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Promotion of Community Participation for Saline Soil Remediation by Alternative Technology of Bio-Organic Fertilizers and Nano Material at Krabueang Yai, Phimai District, Nakhon Ratchasima Province

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Abstract

This paper is applied research to create changes in the community. The objectives of this research were the study of the bio-organic fertilizer production process in Ban-Toey Community Enterprise at Krabueang Yai, Phimai District, Nakhon Ratchasima Province and promoting the community participation in the remediation of saline soil by the alternative technology such as bio-organic fertilizers and nanomaterial. The research methodology of this study was carried out by studying the data sources and information from the community and on-site events or activities Moreover, in-depth interviews, group discussions, observation, questionnaires, demonstrations were also carried out in order to transfer knowledge from the laboratory outcome to the community. The result was found that promotion of community participation for saline soil remediation by alternative technology of bio-organic fertilizers and nanomaterials at Krabueang Yai were operated by share and learn activities, in-depth interviews, group discussion, observation and questionnaires. The demonstrations were also carried out in order to transfer knowledge from the laboratory outcome to the community. After the activities, it was found that the community changes including a deep understanding of the saline soil solutions, production of bio-organic fertilizer, nanotechnology and soil tests. Moreover, Ban-Toey villagers planned to establish soil quality analysis services during the soil adjustment of the field and agricultural area. A cooperative creating was to resolve saline soil problems. In addition, the view of the participants should be changed that nanomaterial could be non-expensive. Participants who were more liberal on new ideas such as nanotechnology can be the better starting point for the solving of saline soil problems and alternatively helping the community to increase agricultural productivity and benefits.

Keywords: Community participation, Saline soil, Alternative technology, Bio-organic fertilizers, Nanomaterial

1. Introduction

Currently, there are new technologies and that can be applied to solve the problems in agriculture including soil quality improvement. One of the technologies is nanotechnology which is used as a better alternative. Nanotechnology is the technology that involves the process of managing, creating, or analyzing of small materials in nanometer (about 1-100 nm) (El-Shall, Graiver, Pernisz, & Baraton, 1995; Masciangioli & Zhang, 2003). Nano-sized particles are applied in environmental applications such as applying in treatment and improvement of the environmental contaminations in soil, water, and air (Jiamjitrpanich, Parkpian, Polprasert, & Kosanlavit, 2012, 2013; Jiamjitrpanich, Parkpian, Polprasert, Laurent, & Kosanlavit, 2012; Jiamjitrpanich, Polprasert, Parkpian, Delaune, & Jugsujinda, 2010). Nanoscale Carbon (nC) is a special element that can be found in many allotropic forms and also it is used in cell culture, biosensors, and can be applied in the environment by being used as adsorbents, filters, water filters, conductor, gas sensors. Moreover, it can used in wastewater treatment, air pollution treatment, etc. In addition, it is environmentally friendly. Bio-Organic Fertilizer (BOF) is an organic fertilizer that has been processed at high temperatures. This process can kill microbes which are causes of plant disease, animal and human disease, as well as general microbes. After that, microorganisms which have fertilizer properties are added to this kind of fertilizer. They help to fix nitrogen for plants and to produce plant hormones to stimulate the growth of plant roots. Also, some microbes can control plant diseases in the soil and stimulate an immunity production of plants. (Department of Land Development, 2013). Krabueang Yai Subdistrict Community, Phimai District, Nakhon Ratchasima

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Province the groups of farmers established and trained to produce bio-organic fertilizer in the community.

So, this research is interesting as it was applied the bio-organic fertilizer which produced by the Ban Toey village community, Krabueang Yai, Phimai District, Nakhon Ratchasima Province in combination with nanoparticles to saline soil rehabilitation. Rice is mainly grown in this area, thus rice husk is used as a saline soil improvement material (soil amendment) both fresh rice husk and rice husk ash. Soil amendment means any material that is put into the soil for improve soil properties to suitability in crop cultivation but not used as a substitute for fertilizer or as fertilizer. Soil amendment can divided into 2 types; 1) Material for physical soil improvement, it will help to make the soil coarse structure, water drainage and airflow in the soil will be improved such as rice husk, sawdust, manure, compost, crop residue, and various polymers. 2) Material for chemical soil improvement, it will help adjust soil pH to increase the absorb ability of plant nutrients; reduce the toxicity of toxic elements in soil.

Therefore, the solving of saline soil problems in Krabueang Yai Community, Phimai District. Nakhon Ratchasima Province which is located on the Korat salt basin and has a rock salt causing problems in salinity spreading, thus this research applied modern technology including nanotechnology combined with local wisdom including bio-organic fertilizer used to reduce salinity in the soil. Also, the process of community participation was used to solve the saline soil problems and achieve sustainable development.

2. Objectives

2.1 To study the production of bio-organic fertilizer of Ban Toey Community Enterprise, Krabueang Yai Subdistrict, Phimai District, Nakhon Ratchasima Province.

2.2 To develop and promote the community participation in the rehabilitation and resolution of saline soil problems with alternative technologies.

3. Scope of research

Conceptual framework consists of concepts, goals and concrete of the things that need to be driven to see results within the time period of operation as shown in Figure 1.

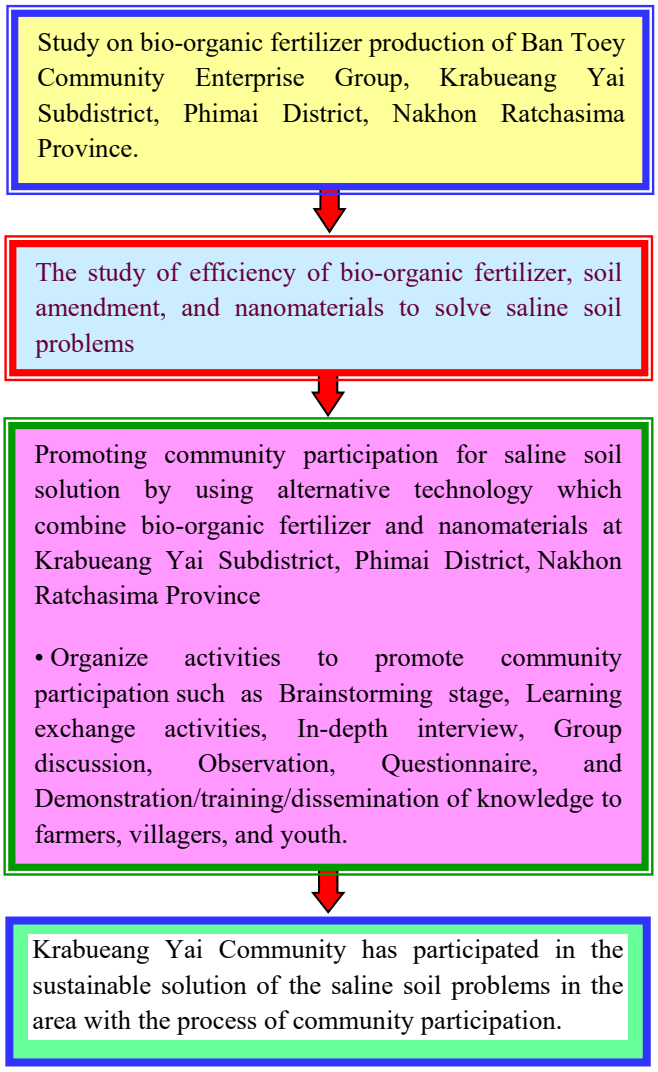

Figure 1. Research conceptual.

4. Methodology

4.1 Study area

Promoting community participation for salt soil solution by using alternative technology of integration of bio-organic fertilizer and nanomaterials are studied at Krabueang Yai Subdistrict, Phimai District, Nakhon Ratchasima Province.

4.2 Population and sample groups of this study

A population is a group of farmers and villagers in the saline soil problem areas at Krabueang Yai Subdistrict, Phimai District, Nakhon Ratchasima Province. The sample groups are farmers and villagers in the salt soil area at Krabueang Yai Subdistrict, Phimai District, Nakhon Ratchasima Province by specific sampling in the

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problematic saline soil area, there were 181 persons.

4.3 Data collection

The research methodology of this paper was divided into 2 parts according to the objectives, which could be implemented as follows:

Part 1: Study of bio-organic fertilizer production of Ban Toey Community Organic Bio-fertilizer, Phimai District, Nakhon Ratchasima Province by interviewing members and community leaders and study the production process of bio-organic fertilizer of community enterprise groups.

Part 2: Promoting community participation for saline soil solution by using alternative technology of integration of bio-organic fertilizer and nano-materials.

Organizing of learning exchange activities, in-depth interviews, group discussions, brainstorming ideas, observing activities, demonstration/knowledge dissemination from research knowledge to the community to solve the saline soil problem in the study area. Also, the organization of learning and exchanging activities among communities, local scholars, researchers, and students were divided into 4 learning bases: Learning base I Saline soil and soil analysis, Learning base II Nanotechnology and environment, Learning base III Bio-organic fertilizer (Ban Toey), and Learning base IV Combining bio-organic fertilizer, nanomaterials and soil amendments to solve saline soil problems. A learning base operated by the community had a role to demonstrate/train/disseminate knowledge to the community (farmer groups and youth).

4.4 Tools used in research studies

(1) Questionnaire, interview and group discussion used as a tool to study community contexts and community problems caused by the saline soil area.

(2) Questionnaire, interview and group discussion used as a tool to study community participation in soil rehabilitation and saline soil problem solving before and after the project implementation.

(3) Specific interviews used as a tool to study the production of bio-organic fertilizer of Ban Toey community enterprise groups.

(4) Scientific equipment in the laboratory was used to study the effectiveness of saline soil reduction of bio-organic fertilizer, soil amendment and nanomaterials. Also, they were used to study the quality of saline soil before and after remediation.

4.5 Data analysis

(1) The study of the community context and the problems of the communities caused by the saline soil conditions and the community participation in the rehabilitation and solution of saline soil problems analyzed by descriptive statistics, average and standard deviation (SD).

(2) Soil quality data analyzed by descriptive statistics, average and standard deviation (SD).

5. Results and Discussion

Promoting the community participation for saline soil solutions by using alternative technology which integrates between bio-organic fertilizer and nanomaterials at Krabueang Yai Subdistrict, Phimai District, and Nakhon Ratchasima Province is an applied research. The results had 2 parts as shown below:

5.1 Bio-organic fertilizer production of Ban Toey community

The study of bio-organic fertilizer production of Ban Toey Community, Krabueang Yai Subdistrict, Phimai District, Nakhon Ratchasima Province conducted by interviewing members and community leaders of Ban Toey and Bio-organic fertilizer community enterprise groups.

Figure 2. Ban Toey bio-organic fertilizer production methods and community enterprise group interviews.

The study of bio-organic fertilizer production of Ban Toey Community by studying the specific formula and the process of production of bio-organic fertilizer of Ban Toey Community by interviewing members and community leaders of fertilizer manufacturer's community groups found that the formula of Ban Toey bio-organic fertilizer consists of 200 kg of animal manure, 100 kg. of molasses, 50 kg. of rice bran, 50 kg. of sugarcane ash, 100 kg bat guano and 80 liters of EM. Mix all ingredients together put into a blender

and using EM as a binder. Production capacity is 200 tons/year for self-use and distribution to members and general villagers.

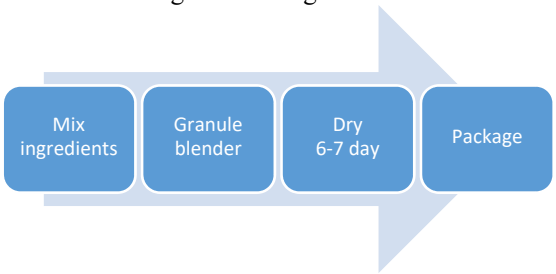

Figure 3. Ban Toey bio-organic fertilizer production diagram.

Figure 4. Ban Toey Bio-Organic Fertilizer Community Enterprise Group.

In addition, the results from in-depth interviews of the Ban Toey bio-organic fertilizer community group found that the fertilizer producer group had developed improve production formulas by constantly changing the ingredients and raw materials in EM production. Community enterprise group had divided duties and responsibilities that consist of a president, secretary, vice president, marketing, accounting, labor and public relations, procurement, inspection, and consultancy department as shown in Figure 8.

5.2 Promoting of community participation

Promoting of community participation in solving saline soil problems by using alternative technology to combine bio-organic fertilizer and nano-material.

5.2.1 Educational exchange activities, in-depth interviews, group discussion to brainstorm ideas, observation, demonstration activities /disseminating knowledge from the research to the community to solve the problem of saline soil in the area was organized. In this activities exchanging knowledge between communities, local scholars, researchers, and students had divided into 4 learning bases: Learning base I: Saline soil and soil analysis, Learning base II: Nanotechnology and environment, Learning base III: Bio-organic fertilizer (Ban Toey), and Learning base IV: Combining bio-organic fertilizer, nanomaterials and soil amendments to solve saline soil problems.

Figure 5. Learning base of activities to exchange knowledge and transfer knowledge.

By allowing the community to play a role in demonstrating/disseminating knowledge to the community (farmers, villagers and youth groups), the activity results showed that:

Learning base I: Saline soil and soil analysis.

Figure 6. Learning base I: Saline soil and soil analysis.

The base I: saline soil and soil analysis to this exchange of knowledge was a base for lecturing and discussing knowledge of saline soil, included the cause, the impact and the approach to the saline solution. In addition, there was the discussion activity and talk about experiences related to saline soil problems and solutions. Also, there were demonstration activities for soil quality analysis

methods including EC values (salinity indicator), pH values, nitrogen, phosphorus, and potassium. From the activities in this learning base, it was found that participants are interested in the content and get practicing tests to analyze the soil collected by themselves. There was also a suggestion and demand in the group discussions that wanted to have the basic equipment in villages and a service unit to analyze the soil quality in the next period before the soil preparation. From the discussion of the participants' ideas and experiences, including questionnaires, it was found that the saline soil problem in the past was more severe than present.

Nowadays, the saline soil problem has caused by the water source that flows passing from the salt field and caused by using a lot of chemical fertilizer. Participants suggested some methods to solve the problem such as adding compost, animal manure, green manure, vetiver grass, leaf scraps, mulching (ground cover), fresh rice husk, and plowing. Moreover, the participants mentioned creating a network and cooperating together in solving the saline soil problems.

Learning base II: Nanotechnology and environment.

Figure 7. Learning base II: Nanotechnology and environment.

Base 2: Nanotechnology and the environment was a base for exchanging knowledge that gives lectures and basic knowledge about nanotechnology for participants to know about nanotechnology and nanomaterials application. Nanotechnology in environmental work is using for treatment soil, water, air, and water pollution. Nanotechnology is used to promote agricultural work, cultivation, disease and various pathogens management. It was found that 54 percent of the participants knew nanotechnology or nano-fertilizer, and 46 percent do not know, mostly they known only the names and properties of the advertisement, but not truly understood meaningful and have never been used. The activities in this base received a lot of interest and questions from the participants. This activity makes the participants more understand about nanotechnology. In addition, the researchers found that the mindsets of the participants had changed that nanomaterials must have expensive; on the other hand, nanomaterials are many types and the price are vary (cheap to expensive). They could accept nanotechnology to be used to solve saline soil problems and help them to increase productivity as well.

Learning base III: Bio-organic fertilizer (Ban Toey).

Figure 8. Ban Toey bio-organic fertilizer.

Base 3: Ban Toey bio-organic fertilizer was a base for learning about bio-organic fertilizer production of groups of Ban Toey bio-organic fertilizer community enterprise which the members of the enterprise group were invited as speakers to give lectures on production knowledge and experience to participants (groups of villagers, leaders, communities, and students). It was found that participants get knowledge of the process of the products and ingredients. Participants are interested to try to make their fertilizer and ask to contact the Ban Toey bio-organic fertilizer community enterprise group for solving the problem of saline soil.

Learning base IV: Combining bio-organic fertilizer, nanomaterials, and soil amendments to solve saline soil problem

Figure 9. Learning base IV: Combining bio-organic fertilizer, nanomaterials, and soil amendments to solve saline soil problems.

Learning base 4: Combining bio-organic fertilizer, nanomaterials and soil amendments to solve saline soil problems was a learning base that using knowledge from the results of the research on the study of the effectiveness of organic nano-biological fertilizer to solve saline soil problems which this research combines Ban Toey bio-organic fertilizer with nano-carbon material and soil amendment (fresh rice husk and rice husk ash) used to improve saline soil. From organizing activities in this base, it was found that the participants transferred the knowledge gained from research and they were interest in the use of knowledge to solve saline soil.

6. Conclusion

Krabueang Yai Subdistrict area is an area experiencing saline soil problems due to the Korat salt basin. It was found that community leaders and general participants had various activities for solving saline soil problems. They tried to solve the problem by using bio-organic fertilizer, compost, rice husk, and soil amendment and reducing chemicals fertilizers. Moreover, this research project helped establishing a unit for soil quality analysis before cultivation. The community created cooperation to solve saline soil problems between villages. The participants encouraged to using nano-bio-organic fertilizer as an alternative to solving the saline soil problems and increasing agricultural productivity.

7. Acknowledgement

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8. References

Department of Land Development. (2013). Salty tolerant plants and salt-like plants. [Online]. Department of Land Development. Retrieved from http: www. Idd.go.th. (25 August 2013).

El-Shall, M. S., Graiver, D., Pernisz, U., & Baraton, M. I. (1995). Synthesis and characterization of nanoscale zinc oxide particles: I. laser vaporization / condensation technique. *Nanostructured Materials*, *6*, 297-300.

Jiamjitrpanich, W., Parkpian, P., Polprasert, C., & Kosanlavit, R. (2012). Enhanced phytoremediation efficiency of TNT-contaminated soil by nanoscale zero valent iron. *International Proceedings of Chemical, Biological and Environmental Engineering*, *35*, 82-86.

Jiamjitrpanich, W., Parkpian, P., Polprasert, C., & Kosanlavit, R. (2013). Trinitrotoluene and its metabolites in shoots and roots of *Panicum maximum* in nano-phytoremediation. *International Journal of Environmental Science and Development*, *4*(1), 7-10.

Jiamjitrpanich, W., Parkpian, P., Polprasert, C., Laurent, F., & Kosanlavit, R. (2012). The tolerance efficiency of *Panicum maximum* and *Helianthus annuus* in TNT-contaminated soil and nZVI-contaminated soil. *Journal of Environmental Science and Health, Part A: Toxic / Hazardous Substances and Environmental Engineering*, *47*(11), 1506-1513.

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Jiamjitrpanich, W., Polprasert, C., Parkpian, P, Delaune, R. D., & Jugsujinda, A. (2010). Environmental factors influencing remediation of TNT-contaminated water and soil with nanoscale zero valent iron particles. *Journal of Environmental Science and Health, Part A: Toxic / Hazardous Substances and Environmental Engineering*, *45*(3), 263-274. doi: 10.1080/10934520903468012

Masciangioli, T. & Zhang, W.-X. (2003). Environmental technologies at the Nanoscale. *Environmental Science & Technology*, *37*(5), 102-108. doi: 10.1021/es0323998