Site Planning of Lertchana Farm under the New Agricultural Theory, Hin Lek Fai District, Prachuap Khiri Khan Province

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Site planning of Lertchana farm is located in Hin Lek Fai District, Prachuap Khiri Khan Province. Lertchana farm has a total area of approximately 110 rais. The purpose of this research was focued on site planning for learning center under the New Agricultural Theory by using Khok Nong Naa model. The methods wre done by interviewing the owner of Lertchana farm, surveying the area, gathering the relevant documents, analyzing data, synthetizing data along with the designing of site planning. Results were divided into 3 major areas. Firstly, upland (Khok) which consisted of 11 areas as follows:- the residential area, the building of learning and service center, the crop area, the orchard, the flower garden in front of the entrance, the hydroponic farm and nursery, the forest area, the area of banana field, the vegetable area, the livestock area, and the parking areas including road in total area of 94 rais which was approximately 85 percent of the total area. Secondly, water storage (Nong) consisted of 3 marsh and rill in total area of 13 rais which was approximately 12 percent of the total area. Thirdly, paddy field (Naa) consisted of organic rice paddy field in total area of 3 rais which was approximately 3 percent of the total area. In this study, all areas were designed to correspond with the New Agricultural Theory and water management which were not only to be a leaning center area for agriculturalists or those who interested in learning but also be a model in order to further develop their own areas.

Keywords: Site planning, New Agricultural Theory, Khok Nong Naa model

Introduction

New Agricultural Theory is a new agricultural model, which created by His Majesty King Bhumibol, Rama 9 of Thailand. The purpose of creating that theory was modifying the land of the farmers' shelter into the most useful farm in order to help the farmers to be self-sufficient. The main strategy of New Agriculture Theory refers to the settlement of the different types of plants or animal husbandry in the same area in order to let those living things to be able to benefit each other (Liencharoen, 1996) and the settlement of the water

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storage management in order to be able to use during the dry season. This theory, the land divided into 3 parts. The 1st part is water storage area or reservoir, which is about 30% of whole land. It used to store water to use throughtout the year and can raise fishes. The 2nd part is the agricultural area, which is further divide into 30% of whole land for rice farm and 30% of whole land for orchard. The 3rd part is the shelter area, which is about 10% of the whole land. It uses to build the house, vegetable garden and animal husbandry (Benjasilp, 1996).

New Agricultural Theory is using and modifying by the farmers in Thailand and for the local language, they have called Khok Nong Naa model. They mostly use Khok Nong Naa model to cope with the problem of the lack of water. This model has stressed on the natural water storages (Hutapaet, 2015). The principle of Khok Nong Naa model derived from three different words and meanings. The first words "Khok" refer to the upland area and it have created for the shelter, the plants and animal husbandry. The second word "Nong" has referred to the water storage area, which has established in the form of pond and pool with the curved shape and different level of depth. The third word "Naa" was the paddy field area and the ridge must be at least 1 meter in height since it could store the water as well as raising fish. Lertchana farm had appied the concept of the principles of this Khok Nong Naa model within the total area of 110 rais (1 rai = 0.16 hactar) and the site plan is in the processed design.

The objectives of this research:
1. To set up the suitable site plan that matched with the needs of owner in Lertchana farm, Hin Lek Fai district, Prachuap khiri Khan Province.
2. To be the learning center under the New Theory of Agriculture.
3. To set up the building elements and others basic facilities of the farm into the particular zone position.

Methodology

Data collection

The data collection conducted by interviewing the farm's owner about their preferences and needs, surveying the real location and gathering the relevant documents. The activities of the interview referred to the survey of the real location that done by walk, car and photograph. The gathering of the relavent documents will be include the data of the amount of precipitation and the soil profile.

Site analysis and site synthesis

In order to meet the objective of research, those collected data used to setted up the site analysis since those data collected to determined the suitabilities and the feasibilities of the farm's owner

The site synthesis done by grouping the activites in the specific zone (the land use zoning) in order to searched for the relationship between each activity to the specific site and by making balloon diagram to searched for the relationship between activities and construction.

The designed of master plan

The ballon diagram could design the site of the farm to find the perfectness site plan in the right scale by using AutoCAD 2016 program.

Result

Result of the data collection

The data received from the interview, Ms.Tassanee Lertusahakul wanted to build the learning resource center inside the farm in order to let the farmers come and learn directly in this area. She applied New Agricultural Theory in this area since this theory mainly focused on beautifulness and could planted more plants. She wanted to plant any crops, which separated into zoning. There were field crops zone, orchard zone, vegetable garden zone, ornamental plant zone, the area for fermented organic fertilizer, water storage which can storage rainfall for using the whole year, the building for the activities, animal husbandry zone, the resident for her own family and her workers, nursery and paddy field with the suitable size for practice.

The survey of the given farm, Lertchana located in Hin Lek Fai district, Prachuap Khiri Khan province with the GPS coordination was 58°12 73.3 ´N 52.6´82°99 ´E (Aerial photomap, 2017). The whole area was 176,000 square meters and the soil profile was Prachinburi, which was a type of sandy soil, (Office of soil survey and research, 2005). Based on the survey by walk, car and photoghaphes from a satellite showed the blank space area without tree; a natural waterway; a pond in the right of entrance; a building next to the entrance; the entrance on the main road, the Baan Nong So school and the Ploy Pool resort (Figure 1).

Base on the relevant literatures showed that, the average annual precipitation in Prachaup Khiri Khan Province was 1,072mm/year or 1.072m/year (The Meteorological Department, 2015).

The calculation of water quantity followed Hutapaet's method (2015), used to calculated the precipitation (rainfall quantity) of the whole area and the quantity of the storable water that can be 100% use in the study area throughout the year. The annual precipitation in Khok Nong Naa could be calculated and divided as:

1) Total water quantity in an area (m^3) = rainfall quantity (m/year) $\times$ area size (m^2)

2) Water quantity on the upland (m^3) = size of the upland (m^2) $\times$ rainfall quantity on the upland (m) $\times 50 \div 100$ (The upland could store 50% of the total water quantity)

3) Water quantity in water storage (m^3) = [width (m^2) X length (m^2) $\times$ height (m^2)] $\times 70 \div 100$ (water storage with slop could store water about 70% of the rainfall quantity, the water in water storage could be evaporated 1cm/day or 300cm/year) (Loypradit, 2015)

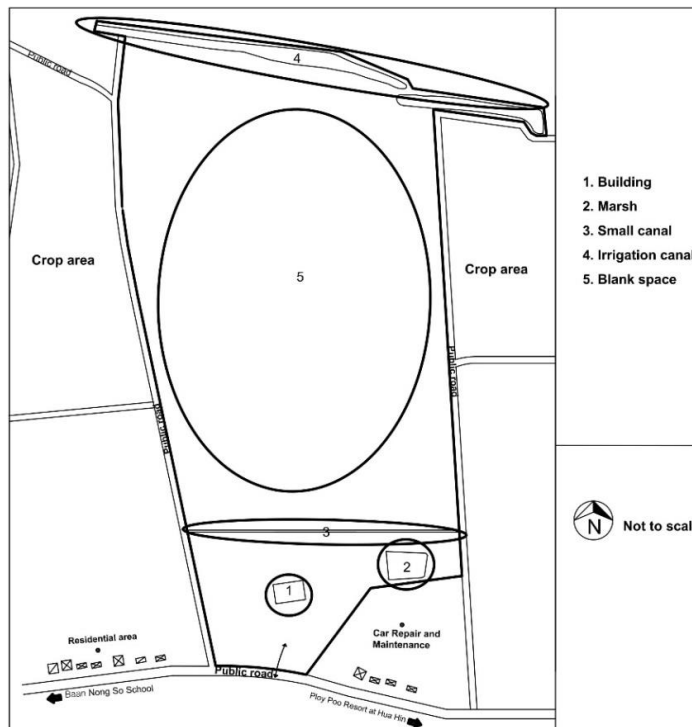4) Water quantity in paddy field (m^3) = Paddy field (m^3) $\times$ ridge height (m)

Figure 1. Site plan

Result of the site analysis and site synthesis

The calculation of water quantity followed Hutapaet's method (2015), calculated the precipitation (rainfall quantity) of the whole area and the quantity of the storable water in the study area as:

1) Total water quantity in an area (m^3) = rainfall quantity (m/year) $\times$ area size (m^2). In this case, the 176,000 square meters farm might had the average of rainfall 1,072m/year (Meteorological Department, 2015); therefore, the total annual precipitation was 188,672m^3/year.

2) Water quantity on the upland (m^3) = size of the upland (m^2) $\times$ rainfall quantity on the upland (m) $\times 50 \div 100$ (The upland could store 50% of the total water quantity). In this case, the 150,400 square meters of the upland area could store the annual precipitation approximately 80,614.4m^3/year.

3) Water quantity in the water storage (m^3) = [width (m2) $\times$ length (m^2) $\times$ height (m^2)] $\times 70 \div 100$ (water storage with slop could store water about 70% of rainfall quantity, the water in water storage could be evaporate 1cm/day or 300cm/year) (Loypradit, 2015). In this case, the 20,800 square meters of water storage could store water approximately 108,640m^3/year.

4) Water quantity in paddy field (m^3) = Paddy field (m^3) $\times$ ridge height (m). In this case, the paddy field was 4,800 square meters with the ridge height 1.5m could store the total water quantity approximately 4,800 m^3.

Sum up, the total area of the farm could store the water 194,054.4m^3. Which was approximately 102.8%.

The site plan of Lertchana farm was trying to apply New Agricultural Theory in their area by creating the learning center inside the farm for farmers or for those who were interested. The site plan was focusing on the beautifulness and the beneficial purposes by modifying the land into the cropland i.e. plant production and plant breeding dissemination etc. Base on the synthesis of all data, the farm divided into 3 parts (Figure 2):

First part was the upland area; namely Khok, consisted of:

1) One way entrance-exit rout closed to the main street, the rout could reach the entire road in the farm inside with 2 lane roads inside the area.

2) The buildings comprised the residential area, which divided into 2 parts, owner's house and worker's house; a learning and service building center; the agricultural nursery and hydroponics; the livestock and composting place; the threshing floor and parking lots area.

3) Planting area consisted of field crop area, orchard, the flower garden in front of entrance, forest area, vegetable garden and banana field.

Second part was the water storage; namely Nong, consisted of: Water storage 1 which located in the south with 4,800 square meters in size and 6-meters depth.

1) Water storage 2 located in the north and it was the biggest pond with 8,800 square meters in size and 9-meters depth.
2) Water storage 3 located in the west and it was the smallest pond with 4,000 square meters in size and 7-meters depth.
3) A stream which connected to the water storage 1 and 2 and its dimension was approximately 3,200 square meters in size and 6-meters depth

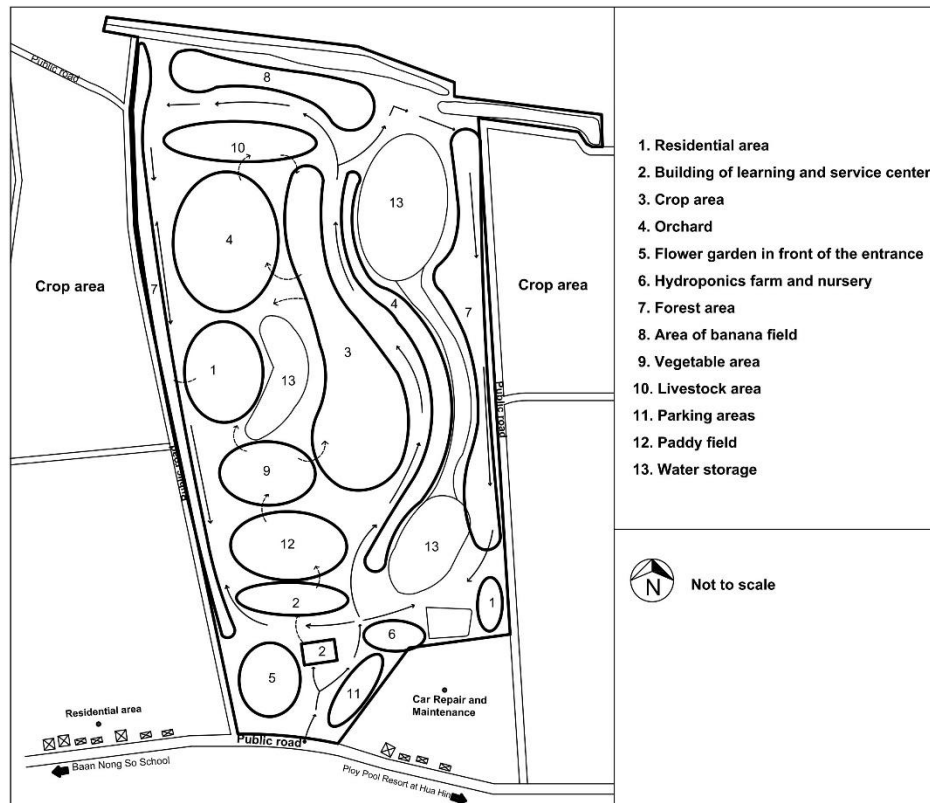Third part was the paddy field; namely Naa, was 4,800 square meters is in size.

Figure 2. Balloon diagram

Result of site planning

After the layout of the site plan of Lertchana farm, the farm divided into 3 main zones and then developed and detailed into an area plan diagram. All of the area plan diagram consisted of 3 main zones (Figure 3).

The main area for designing:

1. Upland (Khok)

The Khok size was 150,400 square meters, approximately 85% of whole area, consisted of the buildings and cropping areas. This upland layed out as:

1.1 Building area

1.1.1 The residential area had divided into 2 zones

First zone was the owner's house. It consisted of four houses that the biggest one was 20m x 20m and the other 3 small houses was 15m x 10m in dimension. There was a storage godown with 5m x 3m in size used to store the agricultural equipmenst and also, there was a parking place for 5 cars.

The second zone was the worker's house which was located near the agricultural nursery. It comprised 4 rooms and each room was 5m x 4m in size.
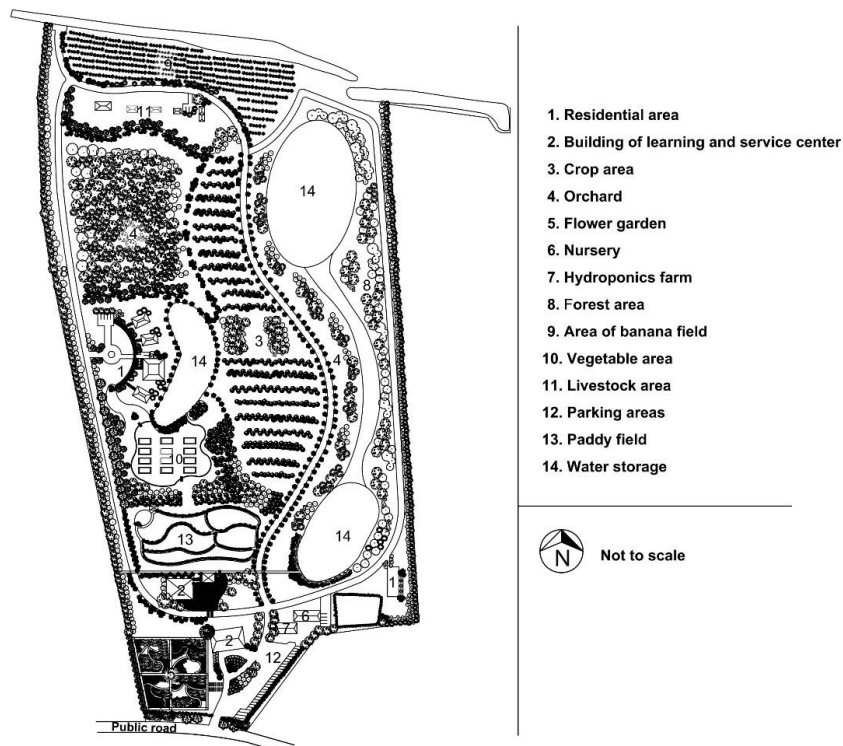

1. Residential area
2. Building of learning and service center
3. Crop area
4. Orchard
5. Flower garden
6. Nursery
7. Hydroponics farm
8. Forest area
9. Area of banana field
10. Vegetable area
11. Livestock area
12. Parking areas
13. Paddy field
14. Water storage

N Not to scale

Figure 3. Master Plan

1.1.2 The building of learning and service center consisted of 3 buildings i.e. 1) the building of leaning center with the size of 20m x 25m was used for the multipurpose of learning, 2) Service center with the size of 20m x 31m was the transformed place from a convention building into a service center as well as a center of product exhibition, 3) Coffee shop with the size of 9m x 12m used for beverages store, coffee, bakery and a lounge.

1.1.3 The zone of agricultural nursery and hydroponics consisted of the hydroponic farm with the size of 20m x 10m and the plant nursery with the size of 25m x 10m which was used for planting crop in this project.

1.1.4 Animal husbandry and organic fertilizer building consisted of poultry house, pig and cow farm, the organic fertilizer building with the size of 5m x 14m, and the equipment storage building with the size of 5m x 7m.

1.1.5 Parking lots area which be able to park 2-3 buses and 25 cars.

1.1.6 Rice drying terrace with the size of 4m x 8m used to store the rice after harvested and to make as a versatile yard.

1.2 Planting area consisted of:

1.2.1 Field crop area used for produce the economic field crops.

1.2.2 Mixed orchard consisted of local and economic fruits which can be eaten.

1.2.3 Ornamental garden consisted of colorful flower.

1.2.4 Forest area planted many plant species i.e. tree, fruit tree, shrubs, mulchings and tuber crops.

1.2.5 Vegetable garden consisted of vegetable and herbs.

1.2.6 Banana field planted banana that could be eaten and processed.

All species of plant in this farm was 117 species which divided into tree, fruit crop, shrub, flower, mulching, tuber crop and herbs that those had been shown as below:

1) Thirty four species of trees were *1) Tectona grandis* L.f., 2) *Hopea odorata* Roxb., *3) Acacia auriculiformis* Cunn., 4) *Thyrsostachys siamensis.*, 5) *Tecoma stans* (L.) Kunth., 6) *Swietenia macrophylla* King., *7) Dipterocarpus alatus.*, *8) Dalbergia cochinchinensis.*, 9) *Afzelia xylocarpa.*,10)*Cassia bakeriana.,*11)*Cassia grandis.*, 12) *Dolichandrone serrulata* (Wall. ex DC.) Seem., 13) *Oroxylum indicum.*, 14)*Syzygium cumini.*, 15)*Polyalthia longifolia.*, 16) *Albizia procera* Benth., 17)*Senna siamea.*, 18) *Lepisanthes fruticosa* Leenh.,19) *Tabebuia argentea* Britt.,20)*Dalbergia cochinchinensis,*21) *Mansonia gagei* Drumm.,22)*Azardirachta excelsa* (Jack)Jacobs., 23) *Wrightia pubescens* R. Br., 24) *Plerocapus indicus.*, 25) *Steblus asper* Lour., 26) *Moringa oleifera* Lam., 27) *Phoenix dactylifera* L., 28) *Alstonia scholaris.*, 29) *Cassia fistula* L., 30) *Cassia fistula* L., 31) *Spondias pinnata* (L.f.) Kurz.,

32) *Tabebuia rosea* (Bertol.) DC., 33) *Pisonia qrandis* R.Br. and 34) *Crescentia alata* HBK.

2) Twenty two species of fruit were *1) Artocarpus heterophyllus.*, *2) Mangifera indica.*, 3) *Musa* ABB group., 4) *Durio zibethinus* Murray., 5) *Nephelium lappaceum.*, 6) *Garcinia mangostana.*, 7) *Lansium domesticum.*, 8) *Citrus aurantiifolia.*, 9) *Parkia speciosa.*, 10) *Phyllanthus emblica* Linn., 11) *Syzygium samarangense* (Blume) Merr. & Perry., 12) *Annona squamosa* L., 13) *Psidium guajava* L., 14) *Tamarindus indica* L., 15) *Bouea macrophylla* Griffith., 16) *Manilkara achras* Fosberg., 17) *Citrus reticulata* Blanco., 18) *Averrhoa carambola* L., 19) *Carica papaya* L., 20) *Salacca rumphii* Wall., 21) *Passifloraedulis* Sims., and 22) *Cocos nucifera* L.

3) Twelve species of shrub were 1) Nerium *oleander* L., 2) *Duranta erecta* L., 3) *Graptophyllum pictum* (L.) Griff., 4) *Duranta repens* L., 5) *Murraya paniculata* (L.)Jac.,6) *Gardenia augusta* (L.) Merr., 7) *Demos Chinensis* Lour., 8) *Dracaena cincta* Bak. 'Tricolor'., 9) *Polyscias fruticosa* (L.) Harms., 10) *Schefflera actinophylla* (Endl.) Harms., 11) *Pandanus amaryllifolius* Roxb., and 12) *Bougainvillea* spp.

4) Sixteen species of flower ornamental plants were 1) *Lantana Camara.*, *2) Cosmos sulphureus.*, *3) Dianthus chinensis.*, *4) Verbena.*, *5) Celosia argentea* L. cv. Plumosa., *6) Otacanthus caeruleus* Lindl 7) *Convolvulus sabatius* Viv. 8) *Spathoglottis.*, 9) *Angelonia goyazensis* Benth., 10) *Kalanchoe.*, 11) *Bellis perennis.*, 12) *Strelitzia reginae.*, 13) *Tagetes erecta* Linn., 14) *Anthurium andraeanum.,* 15) *Dahlia* spp., and 16) *Helianthus annuus.*

5) Nine species of mulching were *1) Dichondra micrantha* Urb., 2) *Acalypha chamaedrifolia* Lam., 3) *Ipomoea pes*-caprae (L)., 4) *Crotalaria pallida* Ait., 5) *Chlorophytum comosum* (Thunb.)., 6) *Mentha cordifolia* Opiz., 7) *Tradescantia pallida* (Rose) D.R.Hunt., 8) *Ruellia tweediana* Griseb., and 9) *Melampodium divaricatum.*

6) Six species of tuber crop were 1) *Alpinia galangal.*, 2) *Colocasia esculenta* var. *esculenta.*,3) *Curcuma longa.*, 4) *Boesenbergia rotunda.*, 5) *Pachyrhizus erosus.*, and 6) *Zingiber officinale.*

7) Twenty four species of vegetable and herbs were 1) *Allium sativum* L., 2) *Ocimum sanctum* L., 3) *Curcuma longa* L., 4) *Cymbopogon citratus* Stapf., 5) *Tinospora crispa* (L.) Miers ex Hook.f. & Thoms.,6)*Ocimum basilicum* L.f. var. *citratum* Back., 7) *Aloe barbadensis* Mill., 8) *Andrographis paniculata* (Burm.) Wall. ex Nees., 9) *Ocimum sanctum* L., 10) *Cucurbita moschata* Decne., 11) *Hibiscus sabdariffa* L., 12) *Cymbopogon citratus* Stapf., 13) *Barleria lupulina* Lindl., 14) *Centella asiatica* Urban., 15) *Allium sativum* L., 16) *Piper betle* L., 17) *Brassica oleracea* var. s*abellica.*, 18) *Capsicum flutescens* Linn., 19) *Lactuca sativa.*, 20) *Daucus carota* subsp. Sativus., 21) *Solanum lycopersicum.*, 22)

Brassica oleracea Alboglabra Group., 23) *Brassica chinensis* var. parachinensis., and 24) *Ipomoea aquatica* Forsk. Var. reptan.

2. Water storage (Nong)

After calculation of the possibility of water quantity in Nong showed that, its size was 20,800 square meters which was took 12% of the whole area. It can storage water which was 108,640 m^3 and divided into 3, Nong 1 located on the south was 8,800 square meters in size, Nong 2 was a medium size which located at the north which was 4,800 square meters, Nong 3 located at the west which was a smallest with 4,000 square meters and a stream with 3,200 square meters in size. All of these water storages were possible for whole year using and it could be for raising fish.

3. Paddy field (Naa)

The full size of Naa was 4,800 square meters, which was approximately 3% of the whole area. Based on the calculation, it could contain 4,800 m^3 of water. The paddy field's ridge was 1.5 in height. The production of the rice was the organic one and on the ridge, it had planted some crop. The paddy field could be a relaxing place for interested people.

Discussion

Based on the principle of New Agricultural Theory, it had divided the land area into different parts i.e. water storage 30%, paddy field 30%, mixed crop and orchard 30% and resident and animal husbandry 10% (Benjasilp, 1996). All the ratio of area can be changed depend on the type of soil profile, weather and the needed of the owner, but it must be suitable (Panyakul and Pramsiri, 2015). This case matched to Mab Aung Natural Agriculture Center (MANAC). MANAC was a successful project which happen had been occurred in Thailand. It located in Chonburi province which was 160,000 square meters and divided into water storage 16,000 square meters which was taken 10% of whole area, paddy field 9,600 square meter which taken 6% of whole area, the resident and mixed crop with orchard 134,400 square meters which was taken 84% of whole area (Loypradit, 2015). The Lertchana farm had adjusted the site propotion of their area into water storage as 12%, paddy field 3%, resident, animal husbandry and mixed crop orchard 85% of the whole area. The landowner was not easy to maintain paddy farm but they might be able to produce an organic paddy field for their family comsumption. The water retention area was 12 percent of the whole area and it could handle the water storage for the farmer 100% use thoughout the year.

The purpose of site plan of Lertchana farm aimed to builde an agricultural learning center in the local area which focused mainly on the proportion of agriculture and made beautyful to the area.

Acknowledgement

Reference

Aerial photomap. (2017). Geographic information system for local management. Available online at www.googleearth.com// (accessed on 01 July 2017).

Benjasilp, W. (1996). King Bhumibol's agricultural development. Medea press partnership. Department of Agriculture, Ministry of Agriculture and Cooperation, Bangkok, Thailand.

Hutapaet, K. (2015). Natural agriculture, Khok, Nong Naa model: Stop the flood, stop the drought for the innovation of water crisis. Green Medea and Product Partnership, Bangkok. Journal of Natural Agriculture, 17(9). pp. 76.

Liencharoen, W. (1996). Alternative farming: meaning, history and technique tethod. World's Equilibrium: Alternative Farming Network, Bangkok, Thailand.

Loypradit, A. (2015). Guide for making hole of Kanom Krok by yourself. Institute of sufficiency economy, Bangkok, Thailand.

Loypradit, A. (2016). Organic agriculture, modification of sufficiency economy philosophy Into "poor people" practices. Return Life to land Company Limited, Foundation for Natural Agriculture, Bangkok, Thailand.

Meteorological Department. (2015). Rainfall statistics at Prachuap Khiri Khan meteorological station year 2004-2016. Available online at http://www. nso.go.th //(accessed on 3th April 2017).

Office of Soil Resource Survey and Research. (2005). Miracle of soil. Department of land development, Ministry of Agriculture and Cooperative, Bangkok, Thailand.

Panyakul, W. and P. Rawimas. (2015). Introduction to Permaculture. Earth Net Foundation. Sopha Publishing Company Limited, Bangkok, Thailand.