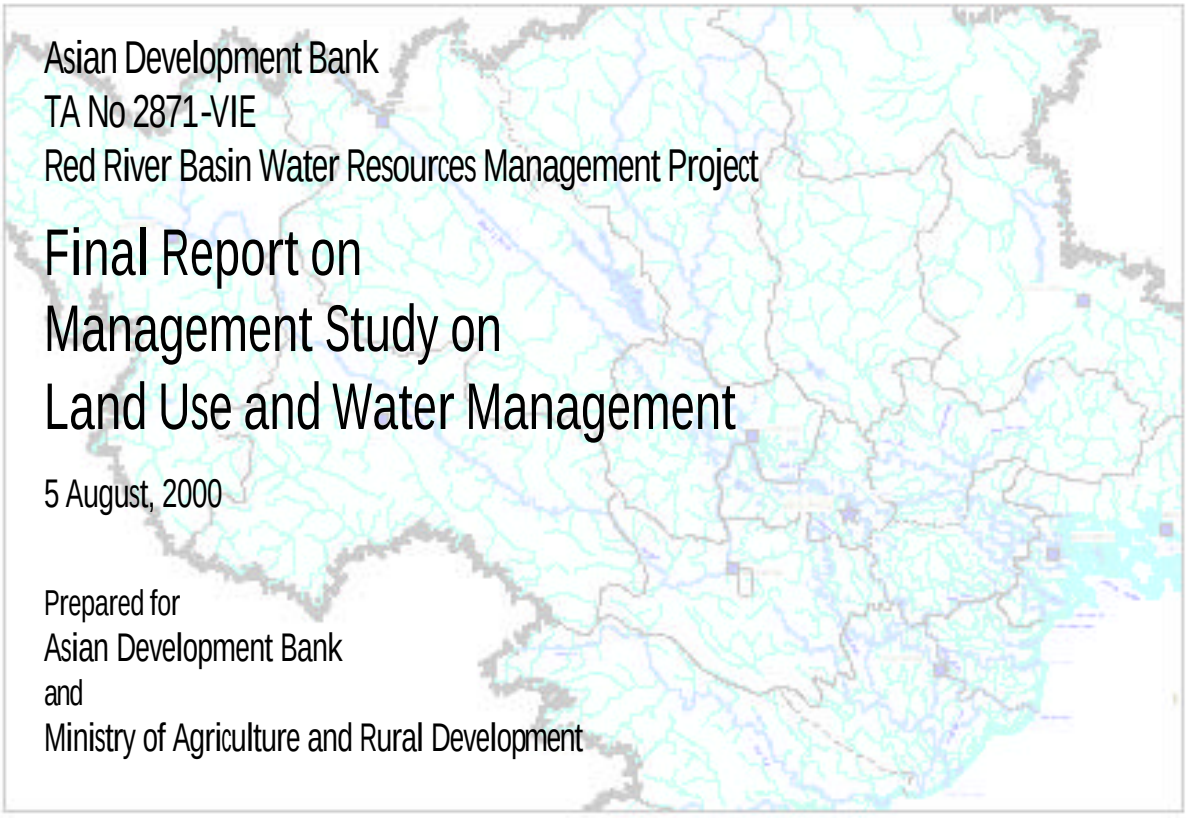

Asian Development Bank
TA No 2871-VIE
Red River Basin Water Resources Management Project

Final Report on Management Study on Land Use and Water Management

5 August, 2000

Prepared for
Asian Development Bank
and
Ministry of Agriculture and Rural Development

WATER **R**ESOURCES **C**ONSULTING **S**ERVICES

Acronyms

DANIDA	Danish International Development Agency
FAO	Food and Agriculture Organization
GIS	Geographical information system
IWRP	Institute of Water Resources Planning
MARD	Ministry of Agriculture and Rural Development
MOC	Ministry of Construction
NIAPP	National Institute for Agricultural Planning and Projections
RRB	Red River basin
RRBO	Red River Basin Organization
RRBWRM	Red River Basin Water Resources Management Project (ADB TA2871-VIE)
RRD	Red River delta
TOR	Terms of reference
UFW	Unaccounted-for water
VIE	Vietnam
WRL	Water Resources Law
WSR	Vietnam Water Sector Review (1996)

Currency

USD 1 = VND14,000

Executive Summary

The Study

The Land Use – Water Management Study investigated selected issues in the Red River Basin related to interactions among land use, water resources, and water resource management. This was a desk study of short duration under the ADB TA2871-VIE, Red River Basin Water Resource Management Project (abbreviated to RRBWM).[1]

The main objective of the Study was to increase understanding of environmental processes affecting water resources management in the Basin. In addition, the Study demonstrates the advantages of integrated water resources management over conventional sectoral methods, to the management of actual situations in the Basin. For reasons of time and resources, it was decided to focus the Study on selected land use-water management issues in each of five zones (see below).

Principles

Improved land and water management in the basin must be formulated based on an appreciation of the larger context of natural resource and environmental sustainability in rural Vietnam (Rambo, 1998):

1. ***Diversity of ecosystems –*** There are many different ecosystems, each with a different structure and dynamics, and each responds differently to human intervention. Therefore, a diversity of development strategies is needed
2. ***Complexity of rural resource systems –*** Rural resources systems can appear simple to urban outsiders, but a typical Tay ethnic minority household (for example) manages a system composed of multiple interacting components, including paddy fields, home gardens, livestock, shifting cultivation fields, and secondary forests.
3. ***Environmental risk –*** Rural Vietnamese are as much or more concerned wth reducing vulnerability to risk as they are with maximizing productivity, because of the very high levels of risk they experience (high even in comparison to other Southeast Asian countries). Environmental hazards include floods, droughts, typhoons, hail, forest fires, agricultural pests, and disease outbreaks.
4. ***Human dimension*** – For development strategies to succeed, they must address ecological, demographic, social, cultural (and economic) realities. Strategies must address the extremely high rural population densities relative to sustainable productive capacity of land; the effects of urbanization; highland ethnic diversity; and the need to empower local people through better education and health and better access to information, credit, and services.

Basin Description

With these points in mind, the report first provides an overview description with accompanying maps showing the basin's rivers, climate, topography, and soils. The report then discusses in some detail (again with accompanying maps), the bounding of the basin itself and the various bounding schemes within it based on subbasins, zones, and administrative units.

The five subbasins of the Red are those of the Da, Thao, Lo-Gam, Upper Thai Binh, and the delta (which is in fact a planning unit rather than a hydrologic subbasin). The zones of the basin as defined here are Mountains, Midlands, Delta (non-coastal areas), Coastal, and Urban. The basin includes all or part of 25 provinces; the splitting of provinces in 1991 and 1995 is fully documented as are changes in the total area of individual provinces during 1985-94.

Urban centres, urban population, and urbanization are discussed in some detail, along with how urban area and population is statistically and administratively defined in Vietnam. A list of existing urban piped water supply systems and actual pumped volumes is included.

A map showing the protected areas established by the Government in the basin is provided. The significance of protected areas for water resources management is (1) these are areas that

[1] The other two studies are of Surface Water Licensing and Water Quality.

have been specifically identified by the GOV as of special value, that is, high social value, which implies potential priority for resource allocation including water; (2) in some cases their special biophysical character or use implies special needs with respect to water resources management (for example, the Everglades, Florida USA).

Land use, land suitability, and the administrative land use planning process are briefly described and compared. Land use in the Mountains and Midlands provinces and the Delta provinces is described, along with charts and maps. The existing water resources infrastructure is briefly described.

Selected Land Use and Water Management Issues in the Red River Basin

Information is provided on the following land use and water management issues:

- Conversion of agricultural land to other uses in the delta
- Role of water and water resources development in well-being of mountain communities
- Afforestation and use of production forest lands
- Rapid uncontrolled groundwater irrigation development (midlands)
- Land use changes and canal lining programme (basin-wide)
- Agricultural diversification in a major irrigation scheme (delta)
- Encroachment on water control infrastructure (delta)
- Special problems and opportunities of the coastal zone
- Future trends in urban water demand (urban zone)

Observations and Recommendations

The observations and recommendations presented related not to specific technical issues or development options related to land use and water management, but rather to the basin planning process, the information base for the basin, and strengthening the Ministry of Agriculture and Rural Development (and in particular the Department of Water Resources and Hydraulic Works Management) to be able to carry out its state water management activities. This is the necessary framework within which the specific issues have to be addressed.

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1 Introduction

1.1 Study Context

The Land Use – Water Management Study investigated selected issues in the Red River Basin related to interactions among land use, water resources, and water resource management. This was a desk study of short duration under the ADB TA2871-VIE, Red River Basin Water Resource Management Project (abbreviated to RRBWM).[2]

The main objective of the Study was to increase understanding of environmental processes affecting water resources management in the Basin. In addition, the Study demonstrates the advantages of integrated water resources management over conventional sectoral methods, to the management of actual situations in the Basin. A Study Progress Report was produced in April 2000 describing the rationale and approach, and documenting work done up to that point.

This Final Report summarizes the work done, provides a brief interpretive description of the basin, and presents the findings of the Study.

1.2 Approach

Study Inception

The original Terms of Reference for the Land Use – Water Management Study, from Annex 6 of the RRBWM Phase II Inception Report, is included in this report as Annex A. These TOR identified the key study components as:

- "Identify likely future land use changes and demographic trends and assess their probable impact on water resource management in the Red River Basin,"
- Recommend "broad implementable basin-wide strategies to minimise/ameliorate adverse effects on the environment," and
- Recommend "feasible community participation options for strategy implementation generally of key catchment land and water resources."

The TOR provided for an Initial Workshop within one week of consultant mobilization, to allow the consultant team and the RRBWM Working Group to "further define the needs of the government with respect to [the land use and water management study], and to develop more detailed terms of reference" for it. A study of four months duration was specified, with staggered staffing of one international consultant and three national consultants averaging about 2.3 person-months each.

The Initial Workshop was delayed to four weeks after consultant mobilization. During the intervening period, the consultants did the following:

- Literature review
- Assemble land use and demographic data
- Field trips to Thai Nguyen and Bac Giang provinces
- Meetings with the National Environment Agency and Forest Inventory and Planning Institute.
- Attendance at RRBWM workshops on surface water licensing and the National Water Resources Council.
- Informal discussions of the Study with other members of the RRBWM team (Dr Geoff Wright, TA Team Leader; Mr Warren Martin, Surface Water Licensing consultant; Dr Pham Xuan Su, Project Manager for MARD, and Dr Nguyen Thai Lai, Head, MARD Water Environment Bureau).

Based on these activities, the Study team undertook a scoping of the key issues.

[2] The other two studies are of Surface Water Licensing and Water Quality.

Initial Workshop

At the initial workshop, the consultants presented an overview of the Study as defined in the original TOR, and asked the project Working Group – composed of officials from a number of central ministries and Basin provinces – for help to focus the Study and prioritise issues for inclusion (the workshop overheads are shown in Annex B).

In response, the Working Group very clearly expressed a broad range of concerns related to land use and water management. They showed an impressive level of awareness and appreciation of the close and many-stranded relationships between land use, water quantity and quality, and societal well-being. The attitudes and knowledge already in place form a strong foundation on which to build improved resource management.

The Working Group did not however directly produce a consensus as to their preferred focus or priorities for the Study and if anything there was a noticeable tendency to introduce new issues to expand the scope even further. The discussions did stress certain themes , and the provincial representatives spoke about some of their experiences in the field.

Options for Study Focus

By this time, a consensus had developed on the Project that the study was too broad in scope for the timeframe and available resources, and needed to be focused down onto priority issues and/or areas, both to achieve a reasonable match between work to be done and the time and resources available, and to ensure that issues of greatest interest would in fact be addressed. A number of possible study options were identified and assessed. These are described below.

Option 1: Calculation/prediction of quantitative land use and water demand trends, past and future.

The TOR suggests the calculation/prediction of land use and water demand trends. To this end, a compilation of available province-level statistics was begun (and has been substantially completed). Several issues were identified:

- The basin is very diverse biophysically and socioeconomically. Basin-wide trends average together processes occurring in many different environments (for example mountain and delta zones). This renders interpretation difficult and limits meaningfulness. Quantitative assessments of land use and water resources trends within smaller, parameter- or process-defined areas requires time-series data at smaller scales. Such data may be available in Vietnam, but identifying processes and areas for which quality data of this type exists and how it can be obtained, is a time-consuming process. Indeed, it would be highly desirable to enhance monitoring and data collection programs routinely to collect some amount of data that is suitable for this type of analysis.
- Past trends computed from available statistical data probably cannot be taken at face value. Data quality should be checked between different independent sources where possible, and computed trends should be compared with trend analyses presented elsewhere (for example, trends reported in the various sector reviews). For instance, the study team's preliminary calculations of forest cover, from the most readily available 1983-1990 province-level statistical data, show *increases in forest cover* in many locations during the earlier part of this period – contradicting other studies that indicate rapid *deforestation* in this timeframe.
- Predicting future trends is not straightforward. Past statistics and past trends cannot be simply extrapolated. Nor can the projections provided in the various sector plans be taken at face value. Sector planning in Vietnam is – in addition to a normal degree of national optimism – still significantly influenced by the central planning approach, which tends to underweight input-side constraints (such as the availability of adequate investment flows or overall absorptive capacity). A multi-sectoral strategic planning approach is needed if such considerations are to be critically assessed. An example of the use of this type of planning approach in Vietnam would be the Red River Delta Master Plan (1995) – which covers part, but not all, of the Red River Basin.

Option 2: Water balance

Clearly there is keen concern in MARD (echoed later by the Working Group at the Initial Workshop) that evolving land use and urbanization could lead to greater water demand and water shortages. However, this would be best addressed in the context of a numerical modelling exercise. It was learned during the period of the Study that IWRP will take delivery of MIKE-C software (provided with DANIDA support) and begin water balance modelling of the RRB over the next six months. [3]

In addition, though, there seems to be some tendency for any and all types of existing or potential "water shortage" to be discussed in relation to (main) river systems having, or becoming, insufficient in water to meet aggregate demand – that is, in terms of "water balance" (or rather, water imbalance). This is a misconstruction, and oversimplification, of the "water shortage" problem, which can be summarized as follows:

(1) There are *localized* irrigation water deficiencies within irrigation schemes, related to deficiencies in distribution operation and infrastructure, and unrelated to insufficient water in the river where the intake is located.

(2) There are inadequacies in urban domestic water supply, related to an inability to develop connection infrastructure fast enough to keep up with urbanization.

(3) Similarly, inadequacies in rural domestic water supply are due to a wide variety of constraints, ranging from a complete lack of locally available potable surface and groundwater supplies in some villages (rainwater collection becomes the only option), to the need for accelerated investment to develop tubewells or other supply infrastructure, to the need to address water quality issues of existing supplies.

(4) And then there are indeed water shortage issues (like salinity control in estuarine environments) that *are* related to declining river flows. These can and should be addressed with a "water balance" approach.

There is a complementary oversimplification on the "solution" side of the "water shortage" issue. There seems to be some tendency for water resources managers to discuss demand as if it were an externally imposed parameter that must be accepted as is. Once this is assumed, all solutions to "water shortage" must relate to increasing water supply. The assumption implicitly excludes the possibility of approaches and solutions related to demand management, such as water charges, water sharing, restrictions, conservation, improved efficiencies, reuse, and so on.

Option 3: Water quality

As this is the focus of the proposed third RRBWM Management Study, it seems logical and efficient that it be de-emphasized in the Land Use Study.

Option 4: Cau River Sub-basin

An intriguing possibility was to focus the Study on the Cau River sub-basin, where an interprovincial sub-basin committee has been in operation since 1997. Two of the six provinces in the sub-basin were visited (Thai Nguyen and Bac Giang), and a collection of reports in Vietnamese created by/for the Cau committee was assessed. Through these activities it became clear that the Cau committee is in effect a partnership between the People's Committees and DOSTEs of the six provinces, addressing water quality issues only and with no or very limited participation of the DARDs[4].

Option 5: Selected Issues in Major Zones

This is the approach that was ultimately taken. It was decided to focus the Study on selected land use-water management issues in each of five zones. The zones are described in Section 3.3. The issues are discussed in Section 5.

[3] Lars Anderson, pers. comm.

[4] Note that since the initial visit steps have been taken by the committee to increase the level of participation of the DARDs.

For each issue, the Study attempted to:

1. Develop a qualitative description of the relevant processes and relationships related to the impacts of land use on water resources; and water resources on perceived outcomes (effects of importance to society, for instance agricultural productivity, public health, security/risk levels). This qualitative description is complemented by quantitative information as appropriate.
2. Review existing and proposed water management strategies and community participation options. These would include both structural and non-structural measures related to water resources management, or more broadly to the management of perceived outcomes.

Due to the short duration, limited resources, and "demonstration" nature of the study, it was expected that level of understanding achieved would vary among the different issues, and this did happen, as can be seen in the presentation of the results in this report (Section 5). At a minimum, the aim was to collect as much available information as possible and identify areas for further investigation.

Modifications and Lessons Learned

During the Study, three things became apparent:

1. There was a need to include overview descriptions of the institutional framework and of the basin in the study report. While there is a large amount of valuable information about the basin in the Red River Basin Profile and the Vietnam Water Sector Review, it is in a form that is rather difficult to use as the basis of a study of basin resources
2. A number of the selected issues could not really be addressed adequately (a not unexpected outcome). There is an enormous amount of relevant information, but much of it is out of date, conflicting, incorrect, inadequately documented, incomplete, and much that is of interest is contained within documents primarily addressing other matters.
3. The Study deals with issues that should be, and hopefully will be, addressed in a basin water resources development and management planning and improvement exercise. It is important that this exercise be well planned and that adequate time and resources are allocated to it. The exercise should first define explicit questions and objectives, conduct thorough investigations and adequate consultation, and then based on the findings, formulate recommendations.

Study Team

The study was undertaken during the period March-June 2000, by Dr Sara Bennett, Environment Consultant; Mr.Dao Can, Land Use Consultant from the National Institute for Agricultural Planning and Projections (NIAPP); Mr Nguyen Van Toan, Water Resources Planner from the Institute of Water Resources Planning (IWRP); and Mr Nguyen The Hue, Ethnologist from the Institute of Ethnology. Maps were prepared by Ms Tran Thi Lan Huong and Ms Nguyen Thi Hong Anh, GIS staff on the TA project team.

2 Institutional Context

2.1 Introduction

This section provides a brief overview of the institutional context for land and water management in Vietnam. There is a large degree of very active institutional reform and development at all administrative levels and only the major features are noted here.

2.2 Policies, Program and Legislation

Policies, program, and legislation in a number of areas are significant to changing land and water management. The most important measures are simply noted here, to demonstrate Vietnam's deep commitment to revitalizing its economic, resource management, and public administration systems:

- *Economic Renovation.* Since 1986, Vietnam has been moving from a centrally planned economy to one in which market activities are playing an increasing role.
- *Rule of Law.* Vietnam has been standardizing the body of law, both to encourage investment and to strengthen State management.
- *Institutional Reform.* As part of structural reforms, Vietnam is streamlining its public sector. In particular, the Ministry of Agriculture and Rural Development was formed in November 1995, consolidating a large number of water and land management-related functions[5]
- *Local Democracy.* Recognizing that rigid top-down policy implementation has adversely affected the economic situation at the grassroots level, the GOV has been active in promoting active participation in the political process of people at the grassroots.[6]
- *Poverty Alleviation.* Since 1998 when the GOV formulated the 1715 Poorest Communes Program, poverty alleviation has been given the highest priority by both Government and donor organizations.
- *Land Law.* With the Land Law passed in 1993 and updated in 1998, the GOV has provided farmers extended land tenure, which in turn has energized agricultural productivity. The Law, however, reserves to the State responsibility for land use planning, with the practical division of control between the State and tenure holders continuing to be worked out.
- *Environment Law.* This defines a framework for environmental protection based on recognised international principles, including among other things 'polluter pays', environmental impact assessment, and State of the Environment reporting.
- *Water Resources Law.* Passed in 1999, the WRL defines a framework for water resources management based on recognised international principles, including among other things integrated water resource management, clear definitions of state management functions, an institutional framework including a National Water Resources Council and basin organizations, and a Water Resources Inspectorate; and encouragement of public and private participation in water resources development.[7]
- *Forest Resources Protection and Development Act[8] and Major Afforestation Programs.* In response to high rates of forest degradation, massive efforts have been taken to

[5] Inter alia, Min. Water Resources in its entirety; small towns water supply from Min. Construction; rural water supply from the Committee for Ethnic Minorities and Mountainous Areas; rural water supply for New Economic Zones from Min. Labour, Invalids and Social Affairs; groundwater surveys from Min. Industry; watershed management from Min. Forestry; land use management from Min. Agriculture. Urban water supply remains with Min. Construction, hydropower with Min. Industry; and some water quality-related functions remain with Min. Science Technology and Min. Health.

[6] Articulated in Decree No. 29/1998/ND-CP of May 11, 1998, Promulgating the regulation on the exercise of democracy in communes.

[7] For a good discussion see: Sector program support to water and sanitation Viet Nam. Final draft, July. DANIDA, 1999, p. 22-3.

[8] Decree No. 58 LCT/HDNN8 of 12 August 1991.

reafforest barren lands, under Program 327 and the current Five Million Hectare Program.

- *Sedentarization.* The Government is committed to reduce drastically shifting cultivation in upland areas, which is highly destructive of forest and soil resources.

2.3 Land and Water Management Institutional Framework

National and Regional-Basin Government Organizations

At the national level, the central departments of a number of ministries have a direct role in land and water management (Agriculture and Rural Development, Industry, Construction, Science Technology and Environment, Transportation and Communication, Fisheries), plus the Ministries of Finance and Planning, and Investment are of course involved.

In addition, national level committees/councils with an interest in land and water management exist, for example, the Committee for Mountainous Areas and Ethnic Minorities and the imminent National Water Resources Council.

At the regional-basin level, Basin Organizations are to be set up following basin hydraulic boundaries as called for in the WRL.

At the subbasin level, the only group currently in existence is the "Cau River Committee". It is headed by the Chairperson of the Thai Nguyen Province People's Committee. Other members include the vice-chairpersons of the People's Committees of the other provinces in the Cau subbasin. The DOSTEs of the subbasin provinces participate as advisors to the committee. MARD and the DARDs have had limited cooperation with this committee, due to uncertainties as to its legitimacy; though sanctioned by the Deputy Premier, its status with respect to WRL is not clear.

Provincial/City Government Organizations

Key government institutions include the Provincial People's Committees; the Departments of Agriculture and Rural Development (DARDs); and the Departments of Science, Technology, and Environment (DOSTEs).

District, Commune, Local Organizations

At these levels there are People's Committees. Producer cooperatives organized within administrative units still exist, with varying functions depending on local arrangements. Some are involved in irrigation. There are numerous programs underway to strengthen participatory irrigation/water management at the local level, including major efforts to create water users' associations within hydrologic (rather than administrative) units.

Service Providers

'Service providers' here refers to entities that provide irrigation system management/irrigation water supply, domestic water supplies, sanitation services, forest management, and so on. Most such entities are the result of full or partial privatization of formerly state-owned enterprises, a process that is ongoing. There are, for example, the 59 Irrigation and Drainage Management Companies (IDMCs) in the Red River Delta that operate and maintain its 30 principal irrigation and drainage systems (see Figure 19).

Non-Governmental Organizations

At the national level, a few non-governmental organizations having a strong interest in land or water management exist. The Vietnam branch of the International Union for the Conservation of Nature is an example.

3 Red River Basin

3.1 Introduction

This chapter presents what is considered to be most important to understand with respect to land and water management in the Basin. It is an attempt to create an interpretive perspective by weaving together information from a wide range of literature sources.

As the purpose of the Study is to help resource managers at all levels understand the challenges they face to achieve sustainability of natural resources and environment, it is useful before turning to a description of the basin, to note four key characteristics related to natural resource and environmental sustainability of Vietnam's rural environment identified by A Terry Rambo[9] as key to:

1. ***Diversity of ecosystems –*** There are many different ecosystems, each with a different structure and dynamics, and each responds differently to human intervention, a diversity of development strategies is needed.
2. ***Complexity of rural resource systems –*** Rural resources systems can appear simple to urban outsiders, but a typical Tay ethnic minority household (for example) manages a system composed of multiple interacting components, including paddy fields, home gardens, livestock, shifting cultivation fields, and secondary forests.
3. ***Environmental risk –*** Rural Vietnamese are as much or more concerned with reducing vulnerability to risk as they are with maximizing productivity, because of the very high levels of risk they experience (high even in comparison to other Southeast Asian countries). Environmental hazards include floods, droughts, typhoons, hail, forest fires, agricultural pests, and disease outbreaks.
4. ***Human dimension*** – For development strategies to succeed, they must address ecological, demographic, social, cultural (and economic) realities. Strategies must address the extremely high rural population densities relative to sustainable productive capacity of land; the effects of urbanization; highland ethnic diversity; and the need to empower local people through better education and health and better access to information, credit, and services.

The rest of this chapter provides a review of the basin's physical characteristics, alternative bounding schemes, human resources, land use, infrastructure, water resources development, industrialization, and urbanization. These are described primarily in terms of the existing situation, with some mention of general trends and sustainability considerations.

3.2 Physical Characteristics

Catchment Area

The Red River Basin has a total catchment area of 169,000 km^2. Slightly more than half of this falls within Vietnam (86,600 km^2), occupying 26 per cent of Vietnamese territory (331,000 km^2). Slightly less than half the Basin falls in China (81,240 km^2) and a small area lies in Laos (1100 km^2).[10]

The RRB is generally considered to include the Thai Binh River basin. The Thai Binh Basin basically drains separately to the delta, except for flows through the Duong River that in the dry season fall below 20 $m^3 s^{-1}$.[11]

Elsewhere in this report, for the sake of brevity "Red River Basin" refers to the basin within Vietnam unless otherwise noted.

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[9] Natural resources and environmental sustainability in Vietnam by A. Terry Rambo. Keynote presentation for the session on natural resource and environmental sustainability, World Bank workshop, "Vision to Action: Rural Development Trends and Priority Issues," MARD Hanoi, 22 April 1998.

[10] Key information sources for this section were the Red River Basin Profile (RRBWRM, 1999), Vietnam Water Sector Review (1996), and the Red River Delta Master Plan (1995).

[11] See Section 3.3 for a discussion of basin boundary issues.

Figure 1: Map - RRB River Network & Selected Water Resources Infrastructure

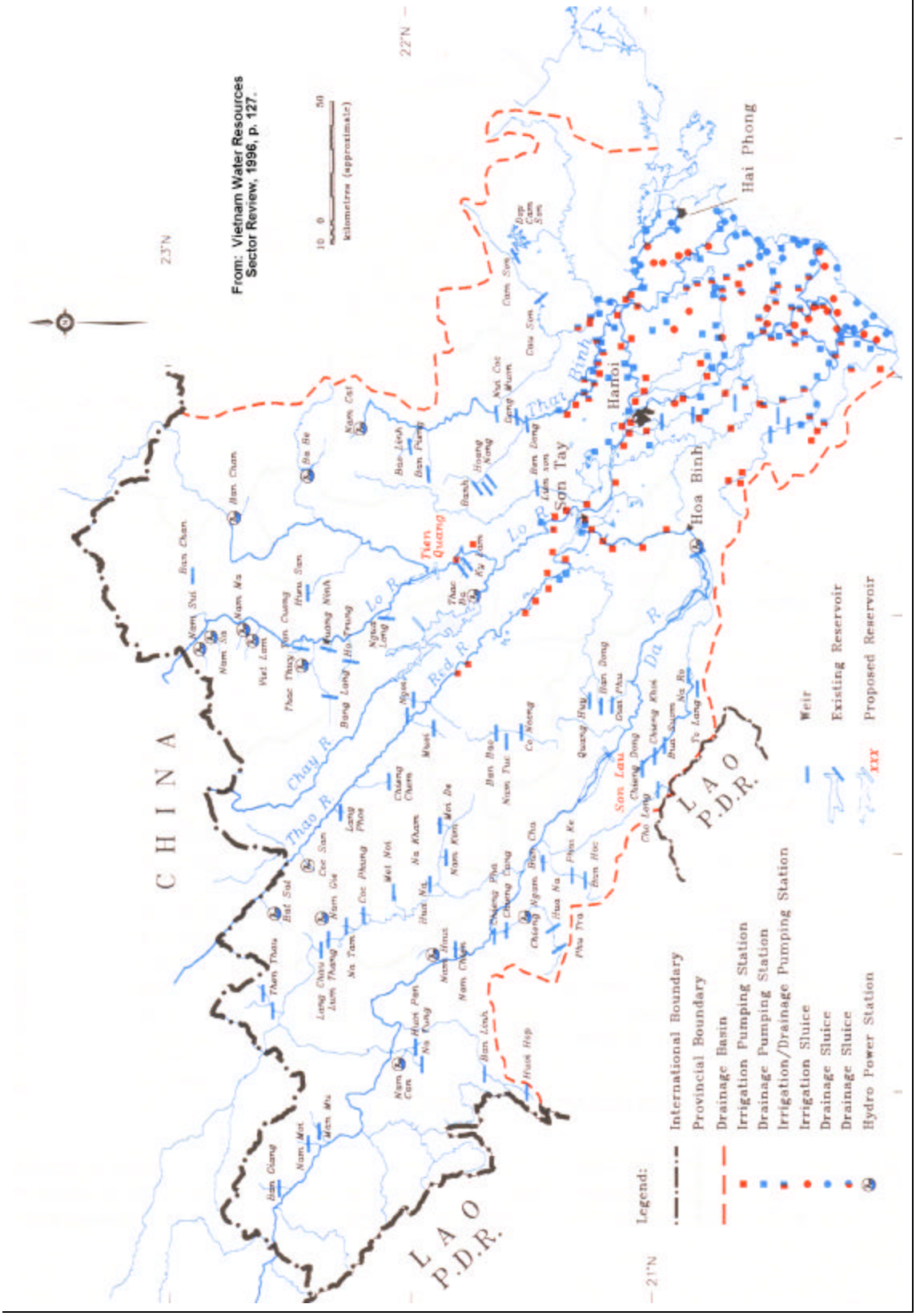
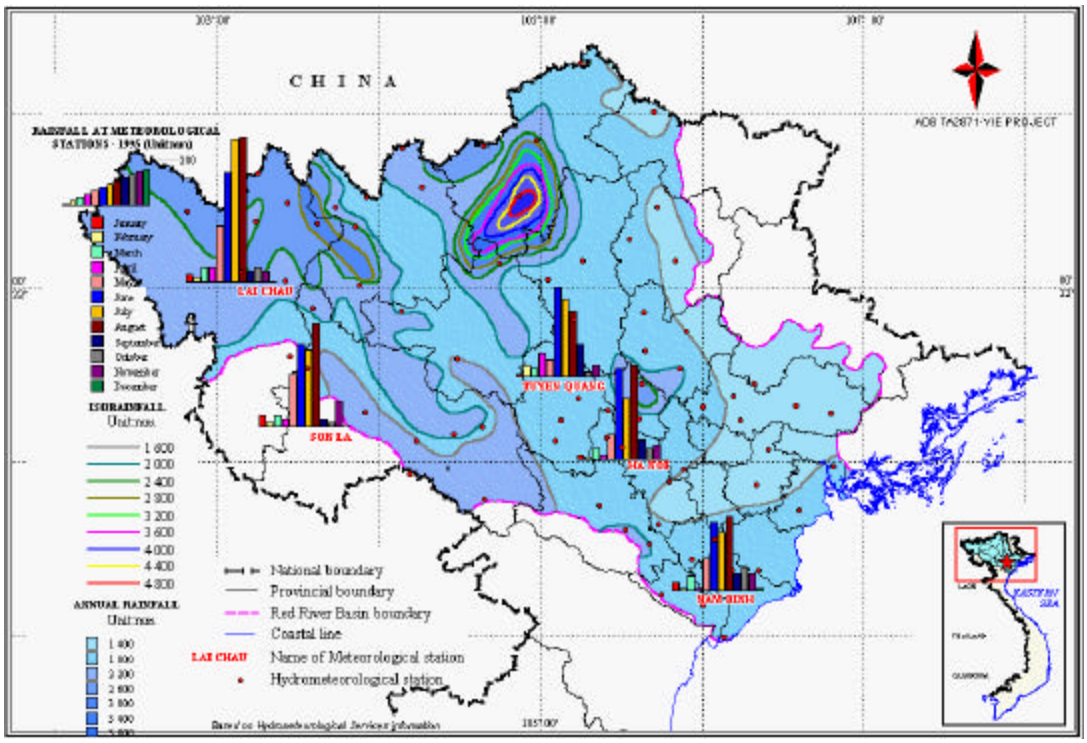


Figure 2: Map – RRB Rainfall



Rivers

The Red River has four major tributaries: the Da, Thao, Chay, and Lo. Above Son Tay, a key control point in the Red River system, these tributaries flow into the Red River. Below Son Tay, the Red River branches out to form the delta (Figure 1).

The Thai Binh has three major tributaries: the Cau, Thuong, and Luc-Nam.

The mean annual discharge of the Basin is about 136 billion m^3.

Climate

Climate is monsoon tropical. Rainfall is abundant. Annual average rainfall for the basin is in the range from 1500 to 2800mm, except for southwestern Ha Giang province where the average exceeds 4800 mm (Figure 2). November to March is the dry season, receiving only 10 per cent of annual rainfall.

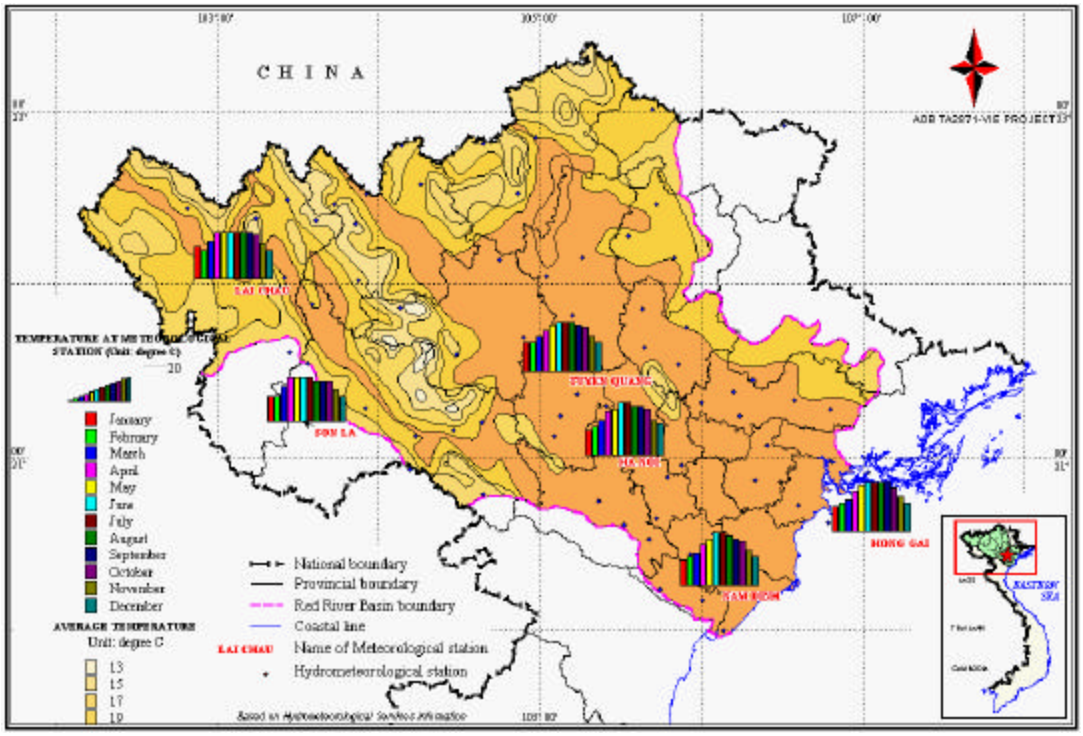
Mean annual temperature varies more or less inversely with elevation (Figure 3). Average monthly temperature is most uniform across the basin in January, the coolest month. May and June are the warmest months. Tropical cyclones are frequent (an average of 15 every decade).

Topography

Basin topography is composed of the central delta lowlands, the midlands, and the mountainous areas (maximum elevation is about 3200 m) (Figure 4). As elsewhere in Vietnam, the topography is the result of erosion of g eologically uplifted soft rock, leaving exposed the underlying intruded granitic rock at higher elevations and deposition of erosional products at lower elevations.[12]

[12] Vu Tu Lap. Vietnam Geographical Data. Foreign Language Publishing House, Hanoi, 1979. Cited in: Barren lands development project, reconnaissance land use study, northern Vietnam. NIAPP/INTERA, 1995.

Figure 3: Map - RRB Average Annual Temperature



The mountainous areas of the Basin are strongly dissected with high relief and very steep slopes. Most of the land area exceeds 25 degrees in slope, which is about the upper limit for sedentary crop cultivation. The highest proportion of very steep land occurs in areas southwest of the Red River (Figure 5).

The major mountain ridge/valley systems, occupied by the main tributaries to the Red River, trend northwest-to-southeast.

Soils

Very high intensity rainfall, highly erodible soils, and inadequate vegetative cover has led to serious erosion over large areas in mountain and midland environments throughout Viet Nam, including the Red River Basin. Estimates of the affected area nationally run as high as 70 per cent.[13]

Soils of the mountainous areas of the basin can be grouped as follows (Figure 6):[14,15]

- ***Ferralic grey soils*** (Ferric Acrisols ACf, 50,000 km^2 in the basin) and ***organic grey soils*** on high mountains (Humic Acrisols ACh, 13,000 km^2 in the basin) are the dominant soil types. The former predominates especially northeast of the Hoan Lien Son mountains. It is strongly weathered, formed on steep slopes, loam to clay loam texture, fair to moderate fertility, and pH 4.5 to 5.5. The latter predominates southwest of the Hoang Lien Son mountains and also further east along the Vietnam-China

[13] Prem N. Sharma. Soil and Water Protection and Watershed Management. Foresty Sector Review Tropical Forestry Action Plan, Vietnam. Ministry of Forestry, Socialist Republic of Veitnam. 1990. Cited in: NIAPP/INTERA, 1995.

[14] The Vietnamese soil classification system is based on the Russion system in which classification criteria depend mainly on color, parent material, and elevation. Approximate equivalents between Vietnamese and FAO/UNESCO soil types are provided in Appendix 1, Table 2 of INTERA-CIDA 1995. Subsequent to this report, in the late 1990s, the FAO soil classification system was revised. Eg Vietnamese classification *yellow-red soils on shale and metamorphic rocks* -> old FAO classification *Orthic Ferrasols* -> new FAO classification *Ferric Acrisols*.

[15] Areas given here for soil type groupings were estimated by GIS software from the NIAPP CD atlas data. Estimation errors using this method/data are not known; but the resolution of this dataset appears to be too coarse to resolve small but important features, in particular alluvial/colluvial soils confined to small mountain valleys.

Figure 4: Map – RRB Topography

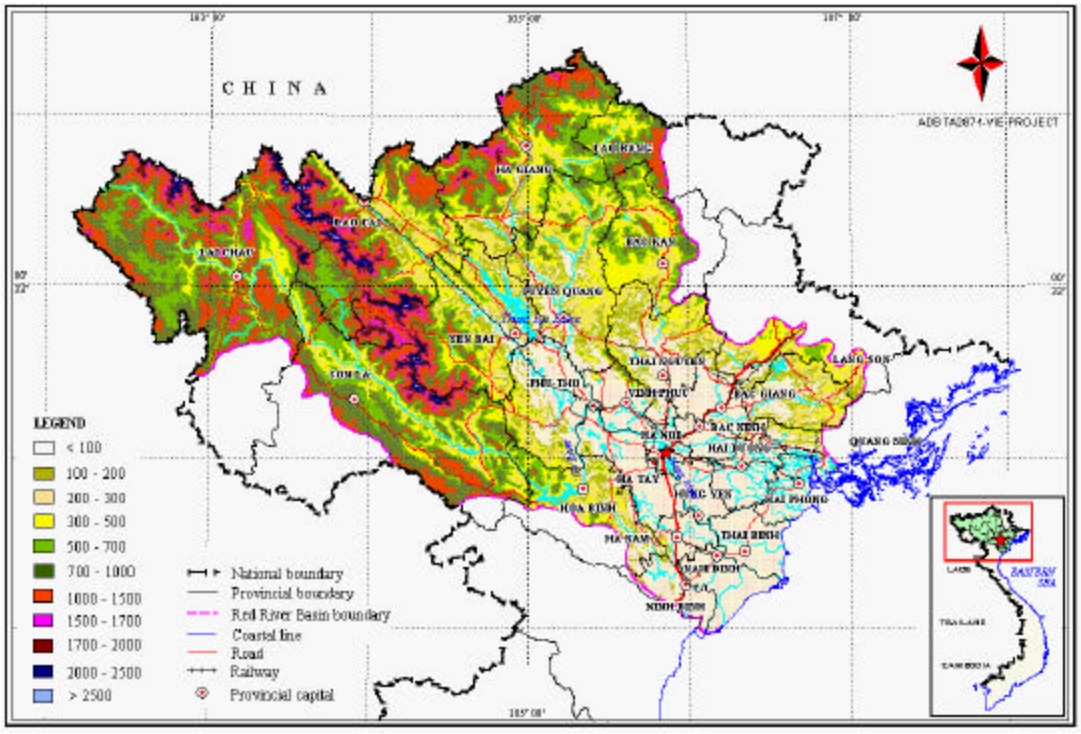


Figure 5: Map – RRB Topographic Slope

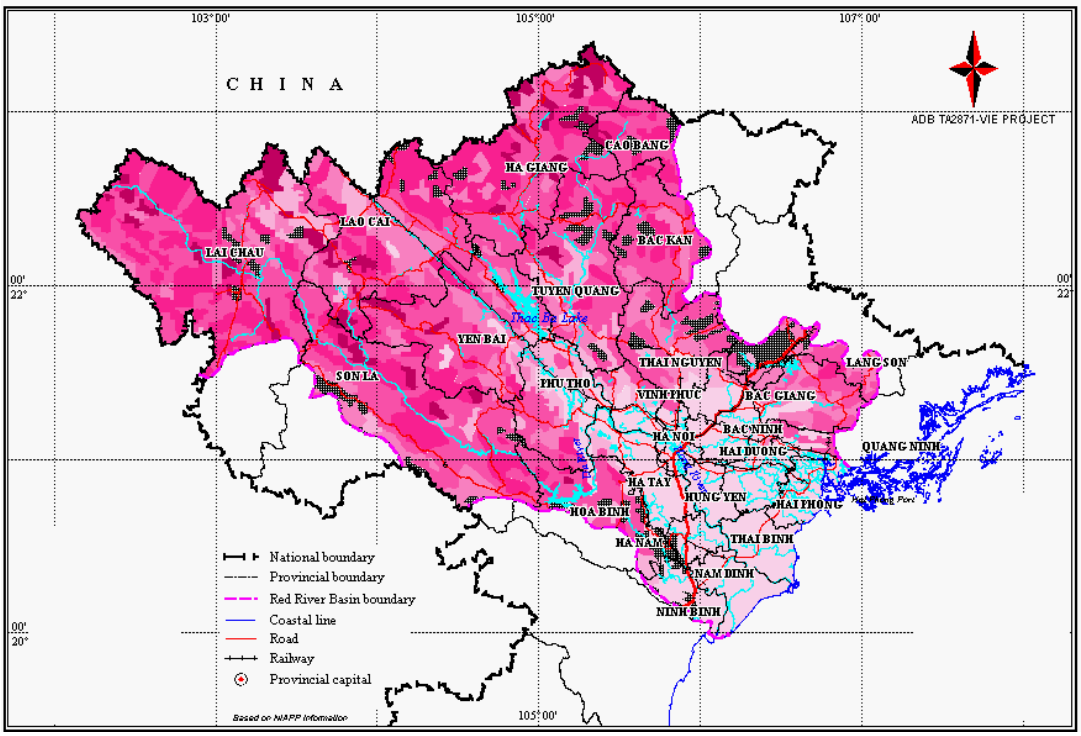
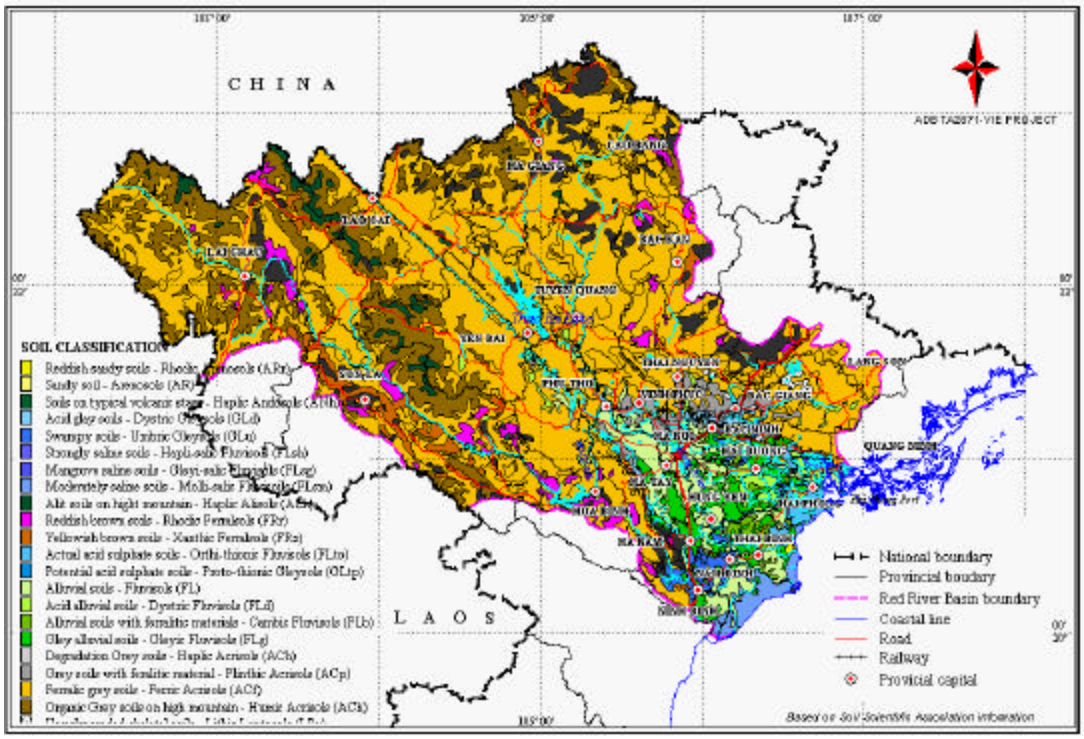


Figure 6: Map – RRB Soils



border. This type is associated with cooler temperatures and as such is less strongly weathered and has higher organic matter content, but beyond this little property data is available. It occurs mainly on very steep slopes and constrains use for food crops and forest production.

- ***Rocky land, severely eroded mountainous/hilly land*** (5200 km^2)**.** Not usable for food crops or forest.
- ***Other upland soils.*** Numerous other soil types occupy the remaining area of the mountain zone. Important to subsistence agriculture are the alluvial and colluvial[16] soils occupying valley bottoms and lower hillsides. Texture ranges from sandy loam to loam and fertility from fair to good.

Soils of the midlands can be grouped as follows:

- ***Ferralic grey soils*** (see above), especially Phu Tho province
- ***Grey soils with ferralitic material*** (Plinthic Acrisols, Acp, 1600 km^2 in the basin)
- ***Normal alluvial soils*** (see below)

Soils characteristic of the delta can be grouped as follows:

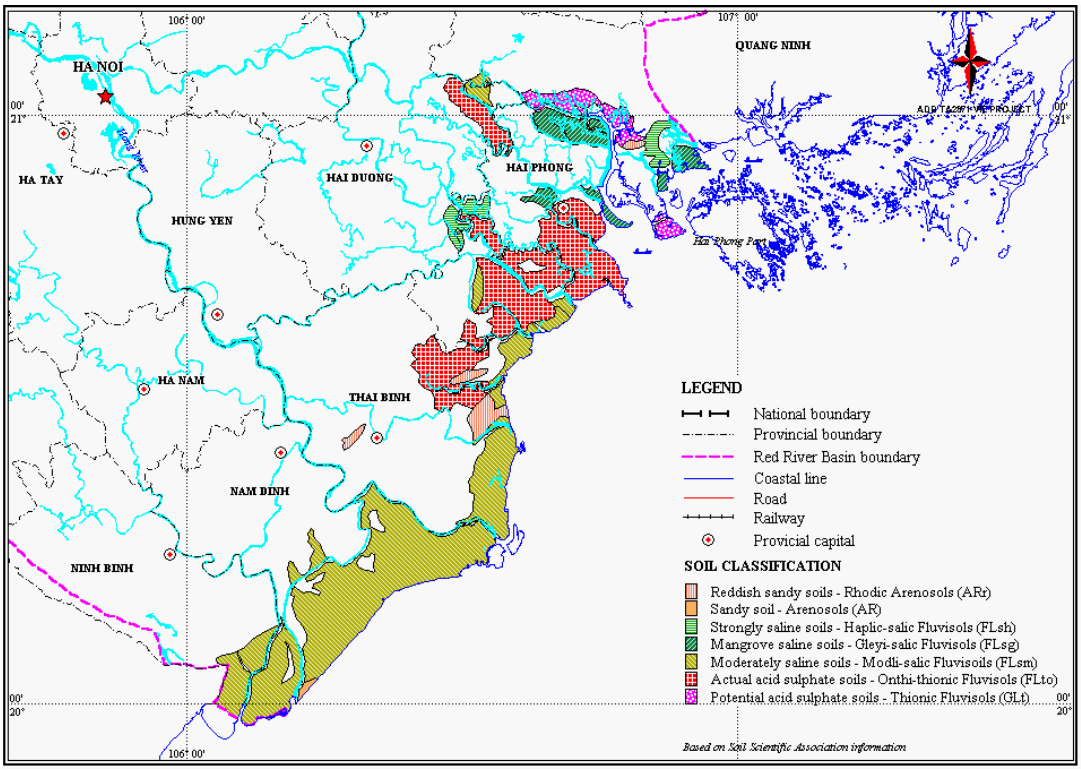
- ***Normal alluvial soils*** (Fluvisols FL, FLd, FLg, FLb; 9300 km^2 in the basin), these are the soils of the core paddy area of the delta
- ***Peaty soils*** (Swampy soils – Umbric Gleysols-GLU, on 835 km^2 in the basin
- ***Saline and acid sulphate soils*** **(**Figure 7**)** on 1800 km^2, of which
    - 940 km^2 is moderately saline (0.05-0.25 salinity units) and cultivable with salt-tolerant rice varieties and careful water management;

[16] In soils, material that has been transported downhill and accumulated on lower slopes and/or at the bottom of the hill.

- 120 km^2 is existing or former mangrove forest area; and
- 64 km^2 is strongly saline (>0.25 salinity units) tidal plain or coastal saline intrusion.

- ***Acid sulphate soils*** on 660 km^2, of which
  - 570 km^2 is actual acid sulphate soils either bare or under natural vegetation; and
  - 88 km^2 is potential acid sulphate soil cultivable with salt-tolerant rice varieties and careful water management.
- ***Sandy soils*** on 62 km^2, of which
  - Sandy soils over 62 km^2 is loamy sand to sandy texture, cultivable with some annual and perennial crops and trees (eg watermelon, sweet potato, beans; bamboo, fruit trees; casuarinas, eucalyptus).

Figure 7: Map - RRB Coastal Soils



3.3 Bounding Schemes: Basin, Subbasins, Zones, and Administrative Units

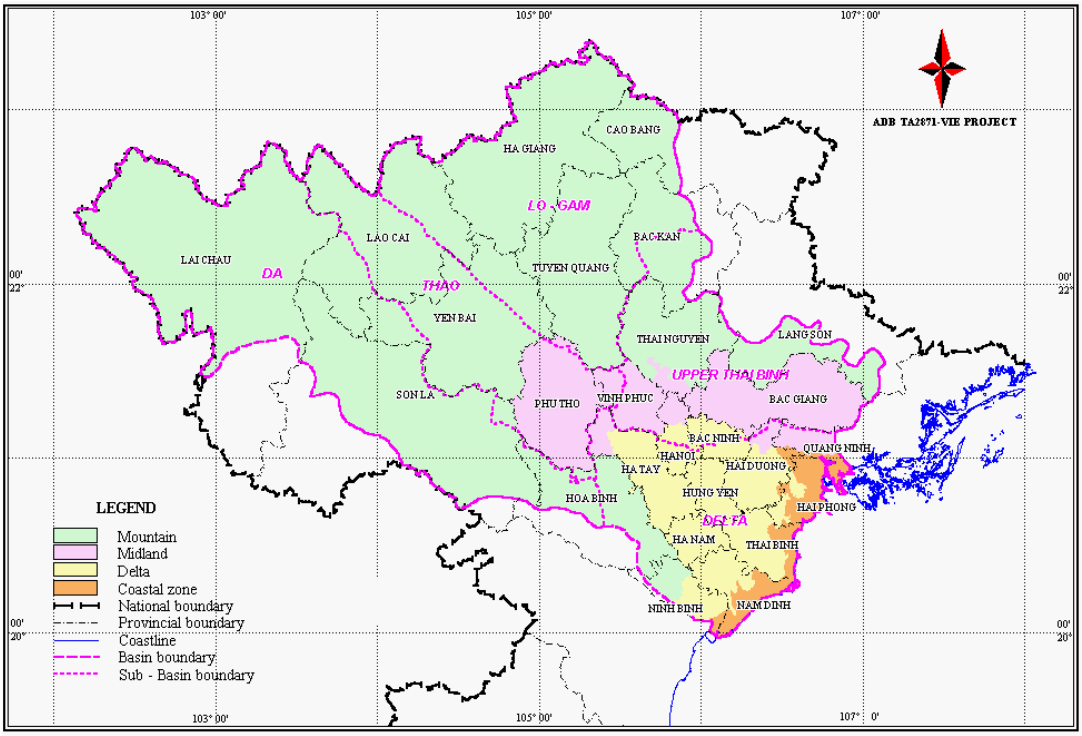
Basin

Water resources planners in Vietnam historically have defined the Red River Basin as consisting of catchments of the Red River and Thai Binh systems. This is also the definition used by the RRBWRM TA.

The Red River Delta Master Plan bounded the delta to include the deltaic parts of the Tien Ken River system, a small basin draining to the sea between the Red/Thai Binh basin and the Chinese border. This additional delta area includes Hong Gai (Ha Long) town.

The Water Resources Sector review on the one hand shows what appears to be the entire Tien Ken basin as part of the Red River and Thai Binh Basin in their map of all the major river basins of Vietnam; (WSR p12); on the other hand their detailed map of the RRB omits it (WSR p127).

Figure 8: Map – RRB Zones and Subbasins



Subbasins

The Red River Basin Profile divided the RRB into five subbasins (Figure 8):[17]

- *Da Subbasin* – catchment of the Da, a tributary of the Red above Son Tay.
- *Thao Subbasin* – catchment of the Thao, also a tributary of the Red above Son Tay.
- *Lo-Gam Subbasin* – groups together the catchments of the Lo-Gam and Chay, the remaining two major tributaries to the Red above Son Tay.
- *Upper Thai Binh Subbasin* – corresponds to the Thai Binh catchment above the delta.
- *Red River-Thai Binh Delta Subbasin* – essentially all of the delta lowlands, plus the southeastern side of the Hoa Binh province hills. The use of the term 'subbasin' for the delta is of course a misnomer; it is a planni ng unit (or zone).

Zones

The current study divides the basin into five main zones (Figure 8):

1. Mountain
2. Midland
3. Delta Non-coastal
4. Coastal
5. Urban

[17] NB subbasin-level statistics presented in this study is computed from provincial-level statistics, area-weighted within subbasins (eg if province *x* falls 30% in subbasin *y*, then 30% of province *x*'s area, population, etc., are attributed to subbasin *y*), unless otherwise noted. Subbasin-level information presented in the RRB Profile was calculated differently, as aggregations of the entire provinces wholly or mostly in each subbasin.

These five zones were identified using the following reasoning.

- The simplest zonation scheme for any river basin has two units, Upland and Lowland. This scheme is at times used for the RRB, with the "Upland" zone consisting of the mountain and midlands together.
- Also in common usage in Vietnam is a three-zone scheme for the RRB: Mountain (ie upland), Midland (transitional between upland and lowland), and Delta (lowland) (Figure 8). By common agreement, the Mountain zone consists of 12 provinces, the Midland zone of four and the Delta of nine. The advantage of this scheme is the common agreement; the disadvantage that it is fairly coarse. In particular it does not capture the extent of the midlands very well. For this reason, in this study an additional four districts were assigned to the Midland Zone (Soc Son, Hanoi; Ba Vi, Ha Tay, Chi Linh, Hai Duong, Ph Yen, Thai Nguyen; and Dong Trieu, Quang Ninh; as shown in Figure 8).[18] It should be noted that agroecological diversity is (relatively) low in the Delta, at intermediate levels in the Midlands, and very high in the Mountain Zone. Indeed, the Mountain Zone consists of many microzones with a variety of physical characteristics, land use systems, etc.[19] Ethnic diversity is also extremely high (see Section 3.4).
- The Study further divided the Delta lowland into (1) a freshwater zone and (2) a coastal zone, transitional between the freshwater and marine environment. The Study takes the boundaries of the coastal zone those of the area of sandy, saline, and acid sulphate soils. (A next step would be to ensure the inclusion of all areas not on these "problem" soil types but having high vulnerability to cyclone damage, salinity or other coastal-related problems with domestic water supply, etc.)
- The Study also defined an urban zone, consisting of town and city areas within each of the other four zones. This was defined to correspond to the administratively classified urban areas in the basin (see below).

Complementarity of Subbasin and Zonal Bounding

Subbasin bounding and zonal bounding are complementary. Subbasin units lend themselves to the consideration of hydrology, downstream impact, and water sharing questions; zones to agroecological and socio-economic commonalities across subbasins.

Administrative Bounding 1: Provinces

At present, 25 provinces lie partially or wholly within the basin. Several of these provinces were divided in 1991, increasing the total from 16 to 20, then several more were divided in 1995, to reach the current number (Figure 9).

For this study, consistent statistical time series data was constructed by re-aggregating post-1995 provinces back into the 1991 provinces.[20] In addition, Hanoi City and Ha Son Binh province have aggregated for some calculations and analyses – because Ba Vi district and Son Tay town (about 1000km^2) were shifted from Hanoi City over to Ha Son Binh province in about 1989.

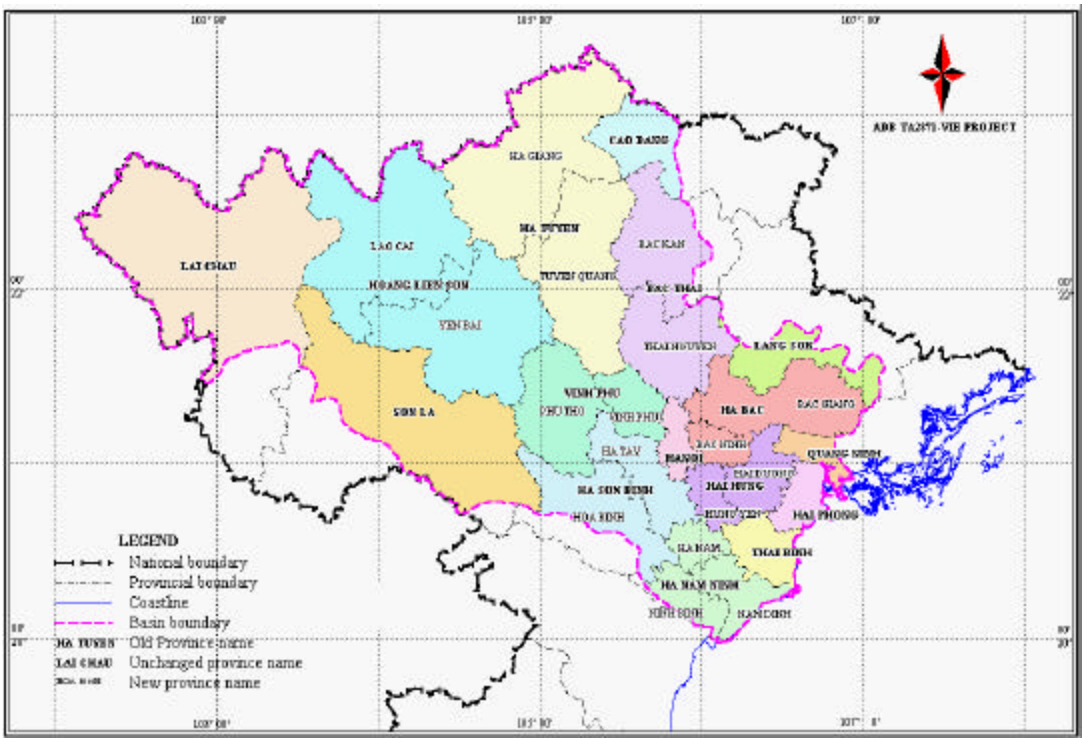
Even after these aggregations, the old/aggregated provinces do not maintain constant area over time (1986-94). Four 'old' provinces (Bac Thai, Vinh Phu, Ha Nam Ninh) increase and one (Hanoi-Ha Son Binh) decreases significantly in area, by as much as 6% (Figure 10). The reason for these variations, which are on the order of 100 km^2 or less for each affected province, is not known. The 25 basin provinces' total area increases by 320 km^2 from 1986 to 1994.

[18] Alternative schemes have been put forward. These include NIAPP's classification at one time of selected districts into a different zone from the parent province (this is where our four additional Midland districts came from); and the Committee for Mountains & Minorities division of the mountains into high mountains and low mountains). None of the alternative schemes has gained general acceptance.

[19] Rambo (op. cit.) cites these examples: mountain-valley systems as in Hoa Binh, valley basins as at Din Bien, high mountains as in Hoang Lien Son.

[20] The alternative is to disaggregate pre-1995 data to the current post-1995 provinces, but this introduces estimation errors.

Figure 9: Map – RRB Provinces Pre-1991 to Post-1995



Administrative Bounding 2: Urban Areas

Urban areas are administratively classified as city (*thành phố*), district capital (*th xã),* and town (*th tr n*). These are abbreviated TP, TX, and TT respectively. TP are further classified as first, second, and third rank.

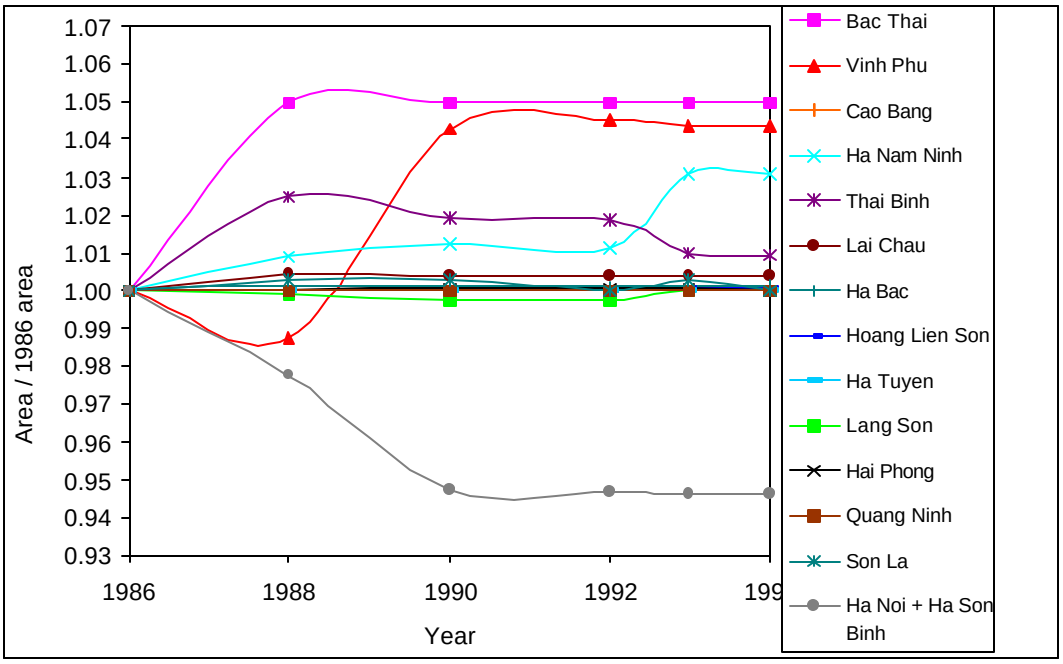
First rank TP are similar in rank to provinces. The RRB currently has two first-rank TP, Hanoi, and Haiphong. First-rank TP are subdivided at the next administrative ("district") level into [urban] subtowns and [rural] districts. Hanoi currently has seven subtowns: four dating to 1954 (Ba Dinh Hoan Kiem, Hai Ba, Dong Da), and three created in 1998 (Thanh Xuan, Tay Ho, Cau Giay).

Second- and third-rank TP are subunits of their respective provincial administrations. The RRB currently has one second-rank TP (Nam Dinh), and four third rank TP (Viet Tri, Thai Nguyen, Hai Duong, Ha Long).

GOV agencies normally (but see Section 3.4) classify areas and populations statistically as "urban" based on the boundaries of the administrative units, rather than on the basis of eg current population density or degrees of economic dependence on agriculture, etc.[21]

[21] There is no standard international (for instance, United Nations) definition of "urban" for statistical purposes. Rather, each nation adopts, and may periodically change, its own definition of urban for the purpose of disaggregating total area and population into rural and urban components.

Figure 10: Residual Area Changes of Old/Aggregated RRB Provinces 1986-94



3.4 Human Resources

Total and Rural Population

The 1996 population of the Red River Basin was 23.8 million.[22] Of this, more than 19.4 million (82 per cent) lived in rural administrative units.

Urban Centres, Urban Population and Urbanization

Locations of urban centres (TP, TX, TT; see Section 3.3) are shown in Figure 12. The 1996 urban population of the Basin provinces was 4.4 million.[23] Of this, 1.2 million people lived in Hanoi, giving it an urban primacy relative to the basin of 26%; another 0.6 million lived in Haiphong.

Urban population in the RRB provinces looks set to double from the 1986 level by 2020 at the latest, and probably before that.[24] This means the RRB will have around 8.5 million urban residents in 2020.[25]

[22] GDS provincial population, times areal proportion of province in the basin calculated using NIAPP CD atlas data

[23] This is the total urban population of the RRB provinces both inside and outside the basin. This is therefore an overestimate that could be improved by excluding ex-Basin cities.

[24] Urban Sector Strategy for Vietnam, ADB 1995. Cited in: The rural-urban transition in Viet Nam, some selected issues. ADB Occasional Paper No. 15, October. Sudipto Mundle and Brian Van Arkadie, 1997.

[25] The figures given in the Red River Basin Profile for urban population growth rate, 2020 urban population , and per cent urban (9,8 per cent, 20 million, and 50 per cetn respectively) are very high. The WSR (Fig. 21., p. 7) based on MPI projections gives national figures of 4.5 falling to 3.5 percent, 44 millino, and 37 per cent respectively. [NB the WSR Executive Summary para. 3 states that urban population will reach 50 per cent of the total in 2030, but the 2030 urban/rural population figures given in the main report actually work out to 46 per cent.]

Figure 11: Chart – Past & Projected Urban Population, Red River Basin Region

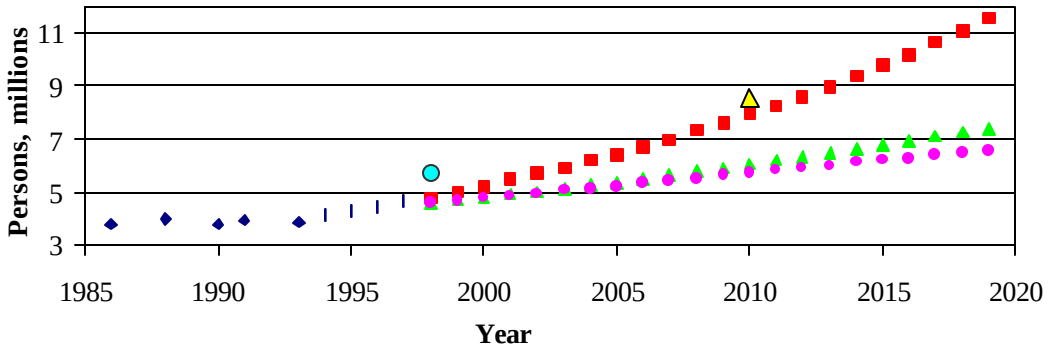
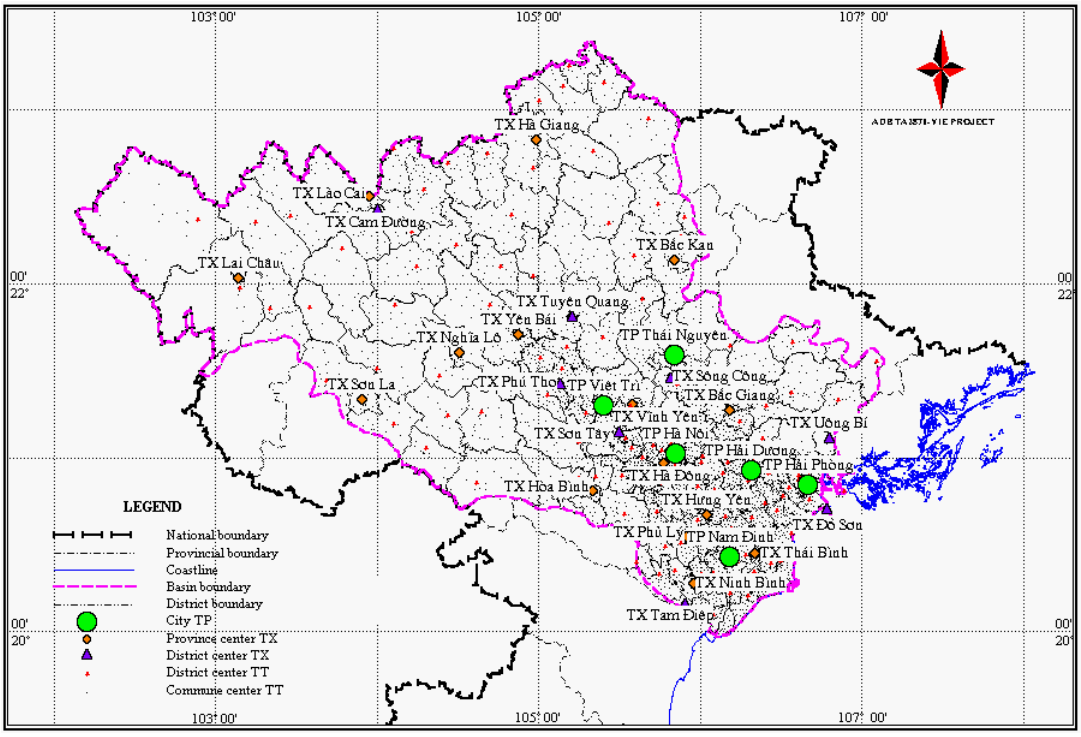
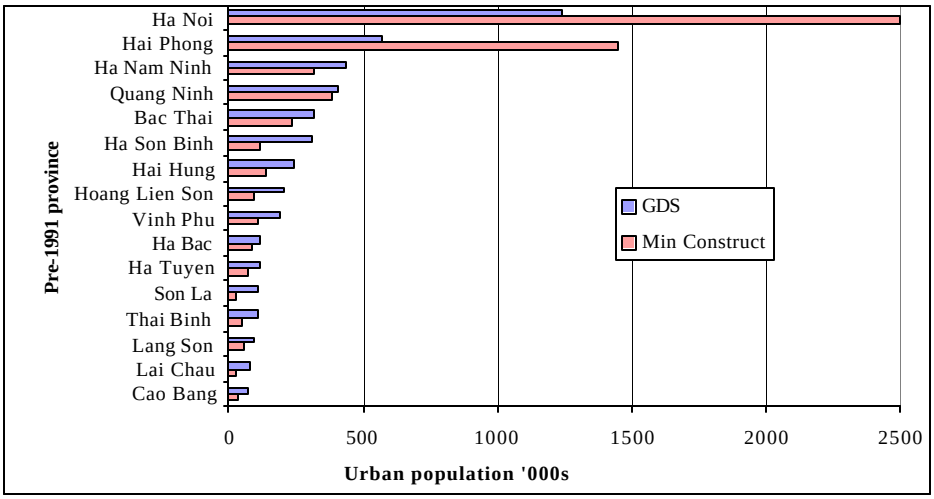


Figure 12: Map - Red River Basin Urban Administrative Units



GDS historical statistics for urban population in the provinces of the Red River region show essentially no growth for the years 1986 through 1993. During this period, recorded urban population fluctuated between 3.75 million and 3.96 million year-to-year. Then from 1993 to 1997, the four most recent years of data, rather rapid annual growth is recorded, with annual growth rates ranging from 3.1 to 6.8 per cent per year.

Figure 13: Chart – Estimated 1997 Urban Population in RRB Provinces



Urban population by pre-1991 province estimated for 1997 from two sources is shown in Figure 13. This illustrates that there are (at least) two different methods in use in Vietnam for counting urban population. The difference in the main cities is that the GDS method includes only the inhabitants of the (nominally urban) subtowns, whereas the Ministry of Construction includes inhabitants of the (nominally rural) districts as well. Why the MOC everywhere else underestimates urban population relative to the GDS count (Figure 13) is not clear (possibly MOC excludes smaller towns without current or planned piped water supply systems? See Table 1). Total RRB provinces population 5.7 million vs. 4.6 million for MOC and GDS respectively.

Urban population by urban centers would be useful to know but was not obtained by this study. The estimated 1997 Hanoi population was reported by MOC to be 2.5 million by MOC and 1.2 million by GDS. Haiphong population was reported as 0.6 million and 1.4 million respectively.

Ethnicity

Vietnam has 54 ethnic groups in eight language groups, and three language systems. Of these, four reside in the delta and midland regions: the majority Viet (Kinh), Hoa, Khmer, and Cham.

The northern mountains are inhabited predominantly by people of 31 groups, belonging to seven language groups in two language systems. Kinh people have lived in the northern mountains for centuries, but the Kinh proportion of the population has increased greatly due to in-migration, in particular the government sponsored New Economic Zone of the late 1970s.

In the mountain zone, the Red River is an ethnologic boundary. In areas west of the Red, the ethnic minority population is primarily of The Thai, Muong, and other Mon-Khmer groups. In areas east of the Red, people of the Tay and Nung groups predominate. H'mong and The Tang Mien people live along the the Sino-Vietnamese border. However, the different groups do not have separate territories. Rather, most communes are comprised of inhabitants from two to five different ethnic groups.

Members of the different groups tend to prefer different types of terrain. The The Thai, Muong, and Tay mostly live in mountain valleys or on small plains along rivers. The Nung, San Chay,

San Diu, and Dao, who migrated relatively recently (some one hundred years ago) to Vietnam, tend to live in higher areas. The H'mong and Tang Mien live at the highest occupied elevations.

Mountain ethnic minority people have a range of traditional livelihood systems, which in general involve management of energy and nutrient flows through several different landscape elements. A wide range of activities is typically involved, eg livestock grazing, upland swidden agriculture, wet rice cultivation in valleys, forest gathering, horticulture, etc. In simplistic terms, a key determinant of the sustainability of livelihood systems involving swiddening is the length of the

fallow period, and this in turn is a function of population density. In recent years, population in the mountains has increased greatly due to in-migration from the lowlands and very high birth rates, and this has meant leaving shorter and shorter fallow periods, plus expansion of swidden to increasingly steep erosion-prone slopes.

Gender

Women play an important role in the agricultural labor force. The feminization of rural poverty is an experience of many women in the recent past: in the 1980s in many areas in the North, many husbands and sons left rural areas in search of work, with the resulting that the rural labor force was composed of up to 70 per cent women in some areas.[26]

3.5 Economic and Social Development

The best recent overview seems to be that of World Bank (1998),[27] which also includes information on the implications for Vietnam of 1997 Asian financial crisis. This will not be summarized here.

GOV Poverty Criteria and RRB Poorest Communes

In 1998, the GOV identified the poorest 1715 communes in the country based on five criteria[28]

1. Natural conditions and location – distance from developing center
2. Existing infrastructure – not built, still temporary, problems, no vehicle access to commune, poor/no electricity, irrigation, clean water supply, school, clinic, etc.
3. Access to social services and information – high illiteracy, poor health, poor information access
4. Unsustainable/vulnerable production systems – high dependence on deforestation, collection of forest products, shifting cultivation
5. Household poverty classification[29]

A total of 220 of these poorest communes (13 per cent of the national total) are located in the Mountain and Midland Zones of the basin. Another 6 communes (0.3 per cent) are located in the delta.

Additional information on poverty is provided in GOV-Donor-NGO Working Group (1999).[30]

[26] From plan to market. Adam Fforde and Stefan de Vylder, 1996. Westview Press, 358 pp.

[27] Vietnam – rising to the challenge, an economic report. Report No. 18532-VN.

[28] The 1715 poorest mountainous and remote communes, 10 pp. Anon. (GOV?) 1998. [In English and Vietnamese.] Documents commune selection criteria used by the socio-economic program to support the poorest mountain and remote communes (Decision No. 135/1998/QD/TTg, dated 31 July 1998).

[29] Ministry of Labor, War-Invalids, and Social Affairs commune-level poverty index. This is calculated as monthly income per capita expressed as rice equivalent per capita: (i) poor <25kg in cities & towns, <20kg in lowlands/midlands, <15kg in mountains; (2) hunger <13kg rice. The MoLISA poverty index dataset was not available to this study. It has been requested by MARD DMU.

[30] Vietnam, attacking poverty. Vietnam Development Report 2000. Joint Report of the Government of Vietnam-Donor-NGO Poverty Working Group, Consultative Group Meeting for Vietnam, 14-15 December 1999.

Table 1: Existing Urban Piped Water Supply Systems

Source: Min. Construct. 1998
Unit: '000 persons

1991-5 Provinces (mostly)	Category			City/Town	Population	Actual pumped volume		
						'000 m3/day		lit/pers-day
	TP	TX	TT			GW	SW	
Hanoi	x			Hanoi	2500	335		134
Hai Phong	x			Hai Phong	1448	39	138	122
Ha Giang		x		Ha Giang	24	4	1	175
Tuyen Quang		x		Tuyen Quang	47	5	0	106
Cao Bang		x		Cao Bang	35	0	2	69
Lao Cai		x		Lao Cai	30	1	0	40
Yen Bai		x		Yen Bai	65	0	8	123
Bac Thai	x			Thai Nguyen	240	15	15	125
Son La		x		Son La	30	4	2	210
Vinh Phu					110	8	32	364
	x			Viet Tri				
		x		Phu Tho				
		x		Vinh Yen				
			x	Phuc Yen				
			x	Xuan Hoa				
Ha Bac		x		Bac Giang	85	0	4	47
Quang Ninh					381	65	34	258
		x		Hon Gai				
		x		Cam Pha				
			x	Bai Chay				
			x	Mao Khe				
		x		Uong Bi				
Ha Tay					60	16	0	267
		x		Ha Dong				
		x		Son Tay				
Hoa Binh		x		Hoa Binh	62	8	3	169
Hai Hung					138	2	17	138
		x		Hai Duong				
		x		Hung Yen				
			x	Cam Binh				
Thai Binh		x		Thai Binh	47	0	10	213
Nam Ha	x			Nam Dinh	220	0	28	127
		x		Ha Nam	30	3	0	100
Ninh Binh		x		Ninh Binh	42	0	4	95
		x		Tam Diep	20	1	0	25
Lang Son		x		Lang Son	55	7	0	127
Lai Chau					31	0	3	97
		x		Lai Chau	11			
		x		Dien Bien	20			
TOTALS/MEAN					**5700**	**512**	**301**	**142**
							Median	**126**
							Min	**25**
							Max	**364**

3.6 Resource Management Systems

Agriculture

Historical information related to agricultural diversification, extension, input levels, yields, damage and crop calendars etc. would be extremely useful, but could not be assembled during the Study timeframe. Land types (a measure of vulnerability to flooding and drainage congestion) seem not to have been mapped in the delta.

The average area cultivated in the RRD over the period 1988 to 1998 has been approximately 480,000ha. Rice is the principle crop, and is always irrigated.

The area supported by pumped irrigation in the RRD averages 360,000ha. By GDS statistics, the area of the summer-autumn rice crop is normally about 10-50,000 ha greater than the winter-spring crop. Up to 40% of the gross cultivable area is planted to vegetable, tuber, and other non-rice crops in the winter season, between October and January.

Forestry

The commonly held view is that deforestation, nationally and in the basin, was rapid and accelerating until recently (mid-1990's), but that since then net reforestation has been occurring as the result of aggressive forestry sector investments, granting of land rights to individual farmers/agroforesters, along with extension of improved management systems and practices.

Cadastry Department data on land use through 1980-1995 documents is consistent with deforestation 1980-1990, and reforestation 1990-5, but this is hardly conclusive confirmation of trends. Comprehensive studies to quantify current forestry land use are currently underway. [31]

Forest lands are categorized broadly as "special forest" which includes protected areas (Figure 14), "protection forest" on higher and/or more sloping lands, and "production forest" otherwise. Some production forest is still held publicly and by state-owned enterprises. The remaining production forest land seems to be managed as an integral part of the household land resource base: production forestry land can be allocated to households, and in general can be converted to terraces for wet rice cultivation or any of a wide variety of tree crops, industrial crops, and agroforestry systems.

"Protection forest" is intended to be managed under forest cover, either by planting or conserving trees. Evidently some protection forest is specifically identified as "watershed protection forest" and managed appropriately, for example, priority afforestation, as within 2 km on either side of the Da. There are conflicts between the protection objective and those of swiddeners in areas classified as protection forest.

[31] Eg ADB TA-3255, Policy and Institutional Framework for Forest Resources Management.

Figure 14: Map - RRB Protected Areas and Other "Special Forest"

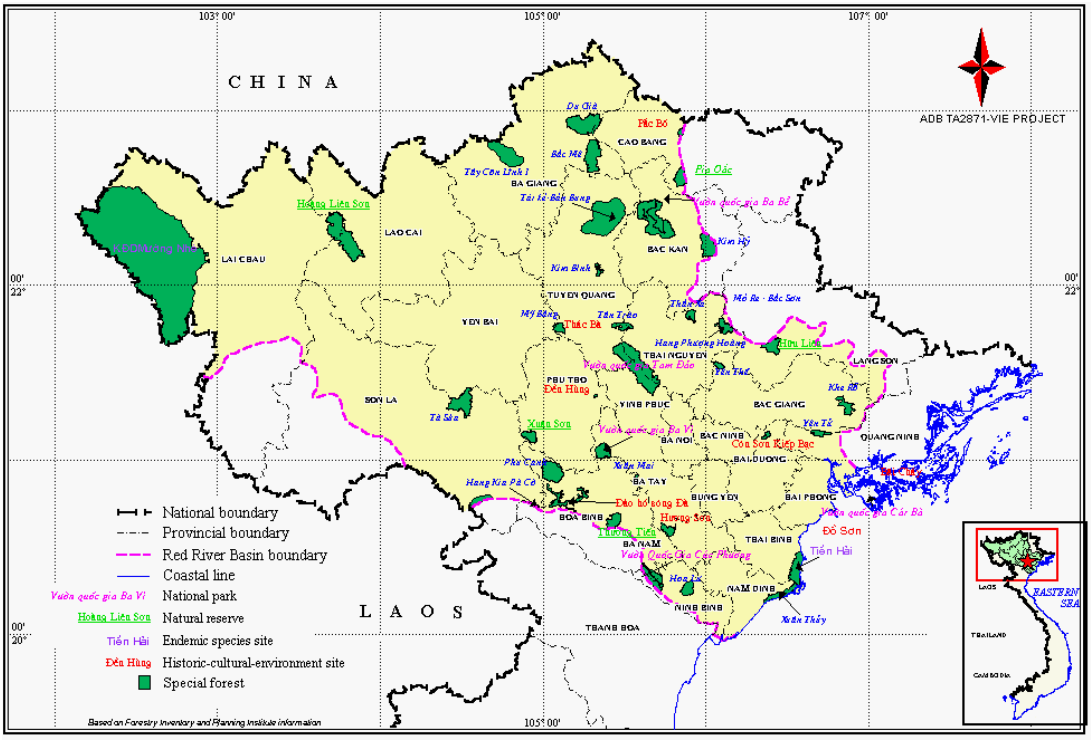
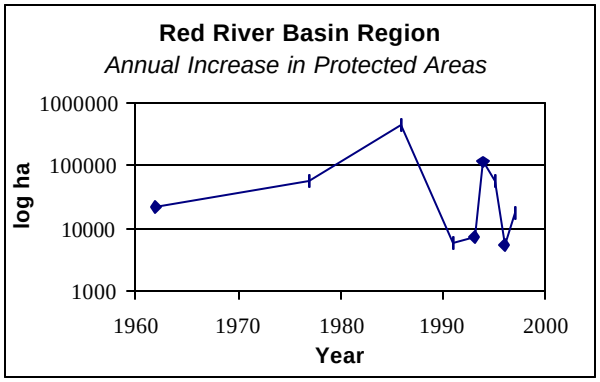


Figure 15: Chart – RRB Protected Area Order of Magnitude increase By Year



Protected Areas

A map of these areas and other 'special forest' areas in the basin is shown in Figure 14 and listed in Table 8 and Table 9. Currently there are about 800,000 ha in protected areas in the basin. In recent years, new protected area in the basin has been gazetted by on the order of 10,000 to 100,000 ha each year (Figure 15).

The significance of protected areas for water resources management is (1) these are areas that have been specifically identified by the GOV as of special value – that is, high social value, which implies potential priority for resource allocation including water; (2) in some cases their special biophysical character or use implies special needs with respect to water resources management (for example, the Everglades of Florida USA).

4 Land Use and Water Resources Development

4.1 Land Use vs Land Suitability

Traditional land use maps are in effect backward looking. At best, they represent current utilization of land. In the context of rapid economic development and/or rapid land degradation – both of which are occurring in the basin – they become quickly outdated.

Though it has not been possible in the present study to include information on land suitability in the basin, it is worth mentioning that land suitability mapping is a powerful proactive tool for resource management.[32] Land suitability identifies one or more prospective alternative land uses as a function of relatively stable characteristics (for example, climatic, topographic, soil, hydrologic, proximity to infrastructure and urban centres), plus other elements, for instance related to policy or economic conditions. Forecasting future water demand, for example, can then be done by modeling the transition from current use to alternative use.[33]

4.2 Administrative Land Use Plans

It has been suggested that the administrative land use plans prepared by Government agencies could be taken as forecasts of expected future land use by water resources managers. The difficulty with this idea is that land use planning in Vietnam is an instrument through which the State expresses its policy to retain control over land use (despite the granting of long-term tenure to farmers). Thus these land use plans are conceptually prescriptive in nature. While prescriptive planning at its best comes to resemble forecasting (that is, plan targets are realistic and feasible, and hindsight will find that they have been achieved), this has not been the experience in Vietnam; the upgrading of planning concepts and processes is an important ongoing activity.

At this stage, administrative land use plans may be a useful input to water demand forecasts, but water resources managers should probably not rely solely on them for land use information; they should also access a broad range of other land use information sources as well.

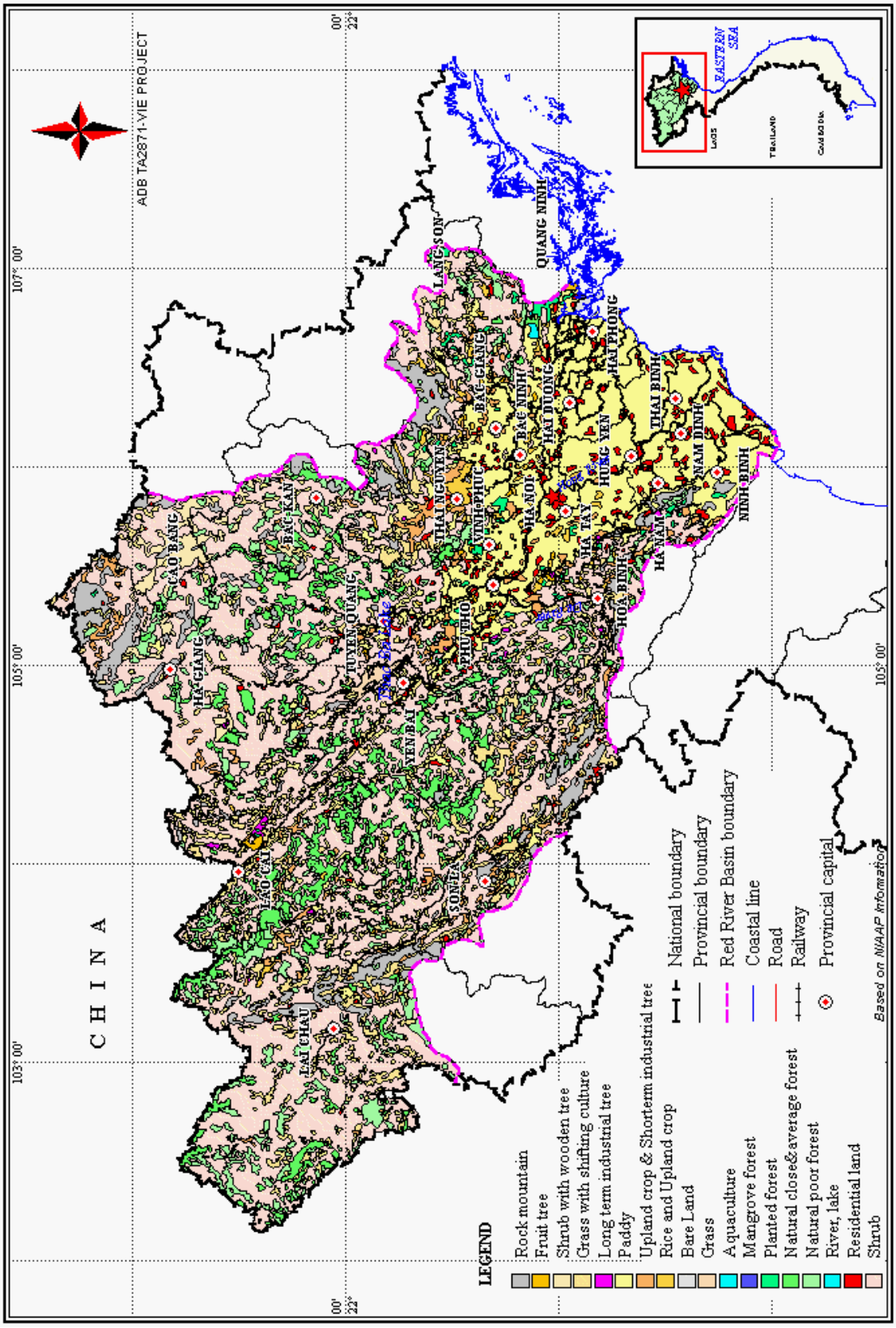
4.3 Land Use in the Basin and Subbasins

Maps of land use in the basin and subbasins are shown in Figure 16 and Annex C.

[32] Barren lands development project, op. cit.

[33] A GIS-based water demand forecasting tool developed for the Irvine Ranch Water District. Webpage at http://www.dsce.com/new.htm . Michael J. Hoolihan and Ali Diba, 1998.

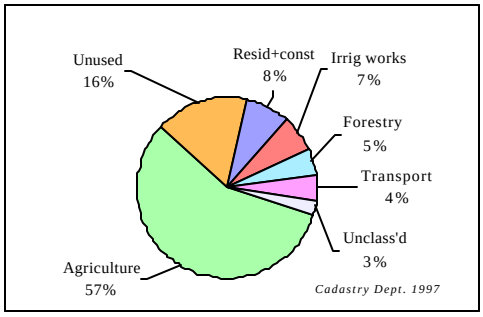
Figure 16: Map - RRB Land Use



4.4 Land Use in the Delta Provinces

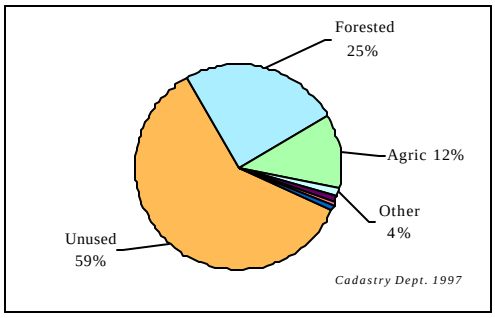
Land use in the Delta Provinces[34] breaks down as follows (Figure 17 and Table 5):

Figure 17: Delta Provinces – Land use 1995



- ***Agricultural lands*** predominate, occupying 57 per cent or almost two-thirds of the area.
- ***'Unused land'***[35] accounts for 16 per cent or almost one-fifth of the area. Much of this is shrub hills in the midlands of Hoa Binh province (Figure 32). In the delta *per se*, land categorized as 'unused' is at a minimum – probably on the order of 5 per cent.
- ***Residential and construction*** areas occupy 8 per cent or almost a tenth of the area.

Figure 18: Mountain and Midland Provinces – Land use 1995



- ***Irrigation works*** occupy 7 per cent or approaching a tenth of the area. This single number alone speaks volumes about the dependence of lowland agriculture on large surface water irrigation schemes; the scale of past investment in these systems and their current value; and the challenge that must be faced to improve their operation and maintenance. The large area occupied by irrigation works area also helps to explain the emphasis placed by water sector managers on works encroachment as a "land use" issue. [For more on encroachment, see Section 5.5].
- ***Forestry, transport***, and ***unclassified*** areas account for the remaining 12 per cent, again about a tenth of the area.

4.5 Land Use in the Mountain and Midland Provinces

Land use in the Mountain & Midland Provinces[36] breaks down as follows (Figure 18 and Table 5, see also Figure 28 through Figure 31, Annex C):

- ***Unused*** land accounts for 59 per cent or almost two-thirds of total area. This is predominantly deforested bare or shrub land and to a lesser extent rock.
- ***Forested*** land accounts for 25 per cent or a quarter of total area. This classification is comprised of areas of natural forest in good to poor condition, plus areas of planted forest.[37] [For more on forestry, see Section 3.6.]

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[34] Here Ha Noi, Hai Phong, Ha Tay, Ha Duong, Hung Yen, Ha Nam, Thai Binh, Nam Dinh, and Ninh Binh.

[35] "Because of the pressure on land in Vietnam, very little of the so-called 'barren lands' are in fact totally unused. [In fact, land use in these areas ranges from] fallow lands in shifting agricultural systems, to recently cleared areas being degraded by monoculture cassave production, to supplying gather areas for fodder/fuel and regions for extensive grazing. The 'barren lands' can generally be said to coincide with the Vietnamese land use types 'grass', 'mixed grass and bush', and 'shifting cultivation.' " Barren lands development project report, p. 2. The author goes on to say that unsustainable land use that further degrades such lands, leading to severe erosion and true 'barren lands' is an urgent issue.

[36] Here Hoa Binh, Son La, Lai Chau, Lao Cai, Yen Bai Ha Giang, Cao Bang, Bac Kan, Tuyen Quang, Thai Nguyen, Lang Son, Quang Ninh, Phu Tho, Vinh Phuc, Bac Ninh, and Bac Giang.

[37] NB Cadastry Department statistics use "forest" to designate land occupied by either natural or planted forest. By contrast, statistics of agencies concerned with forestry (eg FIPI) use "forest" to refer to the total area classified as "forestry land" administratively. This "forestry area" is then classified by use, including "non-forested forestry land" (!).

- ***Agricultural land*** accounts for 12 per cent or slightly over one-tenth of total area. Even so, mountains & midlands agricultural area is 1.7 times, or approaching twice the extent of delta agricultural area – though of lower average productive potential. [For more on agriculture, see Section 3.6.]
- ***Other*** land uses – residential+construction, irrigation works, and transport – account for only 4 per cent of total area. Again, however, in absolute terms, the areas occupied by these uses in the mountain and midlands is not small, at about twice the corresponding delta areas (Table 5).

4.6 Conversion of Agricultural Land in the Delta?

Conversion of agricultural land to other uses is without a doubt happening in many locations (for instance, in Hanoi periurban areas), as any visitor can see, but the statistical picture for the delta as a whole is rather confusing.

The conventional wisdom is that there is an ongoing net loss of arable land in the delta due to population growth and urbanization. Loss rates as high as 4500 ha per year have been reported.[38] This seems much too high. It is about four times the 1980-95 rate in Government statistics (see below), and difficult to believe on practical grounds: Could 45,000 ha (over 6% of the total agricultural area of about 700,000 ha) really be converted over a decade and not be noticed?

GDS statistics for the delta provinces show a net *decrease* in agricultural land use area from 1980 to 1995 of 14,000 ha (-930 ha per year). This is composed of a fairly steady decrease from 1980-1990 of 17,000 ha (1700 per year), followed by an increase of 3000 ha between 1990 and 1995 (+600 ha per year).

GDS statistics for the delta provinces show a net *decrease* in residential plus construction area from 1980 to 1995 of 4000 ha (-270 ha per year): first an increase in of 6000 ha from 1980 to 1990 (+600 ha per year), then a decrease (?) of 10,000 ha from 1990 to 1995 (-2000 ha per year). This is very puzzling, occurring in parallel with increases in total population from 23.0 million to 27.3 million (1986-96), and urban population from 3.8 million to 4.6 million (1986-96).

If agriculture and residential plus construction area have both been shrinking in the delta during 1980-5, what has been expanding? The winners were transportation (+16,000 ha), irrigation works (+10,000 ha), unclassified lands (+9,000 ha), and unused+ forested area (+5000 ha). An estimate of the error bounds of the GDS land use statistics would be very helpful in understanding which of these trends is "real" and which is "noise". It is reasonable to think that the national statistical system is improving over time, such that the later numbers in general have lower error bounds than the earlier ones.

4.7 Water Resources Development

Hydropower

The basin has two major hydropower installations, at Hoa Binh (installed capacity 1920 MW) and Thac Ba (120 MW).

Flooding and Flood Control

An extensive system of river and coastal dikes provides a high level of protection, but even so annual losses average hundreds of dead and over $50 million in damage. Dike strengthening is being addressed.

In small, steep catchments in the mountainous areas, flash flooding is a problem.

[38] Ecoregional approaches for agricultural water management in the RRD – a pilot study for the Thai Binh watershed. Project proposal, June. VIWRR/MARD, 1999. No further information is provided on how the stated conversion rate was caluculated.

Figure 19: Map - RRD Major Irrigation and Drainage Schemes

1. Bac Hung Hai	11. Xuan Thuy	21. Bac Duong
2. Nam Thanh	12. Hai Hau	22. Song Cau
3. Chi Linh	13. Song Nhue	23. Nam Yen Dung
4. An Kim Hai	14. Phu Sa	24. Soc Son
5. Kim Mon	15. Ba Vi	25. Lien Son
6. Bac Thai Binh	16. My Duc	26. Nam Ninh Binh
7. Nam Thai Biinh	17. Thuy Nguyen	27. Bac Ninh Binh
8. Bac Nam Ha	18. Tien Lang	28. Yen Lap
9. Nam Ninh	19. Vinh Bao	29. Uong Bi
10. Nghia Hung	20. An Thuy	30. Dong Trieu

Irrigation and Drainage

The delta currently has thirty major mostly pumped irrigation-drainage schemes with a total design area of 750,000 ha for irrigation and 990,000 ha for drainage (Figure 19).

In addition to the two large hydropower reservoirs, there are 36 smaller reservoirs with a capacity of 400 million m^3 irrigating 39,000 ha*(Figure 1).

In the mountains, there are nearly 900 medium and small reservoirs, 1200 weirs, and 450 small pumping and hydropower stations, irrigating 100,000 ha of winter-spring rice and 210,000 ha of summer-autumn rice.[39]

[39] Red River Basin Profile, June 1999.

Delta Water Balance

In the delta below SonTay, currently flows are adequate to meet water demand throughout the year.

At the irrigation demand peak in January, reliable flow is over twice the total estimated total demand.[40] At the river flow minimum in March, the ratio of reliable flow to total demand rises to about four.[41] Releases from the Hoa Binh and Thac Ba reservoirs play a key role, accounting for on the order of a third of low flows.[42] Localized water shortages and conflicts between users occur, but overall water availability is adequate to meet overall current demand.

Groundwater

Basic information about groundwater in the basin is presented in the RRB Profile (p32-33) and the WSR (p14-16). More detailed information is not readily available. Groundwater wells are subject to registration, but beyond this there are no management interventions, such as allocation or systematic monitoring. A case study of groundwater exploitation in the midlands is presente d in Section 5.2.

[40] In January, total demand is about 660 m^3s^{-1}, consisting of about 30 m^3s^{-1} in domestic and industrial demand (steady year round), and about 630 m^3s^{-1} in irrigation demand. January reliable flow is 1400 m^3s^{-1} as represented by the 85 percent low discharge at Son Tay (ie in an average January, average daily flow exceeds 1400 m^3s^{-1} for 26 days of the month).

[41] In March, total demand is about 300 m^3s^{-1} and 85 per cent discharge at Son Tay is 1270 m^3s^{1}.

[42] Before the Hoa Binh dam, the 85 per cent low discharge at Son Tay was 900 m^3s^{-1}.

5 Selected Land Use and Water Management Issues in the Red River Basin

5.1 The Role of Water in Well-Being and Sustainable Livelihoods – Mountains

Issue

Future development in the northern Mountain zone faces will be a many-stranded process. The focus here is to understand the role of water in achieving sustainable land use and improved well-being of rural mountain households, and how improved water resources management can contribute, within the context of ongoing changes in land management systems related to land tenure allocation and afforestation.

Discussion

Role of Water& Water Resources Development in Well-Being of Mountain Communities

The Participatory Poverty Assessment (World Bank, 1999) highlights the key importance of access to some irrigated land and an adequate domestic water supply, to sustainable land use (in particular erosion control) and household well-being. But achieving effective natural resources management faces difficult challenges: very high slopes, limited existing transport and communications infrastructure, very high levels of biophysical and ethnic diversity, and high levels of poverty, illiteracy, and population growth. Indeed this area has been described as in a "development crisis" (Jamieson et al., 1998).

The main thrust of development assistance currently to mountain communities,[43] is to community-driven and participatory design of integrated poverty reduction activities. Thus, irrigation improvement and expansion, and rural water supply are being financed by communities and Government/donors in partnership, on the basis of communities' own self-generated development plans. In this methodology, communities themselves decide if upgrading water resources infrastructure is their priority for development. Whereas engineers tend to regard upgrading locally constructed water control infrastructure as an investment

Figure 20: Photo – Community water management: seasonal weir, Yen Bai province

[43] Vietnam Northern Mountains Poverty Reduction Project. Aide-memoire, third preparation mission, March 2000.

Figure 21: Photo - Terraced Fields, Sapa, Lao Cai province

priority, [44] (Figure 20), local people themselves may place a higher investment priority on paving a road or upgrading education or health.

The appropriate role for central and provincial government water resources planners in such a process is to provide technical backstopping, training, and information to communities, to help them develop local capacity for very small scale water resources quantity and quality management. An approach along these lines is being provided in Yen Bai province with Bread for the World support, to help to set up and train Water User Associations.

In this model, water resources infrastructure investment is driven less and less by provincial engineers, and more and more by water user groups with technical backstopping from engineers and others.

In some areas, the only source of domestic water is rainwater harvesting. An example is Northern Ha Giang where perennial surface water is limited and groundwater lies at around 200m.[45]

Afforestation

Afforestation of degraded uplands is receiving enormous attention and investment. There are two direct implications for water management - firstly, changes in deliveries of erosion products to water bodies, and secondly, changes in quantity and quality of runoff.

Erosion: Afforestation does reduce erosion, but with a couple of caveats. (1) Afforestation *activities* can disturb the afforested area and cause an increase in mobilization of soil and other materials. The leading example of this is road-building and traffic in formerly remote areas, which can have massive erosion impacts. (2) Even after afforestation has reduced mobilization rates, this may not change the amount of material reaching a particular water body until after a delay of some time. This is because once materials are mobilized, they keep moving down the system, a process that can take years or decades. Stopping further mobilization at the source area does not remove this already-moving material from lower parts of the system.

Changes in runoff: It is often assumed that afforestation will improve runoff characteristics– that it will moderate peak (flash flood) flows and enhance base flows. Field studies of real forested and deforested areas show that the situation is rather more complicated than this. The

[44] Yen Bai DARD Irrigation Subdepartment has an enormous number and value of irrigation schemes on the books for rehabilitation and development, for example, well above imaginable funding levels.

[45] FAO/IFAD "support project for highland development in Ha Giang." [UNDP library Hanoi.]

impact of afforestation on runoff depends on a number of watershed characteristics, not all of them fully understood. The behaviour of tropical forests is an area of active research.[46]

Land Use Changes on Production Forest Lands

Long-term tenure of so-called production forest land (lower elevations and slopes) is being given to farmers, and they are being encouraged and supported to convert land use to cultivation of crops such as corn, coffee, tea, and cinnamon (to name a few), to agroforestry systems such as steep-contour farming, and creating new terraced fields for wet-rice cropping.

It is difficult to make any blanket statement about the implications of these land use changes on water resources and water resources management. It would appear that there is much farming-systems work to be done to understand, optimize, and ensure sustainability of these approaches.

5.2 Rapid Uncontrolled Groundwater Irrigation Development - Midlands

Issue

When economic incentives are strong, groundwater extraction capacity can develop extremely rapidly. If in such situations groundwater exploitation is not effectively regulated, the social and economic costs can be very high. In particular, current investment in groundwater-dependent economic activities can be jeopardized and safe domestic water supplies can be compromised. This in turn can cause severe negative impacts to livelihoods and well-being of families engaged in groundwater-dependent farming as well as those who rely on groundwater for drinking.

Introduction

During a field visit to Bac Giang province in March 2000 by members of the Study team, DARD officials indicated that groundwater wells were being developed to irrigate hill agriculture (orchards and so on) They indicated that they have a list of wells that have been registered with DARD, but they did not know how complete the register was, and had not analyzed this information from a resource management perspective.

Study team members returned to Luc Ngan and Hiep Hoa districts of Bac Giang in April 2000, and talked to farmers and drillers about expansion of groundwater irrigated litchi orchards. The information in this section reflects these discussions, complemented by other information sources.

History of litchi cultivation in the midlands

By about ten years ago, large areas of the midland hills were in a degraded condition as a result of deforestation followed by neglect or inappropriate land management practices. Numerous reforestation and upland cropping systems were tried. For many of these approaches, benefits were found to be limited. Some had adverse effects (for instance, eucalyptus which interferes with soil fertility).

Recently litchi horticulture was shown to be an extremely lucrative activity – initially by farmers who had migrated to the midlands from Hai Hung, an established litchi area. As a result, over the last five years or so, litchi area has expanded extremely rapidly in the midlands.

[46] Water-resource and land-use issues. System-Wide Initiative on Water Management, Paper No. 3. Intl. Water Management Inst., Colombo. I.R. Calder, 1998. Many thanks to Alf Birch for this reference.

In addition to litchi, other irrigated and unirrigated crops are grown on the lowlands and uplands in the midlands, but litchi appears to have been a key driving force behind recent rapid groundwater development.

Litchi plantation in Luc Ngan

As of 1999 in Luc Ngan district, the litchi area was said to be about 6000 ha, virtually all of it established over the last five years or so, and much of it within the last two or three. About 80% is irrigated from groundwater and the rest from surface water.

Plantation density

Litchi plantation density is about 200-400 trees per hectare.

Irrigation requirement

The irrigation requirement for litchi cultivation is four times per month over three months, from 15 January to 15 April, with 0.2 m^3 per litchi tree each time. This works out to about 0.1 $l\ ha^{-1}s^{-1}$ (2.4 m^3 per tree per season, about 800 m^3ha^{-1} or 80mm). This is on the order of 60,000 m^3day^{-1} during the three-month irrigation season, or 18,000 m^3day^{-1} averaged over the whole year.

Scale comparison to urban domestic water withdrawals reported for RRB cities

For purposes of scale comparison only, this rate (60,000 m^3day^{-1}) is comparable to the reported pumping rate for Tam Diep town water supply, and about twice the rate for Dong Anh – Soc Son. [47]

Number of wells, number of well drilling crews, drilling depth and cost in Luc Ngan

Luc Ngan district has about 10,000 small groundwater wells, many or most of which were drilled within the last two to three years. Each well irrigates about 0.5 ha.

Figure 22: Photo - Litchi plantation on eroded bare land, Luc Ngan district, Bac Giang (Dao Can, April 2000)

[47] Red River Basin Profile. RRBWRM ADB TA2871, 1999.

Local people report that they pay about VND1.3 million (USD92) to get a well drilled to 30-35 m depth. The district currently has 200 mobile drilling crews (!), who use very simple drilling equipment.

Future prospects

Groundwater development in Luc Ngan and similar midland areas looks set to continue at a rapid pace until economic returns on litchi cultivation falter, land to expand litchi cultivation runs out, serious problems with groundwater supply develop – or there is regulatory intervention to protect the aquifer. When and how the litchi boom will end is not yet clear, but low prices in 1998 followed by interventions to support prices this year suggest that the boom has reached a mature stage in which interventions to manage supply and grow demand (eg increased processing and/or exports) will become increasing important (see box).

Conclusions

Litchi cultivation in the midlands illustrates the rapidity with which groundwater extraction capacity can be developed when economic incentives are strong.

High priority should be given to immediate development of an effective regulatory response, focusing first on areas of rapid groundwater development. Failure to regulate in such areas could jeopardize investment in groundwater-dependent economic activities and domestic water supplies, and result in mining of the aquifer. This would severely impact livelihoods and well-being of families engaged in groundwater-dependent farming and those who use groundwater domestic supply.

Figure 23: Photo - Groundwater well for litchi irrigation, Luc Ngan district, Bac Giang (Dao Can, April 2000)

Litchi Supply/Demand Management, 1998-9

"The litchi growers of northern Vietnam, particularly in the fruit's heartland of Luc Nan district in Bac Giang province, have been getting some extra money this season.

"Last year consumers were able to buy litchis at around VND6000 per kilo.

"The current street price is around VND16,000-18,000 per kilo, and may stay the same until the end of the season.

"According to Lao Dong newspaper, there are two reasons.

"After last season's glut, litchi growers have kept much of their produce off the market so far.

"And second, the Ministry of Agriculture and Rural Development has been underwriting the purchase of litchis for a local processing industry"

– Viet Nam News, 7 June 2000

5.3 Land Use Changes and Canal Lining Program – Basinwide

Issue

Canal lining currently represents a key element of modernisation efforts within the irrigation sector in Vietnam. The GOV through policy directive No. 15-NN-CS/CT established the guidelines for Government support to this initiative, which promotes lining of irrigation canals at main, secondary, and tertiary levels.

This national programme provides an excellent case study of an existing basin-wide water resources management strategy that is intended to support land use change, ie intensification and expansion of irrigated cropping.

Has the canal lining programme been an effective strategy? What are its strengths and weaknesses? Concern has been expressed that indiscriminate application of this approach regardless of setting has been to the detriment of other, more effective options.

Discussion

Canal lining is intended to reduce pumping costs (by reducing water losses due to seepage and spill); improve the delivery of irrigation water to farmer's fields (increase amounts and reduce system transit times); and to improve cost recovery and equity (by reducing unsanctioned water withdrawals).

MARD's canal lining plan for provinces from Bac Giang to Ho Chi Minh City, during the period from 1997 to 2005, has a total budget of VND5.2 $x10^{12}$ (USD370 million, or USD46 million per year over the eight year period). The programme targets are to line 41,600 km of canal irrigating 1.04 Mha; this will require 17 Mm^3 earth excavation, 7.3 Mm^3 masonry brick, and 0.7 Mm^3 of concrete.

The success of the programme is typically measured in terms of the number of kilometres of canal lined annually.

Researchers in La Khe Irrigation and Drainage Project within the Song Nhue scheme (see Figure 19), one of the larger schemes in the RRD, have found that canal lining is not resulting in improved water management, because the canals have other problems, that canal lining does not address, such as inadequate capacity, inadequate grade, and absent or ineffective water control structures. In these cases, lining alone cannot improve system performance. [48]

Another problem that has been observed is rapid deterioration of the lining, accompanied by rapid increases in canal seepage. Factors that affect canal lining durability and effectiveness include soil mechanical characteristics, water table fluctuations, and construction quality, all of which are highly variable with local conditions. A comprehensive monitoring program at locations covering the range of local conditions would enable engineers to determine the relationship between lining performance and local factors.

An alternative to the blanket application of canal lining would a multi-pronged intervention, including:

- Judicious improvement of limiting sections of infrastructure
- Introduction of effective hydraulic control
- Improved operations, based on
    (1) improved flow measurement ,
    (2) more direct communication between irrigation companies and farmers about actual crop area (increasingly important as diversification proceeds), and
    (3) improved use of collected data

All the foregoing does not mean that canal lining is never appropriate. The challenge is to create planning processes that identify canal lining as the most efficient intervention, when in

[48] Malano, Hector, Nguyen Thuan Anh, and Ha Hoc Ngo, 1998: Integrated water management in pumped irrigation systems in the Red River delta of Vietnam – final report. Australian Center for International Agriculture Research (ACIAR) Project No. 9404. Draft. This document is the source of much of the information in this section.

fact this is the case; and identifies alternative or complementary interventions when these will provide greater returns for unit investment.

5.4 Agricultural Diversification in a Major Irrigation Scheme – Delta

Issue

Response of a major irrigation scheme (Bac Hung Hai or La Khe) to ongoing agricultural diversification

A great deal of work has been done on and in the existing irrigation schemes of the Delta. How are these schemes responding to agricultural diversification? What types of changes are going on in agriculture land use? What has been the water resources management response, in terms of infrastructure development, operational improvements, and community participation?

Discussion

In the spring rice season, crop diversification to vegetables, fruit, and flowers is increasing in some irrigation systems close to the Hanoi urban market. Simulations were undertaken in the La Khe system to determine the impacts of crop diversification (an equal mix of maize, pulse and leaf vegetable crops on suitable soils and elevations, planted in late January/early February; using average weather conditions and calculated crop water requirements).

In this simulation, seasonal water demand was significantly reduced, because the non-rice crops do not require land soaking / soil saturation prior to cultivation, nor water to maintain ponded conditions with percolation losses.

The greatest proportional reductions in water use were in the upper half of the system, because the proportion of non-rice crops that can be grown at the lower end of the system is limited by elevation and heavier soils. In general, the reduction in seasonal water use in per cent is proportional to, but a bit lower than the level of crop diversification in per cent.

Though the quantity of water required is less, the timing of application is much more critical for non-rice crops. Once rice fields are ponded, water is available to the plants as they need it; there is considerable flexibility in irrigation timing to 'top up' the ponded fields. Delivery of irrigation water to non-rice crops is much more time-critical in the absence of an on-field source of water.

Agricultural diversification is seemingly still at an early stage in the basin and primarily farmer-led in areas closest to urban markets. A key constraint to diversification is the very strong preference for rice cultivation, even when returns on other crops would be higher. This is probably due primarily to the subsistence nature of farming for the vast majority of farmers, and their low risk tolerance given their high vulnerability to damage from hazards etc. plus low margin of household safety with respect to crises. To the extent this is the case, reductions in rural poverty and vulnerability, along with the growth of urban markets, would likely unleash much untapped economic potential of non-rice crops. Important but probably lesser factors constraining diversification relate to limitations in extension services and availability of seeds etc.

5.5 Encroachment on Water Control Infrastructure – Delta

Issue

MARD has expressed concern about encroachment on water control infrastructure in the Delta. This issue was included to highlight the fact that land use issues come in all sizes, from the very extensive (mountain forestry) to the very detailed (encroachment onto dykes, water control structures, river floodways, protection forests around reservoirs).

Discussion

Encroachment can be classified as follows:

- Construction of buildings in the Red River safety corridor outside the flood protection dikes

- Filling drainage channels to extend adjacent or create new plots of land, especially in urban and peri-urban areas

Figure 24: Photo - Poor farming family's house, Tien Hai district, Thai Binh province

- Clearance/logging of protection forest around existing reservoirs
- Building of unauthorized permanent works in river floodways (eg Day River)
- Mooring boats on embankments

The motive for a person or group to encroach occurs when incentives outweigh disincentives. The main incentives are (1) free or low-cost access to land in areas where legitimate access is expensive or otherwise difficult (due to land registration procedures or social factors), and (2) the income that is generated as a result of encroachment. These incentives may be heightened by implicit subsidies eg if compensation for flood damage to property is provided to owners of buildings on encroached land, or legal logs are taxed but illegal logs remain outside the system.

The main disincentives are (1) informal / community / participatory social sanctions and (2) official enforcement leading to dispossession, fines, or other adverse consequences. Informal social sanctions depend on building up awareness in society about the adverse effects of encroachment – that it can reduce flood protection, increase drainage problems, harm infrastructure either directly or by preventing necessary maintenance.

The mechanism for formal sanction of encroachment has historically been weak in Vietnam, but a key provision of the LWR is Inspectorate on Water Resources, which is empowered among other things to sanction encroachment. The Inspectorate should probably look at options additional to direct enforcement, that would involve water user groups or local communities in infrastructure protection.

5.6 Special Problems and Opportunities of the Coastal Zone

Issue

The coastal zone faces a number of special problems and opportunities, many of which have a water management dimension.

Discussion

The coastal zone of the delta is affected in various places by salinity intrusion in the rivers; saline groundwater; saline soils; actual and potential acid sulphate soils; sandy soils; and high

winds and seawater flooding during typhoons. In some areas, rainwater is the only source of drinking water. Some affected areas are as a result, extremely poor (Figure 24)

Figure 25: Photo - Sea dike, Tien Hai district, Thai Binh province (Dao Can, 2000)

Methods for dealing with problems related to saline water and soils have included flow augmentation from upstream reservoirs (ie Hoa Binh), river embankments and water control structures to keep saline water out of drainage channel networks and to prevent saline river flooding, development of irrigation water supplies from further up the river systems here water is sweet, flushing of saline soils during land preparation, salt tolerant rice varieties and so on.[49] Careful water management is also key to farming on potential acid sulphate soils.

The enormous investment in sea dykes (Figure 25) has greatly reduced cyclone damage, but risks are still high and act as one of the key constraints to rural development.

In sandy areas, reclamation for agriculture has been pursued aggressively.

Basic and needed water management improvements in coastal zone relate, here as elsewhere, to rehabilitation of existing infrastructure, improved operation and maintenance, and increased local participation through water users associations or similar structures.

Despite its many problems, the coastal zone affords a number of strengths, and development opportunities naturally key off these: shrimp and crab cultivation (Figure 26) (water management conflicts with rice cultivation are a problem); tourism (eg Xuan Thuy and Tien Hai protected areas); and natural wetland productivity, which is substantial if often underestimated.[50]

[49] A study of saline intrusion before and after Hoa Binh found reduced intrusion distances (eg Thai Binh from 25 to 20 km, Van Uc river from 23 to 19, Tra Ly river from 18 to 14 km,

[50] Nielsen, Sanne S., Anita Pedersen, Le Trong Trai, and Le Dinh Thuy, : Local use of selected wetland resources, Cua Day estuary, Red River Delta, Vietnam. Zoological Museum, University of Copenhagen and Wetlands International – Asia Pacific in conjuction with Forest Inventory and Planning Institute and Institute of Ecology and Biological Resources. [bivalve & mollusk collection. 200,000 person days spent annually to collect 1600 tons of bivalves and 30 tons mud crab from 3350 ha area. Collectors 56% women, 32% children, 12% men. Copy at UNDP library Hanoi.]

Figure 26: Photo - Shrimp breeding ponds in Thai Thuy district, Thai Binh province (Dao Can, 2000)

5.7 Future Trends in Urban Water Demand – Urban Zone

Issue

A key concern for water resources managers is to forecast future water demand for different categories of users. One such category is urban water supply. In the Red River basin, how quickly will urban demand grow and where; and what are the implications for water resources management.

Introduction

Urban water supply is of particular interest for several reasons:

- Domestic water supply (both urban and rural) is key to public health, and for this reason is virtually always identified as the highest priority beneficial use
- Urban water supply includes water supply for industries, commercial users, and government offices in urban areas, which are key to national security, economic performance, and employment, and again for these reasons is normally identified as a very high priority beneficial use
- Urbanization is occurring at a fairly high rate in Vietnam, and substantial increases are expected in urban water demand

The information that appears in this Study concentrates on concepts related to the issue of most concern to water resources managers: how much of the water resource will be withdrawn in future years for the purpose of urban water supply.

For additional information on urban water supply in Vietnam, the reader is referred to the massive overview of the national urban water supply situation prepared in the mid-1990s.[51] In addition, information is available from a large number of donors (12 are mentioned in the study just cited) that are involved in supporting the urban water supply subsector.

[51] Municiapl and industrial water supply and disposal – accommodating growth. D. Boggs, 1995. In: Selected working papers, Vietnam Water Sector Review, WB, ADB, FAO, UNDP, and NGO Working Group, 1996.

Domestic Water Consumption[52]

Domestic water consumption – ie the amount of water consumed per person-day – is a function of (Table 2):

1. How water is brought to the household,
2. The number and kind of plumbed appliances/uses in the home in the case of piped systems.

As the numbers show, water consumption is highly elastic at low income levels: consumption doubles or triples when a single tap is provided within the home.

Components of Urban Water Supply

Urban water supply is typically broken down into the components as shown in Figure 27. Residential use is in some cases subdivided into interior (toilets, showers, laundry etc.) and exterior (gardens, lawns, etc). Government water is used by government buildings, in fire-fighting, and so on. Commercial water supply is used in stores, offices, hotels, restaurants, etc.

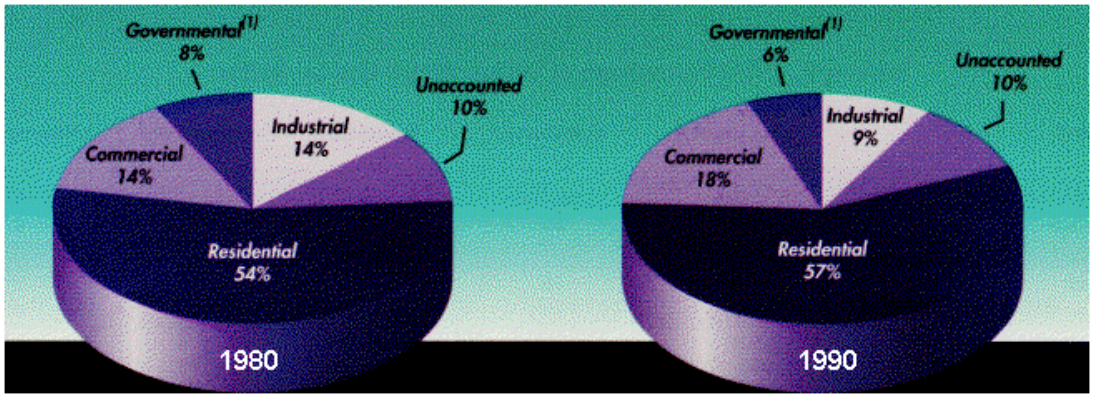
Internationally, urban industrial supply is usually considered to be a subcategory of urban water supply. In Vietnam, by contrast, industrial water supply tends to be considered separately from urban supply, probably because industries in Vietnam tend to pump their own water from surface or groundwater sources, rather than connecting to the city piped system.

Table 2: Water Consumption per Person-Day

Category	Requirement liters/person-day
Survival	2 – 4
Water carried by household members; excludes water brought by water carriers on a commercial basis, and laundry water	22 –27
Water carried by household members, plus water used for washing clothes at the water supply point	40
Dwelling with a single tap and limited plumbing	75 –90
Middle class apartment	130-140
High income, detached/semi-detached house with cars, garden irrigation, etc	250 +

[52] Harry Giles, Urban Water Supply Expert, is gratefully acknowledged as the source of the sections on water requirements, UFW, and leaky systems. These are in turn based on a key reference work for water supply, in developing countries: Water Supply, by A.C. Twort, F.W. Crowley, D.D. Ratnayaka, and F.M. Law , 1997. John Wiley & Sons. January .

Figure 27: Components of Urban Water Use - Example of California USA[53]



Unaccounted for Water (UFW)

Unaccounted for Water (UFW) is defined as the difference between the measured or estimated inputs to a system and the measured and estimated outputs from the system. UFW is normally determined between defined boundaries - usually from the supply meters through to the customers' meters, although the boundary can be extended to the water treatment plants inlet.

In the developing world, UFW is enormous and can be significantly greater than the accounted-for water. Typical of developing country systems would be the Manila and Jakarta systems in which UFW is 55-60 per cent.[54] Some systems could have UFW as high as 70per cent (NB this means 100 liters must be pumped into the system for every 30 liters withdrawn by a consumer – supply is over three times demand). Some developing country cities, such as Bridgetown Barbados and Blantyre Malawi, have well-kept systems that are comparable to those in the developed world; UFW in such systems is on the order of 3 -4 litres per connection-hour or 10-20% of total water input to the system.

UFW has two components:

- *Physical Losses* (leakage) refers to water that escapes and is lost to the system and goes into the ground. It occurs in transmission mains, trunk mains, service mains and the distribution system.
- *Non-Physical Losses* (NPL) refers to water that is consumed but not accounted for; and usually does not generate revenue. NPL consists of theft, meter errors, administrative errors, misappropriation etc (see Table 3).

UFW Audits

A realistic estimate of the causes and extent of UFW requires a careful audit to be carried out. In normal (continuous supply at normal pressures) systems the various components are evaluated by means of tests, studies, reference to records and so on. Sample studies of various areas are normally used and the results extrapolated to describe the total system. A closing figure (difference between the UFW derived from meter readings and the sum of the various individual components) of !10% is normally acceptable. Subsequent audits following more comprehensive and larger scale studies would bring the difference to, say !5%., or better.

Intermittent, low pressure systems bring particular problems that combine to make UFW audits difficult, expensive and time-consuming. The main problems of intermittent, low–pressure systems are the lack of controls on customers' supplies, and the presence of storage tanks.

The only realistic method to carry out a UFW audit on these systems is that based upon the work carried out by TATA Consulting Engineers in Madras in the late 1980s and since used elsewhere in several large urban systems. A small section of the distribution system, typically

[53] From Ch. 6, Urban Water Use, in: Bulletin 160-93, The California Water Plan Update, October 1994. Online at http://rubicon.water.ca.gov/v1cwp/uuse.html .

[54] Urban Sector Strategy. July, 54 pp. ADB, 1999

Table 3: Urban Water Supply - Non-Physical Losses

Type	Subtype	Comments
Free use	Municipal	Street washing, park irrigation
	Water authority	Mains cleaning, repairs and maintenance eg distribution system, pumping station bleeds, sedimentation and filter water etc
	Fire fighting	Fire fighting, hydrant flushing programmes
	Special cases	Could include: religious buildings, armed forces, government buildings and institutes, water utility employees, ex-service men, etc
Meter problems	Supply meters	Under reading =higher UFW levels Over reading = lower UFW levels
	Consumer meters	Under reading =higher UFW levels Over reading = lower UFW levels Faulty meters Tampered meters Meters not working Incorrectly installed and sized meters Meter not installed
Administrative problems	Billing procedures	Meter not registered Account not current Meter readings incorrectly recorded Incorrect billing Meter Reader fraud Water Tanker Operator fraud
Misappro-priation Theft	Connections Hydrants	Illegal Meter bypassed

100-200 connections, is isolated from the remainder by installing control valves. Control devices are then installed on each consumer's supply. All control devices are closed and the system fed with a measured supply from a suitable source (water tankers were used in Madras) to provide an indication of physical losses. Various dedicated surveys and activities eg installing meters accompany these procedures. Other activities are also carried out such as repairing all identified leaks and re-testing. These procedures would stretch the resources of many large urban water utilities and are often handed over to consultants and contractors to carry out the works.

Quantity Problems in Low Pressure, Leaky, Inadequate-Supply Systems

Supply is inadequate to satisfy demand in many urban areas in the Third World. This results in intermittent, low-pressure supplies in which water does not rise above pavement level. This has numerous negative consequences:

- Consumers may rely on underground storage that is either dipped or boosted to an elevated tank. Control devices to the underground tank may be removed or left open to take advantage of any supply. Then when water does come, tanks fill and then overflow – and water is lost.
- Stale, stored water remaining at the start of the next supply period may be thrown away to allow fresh water to be collected.
- Consumers may abstract water directly from the mains using their own pumps.
- Taps of public standpipes may be removed. At the extremities of the distribution system, users may cut standpipes down until, in extreme cases, holes will be knocked out of the bottom of the water main to allow the last drop of water to be drained out.

- Calculation of UFW becomes complicated and inaccurate – how much water is being lost from overflowing storage tanks?

Then, if improvements are made and water is added, pressures will increase but losses will increase even faster, draining off much of the incremental water. This is because leakage is sensibly proportional to the square of the mains pressure (not the square root as one might expect), and so increases rapidly with pressure. The increased water input to the system will not vastly increase deliveries to consumers until the system has been brought up to a suitable standard.

Low pressure systems rapidly deteriorate because the expectations of them are low. Thus installations, both water utility and customers, are badly installed and maintained because the system demands no other:

- Low-pressure drainage pipes may be used instead of high-pressure water mains
- Repairs are made with substandard materials and workshop eg leaks may be fixed by wrapping pipes with vehicle inner tubes
- Entire systems may have only a few control devices on customers' supplies
- Contractors and others make unofficial low-quality repairs that remain invisible to system managers until pressures are increased, or, in extreme cases, no repairs are carried out to minor damage

Quality Problems in Low Pressure, Leaky, Inadequate-Supply Systems

Low-pressure leaky systems are also vulnerable to gross contamination from back-siphonage mechanisms, especially, as is often the case, mains and services are laid through sewage-laden ditches and ponds. Any zero pressure states (worsened where water is abstracted from the mains by pumping) allow external water to be induced into the system through points from which water would exit when the system is pressurised. These points include leakage points, hoses connected to taps, inlets to tanks, etc.

Forecasting Future Population For Urban Water Supply Planning Purposes

Future population for urban water supply planning purposes can be estimated based on historical statistical data and development plans, if these are available and accurate, realistic, and bounding is appropriate (ie 'urban' is the administratively/statistically defined appropriately for water supply development planning). Where information is not available, or its accuracy/realism/bounding is in question, current population can be estimated by counting the number of dwellings of different standards multiplied by the estimated average occupancy, the latter estimated on the basis of sample household surveys.

Forecasting Actual Future Water Withdrawals

As should be clear from the foregoing, from the water resource manager's perspective, forecasting how fast water withdrawals by urban water supply systems will increase in the future is rather complex:

1. What proportion of urban population will be served?
2. For the residential component, how fast will water consumption per capita increase? This will depend strongly on the reliability of supply, social and economic systems, and the extent of sewerage systems.
3. What will be the ratio over time of residential use to other types? Industrial and commercial demand in general will not, in general grow, in constant proportion to urban population. Forecasting of industrial and commercial demand requires more sophisticated tools such as systems engineering models.[55]
4. What will the ratio of total withdrawals (S) to consumption (C) be? [S=C+UFW -> S/C = 1+UFW/C]

[55] See p. 32, Water resources in Vietnam. Mei Xie and IWRR, 1996. In: Selected working papers, Vietnam Water Sector Review, WB, ADB, FAO, UNDP, and NGO Working Group, 1996.

Urban water supply in Vietnam in 2020 could be predominantly very leaky, low pressure intermittent systems with partial coverage in the larger urban centers only – ie much as it is now, with some expansion – or it could be well-kept systems with full coverage in all *de facto* urban areas. Though the Ministry of Construction has prepared perspective plans for investment in urban water supply development, there is a need to distinguish MOC's plan-as-target planning vs. the plan-as-forecast planning that will be needed by MARD water resources managers. Implementation issues such as what the investment profile in urban water supply is likely to be over time given the constraints on absorptive capacity and funding, should be considered.

6 Implications for Red River Basin Planning and Management

6.1 Introduction

Chapter 5 introduced and discussed a range of representative issues that involve the interaction of water and land use. These are generally complex and require the involvement of more than one ministry, agency or province to plan solutions and execute them, and to undertake ongoing management. For instance, the issues facing mountain communities (see Section 5.1) involve management (or lack of it) of a number of natural resources, including forests, water and the environment, within the jurisdictions of a number of agencies and provinces.

The existing institutional arrangements are inadequate to provide the most effective solutions to the problems faced. In particular, effective mechanisms for coordination and collaboration among agencies at central and provincial levels are lacking. This has been recognized by the government, which sees that the establishment of such bodies as the National Water Resources Council and river basin organisations (for the major river basins in Vietnam) as high priority.

6.2 The Role of the Red River Basin Organisation

As has been stated, the coordination of the existing powers and responsibilities of numerous governmental and some non-governmental organisations in the Red River Basin is vitally necessary for the improved management of the water resources, and in particular to address the kinds of issues which were the subject of this Management Study. The Red River Basin Organisation (RRBO) will be essentially a mechanism for coordinating activities that are not adequately coordinated at present, in order to ensure that water resources (and related natural resources) are developed and managed most effectively.

The Red River Basin Commission (which together with its Technical Office, will comprise the RRBO) will meet to deliberate on and agree to priorities for addressing water resource management issues, and river basin planning proposals for the Basin. During these meetings and in associated discussions, each representative will have the opportunity to promote the interests of his or her organisation, negotiate on issues of importance and better understand the position and interests of other stakeholders.

The Red River Basin planning system, described below, is central to the activities of the Red River Basin Organisation. It will be the means whereby the decisions, policies and aspirations of the stakeholder representatives can be put into effect. The RRBO will be responsible for development of plans, their review and submission to Government for approval. Because the RRBO will have no executive powers, it will not be able to approve or enforce the plans without prior approval of Government, either through the Minister of MARD or the Cabinet.

6.3 Basin Planning

The planning process that is to be managed by the Red River Basin Organisation will result in a comprehensive and effective tool for integrated management of the water resources of the Basin. The Red River Basin Plan (see Figure 28) is seen as distinct from traditional master planning. Master plans usually identify a range of development projects and to some extent identify the interactions between the development projects and other water sector issues. Such plans are ***development*** tools[56].

The Red River Basin Plan is not static. It will be a plan or planning system that acts as an ongoing water resources ***management*** tool. It is essentially the type of plan that guides decisions, which may be decisions about (for instance):

- the operation of major schemes to maximise all-round benefits and minimise all-round disbenefits;
- the application of water allocations or the implementation of water quality controls;
- the guidelines for permitting excavations in rivers or for protecting riverine vegetation;

[56] Note that a Master Plan for the Red River Delta has already developed with the assistance of the World Bank.

- agreed decisions which provide an equitable outcome for different areas, such as neighbouring provinces.

The planning system may also be used to define, on a broadly agreed basis such matters as:

- where expenditure priorities lie and how they will be implemented;
- how national pricing and cost-recovery policies should be applied in the Basin or in different parts of the Basin.

The Red River Basin Plan will consist of a number of components as shown in Figure 28. Firstly, and most importantly, is the "integrated framework plan", which sets out the objectives for management of the Basin, strategies to achieve those objectives, policies, standards and so on. It will also identify the key water resource management issues for the Basin and their priorities. Secondly, there will be a series of "component plans" related to resource management, which will cover areas like flood control, groundwater management, water allocation, and so on[57]. Thirdly, there will be component plans dealing with resource development and service delivery, covering such areas as irrigation, hydropower and urban water supply. Fourthly, plans may be developed for subbasins or catchments[58] within the Red River Basin that deal with a range of issues related specifically to that hydrologic planning unit.

These last three groups of component plans will go into greater detail in specifying objectives and strategies, and will also include an action agenda for that component or subbasin/catchment. These objectives, strategies and actions will, of course, need to follow from and be entirely consistent with the integrated framework plan.

Issues related to water and land interactions and their management are likely to be identified in all three groups of components proposed above. For instance, the "groundwater component plan" should identify rapid uncontrolled groundwater irrigation development (Section 5.2) as a high priority issue for the Basin and incorporate integrated water resource management strategies and actions to address the problem.

[57] These areas are sometimes referred to collectively as "stewardship".

[58] Note that the term "subbasin" is normally used to describe a fairly large tributary system within a river basin, while a "catchment" (or "watershed" as it called in the United States and elsewhere) usually refers to a smaller hydrologic unit one or a small number of streams.

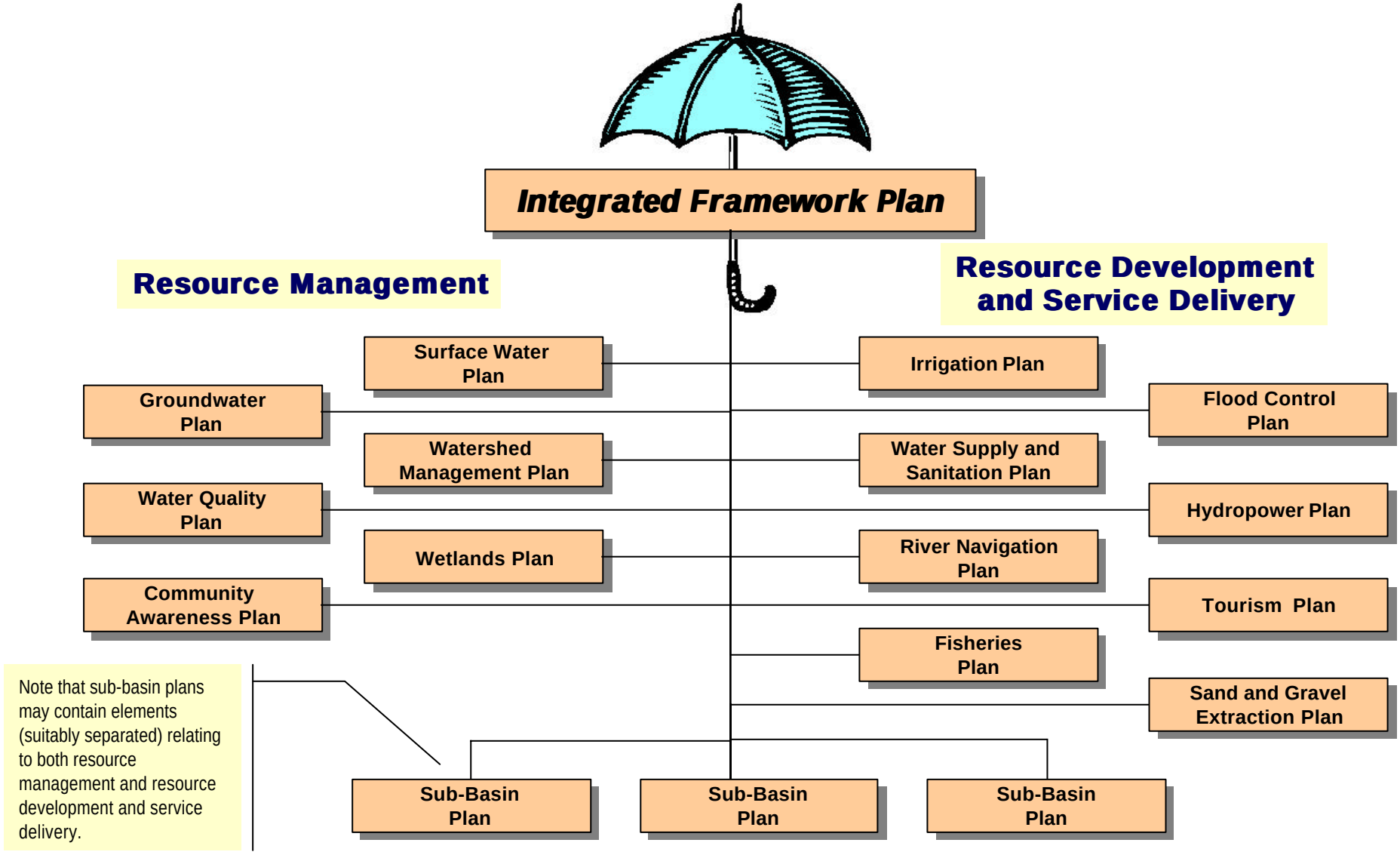


Figure 28: Schematic Diagram of Proposed Red River Basin Plan

7 Observations and Recommendations

1. *Observation*: The central planning model still informs Vietnamese water resource managers' ideas about water resources planning. At the same time, there is an awareness that planning methods in water resources need to be improved. Relatedly and at a more practical level, international and Vietnamese experts use the same words (planning, water balance, land use, etc) with at times quite different understandings of the underlying goals, processes, and outputs.

   There is a need

   a. To develop a better shared understanding of the similarities and differences among (modified) central planning vs. Western-style assessment, forecasting, and strategic planning; and

   b. To strengthen Vietnamese understanding and skills in the latter.

> ***Recommendation*:** A study of recent examples of regional and basin water resources plans from developing Asia could usefully be undertaken.[59] This would then lead into a training activity for MARD water resources planners as well as other stakeholders. This group would undertake to compare and contrast the different planning approaches with each other *and with Vietnamese plans of various types*. Time should be taken in the training carefully to explore terminology and concepts. This exercise should be led by one or more experts who have recently managed the preparation of successful regional/basin plan(s) in developing Asia. Inviting foreign experts (from any discipline) having extensive Vietnam experience (and if possible Vietnamese language skills) to participate would be ideal.

2. *Observation:* Many of the issues brought up by the project Working Group and Vietnamese counterparts with respect to this Study, would best be dealt with in the context of a strategic water resources planning exercise for the basin.

   This undertaking should however be planned carefully, because

   a. Considerable work has been done already for this basin,

   b. Strategic water resources planning is in an active state of development internationally, with many existing examples of successful and not-so-successful planning approaches in developing Asia alone, and

   c. As mentioned above, a measured pace is advisable, given that international and Vietnamese do not yet have a firm shared understanding of the planning enterprise.

> ***Recommendation*:** The proposed ADB Sector Loan includes as the next step in the establishment of the RRB River Basin Organization, the preparation of a "basin framework plan" over a period of about a year, involving on the order of 50 international consultant person-months plus local consultants. The recommendation would be for the framework plan to include as one of its components a detailed terms of reference for a basin strategic water resources planning exercise. Time and resources should be provided to allow for extensive consultation and discussion about the TOR with a variety of stakeholders within and outside GOV.

3. *Observation:* There is some lack of understanding among water resource managers in Vietnam (as in many parts of the developed and developing world) of the difference between "river basin planning" and "catchment (or watershed) management planning". The

[59] Eg the Northeast Regional Plan, which was prepared in the mid-1990s as part of the Bangladesh Flood Action Plan. The author (Bennett) was the environment specialist on the project.

former encompasses the more strategic issues raised in Observations 1 and 2 above, and focuses on institutional, allocative and operational coordination at basin level, while the latter deals more with issues of land and water use, and their interactions at subbasin or catchment level. Catchment management generally addresses priority issues, such and deforestation and its impact on water quality, flooding and so on, in specific catchments ("hot spots"). Both types of planning have an important role to play in the future water resource management of the Red River Basin. In addition, the skills and expertise required to successfully produce such plans are somewhat different.

> ***Recommendation*:** The basin framework plan should identify priority catchment management (land/water interaction) issues that should then be addressed by the preparation of catchment management plans for specific catchments and/or subbasins. In the near future technical assistance should be provided by ADB or another donor to strengthen the capacity of the Department of Water Resources and Hydraulic Works Management (or whatever department may become responsible for water resource management in any future restructuring[60]) within MARD to enable such plans to be prepared.

4. *Observation:* Not long ago (as late as 1996), a key issue in Vietnam was getting access to existing data, which tended to be very closely held by the custodial agencies. For a variety of reasons and despite undoubted continuing conservatism in data-sharing in many situations, the overall situation is now shifting to "too much information" and "lots of low quality data" (TMI and LLQD as they are called in so-afflicted circles), which pose their own problems. The systematic inventory and cataloging of data into the RRBWRM metadatabase is an important first step towards bringing the total data asset under control. There has been some donor support to General Department of Statistics to develop environmental statistics[61]. There are examples of data products that have been produced through interagency cooperation (the National Atlas is an example).

> ***Recommendation*:** The metadatabase being prepared under this TA, the Red River Resource Data Directory, should be complemented by the preparation of an environmental and other statistics database containing actual (historical) data on the basin, that has been quality checked and thoroughly analyzed by specialists in the various disciplines (agriculture, demography, forestry etc). MARD, or the possibly the RBO should explore opportunities for technical cooperation with GDS and/or MOSTE to create such a database as a resource for basin planning.

5. *Observation:* As can be seen from this study, the Department of Water Resources of MARD – until rather recently a Department of Irrigation – faces a broad range of complex issues, related to the Department's responsibility for state management of water resources. There is a need to develop an organizational development plan to guide the strengthening of the Department to carry out its new functions under WRL. (This is separate and distinct from the ongoing and planned efforts related to strengthening the National Water Resources Council and the River Basin Organization; from assistance to implement state water resources management measures such surface water licensing; and from assistance to support basin planning.) The Department does not yet have Government approval to increase the number and type of professional staff to meet its new responsibilities under WRL, but this expansion should be guided by an organizational plan, rather than for the plan to be prepared in a reactive mode, after staff expansions have been approved.

[60] See Observation 5.

[61] Inter alia ADB regional TA in the mid-1990s.

***Recommendation*:** Assistance should provided to the Department to prepare an organizational development plan This plan should address the phasing in of new programs (eg licensing), staffing levels, needed skills and tools, etc. It should among other things provide rationale and guidance for needed staff expansion.[62]

[62] This observation/recommendation is based on discussions with TA consultant Warren Martin in March 2000.

Annex A: Land Use Study TOR, RRBWM Phase II Inception Report

A.1 Overview

Land use and water resource management are closely linked in any catchment. Man's ability to change the landscape to suit his own purposes has always had some effects on the quantity and quality of water running off the catchment and into the rivers and lakes. Today these effects are greater than ever before and threaten the sustainability of water resources in both developed and developing countries.

With rapid urban growth and changes in rural land use in the Red River Basin, including: deforestation in some areas and reforestation in others; development of irrigated cash cropping particularly in the upland areas; increase in urban populations and the corresponding spread of cities, industrialisation and so on, there is a need to assess future water demands,, impacts on water quantity and quality and related issues, to enable better management of water resources in the future.

It has been demonstrated in developed countries and elsewhere that the implementation of amelioration and rehabilitation strategies and measures, particularly at the catchment level, are most successful when led, or at least assisted by the local community. It is therefore important that any strategies developed in this study provide for community participation in their implementation.

A.2 Objective

Generally the purpose of this management study is to conduct a review to identify likely future land use changes and demographic trends and assess their probable impact on water resource management in the Red River Basin. This is aimed at providing the Red River Basin Organisation. when established, with improved knowledge and strategic advantage for its role in planning for the Basin. It could be expected that the recommendations formulated in the process of this study would form the basis of a component of the Red River Basin Plan proposed in the Technical Assistance.

A.3 Project Components

The following briefly describes the six components proposed for this study.

1. Demographic analysis, including urban growth and its impact on rural development, agriculture, and irrigation. Formulate trends to 2020.
2. Land use trend analysis especially forest cover, irrigated lands and industrialisation. Formulate projections to 2020.
3. Water demand trend analysis, by use and location. Formulate trends to 2020.
4. Impact assessment of identified demographic, land use, water demand trends on Red River Basin water resource management, especially quantity, quality, and environmental (including economic, social and physical) impacts.
5. Recommend broad implementable basin-wide strategies to minimise/ameliorate adverse effects on the environment.
6. Recommend feasible community participation options for strategy implementation and management generally of key catchment land and water resources.

A.4 Outputs and Outcomes

The outcome of the study should be improved future management of the water resources of the Red River Basin, through an understanding of the trends in land use change and their impacts on the quantity and quality of the available water resource and the demands for water, and the development of a set of strategies to deal with this phenomenon.

The major output from the study will be a final report clearly documenting the findings of the study, a set of recommendations for practical strategies for dealing with, minimising and if possible ameliorating the adverse impacts of the trends identified on the economic, social and physical environment of the Red River Basin.

A.5 Methodology

The management study will maximise the contribution of national experts on land use planning, demographics and water resource management including senior officials from MARD and other key agencies with responsibilities for the management of water in the Basin, as well as local consultants. Inter alia, two or more workshops will be conducted to get the views of the national experts on this issue, to discuss work in progress, and to finalise the recommendations developed in the course of the study. Specifically, an initial workshop will be held within one week of the mobilisation of the consultant to further define the needs of the government with respect to this issue, and to develop more detailed terms of reference for the study.

The study will be facilitated by an international land and water environment specialist. General oversight of the project will be undertaken by the Team Leader of the Red River Basin Water Resource Management Project. Hydrologic and other specific water planning aspects of the study will be undertaken by the Team Leader who is a Water Resources Specialist with extensive experience as a hydrologist.

Because of the limited budget available, the activity is proposed to be basically a desk study plus workshops. That is, no primary data collection will be attempted. The study will bring together information from previous studies related to forests, agriculture, water resources development, urbanisation, and so on, and existing statistics on population, land use, etc. It will also bring together stakeholders from various institutions, present information to them, and will facilitates discussion on issues and options related to impacts of identified trends in land use on future water resources management.

Annex B: Initial Workshop Presentation

Red River Basin
Water Resources Management Study

Land Use Changes & Impacts on Water Resources Management

Initial Workshop

Why A Land Use Study?

- Prioritized by Working Group because of rapid land use changes
- Increase understanding of natural processes affecting water management
- Capacity building

Why An Initial Workshop?

1. Review the study design
2. Present results of scoping
3. Review information sources for study
4. Get input from the Working Group on –
   - Study priorities – what land use/water resources processes in the Basin are of greatest concern?
   - Past experience of land use & water management in the Basin, and concerns for the future
   - Key information resources

Part 1 – Study Overview

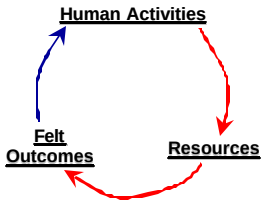
- Objectives
- Methodology
- Flowchart
- Complexity & scope of study

Study Objectives

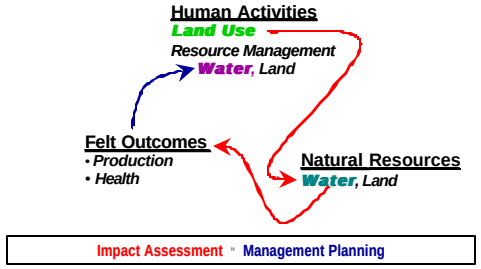
- Assess land use changes in the Red River Basin
- Consider how land use changes will affect water resource management
- Recommend basin-scale water resources management strategies & community-participation options

Study Typology

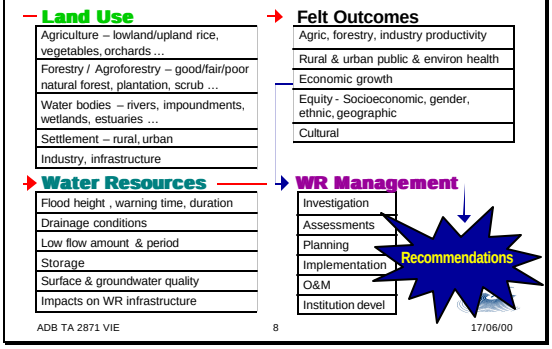
Impact Assessment + Management Plan



Land Use Study



Study Complexity



Scope of Study

- Initial environmental evaluation (IEE) type study
  - Of land use
  - Focusing on environmental management planning for water resources managers
- Geographic scope – Red River Basin (0.1Mkm^2)
  - 2 Socioeconomic Zones, RRD and Northern Upland (within which midland/upland & hills/mountains)
  - 25 provinces, 5 subbasins, ?? lower-order basins
- Study duration – 4 months March-July 2000

Clearly a need to prioritize!

Part 2 – Scoping

- Scoping is …
  - An initial step in impact assessment to locate key areas of concern
  - A scan of available information
  - Results in an initial inventory of
    - Strengths & weaknesses – existing now
    - Opportunities & threats – important for the future
    - Issues – areas of choice or uncertainty
    - Driving forces

Scoping – RRB/National

- **Agricultural intensification & diversification** – land & economic reforms are driving forces, impacts on WR will be complex
- **Population growth & urbanization** – Demographic transition & urbanization have a favorable relationship. Urbanization is not rapid by Asian standards.
- **Regional economic crisis** – has slowed economic growth. Effects are complex.
- **Dam/reservoir development** – Direct linkages between land use & water resources, both locally & upland-lowland.
- **Groundwater** – probably underutilized in many places, needs careful management to develop.
- **Water quality** – increasing contaminant inputs from rural & urban populations, industries (especially SMEs), & non-point land uses (agriculture, forestry) with increasing input levels.

Scoping – Northern Uplands

- **Biophysical & ethnic diversity** – Agroecology varies greatly over short distances. Many ethno-linguistic groups, settlements are highly intermixed. Legacies of Kinh migration programmes.
- **Proximity to China** – Access to Chinese markets. Higher levels of insecurity & indiscipline.
- **Hydropower development** – Existing & future major dams: upland (& Delta) impacts; operational issues. Micro-hydropower.
- **Upland deforestation** – was rapid but may be slowing or reversing, but afforestation alone does not guarantee a solution to adverse impacts on WR. Opium cultivation issues.
- **"Uplands in crisis"?** – Mountain zone facing biophysical, socioeconomic, institutional stresses. Sustainability concerns.
- **Infrastructure & institutions** – Development is difficult due to highly diverse environment with many challenges to improvement.

Scoping – Delta

- **Regional growth engine** – Largest share of Basin population – High population density – High economic growth & urbanization rates – Includes government & trade centres.
- **Floods** – Flood damage potential will increase with increasing urban population & industry.
- **Irrigation & drainage** – Rehabilitate & improve operation of schemes, adapt to changing agriculture.
- **Coastal area management** – Surface & ground water salinity, shrimp farming impacts, acid soils.

Part 3 –Information Sources

- Key documents (initial list)
  - Red River Delta Master Plan
  - Vietnam Water Sector Review
  - CRES Upland Studies
  - Red River Basin Profile
  - NIAPP CD Atlas
- Sources of statistical data (initial list)
  - General Department of Statistics publications
  - National Institution of Agriculture Projections & Planning (NIAPP)
  - Cadastry Department
  - Forestry Planning Institute

Part 4 – Conclusion

Questions For the Working Group

- What would you most like to learn from the Land Use Study? [priorities]
- What are your past experiences of land use impacts on water resource management in the Basin? What are your concerns for the future?
- What are the key information sources on land use / water resources in the Basin?

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Annex C: Subbasin Land Use Maps

Figure 29: Map - Da River Subbasin Land use

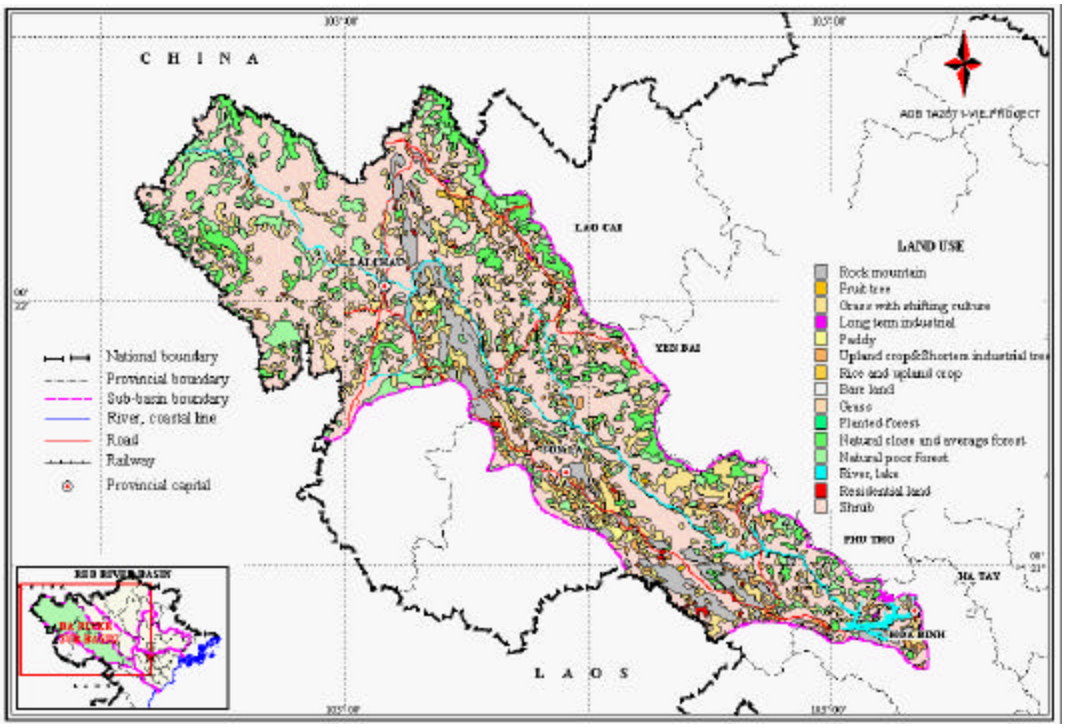


Figure 30: Map - Thao River Subbasin Land use

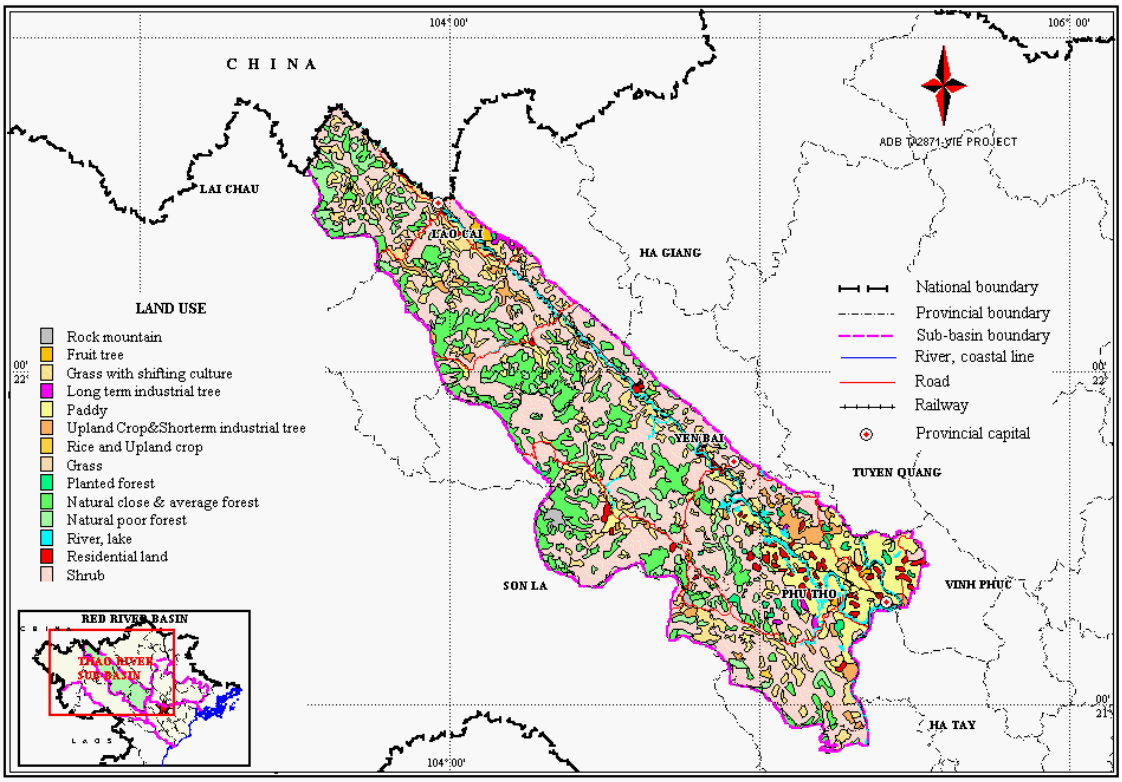


Figure 31: Map - Lo-Gam Subbasin Land use

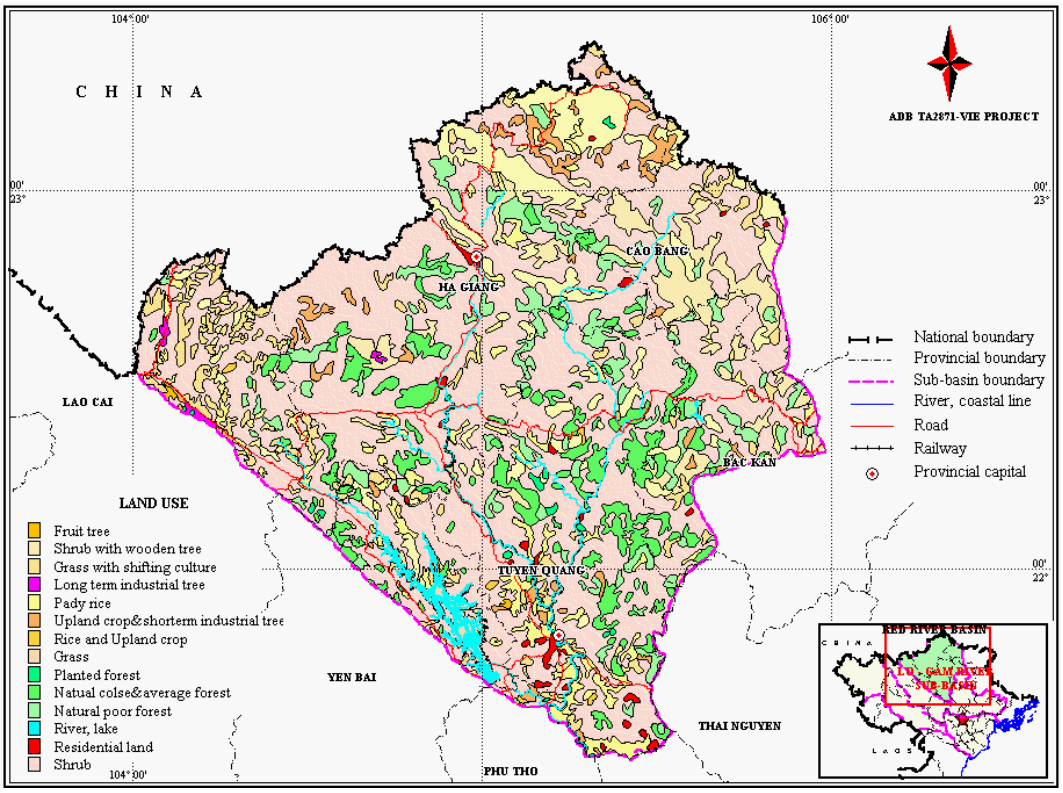


Figure 32: Map - Upper Thai Binh Subbasin Land Use

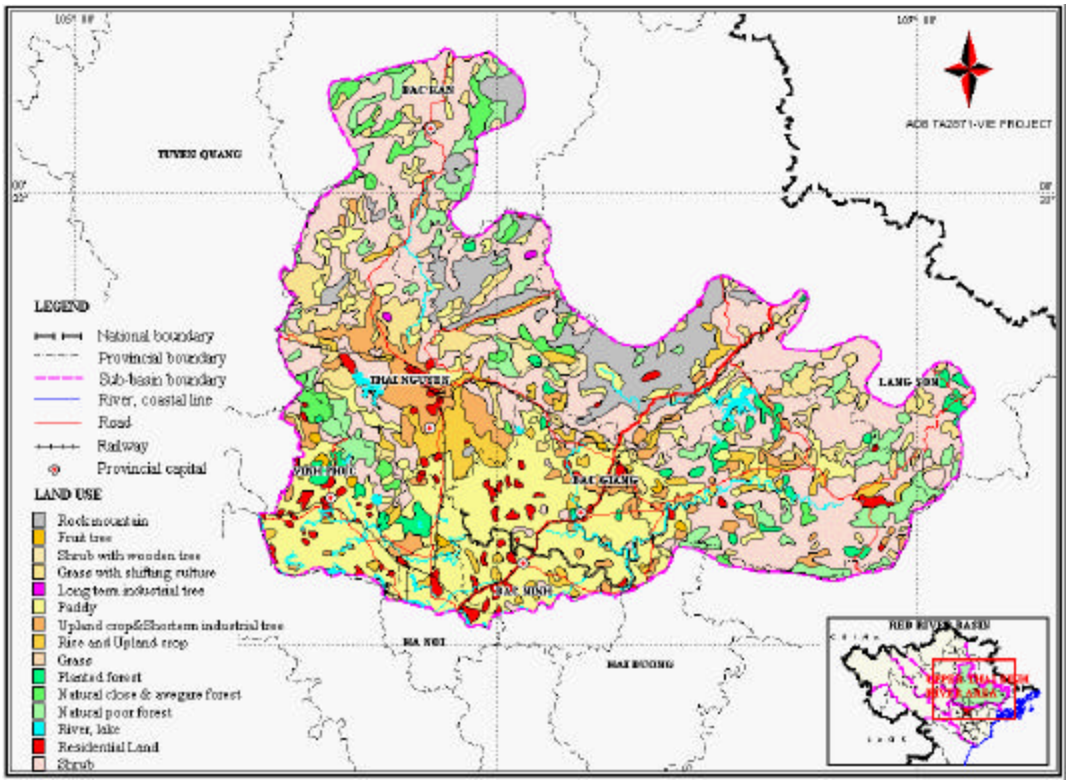
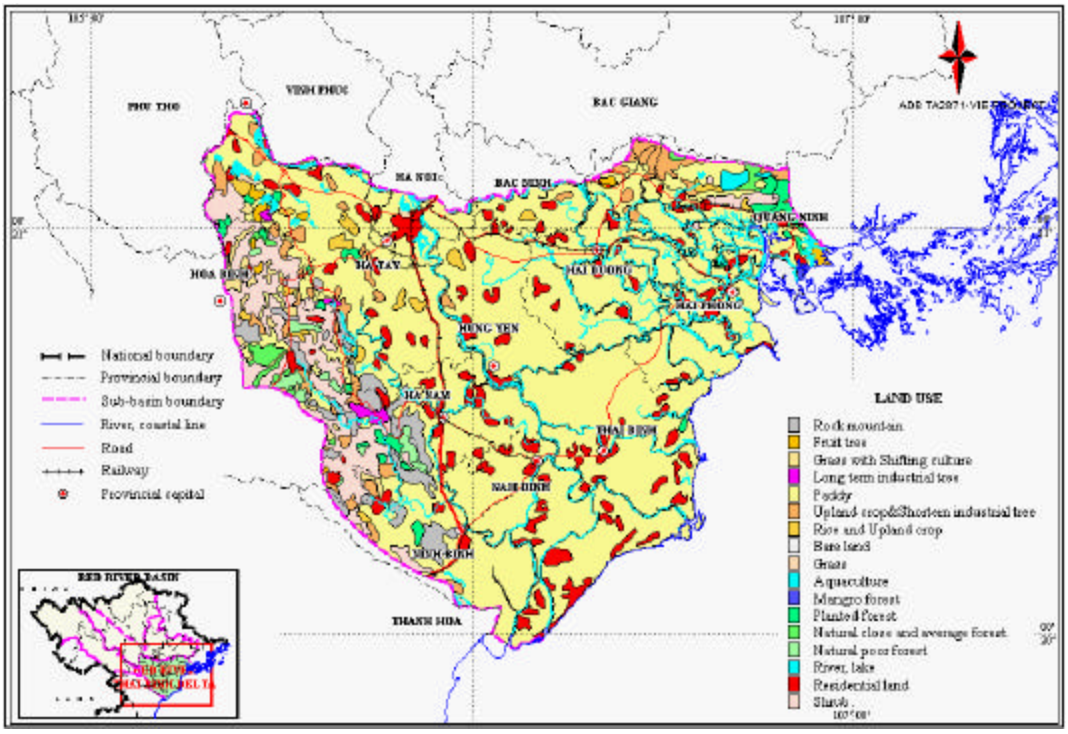


Figure 33: Map - Red River - Thai Binh Delta Land Use



Annex D: Statistical Data, RRB Provinces

Table 4: Historical Land Use Data, RRB Provinces

Source: Report on land use planning up to the year 2010. Cadastry Department, March 1997. [In Vietnamese.]
Units: '000 ha

(a) Red River Delta Provinces

	1980	85	90	95
Total area	1237	1245	1247	1261
Agriculture	734	725	717	720
Unused	205	222	223	208
Resid+const	106	110	112	102
Irrig works	72	70	73	82
Forested	59	37	46	61
Transport	40	47	48	56
Unclass'd	21	34	28	32

(b) Change since 1980 (ha, 1980=0)

	1980	85	90	95
Total area		8	10	24
Agriculture		-9	-17	-14
Unused		17	18	3
Resid+const		4	6	-4
Irrig works		-2	1	10
Forested		-22	-13	2
Transport		7	8	16
Unclass'd		13	7	11

(c) Mountain & Midland Provinces

	1980	85	90	95
Total area	10337	10297	10294	10295
Unused	5019	6477	6630	6154
Forested	3727	2119	1902	2578
Agriculture	1272	1296	1311	1205
Resid+const	196	211	240	110
Irrig works	34	39	54	79
Transport	50	55	59	71
Unclass'd	39	100	98	98

(d) Change since 1980 (ha, 1980=0)

	1980	85	90	95
Total area		-40	-43	-42
Unused		1458	1611	1135
Forested		-1608	-1825	-1149
Agriculture		24	39	-67
Resid+const		15	44	-86
Irrig works		5	20	45
Transport		5	9	21
Unclass'd		61	59	59

(e) Red River Basin Provinces

	1980	85	90	95
RRB total area	11574	11542	11541	11556
Unused	5224	6699	6853	6362
Forested	3786	307	313	303
Agriculture	2006	2021	2028	1925
Resid+const	302	321	352	212
Irrig works	106	109	127	161
Transport	90	102	107	127
Unclass'd	60	134	126	130

(f) Change since 1980 (ha, 1980=0)

	1980	85	90	95
RRB total area		-32	-33	-18
Unused		1475	1629	1138
Forested		-3479	-3473	-3483
Agriculture		15	22	-81
Resid+const		19	50	-90
Irrig works		3	21	55
Transport		12	17	37
Unclass'd		74	66	70

Notes
In Cadastry dataset, 1985 "residential" includes construction and construction is zero. In this table, residential & construction have been aggregated for a

Table 5: Total Area, Pre-1991 RRB Provinces

Source: Statistic Yearbook - GDS

Unit: Km^2

No	Province	1986	#	1988	#	1990	#	1992	1993	1994
1	Ha Tuyen	13631.00		13632.00		13631.80		13632.40	13632.00	13632.00
2	Cao Bang	8445.00		8445.00		8444.60		8444.70	8445.00	8445.00
3	Lang Son	8187.00		8178.00		8167.20		8167.30	8187.00	8187.00
4	Lai Chau	17068.00		17142.00		17139.70		17139.70	17133.00	17133.00
5	Hoang Lien Sc	14852.00		14852.00		14852.00		14851.00	14858.00	14858.00
6	Bac Thai	6194.00		6503.00		6502.90		6502.90	6503.00	6503.00
7	Son La	14168.00		14210.00		14210.00		14210.00	14210.00	14210.00
8	Quang Ninh	5938.00		5938.00		5938.60		5938.60	5939.00	5938.00
9	Vinh Phu	4626.00		4569.00		4823.00		4836.10	4827.00	4827.00
10	Ha Bac	4609.00		4616.00		4614.60		4614.30	4615.00	4616.00
11	Ha Noi	2139.00		2141.00		933.70		920.50	921.00	921.00
12	Hai Phong	1503.00		1503.00		1503.50		1503.50	1504.00	1503.00
13	Ha Son Binh	5978.00		5796.00		6756.10		6764.70	6760.00	6760.00
14	Hai Hung	2555.00		2553.00		2551.70		2551.60	2550.00	2550.00
15	Thai Binh	1495.00		1532.00		1523.70		1523.50	1510.00	1509.00
16	Ha Nam Ninh	3763.00		3796.00		3810.40		3805.40	3879.00	3879.00
	Total	**115151.00**		**115406.00**		**115403.50**		**115406.20**	**115473.00**	**115471.00**

Notes:

There is a transposition typographical error in the original, which has 11468 $km^{2.}$

In '89 Ba Vi & Son Tay town moved from Hanoi (-1207km2) to Ha Son Binh (+960km2), then '95

No data.

Table 6: Total Population of Pre-1991 RRB Provinces 1980-1996 + Estimated 1997

Source: Statistic Yearbook - GDS
Unit: 1000P

No	Province	1986	87	1988	89	1990	91	1992	1993	1994	1995	1996	1997 est	###	###	###
1	Ha Tuyen	930.10		1007.50		1058.40		1119.20	1152.00	1180.50	1203.50	1223.80	1244.10			
2	Cao Bang	558.40		578.60		581.20		613.80	625.20	638.00	549.40	557.90	565.70			
3	Lang Son	555.60		579.90		624.30		655.70	673.60	689.60	703.10	716.30	728.80			
4	Lai Chau	398.80		424.80		453.30		481.50	503.10	520.60	535.20	545.60	555.70			
5	Hoang Lien Son	896.50		983.90		1071.90		1131.20	1172.50	1203.60	1229.30	1250.20	1271.10			
6	Bac Thai	942.30		988.10		1060.40		1118.50	1143.40	1168.00	1278.90	1292.70	1313.20			
7	Son La	603.00		645.20		703.30		753.50	778.10	802.00	818.10	823.50	846.90			
8	Quang Ninh	834.70		851.30		830.90		873.80	882.20	899.60	915.10	925.40	938.40			
9	Vinh Phu	1763.80		1863.70		2081.00		2164.40	2202.90	2248.70	2291.90	2330.50	2368.10			
10	Ha Bac	1972.90		2072.10		2122.30		2222.20	2276.70	2248.70	2337.40	2376.50	2415.00			
11	Ha Noi	2987.50		3097.70		2052.30		2106.00	2160.80	2194.40	2230.10	2285.40	2306.50			
12	Hai Phong	1441.90		1481.20		1483.00		1542.30	1586.20	1615.10	1642.80	1667.60	1692.60			
13	Ha Son Binh	1764.20		1848.30		2763.00		2868.00	2930.30	2985.80	3037.80	3087.90	3137.00			
14	Hai Hung	2476.00		2530.50		2503.30		2611.80	2662.50	2708.60	2743.80	2778.10	2815.20			
15	Thai Binh	1661.80		1710.00		1673.50		1523.50	1763.80	1789.20	1810.10	1830.60	1852.60			
16	Ha Nam Ninh	3139.50		3211.40		3223.30		3349.80	3433.70	3501.40	3558.80	3612.30	3664.89			
	Total	**22927.00**		**23874.20**		**24285.40**		**25135.20**	**25947.00**	**26393.80**	**26885.30**	**27304.30**	**27717.55**			

Notes

Cao Bang lost 90,000 people for 1995&96. Reason not known, typographical error or ?

No data

Table 7: Urban Population, Pre-1991 RRB Provinces

Sources: (1) Statistic Yearbook - GDS for all data except see note 2.
Unit: '000 persons

No	Province	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997 GDS est.	1997 MOC est.
1	Cao Bang	77.60		81.50		49.80	57.90		62.90	64.60	50.80	52.40	67.54	35.00
2	Lai Chau	69.90		61.00		59.00	59.70		62.30	74.30	75.60	78.00	77.46	30.50
3	Lang Son	101.80		106.30		78.80	81.60		87.50	89.60	92.00	95.10	95.88	55.00
4	Thai Binh	105.40		176.30		98.00	99.00		102.00	103.50	106.30	109.30	108.79	47.12
5	Son La	100.60		106.10		94.70	96.60		101.70	103.20	105.90	109.00	110.66	30.00
6	Ha Tuyen	72.00		79.60		89.50	105.00		109.20	111.90	114.20	118.50	119.39	71.00
7	Ha Bac	121.70		122.30		107.00	110.20		114.60	114.80	122.60	126.50	121.54	85.00
8	Vinh Phu	139.60		141.80		245.90	248.60		161.80	163.50	169.50	176.80	186.99	110.00
9	Hoang Lien Son	116.10		128.10		165.60	171.50		179.00	188.30	192.20	200.00	202.89	95.00
10	Hai Hung	183.70		176.30		124.90	128.30		138.50	140.90	145.40	150.50	242.26	138.00
11	Ha Son Binh	175.90		199.00		212.50	237.70		139.10	290.70	300.00	308.80	309.96	121.51
12	Bac Thai	207.00		211.30		198.50	207.00		215.00	219.60	239.80	247.30	311.46	240.00
13	Quang Ninh	359.00		371.10		357.60	411.40		376.60	387.50	395.00	405.40	403.11	381.45
14	Ha Nam Ninh	309.30		316.80		346.90	354.80		369.70	379.80	387.10	400.10	431.26	312.00
15	Hai Phong	457.60		516.30		497.20	506.00		531.90	539.50	554.50	576.00	571.31	1448.00
16	Ha Noi	1153.40		1198.60		1060.80	1063.70		1106.80	1150.80	1200.00	1246.70	1241.11	2500.00
	Total	**3750.60**		**3992.40**		**3786.70**	**3939.00**		**3858.60**	**4122.50**	**4250.90**	**4400.40**	**4601.60**	**5699.58**

Notes

1. No data.
2. From Urban water supply development orientation, Min. Construct. 1998.

Table 8: RRB Protected Areas, Existing & Proposed

Source: Appendix 1, IUCN Vietnam Programme, 1999: Buffer zone management in Vietnam. With modifications.

Protected area			Area by type, ha				Est.	Description
Province	*Name*	*District*	*National park*	*Nature reserve*	*Endemic species*	*Historic-cultural*	*(year)*	
Ninh Binh	Cuc Phuong	Gia Vien	22,200				1962	Forest on limestone
Thanh Hoa		Yen Thuy						
Hoa Binh		Thach Thanh						
Bac Can	Ba Be	Ba Be	7,610				1977	Forest on limestone, lake, gibbon
Bac Can	Kim Hy	Bach Thong	18,555				1997	Forests on limestone
Bac Giang	Yen The	Yen The				883	1993	Evergree dense forest & historical place
Bac Giang	Khe Ro	Luc Ngan	5,675				1995	Primary forest
Cao Bang	Pac Bo	Ha quang				2,784	1977	Places of historical interest
Cao Bang	Pia Oac	Nguyen Binh		10,000			1986	Sub-tropical forest
Ha Giang	Phong Quang	Bac Quang		18,397			1986	Forests on limestone, monkeys
Ha Giang	Bac Me	Bac Me		27,800			1994	
Ha Giang	Du Gia	Yen Minh	24,293				1994	Forest on limestone and on lowland
Ha Giang	Tay Con Linh I	Vi Xuyen	18,790				1995	
Ha Tay	Ba Vi	Ba Vi	7,377				1977	Sub-tropical forest
Ha Tay	Huong Son	My Duc				4,355	1986	Forests on limestone and Huong Pagoda
Hai Hung	Con Son-Kiep Bac	Chi Linh				1,477	1986	Places of historical interest on Nguyen Trai
Hai Phong	Cat Ba	Cac Ba	15,200				1986	Tropical forest on limestone
Hai Phong	Do Son	Do Son				285	1986	Pine forest around holidat resort
Hoa Binh	Thuong Tien	Lac Son		7,308			1986	Forest on limestone
Hoa Binh	Dao Ho Song Da	Ky Son, Da Bac, Mai Son, Tan Lac				3,000	1986	Forests on island
Hoa Binh	Phu Canh	Da Bac	14,461				1995	Sub-tropical forest
Lai Chau	Muong Nhe	Muong Nhe			310,216		1986	Sub-tropical forest, Chukrasia, mammals
Lai Chau	Muong Phang	Dien Bien Dong				962	1986	Evergreen dense forest and Dien Bien Phu
Lang Son	Huu Lien	Huu Lung		10,640			1986	Forests on limestone
Lang Son	Mo Re-Bac Son	Bac Son	4,000				1995	Forests on limestone
Lao Cai	Day Hoang Lien	Sapa, Bat Xat		29,845			1986	Sub-tropical forests on mountains

Table 9: RRB Protected Areas, Existing & Proposed (cont'd)

Protected area			Area by type, ha				Est.	Description
Province	*Name*	*District*	*National park*	*Nature reserve*	*Endemic species*	*Historic-cultural*	*(year)*	
Ninh Binh	Hoa Lu	Hoa Lu				5,624	1996	Limestone and Dinh-Le ancient city
Phu Tho	Den Hung	Thanh Ba				285	1977	Places of historical interest
Phu Tho	Xuan Son	Thanh Son		5,487			1986	Forests on limestone and earth mount.
Quang Ninh	Ba Mun	Quang Ha		1,978			1977	Forest on sea island
Quang Ninh	Bai Chay	Quang Ha				562	1986	Pine forest around holiday resort
Quang Ninh	Ky Thuong			17,640			1994	Erythropheleum forest, big animals
Son La	Sop Cop	Song Ma		5,000			1986	Low tropical forest, big mammals
Son La	Xuan Nha	Moc Chau		38,069			1986	Forests on limestone, monkeys
Son La	Ta Sua	Bac Yen	15,000				1995	
Thai Binh	Tien Hai	Tien Hai			12,500		1986	Mangrove forest, waterbirds
Thai Binh	Thai Thuy	Thai Thuy			13,100		proposed	Mangrove forest, waterfowl
Thai Nguyen	Tam Dao	Tam Dao	36,883				1977	Sub-tropical forest
Thai Nguyen	Hang Phuong Hoang	Vo Nhai	6,000				1991	Forest on limestone, numerous caves
Tuyen Quang	Tam Dao	Tam Dao					1977	Sub-tropical forest
Tuyen Quang	Tan Trao	Tan Trao				6,633	1993	Evergree dense forest & historical place
Tuyen Quang	Tat Ke-Ban Bung	Na Hang		41,930			1994	Forests on limestone, snub-nose monkey
Tuyen Quang	Kim Binh	Yen Son				1,937	1994	Places of historical interest
Vinh Phuc	Tam Dao	Tam Dao					1977	Sub-tropical forest
Yen Bai	Thac Ba	Yen Binh				5,000	1986	Landscape, primates
Total area (overall&by type)		779,741	196,044	214,094	335,816	33,787		