

CHAPTER 4 - ECONOMIC PROFILE OF QUANG BINH FOR VULNERABILITY ASSESSMENT AND EBA

4.1 INTRODUCTION

This Chapter presents the provincial-level economic analysis that contributes to the Vulnerability Assessment for Ecosystem-based Adaptation to Climate Change in Quang Binh. It does not attempt to present a full economic profile of Quang Binh. The study is intended to use only secondary data, and, while many interesting and relevant questions could be posed at provincial level, there are only a limited number of economic factors that are relevant to the discussion and for which sufficiently comprehensive data already exists. Rather, this is essentially a scoping exercise, with the objective of identifying the most important and historically most vulnerable economic activities and assets at provincial level that should form the basis of socio-ecological systems and be prioritised in the vulnerability assessment.

4.2 KEY ECONOMIC FACTORS FOR THE PROVINCIAL EBA ASSESSMENT OF QUANG BINH

4.2.1. *Overview of Questions and Data*

Given the objective of identifying the most important economic activities and assets at provincial level for consideration in the climate change vulnerability assessment, this study focuses on answering a few simple questions:

- What is the current structure and status of Quang Binh's economy?
 - Which sectors contribute most to GDP; exports, employment; land use etc.
 - What are the key activities within those sectors?
 - Who is involved/most important (state, private, smallholder)
- What plans are there for future development?
- What are the key assets supporting economic activity and where are they located
 - Transport (road, rail, ports), power, water.
- How have the key activities and assets been affected by extreme climatic events in the past?

Together with the findings of the ecological and social profiles for the province, the answers to these questions will help establish the units of analysis for the Vulnerability Assessment - the socio-ecological systems (SES) of Quang Binh, and then help prioritise of a small number of the SES for the local level vulnerability assessment.

At the time of research and writing, the SEDP for 2016-2020 was still being finalised. Although an overview was available (QBPPC 2015), much of the background information was omitted. Thus, some of the data presented here is from the previous SEDP 2011-2015 and somewhat out-of-date, or data is compiled from multiple sources, presenting inconsistencies in years or units of analysis. The account presented should thus be taken as indicative, rather than definitive.

For readers at the provincial level, much of the information provided below will be familiar - but presented in a new, concise and useful way. For readers outside the province - it is intended to provide an overview of the economy, highlighting the factors to consider in EbA planning.

4.2.2. Overview of the Status and Structure of the Provincial Economy

4.2.2.1. GDP

Of Vietnam's 63 provinces, Quang Binh represents 2.4% of the total area (806,613 ha) and only 1% of the population (863,350 people in 2013), but has a GDP per capita equivalent to USD 1,240 (2015), only 60 % of the national average (USD 2073). In 2014, total GDP was 43,433 billion VND, (USD 2 billion) representing 1.1% of national GDP. In 2012, the province contributed 1,840 billion VND (USD 90 million) to its own state budget (of the total US\$37.68 billion) or only 0.24%. The remainder of the budget is provided by central government. Thus, Quang Binh is one of the poorest provinces in Vietnam. However, as described below, it is also has one of the fastest growing economies in the country.

4.2.2.2. STRUCTURE OF THE ECONOMY

4.2.2.2.1. Three Sectors

In Vietnam, as elsewhere, structure of the economy is described in terms of the GDP contributions of three main "sectors": i) the primary sector: agriculture, forestry and fisheries (AFF); ii) the secondary sector: industry, including mining and construction; and iii) the tertiary sector: services, including trade and tourism. In Quang Binh, by 2015, "services" was the most important sector, contributing 50.6% of GDP¹, followed by industry at 24.8% and AFF at 24.6%.

4.2.2.2.2. Principal Economic Activities by Sector

Within each of these sectors, a few activities stand out and help to characterise the economy of Quang Binh. Table 4.1 shows some key activities in the three sectors. Often overlooked, the most important sector in the province is retail services and most of these are concentrated in the Dong Hoi and other urban areas. Better known is the fact that construction materials, particularly cement, are the second most important component of the province's economy. Interestingly, the third ranked activity is civil infrastructure construction. More surprising, is that the fourth most important economic activity overall, and single most important within the AFF sector, is pig production.

¹ It is unclear how the value of the service sector is calculated: in the SEDP, it appear includes export and import revenues – sums that are also included under industry and AFF.

Table 4.1: Principal Economic Activities in Quang Binh, by Sector, 2014

| Sector | Activity | Value (m VND, 2014) | Rank |
|---------------------|-----------------------------------|---------------------|------|
| AFF | | (10,258,958) | |
| Agriculture | Cereal production (rice, maize) | 1,784,000 | 7 |
| Livestock | Pig Production | 2,168,366 | 4 |
| Forestry | Timber production | 699,890 | 10 |
| Fisheries | Capture Fishery | 1,896,581 | 6 |
| Industry | | (9,723,327) | |
| Processing | Construction materials (cement) | 2,990,894 | 2 |
| | Food processing (incl beer) | 1,082,792 | 8 |
| | Timber processing | 1,920,652 | 5 |
| Construction | | (4,485,047) | |
| | Civil infrastructure | 2,412,140 | 3 |
| Services | | | |
| | Retail | 12,943,000 | 1 |
| | Tourism (Accommodation, catering) | 1,254,000 | 9 |
| | Export | | ? |

Source: Quang Binh Provincial Year Book, 2015

4.2.2.3. LABOUR AND EMPLOYMENT

Employment provides another perspective on the importance of different sectors to the economy. Table 4.2 presents data on the employment in different sectors from 2010 and 2013. Although “Services” now generate the greatest proportion of provincial GDP, the sector provides only about 11% of the jobs, while the AFF sector continues to provide the most employment, engaging over 65% of the workforce.

Table 4.2: Labourers and Employees by activity, Quang Binh in 2010

| Sector | No. labourers | % | 2013 No. employees | % |
|--|----------------|------------|--------------------|------------|
| Agriculture and Forestry | 255,347 | 56.2 | 2,989 | 7.2 |
| Fisheries | 42,150 | 9.4 | | |
| Construction | 18,574 | 4.1 | 11,985 | 28.7 |
| Industry - Mining, processing | 45,786 | 10.0 | 11,001 | 26.4 |
| Retail, vehicle repair | 34,753 | 7.6 | 8,208 | 19.7 |
| Hospitality | 9,206 | 2.0 | 1,981 | 4.7 |
| Transport, storage, communication | 9,699 | 2.1 | 1,774 | 4.3 |
| Other | 39,021 | 8.6 | 3,773 | 9.0 |
| TOTAL | 454,536 | 100 | 41,711 | 100 |

Source: Quang Binh Statistical Year Book, 2011

Formal employment is another matter altogether - less than 10% of labour is officially employed in a registered enterprise. Of these, approximately 30% are women. The most important sectors are construction and industry - together employing over half the work force. Retail trade is also important.

Data on labour trends between 2005 and 2010 are provided in Table 4.3. They show that employment in all sectors is rising - but negligibly in AFF, while employment in services nearly doubled. In terms of employers, those in agriculture actually decreased over the period, while again, in services they increased substantially. This reflects the restructuring that the government is seeking. Labour productivity doubled in AFF and Services, and increased 200% in industry.

Table 4.3: Quang Binh Labour Statistics by Sector: 2005-2010

| | Unit | 2005 | 2010 | % change |
|--------------------------------|---------------------|--------------|--------------|----------|
| 1. Labour by sector | '000 persons | 410.5 | 454.5 | 10.7 |
| Ag/For/Fish | '000 persons | 291,381 | 298,150 | +2.3 |
| Industry and Construction | '000 persons | 56,580 | 65,290 | +15.4 |
| Trade and Service | '000 persons | 62,496 | 91,060 | +45.7 |
| 2. Employers | % | 100 | 100 | - |
| Ag/For/Fish | % | 71 | 65.6 | -7.6 |
| Industry and Construction | % | 13.8 | 14.4 | 4.3 |
| Trade and Service | % | 15.2 | 20.0 | 31.6 |
| 3. Labour productivity* | Million VND | 11.06 | 28.44 | 157.1 |
| Ag/For/Fish | Million VND | 4.63 | 9.35 | 101.9 |
| Industry and Construction | Million VND | 25.55 | 78.41 | 206.9 |
| Trade and Service | Million VND | 27.77 | 54.50 | 96.3 |

SEDP 2011, * GDP/hh

4.2.2.4. LAND USE

Land use patterns provide a different set of insights into an area's economy. Table 4.4 presents figures for Quang Binh, and Map 4.1 shows the distribution of the principal land uses.

Reflecting the province's mountainous terrain and narrow coastal plain, described in Chapter 3, the principal land use in the province is Forestry, occupying 78.2% of the land, followed by agriculture occupying 10.3% of which paddy rice accounts for 4%.

Table 4.4: Land Use in Quang Binh, 2013

| No. | Use | Area (ha) | % |
|----------|---|---------------|-------------|
| | Total | 806527 | 100.00 |
| 1 | AGRICULTURAL LAND | 716802 | 88.9 |
| 1.1 | Agricultural production land | 82831 | 10.3 |
| 1.1.1 | Annual crop land | 58062 | 7.2 |
| 1.1.1.1 | Paddy land | 32455 | 4.0 |
| 1.1.1.2 | Pasture land for animal raising | 1130 | 0.1 |
| 1.1.1.3 | Other annual crop land | 24477 | 3.0 |
| 1.1.2 | Perennial crop land | 24769 | 3.1 |
| 1.2 | Forest land | 630872 | 78.2 |
| 1.2.1 | Production Forest | 309253 | 38.3 |
| 1.2.2 | Protection Forest | 198043 | 24.6 |
| 1.2.3 | Special Use Forest | 123576 | 15.3 |
| 1.3 | Fisheries Area | 2793 | 0.4 |
| 1.4 | Land for salt production | 84 | 0.0 |
| 1.5 | Others | 222 | 0.0 |
| | | | |
| 2 | NON-AGRICULTURAL LAND | 55181 | 6.8 |
| 2.1 | Settlement land | 5495 | 0.7 |
| 2.1.1 | Urban | 647 | 0.1 |
| 2.1.2 | Rural | 4848 | 0.6 |
| 2.2 | Specially used land | 28590 | 3.5 |
| 2.2.1 | Land used by offices and non-profits agencies | 166 | 0.0 |
| 2.2.2 | Security and defence land | 4938 | 0.6 |
| 2.2.3 | Land for non-agricultural production and business | 2373 | 0.3 |
| 2.2.4 | Public land | 21113 | 2.6 |
| 2.3 | Religious land | 75 | 0.0 |
| 2.4 | Cemeteries | 3013 | 0.4 |
| 2.5 | Rivers and specialized water surfaces | 17969 | 2.2 |
| 2.6 | Other | 39 | 0.0 |
| | | | |
| 3 | UNUSED LAND | 34664 | 4.3 |
| 3.1 | Unused flat land | 10249 | 1.3 |
| 3.2 | Unused mountainous land | 16624 | 2.1 |
| 3.3 | Non-forested rocky mountain | 7671 | 1.0 |

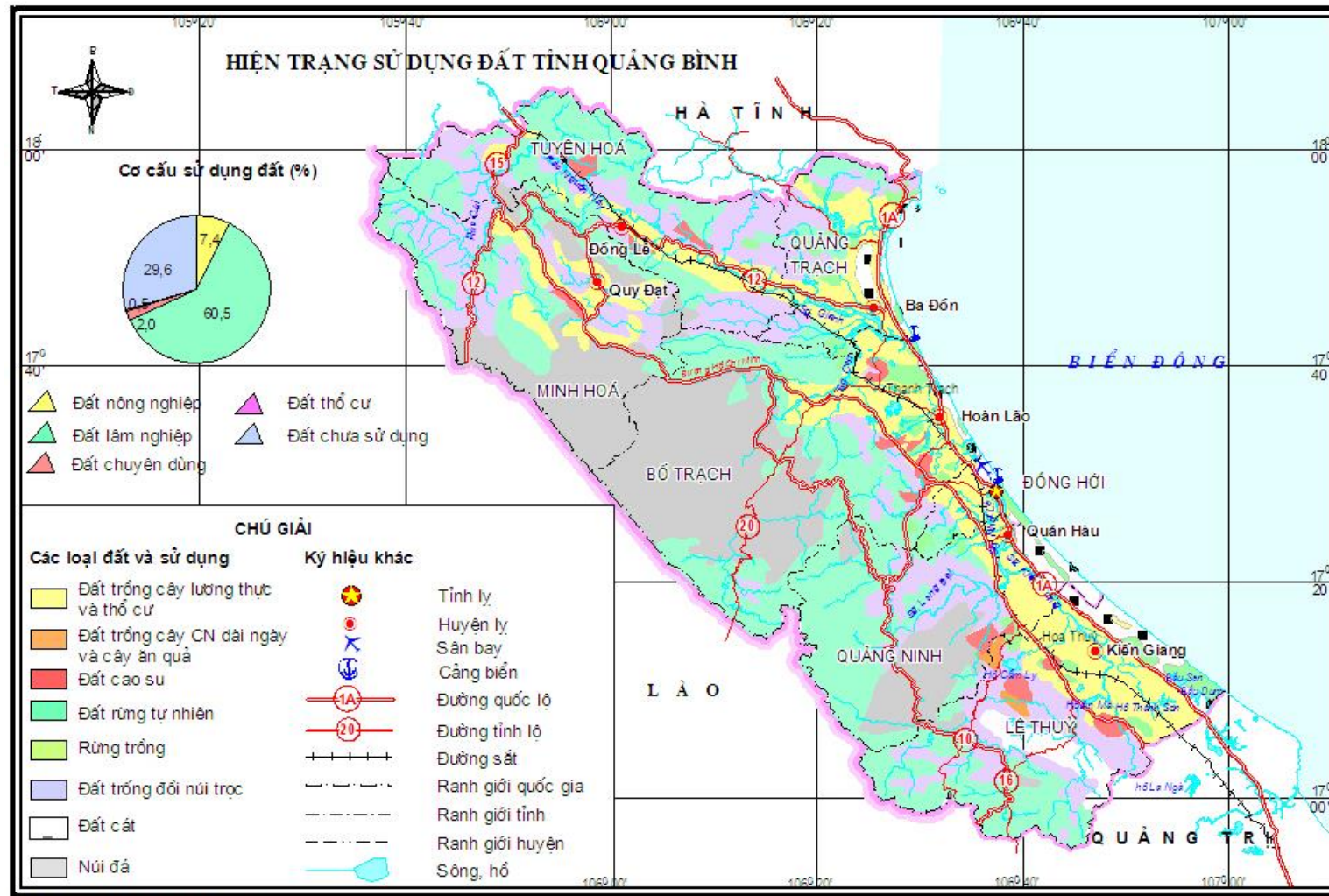
The forest area is split almost equally between protective (special use or conservation - 15.3% of total land - and protection forests - 24.6 %) and production functions (38.3% of total land). The protected forests still contribute to the economy - the special use forests as Phong Nha-Ke Bang National Park, which draws large

numbers of domestic and foreign tourists, and the protection forests, less visibly, in the environmental services they provide to other sectors of the economy and the population in general. The production forests include a small area of managed natural forest and a much bigger area of plantations, both of native pine and exotics like acacia and eucalyptus.

The total area under agriculture represents 10.3 % of the total. The three main uses - paddy, other field crops and perennial crops are also quite balanced (4%, 3 % and 3.1% respectively. The fourth use category - pasture for animal-raising is currently very limited in extent - but economic development plans include considerable emphasis on animal production, so this is likely to change (see below).

The next most important land uses include public land (2.6%) and rivers and lakes or reservoirs (2.2%). Settlements occupy a surprisingly small area - 0.7% of total. Just over 4% of the land is classified as "unused".

Map 4.1: Principal Land Uses in Quang Binh, 2010



4.2.2.5. OWNERSHIP

In 2013, the state still controlled 23% of Quang Binh's economic production, compared to 44% by the private sector, and 32.4% by households. Cooperatives and foreign ownership are not significant, statistically (Table 4.5). Foreign direct investment (FDI) is being encouraged in all of Vietnam, particularly in coastal special economic zones. These areas are amongst the most vulnerable to climate change and as the situation worsens, FDI is likely to decline.

Table 4.5: Quang Binh's Sectoral GDP by Economic Agent, 2013 (billion VND)

| Ownership | State | Non-State | | | | TOTAL |
|---------------|-------|------------|---------|-----------|---------|--------|
| Sector | | Collective | Private | Household | Foreign | |
| TOTAL | 7,748 | 170 | 17,653 | 12,483 | 5.9 | 38,061 |
| % | 23 | .6 | 44 | 32.4 | 0.07 | 100 |
| Industry | 787.3 | 38.9 | 6,428 | 2,462 | 5.9 | 9,723 |
| Retail | 1,146 | 15 | 4,413 | 7,369 | | |
| Accommodation | 44 | - | 312 | 898 | | |

Source: QBSO (2015) QB Statistical Yearbook, 2014

4.2.2.6. EXPORT AND IMPORT

In 2013, the value of Quang Binh's exports was 138.3 million USD, or 0.1 % of Vietnam's total export revenue² (See Table 4.6). This represents a decline from 158.5 million USD in 2011. The main exports are rubber, wood chips and other timber products and pine resin products, titanium and cement. Most of Quang Binh's trade is domestic, within Vietnam. International trade is set to increase. Currently, China is the main trade partner. Much cement goes to Pakistan. Hon La port is the closest port for Laos and parts of Northern Thailand - so trade with these countries is likely to increase.

Table 4.6: Quang Binh, Export Value, Trend and Products, 2013

| Commodity | 2013 | % | 5 yr trend | Main products |
|-------------------------------|---------|------|-----------------|-----------------------------|
| Minerals and heavy industrial | 649 | 0.5 | Fluctuating x 5 | Titanium, cement |
| Handicrafts, light industrial | 31,825 | 23.0 | Increasing | |
| Agricultural | 77,698 | 56.2 | Decreasing | Rubber |
| Forestry | 24,222 | 17.5 | Increasing | Logs, chips, colophon |
| Fisheries | 3,916 | 2.8 | Fluctuating | Frozen shrimps, squid, fish |
| TOTAL | 138,310 | 100 | | |

Source: QBSO (2015) QB Statistical Yearbook, 2014

² Vietnam's total exports in 2013 were USD 143, 186, 372, 666.

http://data.worldbank.org/indicator/NE.EXP.GNFS.CD?order=wbapi_data_value_2013+wbapi_data_value&sort=asc

Imports, on the other hand were worth less than half of exports, at USD 65.64 million. The main imported goods are fuel, raw aluminium (bauxite), timber products for processing and consumer goods.

4.2.3. *Economic development: Performance and Plans*

While Quang Binh is one of the poorest provinces of Vietnam, it is experiencing remarkably rapid growth and provincial government fully intends for this growth to continue. Table 4.7 presents performance data for the economy for the last 5 year planning period (2011-2015) and the growth targets for the present planning period. The economic targets for last planning period have been largely missed, due in part to weakness in the global economy. However, the targets were ambitious to begin with, and the results are still impressive: 6.5% pa GDP growth; 3,100 new jobs per year; 4% pa reduction in poverty rate. Social development achievements are also impressive - and the number of targets has been increased for the coming period.

Table 4.7: Quang Binh economic performance 2011-2015 and targets for 2020

| Indicator | 2011-2015 | | 2020 |
|--|-------------|-------------|--------------|
| | Target | Achievement | Target |
| GDP growth pa | 12-13% | 6.5 | 8.5-9 |
| GDP per capita | USD 14-1600 | USD 1240 | USD 30-3200 |
| GDP total | | | |
| State Budget Revenue | 2,500 b VND | 2,745 b VND | 8,000 b VND |
| AFF value growth pa (%) | 4.5-5 | 4.2 | 4-4.5 |
| Industry value growth pa (%) | 21-22 | 9.1 | 11-11.5 |
| Services value growth pa (%) | 12-12.5 | 6.7 | 9-9.5 |
| AFF (% GDP) | 16.5 | 24.6 | 20 |
| Industry/Construction (% GDP) | 43 | 24.9 | 28 |
| Services (% GDP) | 40.5 | 50.5 | 52 |
| Food production (tonnes) | 27,5-28,000 | 29,800 | n/a |
| Annual job creation (jobs) | 3-3,200 | 3,100 | 3,1-3,200 |
| Poverty reduction rate (%) | 3.5-4 | 4.0 | 2-3% |
| National health care standard met (% communes) | 80-85 | 80.5 | 90.6 |
| Lower secondary school completion (% students) | 100 | 100 | 100 |
| Trained workers (%) | 50-60% | 60% | 65% |
| Communes meet NRD standard | 20% | 21.3% | 50% |
| Urban access clean water (% pop) | 95 | 96 | 97 |
| Rural access clean water (% pop) | 75-80 | 84.3 | 90 |
| Forest cover (%) | 67.5-68.5 | 68 | 69-70 |
| <i>New targets for 2016-2020</i> | | | |
| Social investment capital | | | 60,000 b VND |
| Access national grid electricity | | | 99.8% HH |
| Hospital beds/thousand | | | 25.5 |
| Health insurance participation | | | > 80% |

Quang Binh's socio-economic development strategy seeks to build on its natural advantages and mobilise resources effectively, while protecting the environment and, importantly, responding to climate change. Economic restructuring takes centre stage. Agriculture, particularly those subsectors oriented towards commodity production, will still be promoted, for food security and political stability, but rural areas will be reconceived as satellites to urban areas and more integrated with them. The New Rural Development programme will continue to upgrade rural communes, closer to urban standards.

Table 4.8: Summary of Projects included in the Quang Binh SEDP, 2016-2020

| Sector | No. Projects | Budget (b VND) | % | Notes |
|---------------------------------------|--------------|----------------|------------|--|
| Industry and Power | 75 | 11376 | 27.4 | Shoes, cement, 18 power plants |
| Agriculture Forestry Fisheries | 17 | 3200 | 7.7 | Forest, rubber, dykes, DRR, seafood processing; 32 poor coastal communes |
| Transport | 33 | 9224 | 22.2 | Roads (new, upgrades), bridges |
| Trade, services | 18 | 5629 | 13.5 | Diverse resort and ecotourism development |
| Defence Security | 3 | 530 | 1.3 | Border access and patrol roads ; combat training |
| Public infrastructure | 34 | 6485 | 15.6 | New urban areas, industrial parks, housing, water supply |
| Information/communication | 8 | 1615 | 3.9 | Peripheral, landline, internet. |
| Education | 7 | 1040 | 2.5 | Building upgrading schools, unis |
| Health | 9 | 965 | 2.3 | Build/enlarge/equip hospitals |
| Culture Sports | 11 | 1496 | 3.6 | Golf course, entertainments (Bao Ninh), marine park (Hai Ninh), monument restoration |
| TOTAL | 215 | 41,564 | 100 | |

Source: SEDP Quang Binh 2011-2020

Greater attention will also be paid to the maritime economy, particularly restructuring capture fisheries better to exploit the deeper water resources. However, most emphasis will be put on industry, tourism and services, particularly services relating to tourism. Regionally, Quang Binh will exploit its location to provide logistic and transport services to its landlocked neighbour Laos, to northern Thailand and even to eastern Myanmar. In all sectors, modern technologies and efficiencies will be pursued and infrastructure developed comprehensively to support it all.

Quang Binh's socio-economic development strategy has a strong spatial component identifying special zones and corridors. Two highlighted areas are the western arm of the Ho Chi Minh Highway and the economic corridor of Highway 12A connecting the Cha Lo border crossing with the ports at Hon La and Vung Anh. Both projects will affect the mountains and the forests.

Table 4.8 presents a summary of the 215 projects proposed in the 2016-2020 SEDP, providing further insights into Quang Binh's development strategy. Industry, power and infrastructure get 55% of the total budget. By contrast, AFF receives only 7.7% of the budget, of which at least 30% appears to be for infrastructure. Trade and

services receives 13.5% of the budget, most of which is for tourism related infrastructure. Similarly, education and health focus on building new facilities or improving old ones. The development strategy is thus very strongly infrastructure based - with important implications for climate change vulnerability and adaptation. Additional details on development plans for individual sectors are provided in the next section.

4.2.4. Sectoral Description and Analysis

This section presents further information and analysis on the different sectors of the economy, as needed to help identify the province's economic assets and development priorities for the climate change vulnerability assessment.

4.2.4.1.3. THE PRIMARY SECTOR: AGRICULTURE FORESTRY AND FISHERIES AND MINING

As set out in the preceding section, over 80% of Quang Binh's population and 65% of its workforce depend on this sector, and it occupies nearly 90% of the land area. For some years, agricultural development has focused on the production of commodities, such as rubber, fruit trees and pepper, but basic food production also continues to increase. In pursuit of efficiency, there is a drive to convert underproductive rice paddy to shrimp, fish and other crops have higher economic value. There is also a new drive to promote more commercial livestock production - particularly pigs and dairy cows. The contribution of forestry to GDP is declining, but there is an increasing awareness of the value of forests' environmental services, such as water supply, erosion control and tourism. Fisheries are gaining in importance and the future of fisheries is seen in commercial shrimp production, especially on sand, and the restructuring the capture fishery from many small-scale inshore boats, to larger off-shore boats exploiting the abundant resources of deeper waters.

Across the AFF sector, the government is promoting greater commercialisation and recognises "farms" - larger scale units - in its annual statistics. These may produce annual and perennial crops, livestock and aquaculture products.

4.2.4.1.1. Agriculture

Annual crops

Rice remains the most important annual crop in Quang Binh, both by area and by value. The other important crops are peanuts, maize, sweet potato and cassava. A major policy in annual cropping is the promotion of "large fields" - larger scale production enterprises. In 2015, there were 17 enterprises on 6,509ha (1,269ha rice, 5,020 ha cassava, 40ha maize, 80ha sweet potato, 65 ha chili).

Rice

The total land area available for paddy cultivation is currently about 30,000 ha, the vast majority of which is located on the coastal plain. As shown in Table 4.9, the southern district of Le Thuy has the largest paddy area, while in the mountainous districts of Minh Hoa and Tuyen Hoa, paddy cultivation is restricted to small areas of

flood plain of in narrow river valleys. Three crops are possible, each of around three months: winter-spring (December - March), early summer (April-June) and summer (July/August onward). The area cultivate each seasons depend on water availability - both from rainfall and irrigation. The winter-spring crop is the most extensive - taking 29,000 ha (2014); spring-summer drops to 24,000 ha. Both these areas have increased since 2001, by 12% and 37% respectively, mostly due to the expansion of irrigation. The summer crop however has decreased by nearly 80% and now stands at only 514 ha. Due to drought early in the season, and floods later in the season, the land is being used for other purposes.

Table 4.9: Rice production in Quang Binh, by district, 2013

| Crop | Total | | Winter spring | | Early summer | | Summer | |
|----------------------|--------------|--------------|---------------|--------------|--------------|--------------|------------|--------------|
| District | Area (ha) | Yield (t/ha) | Area (ha) | Yield (t/ha) | Area (ha) | Yield (t/ha) | Area (ha) | Yield (t/ha) |
| Dong Hoi City | 1864 | 4.1 | 982 | 5.5 | 881 | 3.6 | 0 | 0 |
| Ba Don Town | 4944 | 5.2 | 2749 | 5.4 | 2159 | 5.1 | 0 | 0 |
| Minh Hoa | 1033 | 4.1 | 451 | 4.8 | 441 | 4.5 | 132 | 0.49 |
| Tuyen Hoa | 2773 | 5.1 | 1504 | 5.5 | 1269 | 4.6 | 0 | 0 |
| Quang Trach | 6277 | 5.2 | 3181 | 5.4 | 3071 | 4.9 | 61 | 0 |
| Bo Trach | 8713 | 4.6 | 5306 | 5.4 | 3174 | 3.4 | 233 | 0.53 |
| Quang Ninh | 8588 | 4.6 | 4957 | 5.8 | 3541 | 3.1 | 90 | 1.1 |
| Le Thuy | 19414 | 4.5 | 9904 | 6.2 | 9510 | 2.7 | 0 | 0 |
| Total | 53606 | | 29034 | | 24046 | | 516 | |

Drought also leads to saline intrusion, as river debits decline. In the lower Kieng Giang River, farmers are converting paddy fields to aquaculture.

About 36,040 ha are irrigated (FAO 2013). However, decreases in annual rainfall to 60% of normal in 2014 and 80% in 2015 have meant that reservoirs were only filled to 60% capacity in 2014 and 30-40% in 2015. This is creating problems for paddy rice production.

Paddy lands and crops are also damaged by floods. This was particularly serious in 2007 and 2010, in the districts of Le Thuy and Quang Ninh. Table 4.10 provides some statistics on crop damage from flooding from 1989-2010.

Quang Binh is also affected by hot “foehn-like” winds from Laos, between March and April, and these are particularly strong from April to July. The wind decreases humidity, increases evaporation and causes water stress in plants which reduces yields. In 2005, losses of 58 billion VND were incurred.

There are no separate statistics for upland rice or information on how its production is being affected by climate change.

Table 4.10: Damage caused by storms and floods in Quang Binh, 1989-2010

| Damage/Yr | Inundated paddt | Inundated farm produced |
|-----------|-----------------|-------------------------|
| 1989 | 28,500 | 10,299 |
| 1990 | 15,000 | 2,605 |
| 1991 | 12,300 | 1,970 |
| 1992 | 8,918 | - |
| 1993 | 3,871 | 2,253 |
| 1994 | - | - |
| 1995 | 4,178 | 4,648 |
| 1996 | 4,479 | 997 |
| 1997 | - | 2,141 |
| 1998 | - | - |
| 1999 | - | - |
| 2000 | 4,555 | 1,54 |
| 2001 | 6,685 | - |
| 2002 | 322 | 439 |
| 2003 | - | 559 |
| 2004 | 7,827 | - |
| 2005 | 550 | 1,346 |
| 2006 | 7,039 | 1,957 |
| 2007 | 8,701 | 3,372 |
| 2008 | 501.8 | 4,426 |
| 2009 | 386 | 3,819 |
| 2010 | 2,951 | 6,611 |

Source: Total main damage of Quang Binh in the period of 1989-2010

Some new rice cultivation techniques are being introduced, in part in response to climate change. In a few potential water deficit areas, sustainable rice intensification (SRI), which saves 40% of normal water demand, 30% fertiliser and 50% pesticides, while increasing yields, is being piloted. In 2013, 350ha were under SRI and the area is increasing every year. Elsewhere in the province, 9,000ha are now (2015) under ratoon cultivation during the spring-summer season provides a reasonable crop in about 60% of time of conventional transplanted rice, avoiding water shortages, while keeping costs down. In Le Thuy, now 7,500ha of 9,000 of late spring is ratoon rice from the winter/spring crop. In some estuarine areas, salinization is causing declining yields - and there is a drive to covert these underproductive areas, amounting to some 2,000ha, or 7% of the total paddy area, to other crops or shrimp production.

Other adaptation and production strategies being tried in Quang Binh include:

- Switching from longer to medium and short duration rice varieties.

- Switching from rice to non-rice crops, such as maize, green beans or fodder grasses that are less sensitive to drought. In 2013, 380ha were switched to other crops; by 2015, this had increased to 1,500ha.
- Shifting the planting date of the winter-spring rice from December to September, and early summer rice to February, to avoid extreme cold in January.
- Adjusting rice variety, cropping calendar and planting pattern to ensure flowering in May - the optimal time to ensure high and consistent yield.
- Breeding rice for seed in southern provinces of Quang Nam and Da Nang.
- In areas of saline intrusion (Le Thuy and Quang Ninh), introducing crop rotations, of rice and fish, or rice and shrimp.

Table 4.11: Other principal annual crop areas and yields by district, Quang Binh, 2013

| Crop District | Maize | | Sweet potato | | Cassava | | Peanuts | |
|---------------|-------------|--------------|--------------|--------------|-------------|--------------|-------------|--------------|
| | Area (ha) | Yield (t/ha) | Area (ha) | Yield (t/ha) | Area (ha) | Yield (t/ha) | Area (ha) | Yield (t/ha) |
| Dong Hoi city | 57 | 3.7 | 89 | 6.6 | 48 | 7.4 | | |
| Ba Don town | 315 | 5.0 | 850 | 8.3 | 49 | 8.4 | | |
| Minh Hoa | 947 | 5.2 | 140 | 5.6 | 334 | 10.0 | | |
| Tuyen Hoa | 1054 | 5.0 | 330 | 7.3 | 290 | 10.2 | | |
| Quang Trach | 340 | 4.6 | 877 | 7.8 | 571 | 8.6 | | |
| Bo Trach | 1160 | 5.4 | 435 | 7.1 | 3278 | 23.8 | | |
| Quang Ninh | 360 | 3.5 | 191 | 7.4 | 403 | 19.0 | | |
| Le Thuy | 264 | 2.8 | 820 | 6.1 | 870 | 12.3 | | |
| Total | 4497 | 3.7 | 3732 | 7.4 | 5843 | 18.5 | 6500 | 2.7 |

Source: DARD 2014 and 2015

Other field crops

Table 4.11 presents the most recent available data on the cultivation areas and yields of the principal field crops for the districts of Quang Binh. The area under any particular annual field crop depends a lot on market conditions and government policy and in many places, farmers can switch amongst them. Certain crops, notably cassava and maize, are primarily grown for export to China. The government targets certain crops in certain areas - so for example, in some communes, over 97% of house-holds plant cassava. Bo Trach has the largest area of field crops, grown in the hilly area inland of the narrow coastal plain.

Maize is the second most important annual food crop in Quang Binh, helping to ensure food security in the upland districts of Bo Trach, Tuyen Hoa and Minh Hoa, where paddy rice growing is limited. Most of the maize is planted in the spring and summer seasons. The area grown has increased steadily since 2001 and is expected continue to expand as climate change adaptation policy suggests using maize to replace rice in marginal areas with limited irrigation.

In 2015 the total area of cassava in the province was 6,500ha. The area has steadily increased from 3,842ha in 2001 to 5,843ha in 2014 and 6,500ha. In the past, cassava was grown for human consumption, then later for animal food, and now is now high demand for animal food, food processing (for tapioca starch, for candies, cakes), and especially as raw material for industrial production of methanol/ethanol. Now cassava for industrial purposes accounts for 5,500ha, and the area is expanding rapidly. Cassava is normally planted in hilly areas but now is also planted in flat areas, event replacing some rice fields and providing higher production and income. This can also be considered as a form of adaptation as cassava requires less irrigation than rice.

Peanuts are highly suitable on Quang Binh's sandy soils. They have been planted for many years and the cultivation area continues to increase. In 2015, 6,500ha were planted and produced a harvest of 17,300tonnes. Planted in spring, it is being promoted as a Climate Smart Crop, to replace paddy, where irrigation is difficult.

Beans and vegetables, including chili, have also become important since urbanisation and tourism.

Perennial crops

Rubber is the most important perennial crop in Quang Binh, the cultivation area growing rapidly from 3,931ha in 2001 to 17,980ha in 2014. It is very suitable in the lower hill areas of the province, although it suffers from extreme climate events - cold spells in winter that affect latex yields and storm damage; Storm 11 of 2013 damaged half the planted area. Nevertheless, the province plans to adapt to these threats and increase the area under rubber to 23,000ha by 2020. However, planting in 2015 was only 25% of that planned, due to low latex prices.

Pepper is increasingly important. The planted area nearly doubled between 2001 and 2005 to 718ha, but planting then slowed, so by 2014 there were nearly 900ha of pepper. It is grown on relatively small plots, primarily in hilly areas. By 2020 it is planned to have 1,500ha, producing 1,725t/year.

The third key perennial category is fruit, and currently there are 3,500ha with production of 20-25,000 t/yr. The province is focused on developing high-value high-demand crops such as the Phu Trach Pomelo, oranges, bananas through improving garden management.

Livestock

Although livestock numbers are not high, the sector currently contributes about 45% of agricultural GDP. Pigs are most important.

Disease prevention and control are increasingly concerning with serious outbreaks in neighbouring provinces. DARD is developing vaccination programmes and responses to epidemics.

The SEDP aims to raise the contribution of animal husbandry to 48% of the total value of agricultural production by 2020, by:

- Promoting larger more commercial and more intensive animal production units. In 2015 there were 107 livestock farms³, mostly raising pigs, but also including some 20 cattle farms using Zebu hybrids, and poultry. All these farms are located in the coastal districts.
- Continued genetic improvement “Sindhilisation” of cattle herds through AI, with the aim of increasing proportion of highly productive Zebu hybrids from 38% to 65% of the provincial herd by 2020; cross breeding of pigs to increase the proportion of meat to fat.
- Promoting highly nutritious pasture grasses for cattle rearing.
- Promoting high value species: deer, bees, goats, ostriches, French ducks.

4.2.4.1.2. Forestry

The forest sector is extremely important to Quang Binh’s socio- economy and environment. The resource management part of the sector contributes 850,000m VND to the economy, and involves nearly 70% of the land area, while forest industry add a further 1.9b VND and tourism to the Phong Nha-Ke Bang National Park adds another sum. The sector has been transformed in recent years from one based on exploitation (logging) to one focused on plantation development, protection and conservation. These priorities continue to orientate management and planning.

Quang Binh’s Forest Estate

Details of the forest situation in Quang Binh are not easy to understand accurately, as forest statistics are incomplete and inconsistent, and maps are difficult to interpret. Table 4.12 presents data from both DONRE and DARD on forest cover under the three main forest types. According to DONRE’s land use figures from 2013, 78.2% of the total land area, or 630,000ha is forest, with 38% production forest, 25% protection forest and 15% special use forest. However, DARD figures show forest cover of 561,621 ha or 69.6% of total land area, with 34% under production, 20% protection and 15% SUF. Table 4.13 records the forest area statistics in 2014 as they relate to management responsibility and reports 588,948ha or around 70% total forest cover; and elsewhere DARD states plans to increase forest cover to 65% by 2015 and to 70% by 2020, suggesting that the reality was lower than that. A DARD report from 2015 states forest cover at 68%, and anticipates finalisation of plans for the “three forest types” by 2020¹⁰.

³ A “farm” is defined variously by income, area and production capacity, depending on the product and region. In the North Central Coast, a farm exceeds 40 m VND/year (~ USD 2,000), a crop production area > 2 ha; perennial crop area > 3 ha; forests farm > 10 ha; aquaculture area > 2 ha; shrimp area > 1 ha; large animal (cow, buffalo, horse) farm for milk or breeding > 10 head; large animal farm for meat > 50 head; small animal (sheep, goat) for milk or breeding > 20 head; small animal for meat > 100 head; poultry farm > 2000 ha.

Of particular interest to the EbA study is the proportion of natural to plantation forests, as natural forests provide more environmental services than plantations, but plantations tend to deliver more income. Again, there are inconsistencies in the data from different sources, as evident in the different tables. Table 4.12 provides DARD's breakdown of the forest area into natural and plantation forest, indicating that 86% (481,349 ha) of the forest is natural⁴. Other data reveal that of the 14% that is plantation, one-fifth is newly planted. The planted area is increasing by about 1,000 ha per year, but it is not clear how much of the planted area was previously under-productive natural forest and how much was barren land.

Natural forests are further classified by their quality: rich, average, poor and rehabilitation. Criteria for defining these classes, data on the relative extent and understanding on the drivers of quality change were not available. Poor forest is very vulnerable to being converted to plantation.

Table 4.12: Proportion of 3 Forest Types in Quang Binh, 2014

| Forest Type | DONRE (2013) | | DARD (2014) | | | | | |
|---------------------------|----------------|-------------|----------------|-------------|----------------|-------------|---------------|-------------|
| | TOTAL | | TOTAL | | Natural Forest | | Plantation | |
| | ha | % * | ha | % * | ha | % * | ha | % * |
| Production forest | 309,253 | 38.3 | 275,498 | 34.2 | 209,939 | 26.0 | 65,559 | 8.1 |
| Protection forest | 198,043 | 24.6 | 162,867 | 20.2 | 148,224 | 18.4 | 14,643 | 1.8 |
| Special use forest | 123,576 | 15.3 | 123,256 | 15.3 | 123,186 | 15.3 | 70.20 | 0.0 |
| TOTAL | 630,872 | 78.2 | 561,621 | 69.6 | 481,349 | 59.7 | 80,272 | 10.0 |
| % of forest area | | | | 100 | | 86 | | 14 |

Source: QB DONRE; QB DARD – Change in forest cover 2004-14 * of total land area

Forests are also classified by their management arrangements, with consequences for livelihoods and ecosystem services. Table 4.13 provides a summary of available data. Four major types of forest manager can be identified: Special Use Forest Management Boards (2), State Forest Enterprises (2), Protection Forest Management Boards (8) and private households. Together, they manage 86% of the forest area. In addition, there are three minor types of forest manager: military/security; communes and "other organisations". A substantial area of forest (68,568ha) remains unallocated.

Table 4.13: Forest Managers in Quang Binh, 2014

| Management Type | Management | Area | Total Area | % |
|-----------------|------------|------|------------|---|
|-----------------|------------|------|------------|---|

⁴ DARD figures on plantation areas under different managers for 2014 (Table 11) report a total plantation area of 93,000ha. Further, DARD data from 2004 indicate a natural forest area of 334,000ha across the three forest types, so it is difficult to understand how the area under natural forest increased by nearly 30% in the intervening 10 years.

| | Authority | (ha) | (ha) | |
|---|-----------------------------|---------|----------------|------------|
| I. Special Use Forest Management Board | Phong Nha- Ke Bang NP | 126,168 | 126,304 | 21.4 |
| | Historical- Cultural forest | 136 | | |
| II. State Forestry Enterprise | Long Dai LLC | 91,834 | 124,365 | 21.1 |
| | North Quang Binh LLC | 32,531 | | |
| III. Protection Forest Management Board (PFMB) | Minh Hoa PFMB | 19,713 | 148,306 | 25.2 |
| | Tuyen Hoa PFMB | 28,905 | | |
| | Quang Trach PFMB | 12,295 | | |
| | Dong Hoi PFMB | 2,968 | | |
| | Long Dai PFMB | 38,027 | | |
| | Ba Ren PFMB | 11,849 | | |
| | Dong Chau PFMB | 18,327 | | |
| | Coastal Quang Binh PFMB | 11,513 | | |
| IV. Security, defence Units | | | 3,946 | 0.7 |
| V. Private Households | | | 110,950 | 18.8 |
| VI. Not yet allocated | | | 68,658 | 11.7 |
| VII. Communes | | | 2,390 | 0.4 |
| VIII. Other Organizations | | | 4,029 | 0.7 |
| Total Forest Area of Quang Binh | | | 588,948 | 100 |

Source: DARD

Forests on Sand

As of 2015, almost 27,000ha of the coastal sandy areas are designated as protection forest - most of this (about 85%) has some amount of tree cover but there is still about 3,800ha of bare land.

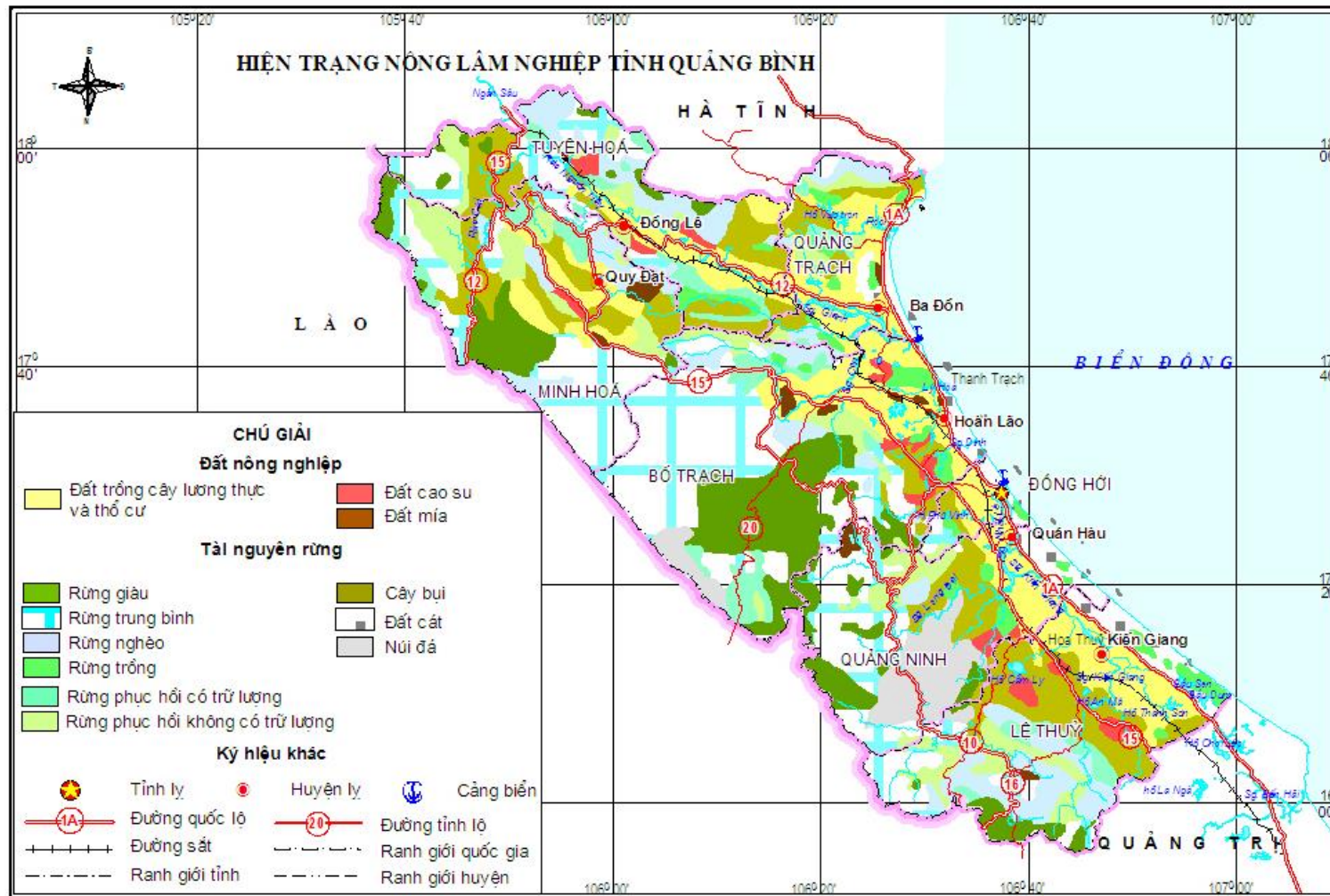
Table 4.14: Areas of protection forest on sand in Quang Binh (ha) (2015)

| District | Total sandy areas | Planned forest land | Protection forest | Bare land |
|--------------------|-------------------|---------------------|-------------------|--------------|
| Quang Ninh | 5,744.0 | 3,609.3 | 3,290 | 319.3 |
| Le Thuy | 10,345.3 | 7,538.1 | 6,756.1 | 782 |
| Bo Trach | 356 | 353.4 | 161.7 | 191.7 |
| Quang Trach | 2,443.6 | 855.1 | 799.9 | 55.2 |
| Dong Hoi | 2,197.9 | 935.3 | 691.3 | 244.0 |

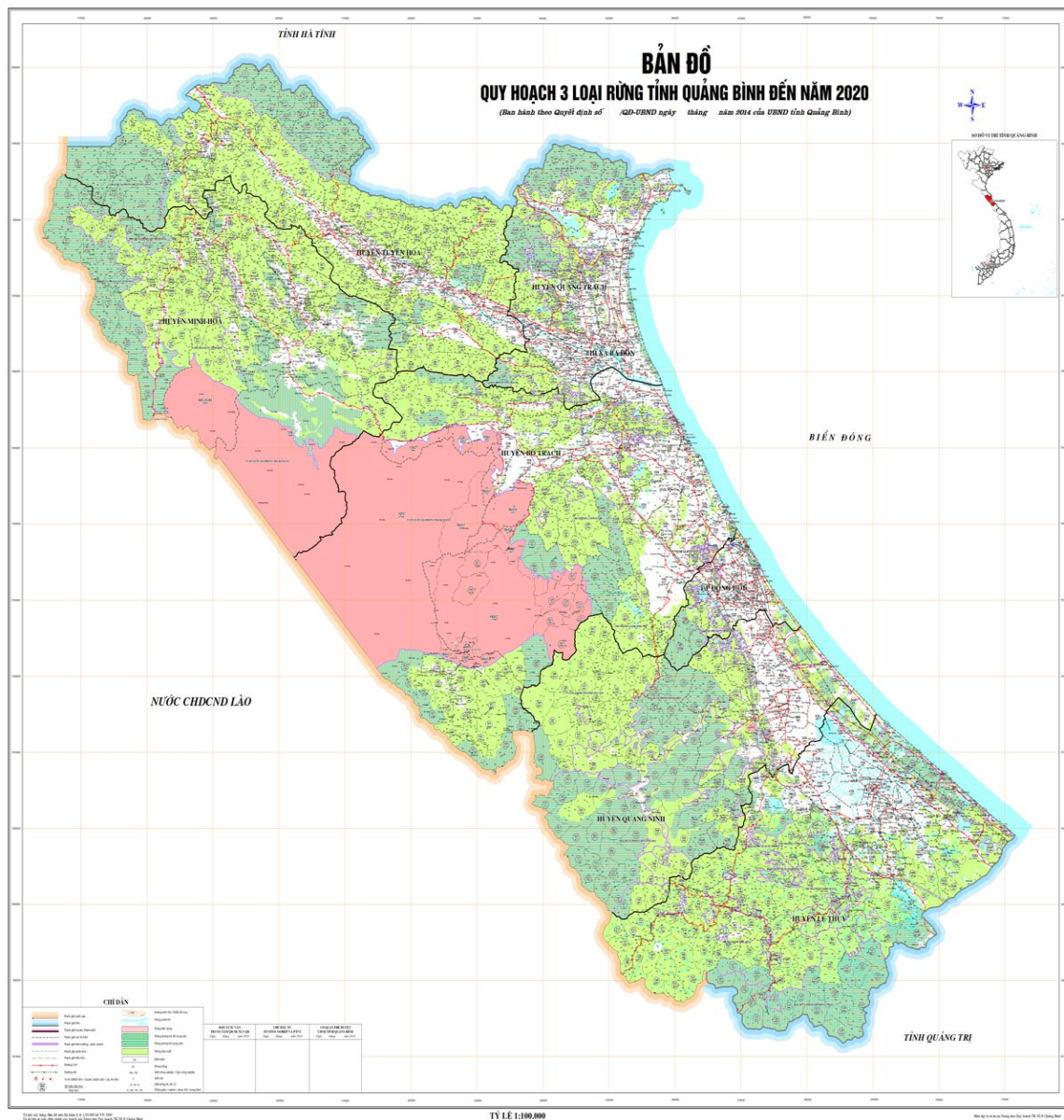
Sources: Forest development Department of Quang Binh province

Protection forests on coastal sands are found in 5 districts. Most of these forests have been established since 1964, as plantations of *Casuarina equisetifolia* to control blowing and moving sand. However, because of poor soil, *Casuarina* often grows poorly and adopts a creeping habit and in recent years foresters have experimented with other species - such as *Acacia auriculiformis*, *Acacia crassicarpa* and some species of *Eucalyptus*. In areas where it does grow well, it is heavily exploited by local people for firewood.

Map 4.2: Current Status of Agriculture and Forestry Industry in Quang Binh 2011



Map 4.3: Forest Management Units in Quang Binh



The single largest forest management unit is the Phong Nha-Ke Bang National park, which consists of 126,168ha of primarily limestone forest. The SFEs are much reduced in size since 2004, largely due to the allocation of their areas to households and forest protection management boards. It is unclear how many households have received forest land, where they are or what they have done with their forests as data does not appear to be collated at the provincial level. There is an issue with the allocation of natural forest to villagers, who usually cut it down and plant crops, rubber or acacia.

The **Special Use Forests** comprise national parks and nature reserves and protect most of the rich very high biodiversity forests, including remaining areas of primary forest on the Eastern flank of the North Truong Son mountains on the border between Vietnam and Lao PDR. **Protection Forest Management Boards** are also responsible

for large areas of natural forest - most designated as watershed protection forest. These estates also include some plantation forest. Quang Binh's two **State Forest Enterprises** manage most of the province's production forest including both natural and plantation forests. **Households** manage 45% of the province's plantations. Land allocation data was not available, but it appears that under-productive natural forest as well as barren forest land is allocated, and much of the former is converted to plantation.

Table 4.15: Plantation forest ownership, Quang Binh, 2014

| Owner | Quang Binh | |
|-------------------------------------|------------|-------|
| | Area (ha) | % |
| Special Use Forest Management Board | 10, 580 | 11.38 |
| Protection Forest Management Board | | |
| State Forest Enterprises | 20,861 | 22.14 |
| Other organizations | 1,510 | |
| Commune People Committee | 18,400 | 19.79 |
| Households | 41,944 | 45.12 |
| Total | 92,944 | 100 |

Source: QB DARD

Forest production

In 2014, the forest sector generated 824 billion VND, 85% of which came from timber harvesting and the remainder from forest planting and services (14%) and NTFP (1%). Around 250,000 m³ of timber is harvested, of which 97% is from plantations. The main species are *acacia* hybrid and *Pinus merkusii*, and there are 5,129ha of rubber on forest land. Overall, 80% of harvested timber is chipped and 20% goes for sawn timber or poles. Harvesting natural forest was prohibited in 2013, but the Long Dai SFE in Truong Son Commune has 31,483ha of FSC-certified natural forest, from which it harvests about 5,500m³ pa of *Aglaia gigantea* (Gội), *Dipterocarpus alatus* (Dầu rái), *Erythrophleum fordii* (Lim), *Garuga pinnata* (Chủa), *Heritiera cochinchinensis* (Huỳnh) and *Sindora tonkinensis* (Gu) (FSC 2015). The North Quang Binh SFE has no quota at all for harvesting natural forest. The key NTFPs are resin, from the pine plantations, bamboo and rattan. Production of resin is dropped by 40% between 2012 and 2014. Some illegal logging does go on - contributing to the local economy - but data are not available.

Table 4.16: Forest production in Quang Binh, 2014

| Item | Volume (m ³) | Value (VND) |
|-------------------------|--------------------------|-------------|
| Timber (natural forest) | 5,500 | |
| Timber (plantation) | 17,300 | |
| Chips and pulp | 230,158 | |
| Bamboo sticks | 343,000 | |
| Pine resin | 2,700 tonnes | |
| Rattan | 958 tonnes | |

Forest Industry

In 2015, there were 77 forest industry units in Quang Binh, of which 70 were timber-based, and 7 were NTFP-based. DARD admits that, in general, the province's forest industry employs primitive technology and generates poor quality products. There are several wood chip mills exporting directly to China and Japan, and also some sawmills processing native timbers and acacia mostly for the domestic market⁵. Another mill processes bamboo into plywood. There are two large furniture factories and numerous smaller facilities in rural areas. There are several boat building yards, using, amongst other species, domestic and imported "lim" (*Erythrophleum fordii*), much of which may be illegal.

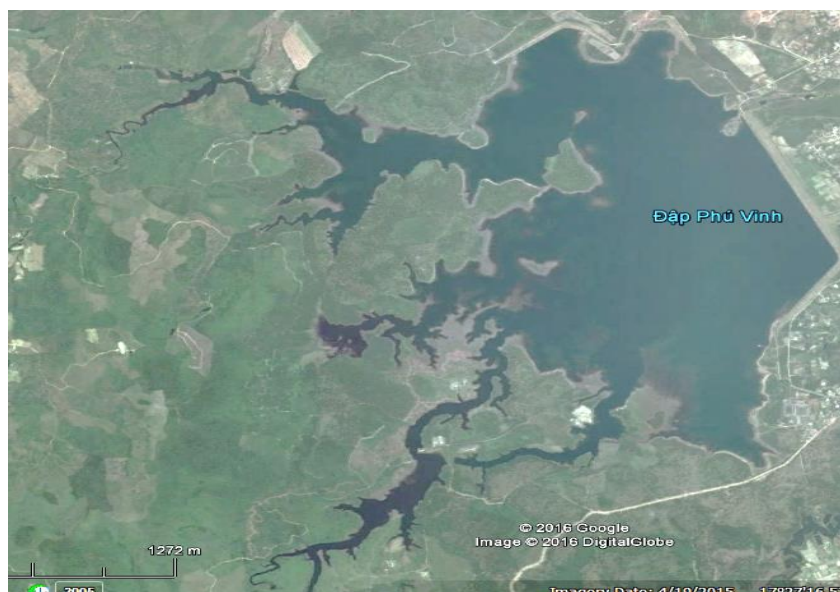
Forest Development

Forestry development to 2020 is, like in other sectors, focused on increasing productivity through application of modern technologies (species selection, quality seed, tissue culture) and business methods, including larger-scale management units.

DARD has a policy of enhancing the economic value of forest land through planting schemes. Most planting is acacia and other exotic monocultures, mostly for pulp. However, short-rotation industrial crops leave soils in critical watersheds vulnerable to erosion for three out of every five to seven years of a rotation, which may have significant consequences for sedimentation and in-filling of downstream reservoirs. Over repeated rotations this could also deplete soil fertility, despite the nitrogen fixing capacity of species like acacia. Photo 4.1 shows the production forest under state forest enterprise management around the Phu Vinh reservoir near Dong Hoi City; the large areas of bare land are likely to contribute to siltation. More work needs to be done to explore the impacts of short-rotation monocultures on the watersheds and consider how EbA approaches could result in better management of this important "green infrastructure".

⁵ Data unavailable

Photo 4.1: Production Forests around the Phu Vinh Reservoir near Dong Hoi City, showing large proportion of bare land



Reforestation has been taking place at a rate of 1-2,000ha per year, and 18-20,000ha are to be planted during the period 2011-2020. Of this, 65% is intended to supply wood processing plants.

Forest protection continue to be a problem, and efforts will be redoubled to control illegal exploitation and clearance and forest fires, including through improved awareness raising, forecasting and communication and preparedness.

Although government policy is to enhance forest protection, combat its illegal use, conserve biodiversity, manage watersheds, many proposed measures seem contrary to these objectives:

- conversion of “poor forest” to rubber and other estate crops;
- large scale “enhancement” of natural forest by plantation establishment;
- increased production of native timber to 10-15,000 m³ pa;
- continued allocation of natural forest to households.

Natural forests are generally quite resilient to climate change, but young plantation forests, like rubber plantations mentioned above, are vulnerable to wind throw and other storm damage.

4.2.4.1.3. Fisheries

The government sees Quang Binh’s future comparative advantage in the marine sector, and wants to concentrate investment to bring fisheries to prominence as a driver of economic development. In 2015, the sector produced 69,000 mt of fish and shellfish - a 134% increase over 2010. In 2014, fisheries contributed 2.9 trillion VND to the provincial economy - less than agriculture and livestock, but more than forestry. Of the 30,000 people employed in the sector, 80% work in the capture fishery, which is about twice as valuable as aquaculture. A considerable number of industries, services and logistics are associated with fisheries, further adding to the economy.

Currently 85% of production is consumed in the province and in the region, and 15% exported, primarily fresh fish, shrimp and squid, to China.

The future of fisheries in Quang Binh is seen as commercial shrimp production, especially on sand, and the restructuring of the capture fishery from many small-scale inshore boats, to a smaller fleet of larger off-shore boats exploiting the abundant resources of deeper waters and, importantly, helping to protect national sovereignty towards sea areas and islands.

There is much interest globally about the impact of climate change on fisheries. In a study by Malone and Brenkert (2008) Vietnam was assessed as the most sensitive country in the world in terms of the importance of its fisheries to its economy, and another recent study (Allison et al 2009) ranked Vietnam as 24th in the world in terms of relative national economic vulnerability to climate change impacts on its capture fishery. Coastal mangroves, salt marshes and coral reefs, which are critical to breeding marine life, are all threatened by temperature rise, storms and storm surges. Coral reefs are degraded by ocean acidification that comes with increasing atmospheric CO₂. The ranges and populations of algae, plankton and fish are affected by increasing water temperatures, as well as the changes in accompanying levels of salinity, oxygen and circulation. In the South China Sea and indeed worldwide, as ocean temperatures rise, species from tropical waters are migrating towards the poles at a rate of about 17km per decade (King 2015). Fishing stock scarcity caused by the new migration patterns is exacerbated by over-fishing. In Vietnam, coastal waters are warming fastest and fish are migrating off-shore - putting them out of reach of many poor artisanal fishermen. Climate change also affects the fisheries through increased incidence and severity of storms, storm surges and water spouts. Many small fishing boats are destroyed each year. Two storm shelters have been built in the Roon and Gianh River estuaries, each accommodating 800 larger boats, but most of the small boats are simply pulled high up on the beach. These changes exacerbate existing political conflicts between neighbouring states; disputes over fishing rights in the South China Sea between China, Vietnam and Philippines are increasingly acute.

Capture fishery

The capture fishery in Quang Binh engages around 28,000 people in 18 coastal communes¹². Over 100 species are exploited, including fish, shellfish, shrimp and squid. Over 57,550 metric tonnes were produced in 2015, an increase of over 130% since 2011. In 2014, the capture fishery earned 1,896,581 million VND, making it the most valuable part of the Primary Sector.

The structure of the capture fishery, shown in Table 4.17, is based on engine size, reflecting the distance from shore of the waters exploited. A diverse array of equipment and technologies is used, including gillnets, seines, trawls.

Table 4.17: Structure of Quang Binh's Capture Fishery

| Engine size (horsepower) | Number of boats | Fishing Area |
|-----------------------------|-----------------|----------------|
| >400 HP | 0 | Distant waters |
| 200 | 800 | Off-shore |
| 94 | 1400 | Off-shore |
| 20 | 2000 | Near shore |
| TOTAL | 4200 | |

Currently there are some 2000 small often woven bamboo-hulled boats (20 h.p.), operated from beaches by groups of 6-10 men and fishing on-shore (within 10km of shore). The fishing season is limited by storms in winter. The main catch is sardines and mackerel, some boats specialise in squid. Routine catches are landed and sold on the beach near the largely poor villages where the fishermen live. Although data are not available, it is said that the near-shore fishery is over-exploited, illegal fishing methods (pesticides, electric current, bleach, small mesh-sized nets) are widely used and the proportion of "trash fish" and "undersized fish" is now around 60%. For this reason, the government is encouraging the redeployment of this labour to larger boats for off-shore fishing, into aquaculture, processing, and even out of the sector altogether, into horticulture and animal husbandry. Loans are made available for groups of fishermen to buy larger boats; nearshore boats should reduce by 300 per year.

By 2020 it is planned to have 1,500 boats over 90 CV, and to have reduced the inshore fleet of boats less than 20 hp to less than 1,000 units. Government also wants to encourage the development of factory fishing fleet of over 1,000 vessels of 400 HP or more, fully equipped with modern fish detecting technology, on board facilities to exploit distant waters, and has plans to develop all the port and auxiliary infrastructure (storm shelters, markets, landings, repair yards) required. Cooperatives will be the main mechanism for consolidating exploitation into larger vessels, and to promote aquaculture development by small operators. Wooden boats will be replaced by iron hulled boats, reducing the environmental impact.

In early April 2016, the fishery was hit by a mass die off of fish, caused by pollution emanating from the Formosa Steel Mill in the Vung Ang Special Industrial Area in southern Ha Tinh. The incident has had a serious impact on the fishing community. Fishing was prohibited until late June, when the company finally admitted responsibility¹². Initially, land based pollution from agriculture and aquaculture, in combination with climatic events and climate change were blamed.

Aquaculture

Quang Binh's aquaculture sector currently occupies nearly 5,000ha and produced 12,000mt in 2015, 85% of which is consumed in province. Production is concentrated in the coastal districts of Bo Trach, Quang Ninh and Le Thuy (see Table 4.18 and Map

4.4), but cage fish rearing is found quite far inland along major rivers. Table 4.19 presents figures for the growth of the sector, showing that it expanded by over 50% between 2005 and 2010, but grew only very modestly (6%) between 2010 and 2014. Today, the biggest production area is for freshwater fish, but the highest value comes from the much smaller area of intensive brackish water shrimp production. However, disease in shrimp rearing is affecting 30-70% of the area - resulting in some producers failing entirely. Disease is likely to be exacerbated by the higher temperatures resulting from changing climate.

Soft-shell turtles (*Tryonyx steinachderi*) are now being raised in freshwater ponds for meat and breeding in a pilot location in Quang Trach (see Map 4.4). They bring high incomes for farmers and another pilot is planned in Le Thuy.

Table 4.18: Aquaculture Area in Quang Binh, by district, 2014

| District | Dong Hoi | Ba Don | Minh Hoa | Tuyen Hoa | Quang Trach | Bo Trach | Quang Ninh | Le Thuy | TOTAL |
|------------------------------|----------|--------|----------|-----------|-------------|----------|------------|---------|----------------|
| Aquaculture Area (ha) | 376 | 480.6 | 36.5 | 66.2 | 244.1 | 1,026.2 | 1,122.5 | 1,616.6 | 4,968.7 |

In Quang Binh, there has been no practice of raising fish (or ducks) in rice paddies, along with the rice crop, but consideration is now being given to this.

Extreme weather events, such as storms and storm surges can flood coastal aquaculture ponds, sweep away fish or kill them from the shock of a rapid salinity change. On the other hand, saline intrusion into near-coast paddy lands makes their conversion to aquaculture a viable option. Fresh water cage aquaculture, which takes place inland Eamu Lake, Minh Hoa commune, is also affected by climate change: temperature rises increase evaporation from lakesurface, leading to water shortages. Enhance algal populations compete with fish for oxygen, reducing fish outputs by up to 50%.

Fish Processing Industry

Currently, Quang Binh as two seafood processing facilities, producing frozen and dried seafood and fish sauce and in future a fish meal processing plant is planned near Hon La port. The government target is that by 2020, 35% of total fish production will be processed, of which 20% will be exported.

Map 4.4: Capture Fishery and Aquaculture in Quang Binh 2011

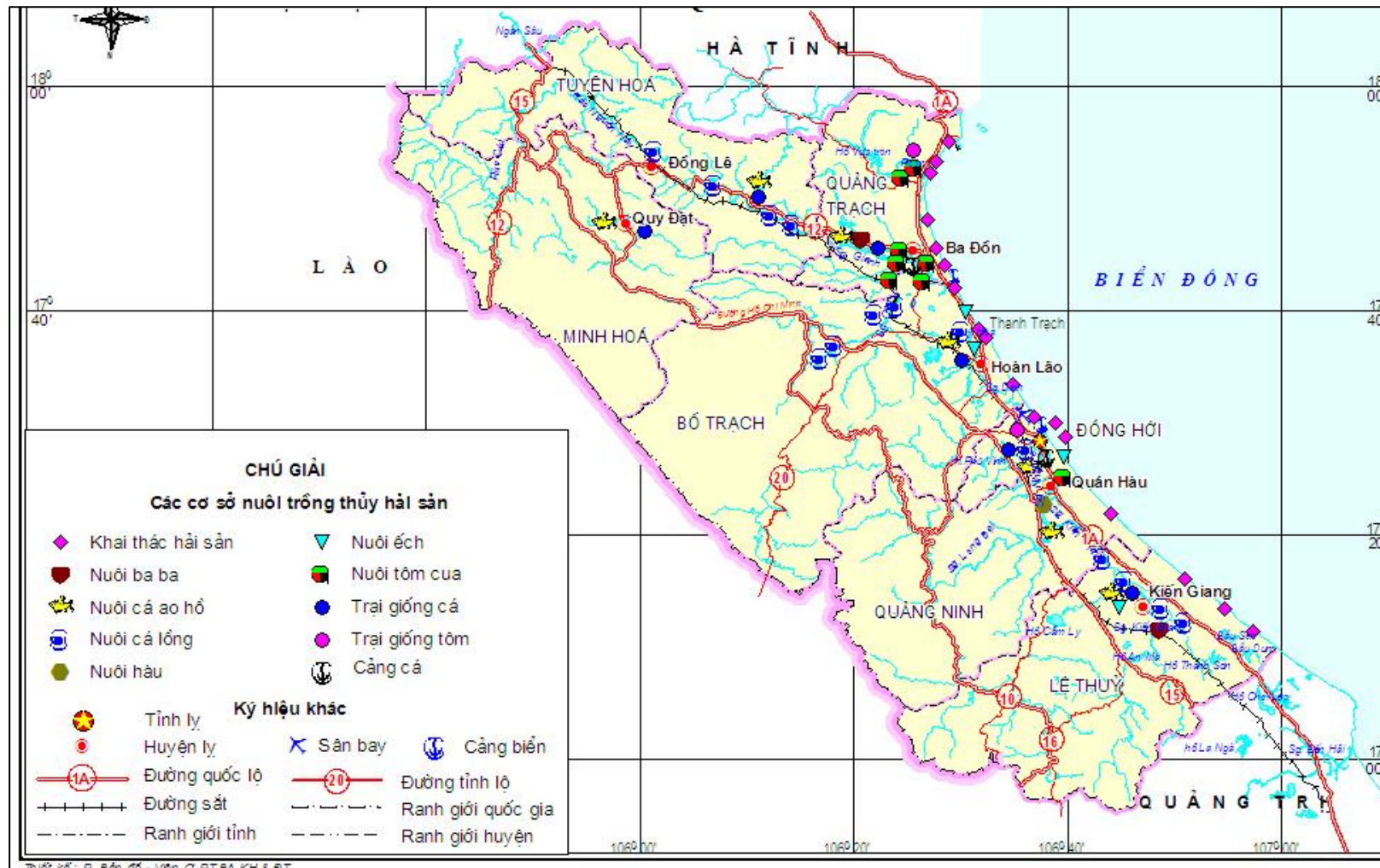


Table 4.19: Aquaculture Area (ha) in Quang Binh by Product, farming method and water type, 2010-2014

| | Year | | | | |
|--|---------------|---------------|---------------|---------------|---------------|
| | 2010 | 2011 | 2012 | 2013 | 2014 |
| By Product | | | | | |
| Shrimp | 1052.5 | 1064.7 | 1068.2 | 1020.3 | 1001.8 |
| Fish | 3464.9 | 3404.0 | 3433.9 | 3477.2 | 3796.2 |
| Other aquatic species | 200.2 | 163.9 | 162.5 | 167.1 | 170.7 |
| By Farming Method | | | | | |
| Intensive aquaculture | 916.1 | 899.6 | 1571.2 | 1247.0 | 1179.0 |
| Semi intensive aquaculture | 1817.5 | 1784.8 | 2281.3 | 2629.9 | 2555.1 |
| Extensive / improved extensive aquaculture | 1984.0 | 1948.2 | 812.1 | 787.7 | 1234.6 |
| By Type of Water | | | | | |
| Freshwater | 3443.6 | 3409.3 | 3426.6 | 3471.8 | 3788.0 |
| Brackish water | 1274.0 | 1223.3 | 1238.0 | 1192.8 | 1180.7 |
| Salty water | - | - | - | - | - |
| TOTAL | 4717.6 | 4632.6 | 4664.6 | 4664.6 | 4968.7 |

Source: DARD 2014 and 2015

The province has 3 shrimp nursery stations, 8 fish nursery stations supplying 5-7 million tiger shrimps larvae, 40-45 mil fish larvae and 4-5 million fish fingerlings annually.

Deeper sea resources are said to be plentiful, but the current fishing fleet is not equipped to exploit it.

4.2.4.1.4. Mining¹⁵

Quang Binh has significant mineral resources, including titanium gold, silver and lead, which are attracting considerable foreign investment from China and Australia. In addition, there is abundant limestone, quartz, kaolin, slate, marble and granite, on which an important building materials industry is based, most notably cement.

Illegal mining of river sand and gravel on the Gianh River has become an issue, causing the river to change course. Likewise, dune mining for titanium leads to erosion of this essential coastal protection feature.

4.2.4.2. THE SECONDARY SECTOR: INDUSTRY AND CONSTRUCTION

The secondary sector transforms raw or semi-processed materials into finished or semi-finished products for consumption or further transformation.

4.2.4.2.1. Industry

Industry (including construction) contributes 25% of provincial GDP. Most important is the production of cement and other construction materials from limestone, clay deposits and other non-renewable natural resources. Food (cassava, seafood, rice), timber (chips, sawn wood, paper) and rubber processing, based on renewable

natural resources are of approximately equal importance. As discussed above, many of these resources are sensitive to climate change. In addition, there are industries based, all or in part, on imported materials - beer, textiles and garments, aluminium, ship building, electronics assembly.

Industrial Development

In the coming years, the government plans for industrial development are to focus on areas where Quang Binh has comparative advantage: the marine economy, including seafood processing, ship building and repair and seafloor mining⁶, as well as improving technologies and increasing production in other existing industries.

Throughout Vietnam, and much of E and SE Asia besides, specially constructed industrial areas are highly favoured by governments as means of stimulating economic investment. They take various forms - industrial parks, special economic zones, etc. Quang Binh currently has two industrial park (Dong Hoi and Hon La) and two special economic zones with preferential investment and tax treatments (Hon La - near the seaport, and the Cha Lo Border Gate Economic Zone in Minh Hoa District, where Asia Highway 131 crosses into Laos). By 2020, it plans to have a network of 8 industrial parks with an area of 2,060ha and distributed in the districts and cities of the province. These can have unintended environmental economic impacts. Site clearance and development degrades natural ecosystems and can create off-site problems. Further multiple economic zones can and frequently do compete with each other and planning should proceed cautiously and step-wise, in full awareness of off-site implications and climate change vulnerabilities.

4.2.4.2.2. Construction

Construction contributed 4.9 bil. VND in 2014, making it the second most important sector by value. This reflects Quang Binh's current stage in the development process, with much of the SEDP focused on infrastructure. The government acts as the main investor in construction projects and there is a tendency to "over-construct". This will not and should not last, and the province is endeavouring to diversify its economic base.

4.2.4.3. THE TERTIARY SECTOR: SERVICES, INCLUDING TOURISM

The services or "tertiary" sector in Quang Binh includes economic activities such as wholesale and retail trading, banking and financial services, legal and accounting services, telecommunications, transport, health care, media, entertainment, hospitality and the like. These are mostly "face-to-face" transactions that do not deliver a concrete product, but support activities in the primary and secondary sectors. The most important tertiary sector activity in relation to EbA in Quang Binh is tourism.

Tourism

⁶ Sea floor mining typically takes place at depths in excess of 800m. Since the Gulf of Tonkin, offshore of Quang Binh is less than 100 m in depth, this implies that exploitation will take place in international and potentially disputed waters.

The number of visitors to Quang Binh in 2015 was 2.86 million, of which foreign tourist arrivals were 46,900, an increase of 8.9% over 2014. Overall tourism revenues, including hotel and restaurant takings, increased 19% to more than VND 179 billion (USD 8 million)⁷.

The main tourist destination is the Phong Nha-Ke Bang National Park and World Heritage Site, which depends on the environmental services of spectacular above and below-ground natural landscapes and in-tact, bio-diverse ecosystems for its draw. The province also has fine white sand beaches, hot springs and numerous cultural/historical sites, including Vung Chua - the resting place of Vietnam's national hero, General Giap. These sites benefit, though to a lesser extent, from the same environmental services. New resort developments and golf courses are planned, but these are more dependent on modern infrastructure, urban-style services and designed landscapes.

Although national tourists to Quang Binh are by far the most numerous, the international tourists are most focused on eco-tourism and pay the most money. The demands of the two very different tourist markets need to be balanced strategically. An interesting illustration is provided by the Son Doong Cave, the largest cave in the world, located in Phong Nha-Ke Bang National Park. In 2014, 243 tourists visited the cave, paying \$3,000/person for 5 night packages. By the end of August 2015, this number had risen to 482, including 47 Vietnamese, and the limit of 500 visitors has already been booked for 2016. It is unclear what impact the planned mass-tourism development of a cable car to the mouth of the cave will have on total revenues from what is currently a niche-market "eco-tourism" asset.

The provincial government recognises the natural advantages that Quang Binh has for tourism, and plans to increase tourism revenues by 18-19% for the period 2011-2020, attracting 1.4-1.5 million tourists by 2020, including 90-100,000 international guests. However, plans for tourism development, as with other sectors, are focused on infrastructure: "Investment in construction of tourism products of high quality, large scale" (SEDP 2011). It has to be realised that from the perspective of international tourists, excessive infrastructure can detract from eco-tourism destinations.

Trade

The total value of Quang Binh's trade in 2014 was 18 trillion VND, mostly arising from retail sales and small supermarkets, notably Coopmart and various services. There are large wholesale "wet markets" in the urban areas Dong Hoi and Ba Dong. Available data show Quang Binh's trade growing at 15% annually.

Rural markets are particularly vulnerable to climate change. Storms and floods can cut off communities for several days, resulting shortages of food and other goods in some locations. The government's "four on the spot" programme is intended to prepare for such events, but it is not implemented everywhere.

4.2.5. Key Assets supporting the economic sectors

⁷ <http://tuoitrenews.vn/business/32206/tourism-revenue-in-vietnamese-province-soars-thanks-to-son-doong-cave-officials>

4.2.5.1. TRANSPORT

4.2.5.1.1. Roads

The National Road No. 1A and the Ho Chi Minh Highway are the main North-south road arteries of the province. On the East-West Transport Corridor, the National Road No. 12A connects Quang Binh with Laos, Northeast Thailand, Myanmar and the Greater Mekong sub-region through Cha Lo international border gate, and this road is considered the shortest and most convenient route to these neighbouring countries.

Landslides present the greatest threat to the provincial road network - affecting all types for roads from the Nation 1A, to small rural roads - and climate change is likely to worsen the impact, if remedial EbA and other measures are not taken.

4.2.5.1.2. Ports

Currently, Quang Binh Authority has restored and upgraded Gianh Port to accommodate vessels of 1,000 tons and increase the loading capacity to 100,000 tons/year. Hon La seaport was put into operation to accommodate ships of 10,000 tons of cargo, and a new area in the city's suburb is being prepared to relocate Nhat Le seaport. Each year Hon La Port handles 1.8 million tons of imported goods, 1.4 million tons of which are transferred to Laos. Sea level rise could eventually flood these port facilities.

4.2.5.1.3. Railways

The national railway system extends 172km through Quang Binh. There are 19 provincial terminals, of which Dong Hoi station is the most important.

Tan Ap Station, near Hon La port complex on the border with Ha Tinh, is the future Trans-Asian transit railway station. Trade relations with Laos, North-east Thailand and Myanmar have been expanded including tourism, commerce, agriculture, forestry, fisheries, minerals, etc. In the Mekong Sub-region, Quang Binh is part of the East-West Economic Corridor and is becoming a significant hub for cross-border trade, cooperation and development.

Many sections of the railway in Quang Binh have been degraded by severe weather events, including erosion of the road bed, flooding and subsidence, and landslides. Quang Binh has the opportunity to promote a "green approach" to these problems, such as protection plantings and renaturation with wetlands, across the Mekong Region.

4.2.5.1.4. Air transport

Dong Hoi airport is located in Loc Ninh commune, Dong Hoi City, Quang Binh Province, 6km from Dong Hoi city centre to the south, near the coastline of East Sea and has the runway 300 meters to the east of National Highway 1A.

4.2.5.2. POWER

Quang Binh has both thermal and hydropower plants for electricity generation and is getting involved in alternative sources, such as solar and wind. Demand figures are not available, but demand is said to be high and the provincial strategy is to generate energy locally to satisfy internal demand, and then supply the national grid.

Decisions regarding energy investment are decentralised to the provinces, but the Ministry is still involved in large scale investments.

The PPC is interested in exploiting the hydro-power potential of small and medium watersheds, for combined irrigation and power production. A preliminary survey of the river power potential showed a total capacity of 1.43 billion kWh of electricity (SEDP). However, the environmental impact of such schemes could be enormous - flooding important forest resources, reducing environmental flows of rivers and aggravating salinization of coastal areas.

Presently, Quang Binh's only hydro-electric plant is the Ho Dam, on the border with Ha Tinh, which generates an average of 1.25 million kwh/month. The dam is controversial and in October 2016 heavy rains, which caused serious flooding throughout the province, damaged the plant and an emergency discharge was needed which caused significant damage to downstream communities (in Ha Tinh). A few years ago, another hydro plant in Ming Hoa District was under construction, but was cancelled because of flood damage to the site.

The Quang Trach thermal plant will total 2,400 MW in two stages and is located near the Hon La port and economic zone. Thermal plants need to be located on the coast with access to salt water for cooling, and freshwater for boilers.

Solar energy is seen as a solution for remote and disadvantaged areas, especially areas where it would be expensive or impossible to connect to the national grid. South Korea is currently supporting such a rural solar power project.

The potential for wind power development along the coast is also being explored. Government does not invest directly in wind power, but subsidies may be available to private investors through feed-in-tariffs to the national grid, to overcome the higher production costs (7c/kwh vs 4c/kwh for coal). Some private investors have come forward and conducted the necessary surveys, but investors are still awaiting government decisions on subsidies.

The PPC is also taking measures to promote energy efficiency and conservation, including energy labelling on appliances, progressive and peak hour pricing of electricity, participation in the global "Earth Hour" and other communication activities.

Besides the flood damage mentioned above, damage to energy infrastructure includes electricity poles being blown down and transmission lines broken in storms.

4.2.5.3. WATER RESOURCES

Water is the most important natural resource and environmental service in Quang Binh and perhaps the one most vulnerable to climate change. A holistic study of the water sector in relation to climate change is urgently needed, taking into account all the economic and domestic sectors supported, the interactions between different water users and their environmental impacts. The CCRAP (2010) presents a summary of Quang Binh's 2009 Plan for water exploration and production to 2020. As the latter document was not available to the present study, some findings presented in the CCRAP are discussed briefly here.

4.2.5.3.1. Water Supply

Overall, Quang Binh has abundant water resources, including natural waterbodies, man-made reservoirs and ground water. However, these resources can be unpredictable and unreliable at certain times of year, and these problems are likely to increase with climate change.

There are two main watersheds (Gianh and Nhat Le) and three smaller ones (Roon, Ly Hoa and Dinh), all emerging from the Truong Son Mountains and crossing the narrow coastal plain to the sea. Average annual discharge rate is estimated at 539 m³/s across the province and total runoff is approximately 16.97 trillion m³. The few natural lakes in the province are located near the coast on the landward edge of the dunes, and probably represent old river courses. They extend over 2,500 hectares in all; largest is Bau Sen in Le Thuy district.

The province has 13 large national reservoirs managed by state irrigation companies, and 147 smaller locally managed reservoirs, with a total volume of 528,793 million m³ (CCRAP, 2011). Besides playing an important role in regulating river flow and providing irrigation, these reservoirs bring other economic benefits to the surrounding communities, notably fish production. Sedimentation of the reservoirs due to erosion in the watersheds is a serious problem, reducing the provinces overall water supply capacity.

Ground water sources in the province are plentiful, but unevenly distributed and of variable quality. The depth of the water table varies depending on terrain and seasonal precipitation. The coastal plain tends to have shallow water table, vulnerable to saline intrusion, while the middle hills are vulnerable to deep groundwater depletion in the dry season.

Water quality in the region is generally quite good, very suitable for agriculture and forestry as well as industrial and domestic use. Saline intrusion is contaminating water in some estuarine areas. Map 4.5 shows the distribution of saline soils (dark pink) in the Gianh River estuary as represented in an undated soil map; it is likely that the extent of the affected area has now increased.

4.2.5.3.2. Water Demand

Table 4.20 summarises the projected water demand by sector, by 2020, presented in the CCRAP of 2010. Although the use of different units of analysis for different sectors makes comparisons difficult, it appears that total demand from agriculture, industry and residential uses will reach around 800 million m³/yr by 2020. In addition, aquaculture is estimated to require 9 million m³/yr. The new golf course developments on the dunes south of Dong Hoi are also expected to use vast amounts of ground water - although some recycling is planned. Problems in supply and quality are localised and seasonal and likely to become more serious in the future.

Map 4.5: Distribution of saline soils (dark pink) in the Gianh River Estuary (date unknown)

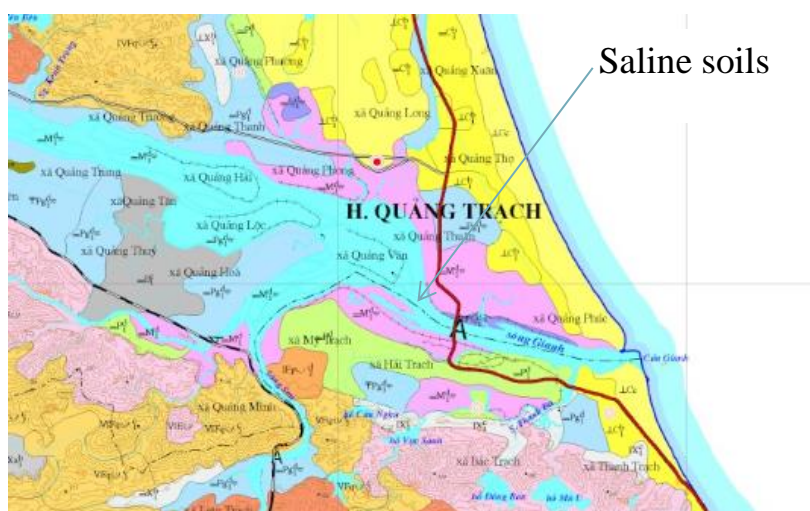


Table 4.20: Projected Water Demand by 2020 by Sector

| Sector | Subsector | Demand | Notes |
|---------------------|-----------|---|---|
| Agriculture | | 1.3 mn m ³ | By 2020 |
| | Rice | 6,550 m ³ /ha | |
| | Crops | 2,001 m ³ /ha | |
| | Trees | 2,132 m ³ /ha | |
| | Livestock | 60 litre/head/day | Cattle/buffalo |
| Industry | | 716,219 m ³ /yr | By 2020 |
| Residential | Urban | 104,517 m ³ /day | By 2020 (270 l/p/day) ~90% surface water |
| | Rural | 58,640 m ³ /day | By 2020 (100 l/p/day) ~ 30% surface |
| TOTAL | | 2.18 m m ³ /day | By 2020 |
| Aquaculture | On sand | 30,000 m ³ /ha/yr = 9 million m ³ /yr | By 2020 for 300 ha Supplied from groundwater |
| Golf Courses | On sand | Data not available | Supplied from ground water |

Source: CCRAP, (2010), quoting DONRE (2009).

4.2.5.3.3. Impacts of Climate Change

The increase seasonal rainfall in predicted from global climate change poses serious threats to numerous dams in the province: they are in danger of breaking due to the inability to contain flood water, in part due to sedimentation reducing the reservoir capacity. Lakes particularly at risk are the Mui Rong, Vuc Tron, Tien Lang, (Quang Trach) Cam Ly, An Ma (Le Thuy), Be (Tuyen Hoa), Vuc Noi, Da Mai (Bo Trach) and Phu Vinh (Dong Hoi city). Floods already submerge and contaminate domestic wells, and this problem is likely to increase in the rainy season.

Rising temperatures and increased frequency of drought means that at other times of year, many, often the same, reservoirs drop below “dead water level” and are unable to supply irrigation water when most needed. Most affected are mid-sized reservoirs, such as Cam Ly, An Ma (Le Thuy), Long Dai, Dieu Ga (Quanh Ninh), Phu Vinh (Dong Hoi), Vuc Noi (Bo Trach), Rao Nana, Khe Sot (Quang Trach), Tien Lang, Be and Dong Ran (Tuyen Hoa)

At the same time, the reduced water flows in the rivers, due to impoundments and off-take for human use, is aggravating saline intrusion in coastal areas, already caused by sea-level rise and storm surges.

4.2.5.4. EXISTING INFRASTRUCTURE RELEVANT TO CLIMATE CHANGE ADAPTATION

As will be discussed in Chapter 8 on adaptive capacity for climate change, Vietnam generally and Quang Binh particularly have long experience in mitigating and responding to climate-related disasters, including floods, tidal surges, saline intrusion and landslides which gives the government and people a head-start in adapting to climate change.

Quang Binh already has an extensive network of dykes and sea walls to cope with flood related issues, including 189km Level IV dykes, 103km of dykes, 153km of sea dykes, 12km of embankments, 107 wiers and a saline intrusion barrier (CCRAP 2010). However, many of them are old and of simple construction, or need to be raised and erosion is occurring much faster than the province is able to build defences. JICA is already working to study hydrodynamics in two main river basins - Giang and Nhat Le - and has helped support the development of an integrated flood-management master plan, as well as showcasing demonstrations of community-based soft-engineering measures.

4.3 DISCUSSION

This scoping of Quang Binh’s economy has considered a range of different quantitative parameters: GDP contribution, land use, employment, contribution to export, as well as more qualitative parameters related to the nature particular activities that explain past vulnerability to climatic events and indicate potential sensitivities to climate change. Table 4.21 presents a preliminary, largely qualitative attempt to consider these factors together and identify the economic activities that should be prioritised for further EbA analysis.

In terms of its contribution to GDP, the proportion of land area used, employment provided and contribution to downstream value-adding activities in the province,

the “agriculture, forestry and fisheries” sector (AFF) remains the most important in Quang Binh’s economy. Although the PPC wants to “restructure” the provincial economy, shifting investment and activity to industry and services, the process over the last five years (at least) has been slower than hoped, and agriculture is likely to remain important for years to come.

Within AFF, the single most extensive land use is forestry, occupying 88% of the sector’s land and 70% of total land in the province. Of this, plantation forestry occupies some 80-90,000ha - around 10% of total land. Although the primary productive value of forestry is not that high, its raw materials feed processing industries worth three times as much, so the overall value of forestry is high. Since plantations are managed primarily on short rotations for chip and pulp wood, their impact on the environment is high. The state is still highly involved in forestry - though roughly 20% of forest land has now been allocated to households.

Crop cultivation is the next most important land use after forestry, taking 10% of total land, divided roughly equally amongst paddy (4%, 30,000 ha), other field crops (3%) and perennials (3%). Rice is also the most important crop in terms of labour and supporting infrastructure, but total contribution to GDP is relatively small. Some of the most important crops - rice, hill rice, acacia, rubber, fruit trees, shrimp - are already experiencing serious sensitivities to climatic events: drought, saline intrusion, wind damage, cold, heavy rain and heat - which are affecting production. Other crops - especially cassava - and natural forest are more resilient. Annual crop cultivation is primarily carried out by small holders, but commercial interests are heavily involved in estate crops, such as rubber and tea, and larger units are being encouraged by government for all products.

Livestock production is just beginning to intensify - with some large cattle units being installed. Pig production is most important and still predominantly part of mixed farming systems on individual small farms.

Fisheries do not occupy a significant area (0.4% total) - either the capture fishery or aquaculture - however their GDP value is growing, and may soon outstrip crop production.

While Quang Binh’s most important industry, cement manufacturing, is based on non-renewable resources, plans for future industrial development are to enhance seafood processing and light manufacturing of clothing and electronics. Seafood processing, based on renewable natural resources, depends on sound management of the coastal and marine environment and the services the ecosystems provide.

There has been considerable progress with climate change adaptation in Quang Binh, building on previous decades of coping with extreme climate events. The government has successfully promoted range of sensible strategies, including crop diversification or switching and land use change, but hard infrastructure development remains at the heart of adaptation plans.

Currently, there appears to be an over-emphasis and over-dependence in the provincial economy on construction. The state is the major sponsor of these projects.

While many of these projects are over-planned and excess to requirements, they generate a lot of demand for labour, materials and services. Climate change adaptation provides a strong justification for further infrastructure development. Ecosystem-based adaptation measures could contribute to a strategy to wean the economy off construction. Development and adaptation are more than just infrastructure.

Water is the single most important asset, natural resource and environmental service supporting the provincial economy. While overall, resources are abundant, there are serious seasonal and local shortfalls that are set to get much worse with climate change. Provincial development plans do not appear to attempt to solve problems in one area, simply create more problems in another. For instance, the construction of more dams to provide power and irrigation will reduce environmental flows in rivers and accelerate salinization in coastal areas.

Table 4.21: Identification of economic sectors for further EbA analysis

| Economic activity | GDP | Future emphas is | Land used | Use of Labour | Organis ation | Export | Base for VA * | Climate damage trends | Environ- mental Impact | Notes | Rank |
|------------------------|-----|------------------------|--------------|------------------|------------------|--------|------------------|-----------------------------|------------------------------|-------------------------------|------|
| PRIMARY SECTOR | | | | | | | | | | Extensive | |
| Annual crops | xx | x | x | xxx | SH | x | x | xxx | xx | Drought, salinisation | xx |
| Perennial crops | x | xx | xx | xxx | SH+Co | xx | x | xxx | xx | Rubber windthrow | xx |
| Livestock | x | xxx | x | xx | SH+Co | | | x | xxx | Disease, heat stress | |
| Plantation Forestry | x | xx | xxx | x | SH+State | xxx | xxx | x | xxx | Acacia windthrow | xxx |
| Protection Forestry | | x | | | SH + State | | | | | | xxx |
| Capture fishery | xx | xxx | - | xx | SH + Co | x | | xx | x | Storms limit on-shore fishing | xx |
| Aquaculture | x | xxx | x | x | SH + Co | xx | x | x | xx | Disease, pollution | xxx |
| Mining | x | xx | x | x | Co | x | xx | x | | Localised Env impact | x |
| SECONDARY SECTOR | | | | | | | | | | Localised | |
| Cement etc | xxx | xx | x | x | Co | xx | xx | x | xx | Localised | x |
| Food processing | x | xxx | x | x | Co | x | | x | | | x |
| Wood processing | xx | xx | x | x | Co | xx | | x | | | xx |
| Construction | xx | x | xx | xx | Co+State | | | x | xx | | xx |
| TERTIARY SECTOR | | | | | | | | | | Localised | |
| Retail/Wholesale Trade | xxx | xxx | x | xx | SH + Co | | | x | | | x |
| Tourism | x | xxx | xxx | xx | SH + Co | | x | xx | x | Extensive | xx |
| KEY ASSETS | | | | | | | | | | | |
| Transport | xxx | xx | xx | x | SH+Co+State | | xxx | xx | xx | | xx |
| Power | xxx | | x | x | Co + State | | xxx | xx | xxx | Transmission pole windthrow | x |
| Water | xxx | | xx | x | Co | | xxx | xx | xx | | xxx |
| Urban areas | xxx | | x | x | Co+State | | | x | xx | | xxx |

4.4 CONCLUSIONS

The economic analysis presented above indicates that while industry and services are set to expand in the near future, EbA should focus on socio-ecological systems relating to the primary sector, based on renewable natural resources, that is Agriculture, Forestry and Fisheries. *A priori*, these activities have both the greatest dependence on ecosystem services and greatest impact on them. Urban areas are also very important to the provincial economy, but the scope of this EbA assignment was to focus on rural areas, so this will not be a priority.

The government remains a major stakeholder in the provincial economy - with 23% of the economy still state-owned. While ultimately EbA needs to be mainstreamed throughout the economy, the government has an important role to play in pioneering and demonstrating the approach in the sectors in which it has a major stake, such as forestry.

Construction is another important sector in the economy with significant impacts on ecosystems and services and one in which the government still plays a major role. There is an urgent need for construction to embrace new approaches to climate change related problems such as flooding, urban heat stress and energy efficiency of new buildings. Approaches like Sustainable Urban Drainage (SUDS) and green construction principles apply ecosystem principles, but are implemented largely through engineering and architectural activities. In the construction sector, the Government is both the regulator and a main investor - and thus the greatest scope for implementing EbA in construction projects is in government hands.

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