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Site Planning of Demonstration Farm under the New Agricultural Theory in Faculty of Agricultural Technology, King Mongkut's Institute of Technology Lardkrabang

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Site Planning of Demonstration Farm in Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang have coveraged total area of approximately 29,600 square meter. The objective of this study was to focus on site planning for agricultural learning center by using Khok Nong Naa Model under the New Agricultural Theory. The methodology of this research was done by interviewing the project's representative, surveying the area, analyzing data, synthetizing data, and designing the site planning. The result was divided into 3 main areas. Firstly, upland (Khok) had 18,400 square meter which was about 62.2 percent of the total area. Khok divided into 2 parts as follows:- (1) buildings structure consisted of museum of technology and agricultural research, multipurpose learning center, fishery science and aquatic animal experimental center, mushroom laboratory and nursery, charcoal burner, composting place, 7waste segregation place, agricultural equipment storage, and 9) threshing floor, and (2) orchard and perennial plant area were the local plant and designed for daily life usage. This area also included the integrated farming plot for vegetable, herb, and flower garden. Seconly, water storage (Nong) had 5,600 square meter which was about 18.9 percent of the total area. It had been provided for the benefit of fishery and cultivation. Lastly, paddy field (Naa) consisted of organic rice field and ridge, the area was 5,600 square meter which took up about 18.9 percent of the total area. In overall, this site planning considered to design for the benefit of the personnel research dissemination in order to not only to convey knowledge directly to agriculturists but also be the guideline and a model of site planning by using this principle for other educational institutions.

Keyword: Site planning, New Agricultural Theory, Khok Nong Naa model.

Introduction

At present, most farms are mono cropping which plant one species of plant in big area for the purpose of gaining more products. Mono cropping take effect on water management and other activities. Burning land area after post-harvest would cause damage on soil structure and the lack of soil fertility would undermine water absorption or kills any beneficial organism etc. Beside these problems, most farmers have used chemical substance to

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getrid of pest. As a result, that chemical substance would spread to the atmosphere or seep to the soil or water. It could destroys many organisms in soil and pollute water which undermind to aquatic ecology. The chemical substance left over on agricultural products would later on become poisonous to the consumer. These issues caused by soil fertility and the toxic of chemical substance have to be addressed. A good way to solve these problems is "natural agriculture" which is a type of sustainable agriculture (Sitthirangsan, 2008). New Agricultural Theory system was initiated by King Bhumibul Adulyadet of Thailand, the theory suggests the farmers divide their land area into four parts with the ratio of 30:30:30:10 which is water storage or reservoir, paddy field, cropping plot and residential area, respectively (Somporn, 2005; Promthong, 2007; Witchachoo, 2012). Afterwards some Thai farmers apply the principle of this theory to their land area in the type of KhoK Nong Naa model (Hutapaet, 2015). Khok (upland) is the area for planting forest, forage crops, residential area, livestock area etc. (Loypradit, 2016). Nong (water storage) is the reservoir with curved shape and different depths to facilitate the living of aquatic animal. Naa (paddy field) has used for planting rice. It divides into small plot with the high and wide ridge, which is used for planting crop (Hutapaet, 2015). All the activities of New Agricultural Theory are modified by each other in the local condition. This principle was to help farmer achieve self-sufficiency at a frugal level because it can establish the work for sustainable and sufficiency living (Panyakul and Promsiri, 2015). Thus, faculty of agriculture technology, King Mungkut's Institute of Technology Lardkrabang has applied the principle of Khok Nong Naa model to manage the land in demonstrated agricultural area, aiming to build an agricultural leaning center for farmers or those who interested.

The objective of this study is to arrange the land in demonstrated agriculture area, faculty of agriculture technology, King Mungkut's Institute of Technology Ladkrabang to build a learning center by applying the principle of Khok Nong Naa model in the scope New Agricultural Theory for the suitable activities.

Materials and methods

Data collection and data analysis

Data collection conducted by compiling the relavant data, interviewing owner's representative, site survey, taking pictures and aerial photomap to determine the area, observing the atmosphere, topography, weather, windy direction, existing plant species, public utility and transportation.

The data analysis was done by site analysis which is derived from data collection to consider land usage which must match with owner's preference

and program analysis to analyze all activities with owner's preference for suitability, possibility and to know the ability or limitation of the land area.

Data synthesis

Data synthesis was done by forming into group to the land use zoning which was proper to the land area and establishing balloon diagram to observe relation of all activities and the building.

Master plan

It was done by arraging the land area obtained from balloon diagram in terms of the most suitable and correct to the objective. This step was done to make master plan by using AutoCAD2016.

Results

Result for data collection and site analysis

We have conducted an interview with Sutheerak Pluemchit, a lecturer in the plant production department, faculty of agricultural technology, King Mungkut's Institute of Technologly Ladkrabang. She was the project manager which was in charge of the transformation of the demonstrated agricultural land area to be an agricultural learning center. At first, those land area was designed by Prof.Ast. Phichet Sowithayasakul, the dean of department of architechture, King Mungkut's Institute of Technology Ladkrabang. The design must follw the concept of Khok Nong Naa model in line with the New Agricultural Theory's philosophy.

Real site survey in demonstrated agricultural land area, faculty of agricultural technology, King Mungkut's Institute of Technology, GPS coordinator 13°43' 46.98" N 100°47'04.91" E showed that, the whole area was 29,600 square meter, averages rainfall was 878mm/year (National statistic organization, 2016). Soil profile in this area was Bangkok series which compiled by clay (Liphan, 2015). There was existed buildings in 3 locations which used for storage agricultural equipments. There were ten rectangular cropping plots surrounded by canal. The cropping plots used by the student to practice plant production and by the lecturer for research (Fig. 1). After collecting the relevant document of the site planing, it showed that New Agricultural Theory must be giving priority to water storage which obtained from rainfall or water irrigation. The calculation method followed by (Promthong, 2007) and (Hutapaet, 2015) to calculate the water quantity for Khok Nong Naa model is:

1. Whole water quantity in an area (m^3) = rainfall quantity (m/year) × area size (m^2). This approximate size of this land area was 29,600 square meter, averages rainfall quantity 878 mm/year (National statistic organization, 2016). Therefore, the total amount of water quantity in this area was 26,048m^3.

2. Water quantity on upland (m^3) = size of upland (m^2) × rainfall quantity on upland (m) × 50 ÷ 100 (The upland could storage 50% of water) (Loypradit, 2015). The whole area of upland was 18,400 square meter, so the whole area of upland was 8,096m^3.

3. Water quantity in water storage (m^3) = [wide (m^2) × length (m^2) × height (m^2)] × 70 ÷ 100 (water storage with slop was can storage water about 70% of rainfall quantity, the water in water storage could evaporate 1 cm/day or 300 cm/year) (Promthong, 2007; Loypradit, 2015). The water storage in this case was 5,600 square meter and the depth was 7 meter. Therefore the total water quantity in water storage was 10,640m^3.

4. Water quantity in paddy field (m^3) = Paddy field (m^3) × ridge height (m). The water in paddy field would seep in soil about 50% (Loypradit, 2015). In this case the paddy field size was 5,600 square meter which included paddy ridge. Therefore, the total water quantity in paddy field was 8,400m^3.

The total amount of water quantity of all land area was 27,136m^3 which was 104.18% of the whole water which can be stored in whole area.

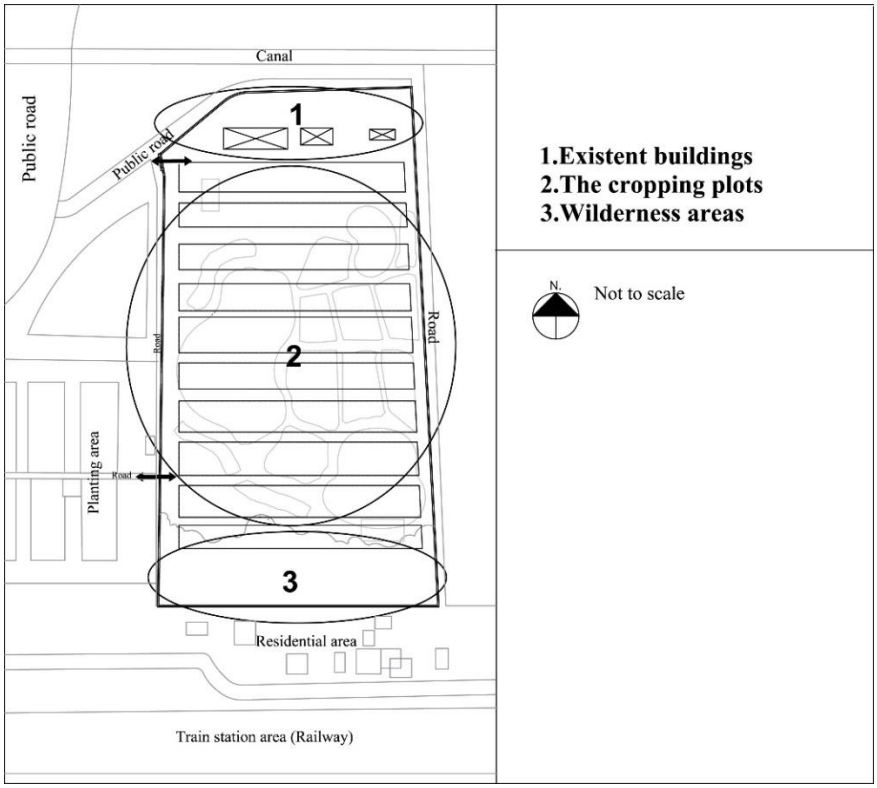

Figure 1. Site plan

Result for site synthesis

The activities demonstrated agricultural area in faculty of agricultural technology, King Mongkut's Institute of Technology Ladkrabang by analysizing, synthesising the data from interviewing, site survey and reviewed relevant documents showed that, the whole area should be divided into 3 parts as below (Fig. 2):

1. Upland (Khok) was the area for some activities such as forestry or planting crops. In fully forest, it could absorb rainfall about 50% out of whole rainfall quantity (Loypradit, 2015).

1.1 Entrance-exit: there were 2 paths of extrance and exit which were 1) the entrance which close to main road, the cars can go inside the area and 2) the entrance which linked to learning building (Bunnark building) which was only footpath.

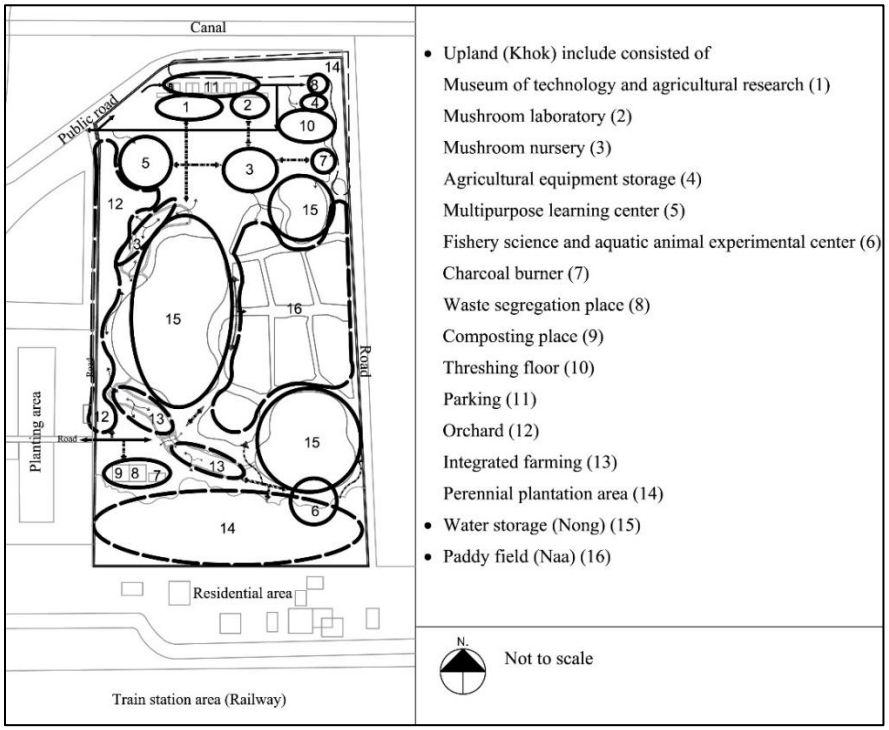

Figure 2. Balloon Diagram

1.2 Construction consisted of 1) museum of technology and agricultural research 2) agricultural equipment storage building 3) mushroom laboratory and mushroom nursery (3 buildings) 4) multipurpose learning center 5) fishery science and aquatic animal experimental center 6) two waste segregation place 7) two carcoal burner 8) composting place 9) threshing floor and 10) parking which could contain 10 cars.

1.3 cropping area consisted of 1) forestry area 2) orchard and 3) three plots of mixed cropping.

2. Water storage (Nong) divided into 3 due to its use 1) big water storage which is used for the whole area, located in the middle of land in the left. 2) Medium size water storage used for fishery and aquatic animal, located in the right and below of the area. 3) Small size water storage which is used for nearby agricultural area, located at the upper right area.

3. Paddy field (Naa) was divided into 9 small plots with high and wide rigde for storage water.

Result for site planning

The site plan of demonstrated agricultural area which was located in the faculty of agricultural technology, King Mongkut's Institute of Technology Ladkrabang for the purpose of building a Khok Nong Naa learning center in scope of new theory of agricultural system which could be suitable usage. The area divided into 3 parts (Fig.3) as below:

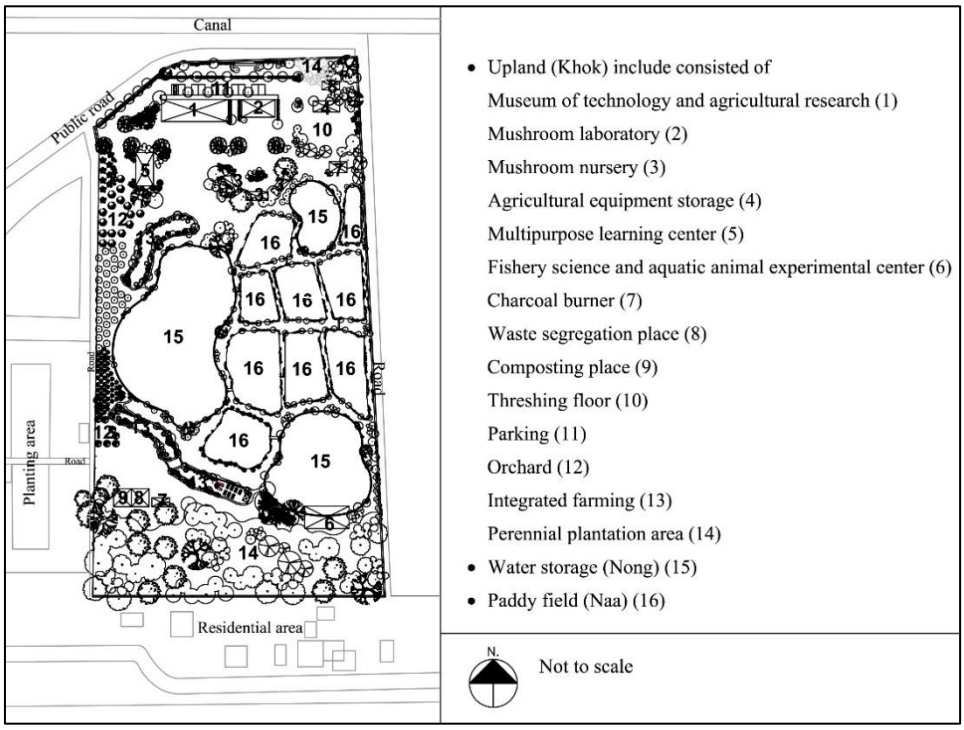

Figure 3. Master plan

1. Upland (Khok)

Khok with the size was 18,400 square meter which took 62.2% of the whole area and could storage water as 8,096m^3. It contained 2 portions which was construction area and cropping area which provided a beneficial to be an agricultural learning center.

1.1 Construction area

1.1.1 The existing three buildings used to stored the agricultural equipment had changed to 1) museum of technology and agricultural research, size 10m × 30m. 2) Agricultural equipment storage building with size was 5m × 12m and 3) Mushroom laboratory with the size was 8m × 15m with three building of mushroom nursery was 3m × 10m which located nearby mushroom laborary for the convenience practicing and do not block the wind direction. Beside of this building, there was a parking area which had the capacity of up to 10 cars.

1.1.2 Two charcoal burners with the size was 8m × 8m which was used for demonstrating the charcoal burning by using chopped wood or firewood for using in household and the smoke could repel the insect, it could also produce pyroligneous acid. The charcoal burner building was builded in the south by following the windy direction which could spread out smoke to cropping area in dry season and another one charcoal burner was builded in the northest to spread out smoke in cold season to repel the insect.

1.1.3 Waste segregation building with the size was 4m × 8m which divided garbage into recycled garbage, waste from agricultural product and normal garbage. Composting building with size 8m × 8m was used to and demonstrate about garbarg segregation. Both waste and compost building located at leeward to avoid bad smell.

1.1.4 Threshing floor with the size was 12m × 18m which used for airing rice after harvesting. The threshing floor couldn't be locate at upwind or at northest as the wind would blow in the dust to whole area (Hutapaet, 2015). In this case, the threshing floor was set at upwind but there weren't any building or activities at leeward the wind and it was also can plant windbreak trees to avoid the rice dust (Panyakul and Promsiri, 2015).

1.2 Cropping area

The idea of planting on upland was to plant different heights, their roots could stab to soil profile in different depths and became net which could storage water (Hutapaet, 2015). In this study, it was divided tree in 3 types as below:

1.2.1 Forestry area which planted any different level of plant's height such as tree, fruit, shrub, mulching and tuber crop.

1.2.2 Orchard which planted local and economic fruit.

1.2.3 Mixed cropping plot which consisted of ornamental plant, vegetable and herbs. There were 3 plots of mixed crops. The plants were the same species but in different styles in each plot which was modern garden, junk garden and general garden.

1.3 There were 114 species of plant which cropping on upland which was:

1.3.1 There were 21 species of trees which were 1) *Dipterocarpus alatus* Roxb., 2) *Aquilaria crassna* Pierre ex H.Lec., 3) *Dalbergia cochinchinensis* Pierra., 4) *Afzelia siamica* Craib., 5) *Afzelia xylocarpa* (Kurz) Craib. T., 6) *Shorea obtusa* Wall., 7) *Swietenia macrophylla* King. 8) *Pterocarpus macrocarpus* Kurz., 9) *Tabebuia rosea* DC., 10) *Milligtonia horentis* Linn.f., 11) *Shorea roxburghii* G. Don., 12) *Dendrocalamus asper*, 13) *Cratoxylum formosum* (Jack) Dyer ssp., 14) *Syzygium gratum* (Wight) S.N. Mitra var. gratum., 15) *Alstonia scholaris* R. Br., 16) *Azadirachta indica* Juss., 17) *Cassia siamea* Britt., 18) *Dolichandrone serrulata* (Wall. ex DC.) Seem. 19) *Murraya paniculata* Jack. 20) *Nyctanthes arbortristis* Linn., and 21) *Dillenia indica* L.,

1.3.2 There were 18 species of fruit which were 1) *Tamarindus indica* L. 2) *Oroxylum indicum* Vent., 3) *Musa sapientum* L., 4) *Mangifera indica* L., 5) *Bouea macrophylla* Griffith., 6) *Bouae bumanica* Griff., 7) *Sandoricum koetjape* Merr., 8) *Dimocarpus longan* Lour., 9) *Lansium domesticum* Corr., 10) *Cocos nucifera* L., 11) *Artocarpus heterophyllus* Lam., 12) *Artocarpus integer* (Thunb.) Merr., 13) *Garcinia mangostana* Linn., 14) *Averrhoa carambola* L., 15) *Baccaurea ramiflora* Lour., 16) *Averhoa bilimbi* L. 17) *Morinda citrifolia* L., and 18) *Citrus aurantifolia* (Christm.) Swingle.

1.3.3 There were 17 species of ornamental plant which were 1) *Hippeastrum johnsonii* Bury., 2) *Chassalia ophioxyloides* Craib., 3) *Chrysanthemum morifolium* Ramat., 4) *Rosa* Spp., 5) *Jasminum sambac* Ait., 6) *Hibiscus sabdariffa* L., 7) *Carthamus tinctorius* L., 8) *Tagetes erecta* L. 9) *Clitoria ternatea* L., 10) *Sesbania javanica* Miq., 11) *Bougainvillea spectabilis* Willd., 12) *Quisqualis indica* L., 13) *Antigonon leptopus* Hook. & Arn., 14) *Hibiscus syriacus* L., 15) *Polianthes tuberosa* L.16) *Crocus sativus* L., and 17) *Aeginetia indica* Roxb.

1.3.4 There were 6 species of mulching which were 1) *Centella asiatica* L., 2) *Marsilea crenata* Presl., 3) *Wedelia trilobata* Hitchc., 4) *Arachis pintoi*, 5) *Crotalaria juncea* L., and 6) *Peperomia pellucida* Korth.

1.3.5 There were 12 species of tuber crop which were 1) *Zingiber officinale* Roscoe., 2) *Alpinia galanga* Sw., 3) *Canna indica* L., 4) *Heliconia* spp., 5) *Ipomoea batatas* (L.) Lam., 6) *Colocasia esculenta* var. esculenta., 7) *Amorphophallus konjac* K.Koch., 8) *Cymbopogon citratus* Stapf., 9) *Chrysopogon zizanioides*., 10) *Pandanus amaryllifolius* Roxb., 11) *Crinum asiaticum* L., 12) *Etlingera elatior* (Jack) R.M. Smith.

1.3.6 There were 27 species of vegetable which were *Cucumis sativus* L., 2) *Cucumis melo* L., 3) *Coccinia grandis* (L.) Voigt, 4) *Psophocarpus tetragonolobus* (L.) DC., 5) *Vigna unguiculate* (L.) Walp., 6) *Cucurbita moschata* Duchesne.,7) *Lagenaria siceraria* (Molina) Standl., 8) *Momordica charantia* L., 9) Mentha × villosa Huds., 10) *Allium ascalonicum* L., 11) *Coriandrum sativum* L., 12) *Anethum graveolens* L., 13) *Eryngium foetidum* L., 14) *Piper sarmentosum* Roxb., 15) *Ocimum tenuiflorum* L., 16) *Ocimum gratissimum* L., 17) *Ocimum basilicum* L., 18) *Solanum lycopersicum* L., 19)

Capsicum frutescens L., 20) *Brassica oleracea* L. Cv. Alboglabra Group, 21) *Brassica rapa* L. (Brassica pekinensis var. laxa Tsen & S.H.Lee), 22) *Brassica oleracea* L. cv. Acephala Group, 23) *Ipomoea aquatica* Forssk., 24) *Polygonum odoratum* Lour., 25) *Amaranthus Lividus* L., 26) *Brassica oleracea* var. capitata L., and 27) *Lactuca sativa* L.

1.3.7 There were 13 species of herbs which were 1) *Albizia myriophylla* Benth., 2) *Amomum verum* Blackw., 3) *Cinnamomum* spp., 4) *Piper nigrum* L., 5) *Allium sativum* L., 6) Ocimum × africanum Lour., 7) *Ipomoea alba* L., 8) *Telosma cordata* (Burm. f.) Merr., 9) *Thunbergia laurifolia* Lindl., 10) *Momordica cochinchinensis* (Lour.) Spreng., 11) *Barleria lupulina* Lindl., 12) *Clinacanthus nutans* (Burm.f.) Lindau., and 13) *Limacia triandra* Miers.

2. Water storage (Nong)

Based on the calculation, water storage could contain amount of water up to 10,640m^3 (include evaporated amount) for agricultural use. Its size was approximately 5,600 square meter which took 18.9% of whole area. The water storage included ditch and basin (Loypradit, 2015). There were 3 water storages: big size water storage was 3,121m^2, medium size water storage was 1,713m^2 and small size water storage was 554m^2. It was curved and of different depths. The shallow part was for aquatic animal and the deep part was for keeping water in usage throughout the year (Promthong, 2007; Hutapaet, 2015). All of water storages connected by small canal which crooked through the planting plots such as mixed cropping plot, orchard and forest due to reduced costs of irrigation equipment (Hutapaet, 2015). If there were abundant of plant, we should make canal larger to be a basin for storage much water.

3. Paddy field (Naa)

Paddy field was 5,600 square meter which was 18.9% of whole area and could store water ou to 8,400m^3. The paddy field produced the organic rice and it divided into 9 plots. The ridge was 1.5-2 meters wide, 2 meters in high for water storage. The 2 meters height of ridge could store 1.5m of water and around 50% of the water could seep down to the soil (Loypradit, 2015), thus we should plant trees in the north and the south of paddy field to keep the shades off the rice (Hutapaet, 2015). If there were a little trees, the farmer could allow the shade on the rice to gain the benefit rather than disadvantage (Panyakul and Promsiri, 2015). On the ridge, we could plant any vegetable or herb or tree which could be use in household, the plant could process to biofermentation for farm such as soil conditioner, organic fertilizer, protect fungi, chasing insect and spread smell to trap the insect.

Discussion

The site plan design of land area to give the maximize must consider the local resource such as limitation, weather condition, soil and water, building location, road and all side area (Panyakul and Promsiri, 2015). Khok Nong Naa model considered from human behavior, culture, soil, water, windy direction and sunlight (Hutapaet, 2015). The principle of new theory of agriculture was to apply the economic sufficiency to earn the living (Committee of sufficiency economic propulsion, 2007; Witchachoo, 2012). New theory of agriculture divided land area to 4 parts and the model structure was 30% water storage, 30% paddy field, 30% cropping area and 10% residential area (Promthong, 2007) or we could divide the area into 3 parts which were 30% water storage, 60% paddy field and cropping area and 10% residential area (Somporn, 2005). The land area ratio didn't need to be the same as the philosophy but it could adjust for suitability of the weather condition and topography (Promthong, 2007; Panyakul and Promsiri, 2015). The farm areas were matching to successful in Thailand such as Suanlormsirin Sufficiency Economic Learning Center, Muang district, Saraburi province. It is located in the 32,000 square meter of land area which divided 10% of whole area for reservoir, 20% for paddy field and 70% for the rest forresidential, cropping area, and animal husbandry (Pandinthong, 2016). Also, Mab Aung Natural Agricultural Center at Baan Bung district, Chonburi province and KSL River Square Natural Agriculture at Muang district, Kanchanaburi province (Loypradit, 2016) are similar to the site plan of this study which divided land area into 18.9% water storage, 18.9% paddy field and 62.2% cropping area with activities area. It didn't have residential area for the trainees because they all could stay in residential area which located out side of the farm. This farm matched the faculty's preference because it could store water up to 104.18% which have confirmed to the concept of Khok Nong Naa model, that's about storage rainfall as 100% (Hutapaet, 2015).

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