owned	5,724,852	6,430,831	6,521,177	6,773,552	1.1%
	%	94.0%	92.8%	86.0%	86.7%	-0.5%

Source: Agricultural Statistics of Thailand, MOTC

Data on distribution of farm holding size is not fully available, but there is data on Nakhon Phanom, which explains a tendency of distribution of farm holding size as shown in Table 2.10. Approximately 55% of farm households have 10 to 39 rai of farmland, while approximately 38% have less than 10 rai of farmland, or approximately 13% of farmland is classified as small farmland.

There are few landless farmers, accounting for 0.47% of farm households in Nakhon Phanom.

It is accordingly concluded that the holding size is not a significant problem at present but it might need to be paid more attention in the future due to proceeding of land subdivision caused by bequests.

**Table 2.10 Distribution of Farm Holding Size
(The Case of Nakhon Phanom in 1998)**

	Household (%)		Area (%)	
Less than 6 rai	14,909	18.9%	56,645	4.5%
6 rai - 9 rai	15,367	19.4%	112,640	8.9%
10 rai - 39 rai	43,780	55.4%	826,093	64.9%
More than 40 rai	4,958	6.3%	276,596	21.7%
Total	79,014	100.0%	1,271,974	100.0%

Source: Agricultural Statistics of Thailand, MOTC

2.1.5 Urban Area

Urbanization gradually proceeds even in the NBR. In 1998, approximately 16% of total population were urban population living in the municipal areas. Urban areas cover 849 km², which is 3.3% of the total area of NBR.

Table 2.11 Urbanization in the NBR

	Population in Municipal Area (1998)	Urban Population Ratio (%)	No. of Municipalities
Nakhon Phanom	97,747	13.7	10
Sakon Nakhon	153,131	14.0	15
Mukdahan	42,896	13.0	3
Kalasin	200,428	20.4	23
Total	494,202	15.9	51

Source: DOLA

2.1.6 Conservation Area

There are four National Parks in NBR, which are mainly located in the Phu Phan Mountain. It is approximately 2,550.2 Km², or 37.0% of the total forested area. On

the other hand, the NBR has 1630.3 Km² of forest reserve and wildlife reserve, which are approximately 23.7% of the total forested area. It shows that approximately 61% of the forest remaining in the NBR are in the protected area.

Table 2.12 National Parks in the NBR

Name	Area (km ²)	Percentage (%)
Forest Area	6,894.0	100.0
National park	2,550.2	37.0
Forest reserve	1,348.0	19.6
Wildlife reserve	282.3	4.1

Source: JICA PLANET Study Team

2.2 Socio-economic Changes Affecting Land Use

2.2.1 Agricultural Restructuring

Agricultural restructuring in the rain-fed area changes land use in dry season. Currently, upland crops such as cassava and sugar cane are cultivated in only few areas in the dry season. However, agricultural diversification and restructuring by mixed farming system may change land use in dry season. In the irrigated area, land use is gradually changing from paddy to products with higher value added like tomato, asparagus and fresh water prawn culture.

2.2.2 Deforestation

Although deforestation slowed down in the 1990s in the NBR, it is still continuing. More deforestation will seriously damage the environmental system of the NBR. In particular, more deforestation in Phu Phan Mountain will reduce water resource capacity as well as living space for wildlife, and more deforestation in the hilly areas will affect over-utilization of the farmland and groundwater, resulting in increased possibility of saltation.

2.2.3 Expansion of Urban Areas

Urban population gradually increases by changing employment structure. Growth of manufacturing and service sectors affects urban population by increasing it. This results in sub-urbanization beyond municipal boundaries. Land use conflict, which is not currently observed in the NBR, will occur between agricultural and urban uses in Sakon Nakhon and Kalasin where land consolidation project areas are located near to the cities.

2.2.4 Decrease of Farming Population

Farm population is decreasing as shown in Table 2.13. Occupation in agricultural sector decreased by 32% during 1980 to 1999, while Industry and service sectors increased by 16.9% and 15.2% per at the same period, respectively. Due to less motivation for continuing farming caused by less income earnings comparing to the other sectors, farm population will decrease more and more in the future. This will result in increased non-cultivated land in the NBR.

Table 2.13 Change of Occupation Structure

	1980		1999		Change of Percentage
	Number	%	Number	%	
Agriculture	369,153	90.5	709,927	58.4	- 32.1
Industry	6,183	1.5	261,751	18.4	16.9
Service	32,650	8.0	243,751	23.2	15.2
Total	407,985	100.0	1,215,429	100.0	

Source: NESDB

On the other hand, farm-holding size has been reduced through a succession of bequests from generation to generation. Since this is a traditional custom, it is assumed that farm-holding size will be reduced even more in the future. Due to smaller farmland size, it would be harder to manage family living with on-farm income, thereby accelerating the decrease of farm population more and more.

2.3 Issues on Land Use Plan

2.3.1 General

The components of the eco-system are forests and paddy fields on the surface of Phu Phan Mountain and acidic, salty, sandy soils with a different water availability between dry and rainy seasons (detailed analyses are described in Chapter 10.3). Forests retain water and maintain variety of wildlife. Although current farmlands are developed through deforestation, agriculture, mainly paddy field, plays an important role in water retention and draining of accumulated salt deposits.

The current agricultural land use pattern is a best mixture of paddy and upland crops in accordance with water availability from the viewpoint of maximization of farm income. However, to improve on-farm income, agricultural diversification and restructuring is necessary in the agricultural sector.

Accordingly, the land use plan should be delineated to show a most appropriate land allocation for future agriculture and natural conservation.

Further, it is anticipated that total farmland in the NBR as well as unit farm holding size will be gradually reduced. It is necessary to integrate farmland to improve efficiency of cultivation.

In accordance with urbanization with the establishment of the Indochina East-West Corridor, urban activities also need to be taken into consideration in the land use plan. These activities should be well coordinated under a sustainable utilization of natural environment of the NBR.

Accordingly, the land use plan should focus on the following issues:

- Balanced Land Use between Agriculture and Environment;
- Farmland Integration; and
- Appropriate Urban Development.

2.3.2 Balanced Land Use between Agriculture and Environment

(1) Environmental Conservation

The forested areas in Phu Phan Mountain have an important function of water retention and providing living space for wildlife. The remaining forested area in the hilly areas mitigates soil erosion caused by upland crop cultivation and maintains moisture in the soil. The forest supplies nourishment to the paddy field. The paddy field has a water retention function and it prevents saltation by washing out the organic salt contents from the paddy field. This environmental system maintains the sustainable ecological cycle of the NBR. Therefore, the natural environment of the NBR should be maintained in order to prevent the collapse of this ecological cycle.

(2) Agricultural Diversification and Restructuring

Agricultural diversification and restructuring is essential to improve the economic situation of farmers, in particular, improvement of on-farm income. Suitable location for crop diversification and crop conversion should be rationally promoted.

Promotion of crop diversification and conversion needs to be examined under careful consideration of environmental conservation. Land use plan is required to allocate land for both purposes effectively and rationally.

2.3.3 Farmland Integration

For the full utilization of farmland in the NBR in the future, special attention should be paid to a wider utilization of smaller farmland and non-cultivated farmland. It would also be effective to support farmers who are enthusiastic about enlarging/modernizing their farms.

2.3.4 Appropriate Urban Development

For further industrialization and expansion of urban economy, it is necessary to designate appropriate urban areas for urbanization including industrial areas in the NBR in response to the establishment of the Indochina East-West Corridor.

Future industrial development needs to be coordinated with urban development to create ripple effects to foster urban centers.

2.4 Land Use Framework

2.4.1 Macro Framework

Macro economic framework is prepared to indicate quantitative development framework of the Master Plan. The major emphases is to increase Per Capita GDP to 34.7 thousand baht in 2020, which is equivalent with 100 thousands baht per household. In terms of population, total population in 2020 is 3,754 thousands in the NBR. Among them, urban population will be 1,107 thousands or 29.5% of total population of the NBR, as shown in Table 2.14.

To achieve this quantitative target, economic structure should be drastically changed through:

- Agricultural restructuring for more added value; and
- Encouragement of non-agricultural activities such as manufacturing and service sectors.

Table 2.14 Macro Economic Framework

	Socioeconomic Indicators						Growth Rates					
	1985	1990	1995	1998p	2010*	2020*	85-90	90-95	95-98	98-2010	2010-20	
NBR												
GRP (million bahts)	37,402	50,106	71,225	66,625	99,933	130,371	6.0%	7.3%	-2.2%	3.4%	2.7%	
Agriculture	12,020	15,810	18,795	17,634	20,664	22,943	5.6%	3.5%	-2.1%	1.3%	1.1%	
Industry	5,139	5,790	11,968	7,279	14,032	20,328	2.4%	15.6%	-15.3%	5.6%	3.8%	
Service	20,243	28,506	40,462	41,712	65,237	87,100	7.1%	7.3%	1.0%	3.8%	2.9%	
Composition of GRP												
Agriculture	32%	32%	26%	26%	21%	18%	-	-	-	-	-	
Industry	14%	12%	17%	11%	14%	16%	-	-	-	-	-	
Service	54%	57%	57%	63%	65%	67%	-	-	-	-	-	
Population (000)	2,559	2,792	3,026	3,115	3,459	3,754	1.8%	1.6%	1.0%	0.9%	0.8%	
Urban	-	-	-	498	813	1,107	-	-	-	4.2%	3.1%	
Rural	-	-	-	2,617	2,646	2,646	-	-	-	0.1%	0.0%	
Outmigrating pop/ year	-	-	-	-5.6	-5.9	-5.6	-	-	-	-	-	
Per Capita GDP (000baht)	14.6	17.9	23.5	21.4	28.9	34.7	4.2%	5.6%	-3.1%	2.5%	1.9%	
Urban	-	-	-	46.2	55.6	60.6	-	-	-	1.5%	0.9%	
Rural	-	-	-	16.7	20.7	23.9	-	-	-	1.8%	1.5%	
Agriculture	-	-	-	6.7	7.8	8.7	-	-	-	1.2%	1.1%	
Non-agriculture	-	-	-	9.9	12.9	15.3	-	-	-	2.2%	1.7%	
Rural household income	-	-	-	70	87	100	-	-	-	1.8%	1.5%	
Disparity Index (National Ave. = 1)	0.38	0.31	0.28	0.28	0.29	0.29	-	-	-	-	-	
Whole Country												
GDP (million bahts)	2,011,033	3,284,106	4,955,352	4,635,926	6,884,339	9,207,162	10.3%	8.6%	-2.2%	3.4%	3.0%	
Population (000)	51,796	56,303	59,460	61,466	69,674	76,584	1.7%	1.1%	1.1%	1.1%	1.0%	
Per Capita GDP (000)	38.8	58.3	83.3	75.4	98.8	120.2	8.5%	7.4%	-3.3%	2.3%	2.0%	

2.4.2 Land Use Framework

(1) Farm Land

By carrying out agricultural restructuring, land use pattern needs to be appropriately changed. Table 2.15 shows target area of each crop to achieve target of agricultural GDP of the NBR in 2020.

Paddy field for major and second rice should be maintained at the current level, but it is necessary to promote integrated farming system in the current paddy field. While, crop conversion and diversification should be encouraged in cassava and sugarcane areas with vegetables, fruits, para-rubber and livestock.

Table 2.15 Land Use Targets

	(Km ²)				
	1998	2000	2005	2010	2020
Second Rice	326	306	261	228	179
Major Rice	5,802	5,802	5,802	5,802	5,802
Cassava	796	752	652	464	464
Sugarcane	249	249	249	249	249
Pineapple	16	16	16	16	16
Groundnuts	69	69	69	69	69
Field crop others	765	766	768	768	768
Rubber	67	72	86	189	230
Tree crops	440	441	442	586	586
Vegetable and flowers	47	60	113	146	195
Total	8,577	8,533	8,458	8,517	8,558

(2) Urban Area

In accordance with increase of urban population, urban should be developed with urban planning in order to avoid disordered urbanization as well as to minimize public investment.

With 1,107 thousands of urban population, approximately 110 Km² of areas should be urbanized under planned manner, as shown in Table 2.16.

Table 2.16 Future Population and Urban Areas Required

		2000	2005	2010	2020
Urban Population	Thousand persons	542	666	813	1,107
Urban Areas Required*1	Km ²	54.2	66.6	81.3	110.1

Note: *1 :assumed with 100 persons/ha of gross population density.

2.5 Land Potential Analyses

2.5.1 Soil Fertility and Water Availability

NBR has relatively poor soils regarding soil fertility in general. Even the NBR hardly expects highest yield, but however, it is still possible to produce various sorts of agricultural products with certain yield, which contributes to increase farm income through agricultural diversification and crop conversion.

The largest bottleneck is water availability in dry season. In dry season, crop cultivation depends basically on the irrigated water and underground water with small-, medium- ponds and large reservoirs. Accordingly, farming land is very limited in the dry season. However, there are plenty of areas with underground water, in particular northeastern part of the NBR. This area has relatively better soil fertility (as referred in figure 2.3), too. It is of great potentiality for agricultural diversification and crop conversion with adequate underground water utilization.

2.5.2 Potential Areas for Crop Conversion and Diversification

(1) Integrated Farming

The suitable areas for rice are widely distributed in the NBR, mainly flat plain areas. The farmers principally try to cultivate rice in the NBR; accordingly paddy field expands to the areas where rice production is not suitable as shown in Figure 2.11.

On the other hand, the suitable areas for cassava and sugar cane are distributed mainly on hilly areas around Phu Phan Mountain; however, cassava and sugar cane are cultivated only in the area where paddy cannot be cultivated as shown in Figure 2.12

Integrated farming can be carried out the current paddy field, cassava and sugarcane area. In the paddy field, rice should be a basic crop with several crops with fish and livestock. It is necessary to develop individual pond for fish rising and use for crop cultivation in the dry season. While, in the field crop areas, combination of crops such as vegetables, fruits, para-rubber and livestock should be taken into account with utilizing groundwater and river water.

(2) Potential Areas for Vegetables and Fruits, and Para-Rubber

In terms of fertility of soils, there are large suitable areas for vegetables, fruits and para-rubber in the NBR. Due to shortage of water in the dry season, these areas are utilized as cassava and sugar cane fields. These areas have a potential for agricultural diversification and crop conversion to vegetables and fruits in case irrigation projects are carried out at the same time.

On the other hand, suitable areas for para-rubber are also widely identified. For growing para-rubber, irrigation facilities need not be prepared, but rather, moderate fertile soil with more than 1,200 mm of annual rainfall is required.

Figures 2.13, 2.14 and 2.15 show suitable areas for vegetables, fruits and para-rubber, respectively.

(3) Potential Areas for Livestock

There are plenty of fallow and grass areas in the NBR. According to GIS analysis, 2,820 Km² or 11% of the total area are identified as fallow and grass lands. These areas can be used for livestock production, in particular fodder production or ranch in case that the lands are going to be integrated.