PROCEEDINGS, 13th Indonesia International GEOTHERMAL Convention & Exhibition 2013
Assembly Hall - Jakarta Convention Center Indonesia, June 12 – 14, 2013

THE INFLUENCE OF GEOTHERMAL FLUIDS CHEMICAL ELEMENTS TO INCREASE CROP YIELDS IN AGRICULTURE AND FISHERING

Nur Aziz Ribowo [1], Maulana Rizki Aditama [2]
Universitas Gadjah Mada[1,2]
Jurusan Fisika, Prodi Geofisika FMIPA -UGM, Yogyakarta
Sekip Utara, UGM, Yogyakarta
e-mail: ribowonuraziz@rocketmail.com

ABSTRACT

The average Indonesian people working as a farmers and a fisherman. We as youth change can offer a solution increasing the value of agricultural and fishery products. Indonesia is a country which has rich in natural resources. For example: Geothermal (M.Kholid al, 2007). This energy is great for us to be thorough and deeper analysis. In addition to the main power source, Geothermal also can be used to increasing the yield. After We had done research and analysis in the laboratory, the content of chemical elements from the geothermal fluid were very useful to improving crop farmers. Of course, with specific methods for applying those idea to produce maximum results for food in developing countries in particular and the other country in general.

In general, studies that have been conducted, the content of elements in the geothermal fluid is an element of Li, Na, K, Ca, Mn, Fe, Mg, F, Cl. This element is similar research implies both geothermal in Indonesia and Mexico and even in the whole world.This proves that the truth content of chemical elements in the geothermal fluid can be used for agriculture and fisheries sector. These elements are needed by plants to grow and thrive.In addition to agriculture, this fluid can be used for the fisheries sector. The first goal of this fluid can be used as a substitute for chemical fertilizer for areas that are around the geothermal area.

Keywords*: agriculture, fisheries, geothermal fluid, a chemical element.*

INTRODUCTION

Nowadays, the basic human needs of the crisis has spreaded to various country. Based on the need for consumption on the concern of the scarcity and cost of basic necessities of human life more expensive, it is necessary to think with rational about solutions of this problem. So with this manuscript we will provide solutions to improve the yields of farmers and fisherman taking care of their farm system. The solutions on offer to resolve this crisis is to utilize resources and natural surroundings as well as the future of renewable energy which is clean and healthy. One of a worldwide project show that the content of the worldwide geothermal playing a roll to be the future of renewable energy in the world. This energy will be never run out as long as there is still volcanic activity. Many of the benefits derived from this renewable energy. In addition to the conversion in the form of electricity, this fact can be utilized for the development of the world's Agriculture and Aquaculture. There are two phases which liquid and vapor. The vapor phase has a main role to motion the turbine and become electricity. While the liquid phase will be going back into the earth to inject an iterative process(Nenny,2001).

Chemical data of thermal manifestation, such as fumarole, hot springs, and acid surface hydrothermal alteration grounds, indicates that Ungaran is typical of hot water dominated system with minimum reservoir temperature of approximately 280°C. The pre-caldera volcanic rocks and the Tertiary marine sedimentary rocks are inferred to be the main reservoir rocks. This system is mainly controlled by northwest-southeast, northeast-southwest, and the Ungaran collapse structures that runs from west to southeast (Budiardjo et al., 1997).

The following is examples data content of chemical elements in the geothermal fluid in Mexico and Unggaran, Indonesia :

Table 1. The Chemical content of the geothermal fluid in the cerro prieto Mexico(Miryani.2001).

	GEYER 238 EL TATIO	OHAAKIPOOL OHAAKI	CHAMPAGNE POOL WAIRAKEI
pH (20°)	7.32	7.05	8.0
Li	45	7.4	10.8
Na	4340	860	1070
K	520	0.1	102
Rb	6.7	1.2	1.1
Cs	12.6	-	2.7
NH_4	3.8	2.6	-
Ca	272	-	26
Mg	0.5	-	0.4
Fe	0.1	5.2	-
Mn	0.4	1060	-
F	3.1	100	6.6
Cl	7922	680	1770
SO_4	30	32	26
HCO_3	46	338	76
B	178		21.9
SiO_2	260		-

Table 2. Chemical and isotopic constituents(unit o/$_{oo}$) of Gedongsongo Manifestations,Ungaran geothermal Prospect,Central Java,Indonesia (Nukman,2011).

Location	West-Ung 01	East-Ung 02
pH	2	6.7
Li	0.1	-
Na	91.8	17.6
K	54.3	6.2
Ca	1.1	10.9
Mg	40.4	3.7
Cl	753.3	790.9
SO_4	3008.3	5.7
HCO_3	-	-
SiO_2	411.0	189.6
$\delta^{18}O$	2.68	-8.19
δD	-9.2	-49.4

Figure.1.Location of the Ungaran Volcano

GEOTHERMAL FLUID CHEMICAL EFFECT TO AGRICULTURE AND FISHERING IN GEDONGSONGO REGION

Agriculture Sector

The common condition that needed by the soil (Hesse,1971):

a. PH value

PH value indicates the concentration of H + ions in the soil solution, expressed as-log [H +]. Increasing the concentration of H + raising potential of the solution as measured by the instrument and converted in the pH scale. Glass electrode is a special selective electrode, H +, to allow for potential measures only due to increase in the concentration of H +. Potential is measured by a comparison of potential electrolyte (calomel or AgCl). Typically used an electrode that is composed of a comparison electrode and electrode glass (electrode combination). The concentration of H + extracted with water declared active acidity (actual) while extracting KCl 1 N states reserve acidity (potential).

b. Fe, Mn, Cu, and Zn DTPA extract

Extractors DTPA (dietilene triamine penta acetic acid) to dissolve the metal ions in the form of chelate compounds. DTPA solution at pH 7.3 has the significant power to extract the iron and other metals.

c. macro and micro nutrients extracts Morgan

Wolf Extractors Morgan (sodium acetate, pH 4.8) was used to determine the availability of nutrients in the soil. pH 4.8 is intended to approximate the pH of the soil around the plant roots are located. Cations and anions can be well dissolved in extracting it. The addition of DTPA to the extractors Morgan enhance the ability to extract metals. Morgan Wolf extractors are used to establish the availability of macro elements of NH 4 +, NO 3 -, P, K, Ca, Mg, SO4 2-and micro elements Fe, Mn, Cu, Zn, and B from the soil. Extractors are suitable for high-pH soil acidic to almost neutral. Macro and micro nutrients in the soil totally extractable by wet incineration using concentrated H2SO4 and H2O2. Macro and micro levels in the extracts were measured using AAS, flame photometers and spectrophotometers.

The common condition that needed by plants to grow well and quickly (Setyorini, 2004):

a. Potassium (K)

Functioning in the process of photosynthesis are:

1.transportation of assimilation, enzymes and minerals, including water.

2.Improved durability / plant immunity against diseases

3.Plants that lack the element of K symptoms: stems and leaves become limp / fall, dark bluish-green leaves and fresh greens are not healthy, the leaves turn yellow and dry ends, embossed brown spots on the leaf.

b. Iron (Fe)

Iron (Fe) is a micro element that is absorbed in the form of a ferry ions (Fe 3 +) or ferrous (Fe 2 +). Fe can be absorbed in the form of a chelate (bond metals with organic matter). Fe minerals such as olivine (Mg, Fe) 2SiO, pyrite, siderite (FeCO3), gutit (FeOOH), magnetite (Fe3O4), hematite (Fe2O3) and ilmenite (FeTiO3). Iron can also be absorbed in the form of a chelate, thus Fe fertilizer made in the form of a chelate. Fe chelate used is Fe-EDTA, Fe-DTPA chelate and others. Fe in about 80% of plants are found in chloroplasts or cytoplasm. Fe absorption through the leaves is considered faster than the absorption through the roots, especially in Fe-deficient plants. Thus fertilization through leaves is often thought to be more economical and efficient. Fe among other functions as a constituent of chlorophyll, protein, enzymes, and plays a role in chloroplast development. Cytochrome is an enzyme containing Fe porphyrins.

c. Manganese (Mn)

Manganese ions absorbed in the form of Mn + . As with other micronutrients, Mn can be absorbed in the form of a chelate complex and Mn fertilization often sprayed over the leaves. Mn in the plants can not move or shift the place of a metal one to the other organs in need. Manganese present in the soil in the form of oxide compounds, carbonates and silicates with the name pyrolusit (MnO2), manganit (MnO (OH)), rhodochrosit (MnCO3) and rhodoinit (MnSiO3). Mn is generally present in the primary rocks, particularly in ferrous materials magnesium. Mn released from the rock because rock weathering process. The results of weathering rocks is secondary mineral mainly pyrolusit (MnO2) and manganit (MnO (OH)). Mn levels in soil ranged from 300 smpai 2000 ppm. The form Mn can be either cation Mn + + or manganese oxide, both divalent and valence four. Flooding and drying, which means reduction and oxidation of the soil affects the valence of Mn.

Mn is a constituent of ribosomes and also could activated the polymerase, the synthesis of protein, and carbohydrates. Acting as a major activator for a number of enzymes in the Krebs cycle, is required for normal photosynthetic function in chloroplasts, no indication is required in the synthesis of chlorophyll. Elements of Mn deficiency include: plants broadleaf

interveinal chlorosis in the young leaves contains Fe but more spread to the older leaves.

d. Boron (B)

Boron in soil mainly as boric acid (H2BO3) and levels ranged from 7-80 ppm. Boron in the soil generally in the form of hydrated borate ion B (OH) 4 -. Boron is available to plants only about 5% of the total content of boron in the soil. Boron is transported from the soil solution to the plant roots through mass flow and diffusion processes. In addition, boron is often found in the form of organic compounds. Minerals in the soil containing boron include tourmaline (H2MgNaAl3 (BO) 2Si4O2) O20 containing 3% -4% boron. Minerals are formed from acid rocks and sediments that have undergone metomorfosis. Other minerals containing boron is kernit(Na2B4O7.4H2O),kolamit (Ca2B6O11.5H2O), uleksit (NaCaB5O9.8H2O) and aksinat. Boron strongly bound by soil minerals, especially seskuioksida (Al2O3 + Fe2O3).
Boron function in plants, among others play a role in the metabolism of nucleic acids, carbohydrates, proteins, phenols and auxin. In addition, boron also plays a role in the division, elongation, and differentiation of cells, membrane permeability, and pollen germination. The indication micro-nutrient deficiency include: stunted growth in meristematic tissues (root tip), die back, low mobility, and development of the fruit is very susceptible to disease.

e. Chlorine (Cl)

Chlorine is an element that is absorbed in the form of Cl-ion by the roots of plants and can also be absorbed by the gas or solution on the plant, such as leaves. Cl levels in plants around 2000-20000 ppm dry weight of the plant. The best levels of Cl in plants is between 340-1200 ppm and were deemed to be in the range of micro nutrients. Chlorine in the soil are not bound by minerals, so it is easily washed away by water draiinase. Cl source is often derived from rainfall. Clor water serves as the transfer of plant nutrients, improve Osmose cells, prevents water loss of balance, improve the absorption of other ions. For coconut and palm oil is considered an essential nutrient. Also plays a role in photosystem II of the photosynthetic process, particularly in the evolution of oxygen. Chlorine deficiency include: abnormal root branching patterns, wilting symptoms (weak and withered leaves), golden color (bronzing) on the leaves, the plant cabbage leaf-shaped bowl.

f. Calcium (Ca)

Calcium serves to stimulate the formation of root hairs, stems harden plants while stimulating the formation of seeds.

g. Magnesium (Mg)

Magnesium has a role to create the perfect green leaves and forms of carbohydrates, fats and oils.

h. Sulfur (S)

Sulfur or also known as sulfur. role in the formation of a pimple and help the growth of seedling roots.

Fishering Sector

Using geothermal water in aquaculture help keep water temperatures consistent, which increases the level of survival rate and make the creatures grow faster . Low-temperature geothermal resources that are not hot enough to produce electricity are very useful to fish farmers. Animals grown in water of the proper temperature grow faster and larger than those in cold water or water with fluctuating temperatures. They are also more resistant to disease and die less frequently(William,2000) .

Fish farmers who have access to the geothermal water can use it to regulate the temperature of their fish pond. Although the mechanism for achieving this is quite complicated, basically what happens is fish farmers open the valve to allow water to flow into the geothermal pond until they reach the desired temperature. The valve are then closed to prevent water from getting too hot. This mechanism is similar to the mechanism on agriculture and irrigation systems when adding hot water to the bath to bring the temperature to the desired level. The water flow can be adjusted throughout the year to account for air temperature. Pond water contains several mechanisms circulation and keep all the temperatures are more stable. Aquaculture operations usually have multiple pools, which are kept small enough to be heated or cooled instantly(Jones,1984).

Systematics and How to Work

Actually the ideas and solutions we created is a simple solution can take advantage of geothermal fluid that had been unused for some injected into a vessel owned by the local community.

The working principle of a geothermal exploitation is taking heat sources in the earth to take steam and steam which will be used to move turbin. In the separator will be split between water and vapor. The water will be in injected back into the

earth for the purpose of an iterative process. Before the water injected into the earth, must be in the form of branch pipe angle formed between the pipes in injected into the earth. So that the water will be injected into the earth does not fully circulate to earth. But the other half will be in the stream to the dam or reservoir owned by communities to be used as fertilizer for the soil and agricultural. Secara this will be beneficial for the local community Geothermal area.

Geothermal fluid shelters made just like a big pool where the heat contained in the container is not easy to release heat to the environment even though it is in an open system. So the hot fluid inside the shelter can keep the temperature warm. In addition it is also the need to create circulatory water system such as a swimming pool that rotates continuously.
With a large shelter can be used as much for fertilizer in agriculture. Seen in this way is a simple, but if all areas are geothermal resources can be utilized for agriculture then there can be no such thing as dying from lack of food and nutrient .

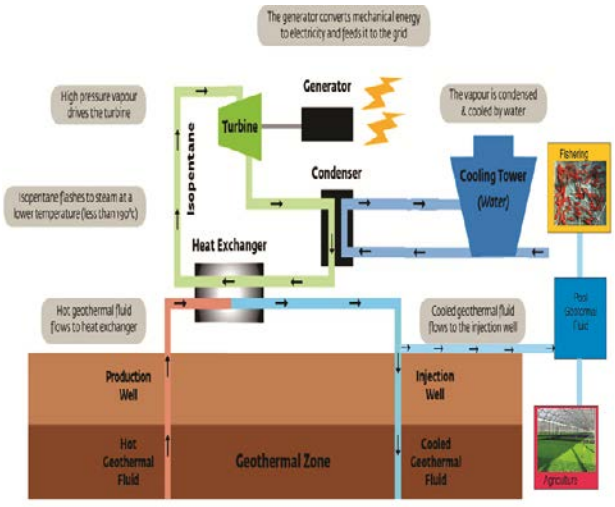

Figure 2 . Mechanisms And Geothermal Plan System**.**

RESULTS AND DISCUSSIONS

In Indonesian geothermal fluid have high and lower pH values . This will affect the agricultural land, where plants will not grow in areas that have a high pH value of about 1-4. Otherwise, crops and fisheries will grow well at pH 5-7. Geothermal fluid will have positive impact on agriculture and fisheries if properly managed. The temperature of the geothermal fluid is accommodated in a place that can sustain such conditions.

If this can be put to good use by people around the geothermal area. They no longer need to buy artificial chemical fertilizers, because geothermal fluids can be a purely natural substitute for chemical fertilizer cultivation and fisheries.

AKNOWLEDGEMENTS

The Authors are thankful to Mr Mochamad Nukman (PhD Student of GFZ) and Universitas Gadjah Mada Geophysical Laboratory for the facilities to carry out the present work and cooperation**.**

REFERENCES

Budiardjo,B.dkk. 1989. *Resource characteristics of the Ungaran Field , Central Java , Indonesia*. Technical Report. Pertamina Co. 8 pp.

Harijoko,dkk.2011. *Water geochemistry and soil gas survey at Ungaran geothermalfield, central Java, Indonesia. Journal of Volcanology and Geothermal Research.*

Nukman,M. 2011. *Overview of Gedongsongo Manifestations of the Ungaran Geothermal Prospect, Central Java, Indonesia : a preliminary account.* PROCEEDINGS, Thirty-Fourth Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, February 9-11, 2009 SGP-TR-187.

Kholid,M,dkk.2007.*PenyelidikanTerpadu(Geologi,Geokimia,Geofisika) Daerah Panas Bumi Bonjol, Kabupaten Pasaman Sumatera Barat,Indonesia*.

Setyorini.2004. *Unsur Kimia yang dibutuhkan oleh Tanaman. National Research Agency, Indonesia*.

Saptadji , Miryani ,N.2001.*Teknik Panas Bumi*. Institute of Technology Bandung,Indonesia.