

BALANCING CONSERVATION AND DEVELOPMENT IN THE NORTHERN HIGHLANDS LIMESTONE THROUGH POLICY DIALOGUE, CAPACITY DEVELOPMENT, AND REGIONAL PLANNING IN THE BAC KAN AND TUYEN QUANG PROVINCES, VIETNAM

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ABSTRACT

Through a long history of shifting cultivation and commercial logging, the natural habitats of the northern limestone mountain of Vietnam have become heavily fragmented. The greatest threat to the corridor's already highly endangered biodiversity comes from poorly planned development projects, including roads, dams, quarries, and mines, and government policies and programs that are poorly adapted to the region's environmental and cultural conditions. The "Balancing Conservation and Development in the Northern Highlands Limestone through Policy Dialogue, Capacity Development, and Regional Planning in the Bac Kan and Tuyen Quang Provinces" supported provinces to address these threats by working with relevant stakeholders to develop and share the Geographic database, compile information on development plans and projects with the potential significantly impact the corridor's biodiversity. to analyze these plans and project to propose least-cost options that will achieve provincial development objectives at lower environmental costs. This study designed and advocated development plans that will balance conservation and economic growth across the northern limestone mountain, and strengthen both the supply and demand for strategic environmental assessments.

Keywords: *Capacity development, geographic database, highlands limestone, policy dialogue, regional planning*

1. INTRODUCTION

The biodiversity corridor prioritizes the northern limestone mountain area including the provinces of Ha Giang, Cao Bang, Tuyen Quang, and Bac Kan. This area is especially important for primate conservation, supporting the growth of populations of native species such as snub-nosed monkeys and black-headed gibbons, which are currently considered critically endangered in the world. This is also an area of international importance for the conservation of special species such as orchids, amphibians, and valuable plants.

Due to the transformation of farming practices and the exploitation and trade of wood, the habitat of the limestone mountains is being fragmented. The main risk is that development projects (road construction, dams, mineral exploitation) have not been optimally planned, and policies are not truly in harmony with natural, social, and cultural conditions, and the region's environment.

Research "Balancing conservation and development in the northern highlands limestone through policy dialogue, capacity development, and regional planning in the Bac Kan and Tuyen Quang provinces, Vietnam" collaborated with stakeholders and local authorities to build a Geographic Information database, collect information on development plans and projects, and analyze those plans and projects to offer options that still achieve the province's development goals at the lowest environmental cost.

2. RESEARCH METHODS

Some methods applied for this research are as follows:

- Survey for preliminary assessment of the research area and field verification, checking results based on geographical data
- Collecting secondary data and available maps serves to build the database
- Building a provincial geographic information database using ArcGIS 10.5 software
- Database analysis to evaluate activities affecting forest resource conservation based on a provincial-level geographical database
- Through meetings and workshops, the parties agree on policy proposals with the Province in the master plan and planning of development projects

3. RESEARCH RESULTS AND DISCUSSION

3.1. Geographic database of Bac Kan and Tuyen Quang provinces

3.1.1. Spatial database structure

- Spatial database established on ArcGIS 10.5 software
- Map reference system: WGS 84; Projection zone: 48 Northern hemisphere
- Map scale 1:100,000
- Total number of layers: 22, as follows:

TT	Layer name	Spatial data
1	Provincial boundaries	Line
2	District boundaries	Line
3	Commune boundaries	Line
4	Current land type	Line
5	Current land use status	Polygon
6	Symbols	Point
7	Contour line	Line
8	Note the altitude	Point
9	Mineral	Point
10	Hydrology (rivers, streams, ponds, lakes)	Line/Polygon
11	Trail	Line
12	Communal roads	Line/Polygon
13	Inter-district road	Line/Polygon
14	Interprovincial road	Line/Polygon
15	Highway	Line/Polygon
16	Bridge	Point
17	Name of the administrative unit	Text
18	Country name, place name	Text
19	Mountain name	Text
20	Name of river and stream	Text
21	Dam	Point
22	Commune	Polygon

The geographic database associated with attribute data on natural, economic, social, land, minerals, and development projects, as follows:

- ✚ Attribute information about population, natural area, number of poor households, number of people.
- ✚ Attribute information about the number of households granted land use rights certificates, land allocation area, and planted forest area.
- ✚ Attribute information about projects in the past 3 years with investment \geq 1 billion VND.
- ✚ Attribute information about mineral deposits
- ✚ Attribute information about dams and reservoirs
- ✚ Attribute information about resettlement projects

3.1.2. Build thematic maps from the geographic database

Based on the province's geographic database, which includes spatial data layers linked to attribute data, different thematic maps of Tuyen Quang and Bac Kan provinces have been built, as follows:

- ✚ Map of distribution of mineral mines
- ✚ Map of dam system distribution
- ✚ Forest resources map

- ✚ Map of poverty rate
- ✚ Map of Current land use status
- ✚ Population density map
- ✚ Map of forestry land allocation area
- ✚ Map of the afforestation area
- ✚ Proposed map of the Ba Be - Na Hang biodiversity corridor
- ✚ Map of proposed conservation areas in Bac Kan province

3.1.3. Some proposals for exploiting and using provincial-level geographical databases

The province's database is a collection of spatial information and accompanying detailed attributes. The database is built quite completely, and is the basis for management and planning in long-term and short term, preserving natural resources in the two provinces of Bac Kan and Tuyen Quang.

3.2. Analyze activities affecting conservation based on a provincial-level geographic database

3.2.1. Bac Kan province

*. Impact of mineral mines on conservation

+ Scope and scale of mineral mine exploitation

- The main types of minerals mined in the province include stone, sand and gravel, lead, zinc, phosphorite, iron, quartz, barite, and gold.

- Number of mineral mines: according to statistics, there are 55 main mines in the province, including 10 gold mining locations, 23 limestone mining locations, 12 lead-zinc mining locations, and 5 sand and gravel mining locations.

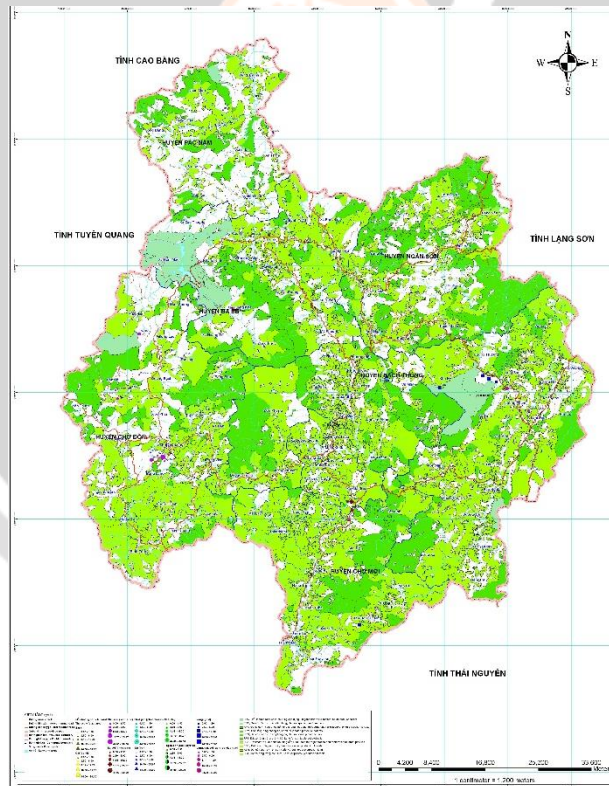


Figure 1. Map of mineral mines in Bac Kan province

+ Effects of some mineral mines on conservation and the environment

- Gold mines in Lang San commune and Kim Hy commune, Na Ri district; Thuong Quan commune, Ngan Son district are at risk of causing difficulties for forest protection: taking advantage of illegal exploitation and transportation of forest products from the Kim Hy Preserving Zone. In particular, illegal gold mining activities have serious impacts, causing loss of agricultural land and water pollution in this area.

- Lead and zinc mining is concentrated in Ban Thi commune and Bang Lung town, Cho Don district with a large number of mines and large scale. The exploitation of lead and zinc ores by the Cho Dien Lead and Zinc Mining

Enterprise affects the air in Bang Lung town, making it very stuffy and uncomfortable. On the other hand, lead and zinc mining activities have caused the loss of hundreds of hectares of forest land in this area. The open mining area is being expanded and gradually encroaching into the Xuan Lac Species Conservation Area. It is necessary to clearly identify and strengthen the inspection and supervision of mining areas in Ban Thi and Xuan Lac. Noise caused by mining and the phenomenon of using ore transportation to transport wood is quite common in this area.

- Limestone mines are scattered in almost all districts and towns in the province, most concentrated in Na Ri, Cho Don, and Ba Be districts. In recent years, the mining output of these mines has met most of the province's infrastructure construction needs, contributing to local economic development. However, stone mining technology is still very rudimentary and does not produce stone output commensurate with its potential; The environment around the mine is affected and unsafe work occurs. Most mines still use low-capacity crushing and screening systems, causing a lot of dust and noise pollution.

- Sand and gravel mining activities need special attention, especially on the Cau River in the Cho Moi district. The exploitation took place continuously, constantly causing vehicles such as cars, workers, and farmers to compete for transport and overload, causing the roads on both sides of the river to be plowed. It is worth mentioning that illegal sand and gravel mining has caused many deep holes in the Cau River to appear close together, and many riverbanks have eroded.

***. Current status of land use and forest resources related to conservation**

+ Current status of land use and forest resource distribution

- Forest resources are a strength of Bac Kan province, contributing to socio-economic development. The proportion of forest land accounts for the majority of the total area of the province. However, the actual land area is still low, and the proportion of bare land, bare hills and mountains is still high, the province needs to prioritize and mobilize the development of afforestation. Special attention should be paid to planting protective forests in bare land and bare hills in the highland communes of Ba Be, Pac Nam, Cho Don, and Ngan Son districts.

- The proportion of agricultural land is very low and fragmented. This is one of the difficulties for production development and improving people's economic lives.

- The province's specialized land for non-agricultural purposes still accounts for a small proportion. The province needs to have orientations for planning concentrated areas and rationally exploiting and using specialized land for non-agricultural purposes.

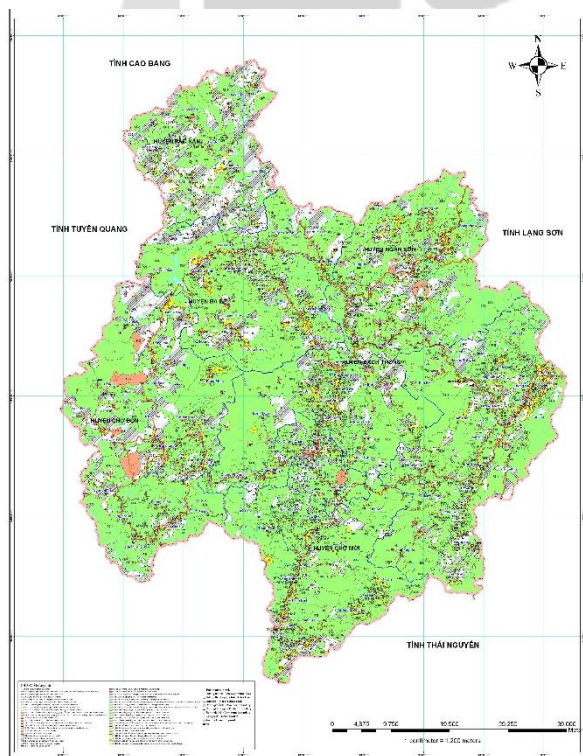


Figure 2. Current land use map in Bac Kan province

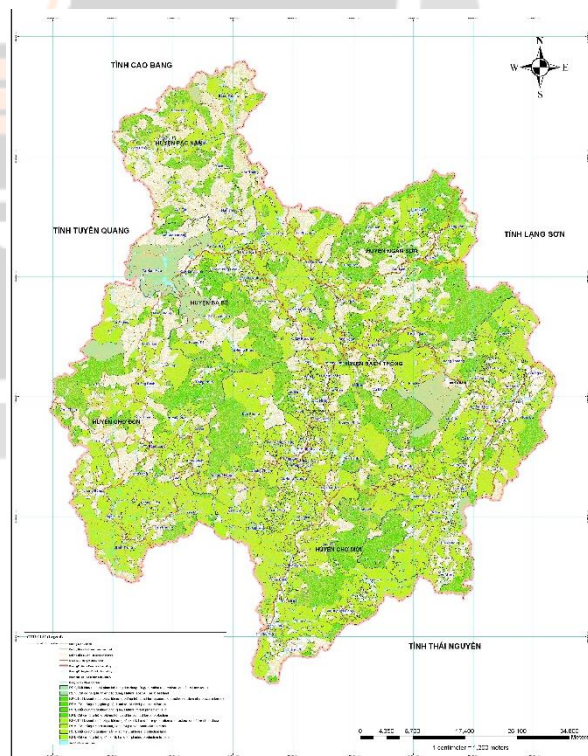


Figure 3. Current forest cover map in Bac Kan province

+ *Forestry land allocation*

- The forest land allocation area is not uniform throughout the province. The highest concentration of forestry land allocation area is in Bach Thong district, Bac Kan City, some communes of Na Ri district, and Pac Nam district. Most of the remaining communes in the province have a very low level of forestry land allocation. This issue needs to be paid attention by authorities at all levels in the coming time to contribute to stabilizing production, forest management and protection.

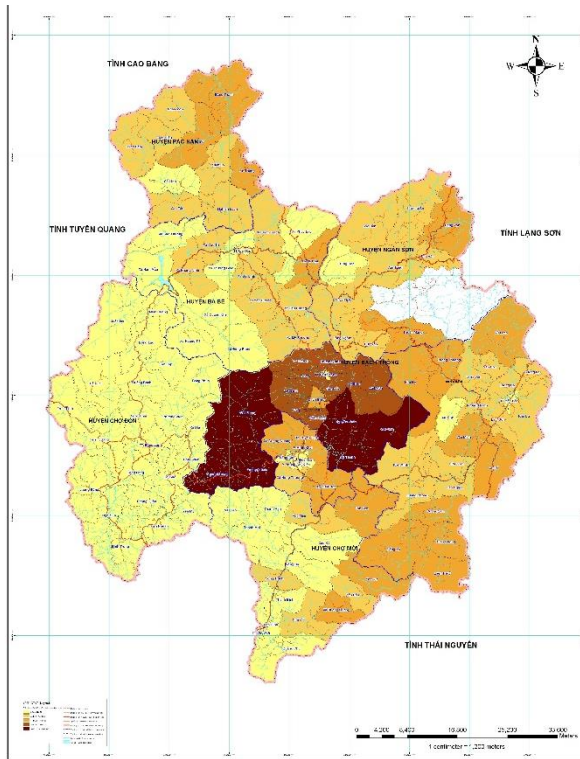


Figure 4. Current forest allocation map in Bac Kan province

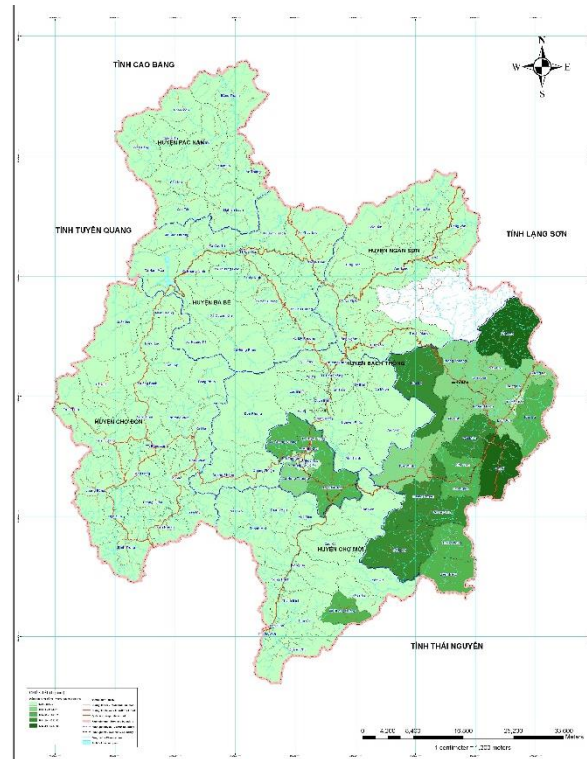


Figure 5. Current forest plantation map in Bac Kan province

+ *Forest plantation*

- A lot of afforestation area is concentrated in some communes of Na Ri district and Bac Kan city, the remaining communes in the whole province have low afforestation area. The province needs to prioritize and pay attention to developing afforestation and protecting forests to green up bare land, bare hills and mountains.

- It is especially necessary to protect and develop afforestation at the Ba Be Lake watershed, including Cao Thuong, Cao Tan, Co Linh communes... to contribute to reducing sandy soil sedimentation into the lake bed, as well as limiting and reducing natural disasters such as flash floods, landslides, erosion, and washing away in this area.

*. *The impact of population and poverty on conservation*

- In general, most communes have a low population density, but the rate of poor households is high.

- The highest population density (10 - 20 persons/ha) is concentrated in Bac Kan City, Phu Thong, Cho Ra, and Yen Lac towns. Some communes bordering towns and cities also have quite high densities of 5 - 10 person/ha

- Population density in the remaining communes is still low, 0.5 - 2.0 persons/ha. Communes located in conservation areas all have low population density.

- However, the highest rate of poor households is concentrated in highland communes of Pac Nam district and communes in the conservation area and buffer zone of Ba Be National Park (over 40%). Communes in Kim Hy conservation area also have high poverty rates (20 -40%). Communes in areas proposed for biodiversity conservation such as Ban Thi, Xuan Lac, Bang Phuc, and Dong Xa, all have quite high rates of poverty. It is necessary to prioritize stable economic development, hunger eradication, and poverty reduction for people, thereby reducing pressure on forest resources.

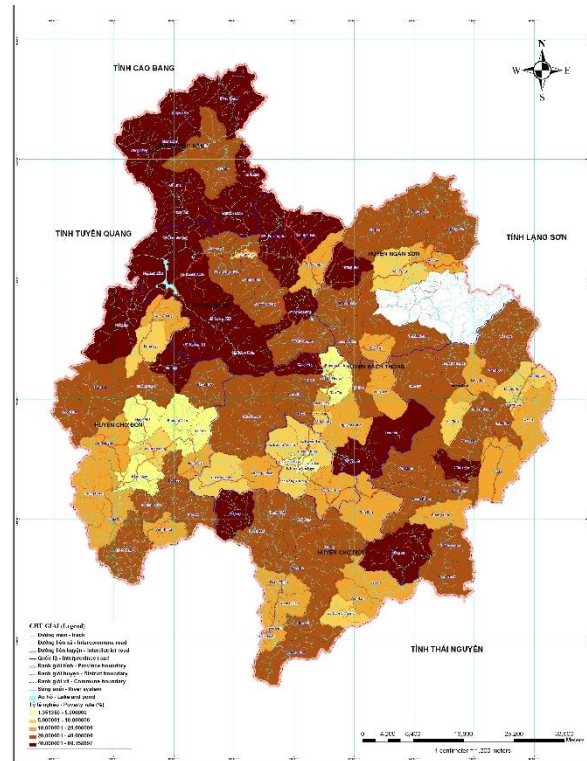
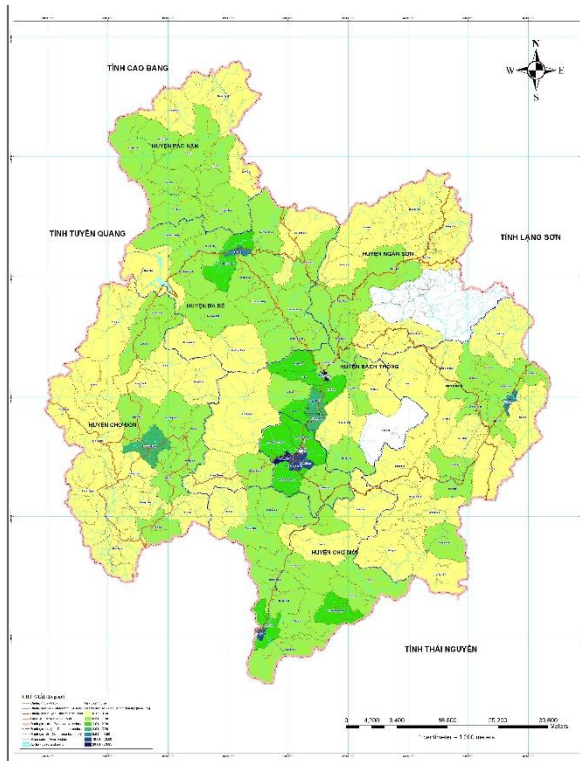


Figure 6. Population density map in Bac Kan province Figure 7. Poverty household map in Bac Kan province

***. Proposed conservation areas and biodiversity corridors**

Bac Kan province is gifted by nature with a scenic spot of Ba Be Lake. Ba Be Lake is one of the 20 largest natural freshwater lakes in the world. The lake has an area of 500 hectares, located in the Ba Be National Park area, with a system of primary forests on limestone mountains with 417 species of plants, 299 species of vertebrates, and 49 species of freshwater fish in the lake.

Na Hang Nature Reserve in Tuyen Quang province has a primeval forest ecosystem with an area of 41,930 hectares. There are Plants with more than 600 species, 76 species of animals: (with the snub-nosed monkey being an endemic species), 263 bird species, 25 snake species, 35 frog species, and 500 insect species.

The biodiversity corridor of the Ba Be-Na Hang conservation area is an adjacent strip of geology, geomorphology, and biodiversity. Therefore, the two provinces of Bac Kan and Tuyen Quang need to agree to prepare a dossier to request UNESCO recognition as a world natural heritage for species diversity conservation and a geology and geomorphology landscape for biodiversity corridors in the Ba Be-Na Hang conservation area. Furthermore, due to the unity and richness of biodiversity, especially the protection of habitats of some rare species such as snub-nosed langurs and white-cheeked langurs, it is necessary to come up with a plan to build an inter-provincial National Park between Tuyen Quang and Bac Kan based on merging Na Hang Nature Reserve and Ba Be National Park.

In some highland areas, there is still a lot of forest area that can form biodiversity conservation areas in the province, such as: Xuan Lac - Ban Thi, Bang Phuc, Dong Xa - Tan Son. When these conservation areas are formed, the diversity of flora and fauna will be rich, while contributing to the local socio-economic development.

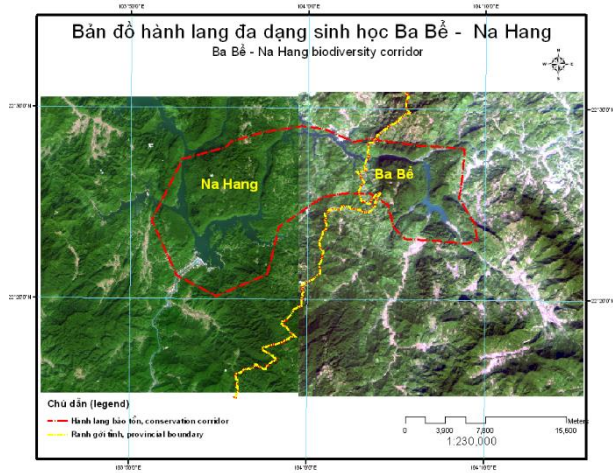


Figure 8. Ba Be – Na Hang biodiversity corridor

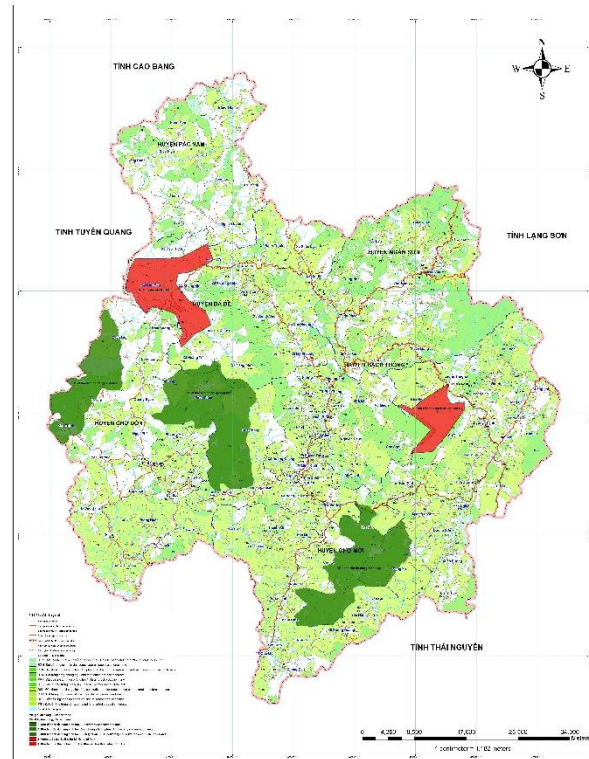


Figure 9. Proposal area for biodiversity conservation in Bac Kan province

3.2.2. Tuyen Quang Province

*. *Impact of mineral mines on conservation*

+ *Scope and scale of mineral exploitation mines*

- The main types of minerals exploited in the province include limestone, sand and gravel, manganese, tin, antimony, barite, iron, kaolin, gold, and tungsten.

- Number of mineral mines: According to statistics, there are 120 main mines in the province, of which the vast majority are exploiting limestone, sand, and gravel.

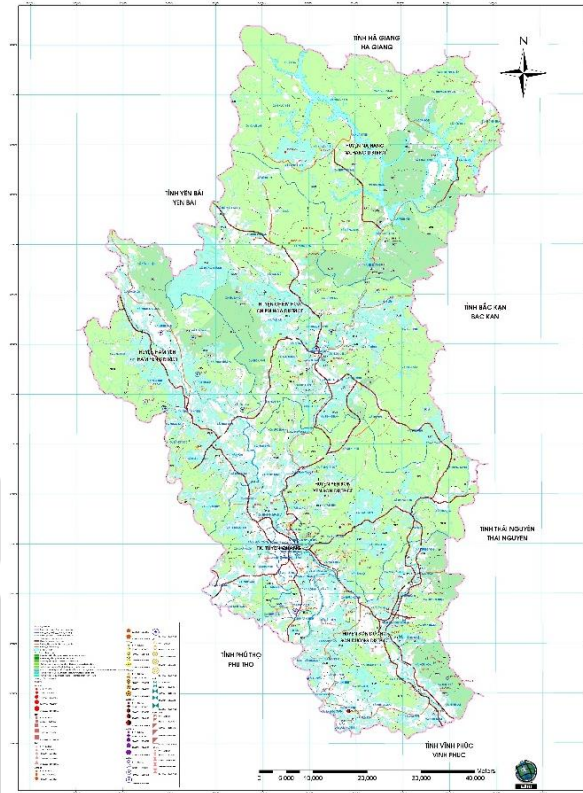


Figure 10. Map of mineral mines in Tuyen Quang province

+ Effects of some mineral mines on conservation and the environment

- Mineral exploitation activities have contributed significantly to the socio-economic development of Tuyen Quang province. However, mineral exploitation activities here still have some shortcomings.

- Investigation showed that illegal placer gold mining on Lo River from Km 60 to Km 75 along National Highway number 2 from Tuyen Quang to Ha Giang province. According to statistics, the Lo River flowing through the area has a total length of 156km. On this river route, there are currently 26 units licensed to exploit sand and gravel minerals for construction. In fact, after obtaining a sand and gravel mining license, many units took advantage of it to illegally exploit placer gold.

- Tin and barite mining is concentrated in Son Duong and Yen Son districts. The prominent problem here is that this mineral exploitation activity has polluted and degraded water sources supplied for agricultural production. Management and technology measures are needed to handle this problem well.

- Manganese mines are concentrated in Chiem Hoa district, here it is necessary to pay attention to management and technological measures to limit pollution of the soil and water environment, especially paying attention to the need for management measures. Effectively handle bandit ore mining in this area, causing serious environmental pollution and loss of agricultural land for people.

- Limestone mining is concentrated in Da Vi commune, Na Hang district, here it is necessary to pay attention to stone mining technology, dust, and noise pollution.

- The exploitation of antimony and limestone in Lang Can commune near the Na Hang lake bed area needs to pay attention to protecting the landscape and environment.

***. Current status of land use and forest resources related to conservation**

+ Distribution of land and forest resources

- Forest land area accounts for the majority of the total natural area. What is worth mentioning here is that the coverage rate in the whole province is quite high. This is one of the strengths of forest management and protection in Tuyen Quang province.

- The agricultural land area accounts for a small proportion and is scattered in the valleys. This is one of the difficulties for agricultural production development in Tuyen Quang province.

- Land specifically used for non-agricultural purposes is limited and not concentrated, this is one of the factors limiting the province's socio-economic development.

- Unused land and bare land, bare hills and mountains in the province are very few with a low rate. This is also a quite outstanding advantage of Tuyen Quang province in terms of good implementation of forest management and protection. Therefore, the degradation of land and forest resources is significantly limited compared to other mountainous provinces.

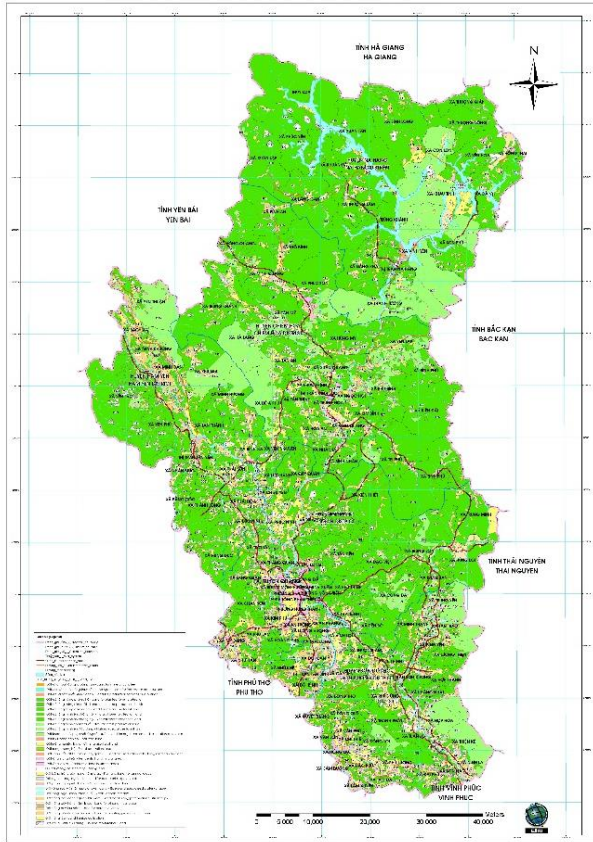


Figure 11. Current land use map in Tuyen Quang province

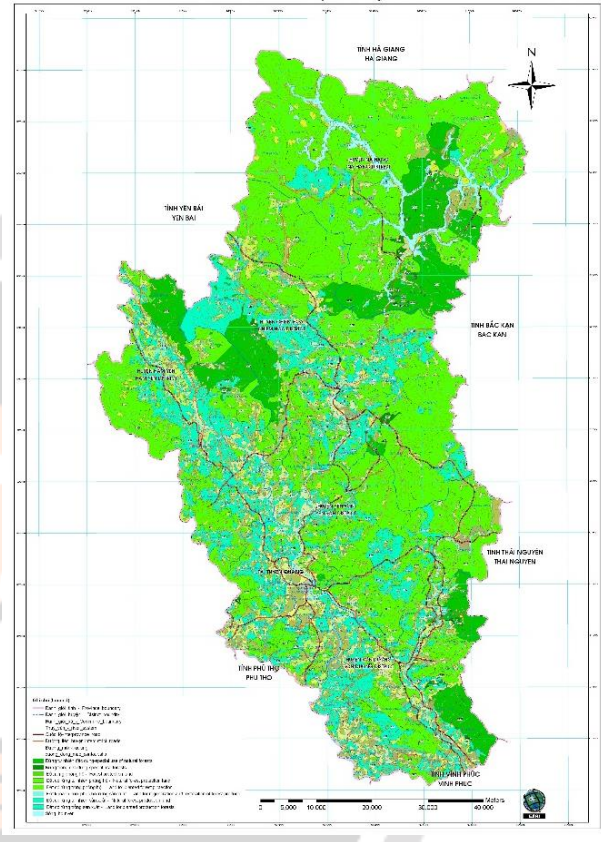


Figure 12. Current forest cover map in Tuyen Quang province

+ Forestry land allocation

- The area of forestry land allocation is still uneven and synchronous throughout the province. About 2/3 of the total communes have low forest land allocation area, especially very low forest land allocation area in highland communes of the districts. Well-implemented forestry land allocation will contribute to stabilizing production development and better implementation of forest management and development in the entire province.

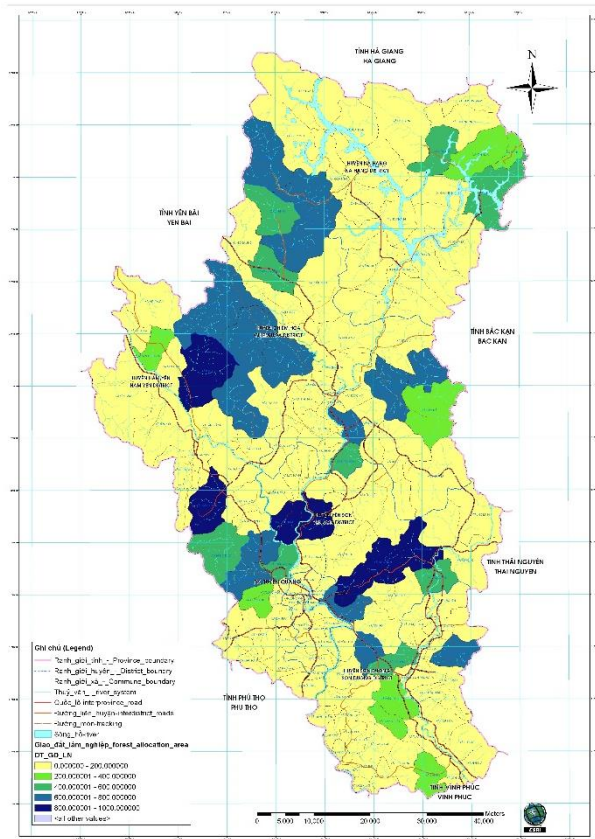


Figure 13. Current forest allocation map in Tuyen Quang province

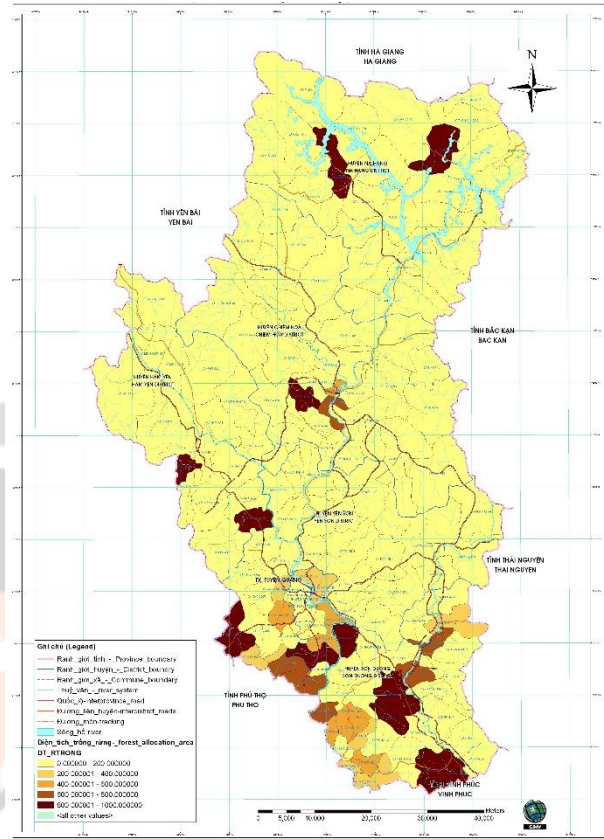


Figure 14. Current forest plantation map in Tuyen Quang province

+ Planting forests

- High afforestation areas are concentrated in central areas of towns, cities and areas near the center. The remaining areas have low afforestation areas, especially highland and remote communes of the province.
- Special priority should be given to developing afforestation and forest protection in the watershed areas of Na Hang Lake to limit lake sedimentation, create beautiful natural landscapes and develop potential tourism in this area.

***. Impact of population and poverty on conservation**

- In general, most communes have low population density, but the rate of poor households is high.
- High population density is concentrated in the central area and areas near the center of towns and cities. Highland communes have low population density. However, the poverty rate is very high in communes in the Na Hang conservation area, highland communes of Chiem Hoa district, Yen Son, and Ham Yen districts.
- The province needs to have more priority policies to develop production and improve living standards for these highland areas. From there, the pressure on forest resource exploitation will be reduced, and biodiversity conservation...

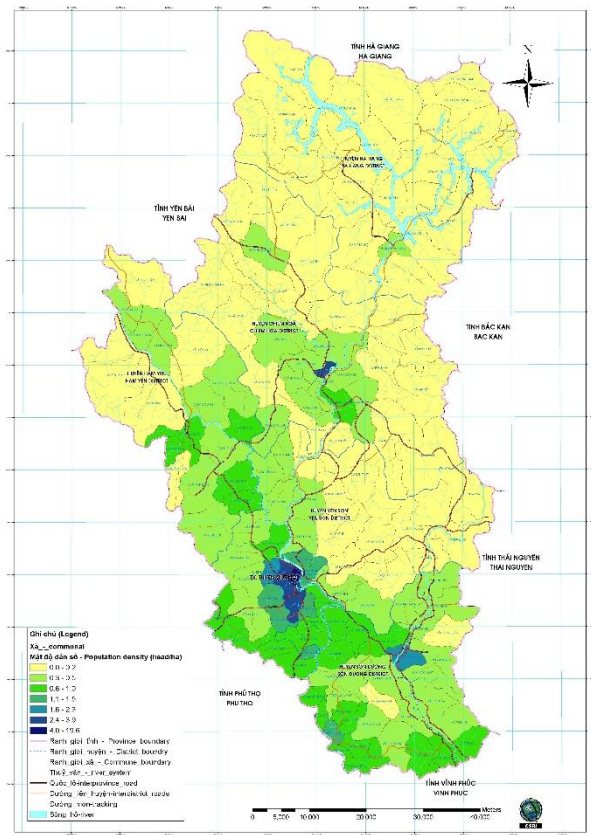


Figure 15. Population density map in Tuyen Quang province

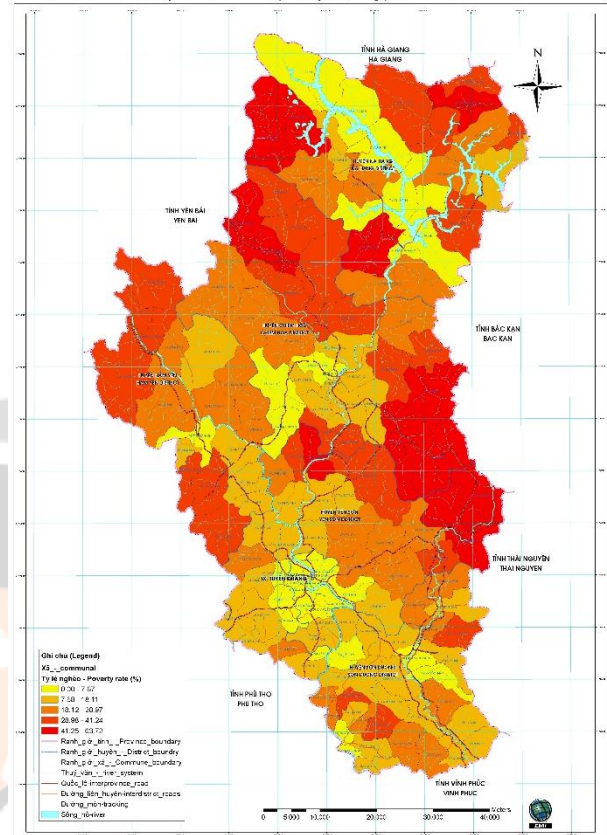


Figure 16. Poverty household map in Tuyen Quang province

***. Impact of dams and resettlement on conservation**

- In general, the system of small dams is distributed throughout the entire river and stream system of the province. This dam system has served and regulated water very well for agricultural production
- However, investigation results show that the Na Hang hydroelectric dam has a great impact on conservation work in this area, according to analysis results:
 - + Water surface area before dam construction is: 86.43 hectares
 - + Water surface area after dam construction is: 838.89 hectares
 - + The flooded area due to dam construction is: 752.46 hectares

Thus, when the flooded area is large, it leads to the loss of agricultural land in the valleys, and the natural forest area in the conservation area shrinks. At the same time, many resettlement areas must be built for people. Furthermore, when the water surface is wide, it will create easy travel conditions for loggers, making management and control of forest products in this area more difficult.

However, besides providing electricity from Na Hang hydropower, the province needs to exploit the potential of the landscape to develop tourism and aquaculture, especially the cultivation of native fish species in this area.

Na Hang Lake has a beautiful landscape that attracts tourists, so a Ba Be - Na Hang tour should be built to develop ecotourism services. It is necessary to build a road connecting Ba Be town with Na Hang Hydroelectric Lake to serve tourists.

Investigation and analysis results show that the resettlement of people to build the Na Hang hydropower plant has an impact on all socio-economic aspects, especially conservation work in this area. When building resettlement areas, it should be noted that: Besides the basic requirements for building a resettlement area, special attention should be paid to the effects of natural disasters (flash floods, landslides) on future resettlement areas. On the other hand, if the resettlement area is located in a conservation area, it will lead to difficulties in management.

4. CONCLUSION

Through research, some results have been obtained as follows:

- A complete provincial-level geographic information database has been built to serve the analysis and assessment of the relationship between the development and conservation of natural resources in the limestone mountain areas of Bac Kan and Tuyen Quang provinces.

- Analyze main activities related to development and conservation in this area and propose dialogue on several policies with localities in planning to ensure harmony between the development and conservation of natural resources and environment, providing a comprehensive view of activities affecting forest resource conservation in Tuyen Quang and Bac Kan provinces

- The research has contributed new approaches in policy analysis and planning based on geographic information data that need to be further researched and perfected.

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