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Raising Public Acceptance of Geothermal Utilization Through Direct Application in Indonesia

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ABSTRACT

Given that most of energy demand is met by burning fossil fuel and fuel oil, a vast opportunity exists for directly and indirectly utilizing indigenous geothermal energy as a cleaner, nearly emissions-free renewable alternative. Although Indonesia is endowed with geothermal energy resources, they have been frequently undervalued because geothermal has only been popular among particular groups: the academicians, governmental members, students, and of course geothermal industrial groups. Nevertheless, public is often overlooked far behind in spreading out the information and knowledge about geothermal energy. Consequently, public acceptability often poses a barrier towards geothermal energy development. The objective of this paper is to provide a simple proposition in introducing geothermal energy to Indonesian people through their fondness of thermal waters recreation.

1. INTRODUCTION

The attitude towards renewable energies is shaped on the one hand by deep rooted cultural and ideological identities. On the other hand, it is formed by changing forms of information. As a source of information in the field of renewable energies the mass media shall not be undervalued, since it has a strong influence on the social acceptance of renewable energies. Mass media not only sets emphasis on certain stories and so structures the public debate with perspectives and viewpoints, but also sets the influences for public perception (Heras-Saizarbitoria et al., 2011).

Throughout history, the main reason why public acceptance in geothermal energy projects in Indonesia, both for electricity generation or direct heat applications is in question is the result in changes to the social environment. On the contrary, better life infrastructure and organization comes with the new project, i.e. better road connections, potable waters supply, better management of the effluent water, better supply to the local market with everyday goods, etc. The type of social acceptance in a local community depends on the level of culture and existing economy, but also on the organization of the initial approach to development of the new economy sector.

Public or social acceptance was defined by Wüstenhagen et al., (2007) as a combination of three categories: socio-political acceptance; market acceptance; and community acceptance (Figure 1). The main focus on this paper goes on reviewing community accepting to geothermal knowledge as their part of life. Community acceptance defines the practical acceptance of site selections within the affected communities (Wüstenhagen et al., 2007) based on an optimal situation for the implementation of geothermal utilization in a community. It can be described by the following points (Huber and Horbaty, 2010):

- Support from expert community; local and national policy makers;
- Sufficient information for general public with positive view on the technology;
- No hindrances from local politicians, residents or NGOs for the concrete site decision;
- The application will support residents in proper effects.

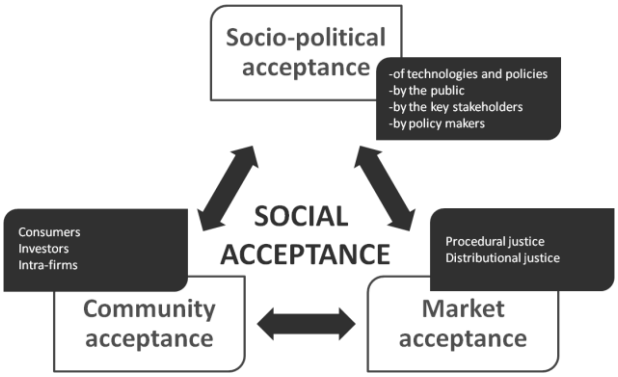

Figure 1. Social acceptance based on Wüstenhagen et al., (2007).

2. THERMAL WATERS RECREATION AS ONE OF GEOTHERMAL DIRECT APPLICATIONS

A large number of hot springs especially those that are easily accessible and in the vicinity of urban centers in Indonesia have been turned into recreational resorts. Those cities are mostly facilitated with hotels, balneotherapy, and swimming pools like Bandung, Garut, Subang, Baturaden to name a few. Apart from its commercial enticements, the trend towards wellness and overall health improvement through lifestyle choices has caused modernization and improvement of the facilities in some well-known hot spring resorts.

Hot spring resorts are differentiated according to their location (sea side, mountainous area) and the chemical composition of their mineral water. They are also classified as being low mineralized (0.6–2 g/l), mildly mineralized (>2–10 g/l) or highly mineralized (>10 g/l). Waters temperature is described as being cold (30– 40°C); or hyperthermal (>40°C) (Sukenik et al., 1999). Ternary diagrams (Figure 2, 3) help people to distinguish the differences types of geothermal waters even though it only reveals 3 main types of thermal waters. Meanwhile Indonesia through Minister of Health Regulation No. 1205/Menkes /Per/X/ 2004 has terms of health services health guidelines for use of thermal waters as follows (Table 1).

Table 1. Health services health guidelines for use of thermal waters in Indonesia.

Temperature	Description
More than 43.3°C	Too hot. The thermal waters is only safe for partial body immersion.
40.5°C - 43.3°C	Very hot. The thermal waters are safe for 5-15 minutes bathing. It is not recommended for people with cardiovascular disease.
37.7°C - 40.5°C	Hot. The thermal waters can be tolerated for body bathing therapy with maximum time 15 – 25 minutes.
36.6°C - 37.7°C	Warm. The thermal waters can be used for herbal bathing therapy with maximum time 15 – 30 minutes
32.2°C - 36.6°C	Neutral. The thermal waters is recommended for body relaxing in 5 – 10 minutes.
26.6°C - 32.2°C	Tepid. The thermal waters can be used for warming-up reflexology.
18.3°C - 26.6°C	Cool. The thermal waters can be used for dramatic warming-up reflexology, no more than 30 seconds, be careful of hypothermia risk.

A bath in a natural hot spring can also be mentally uplifting due to a relaxing time spent in a pleasant environment, often with natural scenery causing an increased feeling of wellbeing. Health benefits from thermalism (balneology, hydrotherapy) also depend on the medical qualifications of adequately trained staff. However, some hot springs seem to work for some people, but not for all, which may depend, according to Clark (1999) on every individual's personal biochemical makeup.

3. MINERAL THERMAL WATERS AND THE METABOLIC EFFECTS

Indonesian people believe that hot waters comes out of the earth has long been recognized as nourishing waters because it contains high mineral good for health. Whereas, not all levels of society are aware of hot springs as part of geothermal system. Some researches with objective have been correlated between advantageous minerals (and other trace elements) and the potential health benefits of geothermal springs (Ghersettich and Lotti, 1996). Many illnesses can be treated by using various types of hot springs which contain beneficial major minerals that generally found in thermal water. The definitions of thermal mineral waters are based on the sum of the cations of Na, K, Ca, and Mg and the anions of SO_4, Cl, and HCO_3 exceeding 1 g/l (Sukenik et al., 1999). The amounts of NH_3, NO, and NO_2 must be negligible, and the waters must be bacteria-free. Some elements, such as iodine, require contents of 1 mg/l or more. It was presumed that most mineral ingredients would be absorbed through the skin, which is an active immune organ and may play an important role in the mechanism, but to date this concept has not been confirmed.

Nevertheless, major minerals that are commonly found in thermal waters can be introduced to the society for their nutritious effect for human body, such as:
Natrium (Na^+): strengthens the system of metabolism; reduces symptoms of arthritis. High concentration of Na^+ ions in the body is needed for the body to retain water. Increasing Na^+ concentration in blood is the compensatory mechanism during heart failure episodes, this occurs during the chronic evolution of any cardiac disease. Decreasing of Na^+ concentration in blood, and waters elimination from the body are the major objectives in heart failure treatment (Ghersettich and Lotti, 1996).

Potassium (K^+): soothes and has anti-allergenic properties; normalize heart rhythm, helps reduce blood pressure, helping to eliminate toxins, improves skin condition, protecting heart from possible toxic effects of some drugs. Thermal waters with high concentration of K^+ allows an exchange through the skin of Na^+ for the K^+ ions.

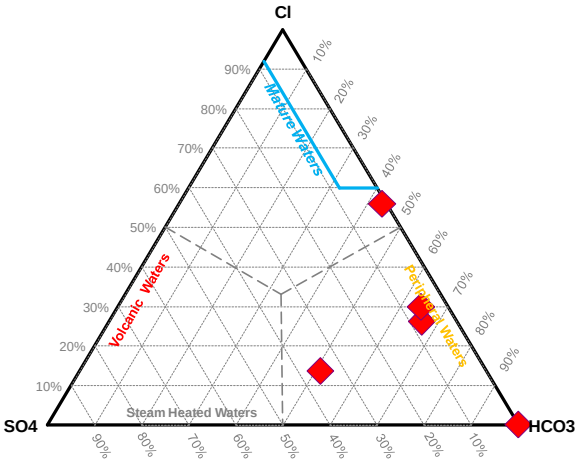

Figure 2. Characteristic of thermal waters in Batukuwung recreational area, Pandeglang. Mostly they fall in bicarbonate type waters.

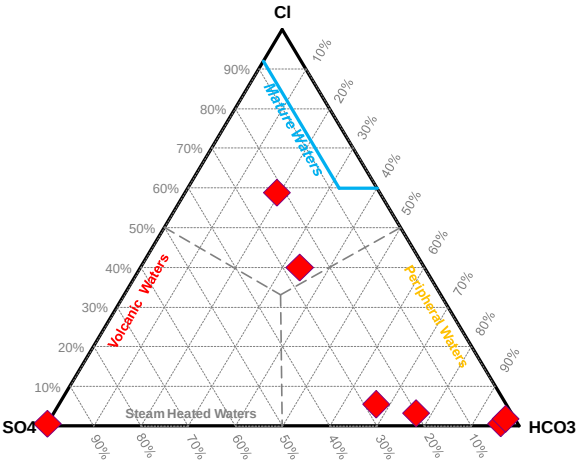

Figure 3. Various characteristic of thermal waters in local bath in Dieng, Central Java. Mostly they fall in chloride-bicarbonate type waters.

Calcium (Ca^{2+}): Relieves swelling and strengthens bones. K+Mg+Ca will strengthen the waters balance of the body causing stimulation of the kidneys. Ca^{2+} also contributes to maintain vessel walls' tonicity, and helps with regulation of cardiac electric activity.

Magnesium (Mg^{2+}): strengthens the protection of the organism, preventing atherosclerosis, reducing the concentration of cholesterol in the vessel wall; helps in maintaining normal heart rhythm, converting blood sugar into energy, maintains muscle tissue and hormone levels. Mg is a key component of our nervous autonomic system which controls the cardiac activity and vascular tonus (Sukenik et al., 1999).

Acid sulphat (SO_4^-): removes toxins, improves bone, hair, nails, joint fluid, spinal vertebral disc condition, anti-inflammatory effect. Sulfate ion is recently proved very important for the rehabilitation of patients with peripheral vessel diseases.

Sulphur (S): can be absorbed through the skin and may have an analgesic effect. Hildebrandt and Gutenbrunner (1998) found that sulphur baths reduced pressure-induced, temperature induced, and spontaneous pain in both normal subjects and patients with rheumatoid arthritis. Sulfur also interacts with oxygen radicals in the deeper layers of the epidermis, producing sulfur and disulfur hydrogen, which may be transformed into pentathionic acid, and this may be the source of the antibactericidal and antifungal activity of sulfur waters Hildebrandt and Gutenbrunner (1998). The therapeutic action of sulfur waters is related mainly to sulfur's keratolytic effect, resulting in peeling Hildebrandt and Gutenbrunner (1998).

Silica (Si): strengthens the bones, immune system, restore the nerves, mucous membranes, hair, nails, a positive effect in treating acne and migraine. Figure 4 shows a local pool that contains high silica concentration.

Figure 4. Thermal waters as traditional local bath in Dieng, Central Java have high concentration of silica.

Acidic hot-spring bath (pH 2, Mn 1.4 mg/l, I 0.3 mg/l) is probably effective for reduction in itch and skin lesion cleansing (Kubota et al., 1997). The example of this kind of thermal water is showed on Figure 5.

Figure 5. Thermal waters and mud in Domas Crater, Bandung, consist of high sulfur concentration and pH below 2 that are believed good for skin health.

Lithium (Li^{3+}): has an important role in autonomic nervous system and psychical mood rebalancing and it is very important in treatment of anxiety generated by cardiovascular diseases.

Radon (Rn): penetrates the skin and even can be inhaled during radon bath treatment. This substance might have anti-inflammatory and analgesic effects (Kutzera and Kokot, 1996). Radon is gaseous, dissolved in thermal waters, and absorbed through skin or by respiration to the lung and eliminated only by respiration. Its disintegration time is about three hours, which avoids radioactive accumulation in the human body which may lead to some negative effects for long-term treatment (Rosca and Farcas, 1993).

Ferrum (Fe^{2+}): improves the quality of the blood, increases resistance to stress and disease, warn fatigue, and improves skin tone. Boron (B) can increase muscle mass, stimulates brain activity, and strengthens bones. Manganese (Mn) nourish the nerves and brain, causes fat and cholesterol breakdown. Chloride (Cl^-) has benefit to the musculoskeletal system.

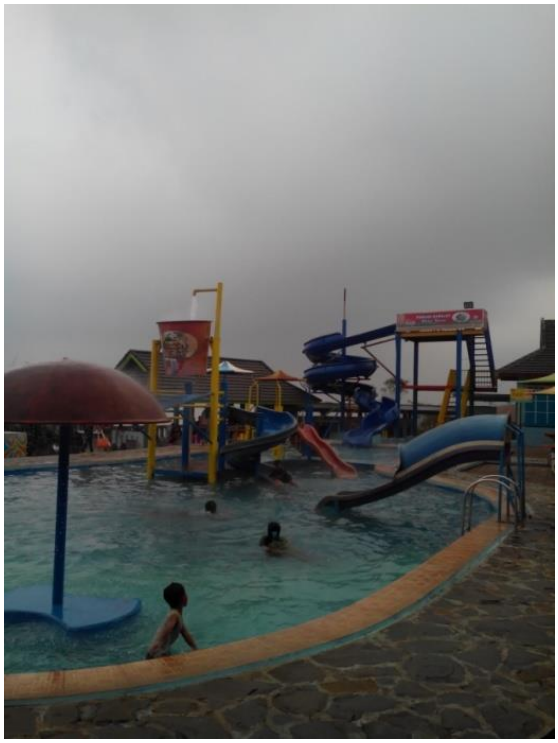

Figure 6. Thermal waters as recreational area in Darajat, Garut. Mostly of them are treated by chemical component to obtain crystal clear thermal waters.

Trace elements: Although the application of mud packs is little of evidence Shani et al., (1985) noted the increase of bromine, rubidium, calcium, and zinc serum concentrations in psoriatic patients after bathing in the Dead Sea. Selenium (70µg/l) which is contained in spa waters can be used for drinking or immersing body to improve psoriatic plaques (Pinton et al., 1995).

Balneotherapy with CO_2 thermal waters (1200 mg/kg water) in 20 minutes can increase oxygen utilization for human's body and widening of the blood vessels, especially the arteries, leading to increased blood flow or reduced blood pressure (Hartmann et al., 1997).

4. LEGAL STATUS FOR THE THERMAL USE OF GROUNDWATER

Up to now, there are still no regulations for using the groundwaters for geothermal direct utilization in Indonesia. There are also no consistent international regulations for shallow geothermal energy even though some countries have some recommendations that are not legally binding (Table 2). Inferentialy, those international direct utilization legislations are scientifically based on ecological, economical and technical aspects. As well as other countries that use the law on groundwaters governing direct use of geothermal activity, Indonesia has the Minister of Energy and Mineral Resources (MEMR) Regulation No. 11 of 2009 (on the Use of Waters and Source Waters or for Business Activities Including Oil and Gas and Geothermal Resources Exploitation) permits that regulate the use of waters or underground waters resources for mining activities was given by the MEMR.

The development activities in geothermal direct use require coordination and cooperation to permit cross-government institutions, official and government institutions. Agencies that may be directly related to the geothermal direct utilization business include:

1) Department of Waters Resources Management,

2) Department of Culture and Tourism, as the manifestation in the form of geothermal hot springs, fumaroles, hot tubs, mud pool, the natural resources that can be exploited for the benefit of tourism activities,

3) Forest Service,

4) The National Land Agency,

5) Department of Industry,

6) The Environment Agency.

Table 2. International regulations for geothermal utilization (Haehnlein et al., 2010).

Country	Regulations	Publication Year
Australia	Energy Resources Act	1967
	The Petroleum and Geothermal Rights in Waters and Irrigation Act	1914

Country	Regulations	Publication Year
	Waters Act	2000
Austria	Osterreichischer Wasser– und Abfallzweckverband (OWAV) Regelblatt 207: Thermal Use of Groundwaters and Subsurface–Heating and Cooling	2009
Belgium	Decree on Environmental Permits (28 / 06 / 1985)	1985
Bulgaria	Constitution	1991
	Law on the Renewable and Alternative Sources of Energy and the Biofuels	2007
	Waters Act	1999
Canada	Waters Act	1985
China	Renewable Energy Law	2006
Czechoslovakia Republic	Building and Planning Act No 183 / 2006	2006
Denmark	Order on Heat Abstraction and Groundwaters Cooling Plants (BEK–1206, 24 / 11 / 2006)	2006
Ecuador	Waters Act	n.a.
Finland	Environmental Protection Act	2000
	Waters Act	1961
France	Decree 74–498 (24 / 03 / 1978)	1978
	Decree 77–620 (16 / 06 / 1977)	1977
	Decree 78–498 (28 / 03 / 1978)	1978
	Mining Law (16 / 08 / 1956)	1956
Germany	Mining Law (13 / 08 / 1980)	1980
	Federal Waters Act (27 / 07 / 1957)	1957
Greece	Decision of Minister of Development No. 9B, Φ166 / OIK 18508 / 5552 / 207 on Installation Permits for Ground Source Heat Pumps	n.a.
Indonesia	Geothermal Law No. 21 / 2014	2014
Lithuania	Underground Law (I–1034, 05 /01 / 1996)	1996
Mexico	Waters Act	1992
Norway	Neighbor Law	n.a.
Philippine	Economic Activity Law	n.a.
	Geological and Mining Law (19 / 11 / 1999)	1999
	Renewable Energy Act	2008
Poland	Waters Act	1974
Portugal	Decree–Law 87 / 90 (16 / 03 / 1990)	1990
Rumania	Environmental Protection Law (No. 265/2006)	2006
	Mining Law No. 61 / 1998	1998
	Waters Law No. 310 / 2004	2004
Slovakia	Waters Law No. 364 / 2004	2004
Slovenia	Mining Law (Official Gazette, 98 / 2004)	2004
	Waters Law (Official Gazette, 67 / 2002)	2002
Sweden	Normbrunn 97	2002

Country	Regulations	Publication Year
	Normbrunn 07	2008
Swiss	Waters Protection Order (28 / 10 / 1998)	1998
The Netherlands	Groundwaters Law	1981
	Mining Law (01 / 01 / 2003)	2003
United Kingdom	Waters Environment Regulations	2005

5. DISCUSSIONS

In order to attain social awareness, geothermal utilization project activities should not result in drastic changes to local conditions, and the affected sectors should be able to see some advantages resulting from the project. Actions to surmount the social barriers in acceptability of geothermal development from the local communities such as:

- Educating local community on the advantages of a profuse local geothermal direct utilization by introducing geothermal energy to the society's daily life. This can be started from familiarizing the geothermal model conceptual on the tourist sites (Figure 7). The model can be created by academicians in collaboration with Department of Culture and Tourism, or any private companies who manage the recreational site. In additional to that, some proper information about the mineral of thermal waters for body nourishment can also be informed. There are some examples of thermal waters information provided in selected geothermal tourist areas (Figure 8 – 10).
- Establishing partnership schemes with local community and spreading truthful information in an understandable way and assimilated with local culture.
- Making local people notified to the presence and benefits of a new energy source, and increasing local infrastructure development.
- Providing educational activities to the general public and to schools about geothermal energy application.

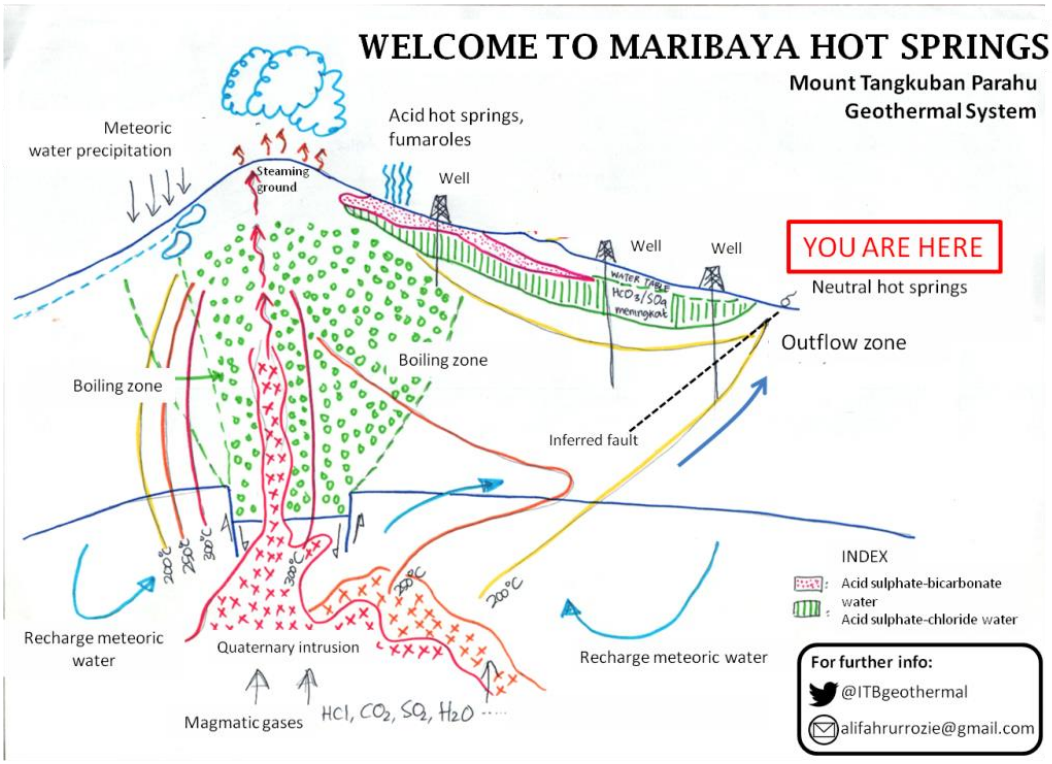

Figure 7. Example of geothermal model conceptual for recreational area. Adapted from Nicholson (1993).

Figure 8. Information about thermal waters chemistry in Ciater Spa Resort, Subang.

Figure 9. Deficient information about thermal waters chemistry in Ciwidey, Bandung. It is said that geothermal waters bring lithium and radium which are good for therapy, and the waters are murky because of its natural state.

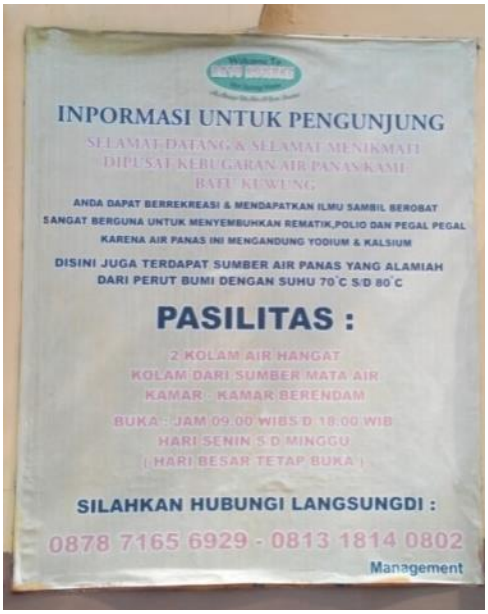

Figure 10. A decent thermal waters information example in Batukuwung recreational area, Pandeglang. It has source temperature 70°C - 80°C. The thermal waters are said consist of iodine and calcium which can be used to overcome rheumatism and muscle pain.

6. CONCLUSION

Public acceptance of the abundance of geothermal energy is necessary to be raised not only for promoting geothermal energy as a concurrently, economically interesting, sustainable and environmentally friendly renewable energy source, but also for minimizing social conflicts in the development of geothermal power plants in some areas. Public acceptance of the geothermal system can be started with insinuating geothermal information into their fondness of thermal waters recreation. Indubitably, this effort needs coordination and cooperation among cross-government institutions, academician, and private companies.

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