



Leibniz Institute of
Ecological Urban and
Regional Development



Management of mineral resource extraction in Hoa Binh Province, Vietnam

Seven recommendations for responsible construction
aggregates mining and contributions to sustainable
urban and regional development

MAREX Publication Series – Issue 1

IMPRINT

Management of mineral resource extraction in Hoa Binh Province, Vietnam –

Seven recommendations for responsible construction aggregates mining and contributions to sustainable urban and regional development

Results of the project MAREX: Management of Mineral Resource Extraction in Hoa Binh Province – a Contribution to Sustainable Development in Vietnam (2015-2018)

Supported by BMBF, Grant Code FKZ 033R122A

Issue 1

Internet: www.marex-project.de

Open Access Publication CC BY-NC-ND-SA 3.0 DE

Authors take responsibility that their manuscript contents do not violate the copyright or any other personal or proprietary rights of any person, entity, or institution.

Editor, responsible for the contents

Prof. Dr. Dr. h.c. Bernhard Müller

Leibniz Institute of Ecological Urban and Regional Development, Dresden
Weberplatz 1 | 01217 Dresden, GERMANY | Homepage: <https://www.ioer.de>

Technische Universität Dresden, Chair of Spatial Development
August-Bebel-Str. 30, Haus 116 | 01219 Dresden, GERMANY |
Homepage: <https://tu-dresden.de/bu/umwelt/lfre>

Authors

Prof. Dr. Dr. h.c. Bernhard Müller (Leibniz Institute of Ecological Urban and Regional Development, Dresden / TU Dresden)

Dr. rer. nat. Peter Wirth, Dr.-Ing. Georg Schiller, Dipl.-Ing. Tamara Bimesmeier, Dr. jur. Juliane Albrecht,
M.A. Anh Minh Vu (Leibniz Institute of Ecological Urban and Regional Development, Dresden)

Prof. Dr. Nguyen Xuan Thinh, M.Sc. Haniyeh Ebrahimi-Salari (TU Dortmund)

Dr. rer. nat. Paulina Schiappacasse (TU Dresden, Lehrstuhl Raumentwicklung)

Dipl.-Ing. Klaus-Dieter Oswald, Dr.-Ing. Wolfgang Riedel (C&E Consulting und Engineering GmbH Chemnitz)

Prof. Dr. rer. nat. Petra Schneider (Hochschule Magdeburg-Stendal)

Design and Layout

Natalija Leutert

Editorial deadline November 2018

Print © IÖR, Dresden 2019

ISBN 978-3-933053-41-1

Management of mineral resource extraction in Hoa Binh Province, Vietnam

Seven recommendations for responsible construction
aggregates mining and contributions to sustainable
urban and regional development

CONTENT

Executive Summary	3
1. Background	5
2. Challenges	8
Weak coordination of land use interests	9
Weak land use planning mechanisms	10
Limited knowledge about the demand for aggregates.....	10
Lack of implementation of state-of-the-art technological standards and operation processes.....	10
Lack of environmental monitoring.....	10
Low capacity of public authorities	11
Lack of systematic dialogue among stakeholders.....	11
3. Recommendations	12
Recommendation 1: Forge a path to the harmonious coexistence of different interests	12
Recommendation 2: Strengthen spatial planning in order to avoid land use conflicts.....	14
Recommendation 3: Improve knowledge about aggregates demand using evidence-based methods	18
Recommendation 4: Apply state-of-the-art technological standards and operation processes	20
Recommendation 5: Upgrade the monitoring systems in order to avoid environmental damage	22
Recommendation 6: Enhance the capacity of public authorities.....	24
Recommendation 7: Intensify the dialogue among stakeholders	26
Annex: Handout for Vietnamese officials	28

Executive Summary

Aggregates mining for the construction industry is an important economic activity in fast urbanizing countries, such as Vietnam. Against this background, the joint Vietnamese-German R&D project MAREX led by the Leibniz-Institute of Ecological Urban and Regional Development (IOER) in Dresden on the German side, was conducted between 2015 and 2018. It dealt with the “Management of Mineral Resource Extraction in Hoa Binh Province – A contribution to sustainable development in Vietnam”.

In the following, seven major recommendations are presented by the German project team. They are supported by a series of nine reports and the documentation of an international conference held in Germany in 2016. They were elaborated during the course of the project and discussed with Vietnamese partners and concerned stakeholders at several conferences and workshops in Vietnam.

The recommendations comprise the following:

1. Forge a path to the harmonious coexistence of different interests
2. Strengthen spatial planning in order to avoid land use conflicts
3. Improve knowledge about aggregates demand by evidence-based methods
4. Apply state-of-the-art technological standards and operation processes
5. Upgrade monitoring in order to avoid environmental damage
6. Enhance the capacity of public authorities
7. Intensify the dialogue among stakeholders

Box 1: Landscape under pressure in Hoa Binh Province, Vietnam



Tower-like limestone mountains in Luong Son, Hoa Binh province (Photo: P. Wirth, IOER)



Limestone mining operation (Photo: P. Wirth, IOER)

1. Background

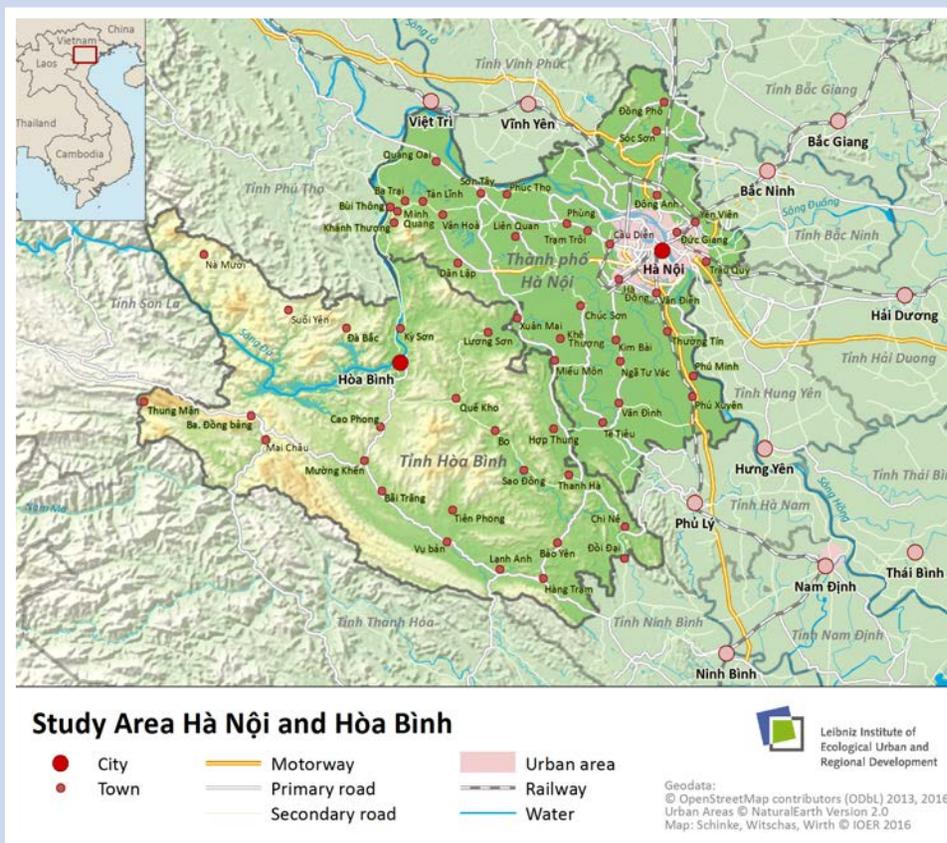
According to the United Nations, more than half of humanity live in cities today, and this figure will continue to rise. By 2030, almost 60 per cent of the world's population will live in urban areas. The growth will particularly occur in developing countries, which will account for 95 per cent of urban expansion in the next few decades.

Compared to these figures, urbanization in Vietnam is still rather low. According to World Bank data, 34 per cent of the population lived in urban areas in 2016. However, the current annual urbanization growth rate of 3 per cent is much higher than in many other countries and well above the world average of 2 per cent. According to national policies, the urbanization rate will be 45 % in 2020.

Urbanization does not come without challenges. The provision of adequate housing, infrastructure, transportation and services, the availability of decent jobs, social integration, the loss of green areas and agricultural land, and environmental pollution are only a few of them to name here.

The Greater Hanoi area, the second largest urban agglomeration in Vietnam, is a prominent example of the related challenges. According to the available forecasts of the Greater Hanoi Master Plan, Vietnam's capital will see fast spatial extension and many new investments in the construction sector during the coming decades.

Box 2: Research area Hanoi and Hoa Binh (Map: IOER)



As urban areas expand, so does demand for mineral resources such as sand, gravel and crushed stone, which are essential raw materials for the construction industry. These mineral resources, often called aggregates, make up about 70-80 per cent of concrete and about 90 per cent of asphalt.

The United Nations Environmental Programme (UNEP) estimates that the annual consumption of aggregates worldwide exceeds 45 billion tons. Gravel and sand account for the largest share. As the price of aggregates is highly transportation sensitive, the minerals for the construction industry are produced in close proximity to the fast growing urban centers.

In the case of Hanoi's neighboring provinces, aggregates mining and the provision of minerals for the construction industry result in adverse environmental impacts, including the destruction of the landscape and the pollution of water, soil and air. Clashes among diverse interests, for example raw material exploitation, environmental protection, tourism and agriculture, also emerge.

In some provinces the karst landscape has deteriorated, and social tensions and conflicts have arisen among stakeholders with varying interests, among them mining entrepreneurs, local residents, natural protection initiatives, environmental tourism providers and farmers. Such clashes of diverse interests, as well as adverse environmental impacts, are evident in Hoa Binh Province, Vietnam.

Bordering Hanoi, Hoa Binh Province offers the valuable construction aggregates needed to support the city's growth. Within the Province, the district of Luong Son is a particularly major aggregates mining area. However, the district is also home to unique hilly formations which attract national and international tourists, and which are severely endangered by the mining of aggregates (Box 2).

In consideration of the related conflicts, the Government of Vietnam, through its Ministry of Science and Technology and the People's Committee of the Province of Hoa Binh, has become active in looking for applicable solutions within the framework of a Vietnamese-German R&D project on the "Management of Mineral Resource Extraction in Hoa Binh Province – A contribution to sustainable development in Vietnam (MAREX)".

The major recommendations from the German project team are presented in the following. They are based on a series of MAREX publications which contain many details concerning relevant issues (Box 3).

The authors expect that these recommendations may help the mining of construction aggregates to be conducted in a responsible way, fully tapping into the Province's economic potential, allowing current and future activities – for example in the agricultural and tourism sectors – to remain undisturbed, protecting other qualities of the Province, and promoting sustainable urban and regional development.

The recommendations and the related material may also be an inspiration for other countries with similar conditions on their way to manage urbanization sustainably. The aim is help promote the development of positive economic, social and environmental links between urban, periurban and rural areas by strengthening national and regional development planning as mentioned in Goal 11 of the United Nations' 17 Sustainable Development Goals, laid down in the 2030 Agenda for Sustainable Development.

Box 3: MAREX Publication Series (Issues 1-9) and Conference Proceedings

1

Management of mineral resource extraction in Hoa Binh Province, Vietnam
Seven recommendations for responsible construction aggregates mining and contributions to sustainable urban and regional development
MAREX Publication Series – Issue 1

2

Monitoring of mineral resource extraction and analysing its impacts on the environment and land cover/land use in Hoa Binh Province
MAREX Publication Series – Issue 2

3

Technical solutions for mining and processing of aggregates and the mining sites after-use
A Cleaner Production Guideline for Vietnam
MAREX Publication Series – Issue 3

4

Cleaner production, mining optimizing approaches and material flow analysis
MAREX Workshop, Hoa Binh, Vietnam, November 2017
MAREX Publication Series – Issue 4

5

Regional material flow analysis
A concept for balancing supply and demand of construction minerals for regions using the example of Hanoi and the borderland province Hoa Binh
MAREX Publication Series – Issue 5

6

The economic impacts of construction aggregate mining on regional development
The case of Hoa Binh Region, Vietnam
MAREX Publication Series – Issue 6

7

Planning for the responsible extraction of natural aggregates
The case of Hoa Binh Province/Hanoi Metropolitan Area
MAREX Publication Series – Issue 7

8

Legal framework for environmentally sound mining in Vietnam
MAREX Publication Series – Issue 8

9

The MAREX Alliance
A Business-Policy Interface for the responsible management of mineral aggregates in Hoa Binh Province, Vietnam
Hội MAREX
Mối liên kết chính sách-kinh tế và quản lý có trách nhiệm đối với khai thác khoáng sản làm vật liệu xây dựng tại tỉnh Hòa Bình, Việt Nam
MAREX Publication Series – Issue 9

Conference Proceedings

In cooperation with:
The Institute of Environment and Pollution

27th - 29th October | 10-14th Floor | University of Applied Sciences
CONFERENCE DOCUMENTATION

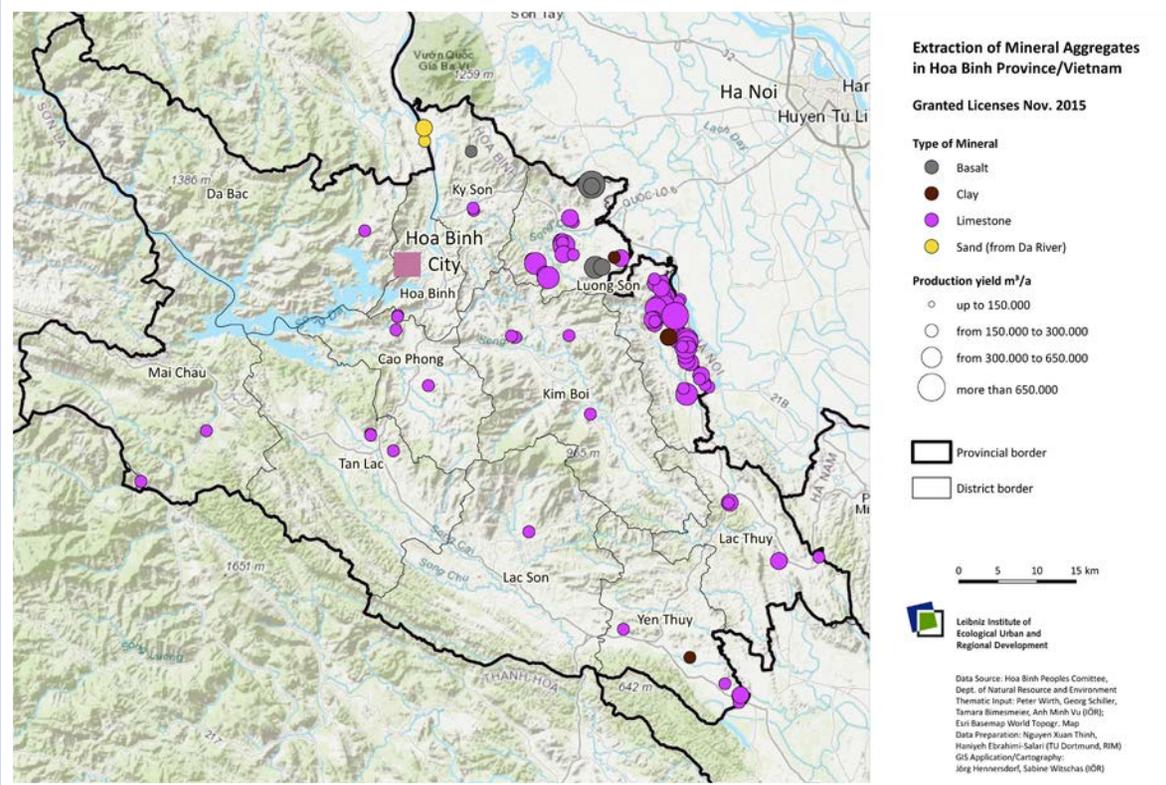
MAREX
Management of Mineral Resource Extraction in Hoa Binh Province –
A Contribution to Sustainable Development in Vietnam
www.marex-project.de

2. Challenges

In Vietnam, increased industrialization is creating greater markets for the use of aggregates, particularly in high growth urban areas like the Hanoi Metropolitan Region. The construction industry has been one of the key economic sectors since the Doi Moi reform which started in 1986. Hoa Binh is one of the important provinces feeding Hanoi with raw materials, mainly crushed stone. The District of Luong Son is the major aggregates mining area in the province due to its geological conditions and its proximity to Vietnam's fast growing capital, which is a key domestic market for aggregates used in the construction sector (Box 4).

Over the past years, Vietnam has developed a rather advanced legal framework for aggregates mining. It meets current international standards, and it provides a solid basis for responsible aggregates mining in Hoa Binh Province. Moreover, the decentralization of decision-making from the national to the provincial level regarding exploration and licensing in the aggregates mining sector, in general, presents opportunities for provincial authorities:

Box 4: Mining sites in Hoa Binh Province, Vietnam (Map: IOER)



- To address land use conflicts, to protect the existing landscape, and to safeguard tourist potentials through wise land use planning and decision-taking;
- To diminish or prevent environmental damages, to allow uninterrupted agricultural production, and to avoid the loss of valuable landscape potentials through the efficient licensing, control and monitoring of mining operations; and
- To enhance the attractiveness of mining areas after mining has ended, and to promote their medium- and long-term reuse for other economic activities, such as tourism, through farsighted planning for rehabilitation and its effective implementation.

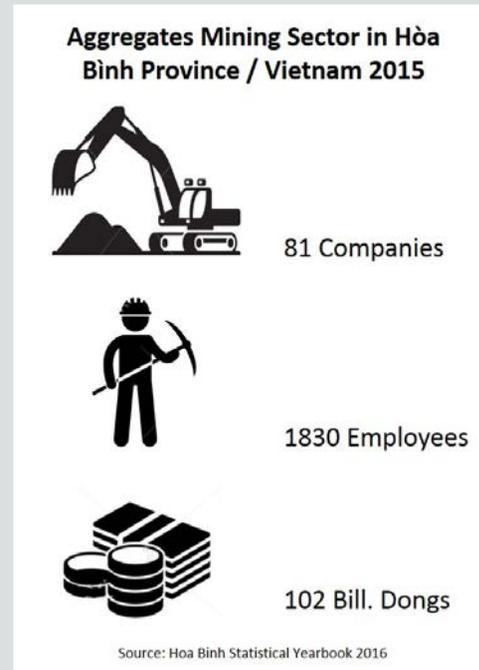
Data show that since the decentralization of licensing in the aggregates mining sector in 2005, the number of mines, the area used for mining, and the quantities of mined material have sharply risen in a rather erratic way. Nevertheless, in Hoa Binh Province aggregates mining plays a minor role in economic terms today. In the year 2015, there were 81 registered companies which provided employment for 1830 persons. The sector contributed only 0.55 per cent to provincial GDP (Box 5).

Compared to this, the challenges of further development may outweigh the economic importance of the mining activities. Luong Son District also offers very promising international and national tourist perspectives due to its outstanding karst landscape and natural environment. However, its characteristic hilly formations are severely endangered by aggregates mining as they mainly consist of materials that are valuable for the construction industry.

As we can see from this example, aggregates mining faces challenges. These challenges could be identified during the course of the project, through documents and data analysis, interviews with stakeholders and systematic site visits. The main challenges can be summarized as follows.

Box 5: Economic Relevance of Aggregates Mining Sector in Hoa Binh Province, Vietnam 2015

(Figure: P. Wirth, IOER)



Weak coordination of land use interests

In Hoa Binh Province, there is a deficit of coordination between the different interests of stakeholders related to aggregates mining and its consequences for other land uses, especially on the local, i.e. district and communal levels. On the one hand, this is due to the hierarchical top-down decision-making structure in the country. The national and provincial authorities decide on the quantity of mineral aggregates to be mined. Mining licenses are granted on the provincial level. Local authorities are hardly involved, or even informed. On the other hand, potential local land use conflicts, e.g. involving the preservation of nature and landscape, nature tourism, and local farming are neither analyzed nor systematically taken into consideration in decision-making processes about the granting of mining licenses. Therefore, problems usually become obvious only after mining has started.

Weak land use planning mechanisms

Within the rather refined Vietnamese planning system there are various types of plans which, in general, provide the opportunity to achieve a well-coordinated land use policy on the provincial level. However, in Hoa Binh Province there are rather weak linkages between the different plans and the respective authorities responsible for their elaboration. Potential land use conflicts and their related impacts – between mining and the development of settlements or the development of tourist routes – therefore remain undisclosed, and there is no systematic procedure for defining the most suitable and least disturbing areas for mining and related industrial activities. The lack of appropriate planning instruments also limits the capabilities of the authorities responsible to plan for the systematic development and enhancement of the attractiveness of mining areas after mining has ended, and to promote their medium- and long-term reuse for recreation or other activities, such as tourism.

Limited knowledge about the demand for aggregates

Aggregates mining is driven by market forces and the intention of the government to provide employment and business opportunities to individuals. As in general there is a high demand for aggregates due to the rapid growth of Hanoi, the authorities of Hoa Binh Province hardly see the need for restricting or imposing limits on aggregates mining. Thus, companies may open mines, expand their businesses, fail, leave or close mines without a clearly established feedback process with the provincial authorities. Neither the businesses nor the provincial authorities have sufficient evidence-based information or forecasts about the demand of aggregates and the development of the market. This makes the sector and its development rather unpredictable.

Lack of implementation of state-of-the-art technological standards and operation processes

The aggregates mining sector in Hoa Binh Province is dominated by rather small scale operations. This is partly due to the government policy of opening up business opportunities for small scale entrepreneurs. However, for reasons of cost efficiency, the small size of businesses in many cases hardly allows the application and implementation of state-of-the-art technological standards and related operation processes in the aggregates mining sector. This hinders mining activities being implemented according to the approved mining operation plans, and proper attention being given to environmental requirements. Although approved operation plans are usually of rather high quality, the realities at mining sites are often disappointing. Post-mining recultivation activities at mining sites are not systematically planned and happen rather haphazardly. On the one hand, this is due to a lack of knowledge and technical skills on the part of the mining operators. On the other hand, there is not much, if any, technical control and advice given by the authorities in charge of the management of natural resources. This results in sub-optimal and high-risk operations, a lack of work safety for employees, conflicts with neighbors e.g. due to unregulated blasting, and severe environmental problems.

Lack of environmental monitoring

Aggregates mining may have severe negative environmental impacts if not properly carried out. Among them are changes in landscapes, the loss of nature and biodiversity, and water, soil and air pollution. The karst landscape is already severely deteriorating, pollution of water, soil and air causes problems, and land use conflicts with regard to nature protection, nature tourism and agriculture are increasingly causing tension. However, to date there is no systematic monitoring of the negative environmental impacts of mining operations and

their related services including transport in Hoa Binh Province. Thus, the respective authorities do not have enough evidence about where and how to act. They also lack sufficient and up-to-date information about violations of mining operations, the closure of mines, or mining companies leaving the sites in a disorderly manner if their business does not take off or is failing. Thus, the authorities responsible for the management of natural resources in the province have very low regulatory capacities regarding the aggregates mining sector. As a consequence they concentrate on the collection of environmental fees and taxes from the mining operators instead.

Low capacity of public authorities

The public authorities responsible for the management of natural resources and extraction of mineral construction materials have only limited capacities to act. This is due to the lack of specialized and sufficiently qualified personnel, very limited budgetary resources, scarce systematic and up-to-date information, a lack of the mobility necessary for regular control activities and surprise visits at mining sites, and limited information, coordination and cooperation procedures with other stakeholders on the different levels. This sharply limits the operational abilities of the staff and prevents them performing their duties efficiently and effectively. Training opportunities are rare, and often limited by day-to-day work.

Lack of systematic dialogue among stakeholders

In general, there is limited systematic dialogue between the different stakeholders regarding aggregates mining activities and their consequences. Although aggregates mining operators created an association of respective businesses in Hoa Binh Province some years ago, there is neither systematic dialogue with the provincial authorities nor structured communication with the general public and special interest groups. This limits the ability to recognize potential land use conflicts and related problems early enough, and to discuss appropriate solutions. This often results in disharmony, unrest and discontent among all concerned parties. If at all, solutions are sought on an individual basis instead of systematically providing for compromise and seeking acceptance.

3. Recommendations

The above-depicted challenges cannot be ignored in the future and require urgent action if the provincial authorities intend to pursue a sustainability-oriented development strategy. In order to be able to fully tap the economic potential of Hoa Binh Province, to allow for current activities to continue undisturbed, e.g. in the agricultural sector, and to protect the tourist qualities of the province, it is of utmost importance to carry out aggregates mining and processing in a responsible and very sensitive way. The German project team has elaborated the following seven recommendations.

Recommendation 1: Forge a path to the harmonious coexistence of different interests

Mineral products are essential for constructing modern societies and economies. But simply meeting market demand for mineral commodities does not comply with society's current expectations of the industry. Further expectations include ensuring that the natural environment is preserved and protected, and that the economic goals of the local community, which are often in sectors other than mining, such as in agriculture or tourism, can also be met (Box 6).

All entities involved, the provincial and local authorities, the extracting industry, and the local population, must first and foremost recognize that multiple interests exist. Subsequently, each entity must learn to pursue its own objectives in ways that move society, and thus the interests of all entities, forward as a whole. In sum, the approach must be both comprehensive, including the entire value chain of minerals extraction and use, and set both long-term and short-term objectives.

Companies participating in mining activities must be able to survive and succeed, which requires an educated and safe workforce, access to capital, and the opportunity for a return on investment, among other essential factors. Local communities must not be left to deal with the resulting upheaval and costs of mining; in contrast, they should receive benefits from the mining activities which extend beyond the life span of the mine itself. Moreover, environmental

impacts must be managed in a way that not only fulfils regulatory requirements, but also safeguards the long-term health, safety and economic security of the local population.

To forge a harmonious existence among all entities, the minimum requirements include:

- a framework for responsible development based on an agreed set of broad principles;
- an understanding of the key challenges and constraints facing the sector at different levels and in different regions, and the actions needed to meet or overcome them, along with the respective roles and responsibilities of actors in the sector;
- a process for responding to these challenges that a) respects the rights and interests of all parties involved, b) is able to set priorities, and c) ensures that action is taken at the appropriate level;
- an integrated set of institutions and policy instruments to ensure minimum standards of compliance as well as responsible voluntary actions; and
- verifiable measures to evaluate progress and foster consistent improvement.

Box 6: In Vietnam's Tourist Industry, Nature is Capital

In the Cu Yen Commune, which is located within the Luong Son District of Hoa Binh Province, La Ferme du Colvert Resort & Spa offers its guests activities and services focused on wellness, nature and the environment. Only 40 kilometers from Hanoi, the facility markets itself as “an exceptional countryside estate, untouched by mass tourism”. Situated on 25 hectares of land and embedded in green countryside including ponds and forests, the resort offers 12 country guest-houses, each of which feature different Vietnamese ethnic and architectural styles. Altogether, the facility can accommodate 200 guests. Most guests who stay at the resort are international.

While no mining activities are located within the immediate area of the resort, the resort's bus, cycling and hiking tours enter neighboring areas where mining is being carried out. “At the moment, the mining areas are too far away to affect our resort in a negative way,” said the manager, Mrs. Phuong Tran Chassedieu (right in the photo). “But the area in which our activities take place is large and sometimes the tours come into contact with the mining areas. We hope the mines don't come any closer.” The resort maintains contacts with the authorities and has received support as it has developed its facilities.



Photo: La Ferme du Colvert

Recommendation 2: Strengthen spatial planning in order to avoid land use conflicts

Vietnam has established a very well refined planning system. However, it is hardly suitable for providing a coordinated basis for aggregates mining. Following some experience with regional planning in Germany, it is proposed to establish a new type of planning instrument, the District Area Master Plan for Aggregate Mining and Post-Mining. This regulates not only where mining shall take place but also what happens after mining, e.g., regarding land use and re-cultivation measures.

The plan shall be elaborated by the provincial authority in charge of the management of natural resources in a transparent and participatory process. All concerned stakeholders, including mining operators, districts and communes, NGOs and special interest groups as well as the population shall be involved in the elaboration of the plan.

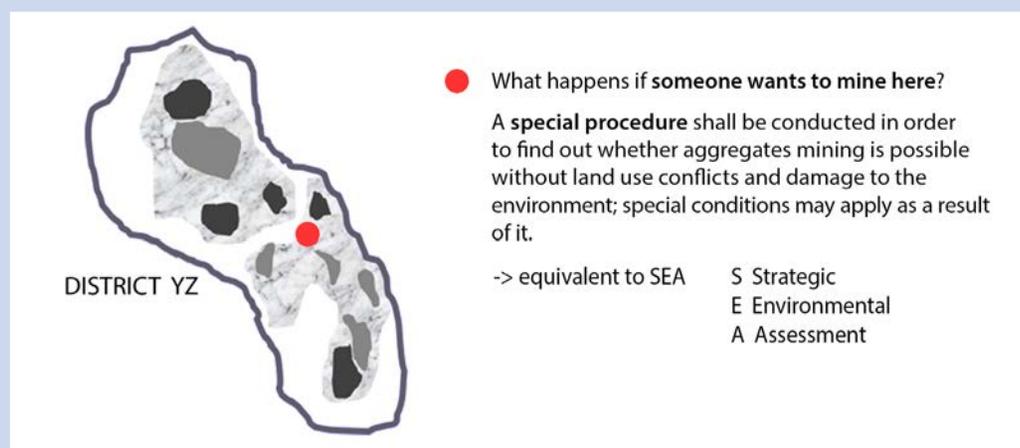
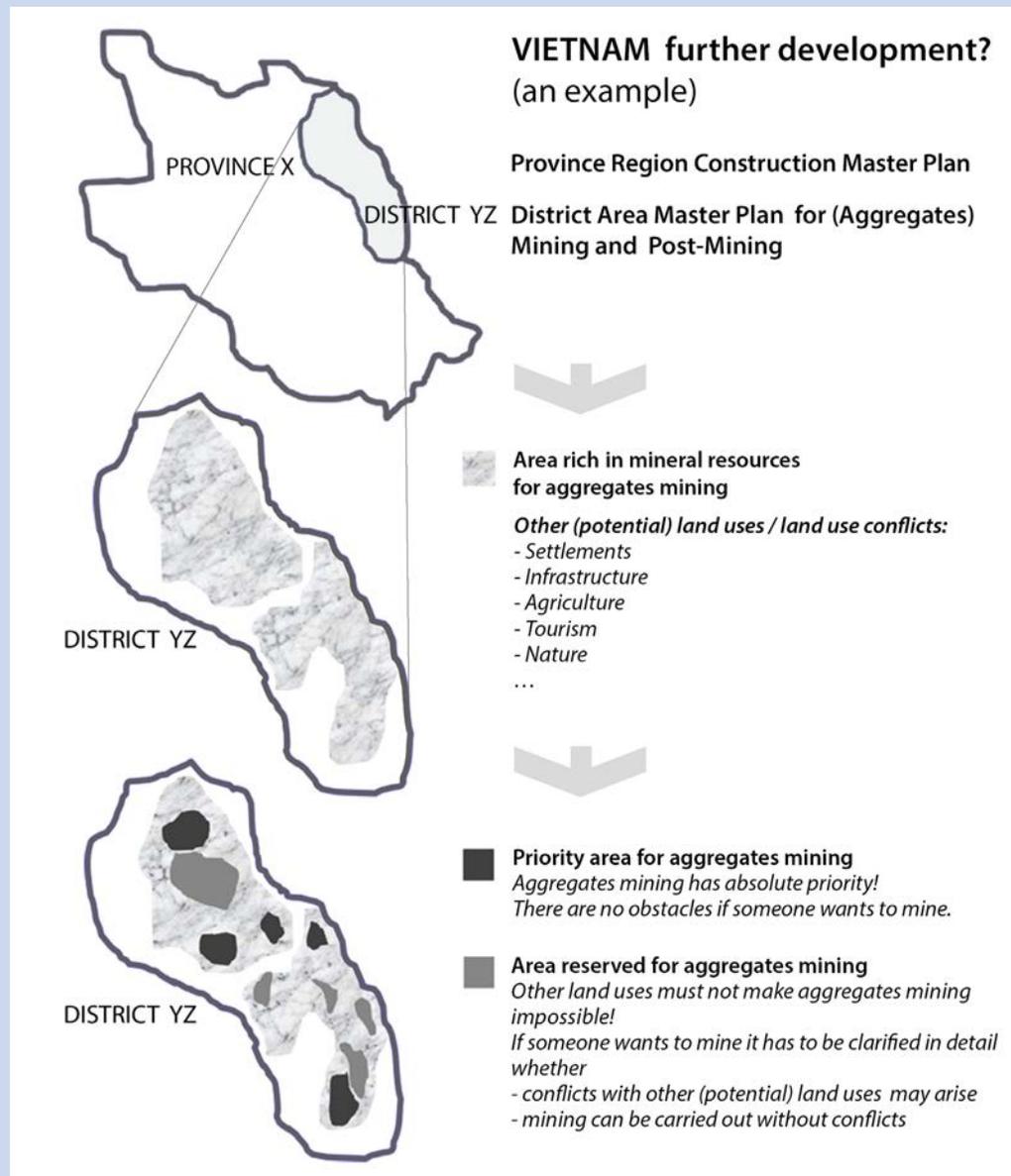
The following steps shall be carried out while elaborating the plan, e.g. for District XY in Province X (Box 7):

- Step 1: Based on geological information on the location of aggregates as well as on the quantity and quality of the mineral resources, and with the assistance of the responsible institutions, the provincial planning authority identifies the areas within District XY which are suitable for aggregates mining.

- Step 2: The planning authority conducts a thorough land use conflict analysis.
 - The analysis includes a medium- and long-term forecast of the demand for aggregates.
 - The planning authority chairs a decision-making process in order to determine how much material of which type of aggregates shall be provided. The respective district authorities and all affected communes shall be involved in the decision-making process.
 - The planning authority conducts a thorough and participatory analysis of potential conflicts with other current and future land uses, involving all concerned stakeholders, including the general public.
- Step 3; The planning authority identifies:
 - Priority areas for aggregates mining where aggregates mining has absolute priority. Here there are no obstacles if a business intends to mine.
 - Areas reserved for aggregates mining where other land uses may be allowed as long as they do not make aggregates mining impossible. If a business wants to mine in such an area, it has to be clarified in detail – whether conflicts with other (potential) land uses arise or whether mining can be carried out without any conflicts being expected.

If a business wants to mine outside of the designated area of these two types of priority zones, a special procedure analysing potential land use conflicts, has to be carried out before a license can be issued.

Box 7: District Area Master Plan for Mining and Post-Mining
(Proposal: B. Müller IOER / TU Dresden)



- Step 4: Regarding post-mining land use, the planning authority shall decide in cooperation with all concerned stakeholders which land uses shall be introduced after mining activities come to an end, e.g. forest area, agriculture, lake, tourism area, nature protection area. This gives the mining operators together with future land users the chance to decide at the earliest convenience about appropriate measures and ways of mining which may help to achieve maximum benefits after mining, e.g. in terms of recreation or nature protection and biodiversity.
- Step 5: The District Area Master Plan for Aggregate Mining and Post-Mining shall be subject to a Strategic Environmental Assessment (SEA) procedure with the following steps:
 - Screening: investigating of whether an SEA shall be conducted
 - Scoping: defining the boundaries of investigation, assessment and assumptions required
 - Documentation of the state of the environment: baseline on which to base judgments
 - Determination of the likely (non-marginal) environmental impacts: usually in terms of direction of change rather than firm figures
 - Informing and consulting the public
 - Influencing decision taking based on the assessment
 - Monitoring the effects of plans and measures after their implementation
 - Participation: involvement of all stakeholders!

All in all, the District Area Master Plan for Aggregate Mining and Post-Mining is a tool to diminish land use conflicts, to prevent environmental damage and landscape deterioration, to safeguard future development potentials, to envisage the future of the district, to give security to the mining companies, to involve all stakeholders, and to establish open and fair participation for the benefit of all.

Box 8: New urban developments



New business district in Hanoi (Photo: P. Wirth, IOER)



Newly built elevated railway in Hanoi (Photo: P. Wirth, IOER)

Recommendation 3: Improve knowledge about aggregates demand using evidence-based methods

In order to carry out planning for responsible mining, an accurate estimate of the long-term supply and demand for building materials has to be made by the respective authorities. Without this essential information, it is impossible for the authorities to plan the allocation of licenses from a long-term perspective. In Hoa Binh Province, a planning-oriented material flow analysis (MFA) was successfully conducted to help more closely align mineral material planning with the expected demand for mineral building materials (Box 9). The results of the model calculation indicated a mismatch between the regional demand for mineral building materials which are annually available, and licensed mining capacities in the long term. The calculated demand for aggregates was significantly below the annually available and licensed mining capacities, implying a current oversupply of these building materials in terms of overall quantity. On the other hand a shortage of sand and clay was indicated.

Moreover, material flow analysis models provide an approach to quantify the effects of specific measurements on potential changes within the future demand of building materials. They are applied to describe metabolisms by quantifying material flows, material stocks and stock changes in a defined system, while keeping a specific subject as well as specific spatial and temporal scales in mind. For example, when applying the material flow model, researchers were able to use the spatial framework of the client relationships between Hoa Binh Province and Hanoi and within Hoa Binh Province for the time period of 2005 to 2035.

In material flow analysis, two calculation approaches are possible: a top-down deductive approach and a bottom-up inductive approach. For the case of material flows from and within Hoa Binh Province, the bottom-up calculation approach offered several advantages. The bottom-up approach provides information on both the quantity and quality of the required materials. Additionally, the bottom-up calculation basis is formed by input parameters such

as elements of the built environment which include buildings and roads. The fluctuating dynamics and the future development of consumption patterns, among them changes in construction, can furthermore be taken into account. In sum, direct references to settlement planning tasks can be established using a bottom-up approach, creating the conditions to better link and integrate different planning areas (infrastructure planning, resource planning, and land use planning) as required by Vietnam's current planning law. In contrast to the bottom-up approach, the top-down approach which is currently applied for the planning of natural resources does not allow a distinction to be made between the individual components of the built environment, such as roads and buildings, but only a continuation of the demand estimation, which is based on a few socioeconomic factors.

The point of departure of a top-down approach is total quantities of an area (e.g. the total quantity of domestic consumption of mineral building materials of a country according to general material groups). The top-down approach then aims to distribute the quantities provided, e.g. per capita consumption. One main disadvantage of this approach is its dependence on the material groups reported in statistics; thus, it can only provide a rough indication of the upper limits of current material consumption. Furthermore, top-down approaches are not suitable for mapping changes in consumer behavior (e.g. a reduction in households or an increase in living space per capita). All aspects considered, due to the limitations described above, top-down approaches have not proved suitable for material flow analyses.

The model consists of three components, a process chain model (see Figure 1), a spatial model and a bottom-up material flow analysis approach (MFA). The components consider the whole chain from mining to processing, to the use of building materials in the built environment to waste management. The spatial model describes the demand induced by construction activity in Hanoi and Hoa Binh as

Box 9: Description of MFA calculation and diagram

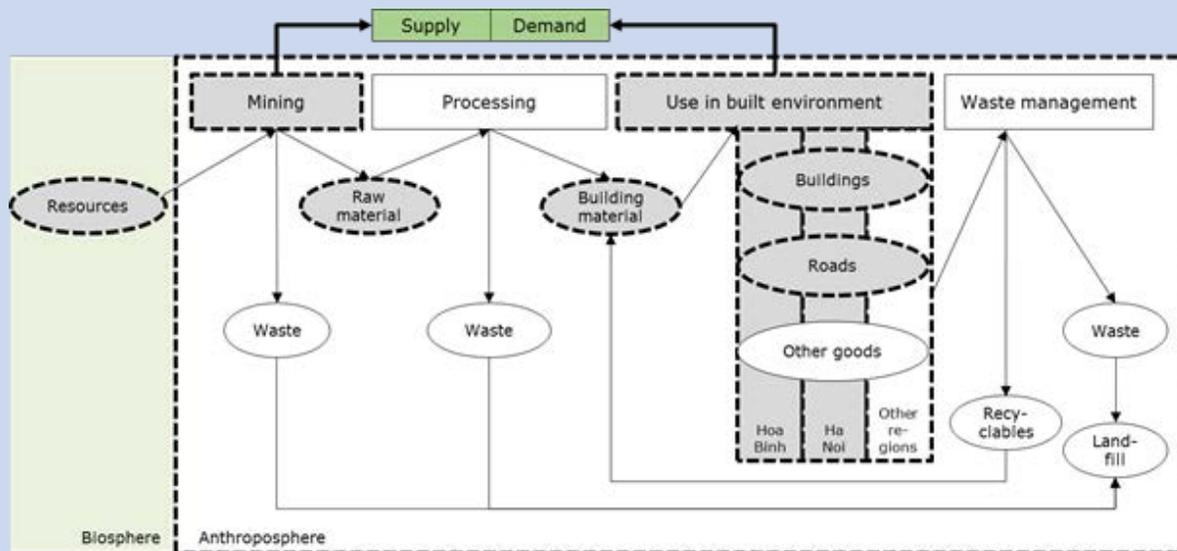


Figure 1. Components and system boundaries of the regional MFA model (research foci in grey)

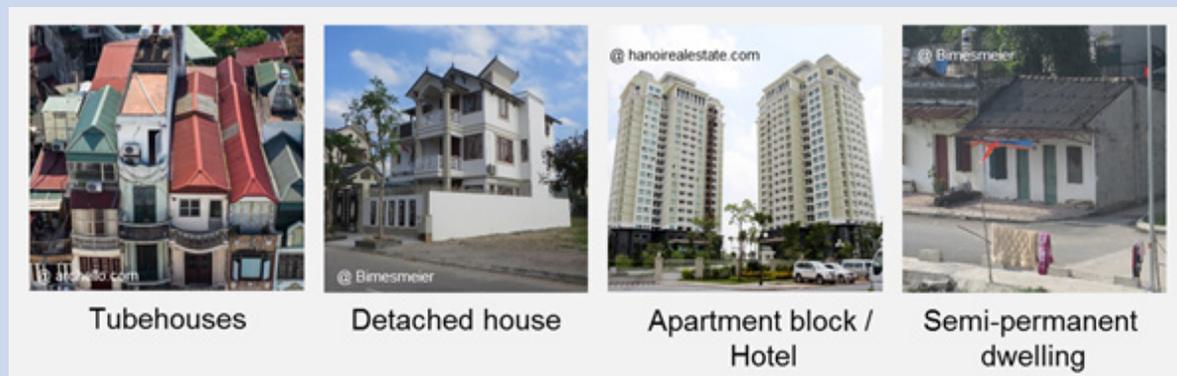


Figure 2: Typical residential houses in Vietnam

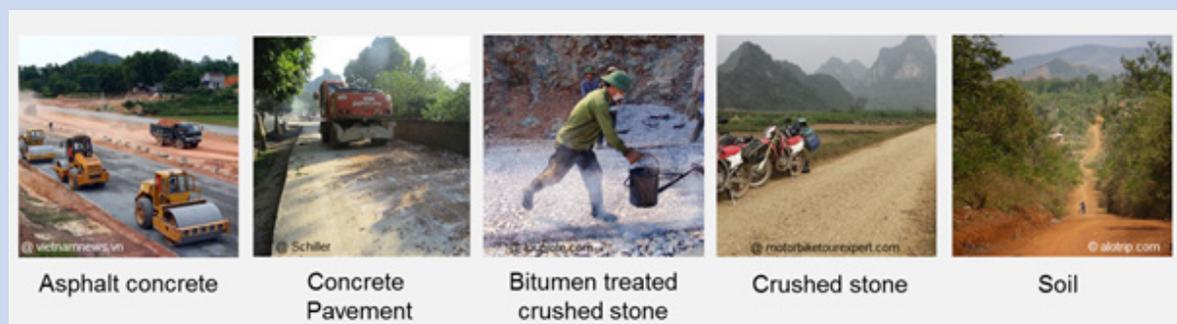


Figure 3: Typical pavement types in Vietnam

well as the supply from the mining province Hoa Binh. The bottom-up MFA approach is based on a survey of construction activity and projections using specific material indicators for building types of built constructions and roads. The definitions of the MCI are based on empirical investigations of typical local construction methods (see Figure 2 and Figure 3).

Overall, it can be stated that the evidence-based calculation method offers quantitative and qualitative orientation for the planning of natural resources. Furthermore, it is suitable for the integrated consideration of settlement planning, resource planning and mutual dependencies.

Recommendation 4: Apply state-of-the-art technological standards and operation processes

Quality control and quality control criteria are fundamental components of any system analysis. The set of quality control tools and criteria used for their review can be summarized as “Good Mining Practice” (GMP), a code of conduct (Box 10).

GMP covers the sitespecific development of good mining activities as well as the criteria, norms and principles which lead to the optimized and responsible utilization of mineral resources. Key aims are to achieve optimal benefits and minimize negative impacts. These aims apply to the whole value chain of the mining process, including supporting activities such as licensing, mining techniques, occupational health and safety, environmental conservation, as well as added value and development of the local community. All activities take place within the framework of existing laws, regulations and standards.

The criteria for GMP have been developed based on experience in mining and mining rehabilitation projects and have been qualified and quantified with data in academic literature.

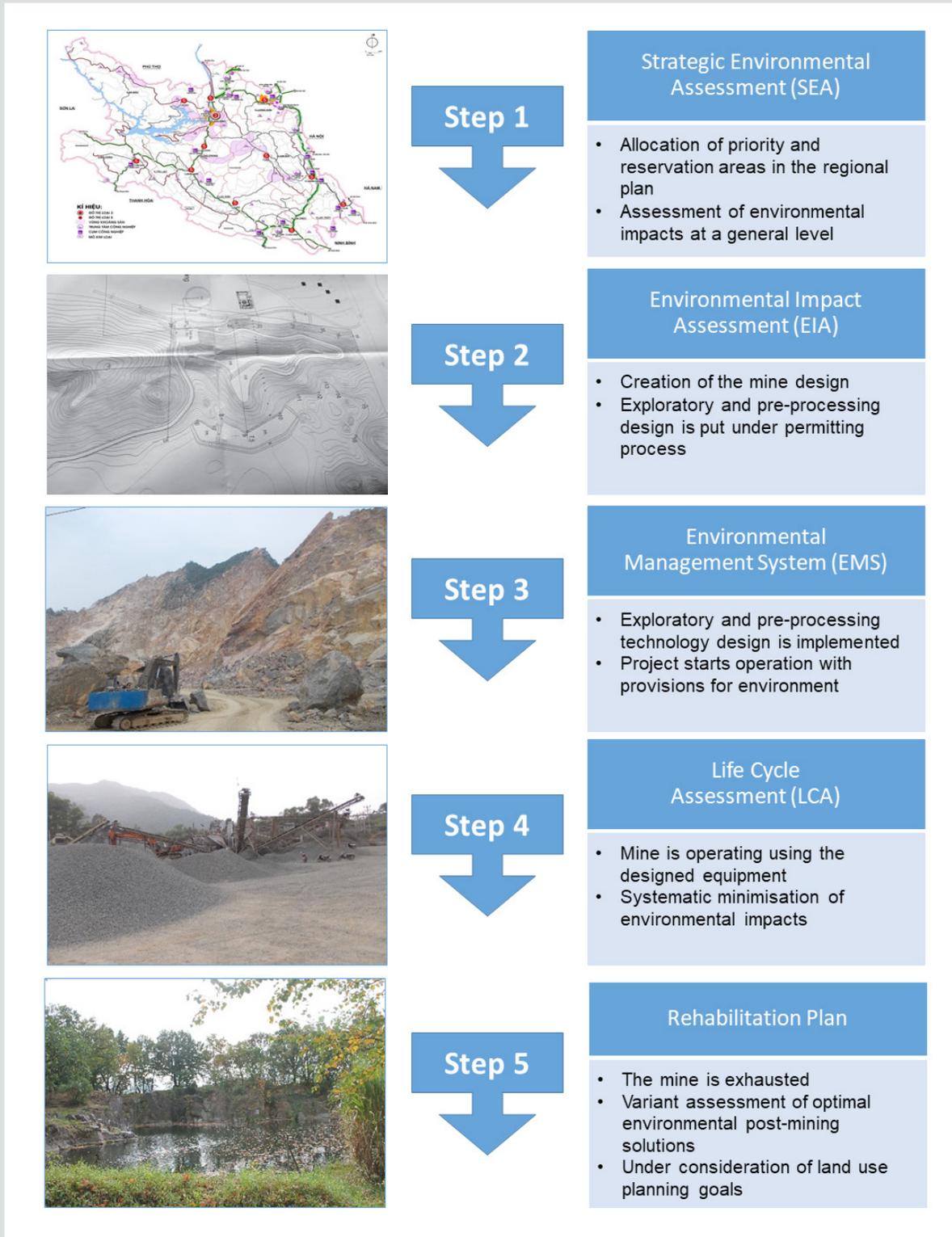
The framework of “Good Mining Practice” includes:

- comprehensive and holistic planning of mining activities based on applicable standards;
- a qualified system analysis with appropriate tools such as material flow analysis (MFA) based on qualified data from the environmental monitoring system;

- implementation of best practice techniques;
- measures and actions which abide by the existing laws and regulations;
- systematic reduction of environmental risks through the implementation of an Emergency Preparedness System (EPS) and an Environmental Management System (EMS) in accordance with ISO 14001 standards;
- provisions devised for the appropriate valorization of ecosystem services that can be made available in closed mines; and
- provision of comprehensive and transparent documentation.

As a result of low revenues from inefficient operations, the main focus of mining companies is currently on social and environmental protection measures implemented by the mining companies to the extent required by law. GMP goes beyond this, however, by integrating and implementing a range of concepts of good environmental practice, specifically pollution prevention, waste reduction, recycling and the reuse of waste resources. Increasing the size requirements for licenses, or merging adjacent sites could improve capacity utilization significantly. A study has shown that merging adjacent sites would achieve savings in all environmental impact categories in the range of 52 % to 94 %.

Box: 10: Overview of environmental assessment approaches related to mining activities (basing on a draft by P. Schneider, K.-D. Oswald, W. Riedel and A. Meyer)





Recommendation 5: Upgrade the monitoring systems in order to avoid environmental damage

Many environmental consequences can result from mining activities. The risk of contamination of the air, soil, groundwater and surface water often becomes reality and plays a role in land use conflicts, particularly when mining activities are located near settlements and agricultural areas. As mining activities increased in Hoa Binh Province, so did the need for the local authorities to monitor and assess the mining activities and develop mitigation measures in response.

Essential to the ability of the provincial administration to monitor the mining activities was the establishment of a database and a GIS software tool (Box 11 and Box 12).

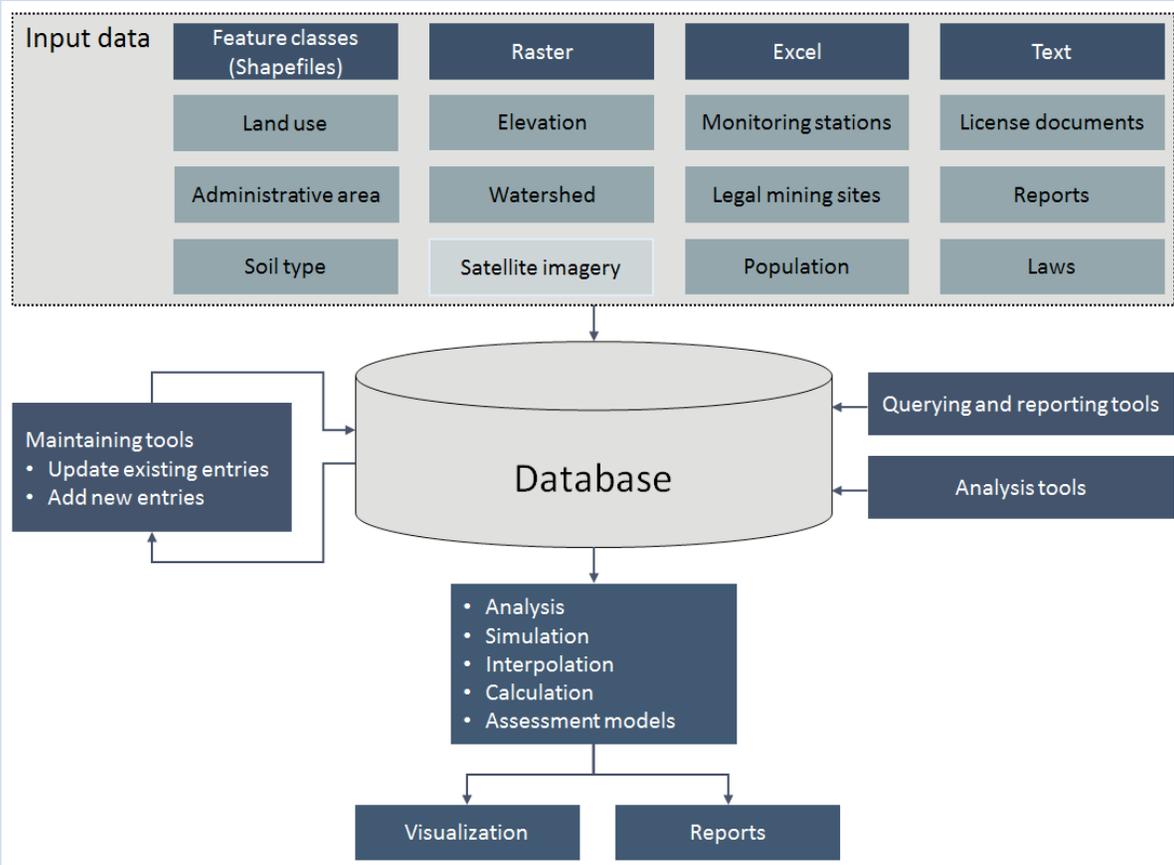
The resulting database consists of multiple spatial and non-spatial datasets stemming from various sources. Among the datasets are feature classes, including administrative land use data, satellite-based land use data, and administrative layers; raster data, such as elevation data and historical satellite data; excel tables containing information about legal mining sites; and MS Word data, such as reports on monitoring data and laws and regulations on limiting values.

The GIS software tool makes it possible to gain an overview of the status of the mining activities and their effects on the environment by generating comparable outputs such as statistical data, diagrams and maps. It features three key functionalities:

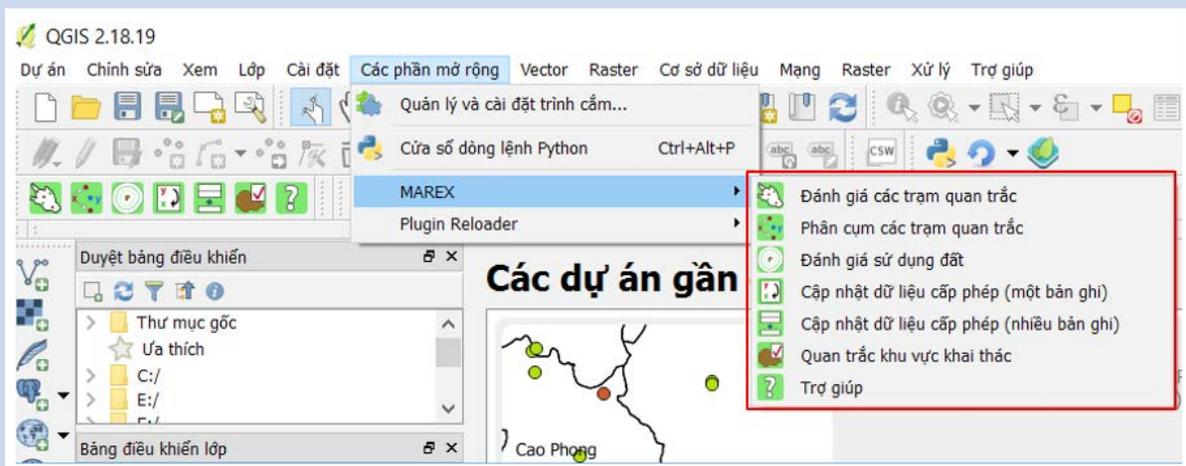
- storage automation and management, including single- and multiple-entry functions and spatial representation of the data on geographical maps;
- querying and reporting functions, which enable users to retrieve data or information from a database according to search parameters and to access the results in a shapefile, map and/or table; and
- analysis functions, which evaluate monitoring stations to detect when limiting values have been exceeded, evaluate land use around mining sites to detect land use conflicts, and cluster monitor stations to determine the level of environmental contamination.

The development of the python-based GIS tool for use as a plugin in QGIS, an open source geographic information system, is of vital importance. Not only is the free availability of the tool guaranteed since it is based on an open source, but a help function is available in HTML format to provide users with a better understanding of the tool. Moreover, the open-source tool is suitable for establishing a database on natural resources and environmental monitoring in other provinces in Vietnam. It supports local authorities in monitoring mining activities and developing mitigation measures by improving the effectiveness of data storage and management as well as enabling real-time analysis.

Box 11: Environmental Monitoring Model for Aggregates Mining in Hoa Binh Province/Vietnam (Source: N. X. Thinh and H. Ebrahimi Salari)



Box 12: Screenshot of the QGIS based Monitoring Software (Source: N. X. Thinh and H. Ebrahimi Salari)



Recommendation 6: Enhance the capacity of public authorities

Ensuring that individual, organizational and strategic capacities are on par with the magnitude of mining activities is essential for realizing responsible mining. At the level of the individual, vital aspects include training in, awareness of, and utilization of state-of-the-art technologies and methods, many of which are expanded upon in other sections of this report. Furthermore, participation in knowledge-sharing and communication platforms such as the MAREX Alliance also serves to enhance individual professional capacities.

At the organizational level, governmental bodies are mandated to license, oversee, and monitor mining activities in all phases of mining operations, from planning to the rehabilitation of the land after the minerals have been extracted. In Vietnam these activities are carried out at a similar administrative level as in Germany – at the level of the province and Bundesland, respectively; this thus offers an opportunity for comparison.

Since 2005, the Vietnamese provinces have been responsible for licensing, facilitating and enforcing regulations, evaluating environmental impact assessments, conducting environmental inspections, and defining management plans for environmental rehabilitation. While on-site inspections of current operations should ideally be carried out twice a year to ensure responsible mining, due to the current agency structure and shortage of staff it is only possible to do so annually.

In the Free State of Saxony, Germany, in which several MAREX partners are located, the Mining Authority of Saxony has been charged with monitoring and supervision. Mining has played an important role in Saxony's local economy since about 1200 A.D. As the industry has evolved, so

has the Authority. Today, the Mining Authority of Saxony has 80 employees and operates on a budget of 75 million Euro. The Authority is responsible for granting licenses; imposing fees; authorizing management plans; monitoring occupational safety; ensuring environmental, health, and safety protection at the workplace; financing post-mining measures; and preventing hazards connected to underground cavities, pits and landfills (Box 13).

Three main departments support the activities of the Mining Authority of Saxony: administration, opencast mining, and underground mining. The latter two departments are further divided according to the materials that are mined, for example opencast mining is divided into the specializations of brown coal, stones and soil. At least two inspections are carried out per year on the 206 mining companies operating in Saxony, as well as additional unannounced inspections, some of which are conducted aerially. In sum, in order to perform the activities mandated to a mining authority by law, the authority or governmental body charged with providing oversight must be staffed by the number of employees that is proportional to the activities that are to be carried out.

Finally, while an authority staffed with experts is important for safeguarding responsible mining activities, the links between the authorities which oversee the planning and implementation of the mining activities, the provincial/state government and the ministry of justice are essential for the enforcement of laws and other requirements. Only when these agencies, departments, and ministries work in tandem is it possible to hold mining companies accountable for carrying out their activities in a responsible manner.

Box 13: Tasks of the Saxony Mining Authority (Source: Cramer 2016)

MINING AUTHORITY OF SAXONY

- **Grant of mining licence**
 - Permission – approval – mining properties / property rights
- Imposing mining related **fees**
- **Authorization of management plans** (scouting plans, master plans, main operational plan)
- Monitoring of **occupational safety**
- **Termination of mining supervision**
- **Environmental, health and safety protection** at the workplace
- **Financing of post-mining measures**
- **Hazard prevention** in regard to underground cavities, landfills and pits of mining (police authority), consulting other authorities, management of underground cavity maps

Stichtagszeitpunkt: 01.01.2013
 Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (2013)

Recommendation 7: Intensify the dialogue among stakeholders

Projects focused on the acquisition of natural resources have myriad stakeholders with varying interests. Among them are the extraction industry, the local, regional and national authorities, the general public, and those working in support of nature protection.

Yet with collaboration, cooperation and communication, the interests of the stakeholders can be aligned and harmonized. The MAREX Alliance, a Policy-Business-Society Interface, was established in 2016 with exactly these goals in mind and serves as a model for interfaces that could be set up throughout Vietnam.

The main objective of the MAREX Alliance is to establish an optimal management and governance model which contributes to and consults on aggregates mining activities. The participants include state management bodies (policy), businesses, the society (the general public of the localities concerned), and researchers and technology transfer specialists. As part of the Alliance, stakeholders work together to implement a program of action which serves the common objective of responsible aggregates mining in Hoa Binh Province. The approach aims to achieve an effective way to extract raw materials, to reduce environmental and social impacts, to deal with the health and safety risks of mining, and to improve

stakeholders' knowledge. Overall, it allows for the implementation of the proper measures within the defined program of action.

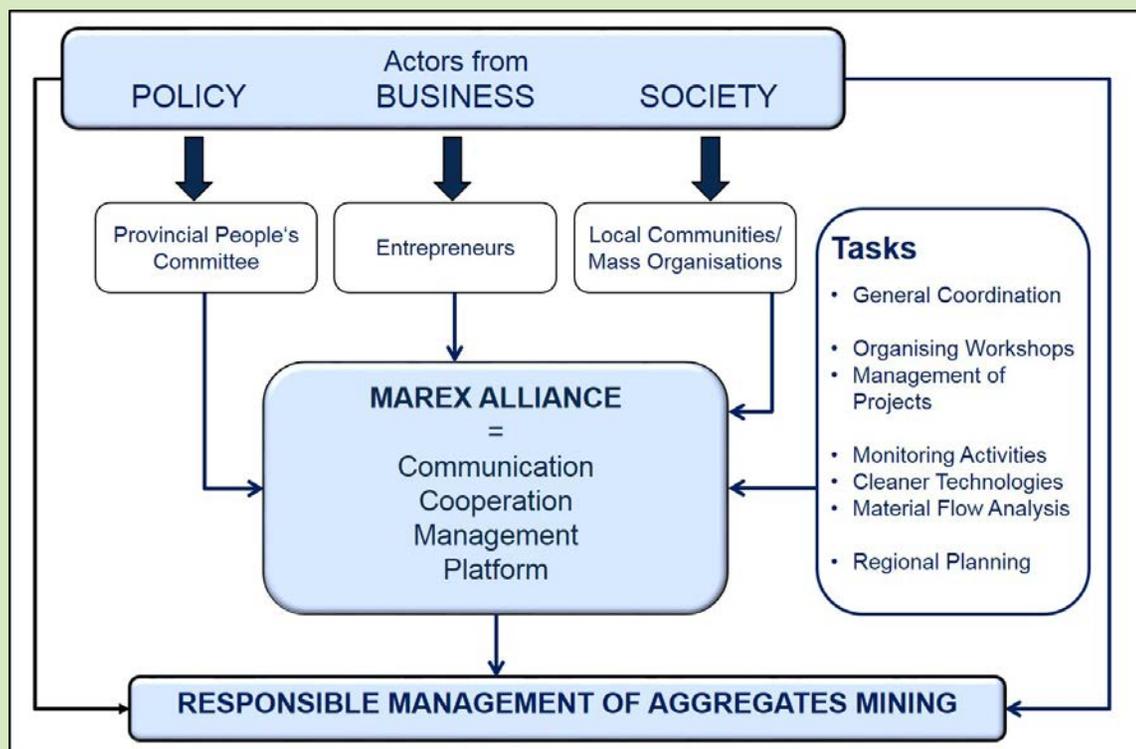
The MAREX Alliance engages in seven fields of work which broadly encompass the following categories: short- and long-term regional planning of potential and established mining areas; training and knowledge transfer in monitoring and evaluation, including environmental quality, environmental impact, cleaner production technologies, and material flow analyses; communication of information to the public connected to environmental quality and pollution; and intensifying cooperation among all public and private stakeholders.

To achieve the objectives described above, the MAREX Alliance holds annual conferences, seminars and workshops, and prepares information for distribution to members of the public, business sector, political spectrum and administration. Essential to the continual progress of the Alliance is a yearly general assembly meeting during which discussions are held and formulations are agreed, speakers are elected, the annual work plans of the Alliance are approved, and the involvement of additional members of the Alliance and external Vietnamese experts is decided upon.

Box 14: The MAREX Alliance: Signing Ceremony and Functional Scheme of the Policy-Business-Society Interface for Aggregates Mining



The founding of the MAREX Alliance on 27th June 2016; from left: Duong Thanh Binh (Director of the Trung Son Company), Prof. Bernhard Müller (Head of the German research team), Prof. Pham Ngoc Ho (Head of the Vietnamese research team), and Bui Van Khanh (Vice Chairman of the Peoples' Committee of Hoa Binh Province) (Photo: R. Vigh, IOER)



MAREX Alliance, functional scheme (Draft: P. Schiappacasse)

Annex: Handout for Vietnamese officials

The following recommendations were elaborated during the course of the project. They were handed over and discussed with the Head of the Communist Party in Hoa Binh Province.

MAREX Germany

Preliminary Findings and Recommendations of the German MAREX team

(1) MAREX¹ is a joint Vietnamese-German project supported by the national governments of both countries. It looks into the **management** of mineral resource extraction in Hoa Binh Province.

(2) After more than two years of cooperation and research, the **German MAREX team** presents preliminary major **recommendations and findings** which are summarized in the following.

Recommendations

(3) Based on the findings of the German MAREX team, the following preliminary **recommendations** have been developed:

(3.1) To more efficiently **tap** aggregates **mining potentials** of the provincial economy, to **guarantee** at the same time that negative **environmental impacts** are minimized, and to make sure that the **tourist potential** of the areas where aggregates mining takes place is not endangered.

(3.2) To improve **knowledge about the demand** of the construction sector regarding the amount and kind of required aggregates as a basis for **informed decentralized decision-making** on the provincial level about issuing new licenses and the opening of new aggregates mining operations.

(3.3) To enhance the **capabilities** of the related authorities through capacity building, the widening of mining expertise, i.e. in mining engineering and operation, and the provision of adequate equipment, in order to facilitate adequate **guidance and control** of aggregates mining operations in the province.

(3.4) To improve the **information basis** about aggregates mining operations in the Province, e.g., by establishing a GIS and remote sensing / satellite images based information system and **monitoring** about mining activities, including the detection of violations of approved operation plans, and their impacts.

(3.5) To improve and use the potentials of **spatial planning** on the regional, i.e. provincial and district level in order to facilitate more informed decision-taking about the **location of mines**, to evaluate potential **land use conflicts** and **negative environmental impacts**, and to decide about priorities, banned areas and necessary compensation measures if conflicts and damage cannot be avoided.

(3.6) To take care that mining operations reach a **size** which allows them to apply current state-of-the-art technological standards and operation processes, and to give proper attention to environmental requirements. New **cooperation models** between existing small mining companies may be considered.

(3.7) To enhance the **dialogue** between the related authorities and the mining companies of the province in order to agree on **principles of responsible mining** and their **implementation**. The already established **MAREX Alliance** between provincial authorities, mining companies and research institutions can become a useful tool for dialogue, an effective discussion platform and a model for cooperation related to **responsible aggregates mining** and **sustainable regional development** in Vietnam.

¹ MAREX stands for "Management of Mineral Resource Extraction in Hoa Binh Province – A Contribution to Sustainable Development in Vietnam". The German project is sponsored by the German Federal Ministry for Education and Research (BMBF).

Major findings and justification of recommendations

(4) Aggregates mining causes a number of **challenges** in the Province of Hoa Binh and especially in its District of Luong Son:

(4.1) Hoa Binh's District of Luong Son is the **major aggregates mining area** in the province due to its geological conditions and its proximity to Vietnam's fast growing capital Hanoi which is a key market of the country for aggregates used in the construction sector.

(4.2) The District also provides for very **promising international and national tourist perspectives** due to its outstanding landscape and nature. However, its characteristic hilly formations are severely endangered by aggregates mining as they mainly consist of materials that are valuable for the construction industry.

(4.3) In order to be able to fully **tap the economic potential**, to allow **current activities to continue undisturbed**, e.g. in the agricultural sector, and to **protect the tourist qualities** of the Province, it is of utmost importance to carry out aggregates mining and processing in a responsible and very sensitive way.

(5) There are **favorable conditions** for successfully dealing with the related challenges and to guarantee **responsible** aggregates mining:

(5.1) The **legal framework** regulating aggregates mining in Vietnam is up to current international standards. It provides a solid basis for responsible aggregates mining in Hoa Binh Province.

(5.2) The **decentralization** of decision-making from the national to the provincial level regarding exploration and licensing in the aggregates mining sector is a great opportunity for the provincial authorities:

(5.2.1) To solve **land use conflicts**, to protect the existing **landscape**, and to safeguard **tourist potentials** through wise **land use planning** and decision-taking.

(5.2.2) To prevent **environmental damage**, to allow uninterrupted **agricultural production**, and to avoid the loss of **valuable landscape** potentials through efficient **licensing, control and monitoring** of mining operations.

(5.2.3) To enhance the **attractiveness** of the mining area **after mining has ended**, and to promote its medium- and long-term **re-use** for other economic activities, such as tourism, through far-sighted planning for **rehabilitation** and its effective implementation.

(6) However, data show that since the decentralization of licensing in the aggregates mining sector, a number of severe **challenges** have evolved as the number of mines, the area used for mining, and the quantities of mined material have sharply risen in a rather erratic way:

(6.1) There is limited knowledge about the **demand** for construction material. Thus, the related authorities have difficulties estimating the current and future needs of mining operations, and issuing licenses.

(6.2) There is a lack of **strategic land use planning** regarding the location of mining operations as well as the size of mining businesses and quantities of material to be exploited.

(6.3) There is a high number of rather **small mining operations** for which it is especially difficult:

(6.3.1) To apply current state-of-the-art mining technologies and related operation processes,

(6.3.2) To implement mining activities according to the approved mining operation plans, and

(6.3.3) To give proper attention to environmental requirements.

(6.4) There are difficulties to **control and monitor** mining operations, i.e. to identify land use conflicts caused by mining, to find abandoned mining sites, and to detect violations of mining operations, due to a lack of personnel, technical capacities and know-how.

(7) All in all, under the **current conditions**, it seems as if the aggregates mining potentials are not tapped in a sufficiently efficient way, and that aggregates mining causes **more negative impacts than common gains** for the province.

MAREX Publication Series

– The final results of the project –

- Issue 1: Management of mineral resource extraction in Hoa Binh Province, Vietnam**
Seven recommendations for responsible construction aggregates mining and contributions to sustainable urban and regional development
Bernhard Müller, Georg Schiller, Peter Wirth, Tamara Bimesmeier, Anh Minh Vu, Nguyen Xuan Thinh, Haniyeh Ebrahimi-Salari, Paulina Schiappacasse, Klaus-Dieter Oswald, Wolfgang Riedel, Petra Schneider
- Issue 2: Monitoring of mineral resource extraction and analyzing its impacts on the environment and land cover/land use in Hoa Binh Province**
Nguyen Xuan Thinh, Haniyeh Ebrahimi-Salari
- Issue 3: Technical solutions for mining and processing of aggregates and the mining sites after-use**
A Cleaner Production Guideline for Vietnam
Klaus-Dieter Oswald, Petra Schneider, Wolfgang Riedel
- Issue 4: Cleaner production, mining optimizing approaches and material flow analysis**
MAREX Workshop, Hoa Binh, Vietnam, November 2017
Tamara Bimesmeier, Pham Thi Viet Anh, Klaus Dieter Oswald, Wolfgang Riedel, Georg Schiller, Petra Schneider
- Issue 5: Regional material flow analysis**
A concept for balancing supply and demand of construction minerals for regions using the example of Hanoi and the hinterland province Hoa Binh
Georg Schiller, Tamara Bimesmeier
- Issue 6: The economic impacts of construction aggregate mining on regional development**
The case of Hoa Binh Region, Vietnam
Paulina Schiappacasse, Bernhard Müller, Peter Wirth
- Issue 7: Planning for the responsible extraction of natural aggregates**
The case of the Hanoi Metropolitan Area
Bernhard Müller, Paulina Schiappacasse
- Issue 8: Legal framework for environmentally sound mining in Vietnam**
Anh Minh Vu, Juliane Albrecht, Denise Füssel
- Issue 9: The MAREX Alliance**
A Business-Policy Interface for the responsible management of mineral aggregates in Hoa Binh Province, Vietnam
Bernhard Müller, Paulina Schiappacasse, Peter Wirth, Anh Minh Vu

All results and information: www.marex-project.de

This booklet is a result of MAREX project:
Management of Mineral Resource Extraction in Hoa Binh Province –
A Contribution to Sustainable Development in Vietnam

MAREX Partners in Germany



Leibniz Institute of
Ecological Urban and
Regional Development



**TECHNISCHE
UNIVERSITÄT
DRESDEN**



technische universität
dortmund

C&E · Consulting und
Engineering GmbH



SPONSORED BY THE



Federal Ministry
of Education
and Research

MAREX Partners in Vietnam



The Institute of
Environment and
Automation



VNU University of Science,
Vietnam National
University

SPONSORED BY THE



Ministry
of Science and
Technology

SUPPORTED BY THE

People's Committee
of Hoa Binh Province,
Vietnam