

GOLD IN MONGOLIA

Overview of value chain
from mine to fine gold jewelry

Technical Report

prepared by Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)

and Mineral Resources Agency of Mongolia (MRAM)

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Preface

The report aims to provide information and data for the production stages of the value-added chain from the mining of gold to the fabrication and retailing of gold jewelry. It addresses open questions and describes opportunities and shortcomings in the value chain from raw gold to jewelry products, and therefore, it is a useful information source for decision makers and entrepreneurs in the gold jewelry sector.

BMZ (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung/Federal Ministry for Economic Cooperation and Development) strives to underpin democratization and poverty reduction by creating a sound mineral resources based economic development of Mongolia. An extension of the value chain of gold to integrate local jewelry handicraft workshops and the retailing of jewelry is in line with this concept because it contributes to the diversification of the Mongolian small-and-medium enterprises landscape.

Collection and processing of data in Mongolia started in April 2012. Official statistics, data present in the Mineral Resources Authority of Mongolia, interviews with numerous experts in this field and the study of published company reports were the main sources of data. Soon after commencing the data collection, it became apparent that much of the raw material supply, manufacturing and retailing of gold jewelry takes place in an informal "shadow economy" and that a discrepancy exists between official statistics and the real world picture. As a result, some of the data were contradicting or inconsistent and, therefore efforts were put in to reconcile the conflicting information. This was especially the case when information on the production and trade of the gold produced in the informal small-scale mines was collected. Inconsistencies in the material flows, missing or contradictory information was checked with comparable data published elsewhere and reviewed in all conscience and the authors believe that the data presented portrays the reality as closely as possible.

This technical report is a contribution to the Integrated Mineral Resources Initiative financed by BMZ. The Integrated Mineral Resources Initiative comprises three operative modules which are a module carried out by GIZ together with NDIC, a second module in which PTB and MASM work together, and a third module which is implemented by BGR together with MRAM. This report has been prepared by the BGR/

MRAM module with the aim to provide basic data on availability and retailing of the raw material gold and its fabrication opportunities in the fine jewelry sector.

Decisions on the extension of the value chain of gold in Mongolia will require additional specialized investigations. The data and information contained in this report will contribute to follow-up studies.

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Glossary of technical terms and abbreviations

Alluvial: the product of sedimentary processes in rivers, resulting in the deposition of alluvium (soil deposited by a river).

ASM: Artisanal Small-scale Mining

Beneficiation: beneficiation refers to the various physical and chemical processes and treatments of a primary ore by the removal of impurities from the gold to prepare it for smelting)

BGR: Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources, Hannover, Germany)

BMZ: Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (The Federal Ministry for Economic Cooperation and Development, Germany)

BoM: Bank of Mongolia (Mongolian Central Bank)

Comminution: Comminution is the crushing and grinding of ore to make gold (or other minerals) available for treatment

Dore (also: doré): Impure alloy of gold, often produced at a mine, usually consisting of 85 – 90 % gold on average, to be refined to a higher purity. The other 10 – 15 % is mostly metals like silver and copper.

EDGAR: (Electronic data gathering, Analysis and Retrieval system of the US Securities and Exchange Commission (SEC)

GIZ: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Gold Bullion: It is a refined and stamped weight of gold. Gold bullion is traded in commodity markets in the form of ingots, bars, or coins. Unlike money and jewelry, gold bullion is valued by its purity and its mass and it has no artistic value. Gold bullion must be at least 99.5% pure.

Cut-off grade (surface mines): The minimum grade at which a unit of ore will be mined to achieve the desired economic outcome

Fine gold: Pure gold of at least 995 parts per 1,000

Fineness: System of denoting the purity of platinum, gold and silver alloys by parts per thousand of pure metal by mass in the alloy. For example, an alloy containing 75% gold is denoted as "750". Many European countries use decimal hallmark stamps (i.e. "585", "750", etc.) rather than "14K", "18K", etc., which is used in the United Kingdom and United States.

Grade: The quantity of gold contained within a unit weight of gold-bearing material, generally expressed in ounces per short ton of ore (oz/t), or grams per metric tonne (g/t).

Good delivery bar: Gold bar which meets the London good delivery status

g/t: Grams per tone

informal sector (or informal economy): a broad term that refers to that part of an economy that is not taxed, monitored by any form of government, or included in any gross national product (GNP), unlike the formal economy. Other terms used to refer to the informal sector include Black Market, the Shadow Economy or Underground Economy. By their nature, informal economic activities escape regulation but that does not necessarily imply that they are *sensu strictu* criminal.

JORC: Australasian Code for Reporting Exploration Results, Mineral Resources and Ore Reserves

Karat: (symbol K): A karat is the measure of the actual amount of pure gold present. Pure gold is known as 24 karat gold. If gold jewelry is then taken as consisting of 24 parts, jewelry of 18 karat gold would mean that 18 parts are pure gold, and the remaining six parts are other metals. Particularly prevalent in India and the Middle East (and also in Mongolia) is jewelry of 22 and 21 karat which is made of 91% and 87% pure gold respectively. Not to be confused with Carats which are a unit of measurement of the weight of diamonds and other gemstones (1 carat equals 0.2 grams)

kg: Kilograms

London gold fixing or gold fix: it the procedure by which the price of gold is determined twice each business day in London by the five members of The London Gold Market Fixing Ltd. The Gold Fix establishes the price at which the gross amount of gold on buy orders matches the gross amount of gold on sell. The gold price set at the London Gold Fix is used by large gold owners, including refineries and gold mining companies, Central Banks, to value their inventories.

London good delivery status: Awarded by the London Bullion Market Association to refiners that meet certain criteria with respect to their refining standards. This status gives refiners international recognition for the quality and purity of their products

LBMA: London Bullion Market Association

Mineral resource: A mineral resource is a concentration or occurrence of material of economic interest in or on the earth's crust in such form, quality and quantity that there are reasonable and realistic prospects for eventual economic extraction. The location, quantity, grade, continuity and other geological characteristics of a mineral resource are known, estimated from specific geological evidence and knowledge, or interpreted from a well-constrained and portrayed geological model. Mineral resources are subdivided, in order of increasing geological confidence, into inferred, indicated and measured categories. The mineral resources are inclusive of those resources which have been modified to produce ore reserves.

MASM: Mongolian Agency for Standardization and Metrology

MNT: Mongolian Togrog (Mongolian currency; average exchange rate in 2011 was 1,228 MNT per 1 US\$¹)

MRAM: Mineral Resources Authority of Mongolia

NDIC: National Development and Innovation Committee

NSO: National Statistical Office of Mongolia

Ore Reserve: An 'Ore Reserve' is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined. Appropriate assessments and studies have been carried out, and include consideration of and modification by realistically assumed mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors. These assessments demonstrate that at the time of reporting, extraction could reasonably be justified. Ore Reserves are sub-divided in order of increasing confidence into Probable Ore Reserve and Proved Ore Reserve.

¹ CIA, The World Factbook, Mongolia
(<https://www.cia.gov/library/publications/the-world-factbook/geos/mg.html>)

Ounce: In gold mining and trade, the term ounce refers to one troy ounce which equals 31.1035 grams.

Placer: accumulation of valuable minerals formed by gravity separation during sedimentary processes

PTB: Physikalisch-Technische Bundesanstalt (National Metrology Institute, Germany)

Refining: The final purification process of a metal or mineral

SEC: United States Securities and Exchange Commission

SEDAR: (System for Electronic Document Analysis and Retrieval) is the system used for electronically filing most securities related information with the Canadian securities regulatory authorities. Filing with SEDAR started January 1, 1997, and is now mandatory for most reporting issuers in Canada. Information on the rules for electronic filing can be found in http://www.sedar.com/sedar/sedar_rules_forms_en.htm

Smelting: A pyro-metallurgical operation in which gold is further separated from impurities.

Spot price: the current price of a metal for immediate delivery

t: tonne, used in metric statistics, equal to 1,000 kilograms. The term "ton" is used in imperial statistics, it is equal to 2,000 pounds and also referred to as a "short ton". In this report, the metric tone (t) is used. To avoid confusion with the imperial ton, it is also known as the metric tonne and metric ton. The symbol "t" is used for the tone (metric) in this report

Total cash costs: Total cash costs include site costs for all mining, processing and administration, reduced by contributions from by-products and are inclusive of royalties and production taxes. Amortization, rehabilitation, corporate administration, retrenchment, capital and exploration costs are excluded. Total cash costs per ounce are the attributable total cash costs divided by the attributable ounces of gold produced.

Total production costs: Total cash costs plus amortization, retrenchment, rehabilitation and other non-cash costs. Corporate administration and exploration costs are excluded.

1. Introduction

What is gold?

The chemical symbol of gold is Au, derived from the Greek word aurum. Gold possesses unique properties:

- Gold is virtually indestructible because it is corrosion resistant.
- Gold forms alloys with most metals. Those most commonly encountered are mercury, silver, lead, and copper. Gold and mercury form alloys over the complete range of proportions. This characteristic is used in the amalgamation process. Mercury can be separated from gold by distillation, leaving a gold product containing 0.1-1% Mercury.
- Its electrical conductivity is ranked third behind silver and copper. It is the most malleable metal and it can be hammered into extremely thin sheets without structural damage.
- Gold is biocompatible and non-allergic and therefore it is used in dentistry and medical applications.
- Gold is raw material for many industries and it is a monetary asset.

What is a value chain?

A value chain links the steps a product takes from the primary producer to the consumer. It includes research and development, input suppliers and finance. For example, the gold value chain spans the production steps from the ore in the ground to the retailing of the fine gold jewelry.

A value chain may be viewed and analyzed from the perspective of a global enabling environment, a national enabling environment, or a company enabling environment.

Schmitz (2005) postulates that the analysis of a value chain has become an increasingly useful approach to gain a comprehensive view of the various inter-locking stages involved from taking a good or service from the raw material to production and then to the consumer.

2. General production steps and tax regime of a value chain

General production steps

The mining cycle of gold begins with the search, exploration and assessment of an ore deposit which is then developed into a mine.

Mining of the ore takes place in small-scale alluvial diggings, as a mechanised mining operation in soft or hard rock, or gold may be a by-product of other mineral mining activities. Beneficiation is a complex process and comprises crushing, comminution, and concentration of crushed ore by gravity or other processes like leaching and flotation. Fine- to coarse-grained native gold from a gravitationally prepared concentrate is smelted to a gold-rich dore which contains about 85-90 % gold and a high content of silver. Very fine-grained gold and gold contained in hard rocks is dissolved in cyanide, precipitated, and the precipitate is then smelted to dore bars. By-product gold contained in copper ore remains in the copper concentrate and is recovered in the copper smelter.

Dore and the gold recovered from the copper smelter are refined to bullion gold bars containing 99.5 % gold. The balance normally is silver and copper. For special applications, gold may be refined to 99.9 % gold content. A generic model of the inputs and outputs of the gold production steps are shown in figure 1.

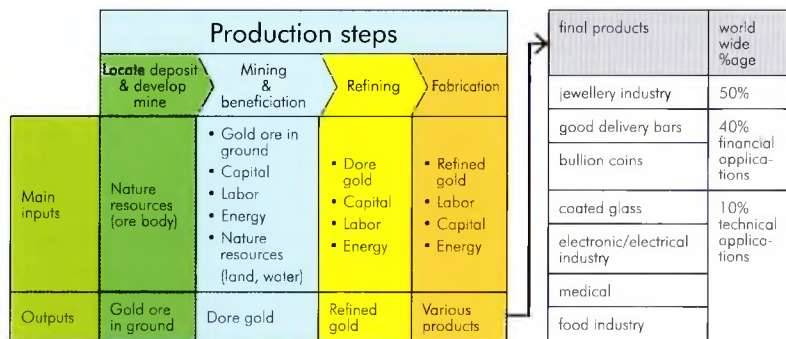


Figure 1: Production steps, inputs and outputs at the various stages of the value chain of gold from mine to final products

Tax regimes and revenue created by gold mining:

Current tax rates on gold exploitation are:

- Royalties²: flat-rate royalty of 5 % plus surtax-royalties which depend on the price of gold, e.g., when the gold price is above 1300 US\$/oz, a surtax-royalty of 5 % is applied
- Corporate income tax: 10 % (25 % for taxable profit exceeding 3 billion MNT)
- VAT: sold gold is VAT exempted³
- Customs: 5% for export; imports are custom free.

Apart from tax revenues and royalties, gold mining creates revenues through the payment of exploration and mining fees.

- Exploration fees:
Exploration fees in US\$ for 1 hectare are
US\$ 0.1 for the first year
US\$ 0.2 for the second year
US\$ 0.3 for the third year
US\$ 1 for each of the forth to sixth years
US\$ 1.5 for each of the seventh to ninth years.
- Mining licence fees: for gold and other metals: 15 US\$ for each hectare.

In the year 2010 the total revenue for the State Fund from taxes, exploration and mining licence fees for gold mining amounted to 78,672.54 million MNT.

The income tax for small-scale gold miners organized in partnerships is a flat tax of 53,000 MNT per month per miner to the local government, regardless of income⁴. However, the law is not being enforced. In the Bornuur Soum, where the local NGO assumes the position as intermediary between government institutions and partnerships, recent negotiations focus on the procedure which regulates how the partnerships should pay taxes.

2 Minerals Law Article 47 and amendment to Article 47 passed on November 25, 2010

3 VAT Law of Mongolia, Article 9, 9.2.15

4 Law on Income tax on Citizens Running Production and Services With Income Not Identifiable, Article 16, amended in the year 2010

3. Mining and beneficiation

3.1. Status of gold mining operations

Gold mines in Mongolia fall into three groups according to their size, mode of operation and status. These are:

- Illegal artisanal mining operations.

Illegal mining takes place outside of regulations and state control. It is very destructive to the organized mining operations and the environment, because sometimes the illegal miners encroach on legal concessions, they rework cultivated mine dumps and do not restore the mined out sites.

- Organized partnerships of artisanal mining

To overcome the problems caused by illegal mining, the government created a legal frame for the artisanal miners. Regulation No. 308, entitled "Extraction Operations of Minerals from Small Scale Mines" was passed on December 1, 2010. According to Resolution 308, small-scale miners may form partnerships which are controlled and advised by the soum/district governor. According to Article 3.10 of the regulation, the partnerships submit reports on their operations to the MRAM before the 15th February each year. However, the formation of partnerships is still in the incipient stage, and reporting of production has not been established yet. Regulation 308 also applies to small-scale gold mining and therefore, ASM gold miners are no longer illegal.

- Mechanized mining.

The size of mechanized gold mines varies considerably. It includes simple workings in alluvial placers using trucks and mechanized shovels, operations in rivers using large dredges, and the modern mines which exploit low-grade gold deposits and refractory ores in hard rocks. The gold mined from mechanized operations is sold to the BoM or commercial banks. The Boroo Gold Company sends its production directly to refineries in Canada. The annual production figures of the mechanized mines range from some tens of kg of gold to more than 1 tonne per mining operation.

3.2. Types of gold occurrences in Mongolia

Placer gold deposits⁵

The important placer mines are located along flood plains in the Zaamar, Bayangol and Tolgoit areas.

Gold placers mined in large open-pit operations contain 1 to 5 grams of gold/m³, and the ore is mined from between 5 to 40 m of depth (Photo 1). Oftentimes, the technology employed is out-dated and wasteful. Ore recovery is low and invites illegal miners to wash gold from the waste dumps.



Photo 1: Mid-sized alluvial mine, Sharyn Gol; June, 2010

Placer mining is very dependent on climatic conditions, as water is instrumental for separating gold from the sand and gravel. For a typical placer gold mine in Mongolia, water is available for only 155 days a year⁶ and this short window of opportunity has immense implications for the viability of placer operations.

Dry placers

Dry placers occur in the South Gobi, where gold is extracted utilizing dry-washers. Mining of dry placers is steadily increasing.



Photo 2: Boroos open pit mine; October 2007

Hard-rock deposits

Gold in this deposit type occurs as disseminations in altered rocks (skarn), supergene enrichments, vein deposits or it may be associated with sulphide minerals.

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- 5 Placer gold deposits are accumulations of free gold flakes, grains or larger nuggets in loose, unconsolidated material (rubble, sand, also slope scree) that have been eroded from rocks. Placer gold is often associated with other heavy minerals. Placer gold, located near rivers, is extracted from the sediments by manual or mechanized washing and consumes large amounts of water
 - 6 Grayson, R. and B. Tumenbayar, The role of placer mining companies in the State-sponsored gold rush in Mongolia; World Placer Journal volume 5 : December 2005, 35 p.

At the present time, two large gold mines are working in hard-rocks, which are the Boroo gold mine (Photo 2) and Olon Ovoot. The Boroo gold mine lies approximately 110 km northwest of Ulaanbaatar. The operation started in 2002 and at the present time the high-grade portions are mined out and the company extracts gold from the low-grade material and prepares cyanide heap-leaching. The proven and probable ore reserves of the mine were 16,349 million tonnes which at a grade of 1.2 g/t contained 615,000 ounces of gold (19,129 kg). The reserves have been estimated based on a gold price of \$ 825 per ounce⁷.

By-product gold in copper ore

Oyu Tolgoi ranks among the world's largest copper mines with gold and silver as by-products. The gold grades in the ore are 0.37 g/t in the ore reserve, and 0.47 g/t in the mineral resources. Altogether, about 1,430 tonnes of gold (46 million ounces⁸) of gold could be present in measured, indicated and inferred resources of all ore bodies at Oyu Tolgoi, using a 0.3 % Cu equivalent cut-off grade. The Oyu Tolgoi mine expects to produce about 20 tonnes of gold annually starting from 2013. This gold however, will not enter the Mongolian market, as it is sold with the copper concentrate.

In minor amounts, gold is also present in the sulfide ores mined by the Erdenet Mining Company.

3.3. Gold mining: production statistics, employment, mining costs

Production statistics - The global picture

Worldwide gold production is increasing; this is due to the steadily increasing prices. Major producers are China, followed by Australia, the U.S.A., Russia, and South Africa. Global production figures are shown in table 1.

The Mongolian situation

The gold production figures for Mongolia, the global production and the Mongolian contribution to the global gold production are shown in table 1.

7 Technical Report on the Boroo Gold Mine, Mongolia; Centerra Gold Inc., December 17, 2009, Toronto, Canada

8 Oyu Tolgoi Project, Technical Report, June 2010

During peak production (2005 to 2007), Mongolia contributed between 0.9 to 0.77 % to world production.

Of the ten largest gold mining sites in Mongolia, eight exploit placer gold, while two operations mine hard-rocks. Many of the placer gold mines are located in the terraces of the Tool River e.g., the *Tuul golyn goldrol* (Bulgan Province, Buregkhangai district), *Tosongy goldrol* (Tuv province, Zaamar district), *Baruun zakh zag* (Bulgan Province, Buregkhangai district), *Tosongyn goldrol* (Tuv Province, Zaamar district) and the *Baga khailast* (Tuv Province, Zaamar district); *Ikh dashir* is another big placer gold mine and is located in the Bayangol district of Selenge province; the *Olt* group of placer mines occurs in the Uyanga district of Uvurkhangai province; and *Buurugyn am* is located in the Jargalant district of Bayankhongor province.

The *Boroo* gold mine (Selenge province, Bayangol district) is by far the largest gold mine in Mongolia. In 2011, it produced 1842 kg of gold and expects to produce the same amount in 2012. *Olon Ovoot* is another important hard-rock gold mine. Because of its importance, the production figures of the *Boroo* gold mine are shown separately in table 1.

Together, the 10 largest mines produced 4.9 t of gold in the year 2010, which is about 82 % of the total production. The remaining 18 % is produced by about 100 companies.

Since 2005, gold production in Mongolia has been decreasing. The reasons are manifold: the collection of the windfall profit tax from 2006 until the end of 2010; the introduction of the Law on Prohibition of Exploration and Mining of Minerals in the Protection Zones of Water and River sources and Forest Zones in the year 2010; and a temporary shut down of the mine and labor strike at the *Boroo* gold mine⁹. Also, the easily and at low cost mineable placer deposits of gold are coming to an end and gold mining is increasingly taking place in hard rocks. Hard-rock gold mining is more costly and requires more technical skill and equipment than placer mining.

It remains to be seen whether the high gold prices will increase future gold production.

9 Centerra Gold. Inc., (2010), Annual report 2009; Toronto, Ontario; Canada, 112 p.

Year	2006	2007	2008	2009	2010	2011
Total official gold production in Mongolia (t) ¹⁰	21.267	18.087	15.184	9.803	6.037	5.703
Production of Boroo mine (t) ¹¹	8.796	7.917	5.992	4.683	3.457	1.842
World gold production, (t)	2,370 ¹²	2,360 ¹²	2,290 ¹²	2,450 ¹²	2,560 ¹²	2530 ¹³
Contribution of Mongolia to world production (%)	0.90	0.77	0.66	0.40		

Table: 1 Mongolian and global gold production

A special case: gold production by ASM¹⁴

Special attention is drawn to the gold produced by ASM in Mongolia. Because their production is not officially registered, estimates of their production depend on the estimating institution. The government estimated that before partnerships were established, illegal mining produced a few tonnes of gold per year and that about 30,000 people engaged in it, while estimates of others^{15,16}, indicate annual gold production ranging from 5 to 10 tones/year before 2005 and that at that time around 100,000 people were involved. The most recent

10 MRAM and Mongolian Statistical Office, Monthly Bulletins December 2009, 2010, 2011

11 Various company reports

12 USGS, Mineral Commodity Summaries, January 2012

13 Raw Materials Data page, Raw Materials Group (RMG), Sweden

14 There is as yet no widely accepted definition of artisanal and small-scale mining. The terms have, therefore, been used to cover a broad spectrum of activities. The broadest distinction is between artisanal mining, which may involve only individuals or families and is purely manual, and small-scale mining, which is more extensive and usually more mechanized. The distinctions are based on some common criteria, such as: production, depth of workings, capital investment, mineral type, use of machinery or explosives, number of workers, size of concession, etc. ASM may be carried out formally or informally. Partnerships e.g. are formal ASM operations.

15 Grayson, R. et al. (2004): The People's Gold Rush in Mongolia – Rise of the 'Ninja' Phenomenon; World Placer Journal 2004, Volume 4, 112 pages

16 Project-Consult (2005): Project document on the Support for Artisanal Mining Project in the framework of Sustainable Natural Resources Management for Poverty Alleviation in rural Mongolia 1/7/2005 – 31/12/2006; Bad Vilbel, 2005

figures indicate that the annual production of ASM gold mines are between 4 to 7 t/year¹⁷.

To check the plausibility of the production figures estimated for ASM, one may start by assuming a daily production of 0.5 grams per person. Accepting that 40,000 or more miners are involved and that they work 150 to 200 days/year, one arrives at a total production of 3 to 4 t per year. Although this calculation is very crude, it shows that the gold output of ASM is in the magnitude of “several tonnes a year”

The SAM project succeeded in establishing efficient and environmentally friendly gold processing plants for small-scale gold mining. One plant, for processing ore from hard-rock mines and which is well described by the SAM project, has been built in Bornuur. This plant is able to recover 81 % of gold from the run-of-mine ore by solely using gravitational methods, without the use of cyanide or mercury. The high recovery and elimination of mercury in the gold production process are key incentives for the high acceptance by the miners. On a daily average, about 80 miners access the processing plant and on an annual average produce about 75 kg of ore through the plant.

The Government Resolution of Mongolia No. 308 (Regulation on extraction of minerals from small scale mines, Article 9.1) states they “shall sell their extracted minerals to legal persons authorized by the applicable legislation for selling and buying”. The commercial pathways of gold processed in the processing plants are obscure. An interviewed owner of a processing plant complaint that the partnerships sell only a small part of their gold to the processing plant and that, as a consequence he has to wait over three months to collect enough gold to sell it to the BoM.

17 Swiss Agency for Development and Cooperation SDC (2011): SDC experiences with Formalization and Responsible Environmental Practices in Artisanal and Small-scale Gold Mining in Latin America and Asia (Mongolia)

Number of mines and employment statistics

The number of operative, officially registered gold mines is shown in table 2.

According to the latest censorship (MRAM, internal data) 155 partnerships for gold mining existed in the year 2011 with 1136 registered miners. In 2010, mechanized mines employed a total staff of 3303, of which 104 were foreigners.

	2008	2009	2010	2011
Total	100	120	98	110
Placer mining	97	117	95	107
Hard-rock mining	3	3	3	3

Table: 2 Number of registered gold mines¹⁸

Production costs

Gold production costs for placer mining in Mongolia range from 35,000 to 52,000 MNT/gram, with an average of 45,000 MNT/gram (878 to 1358 US\$/ounce, assuming an exchange rate of 1,235 MNT to 1 US\$). A note of caution is introduced here when comparing Mongolian gold production costs with costs reported in other countries. Apart from production costs, the cost reporting scheme used by the companies to report their costs to MRAM includes costs for rehabilitation and recultivation, exploration expenses, fees for nature resource usage, taxes, royalties, licence fees, etc. and therefore are different from the commonly reported total cash costs¹⁹ or total production costs²⁰.

¹⁸ Source: MRAM, unpublished data

¹⁹ Total cash costs include site costs for all mining, processing and administration, reduced by contributions from by-products and are inclusive of royalties and production taxes. Amortization, rehabilitation, corporate administration, retrenchment, capital and exploration costs are excluded

²⁰ Total production costs include costs such as mining, processing, administration, royalties, depreciation, and amortization but exclude amortization, reclamation costs, financing costs, capital development and exploration

Total operating costs of the Boroo gold mine, retrieved from SEDAR, are:

2008: 490 US\$/oz

2009: 673 US\$/oz

2010: 786 US\$/oz

2011: 828 US\$/oz.

Gold production costs will increase in the future; hitherto marginal operations will go into production because of the increasing gold price.

3.4 Beneficiation

Figure 2 shows the schematized flowsheets for the processing of typical gold ores which occur in Mongolia. Today, the amalgamation line of processing is not allowed in Mongolia, although it has been used extensively by ASM in the past. For the sake of completion, it is included and marked by dotted lines in figure 2.

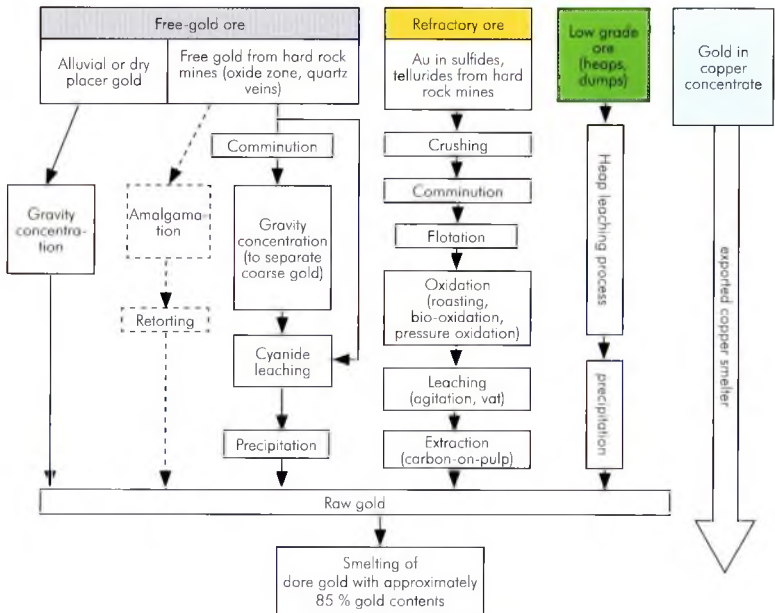


Figure 2: Schematized flowsheet for processing of common gold ores in Mongolia

4. Registration of production, trade and retail channels of gold

4.1. State Assaying Agency (MASM Assay Department)

Gold produced by license holders must be assayed and registered by the State Assaying Agency, which is a special gold laboratory of MASM. The legal ways of recording the production and trading gold are like this: Mine production is recorded at the State Assaying Agency²¹. This laboratory smelts the delivered material to a gold dore. The lab returns the gold to the miner and informs MRAM about the amount of gold assayed.

Fineness of gold delivered from the mines varies from 700 to 900. The gold laboratory analyses the delivered concentrate only for gold, platinum group metals and silver, as mandated in the Treasury Law, Article 12/3. Each bar is marked with a number and a record is prepared for this specific bar.

4.2. The role of the Bank of Mongolia (BoM) in the gold market

In 2002, a process of deregulating the gold market was initiated. In the monetary policy guideline of 2002 it has been laid down that the BoM is to liberalize the domestic gold market²². In the same year, article 3.3 of the Treasury Law was amended to provide legal grounds for domestic precious metal refining. After making amendments to the Minerals Law in 2006 and passing some regulations²³ the BoM is still the main gold buyer but no longer the sole trader.

The participation of the Treasury Fund of the BoM concerning the value chain of gold is laid out in the Treasury Law. The BoM is the main actor regarding

- purchasing of gold
- sending gold abroad for refining
- storing gold bullion bars
- supplying the domestic gold manufacturing sector (However, the BoM has not sold any gold on the domestic market in recent years).

21 The Minerals Law of Mongolia, 2006, Article 46.1

22 http://www.mongolbank.mn/documents/moneypolicy/monetarypolicy_guidelines2002e.pdf

23 Regulation Nr. 117, Ministry of Finance, 2002; joint Regulation Nr. 705/222 by Customs and Chamber of Industry and Trade, passed 2003 and implemented 2004

The BoM prepares a tender for the refining of dore gold and selects the best offer.

Every working day the BoM announces the gold buying price in MNT per gram of gold, which is based on the London Gold Fix²⁴ (see chapter 4.5). When buying gold, the BoM also covers assay discrepancy risk exposure. Assay discrepancies may be high. In 2009, for example, they amounted to a loss of USD 1.4 million.

To increase gold sales to the BoM, in March 2009 the BoM revised the methodology of purchasing gold and offered a centralized service for purchasing, physical delivery, verification of assay, encasing, storage, confirmation and signing of gold trading contracts, and its monitoring to the precious metals Treasury Fund.

Table 3 summarizes the amount of gold bought and sent abroad for refinement. The table also shows the total official production minus the Boroo production, because this is the gold source accessible to the BoM.

In the years 2008, 2009 and 2010 the amount of gold sent abroad for refinement was higher than the amount of gold bought by the BoM. This is possibly due to an overhang of gold bought in previous years.

	2008	2009	2010	2011
Total official gold production minus Boroo production (t)	9.192	5.120	2.580	3.861
Amount of gold bought by BoM, rounded (t)	8.2	5.0	2.1	3.3
Gold purchases of BoM as % of official gold production apart from Boroo	89 %	98%	82 %	85 %
Gold sent abroad by BoM for refinement	11 ²⁵	5.2 ²⁶	2.3 ²⁶	

Table 3: Amount of gold purchased by BoM and refined

²⁴ <http://www.mongolbank.mn/eng/dblistgoldsilverprice.aspx>.

²⁵ Source: BoM, Annual Report 2009

²⁶ Source: BoM, Annual Report 2010

The drop in gold bought by the BoM in 2009 was mainly due to the termination of mining activities of the “Altan Dornod Mongol” company, which sold 2.7 tons of gold to the Bank of Mongolia in 2008. Furthermore, a decrease in the sales of gold by the “Mongol Gazar” company to the Bank of Mongolia by 1.2 tons or 68 percent from the previous year accounts for this drop.

4.3 Formal and informal channels of trading gold in the domestic market

The legal and illegal flow of gold from the mines to the fabrication sites is shown in figure 3.

Formal gold trade

Official statistics do not indicate how much gold was sold by the ASM gold miners. The only figure available was presented by the SDC²⁷ at a technical meeting, saying that 237 kg of gold were sold by the ASM to the BoM in 2007. As the annual ASM production is in the order of several tonnes/year, it is apparent that tons of gold mined by the ASM disappear in an underground economy.

Also, no statistics are available to quantify the amount of gold which has been bought by the local jewelry industry. From jewelry workshops it was learned that the procedure to buy gold from the BoM or any other commercial bank is too bureaucratic to be practical.

The BoM²⁶ notes that illegal operations such as gold smuggling and selling abroad are so voluminous that they have created an artificial demand for foreign currency.

The reality of retail channels of ASM gold production²⁸.

The small-scale miners sell their raw gold or dore to trusted private gold buyers. They may be local shop keepers, or they may be buyers who periodically travel to the mine sites. Apart from buying gold, they provide loans, because the ASMs are usually distant from commercial banks.

27 M. Dubach (2008): Government of Mongolia-External Partners’ Technical Meeting, January 28-29, 2008, Ulaanbaatar, Mongolia. The Mongolian Mining Sector – Key Issues from the Artisanal Miner’s perspective. Swiss Agency for Development and Cooperation, SDC

28 International Labor Office (2006): Informal Gold Mining in Mongolia; ILO, Bangkok, 112 p.

The gold bought by the local buyers is sold to bigger intermediaries. Finally, the gold ends up in the hands of foreign clients, mainly from China and Korea.

The reasons why small-scale gold miners do not sell to the BoM are manifold:

- The informal miners do not have the time and money to travel to Ulaanbaatar
- Gold must be purified to dore gold before selling it to the BoM, a process which requires financial resources
- The intermediaries provide credit and trade gold for supplies

With the advent of partnerships, some of the gold mined in artisanal operations enters the officially recorded gold flow. However, it is anticipated that not all small-scale miners will be organized in partnerships and therefore, illegal gold trading will continue.

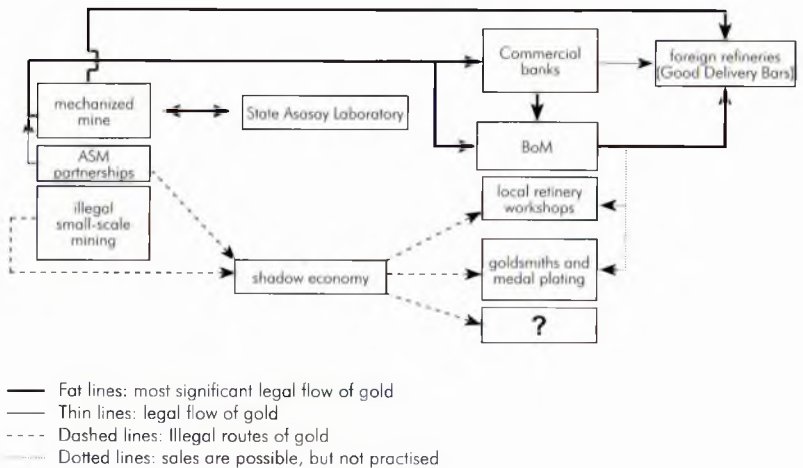


Figure 3: Flow of gold from mine to fabrication

4.4. Gold export and import

The amount of exported gold is shown in table 4.

Raw gold has not been imported in the past years

	2008	2009	2010	2011
Gold exported (non-refined) ²⁹	22.13	10.877	5.060	2.7

Table: 4 Gold export (t), 2008 until 2011

According to a regulation³⁰ issued in 2004, gold mining companies and individuals are permitted to export gold. Requirements are that the gold bars should be assayed in the State Gold Laboratory, all taxes must be paid, and a certificate of origin has to be presented.

4.5. Determination of contemporary gold price

Gold prices are determined at the London Gold Market Fixing Ltd. This group consists of representatives of 5 banks, all members of the London Bullion Market Association (LBMA). The London Gold Fix represents the price of balanced supply and demand. The actual and historic London Gold Fixes (AM and PM) can be obtained from the LMBA webpage.

The London Gold Fix applies to the internationally traded standard bar which conforms to the specifications of the London Bullion Market Association for "good delivery bars." It must have a purity of 995 fine minimum (typically ranging between 995 and 998 fine), carry a serial number, be of good appearance and regular shape, and bear the stamp of one of the four dozen or more refiners worldwide that are on the Association's list of approved "smelters." Individual good delivery bars may range in weight from 350 to 430 ounces (10,886 to 13,374 g).

²⁹ National Statistical Office, various Monthly Bulletin Statistics

³⁰ Regulation Nr. 705/222 passed by Customs and Chamber of Industry and Trade in 2003 and implemented 2004



Figure 4: historical gold prices, in US\$/oz

Apart from the London Gold Fix, spot or OTC prices are quoted. Spot prices are oriented towards the London Gold Fix, but they are buyer-seller agreements and include gold which does not meet the Good Delivery Bar specifications. An overview of the gold prices in the years 2011 and 2012 is given in figure 4. Gold prices also reflect the strength of the currency quoted and inflation, and therefore they do not necessarily portray the value or the supply/demand situation.

5. Refining

General characteristics of sector

Refining gold makes the final product which may be used as raw material for the fabrication of many products and as a monetary instrument. The term “gold refining” is used for purification of dore gold or any other form of gold concentrate from mines (primary gold), the recycling of gold from scrap material and for the recovery of gold from dust, filings and sweeps from jewelry workshops (secondary gold).

Refineries may be small workshops in the case where gold scrap is recycled or under the circumstances when goldsmiths prepare their own raw material from re-melting gold. Many types of equipment for small refinery workshops are commercially available and prices range from a few hundred dollars upward.

The most popular processes applied by large commercial refineries are the “Miller” process and the “Wohlwill” process. The Miller process of refining gold is the easier of the two but it produces a lower grade quality of gold of at least 99.5 percent purity. The Wohlwill process produces a higher quality gold at 99.95 to 99.99 percent purity and is done electrochemically. The Miller process is what most refinement agencies employ to refine and process gold.

The Mongolian situation

The pureness of the gold processed by the local gold- and silversmiths may vary considerably. Secondary gold (re-melted jewelry) may have been soldered with low-grade soldering material, lowering the fineness stamped on the main body of the re-melted jewelry. Raw gold worked by local goldsmiths may come from primitive processing plants and iron may be admixed from abrasion of the mining and processing equipment. Alluvial gold may contain a variable amount of silver. For these reasons, refining primary and secondary gold before fabricating jewelry is very important.

When asked about refining facilities in Ulaanbaatar, the authors were informed by the small workshop owners that the goldsmiths could refine the gold on their own, using acid (aqua regia process). The licensed manufacturers maintain refining laboratories away from the jewelry workshops, because the acid process emits toxic fumes.

No internationally recognized commercial refineries are operating in Mongolia.

6. Fabrication and end uses

6.1. Availability of gold for local jewelry fabrication

The global picture

The consumption of gold produced in the world is about 50% in jewelry, 40% in investments, and 10% in industry.

Gold consumption in the jewelry and technical fields is expected to decrease because the high price would limit jewelry purchases and redesign and the usage of substitutes for gold in the technical area will also decrease consumption.

On the other hand, the purchase of gold as a safe haven for investments, hedge against economic failure and downturn, portfolio diversifier and as a store of wealth is increasing.

The Mongolian situation

The Law of Mongolia on Licencing states that for the manufacturing of jewelries of precious metals and stones a licence must be obtained³¹.

An estimation of the local gold consumption is difficult. An important consumer is the jewelry industry, but this sector obtains most of its raw material from informal sources (chapter 4.3). It is not known how much raw gold is stored by individuals as a safe-haven for money. Gold consumption by other sectors (technical and medical) is insignificant.

No statistics exist which provide information regarding the domestic gold trade. From the disclosures of the BoM, which is the largest gold buyer in Mongolia, no gold has been sold to local buyers.

6.2. Coins, bars for safe-haven investment

The global picture

While the amount of gold used for the fabrication of jewelry, in the technical fields and for dental and medical uses decreased, minting of gold coins recognized as a monetary means was the only end use which showed a marked increase.

31 Law of Mongolia on Licencing, 2001, Article 15.10.2.

The Mongolian Situation

Gold coins recognized as monetary instruments or refined bullion bars are not produced in Mongolia.

6.3. Electric and electronic industries

The global picture

For electrical and electronic products, base metals clad with gold alloys are widely used to reduce the usage of expensive gold. In many cases, palladium, platinum, silver and sometime copper may substitute for gold and the industry tries to redesign these products with the objective to maintain high-utility standards with lower gold content.

The Mongolian situation

As these items are mass produced and require advanced technology, they are not manufactured in Mongolia.

6.4. Dentistry, medical uses

The global picture

Owing to an increase of non-metallic substitution (ceramics) the usage of gold displays a slow decline.

The Mongolian situation

Several dentists maintaining their own dental laboratory have been interviewed. Very few patients ask for gold inlays, dentures or tooth crowns of gold. On average, 4 grams would be required for one tooth crown. Some dental clinics have small stocks of imported raw material, while others would require the patient to bring his/her own gold. The amount of gold consumed in dentistry and medical uses in Mongolia is negligible.

6.5. Medals and imitation coins (nonmonetary coins)

The global picture

Because of the volatile and current high gold price, a marked decrease is noted.

The Mongolian situation

In an era of the centrally planned economy, the company Zoos Goyol was an important producer of gold medals, coins and gold plated medals. In 1986 the company produced about 6 million coins, 500 medals and badges, 400 pendants and inlays and 70 thousand gold and silver articles in four workshops. In 1998, the company was fully privatized and production has since decreased drastically.

Gold plated medals are sold in many places. Possibly, apart from Zoos Goyol more formal and informal medal plating companies exist.

6.6. Jewelry fabrication and trade

The global picture

The jewelry sector includes gold, silver, costume and fashion jewelry. Jewelry made of gold, silver and platinum is referred to as fine jewelry so as to distinguish it from the less valuable forms of jewelry. Jewelry in its wider sense also includes accessories such as cufflinks, tie-pins and watches made of precious metal.



Photo 3: ready-to-use
yellow color gold grain

The top six gold jewelry manufacturing countries are (in descending order): India, China, Italy, Turkey, the U.S.A. and Saudi Arabia. Gold jewelry production in China shows a strong and consistent increase, while the fabrication in other countries shows a decrease.

Apart from gold, raw materials for gold jewelry making are a variety of natural or synthetic gemstones and natural or cultured pearls. Pure (refined) gold is too soft for gold jewelry and therefore it is mixed with other metals to make it more wear-and-tear resistant and to give it different shades of color.



Photo 4: Example of gold wire

Raw materials may be bought from commercial suppliers or made by goldsmiths themselves from gold of known fineness. Commercially available raw material is sold in the form of ready-to-use casting grains, wire, tubes, plates or solder in many color tones (yellow, white, brown, green, grey, etc.) and a wide range of karatage (e.g., 9, 14, 18, 22 karat). Examples of pre-fabricated raw materials are shown in photos 3 and 4.

Jewelry may be classed into hand made jewelry and machine made jewelry.

The tools used for hand made jewelry are the traditional smith's hammers, drills, punches, gravels, files and blowtorch. Handmade fine gold jewelry products are more intricate and artistic than machine made and the producer can demand a higher price for unique design.

The basic method of mechanized production is for components to be cut and stamped with individual steel dies, which are manufactured for each component of each individual item of jewelry. As die manufacturing is an expensive operation it is cost-effective only where high numbers of the same item are being produced.

The typical cost structure of jewelry manufacturing is:

- Fine jewelry: 70-80 % raw materials, 10-20 % labor, plus unspecified consumables and associated costs
- Costume/fashion jewelry: 50-70 % raw materials 20-30 % labor, plus unspecified consumables and associated costs.

The precise rate of gross profit depends upon the product mix of goods but some typical gross profit rates are:

- Low quality jewelry: 23% to 33%
- Medium quality jewelry: up to 50 %
- High quality jewelry: 50 % plus.

The Mongolian situation: workshop structure and production techniques, sources of raw materials, retailing

It was difficult to arrange enough interviews with gold- and silversmiths to obtain a meaningful picture of the sector. For the most part requests for an interview were either declined or excuses were found to evade the request, and in general, the interviewed persons were not very forthcoming. This reaction of the workshop owners is self-explanatory and confirms the findings that much of the business is done underground: unregistered small workshops exist; gold is obtained from informal sources, and production is underdeclared.

a) Local production techniques:



Photo 5: Local gold- and silversmith workshop in Ulaanbaatar

About five goldsmiths in Ulaanbaatar are able to make gold jewelry which is competitive with imported jewelry. Only two goldsmiths manufacture earrings. Necklaces and chains are not made in Mongolia. One of the larger establishments which has a total staff of about 20, uses CAD/CAM systems to design and computer sculpt the wax models. The big jewelry workshops possess their own outlets in Ulaanbaatar.

They also run their own refineries, utilizing acid (aqua regia) to purify the gold. As mentioned earlier, because of the toxic fumes they are located away from the workshops and have not been visited.

The techniques applied for making rings and earrings, are die casting, casting in wax and hammering the gold into metal forms (casts). Die casting is applied in the larger establishments and permits the production of large quantities of the same design.

The gold jewelry fabricated in Mongolia is of high purity. Most pieces are of 22 karat; this corresponds to a fineness of 916.

A typical medium-sized gold- and silversmith workshop is shown in photo 5.

b) Sources of raw materials and consumption by the jewelry manufacturing sector:

Sources of gold are either the informal gold mining sector, pawnshops or purchases of old jewelry from individuals who want to have a new piece made or turn jewelry items into cash. If gemstones or pearls are mounted, they are mostly imported from Korea.

In recent years, the BoM has not sold any gold to local gold jewelry workshops. The general consensus of the interviewed goldsmiths is that the process is too bureaucratic and that they can buy gold much cheaper through intermediaries from the informal gold mines. At a time when the London Gold Fix PM stood at 67,700 MNT/gram, it was observed that a local gold- and silversmith offered 51,000 MNT for 1 gram to an incognito individual. The gold was coarse-grained alluvial gold, indicating that it was mined with primitive recovery technology.

The National Statistical Office³² provides the production figures shown in table 5:

	2009	2010	2011
Jewellery (pieces)	1,255	1,325	1,048

Table 5: Recorded local jewelry production, 2009 to 2011

Assuming that the manufactured jewelry is mostly finger rings with a fineness of 750 (18 karat) and average weight of perhaps 4 grams per ring, one arrives at a gold consumption of 3144 grams (3.144 kg).

A rough back-of-the-envelope calculation is made to verify the magnitude of this apparently low figure for official gold consumption:

As a rule, a goldsmith may produce 5 simple, hand made finger rings per day. This was confirmed in an interview, where the authors were informed that one goldsmith may process about 20 grams of raw gold per day. Assuming that there are dozens of informal establishments in Mongolia one arrives at an annual production of a few tens of thousands of pieces produced in the one-man workshops. The three or five big jewelry manufacturers, because of their mechanized production, may possibly produce above or about 100,000 pieces or more per year. The small-scale workshops altogether may produce

32 National Statistical Office, Monthly Bulletin of Statistics, December 2011

up to 20,000 pieces a year. A very conservative estimation arrives at an annual production of 120,000 pieces (4 grams each) which would require about 450 kg of material per year. Taking an average fineness of 750 (18 karat), this equals the consumption of about 340 kg of pure primary and secondary gold. This number is far from the 3.144 kg calculated above from the data which is shown in table 5. The rough calculation indicates that only a fraction of the local jewelry production is reported to the NSO. One may safely assume that a certain portion of the production made in licensed companies disappears in informal retail channels (e.g. underdeclaration of revenue figures, evasion of taxes).

From interviews and observations it is known that a large part of the primary gold which enters jewelry production comes from the ASM (see chapter 4.3). As the ASM production is several tonnes per year and only a few hundred kilograms are absorbed by the local jewelry workshops, it follows that most of the ASM-produced gold is unaccounted for. It may be that the shadow jewelry sector is much larger than assumed, or much of the ASM-produced gold is smuggled across the border or stored for safekeeping.

c) Retailing, import and export:

The large gold- and silversmith workshops established either their own jewelry shops in Ulaanbaatar, or they sell to established retail shops. Most of the upper-end jewelry workshops located in shopping arcades however, do not offer Mongolian-made fine gold jewelry.

The small workshops either sell directly to customers who come to the workshops, or they sell to jewelry markets where many traders rent small stalls to offer locally produced or imported jewelry. The locally fabricated jewelry is readily recognized by its deep yellow color. Approximately 70 % of the sales are imported jewelry.

The price of the jewelry depends on the London Gold Fix of the day when the jewelry was made. At the beginning of July, when the London Gold Fix was 67,700 MNT/gr, one gr of jewelry (cast ring) sold for 90,000 to 100,000 MNT. Each piece seen in the displays was hallmarked by the State Assaying Agency (see chapter 4.1).

The NSO³³ provides the number of jewelry imports and exports (table 6). However, the NSO import- and export values are aggregated values of HS code 71 and include silver and gold jewelry, pearls and jewelry imitations.

A rough estimate of how much of the imported jewelry is fine gold jewelry can be made by using the data from the United Nations Commodity Trade Statistics Database³⁴ (UN comtrade), but this data is only available up to 2007.

A search in the "UNcomtrade" data base shows that in 2007, the import value of HS³⁵ code 711319 (Articles of jewelry and parts thereof, of other precious metal, whether or not plated or clad with precious metal) amounted to 93,845 US\$. Silver jewelry (HS711311) and gold plated jewelry (HS 711320) are not included because they have their own code. Platinum jewelry is aggregated under HS code 711319, but platinum jewelry sales are insignificant in Mongolia, and therefore for practical reasons one may assume that HS code 711319 mirrors an import value of 93,845 US\$ for fine gold jewelry. The NSO³⁶ reports an import value of 587.6 thousand US\$ for the aggregated item "natural and cultural pearls, precious metals and jewellery" for the year 2007. It follows, that of the aggregated jewellery import (587,600 US\$), about 16 % (93,845 US\$) were fine gold jewelry in the year 2007.

	2009	2010	2011
Import: precious metal, jewellery (CIF value, thous US\$)	832.9	1,370.8	2,891.8
Export: precious metal, jewellery (CIF value, thous US\$)	308,525.2	178,351.5	113,185.0

Table 6: Import and export of aggregated silver, gold and imitation jewelry (HS code 71)

33 National Statistical Office, Monthly Bulletin of Statistics, December 2011

34 (<http://comtrade.un.org/db/dqBasicQueryResults.aspx?cc=7113,%20711311,%20711319,%20711320&px=H2&r=496&so=9999&rpage=dqBasicQuery&qt=n>)

35 Harmonized Commodity Description and Coding System

36 Mongolian National Statistical Office, Monthly Bulletin of Statistics, December 2008

7. Some thoughts on the formation of a gem and fine gold jewelry cluster in Mongolia

Apart from gold, which is the subject of this study, other raw materials are needed. These are precious stones which would have to be imported and semi-precious stones which may partly be mined in Mongolia and partly imported. The investigation of the raw material base for precious and semi-precious stones requires specialized geological, mineralogical and gemmological investigations.

The formation of a gem and jewelry cluster would affect industries and the services of gold mining, beneficiation/recovery, refining, gold trade, jewelry manufacturing and retailing, semi-precious stone mining and cutting and polishing. Quality control institutions and skills training facilities would have to be established and capacitated adequately; procedures for the trade of raw materials and the final products would have to be determined and implemented. Peripheral businesses like the financial industry to provide capital and credit, security services and insurance industry, import businesses for machinery and raw materials etc. would also be involved. In short, a gem and jewelry cluster would penetrate many other sectors and produce considerable socio-economic effects.

Expanding the jewelry industry would certainly contribute to diversifying the mineral-based economy of Mongolia.

8. Conclusion and Recommendations

Conclusion

The available data is too scarce and incomplete to model the value chain from mine to jewelry. Especially in the ASM subsector, too much data is missing to provide hard evidence for the net income of the ASM gold miners or the profit of intermediaries.

However, an attempt is made to compile inputs, revenues and gross margins³⁷ from one major production step to the next (see table 7). Cornerstones to investigate the value increase from mine to final product are:

- The estimated average of 45,000 MNT (see chapter 3.3) is used as reference for the production costs, because small and medium sized alluvial gold mines will be the preferred supplier in a formalized raw gold trade. This value is close to all-inclusive costs, but an entrepreneurs' salary and business risk and the costs for making gold dore bars and assaying costs should be added as these are not included in the cost calculation presented by the mining companies. These add-ons are estimated to raise the cost price to 50,000 MNT/gram of gold.
- There are no commercial refineries in Mongolia, and refining of the dore gold is carried out in the jewelry workshops. The best estimate for refining costs in the jewelry subsector is provided by SHORT, R. and B. RADEBE³⁸. They suggest an average of 1.5 %. A formal gold producer therefore will be willing to pay the London Gold Fix minus the refining charges, which comes down to 68,881 MNT/gram of gold, taking a London Gold Fix of 69,930 MNT/gram³⁹.
- The selling price of fine gold jewelry (21 or 22 karat): average 110,000 MNT/gram. This translates to about 98,000 MNT/gram of pure gold.

37 gross margin is the difference between cost price and sales revenue, expressed as a percentage of cost price; includes VAT

38 Short, R. and B. Radebe (2008): GOLD in South Africa 2007 Mining, Refining, Manufacturing, Retail, Investment; Genesis Analytics (Pty) Ltd, 61 p. (http://www.goldinsouthafrica.com/images/Gold_in_SA_2007.pdf)

39 London Gold Fix PM as of July 27, 2012: 1628.25 US\$/troy ounce; exchange rate 1 US\$ buys 1345 MNT

From this data, the value increases for a mining-beneficiation-separation step and a refining-fabrication-retailing step could be estimated. The total value added from the gold in the ground to the jewelry piece in the jewellers shop adds up to 96 % and is comparable with numbers obtained in the literature from other countries^{38,40}. The mark-up of the mining step is about 38 %, while the mark-up of the refinery-fabrication-retail step is about 42 %. If the workshops are able to recover the silver contained in the gold, they can improve their margin. The silver recovery has not been taken into account in the indicative value chain estimation.

This study shows that the supply side of gold is fragmented and thus presents competitive, polypolic market conditions and it also shows that the jewelry industry would not depend on imported gold. In the subsection on "Sources of raw materials and consumption by the jewelry manufacturing sector" (section 6.6) an input of a few hundred kilograms of gold per year into the jewelry fabrication was estimated. The supply of this amount by the domestic mining industry is no problem and would not interfere with the activities of the Treasury Fund of the BoM.

As the costs for the raw material gold may amount to up to 90 % of the production costs for fine jewelry, it is imperative that the legal and administrative environment considers low taxes, and makes provision for credit and loans to the gold workshops and jewellers.

Labor costs are the second highest cost factor. At the moment, Mongolia still possesses a comparative advantage, but with the strong Togrog and ongoing labor cost inflation, this advantage may be lost soon. Hard competition can be anticipated from low cost producing countries (Turkey, Thailand, Republic of Korea, Phillipines, Israel, Middle East and China). China is fast emerging as a major significant competitor for the international fine jewelry industry with cheap labor as well as modern and automated factories.

Adequate assay facilities for the determination of the composition of gold ore exist. The Law on Treasury requires (and at the same time limits) the special gold laboratory of MASM to assay gold and silver only. Physical properties of gold, including the color, depend on the

40 Mziray, S. (2008): The applicability of mining and trade laws on competitiveness of small scale gold miners in Tanzania and Zambia; for Round Table Africa – An overview of gold value chains for Tanzania and Zambia, 31 p. (<http://www.roundtableafrica.net/getattachment/Value-Chain-Research/Value-Chain-research/Value-Chain-research/Sheila-Mziray-Gold-Value-Chain-Analysis-of-Tanzania---Zambia.pdf.aspx>)

presence of other metallic elements. Therefore, it would be desirable that other chemical elements which may be present in the raw gold will also be analysed. These could be the platinum group metals, base metals such as copper, but also noxious elements should be determined. Mercury, for example, is a known toxic element, and nickel may cause allergies when present in higher amounts, especially in gold as applied in the medical and dental fields.

Hallmarking the products is also carried out by the special gold laboratory of MASM. The laboratory has acquired an X-ray fluorescence spectrometer and at the time of writing this report the equipment is being put into operation. In the jewelry industry, this equipment is known as karatmeter. In a non-destructive method, a karatmeter determines the fineness of the product with an accuracy of 0.01 weight-percent which is perfectly adequate.

Production steps	Description of inputs	Value of inputs (cost price) (MNT/gram)	Revenue (MNT/gram)	value added (MNT/gram and %age)
In-house-refining, production of jewelry and retailing	Company profit Retail costs Taxes Fabrication Refinement/smelting of primary and secondary gold in workshop	68,881	98,000	29,119 (which is equivalent to 42 %)
Mining and beneficiation	Company profit and business risk Gold dore bar and assaying costs Taxes, royalties Capital costs Reclamation and reclamation Re-investment (exploration, enlargement of mines, processing plant) Processing of ore Mining costs (average of placer mining)	50,000	London Gold Fix (July 27, 2012) minus 1.5 % for refining charges: 68,881	18,881 (equivalent to 38 %)

Table 7: Tentative inputs and revenues in major production steps of value chain (gold prices and exchange rates as of July 27, 2012)

Recommendations

The insight gained through the preparation of this study also allows for the provision of some suggestions to the structuring of a fine jewelry production subsector.

The success of a jewelry industry rests on a secure and long-dated supply of competitively priced raw materials, mainly the domestically produced gold. For company, internal marketing strategies and socio-economic considerations, prospective gold sources are the intermediate and small-scale sized mines. A challenge lies in creating a legal framework to channel the informal gold production into the supply line. Mongolia has collected much experience with the formalization of the artisanal and small-scale gold mines. From numerous years of experience and trials the architects of the ASM resolution learned that impetus and incentives for formalization must be provided rather than controls and restrictions. Thus, a legal and administrative environment must be created which makes it profitable and worthwhile for the artisanal gold miners and the goldsmith workshops to use the official channels of the gold trade.

The implementation of a thorough market analyses is imperative before investments are made or a policy is put into place. Areas to be explored are:

- Investigation of the local demand profile which is controlled by a small population number, with strong buying power of parts of this population
- Export opportunities and the effects of seasonal tourism would also be items to investigate.
- Branding of product lines and outlets would help to bring the products out of anonymity.
- Identification of the price range which yields the greatest profit
- Currently, fairtrade-fairmined (FTFM) initiatives in the jewelry sector are experimenting in several parts of the world and it would be worthwhile to share experience with this movement. FTFM counts on the assumption that buyers are willing to pay a somewhat higher price if the product is certified to have been mined in an environmentally friendly and conflict-free way.

When asked for needs and deficits in the jewelry fabrication, those surveyed most often said that proper training of gold- and silversmiths in the design, operation and use of modern and advanced machines and tools would be helpful. Support of the jewelry fabrication sector would include building the technical and artistic capability of staff, but should also include facilitating access to credit lines to acquire modern equipment and production facilities.

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