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Kaala Natural Farm under the New Agricultural Theory, Chiang Dao District, Chiangmai

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Kaala Natural Farm is located in Chiang Dao District, Chiangmai Province. The total area was 15 rais. The purposes of this study were to plan and to develop this area to be an agricultural learning center under the new theoretical agriculture and organic farming by using the Khok Nong Naa Model The methods of this study were as follows; 1) collecting data by surveying the site, interviewing the owner's requirements and correcting the relevant documents. 2) Analyzing and synthetizing data and 3) designing the site planning. The results of this designing were divided into 3 parts. First, upland (Khok) had 8 rais which accounted for 54 percent of the total area. It was divided into 2 parts as follows; 1. Buildings structure which consisted of the residential area, greenhouse, the building of learning and service center 2. Orchard and the forestry area. Second, pond (Nong) had 4 rais which accounted for 26 percent of the total area. Third, paddy field (Naa) had 3 rais which approximately for 20 percent of the total area. However, the method of organic farming was used in the process of farming. Therefore, agricultural process in Kaala Natural Farm was intended to be the agricultural learning center for agriculturists who were interested in learning and using this approach to further developing their own areas.

Keywords: Site planning, The New Agricultural Theory, Khok Nong Naa Model

Introduction

The main occupation of Thai people is farmer, which the main income is selling agricultural products. Mono cropping agriculture in long period will destroy the soil fertility which is the major reason to decrease agricultural products. To avoid this problem, many Thai farmers have turned to sufficient economic agriculture or mixed farming. They manage the area by establishing a pond to cope with the drought (Hormphu, 1997) New Agricultural Theory is a part of sufficient economic agriculture, which divide area into parts for the highest benefit and sustainable living. New agricultural theory has divided into 4 parts. First part is 30% of the whole area for a pond and also for raising fish

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for consumption. Second part is 30% for paddy field that is a main food for consuming throughout the year. Third part is 30% for growing crops such as field crop, fruit and vegetable and the last part is 10% for accommodation and animal husbandry or growing mushroom. All the ratio of these lands can change depend on suitability and useability. New Agricultural theory causes Thai farmers had enough food for eating throughout the year (Keardpud, 2009).

Khok (upland) Nong (pond) Naa (paddy field) model is a type of agriculture which have focused on land and water resource allocation for the most effective goals which have to be in line with the area, weather and topography. This model is matched with New Agricultural Theory which belongs to His Mejesty King Bhumibol of Thailand (Hutapaet, 2015).

There are many farmers have tried to apply this theory. They plant diverse crops and arrange the area for beneficial usage. Kaala natural farm is located in Chiangmai province and cover an area which is 15 rais (1 rai = 0.16 hactar). The owner is interested in New Agricultural Theory and has applied it by building an organic agricultural learning center. It was on processing of designing the site plan.

The objective of this study is to layout and arrange the farm to match with the owner's need, to establishe the organic agricultural learning center in the scope of New Agricultural Theory and to build suitable constructions for some activities.

Methodology

Data collection, site survey and site analysis

Data collection was done by interviewing the farm's owner about their need, surveying location which related to the weather, topography, the wind direction, and plant species, reviewing relavant documents and analysing the data.

Site synthesis

The site synthesis was done by gathering all data from interviewing with owner, site survey including other activities. They should be matched with the area and then made balloon diagram for indicating the relation between activities and the area.

Master plan

It was designed by balloon diagram for the perfectness of the site plan by using AutoCAD 2014.

Results and Discussion

Results for Site survey and and site analysis

The result from interviewing the farm's owner showed that they wanted the area to become a New Agricultural Theory center which consisted of any activities such as organic products selling, forestry area planting, mixed cropping for wind break, conservation of native plants. There were paddy field and organic vegetable plating which the design must depend on principle of Khok Nong Naa model.

The result of site surveying in Kaala farm which was located in Chiangdao district, Chiangmai province on the GPS coordinator 19 ๐23'41.8"N +98 ๐56'33.5"E (Aerial photomap, 2017) showed that the size of area was 15 rais. Average temperature was 27^{o}C. Average rainfall quantity was 1,897.6mm/year (Meteorological Department, 2015). Average number of rainy days was 159.2days/years and the most amount of rainfall quantity was 84.4mm/day (data year 2010-2015). This area was close to foothill and area at below was planted the monocropping such as corn, sugar cane and longan etc. Around this area, there weren't any building or tree. The former plant was bamboo which separated the area and it also had 4 rais lemon farm and 1 rai of paddy field (Fig. 1).

The below data was the calculation method following (Promthong, 2007 and Hutapaet, 2015) to apply with Khok Nong Na model:

1) Whole water quantity in an area (m^3) = rainfall quantity (m/year) X area size (m^2).

2) Water quantity on upland (m^3) = size of upland (m^2) X rainfall quantity on upland (m) X 50 ÷100 (The upland can store 50% of water) (Loypradit, 2015).

3) Water quantity in a pond (m^3) = [wide (m^2) X length (m^2) X height (m^2)] X 70 ÷100 (a pond with slop can store water about 70% of rainfall quantity, the water in pond could be evaporated 1cm/day or 300cm/year) (Auporn, 2015)

4) Water quantity in paddy field (m^3) = Paddy field (m^3) X ridge height (m). The water in paddy field would seep in soil about 50% (Auporn, 2015).

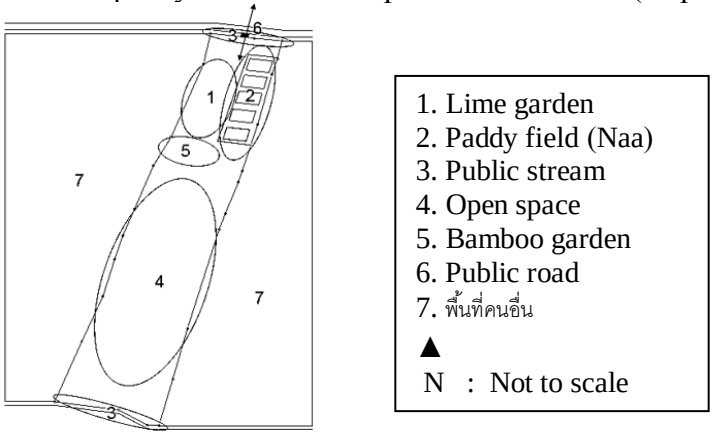


Figure 1. Site plan

Results for site synthesis

The data had gotten and another step was to calculate the water quantity which could storable in Khok Nong Naa as below:

1. Whole water quantity in an area (m^3) = rainfall quantity (m/year) X area size (m^2). This area was 15 rais with the statistic rainfall was 1,897mm/year, therefore, the water quantity of this area was 45,600m^3.

2. Water quantity on upland (m^3) = size of upland (m^2) X rainfall quantity on upland (m) X 50 ÷ 100 (The upland could store 50% of water) (Auporn, 2015). The whole upland area was 8 rais, therefore, the upland could store water quantity as 12,160m^3.

3. Water quantity in water storage (m^3) = [wide (m^2) X length (m^2) X height (m^2)] X 70 ÷ 100 (water storage with slop could store water about 70% of rainfall quantity, and the water in pond could be evaporated 1cm/day or 300cm/year) (Loypradit, 2015). The pond in this case was 4 rais with 5m in the depth; therefore the water quantity of pond was 22,400m^3.

4. Water quantity in paddy field (m^3) = Paddy field (m^3) X ridge height (m). The water in paddy field would seep in soil about 50% (Auporn, 2015). In this case, the paddy field size was 3 rais and ridge height was 1.5m, therefore, the water quantity in paddy field was 7,200m^3.

The balloon diagram of Kaala Natural farm by analysing the data from interviewing and site surveying showed that the area was divided into 3 parts as below (Fig. 2):

1. Upland (Khok) was for any activities such as building the resident and planting any crops or forest. The forest could keep the quantity of rainfall as 50% (Auporn, 2015).

1.1 Entrance-exit was setted to be one way because side area was owned by other and the back side was forest and waterway. In addition, one way extrance-exit was a good choice for the security.

1.2 The construction consisted of 1) learning center building 2) a shop 3) Equipment storage building 4) animal husbandry area 5) composting place 6) clay houses 7) kitchen and 8) two places parking.

1.3 Cropping area consisted of 1) forestry area 2) mixed orchard 3) herbal garden 4) organic vegetable garden and 5) paddy field.

2. A pond (Nong) had divided into 3 water storages for suitable usage of the whole area. First water storage was a big one which was located in lower area because there was the forestry area. Second one was medium water storage which was located on upper of the farm which used for paddy field and the last one was the smallest water storage which was located on upper of the farm which used for herbal garden and mixed orchard.

3. Paddy field (Naa) was divided into 4 smaller plots with the height and widely ridge.

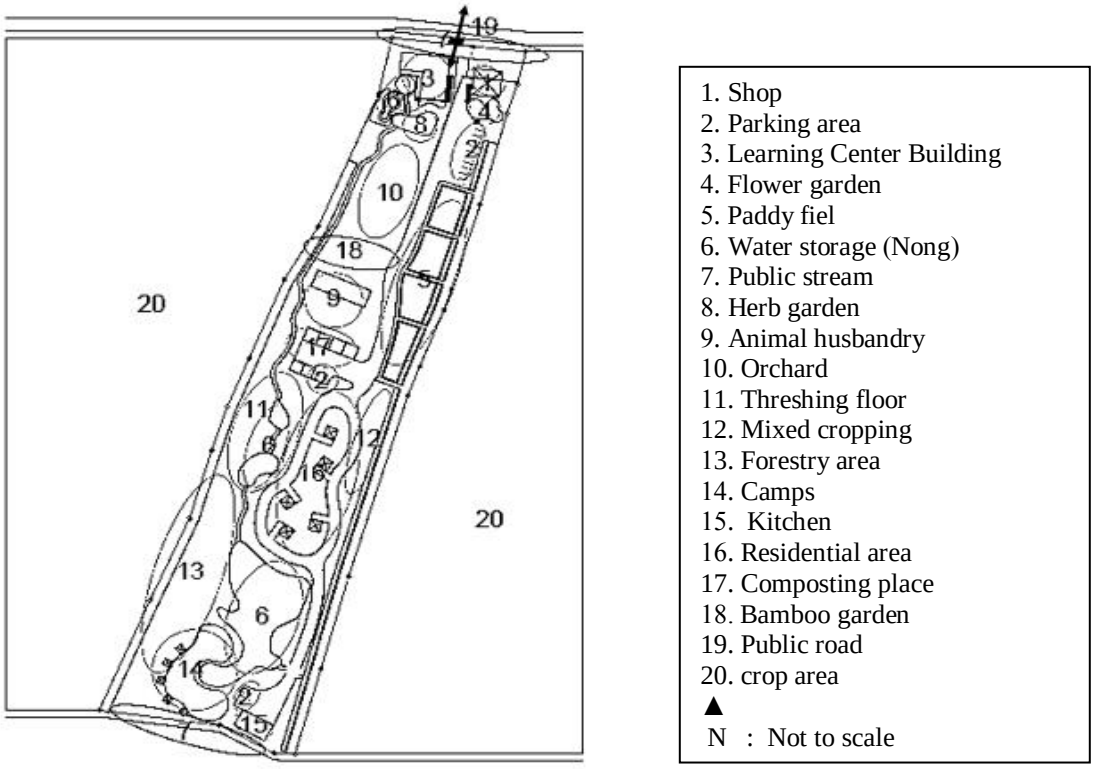


Figure. 2 Balloon diagram

Results for site planning

The master plan divided the land area into 3 parts (Fig. 3) as follows:

1) Upland (Khok)

Khok was used for building the constructions or planting crops. Khok also can plant forest that could be multiple usages such as food, produce equipment, build the house and tree shade. Forest could store the rainfall quantity as 50% but it depended on the type of forest and soil profile (Loypradit, 2015). In this case, the size of Khok was 8 rais which was taken 54% of the whole area. The area was divided into 2 parts which the first parts was for residential area, and the second part was for planting crops.

1.1 Building area

1.1.1 Learning center building was 20m x 21m which could contain 20-30 people who were interested in New Agricultural Theory.

1.1.2 Shop was 12m x 12m which was for selling the products that were produced in the area such as organic vegetable, herbs and fruits etc.

1.1.3 Clay house was 5m x 5m. Clay house was made from clay to economise the resource, and the temperature in house was about 25-25^{o}C over year. The house was builded in type of group which was 5 houses per place in the middle of farm. It was used for the visitors. The side of the house was for growing vegetable, nursery and mushroom farm.

1.1.4 Equipment storage building was 8m x 25m and was located in the middle of mixed orchard and forest, for conveniently usage.

1.1.5 Animal husbandry area which raised duck and chicken. The coop was builded with good ventilated which had enough oxygen and could release the bad gas. The good coop had to spread out of the resident at lease 50m.

1.1.6 Camp field which located in the lower area, used for staying of the visitors.

1.2 Planting and forestry area

The plant which planted in the area would be different in height as 5 levels which were big trees, medium tall trees, shrubs and tuber crop. It helped the soil to had a different level of root system. Beside of these plants, should planted *Chrysopogon zizanioides* L. to protect the soil profile and soil collaps (Khomson, 2015). Planting area was divided into 7 types which were 1) trees 2) fruit 3) shrub 4) mulching 5) climbing crop 6) tuber crop and 7) herb.

1.2.1 There were 23 species of tree which were 1) *Lagerstroemia cuspidate* Wall., 2) *Cassia fistula* L.(3 , *Millingtonia hortensis* L., 4) *Couroupita guianensis* Aubl., 5) *Alstonia scholaris* (L.) R. Br., 6) *Veitchia merrillii* (Becc.) H.E. Moore., 7) *Streblus asper* Lour. *8) Cyrtostachys renda* Blum. , 9) *Tabebuia argentea* Britt. , 10) *Morinda citrifolia* L. , 11) *Caesalpinia sappan* L. , 12) *Diospyros decandra* Lour. , 13) *Dracaena Lourieri* Gagnep , 14) *Pterocurpus indicus* Willd. , 15) *Tabebuia rosea* (Bertol.) DC., 16) *Peltophorum pterocarpum* (DC.) Backer. ex K. Heyne ,17) *Aquilaria crassna* Pierre ex Lecomte., 18) *Lagerstroemia speciosa* (L.) Pers., 19) *Homalium tomentosum* (Vent.) Bent., 20) *Bauhinia purpurea* L., 21) *Syzygium cumini* (L.) Skeels., 22) *Dipterocarpus alatus* Roxb. ex G. Don., 23) *Dolichandrone serrulata* (DC.) Seem.

1.2.2 There were 20 species of fruit which were 1) *Spondias pinnata* (L.f.) Kurz. , 2) *Tamarindus indica* L., 3) *Averrhoa carambola* L., 4) *Artocarpus heterophyllus* Lam., 5) *Phyllanthus emblica* L., 6) Dimocarpus longan Lour. ,7) *Phyllanthus acidus* (L.) Skeels. , 8) *Aegle marmelos* (L.) Correa ex Roxb. 9) *Manaifera indiea* L., 10) *Syzygium iambos* (L.) Alston., 11) *Annona squamosa* L., 12) *Psidium guajava* L., 13) *Punica granatum* L., 14) *Bouea macrophylla* Griffith., 15) *Dolichandrone serrulata* (DC.) Seem. 15) *Morusalba* Linn., 16) *Spondias cytherea* Sonn. ,17) *Acerrhoa carambola* L. ,18) *Molinda Critiforia* Linn,. 19) *Averrhoa bilimbi* L. and 20) *Litchi chinensis* Sonn.

1.2.3 There were 12 species of shrub which were 1) *Jatropha integerrima* Jacq., 2) *Graptophyllum pictum* Griff., 3) *Wrightia pubescens*

R.Br., 4) *Ixora coccinea* L., 5) *Bougainvillea spectablilis* Willd, 6) *Lagerstroemia indica* L., 7) *Hibiscus rosa - sinensis* L. cv. Matensis., 8) *lxora stricta* Roxb. ,9) *Juniperus horizontalis* Moench., 10) *Carmona retusa* (Vahl) Masam., 11) *Crinum asiatieum* L., 12) *Dracaena fragrans* (L.) *Ker Gaw.*

1.2.4 There were 6 speices of mulching plant which were 1) *Orthosiphon aristatus* (Burm.f.) Miq., 2) *Mimosa pucida* L., 3) *Stevia rebaudiana* (Bertoni) Bertoni, 4) *Hemigraphis alternate* (Burm.f.) T. Anderson., 5) *Tradescantia spathacea* Sw. and 6) *Chrysopogon zizanioides* (L.) Roberty.

1.2.5 There were 5 species of climber plants which were 1) *Telosma cordata* (Burm.f.) Merr., 2) *Coccinia grandis* (L.) Voigt., 3) *Sarcostermma acidum* (Roxb.) Voilgt, 4) *Antigonon leptopus* Hook. & Arn. and 5) *Sechium edule* (Jacq) Swartz.

1.2.6 There were 8 species of tuber crops which were 1) *Zingiber officinale* Roscoe, 2) *Boesenbergia rotunda* (L.) Mansf., 3) *Allium sativum* L., 4) *Curcuma longa* L. 5) *Alpinia nigra* (Gaertn.) Burtt., 6) *Zongiber officinale* Roscoe., 7) *Zingiber purpureum* Roscoe and 8) *Allium sativum Linn*.

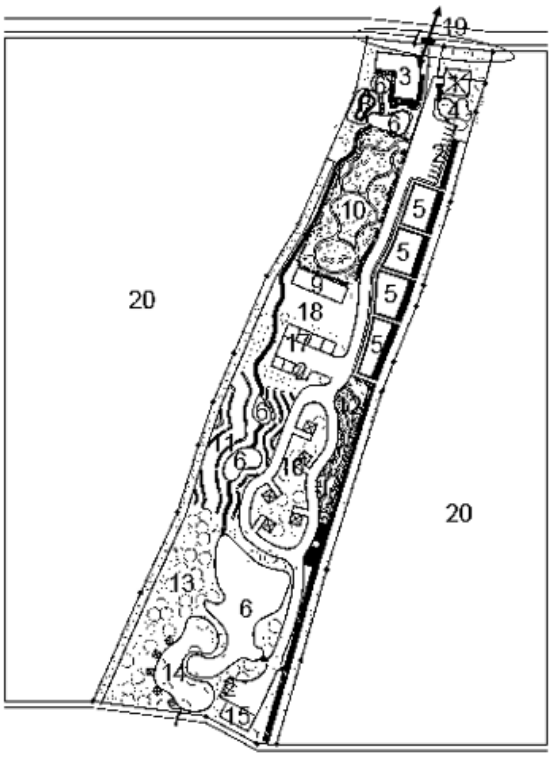
1.2.7 There were 17 species of vegetable and herb which were *Piper sarmentosum* Roxb., 2) *Hoya ovalifolia* Wight & Arn., 3) *Piper betal* L., 4) *Ocimum sanctum* L., 5) *Cymbopogon citratus* Stapf., 6) *Citrus aurantifolia* Swing., 7) *Ocimum basilicum* L.f. var. citratum Back., 8) *Musa sapientum* L., 9) *Aloe barbadensis* Mill., 10) *Andrographis paniculata* (Burm.) Wall ex. Nees., 11) *Solanum trilobatum* L., 12) *Morinda citrifolia* L., 13) *Cucurbita moschata* Decne, 14) *Cassia sianea* Britt., 15) *Hibiscus sabdariffa* L., 16) *Imperata cylindrical* Beauv., 17) *Barleria lupulina* Lindl.

2. Water storage (Nong)

Water storage was included with the ditch; small water way which used for stored the water for agriculture (Auporn, 2015). In this case, there were 4 rais of water storage which was taken 24% of whole area. There were 3 water storages. First water storage was the biggest one which was 7,800m^2 and the other 2 smaller water storages which was 600m^2 and 455m^2. The good water storage should curved and had different level of the depth due to the square water storage couldn't allow fish to laying the eggs (Hutapaet, 2015).

3. Paddy field (Naa)

In this case, Paddy field was 3 rais and there was ridge with the height of 1.5m – 2m for store the water and raising fishes. The water in paddy field would seep down to the soil profile about 50% but it wasn't been useless, it could keep water and moisture and in soil profile. Paddy ridge would be large due to could plant any crops such as vegetable, fruit or tree. The trees should plant on the south and north of the paddy field for avoided shade to cover the rice field (Hutapaet, 2015).



1. Shop
2. Parking area
3. Learning Center Building
4. Flower garden
5. Paddy field Naa
6. Water storage (Nong)
7. Public stream
8. Herb garden
9. Animal husbandry
10. Orchard
11. Terrace vegetable garden
12. Mixed crop garden
13. Forestry area
14. Camp
15. Kitchen
16. Housing area
17. Organic fertilizer
18. Bamboo garden
19. Public road
20. Crop area

▲
N : Not to scale

Figure 3. Master plan

Discussion

New Agricultural Theory belonged to sufficiency economic philosophy which was supporting the farmer for earning a living (Witchachoo, 2012). Khok Nong Naa model was consisted of soil, water, windy direction, sun light and human which every composition was proper to each other the most benefit (Hutapaet, 2015). New Agricultural Theory was divided area into 4 parts. First part was taken 30% of the whole area for water storage. Second part accounting for 30% was for paddy field. Third part or 30% was for cropping such as field crop or orchard and another 10% was for accommodation. All the ratio of the land was flexible and can change depending on soil profile, weather or windy direction etc. (Keardpud, 2009). There were many successful organic agriculture by applying this theory in Thailand such as 1) Mab Aung natural agricultural center, Baan Bung district, Chhonburi province 2) Institute for sustainable agriculture community (ISAC), Chiangmai-maejoe street, Nong-jork sub-district, Sansai district, Chiangmai province 3) Learning center of sufficiency economy, Mae-naterng sub-district, Pai district, Maehongsorn province 4) Doiraiplaifah organic agriculture, Thasai sub-district, Moueng district, Chiangrai province and 5) Organic and biotechnology leaning center,

Khorum sub-district, Phichai distruct, Uttaradit province (Loypradit, 2016). In this farm was matched to New Agricultural Theory which was divided area into 1) Cropping and raising animals (54%), water storage (26%) and paddy field (20%). The ratio of area was confirmed to owner's preference because there were few people living in this farm, so it wasn't suitable to have large paddy field because it was difficult to work. The owner chose to plant forest and orchard instead of paddy field. The important thing in this farm was they had enough water quantity to use throughout the year (Promthong, 2007).

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