

# Socio-demographic characteristics of traditional gold smelters in Makassar, south Sulawesi, Indonesia

Hasriwiani Habo Abbas<sup>1,4</sup>, Masayuki Sakakibara<sup>1,2</sup>, Lukmanul Hakim Arma<sup>3</sup>, Iva Hardi Yanti<sup>4</sup>

<sup>1</sup>Departement of Earth Science, Graduate School of Science and Engineering, Ehime University, 2-5 Bunkyo-cho, Matsuyama, Japan

<sup>2</sup>Faculty of Collaborative Regional Innovation, Ehime University, 348-58 Tomegamori, Takizawa, Iwate 020-0137Japan

<sup>3</sup>Faculty of Engineering, Hasanuddin University, Jl. Perintis Kemerdekaan km. 10, Tamalanrea, Makassar, Indonesia

<sup>4</sup>Faculty of Public Health, Muslim Indonesia of University, Gedung Menara Lt.9, Jl. Urip Sumahorjo Km 5, Makassar, Indonesia Indonesia

Email: haboabbashasriwiani@yahoo.com

**Abstract.** The traditional gold smelting in Makassar, South Sulawesi, Indonesia, is an informal work with the manufacture of gold jewelry as the core activity. Stages of the gold processing include panning, smelting, and refining with mercury. In the current study, we used a social demography analysis to classify the traditional gold smelter workers in this region. Data (e.g. sex, age, education level, time working, and income) were obtained from a questionnaire survey of 58 smelter workers in the Wajo and Tallo Sub-districts of Makassar. Results showed that 84.5% of the workers were males aged from 21 to 50 years with on the average 15 year of work. The gold smelter were last educated in elementary school (31.0%), junior high school (36.2%), and senior high school (27.6%) levels whereas 5.1% have no education. We found that the monthly income of an un-skilled worker was ~Rp. 2 million (USD 147.0) whereas that of a skilled worker was between Rp. 2.5 million (USD 183.76) and Rp. 5 million (USD 367.51). An owner could earn over Rp. 5 million (USD 367.51) per month. The result suggested that the traditional gold smelting used rudimentary technique and attracted young people with a low education level. This business continues to exist because the worker earn sufficient income and may higher through mastering gold smelter proficiency.

**Keywords:** Socio-demographic, Goldsmith, UAGM

## 1. Introduction

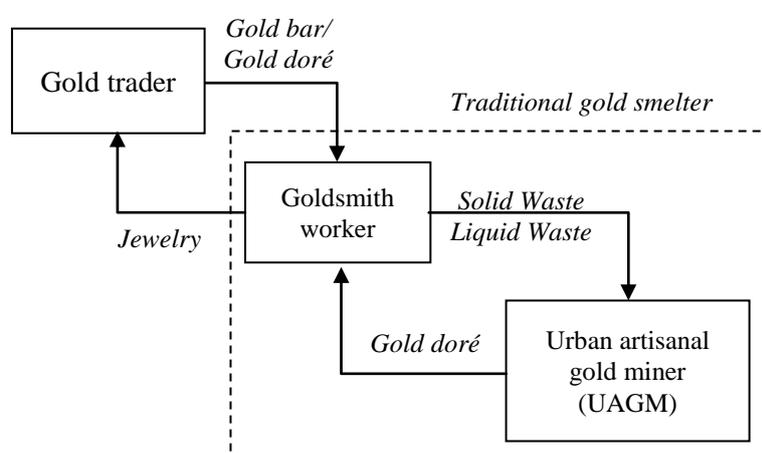
Makassar, in the southern part of Sulawesi, is the fifth largest city in Indonesia in terms of population. According to the Statistics Center of Indonesia, the main business fields are trade, processing industries, services, transportation and communication, banking, and finance [1]. One of the traded commodities is gold jewelry. Since a gold shopping center was formally established in the 1970's, Makassar has become one of the main gold trading centers in Indonesia. Shops sell various styles of both local and imported gold items.

In Makassar, jewelry is produced from local gold in traditional gold smelters. The job of those working smelters is to make gold jewelry and to recover fine gold particles from the waste generated during goldsmith activities. Other smelters in the urban part of Makassar recover gold from waste



using a recovery process that is quite similar to the artisanal gold process used at mining sites. Herein, those who recover gold from waste are referred to as urban artisanal gold mining (UAGM) workers.

The goldsmiths make gold jewelry by refining, casting, forming, and shaping a gold bar or gold doré. Jewelry trader buy gold doré from gold shop in artisanal and small-scale gold mining (ASGM) sites. The goldsmith is requested by the gold trader to make jewelry. In order to get a malleable composition, the gold doré is refined by burning using a torch flame in an open clay bowl, and then alloyed with silver (Ag) or Copper (Cu) (e.g., alloy material comprising 65% Au and 35% Cu). The gold alloy is then reduced to granules of diameter 2–3 mm to facilitate re-melting and subsequent jewelry fabrication such as forming, hammering, bending, cleaning, and polishing. Generally, the gold doré still contains small amount of mercury, which may potentially contaminate the surrounding environment during smelting or refining [2,3]. The goldsmith activities generate waste containing fine gold particles. This waste is processed by the UAGM worker to recover the gold particles, which are then returned to the goldsmith. The working relationship among the gold shops, goldsmith workers, and UAGM workers is shown in Figure 1.



**Figure 1.** The work relations between gold shop, goldsmith, and UAGM.

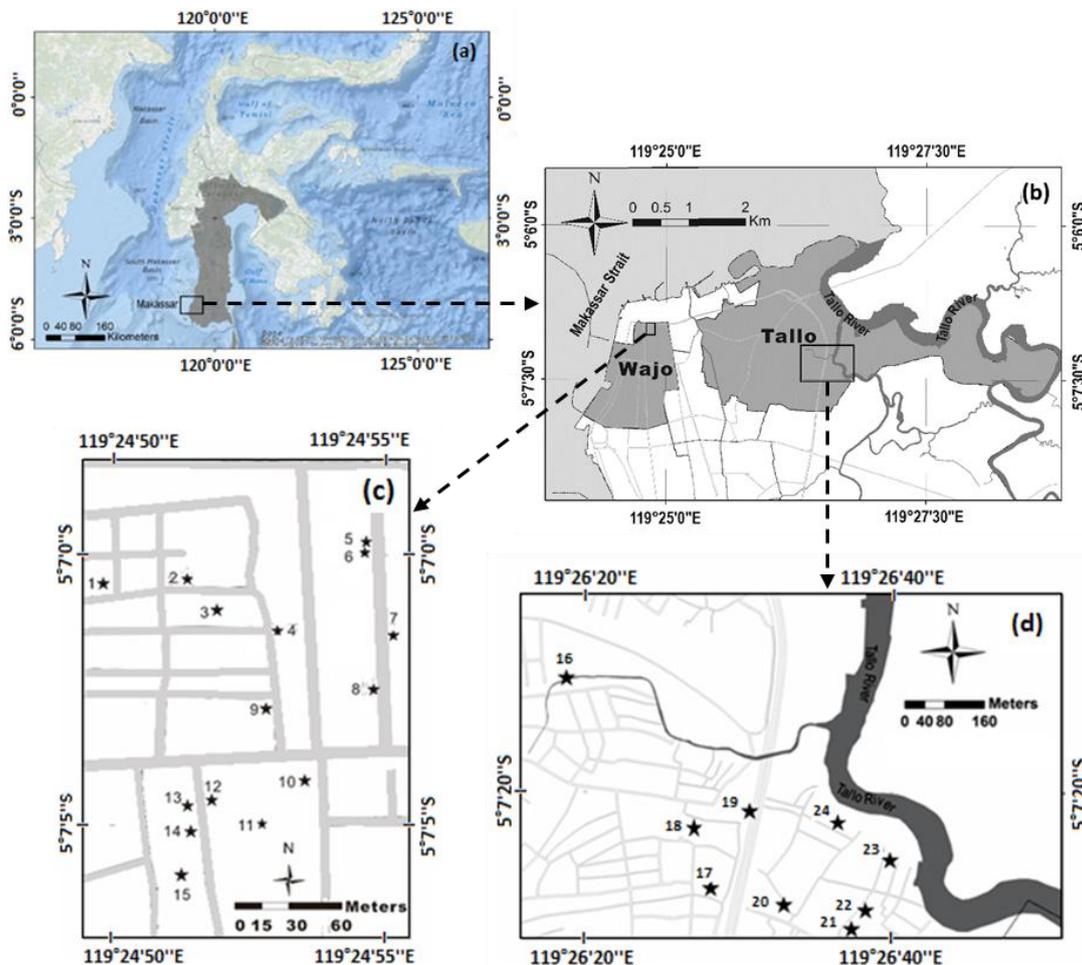
The UAGM does not excavate primary or secondary ore but collects the waste from goldsmith activities and recovers the gold incorporated in the waste. The recovery process relies on rudimentary amalgamation and smelting techniques during which mercury is released to environment. The waste is put into a flooded pond. The pond occupies an area of about 1–2 m<sup>2</sup> and is 30–40 cm deep. These processes are mostly done in the open yard of the urban miner's house. Few workers use shallow dishes to pan the slurry, while others use a carpeted sluice box in which the gold particles settle because of the density of the gold. Most workers use low-capacity rotating trommel because it is more efficient for obtaining amalgam gold than the dishes or the carpeted sluice boxes. Amalgamation is applied in panning or in rotating trommel. Liquid mercury was added and mixed in rotating trommel for 3–4 hours. To obtain gold amalgam resulted from rotating trommel, the excess mercury is squeezed through a fabric and may be re-used 2–3 times.

While there have been many studies of ASGM activities, few researchers have examined the traditional gold smelting industry. Public health research has focused mainly on the impact of mercury exposure on the health of people living near to ASGM and gold shop activities [4–7]. Previous studies have shown that after skin contact with mercury during the amalgamation process, workers in gold shops developed physical and mental health problems [8]. Mercury vapor from smelting in gold shops is released to urban air and dispersed by wind. An integrated socio-demographic study, in which socio-demographic factors (e.g. population density, sex, income, and level of education) are characterized, complements a public health assessment. However, these factors have not been assessed in traditional gold smelting communities. To our knowledge, no previous studies have reported the socio-

demography of traditional gold smelters who operate in urban areas of Makassar. In this study, therefore, we present socio-demographic information about the smelters, such as the number of workers, age, sex, educational level, income, and length of employment. The traditional gold smelting industry in Makassar, which has been active for more than 40 years, is informal and dominated by small businesses. In this study, we also present background information that might help to explain why this sector persists.

## 2. Data and Methods

Data were collected in period March 2015 – March 2016. There were 33 UAGM workers and 25 goldsmiths participated in this research. Data for the socio-demographic information of the gold smelters namely sex, age, period of employment, education, income, qualification such as owner, skilled and un-skilled workers, were obtained using a questionnaire. The gold smelters were living in sub-district of Wajo and Tallo, Makassar city shown in Figure 2. An observation were conducted to figure out the process of making jewelry and urban mining.



**Figure 2.** Maps of sampling sites at traditional gold smelters. (a) Sulawesi island with the location of Makassar city (square box) in south-Sulawesi (grey area). (b) Sampling sites (two square boxes) in Wajo and Tallo sub-district. (c) and (d) sampling points at Wajo and Tallo sub-district, respectively.

## 3. Results and Discussion

The socio-demographic information of the smelters is summarized in Table 1. Additional table recording socio-demographic information of the gold smelters in every sites shown in Figure 2(c) and

(d) was provided in the appendix. The majority are male, aged between 15–65 years old. However, women may be engaged in this work, as the results show that 15.5% of the smelters are women [15,16]. Figure 3 shows that workers of productive age, 25–45 years old, dominate these occupations. In this range of age, they have high working hours. The workers comprise skilled workers, who play an important role in this industry, and un-skilled workers. Many of the skilled UAGM workers are in the 25–39 year old age group (44%) as shown in Figure 3a while skilled goldsmith are mostly in the 30–44 year old age group (36%) as shown in Figure 3(b).

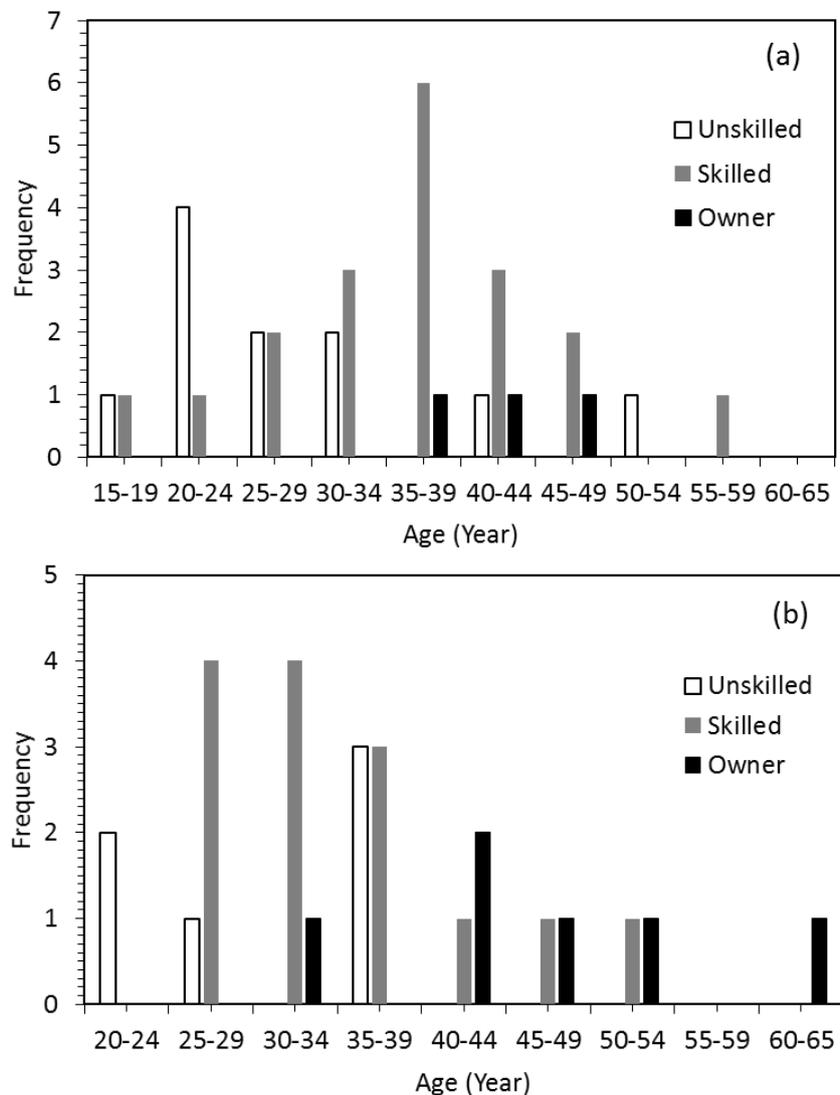
**Table 1.** Characteristics of socio- demographic traditional gold smelters

Socio-Demographic characteristics	UAGM (n=33)		Goldsmith (n=25)	
	n	%	n	%
Sex :				
Male	28	84.8	17	68
Female	5	15.2	8	32
Age :				
18 – 19	2	6	0	0
20 – 24	5	15	2	8
25 – 29	4	12	5	20
30 – 34	5	15	5	20
35 – 39	7	22	6	24
40 – 44	5	15	3	12
45 – 49	3	9	2	8
50 – 54	1	3	1	4
55 – 59	1	3	0	0
60 – 65	0	0	1	4
Owner	3	9.1	5	20
Skilled worker	19	58	14	56
Un-skilled worker	11	33	6	24
Length of service, Mean (Year) max. – min.	14.8 (3 – 40)		15.5 (3 – 40)	
Level of education :				
No education	2	6	1	4
Elementary school	13	39	5	20
Junior high school	9	27	12	48
Senior high school	9	27	7	28
Income :				
< 2.5 million rupiah	11	33.3	6	24
2.5–5 million rupiah	19	57.6	14	56
5–8 million rupiah	3	9.1	5	20

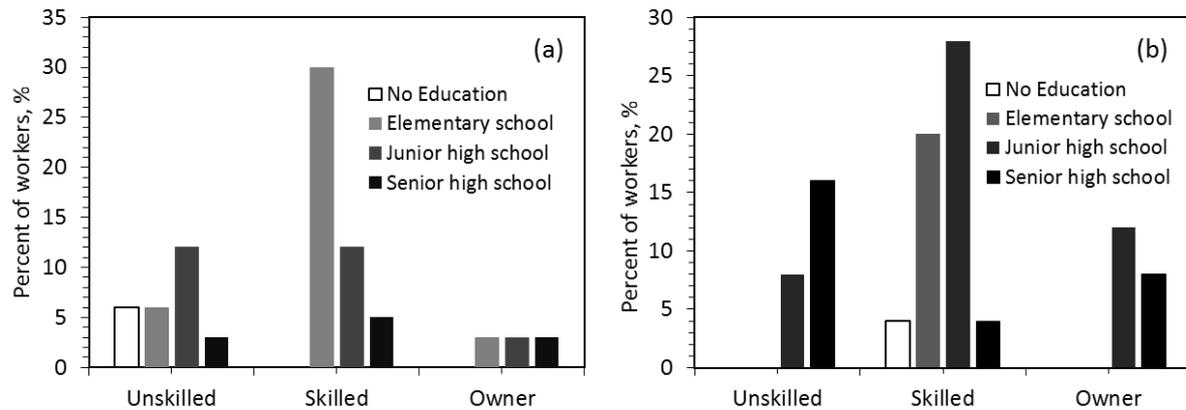
Figure 3 also demonstrates that the business owners are either between 35 and 49 for UAGM or between 30 and 65 years old for goldsmith. During our interviews we found that owners between 60

and 65 years old were first generation traditional smelters whereas owners between 30 and 50 years old were second generation smelters who are continuing the business after retirement of their parents or elders. We also noted that children were not involved in the work but were living in the areas around the smelters. This contrasts with the ASGM industry, in which many children work at the mining sites [17,18].

Education level is an important socio-demographic factor that can be used to study the characteristics of this community of traditional gold smelters. The education levels of the un-skilled and skilled workers, and the owners of both the goldsmith and UAGM activities, are presented in Figures 4 and 5. The majority of the skilled goldsmith workers have a low level of education, having only attended elementary and junior high school. The education level of the UAGM workers, however, is relatively lower than that of the goldsmiths. This indicates that simple, traditional technologies and management practices are used in this industry. In fact, this entire business depends on the technical skills of the workers and there are no formal education requirements.



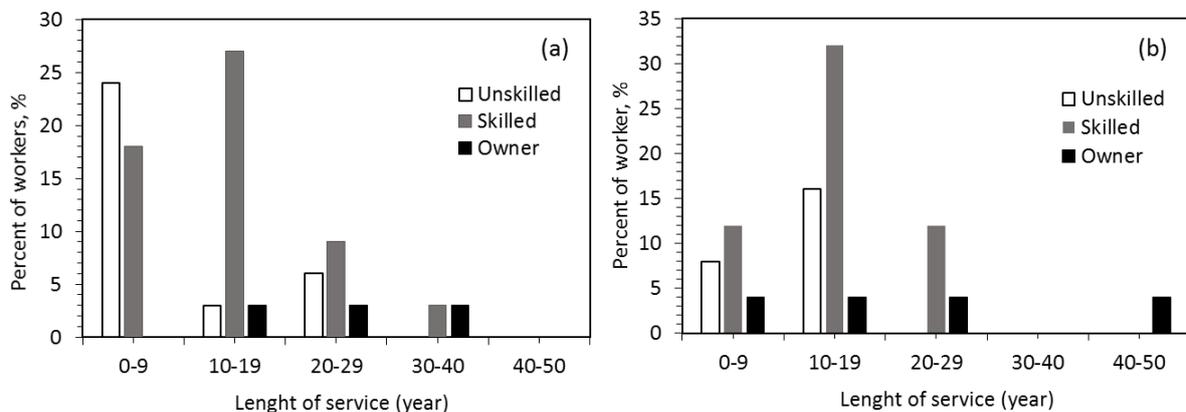
**Figure 3.** Distribution of traditional gold smelter classified by owner, skilled, and un-skilled workers in (a) UAGM and (b) goldsmith.



**Figure 4.** Distribution of unskilled and skilled worker, and owner classified by educational level. (a) UAGM worker. (b) goldsmith.

The workers may improve their skills by serving as apprentices. Therefore, workers are classified as un-skilled and skilled according to their experience. As shown in Figures 5(a) and (b), the majority of both UAGM and goldsmith skilled workers have been working for between 10 and 19 years. The goldsmith workers need to have higher skills because they have to successfully master the gold composition (Au–Ag) process, and the jewelry manufacturing, design, and decoration processes. To maintain their businesses, the owners hire new workers, mostly their own relatives.

The new workers are trained to be skilled workers and to become proficient goldsmiths. The workers are introduced to this work at between 18 and 20 years of age to ensure they are able to master the skills required by the ages of 25–45 years of age. Most of the 24% un-skilled workers are new workers and receiving ‘on-the-job’ training (Figure 5).



**Figure 5.** Distribution length of service of the unskilled and skilled workers, and owner. (a) UAGM worker. (b) goldsmith.

The workers’ income is determined by their skill level. Hence, unskilled workers earn Rp. ~2.5 million per month, while skilled workers can earn Rp. 2.5–5 million. The minimum wage of employees in Makassar is Rp. ~2.3 million. The income of the owner, at Rp. 5–8 million per month, is considerably higher. Second-generation owners who have held their own business for 3–5 years are already earning around this amount.

These socio-demographic characteristics suggest that the traditional gold smelting industry is attractive to urban inhabitants in Makassar, and especially to young people with a low education level. Although it is an informal industry, traditional gold smelting continues to exist, mainly because the

income is sufficient for daily life. There is also the opportunity to upskill and become a skilled worker, thereby increasing one's income.

The UAGM industry applies a recovery process to waste generated by the manufacture of gold jewelry. The stages of the recovery process are similar to those of the ASGM industry in Indonesia, and they include panning, amalgamation, and smelting [7,9–13,19]. Although the recovery process is relatively straightforward, the number of UAGM workers shows an increase over time. There are no official records of the number of traditional smelters in the Makassar government, but our interviews indicate a slight increase in the number of UAGM workers and a decrease in the number of goldsmiths in this research period. This contrasts with the ASGM industry in rural Indonesia, which is showing rapid growth.

#### 4. Conclusions

Traditional gold smelters in Makassar have unique demographic characteristics. They either work as goldsmiths or urban artisanal gold miners. Most of them are in productive age and have only a low level of education, yet they can improve their skills by serving an apprenticeship while working, thereby increasing their income. Mercury released into the environment during the traditional gold smelting process raises the risks of mercury pollution among the inhabitants of Makassar. We recommend a follow-up epidemiological study to assess the degree of mercury pollution in urban areas of Makassar.

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