JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

INSTITUTE FOR RESEARCH AND DEVELOPMENT OF CERAMIC INDUSTRY (IRDCRI),
MINISTRY OF INDUSTRY AND TRADE, THE REPUBLIC OF INDONESIA

STUDY ON DEVELOPMENT OF RAW MATERIAL OF CERAMIC INDUSTRY IN THE REPUBLIC OF INDONESIA

(SUMMARY)

FEBRUARY 1997

UNICO INTERNATIONAL CORPORATION
KITAKYUSHU INTERNATIONAL TECHNO-COOPERATIVE ASSOCIATION

TOKYO, JAPAN

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Abbreviation (*)

3PG	Geological Research and Development Center: GRDC
	(Pusat Penelitian dan Pengembangan Geologi)
AAS	Atomic Absorption Spectrometer
ADB	Asian Development Bank
APTALI	Association of Clay Supplier
ASAKI	Indonesian Ceramic Industries Association
	(Asosiasi Aneka Industri Keramik Indonesia)
ASTM	American Society for Testing and Materials
BAPIK	Agency for Development of Small-scale Industries
	(Badan Pengembangan Industri Kecil)
BAPPEDA	Regional Planning and Development Agency
BBK	Institute for Research and Development of Ceramic Industries: IRDCRI
	(Balai Basar Penelitian dan Pengembangan Industri Keramik)
BC	Belt Conveyor
BE	Bucket Elevetor
BOD	Biological Oxygen Demand
BPPIP	Research and Development Agency for Industry and Trade
BPPIS	Laboratory and Testing Institute for Industrial Products Semarang: LTHPS
	(Balai Penelitian dan Pengembangan Industri Semarang)
BPPISu	Laboratory and Testing Institute for Industrial Products Surabaya: LTHPSu
	(Balai Penelitian dan Pengembangan Industri Surabaya)
BPPT	Agency for Assessment and Application of Technology
	(Badan Pengkajian dan Penerapan)
BPS	Central Bureau of Statistics
	(Biro Pusat Statistik)
CMC	Carboxyl Methyl Cellulose
COD	Chemical Oxygen Demand
CSFU	Common Service Facility Unit
DMR	Directrate of Mineral Resources
	(Direktorat Sumberdaya Mineral: DSM)
DO	Dissolved Oxygen

(*) Descriptions in parentheses show the names in Indonesian.

DPE	Department of Mines and Energy
	(Departemen Pertambangan dan Energi)
DSM	Directrate of Mineral Resources: DMR
	(Direktorat Sumberdaya Mineral)
EIRR	Economical Internal Rate of Return
EPMA	Electron Probe X-ray Microanalyser
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GIRIN	Government Industrial Research Institute Nagoya
GRDC	Geological Research and Development Center
	(Pusat Penelitian dan Pengembangan Geologi: 3PG)
ICDD	International Center for Diffraction Data
ICP	Atomic Emission Spectrochemical Analysis
IKAD	PT. Angsa Daya
IMF	International Monetary Fund
IMOLA	PT. Indopenta Sakti Teguh
IR	Infrared
IRDCRI	Institute for Research and Development of Ceramic Industries
	(Balai Basar Penelitian dan Pengembangan Industri Keramik : BBK)
IRR	Internal Rate of Return
ISO	International Organization for Standardization
ITB	Bandung Institute of Technology
ITIT	Institute for Transfer of Industrial Technology
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
LGPN	National Mining and Geology Institute
LIPI	Indonesian Institute of Science
LTIIPS	Laboratory and Testing Institute for Industrial Products Semarang
	(Balai Penelitian dan Pengembangan Industri Semarang: BPPIS)
LTIIPSu	Laboratory and Testing Institute for Industrial Products Surabaya
	(Balai Penelitian dan Pengembangan Industri Surabaya: BPPISu)
MDCM	Manpower Development Center for Mines
MIDC	Metal Industrial Development Center
MOI	Ministry of Industry
MOIT	Ministry of Industry and Trade

MTDC	Mineral Technology Development Center
MTRDC	Mineral Technology Research and Development Center
	(Pusat Penelitian dan Pengembangan Teknologi Mineral: PPPTM)
NEDO	New Energy Development Organization
OEM	Original Equipment Manufacturer/Manufacturing
PDII	Indonesian Scientific Document Center
PJP	Long Term (25 years) Development Plan
PPPTM	The Mineral Technology Research and Development Center: MTRDC
	(Pusat Penelitian dan Pengembangan Teknologi Mineral)
PUSTAN	Center for Industrial Standardization
	(Pusat Standardisasi Industri)
PV	Polyvinyl
QACS	Quality Assurance Certification Scheme
R/D	Research and Development
REPELITA	Five Years Development Plan
	(Rencana Pembangunan Lime Tahunan)
S/W	Scope of Work
SCRL	Saga Ceramics Research Laboratory
SEM	Scanning Electron Microscope
TG/DTA	Thermogravimetry / Differential Thermal Analyzer
TOC	Total of Carbon
TSU	Technical Service Unit
	(Unit Pelayanan Teknis: UPT)
UPT	Technical Service Unit: TSU
	(Unit Pelayanan Teknis)
UV	Ultraviolet
WBB	Watts Blake Bearne & Co., PLC
XRD	X-ray Diffraction

Table of Contents

PART I Introduction

1 Background, Objective, and Scope of the Study

1.1 Background and Objective of the Study

The primary objective of the study is to develop a plan for establishment of a reliable supply system of better-grade ceramic raw materials as part of efforts to promote the ceramic industry, particularly the tableware, novelty, tile, and sanitary ware manufacturing industries in Indonesia.

Major issues facing the ceramic industry are quality assurance and productivity improvement. Raw materials have significant influence on both issues. Current problems related to local raw materials in the country are as follows:

(1) Difficulty in obtaining raw materials of consistent quality because of poor resource conditions in mines;

(2) Inconsistency of raw materials quality from one supply lot to the next because of the small scale of operation of raw material quarrying, and

(3) Poor grade of raw materials available.

As a result, ceramic manufacturers use imported materials or blend imported and local materials according to the intended use. They also purchase local materials from remote sources when required. These supply conditions lead to high material costs, and to difficulty in maintaining process control so as to manufacture products with stable quality. They also lead to a high rejection rate.

In 1991, a subsector development study was conducted on the Indonesian ceramic industry by JICA at the request by the Indonesian government. The study conclusion pointed out the importance of stable supply of better-grade raw materials and sub-materials for development of the ceramic industry. The Indonesian government, while conducting follow-up research and study under the leadership of IRDCRI (Ceramic Research Institute) to identify local sources of raw materials, has recognized that the identifying of resources is not sufficient and that development of a supply system of raw materials having quality sufficient for use in final products, in addition to physical exploration, are needed. Thus, the government requested the Japanese government for support to establish a ceramic raw material development plan.

JICA sent a preparatory study team in March 1995 and agreed with the Indonesian government by signing the Scope of Work (S/W) agreement covering the scope and content of the study. Based on the S/W, JICA assigned a study team consisting of

UNICO International Corporation and Kita-kyushu International Techno-Cooperative Association. The present report compiles the results of the study conducted by that team.

1.2 Scope of the Study

On March 29, 1995, the scope of the study set forth in the S/W agreed on between the preparatory study team and the Indonesian government is summarized as follows.

1. Ceramic Industry in Indonesia
   1-1. Current State of the Ceramic Industry
   1-2. Breakdown of the Ceramic Industry (domestic and export/import markets)
   1-3. Demand Forecast of Ceramic Products
   1-4. Review of present institutional framework and policy relevant to promotion of the ceramic industry

2. Current State of Development of Ceramic Products and Raw Materials in Indonesia, and Major Issues
   2-1. Existing ceramic raw material resources (sites), reserves, and grade
   2-2. Distribution of Ceramic Raw Materials
   2-3. Supply of Ceramic Sub-Materials (Pigment, Glaze, etc.)
   2-4. Ceramic Raw Material Development Organization in Indonesia

3. Selection of Ceramic Products and Raw Materials with Competitive Advantages
   3-1. Selection of Competitive Ceramic Products
   3-2. Evaluation of Ceramic Raw Materials Available at the Sites with Development Potential - Quality and Quantity Perspectives

4. Formulating the Ceramic Raw Material Development Promotion Plan for Stable Supply of Quality Raw Materials
   4-1. Formulating Improvement Plans for Ceramic Raw Material Distribution System
   4-2. Reinforcing Government Involvement and Role

2 Outline of the Study and Organization of the Report

2.1 Basic Framework of the Study

The study (1) involved the following investigative and analytical activities in technical and economic fields to collect data and information required for formulation of the ceramic raw material development plan, and (2) formulated the development plan.

1) Field survey of raw material sites and sampling
2) Analysis and evaluation of raw material samples
3) Interview survey on ceramic manufacturers and their association
4) Survey on R&D and technical support organizations related to ceramic products and raw materials
5) Policy survey related to the ceramic industry

2.2 Field Survey

The study conducted four field surveys, based on which conceptual design of the plan was developed and then, defined in detail.

2.3 Organization of the Report

This report consists of two volumes, "Executive Summary" and "Main Report."

The main report is divided into "Introduction," "Conclusion and Recommendations," and "Detailed Discussion." "Introduction" describes the objective, background, and scope of the study. "Conclusion and Recommendations" discusses the need for formulation of the ceramic raw material development plan, and possibility of commercial development of local materials as well as limitations, and presents the draft plan with major benefits expected from its implementation, and evaluation of financial and economic feasibility. Also, recommendations cover activities deemed absolutely necessary for implementation of the plan, and other activities which are important from the viewpoint of promoting the ceramic industry, although not directly related to ceramic raw material development. Finally, "Detailed Discussion" presents the details of evaluation and analysis as the basis of the conclusions and detailed data for each specific subject of the study.

3 Current Status of Ceramic Industry in Indonesia

3.1 Economy in Industry Sector and Ceramic Industry

(1) GDP and ceramic industry subsector

The GDP in 1994 was recorded at Rp. 377,400 billion. It was equivalent to US$ 174,600 million. The GDP was composed of shares of 23.9%, Rp. 90,000 billion (1994 value) from the industrial sector. Among the industry sector, the ceramic industry subsector[1] contributed an extremely small share as shown in Table 1:

Table 1 Production and Raw Materials Used in the Ceramic Subsector

(Unit: Billion Rp.)

	Goods produced (A)	Raw materials used (B)	(A - B)
Manufacturing Industries total (a)	114,508.6	62,926.2	51,582.4
Ceramic Industries total (b)	776.6	190.7	585.9
• Household Wares (Industry code:36111)	131.5	41.8	89.7
• Structural Materials (Industry code:36112)	645.1	148.9	496.2
(b/a) (%)	0.7	0.3	1.1

Source: BPS, Large and Medium Industrial Statistics, 1993

(2) Current economic development plan

Indonesia's economic development plan consists of REPELITA (the five year economic plan) which sets forth medium-term policy objectives (or basic policy for economic operation), and the 25-year PJP (long term development program) which is composed of long term visions.

The previous PJP I period (25 years, started in 1969 and ended in 1993) is considered as a preparation stage in the Indonesian economic development process in building the foundation for taking off towards economic self-reliance. The PJP II period (25years started in 1994 and ends in 1998) meanwhile, is defined to involve the take-off process.

During this period, the plan has the target economic growth rates of 6.2% in REPELITA VI and 8.7% in REPELITA X, averaging 7% throughout the period (6.8% during the PJP I period). The plan also aims to achieve a quadrupling of GDP per capita.

The plan envisages economic growth of 6.2% per annum over the five-year period.

[1] Large and medium size manufacturers only.

The major engine for economic growth will be the manufacturing sector with a target growth rate of 9.4%[2].

Table 2 shows the production target of ceramic industry under REPELITA VI with the estimated actual figure until 1995. Eighteen percent average annual growth is targeted.

Table 2 Production Target of Ceramic Industry (PELITA VI)

(Unit: Million Rp.)

	1994	1995	1996	1997	1998
Sanitary Ware					
• Plan	73,467	84,618	97,416	112,185	129,195
• Actual	48,600	67,500			
Foor/wall Tile					
• Plan	1,070,510	1,282,430	1,536,400	1,840,770	2,205,570
• Actual	1,050,000	1,400,000			
Tableware					
• Plan	348,047	400,714	461,353	531,013	611,374
• Actual	180,000	286,062			
Roof Tile					
• Plan	48,233	55,709	64,344	74,317	85,837
• Actual	52,500	88,199			

Source: MOIT

The industrial policy for the ceramic industry is reportedly still under preparation.

3.2 Subsector by Product and Its Size, Structure and Characteristics

The major ceramic products produced in Indonesia are classified into (1) floor and wall tiles, (2) sanitary ware, (3) tableware, (4) novelties products, (5) building bricks, and (6) roof tiles. Bricks and roof tiles are produced using clay available locally, and have faced no significant problem regarding supply of raw materials.

3.2.1 Tiles

Major products are floor tiles, wall tiles and mosaic tiles. Production of floor and wall tiles grew significantly between 1992 and 1995, an average rate of over 10% annually.

According to the Ministry of Industry and Trade (MOIT), 46 companies are currently manufacturing floor and wall tiles in Indonesia, and one company produces mosaic tiles

[2] Including the oil and gas sector. 10.3% growth is assumed for the non-oil/gas industry sector alone.

only. MOIT expects tile production, with the baseline year in 1995, to grow at an annual 20% up to 1998.

Tile manufacturers in Indonesia are dominated by local enterprises, and unlike sanitary ware makers, few foreign-affiliated manufacturers are operating. These tile manufacturers are relatively large production capacities and often employ more than 1,000 workers.

Characteristically, tile manufacturers obtains raw materials for tile body mostly from local sources. Locally available materials, however, present various problems including quality variation and unreliable supply capacity and schedule.

3.2.2 Sanitary ware

Major product items in the sanitary ware industry are toilets and wash basins. Sanitary ware production recorded strong growth in the late 1970s and accelerated in the 1980s.

In Indonesia, 9 companies are manufacturing sanitary ware. Sanitary ware production is projected to grow at an average 15% up to 1998 according to MOIT.

The sanitary ware industry can be roughly divided into joint ventures between local and foreign companies and local enterprises wholly owned by local capital. Local enterprises mainly serve the domestic market and export few products. Because of a high level of emphasis on productivity improvement, the ratio of the use of imported material is comparatively higher, with using 50% of locally procured materials, but they are still competitive in the international markets due to their efforts to reduce total production costs. It should be noted that some of raw materials such as kaolin used as glaze and feldspar, as well as sub-materials such as pigments are mostly imported

3.2.3 Tableware

At present, tableware is produced by 36 companies. MOIT projects that production of tableware will expand at an average rate of 15% annually up to 1998.

Among tableware manufacturers, most of the midsize or larger companies have received, at their initial stage of operation, capital contribution and production technology from foreign companies including some from Japan and Taiwan. Some of them have terminated equity participation by foreign partners but are still receiving technical support.

There are other companies that have accepted foreign capital, production technology and equipment at their startup, and have been continuing production on their own since then. These companies are mainly specialized in production of low-end products for domestic general consumers. They often use locally available raw materials and sub-

materials as far as available.

3.2.4 Novelties

Major novelties products are ashtrays, earthen wares, ornaments, and small statutes.

Novelty products are labor-intensive in nature. They are characterized by small-scale family-operated manufacturing. They form clusters of manufacturers over the country. The products are mainly destined to the domestic market. A few companies are foreign affiliated operations. However, foreign firms increasingly feel limitation in art technique of local workers.

3.3 Ceramic Raw Material Suppliers

In terms of ownership, most suppliers are private enterprises which have a mining license and employ workers for mining. These enterprises can be divided into several distinguishable types according to the type of operation and management.

The first type, as seen in Monterado and Lampung, is represented by medium- and large-enterprises with established management and financial position. Mines developed by these enterprises produce raw materials of sufficient levels of quality, and have commercial reserves. Basically, they can be successfully developed by these enterprises as judged from mining methods employed.

In the second type, ceramic manufacturers control mines, i.e., while they do not necessarily have a mining license or actually operate the mines, the mine supplies its products to a particular company only. However, raw materials from these mines do not meet quantity requirements of their customers because of quality problems or limited ore reserves. Nevertheless, mining operations can be managed by manufacturers as judged from the mining method.

The third type involves specialized suppliers operating in the form of one-man ownership. They supply products to more than two customers. Mining is not carried out according to any production plan. Rather, they excavate an area which seems to contain high-grade materials upon receipt of a customer's order. In fact, they often cause quality problems for manufacturers.

3.4 Policy and Programs Related to Promotion of the Ceramic Industry

There is no industrial policy specific to the ceramic industry.

In fact, ceramic materials are not viewed as important minerals for the country's industrial activity.

The Indonesian government classifies mineral resources into three classes according to its policy priority. Crude oil and natural gas are primary examples of the most important resources, which are controlled and developed by the central government. Minerals for ceramic materials are classified as the third class and are under control of local government.

Thus, in developing ceramic raw materials, direct support from the central government cannot be expected. Most of local governments may be willing to provide support, as judged from their policy, but they do not have financial resources to provide meaningful support.

It should be pointed out, however, that the current classification of minerals is solely based on direct contribution to the national economy, and thus it does not necessarily reflect another important policy priority contemplated in the economic development plan, i.e., to avoid concentration of economic development efforts in a certain area or industry. It is important to reiterate that, from the viewpoint of promoting small enterprises or local industries, the development of relatively unimportant minerals, such as ceramic materials, creates an important value to the country's overall development objectives.

3.5 Public Service, R&D, and Technical Guidance Related to the Ceramic Industry

The Ministry of Industry and Trade is responsible for the industry sector as a whole. The Ministry of Minerals and Energy bears some responsibility for development of ceramic raw materials. As for promotion of small enterprises, the Ministry of Cooperatives and Small Industry Promotion shares responsibility with the Ministry of Industry and Trade.

BBK, which is operating under BPPIP, is in charge of research and development related to the ceramic industry. Small Industry Development Agency has UPT (Technical Service Unit) which is responsible for technical guidance in regions.

Finally, agencies related to ceramic raw material development are DSM and MTRDC under the Ministry of Minerals and Energy.

PART II Conclusion and Recommendations

1 Conclusion

1.1 Need for Development of Ceramic Raw Materials and Basic Requirements for the Development plan

The need for a ceramic raw material development plan primarily comes from the interest of securing sustainable growth of the ceramic industry. At the same time, establishing an adequate plan is needed also in view of promotion of economic activities in mining and supply of ceramic raw materials.

The necessity for establishing the material development plan, with the objective of supporting sustainable growth of the ceramic industry, has arisen from the fact that, while the ceramic industry has been growing as a modern capital-intensive industry, supply of ceramic raw materials has relied on local microenterprises and small enterprises. In fact, those engaged in mining and supply of ceramic raw materials do not use machinery or equipment except for trucks, and mining operations are mainly done manually. Also, grading of mined raw materials has been undertaken entirely on the experience of personnel engaged. Expertise and know-how related to production technology of the ceramic industry have not been provided to the upstream sector as feedback information. The technological gap between the downstream and upstream sides has impeded growth of the ceramic industry in the following areas:

1) Quality of ceramic raw materials supplied from local sources varies greatly from one supply lot to another, making quality management of products difficult. As a result, the reject rate of final products is high, increasing production costs.
2) Supply of local materials is not stable and the manufacturers need to hold sizable inventories particularly during the rainy season, to continue their stable production.
3) Some local ceramic raw materials have poor quality to cause of production problems in terms of color and moldability, giving manufacturers virtually no choice but to rely on imported materials. This further increases the production cost and forces manufacturers to hold large inventories to assure uninterrupted production.

However, from the mining and supply side of raw materials, the need for the ceramic raw material development plan is not perceived to the significant. This is due to the fact that since production of ceramic raw materials is chiefly undertaken by small enterprises, expansion of their production is not only difficult but it is also hard for them to have an

interest[3] in expansion. Nevertheless, from macroeconomic viewpoints, stable operation and growth of mining and supply seem to be essential because of:

1) Economic effects created through ensuring the optimum use of available resources by improvement of mining methods. The present mining methods will exhaust resources in a short period of time while making otherwise exploitable resources unusable.
2) Economic effects brought about by substitution of imported raw materials with local ones
3) Development of local industries and creation of employment opportunities in rural areas.

At present, however, no effort is being made to pursue common interests of the ceramic industry and the raw material supply sector. In particular, it is difficult to expect such move on the supply side, at least in the short run, given the nature of the present management structure.

This plan focuses on efforts to narrow the gap between the two sides in terms of technology and management, thereby contributing to stable growth of the ceramic industry, while emphasizing modernization of operation on the supply side.

For the successful implementation, however, the plan must be in line with the behavior of the ceramic industry when procuring raw materials. In fact, the magnitude of the need to overcome the problems of raw material supply, as felt by the ceramic industry, varies with product types and market segments they serve. Their needs with regard to the raw materials development plan may be classified into the following four types:

1) Tile manufacturers do not necessarily demand high-grade materials. In fact, they do not want them if high quality is translated into an additional cost. Rather, they desire to have a stable supply of ceramic raw materials in terms of quantity and quality, and not face to a significant cost increase. As for development of ceramic raw materials per se, they have high expectations.
2) Sanitary ware manufacturers, particularly those of foreign affiliated companies, look for high-grade materials and are ready to accept an additional cost for beneficiation and other processes, so far as the materials can compete with currently imported materials in terms of quality and price. They are interested in the raw materials to be made available through the development plan, from the standpoint of this principle.

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[3] For relatively large operators, there is no need to obtain external assistance to expand production.

3) There are few tableware manufacturers who target the high-end market, and their expectation for development of ceramic raw materials has not come to light yet. At present, they manage to secure appropriate raw materials including use of imported ones.

4) Novelty product manufacturers are expecting the supply of raw material pre-mixtures which can be readily processed. Essentially, they want to manufacture products of stable quality, without the need for special blending efforts according to the quality of raw materials which varies by supply lots. It should be noted, however, that the ingredients of pre-mixtures are required to be designed to meet the characteristics of product types which vary among the producing districts.

Thus, the raw material development plan must match these needs of varying levels. The following sections analyze the needs for ceramic raw material development commonly observed among these subsectors, and difference in their needs.

1.2 Technical Viability and Limitations of Indigenous Minerals in Development of Ceramic Raw Materials

(1) Overview

Technical assessment of ceramic raw materials chiefly covers the following:

1) Viability of quarrying development and stable supply;
2) Viability to ensure stable quality; and
3) Viability to improve quality.

As a result of the technical assessment, Sukabumi was selected as the stable supply source of clay for development, while satisfactory results were not obtained for the viability of quality improvement. Banjarnegara was selected as the major feldspar source for development; there quality is identified technically as being capable and in need of improvement (Table 3).

(2) Clay

Four sources were evaluated; Parungpanjang, Sukabumi, and Cipeundeuy on Java, which are currently used by the ceramic industry, and Monterado on Kalimantan which is under development.

On the basis of overall technical considerations, the Sukabumi clay was selected as the source best suited for development. In fact, however, the Sukabumi clay is not particularly high in grade, and is difficult to improve in terms of both beneficiation

Table 3 Summary of Raw material Evaluation by Source

Raw material	Source	Evaluation results				
		Overall evaluation results	Evaluation in view of mining conditions, and locational advantage to the markets	Evaluation of quality		
				For tile	For sanitary ware	For tableware
Clay	Sukabumi	The most advantageous in terms of development for tile use 1) Possible to use for tile 2) Proximity to the markets 3) Possible to develop in large scale However, 1) Quality is not excellent 2) Improvement of quality is technically and economically difficult	- Possible to develop in large scale development - Difficulty in mechanical quarrying - Proximity to the markets	△	X	X
	Parungpanjang	Difficult to use as a major raw material. In adequate for major development. 1) Excessive plasticity 2) Difficulty in water supply and drainage 3) Difficult to develop in large scale	- Difficult to develop in large scale - Difficulty in water supply and drainage - Proximity to the markets	X	X	X
	Cipeundeuy	Inadequate for major development due to difficulty in access and transportation. Good for use specialized in refractoriness.	- Difficult to develop in large scale - Difficulty in transportation of raw materials - Disadvantage in proximity to the markets	△	X	△
	Monterado	Inadequate for major development due to locational disadvantage to the markets for tile use. No need for further development support since under development by J/V with foreign affiliated firm	- Possible to develop in large scale - Easy to quarry - Remoteness to the markets	○	○	○

Table 3 Summary of Raw material Evaluation by Source

Raw material	Source	Evaluation results				
		Overall evaluation results	Evaluation in view of mining conditions, and locational advantage to the markets	Evaluation of quality		
				For tile	For sanitary ware	For tableware
Feldspar	Banjarnegara	The most advantageous position for major development due to consistent quality, proximity to the markets, and potentiality for large scale development. High iron contents and low alkali contents without beneficiation.	- Possible for development in large scale - Easy to quarry - Relatively advantageous location to the markets	Without beneficiation ○ With beneficiation ○	Without beneficiation × With beneficiation △	Without beneficiation × With beneficiation ○
	Pangaribuan	Inadequate for major development since it is already exploited	- Impossible for development - Remoteness to the markets	△	×	×
	Narawita	Inadequate for further development because of small scale resource and quality feldspar is already exploited	- Inadequate for development in large scale - Quality feldspar is already exploited - Disadvantage in proximity to the markets	○	×	×
	Lampung	Under development stage (No need for further development assistance)	- Potentiality for major development - Easy to quarry - Advantageous location to the markets in West Java	○	△	△
Pottery stone	Pacitan	Difficult to justify the major development due to insufficient information available on resources particularly on pottery stone.	- Difficult to develop in large scale - Difficult to quarry - Remoteness to the markets	○	△	△

○ : Possible to use as the major raw material

△ : Possible to use only as a supplementary raw material, or some limiting factors for use.

× : Not suitable for use

technology and economy. Furthermore, many deposits have been exploited in an uncontrolled manner over a long period of time and will not be viable for further development. Nevertheless, the Sukabumi clay was selected as the source for development because of the fact that it had the following advantages which more than compensated for the above drawbacks: (1) the source is strategically located in terms of transportation of products to major consumers, namely floor and wall tile manufacturers - representing major portions of the ceramic industry - which are located in Jakarta and West Java, (2) the clay, although low in grade, is still acceptable for tile manufacturers, and (3) while uncontrolled mining is carried out extensively, large exploitable areas still remain intact.

The Monterado clay is most promising in terms of grade and scale of reserves, but it was not selected because of its remoteness to the market and also because of a fact that a foreign-affiliated company has already started commercial development to make external development support less necessary.

The clay resources in Parungpanjang and Cepeundeuy were not selected as they have unique characteristics not suitable for general purpose use, and further, their mining development seem technically difficult.

The results of technical assessment on the four clay sources are discussed in detail below.

1) Sukabumi clay

The quarrying sites are located in Cicantayan District (northern site) and Padaraang District (southern site), and both are accessible to a main road allowing truck traffic after a few kilometers of mountain roads.

According to the DSM report, the entire mine site area is 500 ha, with thickness of 20m. However, observation at the excavated sites indicates that the deposit is a few meters thick. The Sukabumi Clay Mining Cooperative estimates the clay mine area to be 150ha with 10 million tons in reserve.

The deposit is made of three layers. The first layer is red clay lacking plasticity, 0.5 - 3 m thick (or more in some places). The second layer is made of brownish gray clay having relatively high plasticity, and its thickness varies greatly, containing silica stone or sand (sandstone) in mass. The third layer contains gray clay which is highly plastic. As the Gunung Walat mountain at the south end of the quarrying area is made of silica stone or sand, their contents presumably increase southward.

The southern mine has been excavated indiscriminately and it is not suitable for further development. The northern quarrying site seems to have significant reserves,

but its complex vein structure makes it difficult to exploit clay of sufficient grade by simple mechanical development.

In addition, clay deposits seem to be located in the flat area which has been developed as residential or agricultural land, so that a detailed reserve survey, which may open up an opportunity for large-scale development, should be conducted for the entire area.

Raw soil is composed mainly of kaolinite. It is clay containing mica minerals such as sericite, and quartz, and is rated as more or less low grade in terms of aluminum content. Plasticity is not very high, while iron content is very large but varying widely, between 4% and 15%, according to mining location. It is difficult to improve the clay's grade by beneficiation processes such as elutriation and iron removal.

The cast-in test using the clay with a relatively small iron content showed good dispersibility, but plasticity (particularly, workability) and thickening are not satisfactory. Together with a high iron content (4.17%), these drawbacks make the Sukabumi clay unsuitable for sanitary ware production.

Also, it is not suitable for tableware due to the lack of plasticity and unfavorable color caused by the high iron content.

On the other hand, it can be used as plastic materials for tiles and roof tiles, as well as such red ceramic raw materials as terra-cotta.

2) Parungpanjang clay

An arterial road and a local road can be used for access, except for 25-minute drive over an unpaved road to the site. However, the road to the district is always congested and a long period of time is required for transportation compared to actual distance.

The quarrying site is located over a flat area along the road. According to DSM, the deposit is 45m thick and extends over 40ha, while quarry operators claim that it is 58m thick. As observed in the pit under excavation, top soil (red clay) is 1.2m - 1.5m deep, followed by 0.5 - 0.7 m of a clay layer with a high iron content and high plasticity, below which a mixture of various ball clays from white super ball clays to ones in varying brown color. There are no boring data available, and because of the limited data and information it is difficult to make quantitative judgment on feasibility of major development. Local conditions suggest that water drainage is required for quarrying operation to be performed during the rainy season, but installation of water supply and drainage equipment is expected to face various technical difficulties, as would be the case for the provision of elutriation and other equipment. In conclusion, the mining site is not suitable for large-scale development.

Raw soil is primarily composed of halloysite which mixes with quartz and cristobalite. It also contains montmorillonite. Plasticity is very high. It is characterized by high iron content that gives it an unsuitable color, except for those classified as super ball clay.

The very high plasticity limits the amount that can be blended as a slip material. The cast-in test using the super ball clay showed poor dispersibility due to the montmorillonite content, that prevents formation of an adequate sludge. Thus, it is not suitable for sanitary ware production.

For tile production, the clay can be used in a small amounts as a binder. However, it is not suitable as a principal material due to high plasticity and small particle size that results in large firing shrinkage and thus uncontrollable variation of product dimensions.

For tableware production, while plasticity is a favorable factor, the difficulty in slurry adjustment makes it unsuitable for such wet manufacturing process as wet crushing in a ball mill or cast-in molding, etc. Also, the high iron content is not appropriate for medium- or high-grade products due to unfavorable coloring.

3) Cipeundeuy clay

The quarrying site is approximately 3km off a main road from which there is a difference in height of 300m. There is only a mountain road to the site, with enough width to allow only one person, and excavated clay is carried by workers.

According to DSM, the mine site area is 27ha, of which approximately 0.5ha has been excavated. The deposit is 18m thick and there are water springs beneath it. Judging from the state of existing pits which have been excavated for a long period of time, and that of new pits, clay's sedimentation is relatively stable, and exploitable veins seem to extend in a wide area.

However, topography makes the use of machinery difficult, and such transportation equipment as ropeway is not technically or economically feasible. Thus, the site is not suitable for major development.

The Cipeundeuy clay is mainly made of kaolinite and contains cristobalite and sericite. While plasticity is relatively low, the small iron content seems to make it suitable for tableware production. In particular, high fire resistance opens up the use for ceramic raw materials, but the cristobalite content requires special care in use.

For tile production, the clay is sufficient in terms of quality and is already used in some products.

With high fire resistance, firing at 1,250℃ turns it into cream color, which changes

into gray color with further densification. Thus, the clay is suitable for refractory production and can be used to make kiln bricks for ceramic firing by converting it into chamotte.

4) Monterado clay

The quarrying site is situated approximately 80km north of Pontianak, West Kalimantan. Gentle rolling hills extend 30km north of the area and are extensively covered by white sandy top soil. Below it, high quality ball clays are reported to be present. Although there is no accurate data on reserves, according to information from a company which has started mining in this area, four companies have applied for mining licenses to develop mining sites totaling 5,000ha, and the company has already confirmed presence of veins for 200ha and has started excavation. In a proven mining site, top soil is sand (silica sand), 1m deep, below which ball clays are present for 3m-5m in depth.

The site can be accessed by using a 6km paved side road (5-6m wide) from a main road. Products shipped to Java are carried by ship on the Kapuas river, starting from Wajok, a 30-minute drive northward from Pontianak. In Wajok, a port capable of accommodating a 5,000-ton class ship is under construction.

The Monterado clay is primarily composed of kaolin and quartz. In particular, kaolin has a high level of purity and contains little coloring matter such as iron. While particles are relatively coarse, the clay shows good plasticity. The cast-in test results indicate excellent dispersibility and sufficient plasticity. Thus, it can be used as a primary material for sanitary ware[4].

Also, adequate plasticity and a relatively low iron content make it suitable for tableware. The color seems to be acceptable without special treatment, and suitable for medium-grade products.

(3) Feldspar

Three feldspar sources were investigated, Banjarnegara and Narawita on Java, and Lampung on Sumatra. Based on comparative analysis, Banjarnegara was selected as the highest potential source. The Banjarnegara feldspar is rated as a relatively high grade and can be used for tableware through some beneficiation. Also, the mine site, on Java, is located conveniently for the transport of feldspar to manufacturers who are located throughout the island. Also, deposits seem to be suitable for major development.

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[4] Yet, plasticity falls below that of ball clay in the UK and gairome clay in Japan.

Besides the Banjarnegara, there is another source of feldspar, Lampung, which can supply tile manufacturers in West Java. The grade of feldspar is relatively high, though the alkali content is as low as 7%. Nevertheless, the location on Sumatra requires a high transportation cost except for the area west of Java. Also, the mine site has been developed by a single mining company which is relatively well managed. For these reasons, the site was excluded from potential sources for new development under the present plan. However, it is expected to develop into a major supply source rivaling Banjarnegara, and if the mining company faces difficulty in development, appropriate support should be provided by the government.

1) Pangaribuan feldspar

According to the analysis and tests of the collected samples, the raw feldspar is primarily composed of nearly pure microcline, with little iron and titan content, and shows good coloring. However, the mine has been mostly excavated and only the weathered granite, which is the base rock, is left. Thus, the site is not suitable for major development.

2) Banjarnegara feldspar

It is connected to a main road via a mountain road; it takes about an hour to or from Banjarnegara. The mountain road is suitable for five-ton trucks. There are three mines in an area extending 15km east and west, and deposits seem to extend in a dike form. At present, all the mines are excavated manually, although topography allows for introduction of heavy equipment.

According to DSM, the Ds.Kalitengah mine has 495ha and 60m in depth, while the Ds.Kebon Dalem mine covers 192ha with 50m thick[5].

Judging from topographic and geological conditions, feldspar deposits can be discovered outside of the present 15km range, and are expected to become a major part of feldspar resources in Indonesia, although no detailed resource survey has been conducted.

Major components are white feldspar, quartz, and microcline, and their alkali content is low at 7-8%. Iron content is high and adversely affects coloring unless some beneficiation is carried out.

There is only a small variation in quality among samples collected in the large mine site. Iron can be removed by beneficiation treatments.

[5] Data on the Ds.Kebutuh Jurang mine are not available.

The Banjarnegara feldspar can be used for sanitary ware production where kaolin, feldspar, and quartz are used as the base materials, if it is refined. Also, it can be used for tile production without special beneficiation.

The possibility to use this for tableware production depends on the possibility of removal of mica that causes poor coloring. If the mica can be successfully removed, in terms of other quality aspects, the Banjarnegara feldspar can be used even for high-grade products.

3) Narawita feldspar

From the main road, it takes more than one hour rough drive on a unpaved mountain road to the site. Then another 15-minute drive is required to reach Narawita Hill. The road manages to accommodate five-ton trucks. Narawita Hill consists of a 20ha feldspar mountain and a 20ha quartz mountain. The existing mine is located on a 30m cliff, from which veins extend 1-2km in all directions. Boring surveys have confirmed that the ore bed extends 40m downward from the current excavation face. The excavation face (vertical section of the cliff) shows the presence of faults that run in all directions, together with brown color layers of rock containing corroded iron on its surface, white or light gray color layers containing high-grade feldspar, intermediate light brown color layers, and others, forming complex texture and structure. Many sections around the better-grade feldspar layer have been manually excavated, while low-grade portions are left intact. Field observation indicates that better-grade feldspar represents only 5% to 10% of the total.

In addition to the fact that the reserves are small, and located remote from the market, the available good color layers are already limited due to the progress of excavation. The apparently white surface also includes poor color portions, being a sign of resulted in unstable quality. Therefore, the site is unsuitable for major development.

Mineral composition includes sanidine, tridymite, cristobalite, and quartz, with partial inclusion of sericite.

Alkali content is low at 6%, an unsuitable level for sanitary ware production.

Although the iron content is relatively low, 0.5% in white portions and 1.5% in colored portions, the low alkali content makes the material unsuited for tableware production. In terms of color alone, this feldspar is relatively favorable and acceptable for medium-grade products. However, if porcelain is assumed to be the type of ceramic products to be made, a large amount of other complementary materials and feldspar would have to be added, making it difficult to use Narawita feldspar by itself.

It is acceptable for tile production in terms of quality.

4) Lampung feldspar

The mine site is reached by driving an additional 3km on a side road. The side road is not paved, and in some sections, the maximum speed of a jeep is limited to around 10km/h. It is, however, generally flat and 7-8m wide to allow large trucks (20-ton class) to carry mined mineral products.

Top soil has the whitish color peculiar to granite zones, making a sharp contrast to the reddish color found in Java, which indicates a high iron content.

The entire mine site is located within this granite zone where weathered granite can be observed everywhere and feldspar is seen at the bottom of a river flowing nearby. The mine site covers 30ha, and feldspar resources are present over a distance of 1km around the mine and reach 30m in depth. According to DSM, feldspar reserves in this area are estimated at 12.5 million m^2 and constitute major deposits.

Sandy portions which account for approximately 70% of top soil, contain 7% alkali and 0.35% iron.

Sandy layers on top, that are currently being excavated, are relatively poor in feldspar and alkali content. If the alkali content can be increased, the Lampung feldspar seems to be suitable for tableware production because of the low iron content. The mass portions are already used for tile production.

As for sanitary ware, it can be used for composition of kaolin, feldspar and quartz. However, the low alkali content and a long distance to the market are clear disadvantages.

(4) Pottery stone

- Pacitan pottery stone

The mountain road is paved (low-grade) and is extensively damaged. Its width allows two passenger cars to pass each other. There are many steep slopes. It is difficult for five-ton or larger vehicles to be operated on the road.

Judging from the excavation face, the ore bed appears to be relatively uniform. It presumably extends vertically as there is a vertical distance of 50m from the mountain top where pyrophyllite is excavated to the outcrop of pottery stone.

The area was investigated by a land survey company under contract to the East Java government. Test pits were excavated at 40m-60m intervals over an area of 1km east-west and 500m north-south, and presence of rich pyrophyllite resources was confirmed. DSM also surveyed the area and estimated 5,188,000 m^3 of pottery stone reserves

(according to Bahan Galian Industri di Indonesia).

Major components are quartz and sericite. It is considered to be low-grade pottery stone as the sericite content is low. As is evident from the color, iron (Fe_2O_3) and titan (TiO_2) contents are very low, 0.08% and 0.28% respectively. Plasticity is sufficient to mold small products. For sanitary ware, it can be used as a supplemental ingredient.

For tile production, it can be used as a primary material. In fact, it has previously been used for the purpose, but use was terminated due to unfavorable mining and transport conditions as well as the long distance to the market.

As for tableware, it may be used for medium-grade tableware products, since the low iron content makes for good coloring, though the quality is not high due to the low sericite content. Further, it needs to be used with clay having high plasticity and a favorable color because its plasticity is not high enough as required for pottery stone.

1.3 Ceramic Raw Material Development Plan

1.3.1 Planning concepts

(1) Selection of planning concepts

In consideration to the needs and requirements for ceramic raw material development, and technical potential and limitations of resources, which were identified and evaluated in the previous sections, three planning concepts as a basic framework for the contemplated plan are established as follows:

1) Supply ceramic raw materials having stable quality, not necessarily high grade, to the tile industry, which is the largest sub-sector of the ceramic industry in the country, as the plan's primary target.
2) Develop a system to refine the above raw materials and supply them to tableware and sanitary ware manufacturers.
3) Develop small-scale ready-mix body supply facilities near clusters of small ceramic producers that are located throughout the country, and supply one or a few clusters nearby with the premixed body, having preparing it according to the requirements in each cluster.

In establishing the above planning concepts, the following factors were taken into account:

1) Supply of premixed body

At present, only small novelty manufacturers want supply of premixed body and demand has not reached a critical level to justify the development of a major system. Other manufacturers are reluctant to disclose their own blending know-how, and further, they have their own blending facilities and testing facilities for self-protection against the unstable quality. Thus, development of the supply system of premixed body should be considered after establishing manufacturers' confidence in external supply sources through operation of supply system of raw materials of stable quality, and the establishing of close linkage between suppliers and ceramic manufacturers.

However, the small-scale community-based premixed body supply facility is a possible concept in that the novelty manufacturers supply products of uniform materials and product levels in each cluster.

2) Improvement of quality of ceramic raw materials

The need for quality improvement is particularly high among sanitary ware manufacturers. Tile manufacturers, strongly hoping for the supply of raw materials with stable quality, cannot not absorb much cost increase. Tableware manufacturers do not have any particular expectation for quality improvement, but they are likely to use improved raw materials if it is technically and economically feasible to do so. Meanwhile, quality improvements of currently available raw materials require accepting significant additional costs.

Thus, quality improvement efforts must be limited to the scope that is technically and economically viable, and in particular, the first step should focus on stabilizing quality.

3) Possible blending of raw materials from different sources

Transportation costs account for major portions of clay and feldspar prices in the country, and blending these materials from different sources has additional cost impact. For instance, typically the price of clay at a mining site ranges between Rp.8 - 10/kg, while the price of clay from other sources exceeds Rp.20/kg. Thus, the first step of quality improvement should be limited to the use of raw materials available at a particular site.

4) Use of sources outside Java

The Monterado clay and the Lampung feldspar available outside Java have high development potential because of the large scale of reserves. In consideration to the following unfavorable factors, however, they are not considered in the plan:

a) the plan primarily serves tile manufacturers on Java, for whom high transportation

costs will be a major bottleneck; and

b) the two sources are currently operated by companies having sound technical and management bases, who do not require outside support for new development.

So far as these sources are commercially available, development of sources in Java should be limited to those that are technically and economically viable. In addition, development projects should be planned and implemented in consideration of possible use of sources outside Java, e.g., blending them with materials produced in Java.

(2) Operationalization of the planning concepts

The first planning concept mandates the ability to supply raw materials of adequate quality to tile manufacturers in Java, particularly West Java, where demand is concentrated, without significant cost increase required for beneficiation and transportation. Also, the following restrictions need to be considered:

1) the transportation cost dictates the use of raw materials which are available in Java, particularly the western or central region;
2) the transportation cost represents 40% - 50% of the prices of currently used clay and feldspar, as delivered to users, so that transportation of raw material from one source to another for blending purpose, followed by transportation to customers, is cost prohibitive.

As a result, stable quality is to be achieved by using raw materials from a single source and by careful grading at the mining site, blending, and quality control. Mining sites were selected in Sukabumi for clay and in Banjarnegara for feldspar, as they are relatively close to buyers, products are acceptable in terms of grade, and resources are commercially exploitable in terms of reserve scale and accessibility. No other candidate site meets these requirements.

The second planning concept (supply of refined materials) is difficult to implement if raw materials available in Java are to be used; there is a technical difficulty for clay and a cost obstacle for feldspar. As a result, imported materials should be used instead, and for future options:

1) as for feldspar, possibilities should be assessed often demand grows sufficiently to justify a large beneficiation plant.
2) as for clay, further resource surveys should be continued in an attempt to discover new prospective sources.

It should be noted that the Monterado (Kalimantan) clay and the Lampung (Sumatra) feldspar are commercially exploitable in terms of product grade. Further, it is difficult

to find high-grade materials in Java, as judged from its geological conditions. In considering the above two options, therefore, the blending of these materials with those available in Java seems to be a realistic strategy.

The third planning concept must take into account the following factors:

1) an organization to provide technical assistance is required near a cluster of producers in order to meet the needs peculiar to each locality; and
2) it is difficult to deploy the facilities to supply premixed body near all the clusters of producers because of difficulty in establishing an implementation body in each locality and due to the lack of experience in such an undertaking.

Instead, it is viable to start a pilot project in a production area that already has high demand for premixed body, as it will serve as a model for the rest of the country as a result of subsequent, specialized publicity efforts, and diffusing the experience and know-how gained. Kiara Condong was selected as the best suited production area. Other areas include those which are already served by public organizations or private enterprises to supply premixed body, such as Malang and Plered, and those where relatively simple products are manufactured and quality of raw materials is not a major concern. These areas can be dealt with on the basis of experience in the pilot project.

1.3.2 Plan outline

The selected projects comprising the ceramic raw material development plan, and the relationships among projects as well as between projects and major users, are shown in Figure 1 and Table 4.

Six potential projects have been selected, as summarized below. However, as a result of the detailed evaluation of each project, 4 projects, namely, (1), (3), (5), (6), are recommended for implementation. Detailed evaluation of the project (2) was not undertaken, since it would face technical difficulty in implementation.

(1) Sukabumi clay supply project

The primary purpose of the project is to supply clay of stable quality to the tile industry which is the largest sub-sector of the ceramic industry in the country. No beneficiation to improve clay quality will be conducted.

Figure 1 Outline of Ceramic Raw Materials Development Plan

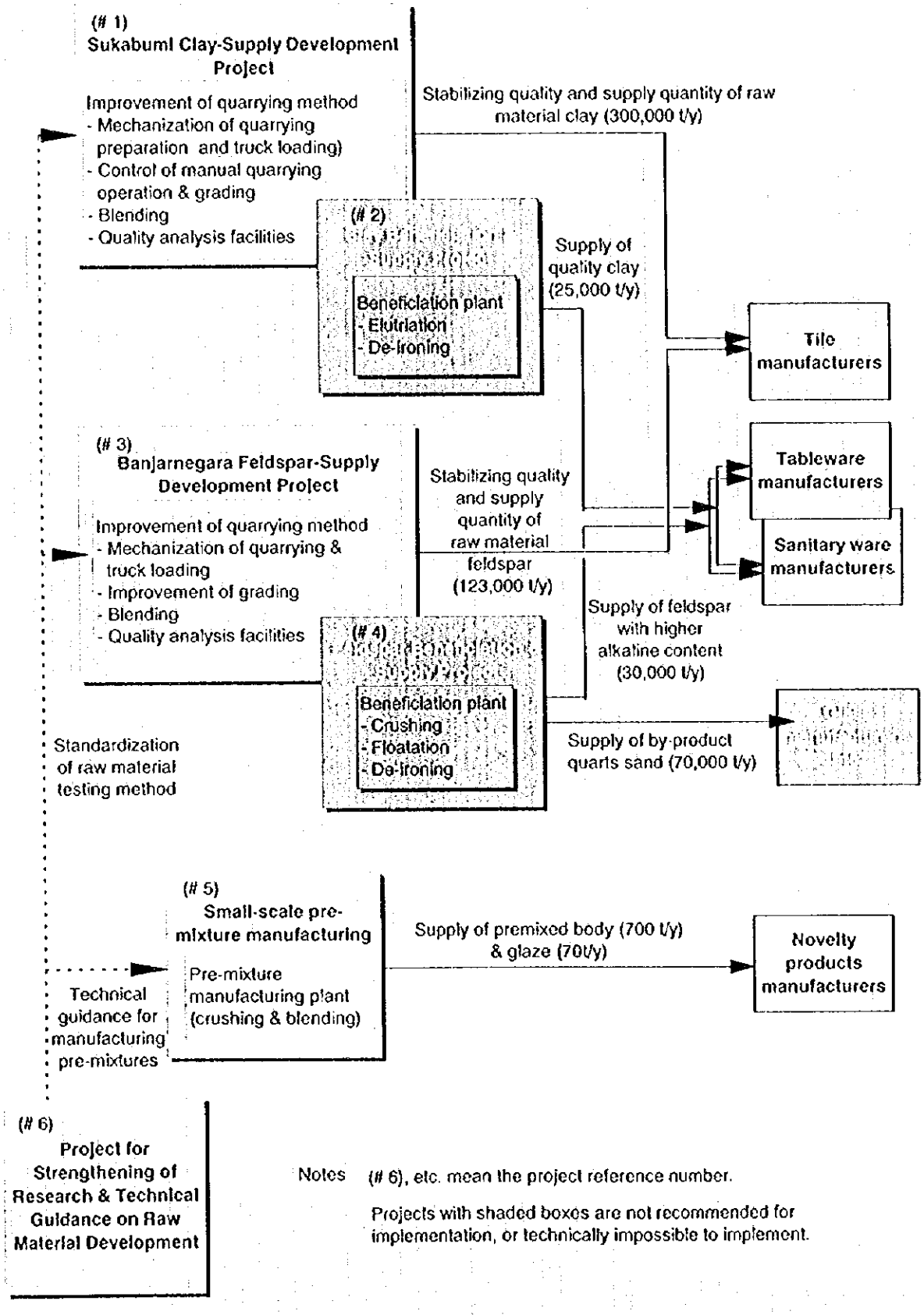


Table 4 Summary of Ceramic Raw Materials Development Plan

No.	Project	Objectives	Project Description	Evaluation Results	Estimated Initial Fund Requirement
(1)	Sukabumi Clay Supply Development Project	Stabilize quality and supply quantity of raw material clay	Location: Sukabumi (Land under ownership of National Gov't) Contents: 1) Large-scale quarrying development 2) Efficient quarrying development with mechanization of quarrying preparation and truck loading 3) Cotrol of manual quarrying operation & grading 4) Construction of stockyard for grading 5) Construction of blending facilities 6) Installation of equipment for quality analysis Beneficiaries: Tile manufacturers in West ant Central Java Capacity: Shipment capacity: 300,000 tons/year Implementation: Private operation	Implementation recommended (High technical effects anticipated; Reasonable profitability; High economic effects) - FIRR: 23.2% - EIRR: 24.3%	Rp. 10,304.9 million (US$ 4,422.6 thousand)
(2)	Refined Clay Supply Project	Supply of quality clay	Location: Sukabumi (Land owned by the National Gov't) Contents: Construction of refining plant - Beneficiation (elutriation) - De-ironing Beneficiaries: Sanitary ware manufacturers in West Java Capacity: Shipment capacity: 25,000 tons/year	Impossible for implementation (De-ironing is technically impossible)	
(3)	Banjarnegara Feldspar-Supply Development Project	Stabilize quality and supply quantity of feldspar	Location: Banjarnegara (Land owned by provincial Gov't) Contents: 1) Improvement of quarrying development 2) Efficient quarrying development with mechanization of quarrying preparation and truck loading 3) Cotrol of manual quarrying operation & grading 4) Construction of blending facilities 5) Construction of beneficiation plant 6) Installation of equipment for quality analysis Beneficiaries: Tile manufacturers in Java Capacity: Shipment capacity: 123,000 tons/year Implementation: Private operation	Implementation by private initiatives recommended (High technical effects anticipated; Reasonable profitability; Low economic effects) - FIRR: 32.7% - EIRR: 4.6%	Rp. 10,602 million (US$ 4,550.5 thousand)

Table 4 Summary of Ceramic Raw Materials Development Plan

No.	Project	Objectives	Project Description	Evaluation Results	Estimated Initial Fund Requirement
(4)	Refined Feldspar Supply Project	Supply of feldspar with higher alkaline content	Location: Banjarnegara (Land owned by the Provincial Gov't) Contents: Construction of beneficiation plant - Crushing facilities - Floatation facilities - De-ironing Beneficiaries: Sanitary ware and tableware manufacturers in Java, Glaze manufacturers Capacity: Shipment capacity: Refined feldspar 30,000 tons/year, Quartz sand 70,000 tons/year Implementation: Private operation	Implementation not recommended (Technical effects are expected; but profitability not expected because of small in size, and low yield rate of feldspar) - FIRR: -3.2% - EIRR: -3.5%	Rp. 68,410.2 million (US$ 29,360.6 thousand)
(5)	Small-scale Premixed Body & Glaze Manufacturing Project	Supply of premixed body & glaze to the local small scale novelty mfrs.	Location: Bandung (at BBK) Contents: 1) Construction of premixed body & glaze manufacturing plants 2) Procurement of raw materials, and manufacturing and supply of pre-mixtures and glaze 3) Installation of equipment for quality analysis Beneficiaries: Novelty manufacturers in Kiara Condong Capacity: Shipment capacity: 700 t/y of body & 70t/y of glaze Implementation: UPT/BBK Others: Model project for dissemination in other producing districts	Implementation by government sector recommended (Profitability is improved with implementation by government sector; Recommend implementation because of expected economic contribution to the development of local industry, national economic effects, and role played as a pilot project) - FIRR: 7.5% (Implementation by government sector: 15.5%) - EIRR: 11.5%	Rp. 1,303.7 million (US$ 559.5 thousand)

Table 4 Summary of Ceramic Raw Materials Development Plan

No.	Project	Objectives	Project Description	Evaluation Results	Estimated Initial Fund Requirement
(6)	Project for Strengthening of Research & Technical Guidance on Raw Material Development	Strengthening of technical support system for the above raw material development projects	Contents: 1) Supplementary technical study - Boring survey for Sukabumi and Banjarnegara - Sample raw material evaluation at users' plants 2) Strengthening of functions of BBK in providing continuous assistance, including; - Standardization of raw material testing method - Research on manufacturing conditions of premixed body and its improvement - Product development research taking into account the limitation of local raw materials 3) Establishment of international training courses in BBK on raw material development Beneficiaries: The above projects and ceramic industries Implementation: BBK	Implementation recommended	1) Supplementary boring survey - Sukabumi US$ 1,050,000 (US$ 270,000 for the sites required for the 1st 5 years only) - Banjarnegara US$ 370,000 2) Additional testing equipment US$ 124,000 3) Other expenses

(2) Sukabumi refined clay supply project

The project aims to supply clay suitable for use by tableware and sanitary ware manufactures by beneficiation of the Sukabumi clay.

(3) Banjarnegara feldspar supply project

The primary purpose of the project is to supply feldspar of stable quality to the tile industry which is the largest sub-sector of the ceramic industry in the country. No beneficiation for quality improvement will be conducted.

(4) Refined feldspar supply project

The project aims to supply feldspar suitable for use by tableware and sanitary ware manufacturers by beneficiation of the Banjarnegara feldspar. It will also supply feldspar for production of glaze.

(5) Small-scale premixed body and glaze supply project

The project constructs a facility to supply premixed body and glaze to clusters of small-scale novelty manufacturers in Kiara Condong. It serves as a pilot plant to collect data and information to be supplied to similar facilities serving other clusters.

(6) Project to build up capabilities for ceramic raw material research and development and technical assistance

The project is designed to build up resources and organizational efforts in the areas of ceramic raw material R&D and technical assistance under the leadership of BBK.

1.3.3 Sukabumi clay supply project

1.3.3.1 Project concept

To improve the quarrying management and grading to ensure supply of the Sukabumi clay with stable quality. A blending facility of different grade clays will be constructed. Instead of selectively quarrying and shipping higher-grade products only, lower-grade products which are currently discarded will be mixed with higher-grade ones to improve mining yield. Target quality levels are those suitable for use by tile manufacturers.

To facilitate quarrying work and transportation of excavated materials, heavy equipment will be introduced.

To control clay quality at a certain level, analytical instruments will be introduced to trace clay quality during mining and before and after the mixing operation.

1.3.3.2 Project outline

(1) Production capacity

The annual production capacity is assumed to be 300,000 tons.

Major customers are floor and wall tile manufacturers in West Java. Judging from the grade of clay currently produced at the mine, it is unlikely to be usable for production of tableware and sanitary ware. It is difficult to ship the clay to central and eastern parts of Java because of high transportation cost.

Annual forecast demand in 1998 is approximately 950,000 tons, of which the project will supply slightly more than 30%.

As shown in Table 5, an increase in production capacity improves profitability further. However, to allow for a risk of lower sales, it is undesirable to increase the production capacity above the assumed level. On the other hand, lower capacity will decrease profitability.

Table 5 Change in IRR with Change in Production Capacity and Operation Rate
(Sukabumi Clay Supply Project)

		Production Capacity (ton/year)			
		420,000	360,000	300,000	240,000
Operation Rate(*1)	100%	27.4%	25.5%	23.2%	18.6%
	Low case(*2)	15.4%	16.8%	18.4%	

(*1) Operation rate in the 2nd year. The operation rates are 65% for the 1st year in both cases.

(*2) The maximum saleable volume is assumed at 240,000tons.

(2) Project site

The project site is located in the Sukabumi clay mountain. As the southern pit has been excavated indiscriminately and is not suitable for new development, the new development will focus on the northern pit.

(3) Quarrying area

A few quarrying sites will be selected in the northern mine. Assuming that deposits are 5m thick and production will last 20 years for two sites, each site requires 40ha.

Prior to quarrying, top soil will be removed by using an earthmover, and site preparation will be done to make the excavation face widely visible and facilitate quarrying planning.

As clay layers in the site form a complex structure, mechanical excavation causes the mixing of clays of different grades, making planned blending in the subsequent stage

difficult. Excavation will therefore be carried out manually. At the primary stockyard to be provided in the site, excavated clay will be visually classified (based on content of quartz sand and iron [or color]) into 3 to 4 grades and will be stockpiled.

Clay stocked at the primary stockyard will be loaded onto trucks by using the above equipment for transportation to the secondary yard.

Crude clay is assumed to be transported to the secondary stockyard by a contractor who is currently engaged in excavation and transportation. However, loading equipment needs to be added to avoid congestion at the shipping area of quarrying site.

(4) Blending and shipping

At the secondary stockyard and the mixing plant, graded clays will be mixed to produce and store clay of specified quality.

The crude clay is mixed using a mixer to be homogenized.

According to the results of magnetic de-ironing test conducted in the study, iron removal was not significant as the color after firing improved only 5 to 6% in the degree of whiteness. Further, according to the evaluation tests conducted, clay refined by this method still contains a high percentage of iron to disqualify it for use as a principal ingredient for porcelain, sanitary ware, insulators, and refractories which require a higher level of quality. For the present project, therefore, dry mixing, rather than wet mixing/beneficiation, is assumed.

Thus, crude clay transported from the site will be classified according to the grade and stored temporarily. Clay of each grade will be carried by a wheel loader to a box feeder, in an amount determined according to the preset blending ratio. From the box feeder, clay will be batched and fed to belt conveyors for dry mixing. Mixed clay will mostly be stockpiled outside, while part will be kept under a shelter prior shipment during periods of rain. Finally, it will be loaded to users' trucks by the equipment provided for the purpose.

(5) Quality control equipment

To effectively evaluate and control the quartz sand/clay ratio and color after firing, which are the most important factors in quality control, it is recommended to facilitate work by acquiring sieves, a dryer, an electrical furnace for firing, some small devices, balance, and molds for firing work pieces. Chemical analysis, etc. will be requested to BBK.

1.3.3.3 Required funds, profitability, and risk related to the project

(1) Estimated initial fund requirements

The estimated initial funds required for the project are summarized in Table 6.

Table 6 Estimated Initial Fund Requirement
(Sukabumi Clay Supply Project)

	Rp. million	US$ 000
(1) Land acquisition & preparation	1,328.2	570.0
(2) Building & warehouse	370.8	159.1
(3) Facilities	7,843.5	3,366.3
1) Machinery & equipment	1,509.1	647.7
2) Vehicles	6,334.4	2,718.6
(4) Others (*)	762.4	327.2
Total	10,304.9	4,422.6

(*) Including pre-operating expenses, initial working capital, etc.

(2) Profitability

Except for the first year, revenues will exceed total production costs. Accordingly, profitability measured by IRR is high at 23.2% for before tax and 20.1% for after tax, high enough to attract private investment.

(3) Risks

Changes in profitability due to variation of major influencing factors are summarized in Table 7. There is a relatively small risk that the project's profitability falls below a level that makes private investment viable.

Table 7 Change in IRR with Change in Major Factors Affecting Profitability
(Sukabumi Clay Supply Project)

	Change in Sales Price		Change in Operational rate		Change in costs of vehicles and facilities		Change in Project Life	
Sales Price	Deviation from the base case	IRR before tax	Operational rate(*)	IRR before tax	Deviation from the base case	IRR before tax	Project Life	IRR before tax
(Rp./kg)	(%)	(%)	(%)	(%)	(%)	(%)	(years)	(%)
28.8	+20	33.5			-20	27.3		
26.4	+10	28.5			-10	25.1		
24.0	0	23.2	100	23.2	0	23.2	20	23.2
21.6	-10	17.6	90	20.9	+10	21.5	15	22.6
19.2	-20	11.5	80	18.4	+20	20.0		
16.8	-30	4.3	70	15.8				

Note: (*) Operational rate in the 2nd year and onwards. The operational rates in the 1st year are 65% for all the cases.

The possibility of an 10% decline in the assumed price is very small. Even if the

10% decline occurs, IRR can still be maintained at 17.6%. Thus, the project faces a small risk of deteriorated profitability caused by price declines.

Another risk is lower clay demand than expected, which results in a lower operating rate. IRR falls to 20.9% at the operating rate of 90% and 18.4% at 80%. Again, this risk is not serious in terms of project viability. The equipment cost is expected to decline below the present estimates.

1.3.4 Banjarnegara feldspar supply project

1.3.4.1 Project concept

The project's primary purpose is to streamline quarrying and transportation of the Banjarnegara feldspar through mechanization, and ensure stable supply in volume.

In order to ensure supply of the feldspar having stable quality, the project will improve the quarrying management and grading. A facility for blending different grade of feldspars will be constructed. Instead of selectively quarrying and shipping higher-grades products only, lower-grade products which are currently disposed will be mixed with higher-grade ones to improve mining recovery. Target quality levels are those suitable for use by tile manufacturers.

To control feldspar quality at a certain level, analytical instruments will be introduced to trace feldspar quality during mining and before and after mixing operation.

1.3.4.2 Project outline

(1) Production capacity

Annual production capacity at the site is assumed to be 123,000 tons.

Judging from the grade of feldspar currently produced at the mine, it is difficult to expect that it will be used by tableware and sanitary ware manufacturers.

Annual demand forecast in 1998 is approximately 894,000 tons, of which the project is assumed to supply 14%.

The larger capacity continues to improve profitability (Table 8). Further, the profitability is high enough even at an 80% of the assumed capacity (98,400 tons/year).

In fact, if future demand growth is fairly certain and potential feldspar resources do not show significant problems, the production capacity can be further increased.

Table 8 Change in IRR with Change in Production Capacity and Operation Rate
(Banjarnegara Feldspar Supply Project)

		Production Capacity (ton/year)			
		172,000	147,000	123,000	98,400
Operation Rate(*1)	100%	39.3%	36.2%	32.7%	28.5%
	Low case(*2)	23.9%	25.4%	26.8%	

(*1) Operation rate in the 2nd year. The operation rates are 65% for the 1st year in both cases.

(*2) The maximum saleable volume is assumed at 98,400tons.

(2) Project site

The project site is the Kalitengah mine which is best suited for large-scale development among three mines under operation and has sufficient reserves for long-term exploitation (according to DSM's survey, the mine site is 495ha and 60m deep). The working face is located on a small hill which is relatively remote from houses, and a few more working faces are on an adjacent hill.

The secondary stockyard will be established at a stockyard operated by the prefectural government with some expansion. The blending plant will also be accommodated within the same site.

(3) Quarrying

Prior to the start of quarrying at the Kalitengah mine, top soil will be entirely removed from the quarrying site, followed by bench cut excavation to allow the understanding and estimation of resource distribution and quality. An earthmover will be used to quarry and transport crude feldspar to the primary stockyard, as well as truck loading for transportation to the secondary stockyard. Trucks will be used for transportation from the primary stockyard to the secondary stockyard.

At other quarrying sites, ongoing quarrying operation will be continued and crude feldspar will be received by the secondary stockyard.

(4) Blending and shipping

The secondary stockyard operated by the prefectural government will be expanded, and the blending plant will be constructed within the site.

The homogenization is assumed to be accomplished by dry mixing.

While the Banjarnegara feldspar has relatively uniform quality, careful analysis reveals variation among cutting faces, i.e., the difference in tone due to the content of iron compounds, and the differences in fluxing and sinter points due to content variation of quartz and feldspar. All these factors cause product (tile) dimensions, tone, and

sintering temperature to deviate from design values, and lower the yield.

However, water sieving produces 30% to 40% undersize, which is usually not used for tile production, and thus, lowers yield significantly and increases costs. Also, a large amount of undersize must be treated by re-sieving to remove sludge and fine sand before it can be used for construction or to remove detrimental constituents for blending with over size for use as tile materials. This further increases cost.

Thus, the dry mixing method is assumed for homogenization in the present project, since the major quality target is for tile materials.

Namely, crude feldspar transported from the site will be classified according to the grade and stockpiled. Feldspar of each grade will be carried by a wheel loader to a box feeder, in an amount determined according to the preset blending ratio. From the box feeder, feldspar will be batched and fed to belt conveyors for dry mixing. Mixed feldspar will mostly be stockpiled outside, while some portions will be kept under a shelter for shipment under rain. Finally, it will be loaded to user's trucks by earthmover for shipping.

(5) Quality control equipment

Using this equipment, such minimum quality characteristics as color after firing and refractoriness will be tested for the samples collected from mixed feldspar, and the results will be fed back to quarrying site and the blending plant for better grading control, mixing ratio control of the blending plant and product stock control.

1.3.4.3 Required funds, profitability, and risk related to the project

(1) Preliminary estimates of initial fund requirements

The estimated initial funds required for the project are summarized Table 9.

Table 9 Estimated Initial Fund Requirement
(Banjarnegara Feldspar Supply Project)

	Rp. million	US$ 000
(1) Land acquisition & preparation	1,039.4	446.1
(2) Building & warehouse	52.2	22.4
(3) Facilities	9,429.4	4,047.0
1) Machine & equipment	897.4	385.2
2) Vehicles	8,532.0	3,661.8
(4) Others (*)	81.5	35.0
Total	10,602.5	4,550.5

(*) Including pre-operating expenses, initial working capital, etc.

(2) Profitability

Revenues will exceed total production costs from the first year. Accordingly, profitability measured by IRR is high at 32.7% before tax and 28.0% after tax, high enough to attract private investment.

(3) Risks

There are few factors that adversely affect profitability to threaten the project's viability (Table 10).

Table 10 Change in IRR with Change in Major Factors Affecting Profitability
(Banjarnegara Feldspar Supply Project)

Change in Sales Price			Change in Operational rate		Change in costs of vehicles and facilities		Change in Project Life	
Sales Price (Rp./kg)	Deviation from the base case (%)	IRR before tax (%)	Operational rate(*) (%)	IRR before tax (%)	Deviation from the base case (%)	IRR before tax (%)	Project Life (years)	IRR before tax (%)
51.6	+20	39.9			-20	39.3		
47.3	+10	36.3			-10	35.7		
43.0	0	32.7	100	32.7	0	32.7	20	32.7
38.7	-10	29.0	90	29.9	+10	30.1	15	32.4
34.4	-20	25.2	80	26.8	+20	27.9		
30.1	-30	21.2	70	23.6				

Note: (*) Operational rate in the 2nd year and onwards. The operational rates in the 1st year are 65% for all the cases.

1.3.5 Banjarnegara feldspar beneficiation and supply project

1.3.5.1 Project concept

Feldspar processed by the dry mixing method has an acceptable grade for tile manufacturers but is not suitable for tableware and sanitary ware production. This project will produce and supply refined feldspar with quality to be used as the body and glaze for sanitary ware and tableware. It includes the installation of a beneficiation plant to raise the alkali concentration to 10% and remove iron, titan, and mica to reduce their content below 0.3%.

The project presumes implementation of the Banjarnegara feldspar supply project.

1.3.5.2 Project outline

(1) Production capacity

The production capacity of refined feldspar is 30,000 tons per year. Quartz sand as a byproduct will be produced at the rate of 70,000 tons annually.

Sanitary ware production always uses more than two types of feldspars which are blended in varying proportions. Also, it can use only a combination of kaolin, feldspar, and quartz. The estimated demand of feldspar will be approximately 3,000 tons in 1998 (or 2,000 tons with demand size in 1995).

For tableware production, the Banjarnegara feldspar is not suitable for high-grade products since it contains mica, though it in very low concentration, and low alkali content (slightly less than 10%). When using this feldspar, it is necessary to be blended with imported feldspar to increase the alkali content. Potential sales will account for feldspar amounting to around 29,000 tons in 1998 (or 19,000 tons based on the 1995 demand).

As a result, total potential sales of the Banjarnegara feldspar for tableware and sanitary ware production are 32,000 tons in 1998 (or 21,000 tons based on the 1995 demand). Some demand for glaze is expected to be added to this amount. In determining the production capacity, however, commercial sales of quartz sand that is separated as a byproduct need to be taken into account. Since quartz sand is mainly used for glass production which has strict requirements for the upper limit of iron content, the feldspar production capacity is assumed to be 30,000 tons (therefore, 70,000 tons of quartz sand).

Profitability for the project, measured by IRR, is -3.9%. The negative feasibility comes from the small production capacity. Larger capacities will bring some improvements in profitability (Table 11), but this level of capacity is still below a viable level, even at the 45,000-ton capacity.

Table 11 Change in IRR with Change in Production Capacity and Operation Rate
(Banjarnegara Feldspar Beneficiation and Supply Project)

		Production Capacity (ton/year)			
		45,000	37,500	30,000	22,500
Operation Rate(*1)	100%	-3.0%	-3.3%	-3.9%	-4.7%
	Low case(*2)	-10.7%	-8.9%	-6.7%	

(*1) Operation rate in the 2nd year. The operation rates are 65% for the 1st year in both cases.

(*2) The maximum saleable volume is assumed at 24,000tons.

(2) Project site

Within the secondary stockyard site (or its adjacent site) of the Banjarnegara feldspar supply project.

(3) Beneficiation equipment

Feldspar with consistent quality produced by dry mixing in the preceding project is refined at a plant consisting of crushing, water washing, classification, and floatation processes.

According to the laboratory test conducted on the feldspar samples, by selectively crushing optimum particle sizes and separating mica from feldspar and quartz, followed by water washing, the iron content can be reduced to around 0.2%, and color after firing can be improved to the level of standard grade of the Masuda feldspar in Japan. However, a part of feldspar, which is relatively soft, is also crushed in the crushing process and removed as undersize in the classification process. In this case, the over size alone cannot achieve sufficient sinterability. Also, this method alone does not improve color after firing. Magnetic de-ironing (25,000 Gs) can reduce the iron content to 0.15% or less and color after firing is improved to that of the Masuda feldspar. However, the method is not capable of raising the alkali content.

Acid de-ironing is another effective method of reducing the iron content, and laboratory test results indicate possibility of improving the iron removing effect and color after firing. However, problems remain in terms of the long hours required for acid treatment, high cost, and need for neutralization or recovery of acid after treatment.

Further, it has been confirmed that floatation can increase the alkali concentration to nearly 10%.

Based on the above laboratory test results, a beneficiation process has been adopted to combine crushing, water washing, classification, magnetic de-ironing, and floatation processes, not including acid treatment. Also, undersize obtained after water washing is recycled to the process after removing clay and iron contents. The process flow is summarized as follows:

1) To use feldspar which is dried mixed for consistent quality
2) To crush it in a drum washer, while washing away impurities such as clay and iron contents;
3) To pulverize(150 -200 meshes) the washed feldspar and quartz;
4) To remove an iron content from the pulverized feldspar and quartz by strong magnetism of 20,000 Gs.;
5) To increase the feldspar content in the slurry after iron removal through the floatation process; and

6) To recover feldspar in the slurry settled and separated in a pit.

(4) Stockyard

To encourage natural dehydration from the feldspar-contained slurry, the stockyard will be sheltered and finished with concrete floor with a 5 to 6 degree slop.

(5) Quality control equipment

Quality control tests to be conducted at field will mainly cover grain size analysis and melting test. Other tests will be conducted by BBK or other public organizations. Testing equipment for the feldspar supply project will be used for this purpose.

1.3.5.3 Required funds, profitability, and risk related to the project

(1) Estimated initial fund requirements

The estimated initial funds required for the project are summarized in Table 12. 94.4% of the total fund requirement is the cost of beneficiation facilities.

Table 12 Estimated Initial Fund Requirement
(Banjarnegara Feldspar Beneficiation and Supply Project)

	Rp. million	US$ 000
(1) Land acquisition & preparation	560.5	240.6
(2) Building & warehouse	435.0	186.7
(3) Facilities	67,333.5	28,898.5
1) Machine & equipment	64,917.7	27,861.7
2) Vehicles	2,415.8	1,036.8
(4) Others (*)	81.2	34.8
Total	68,410.2	29,360.6

(*) Including pre-operating expenses, initial working capital, etc.

(2) Profitability

Although revenues will exceed total production costs in the second year and after, they will not cover depreciation expenses for equipment. Thus, profitability measured by IRR show a negative value of 3.9% before tax, indicating that the project is not feasible.

As mentioned earlier, the small production capacity is a major factor in poor profitability, which is further deteriorated by a low yield of refined feldspar (30%; the remaining portion will be separated as quartz sand).

Even if sales prices of refined feldspar and quartz sand increase 20%, IRR will be still negative at 1.2% (Table 13).

Therefore, the project cannot be justified unless the conditions change so that

production capacity is increased.

Table 13 Change in IRR with Change in Major Factors Affecting Profitability
(Banjarnegara Feldspar Beneficiation and Supply Project)

Change in Sales Price				Change in costs of vehicles and facilities	
Sales Price (Rp./kg)		Deviation from the base case	IRR before tax	Deviation from the base case	IRR before tax
Refined feldspar	Silica sand	(%)	(%)	(%)	(%)
148.8	21.6	+20	-1.2	-20	-1.3
136.4	19.8	+10	-2.5	-10	-2.7
124.0	18.0	0	-3.9	0	-3.9
111.6	16.2	-10			
99.2	14.4	-20			
86.8	12.6	-30			

Note: (*) Operational rate in the 2nd year and onwards.
The operational rates in the 1st year are 65% for all the cases.

1.3.6 Small-scale body and glaze premixing project

1.3.6.1 Project concept

The project will manufacture and supply premixed body and glaze to a localized community (cluster) of novelty manufacturers.

Most novelty manufacturers are small enterprises or microenterprises, who form clusters throughout the country. They blend raw materials as required; the grade of those materials varies with delivered lot, making proper blending difficult. Also, raw materials often contain constituents unsuitable for ceramic production, which adversely affects the quality of final products. For this reason, novelty manufacturers will welcome availability of premixed body with consistent quality. In addition, they anticipate that the premixed body of better quality leads to the improvement of product quality.

Under the project, the body and glaze will be prepared on the basis of the existing ones at the initial stage and will be gradually modified. The project will serve as a model case to launch similar projects in other clusters of small ceramic manufacturers.

1.3.6.2 Project outline

(1) Production capacity

The annual production capacity is set at 700 tons for premixed body and 70 tons for glaze.

Major customers are novelty manufacturers in Kiara Condong. Shipment to other areas is not feasible while the existing blend is used. In the future, production activity may be diversified if required, with the improvement of the premixed body and production of the premixed body for other clusters.

In Kiara Condong, approximately 40 tons/month (480 tons/year) of body are consumed. The production capacity is set to meet future growth as well as supply to other areas. Glaze consumption is generally around 10% of body consumption, so that the production capacity is assumed to be 70 tons.

The assumed production capacity is not large enough to make the project viable. The production volume in this range does not justify commercial production (Table 14).

Table 14 Change in IRR with Change in Production Capacity and Operation Rate
(Small-scale Body and Glaze Premixing Project)

		Production Capacity (*3) (ton/year)			
		980	840	700	560
Operation Rate(*1)	100%	10.8%	9.3%	7.5%	5.0%
	Low case(*2)	1.0%	2.1%	3.5%	

(*1) Operation rate in the 2nd year. The operation rates are 65% for the 1st year in both cases.

(*2) The maximum saleable volume is assumed at 560tons.

(*3) Production capacity of body premix. The production capacity of glaze is assumed as 1/10 of body premix in each cases.

(2) Project site

The project will be implemented in Kiara Condong. It is desirable to establish the facility within BBK partly because the pilot nature of the project requires continuous technical support, and partly because some of BBK's facilities and equipment can be used.

(3) Production equipment

1) Premixed body production plant

Raw materials (kaolin, clay, feldspar, quartz, etc.) are batched according to specified blending proportions and fed to a ball mill for wet crushing and blending. The slip produced from the process passes through a screen to remove uncrushable portions, is subject to iron removal and dehydrated in a filter press to form a cake. It is shipped as the premixed body or is deaerated through a deaeration extruder before shipment.

2) Glaze production plant

Raw materials are batched according to specified proportions and fed to the ball mill

for wet crushing and blending. The glaze so prepared passes through a 200-mesh screen to remove uncrushable portions, and after iron removal, it is packed in a polyvinyl tanks (30 liters).

(4) Quality control

The necessary equipment will be installed for the following tests to be conducted.

1) Grain size analysis
2) Measurement of water content
3) Firing test
4) Reaction between the body and glaze

1.3.6.3 Required funds, profitability, and risk related to the project

(1) Preliminary estimate of initial fund requirements

The estimated initial funds required for the project are summarized in Table 15.

Table 15 Estimated Initial Fund Requirement
(Small-scale Body and Glaze Premixing Project)

	Rp. million	US$ 000
(1) Land acquisition & preparation	97.9	42.0
(2) Building & warehouse	27.0	11.6
(3) Facilities	1,149.0	493.1
1) Machine & equipment	1,149.0	493.1
2) Vehicles	-	-
(4) Others (*)	29.8	12.8
Total	1,303.7	559.5

(*) Including pre-operating expenses, initial working capital, etc.

(2) Profitability

Although revenues will exceed total production costs in the second year and after, profitability measured by IRR shows 7.5% before and after tax, that is not attractive enough for private investment.

Alternatively, if the project is implemented by BBK and UPT at BBK's site, cost savings can be expected in the following areas, and IRR improves to 11.0%:

1) Equipment cost
   a) Two ball mills currently in use will be used for body production; they are to have rubber inner lining.
   b) No testing equipment for quality control will be required.

2) Land acquisition and preparation costs will not be required
3) Interest payment will be saved by relying on government assistance for initial funds.

Furthermore, if the project is managed by UPT/BBK, labor cost and overhead will be financed by government budget. As a result, IRR improves to 15.5%.

Although profitability is not high enough to attract private investment, positive cash flow will be generated in the second year and after.

(3) Risks

It is assumed that the project is managed by the government within BBK's site. There are few factors that adversely affect profitability, so as to jeopardize the project's viability (Table16).

Table 16 Change in IRR with Change in Major Factors Affecting Profitability
(Small-scale Body and Glaze Premixing Project – Alternative Case)

Change in Sales Price			Change in Operational rate		Change in costs of vehicles and facilities		Change in Project Life	
Sales Price(*1) (Rp./kg)	Deviation from the base case (%)	IRR before tax (%)	Operational rate(*2) (%)	IRR before tax (%)	Deviation from the base case (%)	IRR before tax (%)	Project Life (years)	IRR before tax (%)
540	+20	22.0			-20	19.4		
495	+10	18.9			-10	17.3		
450	0	15.5	100	15.5	0	15.5	20	15.5
405	-10	12.0	90	13.6	+10	14.0	15	14.3
360	-20	8.1	80	11.5	+20	12.7		
315	-30	3.5	70	9.2				

Note: (*1) Sales price of pre-mixed body.
(*2) Operational rate in the 2nd year and onwards.
The operational rates in the 1st year are 65% for all the cases.

The assumed price is based on the body made in Malang that is purchased in Bandung, and a price decline will not be probable. Rather a 20% increase in sales price is highly likely.

Considering the annual consumption of 480 tons in Kiara Condong, the low operating rate assumed here may be possible, in which case IRR falls to 9.2%.

The equipment cost is expected to decline below the level of present estimates. If the actual equipment cost is 20% lower than the estimate, IRR will become 19.4%,

In any of the above cases except for a 30% decline in sales price, positive cash flow will be generated from the second year (from the sixth year, in the case of a 30% decline in sales price)

1.3.7 Project to build up technical assistance capabilities related to ceramic raw material supply

1.3.7.1 Project concept

The project is designed to provide the technical assistance for ceramic raw material supply and to build up technical capabilities in this connection. The project consists of the following three programs:

1) Implementation of a supplementary technical study to support promotion of the recommended project to develop ceramic raw materials
2) Strengthening of the functions of BBK in its provision of continuous assistance in development of ceramic raw materials, and
3) Establishment of international training courses on ceramic raw material development in BBK for BBK to keep up with the updated technologies

1.3.7.2 Project outline

(1) Project implementation body

BBK is assumed to be primarily responsible for the project. However, as the project involves matters related to the mining of ceramic raw materials, BBK will request support, as required, from Geological Research and Development Center of Development of Mineral Resources (DSM) under the Directorate of Mineral Resources, and Mining Technology Research and Development Center (MTRDC) under the Directorate General of Geology and Mines, both of the Ministry of Mineral and Energy.

(2) Activities

Activities to be conducted under the project are summarized as follows.

1) Supplementary technical study to support promotion of the recommended project to develop ceramic raw materials

a) Objective

Since for the present study there is still an insufficiency in detailed technical data to enable potential investors to make a decision on implementation, it is recommended to conduct the supplemental technical study on Sukabumi clay and Banjarnegara feldspar mine sites, and collect the technical data required, as follows:

1. Preliminary survey : Collection of data and information useful for planning of boring surveys, such as detailed geological conditions and geographical distribution of mines, with field survey
2. Preparatory survey : Determine the scope of the boring survey and the basic plan

3. Boring and core sampling
4. Evaluation of core samples : Evaluation to determine mining policy and define criteria for grading, conditions for beneficiation, and blending
5. Evaluation of raw materials and research on mining and beneficiation conditions
   - Evaluation of marketability of the Sukabumi clay and the Banjarnegara feldspar (in view of use for tile);
   - Detailed examination of beneficiation conditions for the Banjarnegara feldspar;
   - Evaluation of marketability of the refined Banjarnegara feldspar (in view of use for sanitary ware and tableware); and
   - Evaluation of marketability of quartz sand as byproduct of the Banjarnegara feldspar (in view of use for glass manufacturing)

   The evaluation of marketability will be conducted at manufacturing plants or pilot plants of ceramic manufacturers under arrangement of the subcommittee.
6. Preliminary environmental impact assessment
7. Data analysis and reporting

b) Resources required by the project implementation body

The study committee will be organized under the leadership of BBK, including representatives from DSM and MTRDC. Under the committee, (1) a boring subcommittee will be organized for coordination of boring surveys, and (2) a raw material evaluation subcommittee will be organized to evaluate suitability of raw materials to be obtained from the projects.

BBK's and MTRDC's staff will be assigned as the key members for implementing the study. In addition, it is desirable to invite a study team from abroad consisting of engineers having expertise in the following areas for technical assistance (or conducting joint study);

1. Boring surveys on ceramic raw materials
2. Beneficiation of ceramic raw materials

Assumes installation of the following additional testing equipment (for details, see the latter part of this section)

- X-ray fluorescence analyzer
- Glass bead manufacturing equipment

For boring, MTRDC or DSM equipment will be used.

Preliminary cost estimates for the boring surveys are as follows:

- Sukabumi clay mine: US$1,050,000 (or US$270,000 if limited to deposits covering first 5 years of mining)
- Banjarnegara feldspar mine: US$370,000

- Other costs and expenses related to daily activities and sample analysis

Estimated required period for the survey: Approximately 15 months

2) Strengthening of functions of BBK in providing continuous assistance in development of ceramic raw materials

a) Objectives and contents

1. Standardization of raw material testing methods : The project aims to develop standards for ceramic raw material testing methods, to thereby standardize various testing methods to be adopted and practiced by quarry miners, suppliers and customers. The standardization will enable the supply side to perform quality control on the basis of the results obtained from the standard testing methods, while customers will be able to use test results received from suppliers for blending control at their facilities.
2. Research on quality improvement of premixed body for small-scale novelty manufacturers : Under the project to supply premixed body to small-scale novelty manufacturers, the body will be initially produced on the basis of the blending ratio currently in use. Meanwhile, it is important to make efforts to improve the quality of the body in an attempt to change raw materials for the improvement of product quality, profitability, and/or consistent quality.
3. Product development making most of available local materials and dissemination of them : Recognize limitations of locally available raw materials and develop products which make most use of properties and characteristics peculiar to such materials.
4. Continued exploration efforts of ceramic raw materials : During the study, there were some resources which were not selected by the study team as promising, due to the lack of data. In particular, the following resources are recommended to be made the objective of further study and research;
   - Clay resource surveys around the Sukabumi clay mine, particularly nearby valleys and flat areas
   - Pottery stone in Pacitan
5. Raw material analysis and testing service : To build the capability to perform analyses and tests on raw materials produced at the beneficiation and blending factories, which cannot be performed at these factories; to provide assistance for maintaining the precision of testing equipment at the factories; and to develop resources and skills to provide technical guidance for quality improvement and stabilization based on test results.
6. Technical consultation and guidance service : To provide technical consultation

and guidance service on the basis of the results of the above analyses and tests.

7. Information service : To publish and provide research and study results to scientific journals and internal organs of various organizations.
8. Human resource development : To train BBK's staff to perform work required for the above activities.
9. Other areas requiring improvement
   - Ensuring the continuous operation of the pot mill
   - Stable supply of municipal water
   - Need to equip with a low-temperature dryer for the gypsum mold
   - Need to equip with a pH meter
   - Need to equip with refractoriness measuring equipment

b) Resources required by the project implementation body

BBK's present staff will basically be responsible for the implementation of these research projects. Nevertheless, expatriate engineers are recommended to be invited for technical transfer at the initial certain period of time (1 to 2 years), particularly for the following purpose:

1. Research on quality improvement of premixed body for small-scale novelty manufacturers
2. Technical consultation and guidance service

To conduct the above activities, most of the required testing equipment is available at BBK, and the additional equipment needed and the required funds for these are as follows:

- X-ray fluorescence analyzer: US$ 95,200
- Glass bead manufacturing equipment: US$ 28,600

Expenses required for these projects may be covered basically by BBK's operating budget. Nevertheless, special consideration is required with regard to additional budget allocation, or allocation of revenue from the services to the relevant expenses.

3) Establishment of international training courses on ceramic raw material development in BBK for BBK to keep up with the updated technologies

a) Objective and content

Such training courses contribute not only to nurturing the manpower required for raw material development, but also to stimulating efforts to raise BBK's own technology levels, leading to reinvigoration of the research institute itself through working with foreign trainers and professionals.

Such training courses at the international level used to be held in Japan, but

discontinued. BBK is one of the best institutes in terms of its linkage with the industry among those in Asia, and has been active in dispatching their staff to universities and colleges as the lecturers, and receiving trainees locally to the institute. If these activities are further developed by inviting a part of lecturers from abroad, the establishment of training courses at the international level will be feasible. The example of the training courses are given in Table 17.

b) Resources required by the project implementation body

It is necessary to organize the planners and coordinators within the BBK for the course management, and also necessary to organize lecturer team by the staff, while requesting other relevant companies and institutes for providing lecturers to support the BBK. Further, it is recommended to invite the lecturers from abroad, if necessary.

As for the facilities, the training facilities under construction by BBK under the assistance of Asian Development Bank, may be used for this purpose.

For assistance in recruitment of trainees abroad, invitation of foreign lecturers, and filling a deficit in expenses for establishment of the courses, the request for foreign organizations for technical cooperation will be desirable. Also, for the training of BBK's staff for planning and designing the courses, invitation of foreign experts for course planning is recommended.

1.4 Economic Effect of the Plan

1.4.1 Economic Internal rate of return

Economic internal rate of return (EIRR) on investment was estimated by assessing the economic costs and benefits for projects comprising the plan from national economic standpoints of Indonesia.

The results are summarized as follows.

(1) Sukabumi clay supply project

EIRR is 24.3%, which is sufficiently high to indicate that the project will produce a significant economic effect.

(2) Banjarnegara feldspar supply project

EIRR is 4.6%, which represents a very small economic effect from the project. This is because the cost for required equipment is relatively large, and additional costs for raw materials are considered to be zero (not negative as in the case of the Sukabumi clay),

Table 17 Example of Training Courses for Ceramic Raw Material Development (1/2)

Name of Training Courses	Subjects	Contents	Type of course	Duration
1. Basic course in ceramic raw materials	(1) Minerals for ceramic raw material; kind, classification, and properties	Learn about the basics of ceramic raw materials in general; kinds, classifications, properties (1) Silica, (2) Clay, (3) High alumina, (4) Feldspar, (5) Limestone, (6) Magnesia, (7) Chrome, (8) Carbon	Lectures and practices	Around 2 months
	(2) Minerals for ceramic raw material; origin, endowment	Learn about the basics of deposits of ceramic raw materials; geographic origin, endowment in Southeast Asia (1) Geological classification (2) Mineral classification : a) Igneous rocks, b) Sedimentary rocks, c) Metamorphic rocks (3) Size of deposit : a) General classification, b) Ceramic raw materials		
	(3) Minerals for ceramic raw material; chemical & physical properties	Learn about the basics of chemical and physical properties of ceramic raw materials (1) Chemical composition, (2) Crystal structure, (3) Shape, (4) Color, (5) Specific gravity, (6) Hardness, (7) Optical property		
	(4) Basics of evaluation methods of raw material minerals	Learn about the basics and practical evaluation methods of chemical and physical properties of ceramic raw materials (1) Chemical analysis : a) Fluorescent X-ray analysis, b) Atomic absorption spectrometry, c) Spectrochemical analysis, d) Flame photometric analysis, e) Chromatography (2) Microstructure analysis : a) X-ray diffraction, b) Electro microscope, c) Photo microscope (3) Other physical property : a) Specific gravity, b) Particle size distribution, c) viscosity, d) Hardness, e) Differential thermal analysis		

Table 17 Example of Training Courses for Ceramic Raw Material Development (2/2)

Name of Training Courses	Subjects	Contents	Type of course	Duration
2. Practical course in ceramic raw materials	(1) Orientation for ceramic products manufacturing	Learn about the outline of manufacturing and technologies of the ceramic products (1) Tile, (2) Sanitary ware, (3) Tableware, (4) Novelty goods	Lectures, factory visits, and practices	Around 2 months
	(2) Quality requirements and methods of quality control by type of ceramic products	Learn about the outline of manufacturing and technologies of the ceramic products (1) Principal materials : a) Clay/Kaolin, b) Silica, c) Feldspar, d) Toseki, e) Agalomaterite (2) Glaze/Pigment		
	(3) Practical technology in ceramic raw material evaluation	Learn about the practical evaluation technologies and exercises about the quality of ceramic raw materials (1) General chemical and physical property (2) Mixing test (Clay plasticity & viscosity, slip castability, dry strength & shrinkage) (3) Firing test (Firing coloration, firing strength & shrinkage, deformation, water absorption)		
3. Beneficiation technology for ceramic raw materials	(1) Mining technology and quality control	Learn about the practical technologies for preparation of body	Lectures, mining site visits, factory visits, and practices	Around 2 months
	(2) Beneficiation technology	Learn about the beneficiation technologies and their practices; crushing, washing by water, classification, de-ironing, floatation		
	(3) Body manufacturing technology	Learn about the exploration and mining technologies of ceramic raw materials and quality control technologies		

whereas the increase in economic value obtained from the project is relatively small. Notably, FIRR for the project is fairly high at 32.7%, because the feldspar price is high at Rp.43/kg though the price of crude feldspar is also assumed zero at the mining site.

(3) Refined Banjarnegara feldspar supply project

EIRR for the project is -3.5%, and no economic effect is expected.

(4) Small-scale premixed body and glaze production project

EIRR for the project is 11.5%. FIRR is 7.5% if it is implemented as an independent project without government assistance, and 15.5% if government assistance is obtained. Thus, in consideration of its indirect benefits and other economic contribution, it will generate positive value to the national economy.

Further, indirect benefits are difficult to be quantified in an objective and accurate manner, and if included in the EIRR calculation, they could cause overestimation of the project's effect. Thus, they are separately accounted for, as discussed in the following section, excluding from IRR calculation.

1.4.2 Indirect benefits and other economic contributions

1.4.2.1 Indirect benefits and other economic contribution

Major indirect benefits created by the projects are estimated as follows:

1) Increase in employment opportunity

The increase in employment opportunity created by construction and operation after completion:

1. Sukabumi clay supply project: 30 persons
2. Banjarnegara feldspar supply project: 21 persons
3. Refined Banjarnegara feldspar production project: 30 persons
4. Small-scale premixed body and glaze production project: 8 persons

(The multiplier effect is not considered in the above.)

2) Trickle-down effect on related industries

The effect includes increased consumption of construction materials, such as steel materials and cement, and other materials used for commercial operation.

3) Contribution to the development of regional economy

Construction activities and commercial operation after completion will stimulate the

transportation and commerce sectors, contributing to regional development.

These indirect benefits, however, are difficult to quantify in a reasonable and accurate manner.

1.4.2.2 Other economic contributions

Other economic contributions include the savings in foreign exchange expected from the refined Banjarnegara feldspar supply project. Based on the previous assumption of domestic and foreign currency portions, the balance of payments resulting from projects over a 20 year period is estimated in Table 18;

Table 18 Estimated Saving of Foreign Exchange
(Banjarnegara Feldspar Beneficiation & Supply Project)

(Unit: US$'000)

Year	Inflow (A)	Outflow (B)		Balance (A)-(B)
		Cost for Machine & Equipment	Substitution of Imported Feldspar	
-1	0.0	14,449.2	0.0	-14,449.2
1	0.0	0.0	-951.3	951.3
2	0.0	0.0	-1,550.0	1,550.0
3	0.0	0.0	-1,596.6	1,596.6
4-20	0.0	0.0	-1,596.6	1,596.6
Total	0.0	14,449.2	-31,240.1	16,790.9

In addition, all of the projects will create opportunities for new product development through supply of stable and improved raw materials, which will indirectly result in foreign exchange earning, e.g., the tableware industry may be able to enter medium- and high-grade product markets, and the novelty product industry can develop export-oriented products.

At the mining sites, the projects contribute to alleviation of environmental damage by use of lower-grade materials currently disposed as waste.

1.5 Plan Implementation System and Schedule

1.5.1 Plan Implementation system

The implementation of each project comprising the ceramic raw material development plan is assumed as follows:

1) The clay and feldspar supply projects are assumed to be implemented by private

initiatives. In establishing companies supplying raw materials, it is desirable to obtain equity participation of many ceramic companies, which will help improve communication between suppliers and users, while securing the market for new products.

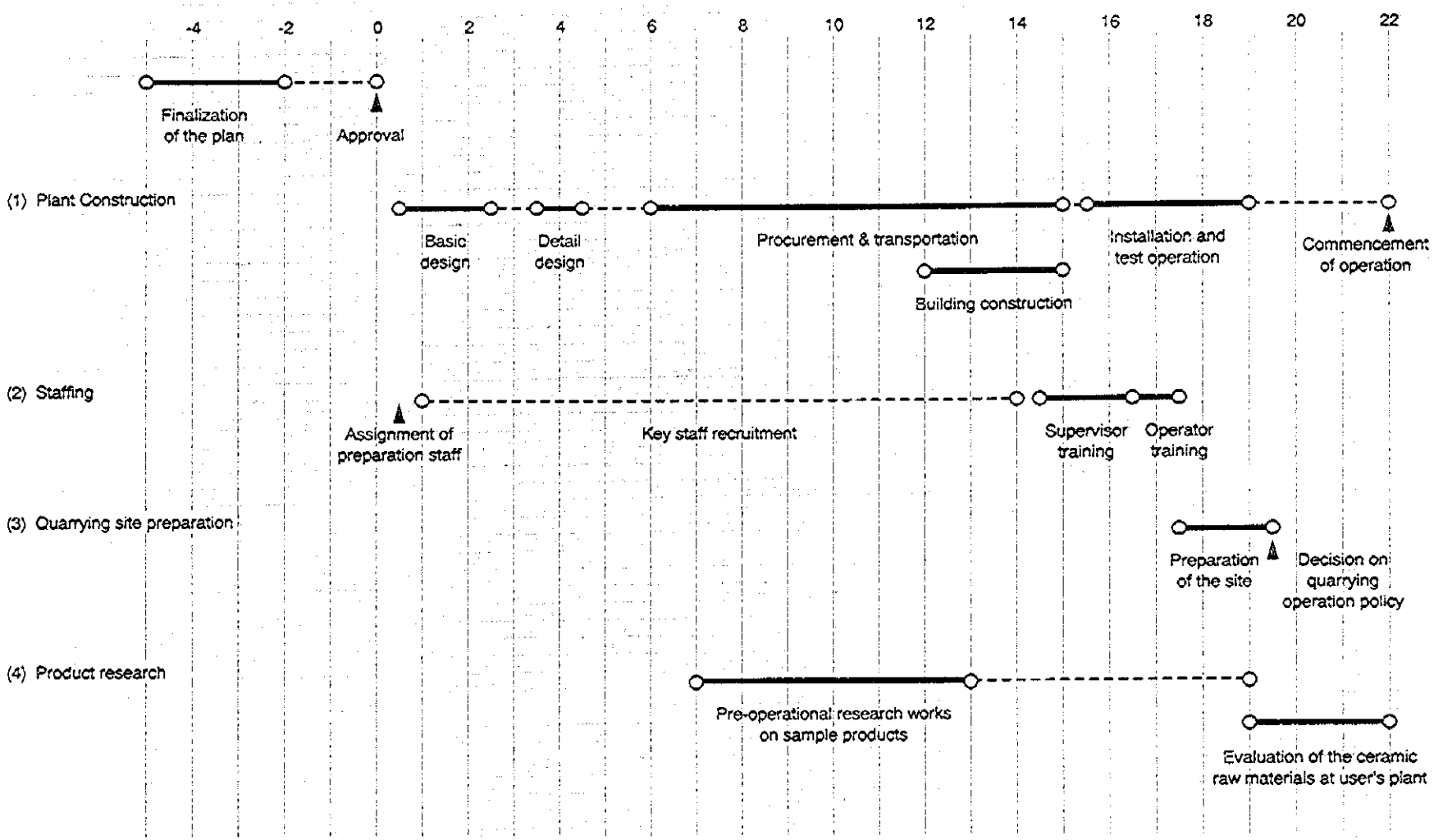
2) The supply of premixed body to small ceramic manufacturers should preferably be implemented as a pilot project by UPT under the Directorate of Small Industry Development, the Ministry of Industry and Trade, and with technical assistance by BBK. In future, the service will be expanded to major ceramic production centers in the rest of the country, while inducing investment broadly from the private sector.

3) BBK will be primarily responsible for building up the technical assistance functions.

1.5.2 Plan Implementation schedule

The preliminary implementation schedule for the plan is shown in Figure 2. It is expected to take 22 months after the project concept is finalized and a final decision is made, until commercial operation starts.

Figure 2 Implementation Schedule



2 Recommendations

2.1 Recommendations on Implementation of the Ceramic Raw Material Development Plan

(The recommendations are summarized in Table 19.)

2.1.1 Recommendations on Implementation

It is recommended that the government take immediate action to implement all the projects except for the Banjarnegara feldspar beneficiation and supply project.

Actions required for implementation of the clay and feldspar supply projects are as follows:

1) To make the results of this study known to the public and take broad initiatives to encourage project implementation;
2) To conduct supplemental studies and research to collect detailed technical information required for final decisions on the projects, provide it for potential investors, and to promote finalization (for detail, see 1.3.7);
3) To establish an organizational setup capable of providing adequate technical support for a variety of challenges and issues to be encountered during the finalization of the plan, start-up of operation, and full-scale operation (for detail, see 1.3.7); and
4) To provide necessary assistance in upgrading access roads between mining sites and stockyards.

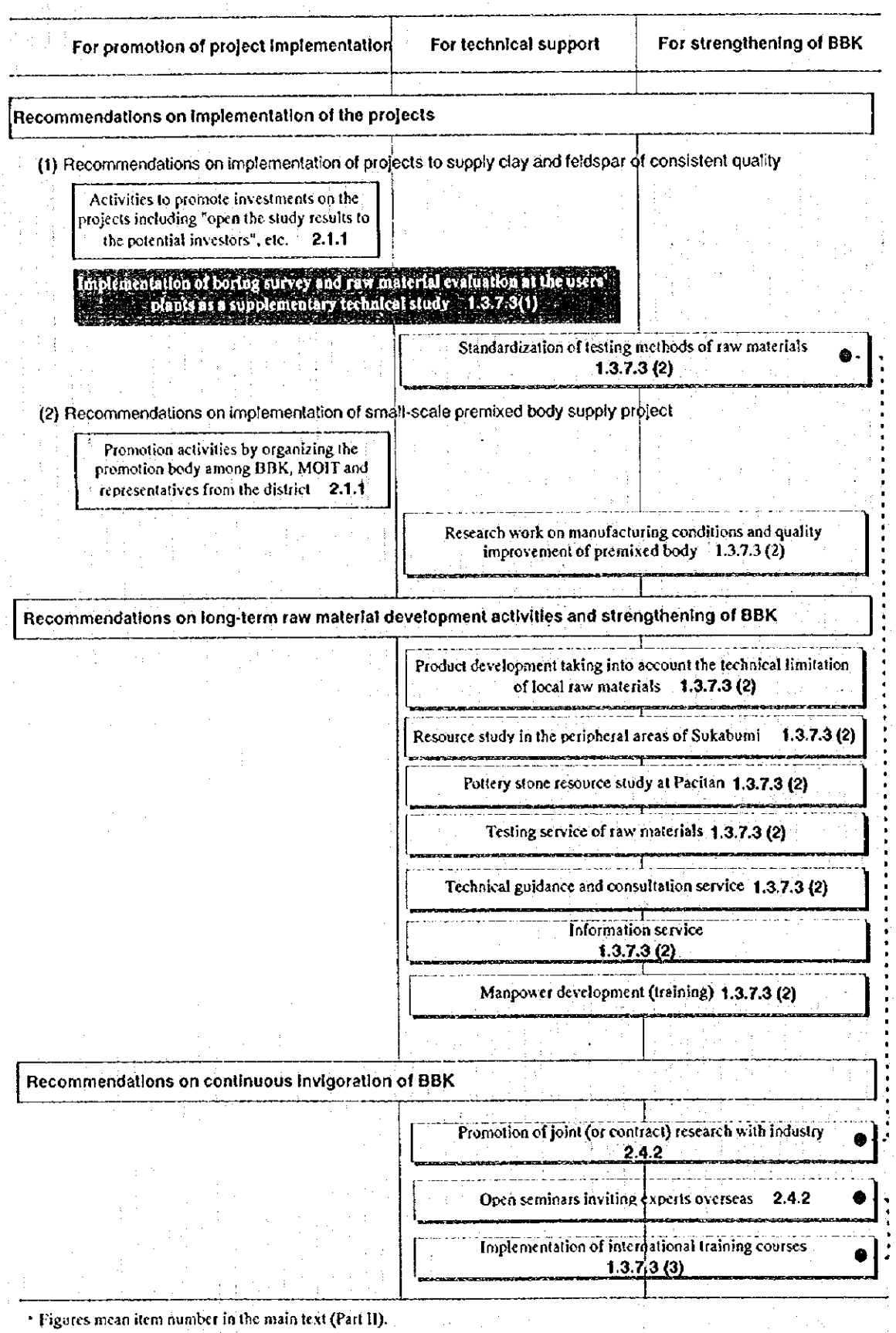
Actions required for implementation of the small-scale premixed body and glaze supply project are as follows:

1) To establish a project promotion body by having discussions among BBK, Directorate of Small Industry Development, MOIT, and representatives from Kiara Condong on implementation as a pilot project; and
2) To finalize the project concept by reviewing and discussing technical factors of the project among BBK and representatives of Kiara Condong.

Actions required for implementation of the project to build up ceramic raw material research and development and technical assistance capabilities are as follows:

1) To establish an implementation body with related organizations to mobilize resources to provide technical support for ceramic raw material development; and

Table 19 Summary of Recommendations



* Figures mean item number in the main text (Part II).

2) To formulate a technical support plan, secure manpower and budget.

2.1.2 Recommendation on Implementation of supplemental technical study required for implementation of the plan

It is recommended to conduct the supplemental technical study which is outlined in the following sections, while promoting the projects, since the present study is still insufficient in detailed technical data to enable potential investors to make decision on implementation.

The proposed content of the supplemental technical study is as follows.

Namely, to promote implementation of the proposed projects, the results of the study will be announced to invite participation of ceramic manufacturers, ceramic material distributors, and government authorities and organizations. Yet, technical information required for final investment decisions is still incomplete. In particular, data on raw materials deposits, which are the basis for project implementation, are fairly limited, and boring surveys are required to collect site-specific data and information. Further, it is also necessary to collect data required for final project proposal, on the basis of samples collected from the specific candidate mining sites which will be identified on the basis of such boring survey. The proposed content of the supplemental technical study is given in 1.3.7.

2.2 Other Recommendations Related to Ceramic Raw Material Development

Indonesia has high potential and resources to spur further development of the ceramic industry. To leverage these resources to promote the industry, following are recommended in the area of activity related to ceramic raw material development in view of long-term efforts (for detail, see 1.3.7).

1) Product development recognizing quality limitations of locally available raw materials and making most use of properties and characteristics peculiar to such materials
2) Continued exploration efforts of ceramic raw materials particularly for some resources which were not selected by the study team as promising, due to the lack of data, but still seem to have potentiality to be developed

2.3 Recommendation on strengthening of BBK

2.3.1 Strengthening of BBK for raw material development

The expected roles to be played by BBK in development of ceramic raw materials are still large. It is recommended, in this context, to build up its capacity for the institute to have sufficient capability to undertake its responsibility as anticipated in 1.3.7.

2.3.2 Recommendation on continued efforts of BBK to keep its ability

The continued efforts of BBK is recommended to enable BBK to keep its technical ability and facilities to keep abreast of technological advancement in the ceramic industry.

The following approaches are recommended as the effective ways to accomplish the intended objective in the form of indirect effect:

1) To encourage inflow of information from outside : For instance, public lectures by outside experts on a periodical basis will help BBK to maintain contact with the industry[6] and make BBK to be exposed to latest technical information.
2) To take leadership in technological initiatives: For example, undertake research either independently or jointly with industry on the matter required for promotion of standardization (for detail, see 1.3.7).
3) To receive trainees from other countries: Working with foreign trainees and professionals stimulates efforts to raise own technology levels, leading to reinvigoration of the research institute itself (for detail, see 1.3.7).

Through these activities, BBK should make consistent efforts to maintain close linkage with outside and upgrade its levels of technological ability and facilities.

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[6] The study team believes that Ceramic Research Institute is maintain close contact with the industries. However, principal contacts are often limited to sales departments, and we are emphasizing the need for forward-looking activities that make the industries feel the need for organizing technical committees.