

The Sustainable Development Goals, or SDGs, also known as the Global Goals, were adopted by all united nation members. The SDGs are integrated, universal and transformative—that is, they recognize action in one area that will affect outcomes in others, and development must balance social, economic and environmental sustainability. Simultaneously, UI GreenMetric World University Ranking is one of the most important organizations which believes that many universities around the world have strong efforts to implement environmentally friendly and sustainable policies and programs. In 2019, the UI GreenMetric World University Ranking has the major important topic which involves the SDGs **“Sustainable University in a Changing World: Lessons, Challenges and Opportunities”**. The subtopics can be described from Kasetsart University’s concepts as following: **Lessons**--This suite of lessons looks at the environmental threats to the planet and provides plenty of involving interactive tasks to help people in community understand how they can live more sustainable lives. Particularly, the lesson is defined as one of the most significant procedure to transform the community. Hence, the lesson is one of the most important practices that the university always realizes. **Challenges**- - Basically, sustainable development is a long- term solution to how the university plans indefinite progress in the future without causing damage to the environment so as to guarantee a safe habitat for the next generations who will continue to develop their economies, societies, and care for the environment with a similar ideal in mind. This satisfies the needs without sabotaging the opportunities of others. The concept covers a broad scope of matters such as environmental, social, and economic development which continues to prove its importance in our lives as it affects all aspects of them. The challenges are so necessary in current environment and they can help in living a more conscious and altruistic life. Kasetsart University has an effort to conduct knowledge resources by integrating with agricultural, environmental management and so on. **Opportunities**-- The Sustainable Development Goals present a unique and critical challenge for universities around the world. But they’re also bringing to light some of the biggest investment opportunities in a generation. There are big opportunities for purposeful development in the universities’ community. By finding better solutions to some of the challenges which are not only helping to achieve the SDGs; they are also opening up substantial growth opportunities, because they are meeting an unmet need and tapping into long- term demand drivers. From the three significant subtopics are the university’s intentions which are steadily and regularly concerned to construct identity of community in Kasetsart University.

As it was mentioned earlier, Kasetsart University has intentionally concerned in what the world has being faced and what the university have to necessarily do. Continuously, there are many university’ s policies that relate to enhance quality living of all people in the university and community around us. The mentioned policies earlier, they are called **“Three Paradigms of Transformation”** which are the main concerns for developing the university. The paradigms are the key elements to integrate people’s cooperation surroundings the community and in Kasetsart University. Firstly, the first paradigm is determined as **“Public Service”** which is a significant service intended to serve all members of the community. Latterly, the second paradigm relates to **“Social Engagement”** which includes activity, interaction, social exchange, and lack of compulsion. The university has built the continuum of community commitment to develop this paradigm such as transactional, transitional and transformational engagement. And the last paradigm is defined as **“Agricultural Innovation”** which means working process with leading agricultural researchers, businesses, landowners, and farmers to develop the knowledge and technologies that will make modern farming more sustainable, resilient, and productive. Through practical and interactive workshops, farm walks, and on- farm demonstrations, this will help the community to put knowledge into practice. Furthermore, Kasetsart University always realize in constructing a happy, vibrant community, and also making strong social connections that create a sense of belonging. And along with belonging comes a sense of responsibility to support each other. With a strong sense of belonging and knowing other community members will take care of each other comes a sense of peace, security, and meaning. Consequently, the **“Three Paradigms of Transformation”** are the major factors that can be seen in Kasetsart University’ s activities.

[1] Setting and Infrastructure (SI)

[1.1] Number of Campus sites

	<p>Main campus, Bangkhen campus (Kasetsart University, Thailand)</p>
	<p>Main campus, Bangkhen campus (Kasetsart University, Thailand)</p>
	<p>Main campus, Bangkhen campus (Kasetsart University, Thailand)</p>
<p>50 Ngam Wong Wan Rd, Lat Yao Chatuchak Bangkok 10900 Thailand Longitude = 13.84725 Latitude = 100.57157</p>	
<p>www.ku.ac.th</p>	

This is the original and main campus of the university. It is situated on the area measuring 846 rai (135 hectares) in the lower part of the northern zone of Bangkok at the distance of approximately 6 kilometers to the south of Don Mueang International Airport. At present, 15 faculties, 6 offices, 6 institutes and the Graduate School of the university operate at this campus with a total student population of approximately 38,681. The faculties are Agriculture, Agro-Industry, Architecture, Business Administration, Economics, Education, Engineering, Environment, Fisheries, Forestry, Humanities, Science, Social Sciences, Veterinary Medicine and Veterinary Technology. The headquarters of all colleges, institutes, centers and offices of the university are also located in the campus.

	<p>Kamphaeng Saen Campus (Kasetsart University, Thailand)</p>
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<p>Kamphaeng Saen Campus 1 Moo 6, Malaiman Road, Kamphaeng Saen, Kamphaeng Saen District, Nakhon Pathom 73140 Thailand Longitude = 14.02372 Latitude = 99.97487</p>	<p>http://kps.ku.ac.th/v8/index.php/en/</p>

Kasetsart University, the first Higher Education Institute in Thailand to offer an academically strong program in agriculture, has been established since 1943. It was located in the area belonged to the Ministry of Agriculture and Cooperatives called Kaset Klang Bangkhen or Central Kaset Bangkhen.

In 1965, M.L. Xujati Kambhu, the University President at that time, perceived that the existing area at Bangkhen was not adequate to support the educational expansion according to the National Social and Economics Development Plan. He then searched for a new site. The University Council considered that Kamphaeng Saen District was the most appropriate site for several reasons. Firstly it was only 80 kilometres from Bangkok and 30 kilometres from down town Nakhon Pathom Province. Secondly, the soil was fertile suitable for cultivation. The water can be channeled from the Meaklong River through the irrigation canel dug from the Vajiralongkorn Dam in Kanchanaburi Province. Moreover, big plots of land were available. The Council, then, presented the University master plan to the Cabinet for the purchase and development of land. It was approved on December 6, 1996. Kasetsart University bought altogether 7,951 rai of land and the first phase building were constructed in 1974 and finished in 1978.

On November 12, 1979, Kamphaeng Saen Campus started teaching and learning activities by moving the third and fourth year students in faculty of Agriculture and agriculture related programs from Bangkhen to Kamphaeng Saen. From 1990, Kamphaeng Saen Campus could offer classes to students from the first to the fourth year including graduate students.

	<p style="text-align: center;">SriRacha Campus (Kasetsart University, Thailand)</p>
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	<p>SriRacha Campus (Kasetsart University, Thailand)</p>
	<p>SriRacha Campus (Kasetsart University, Thailand)</p>
<p>Sriracha Campus 199 Moo 6 Sukhumvit Road, Tung Sukla, Sriracha District, Chonburi, 20230 Thailand Longitude = 13.12089 Latitude = 100.91940</p>	<p>http://www.src.ku.ac.th/index.php?Lg=en</p>

This campus occupies the area of 199 rai (32 hectares) in Si Racha District of Chon Buri Province at the distance of approximately 107 kilometers to the east of Bangkok. It was originally an agricultural research station of the university since 1954. Its establishment as a campus took place in 1989 and was dictated by the pressing of the country shortage of high quality manpower as a consequence of the Eastern Seaboard Development Project.

In the campus offers degree courses and short-term training programs in four faculties which are Management Sciences, Engineering at Si Racha, Economics at Si Racha and International Maritime College.

The campus also provides special master's degree programs in Business Economics, Agribusiness, Industrial Administration and Development and so on.

		<p>Chalermphrakiat Sakon Nakhon Province Campus (Kasetsart University, Thailand)</p>
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		<p>Chalermphrakiat Sakon Nakhon Province Campus (Kasetsart University, Thailand)</p>
<p>Chalermphrakiat Sakon Nakhon Province Campus 59 Moo 1 Tambon Chiang Khrua, Muang district, Sakon Nakhon Province, 47000, Thailand Longitude = 17.29016 Latitude = 104.10856</p>		<p>http://www.csc.ku.ac.th/en/</p>

Chalermphrakiat Sakon Nakhon Province Campus is the fourth campus of Kasetsart University. The campus was established in 1996 to commemorate the Golden Jubilee Anniversary of his Majesty King Bhumibol Adulyadej's accession to the throne. To mark such significance, His Majesty the King graciously granted permission for the university to include the modifying term "Chalermphrakiat", literally meaning "upholding the honor of His Majesty the King", in the name of the campus. The campus intends to provide much needed development - accelerating academic services and expected to be the center of education for the upper northeastern region of Thailand. Therefore, the campus will meet the needs of the growing region and will support the government's policy of expanding educational opportunities to the distance provinces. The campus aims are for development in management, education, teaching, research and human resources. These aims are in line with Kasetsart University's four primary objectives of learning and teaching, research and development, academic services and extensions, and promotion of traditional arts and cultures.

[1.2] Campus setting



Bangkhen (Kasetsart University, Thailand)

- 1.) In the initial period (1904-1913), agricultural education was first established. In 1904, Prince Phichaimahintharodom, Director of the Department of Sericulture of the Ministry of Agriculture, founded the School of Sericulture in Tambon Thung Saladaeng, Bangkok, adjacent to the mulberry gardens and the Sericulture Experimental Station. Initially, the School offered a two-year program devoted to sericulture alone, but in 1906, the program was extended to three years and expanded to include instruction on the cultivation of other crops and also on veterinary science, and at the same time, the name of the institution was changed to the School of Agriculture.



In 1908, the Ministry of Agriculture merged the three schools under its jurisdiction, namely, the School of Surveying, which had been founded in 1882, the School of Irrigation, founded in 1905, and the School of Agriculture, in order to train personnel to serve in the various departments and divisions of the Ministry. The school was named the School of the Ministry of Agriculture and was located in the Sapathum Palace. At the same time, a new curriculum, Thailand's first tertiary-level agriculture curriculum, was drawn up and was inaugurated in 1909.

In 1913, the Government of Siam merged the School of the Ministry of Agriculture with the Civil Service School, which was established under the Ministry of Public Instruction and Religion, because the purposes of the two were identical. Agricultural education was thus placed under the Ministry of Public Instruction and Religion.

2.) In the middle period (1914-1923), the first primary school agriculture teacher training school was established. The Minister of Public Instruction and Religion, Chao Phraya Thammasakmontri (Sanan Thep-hatsadin na Ayutthaya), founded the Primary School Agriculture Teacher Training School at Ban Suan Luang in Bangkok. The School offered a two-year program for graduates of Secondary Level 3 (the entrance requirement was later raised to Secondary Level 6). Upon completion of the program, graduates were awarded a certificate in primary school agricultural education. In 1918, the School was relocated to Tambon Phra Prathon in the Meuang District of Nakhorn Pathom Province.

3.) In the later period (1924-1942), the primary school agriculture teacher training school system was established in all regions of the country. In 1924, the Primary School Agriculture Teacher Training School was moved from Nakhorn Pathom Province to Tambon Bang Saphan Yai in Bang Saphan District of Prajuab Khirikhan Province, and in 1926, a second primary school agriculture teacher training school was established in Tambon Thap Kwang in Kaeng Khoi District of Saraburi Province. Following this, agricultural education on the primary and secondary levels was provided through primary- and secondary-level agriculture technical schools.

Toward the end of the year 1931, Mom Chao Sitthiphorn Kritdakorn, Director of the Agricultural Research Department of the Ministry of Agriculture, proposed that agricultural research stations be set up in the Northeastern, Southern, and Northern Regions together with primary school agriculture teacher training schools so that agricultural research and agricultural education could be carried out in concert. As a result, primary school agriculture teacher training schools and agricultural experiment stations were established in each region of the country, and in this way, the Ministry of Agriculture once again became involved in agricultural education.

In 1933, the Non Wat Primary School Agriculture Teacher Training School was established in Tambon Non Sung, Non Sung District, Nakhorn Ratchasima Province, and the Mae Jo Primary School Agriculture Teacher Training School was established in Tambon Nong Han, Sansai District, Chiang Mai Province.

In 1934, the Khor Hong Primary School Agriculture Teacher Training School was established in Tambon Khor Hong, Hat Yai District, Songkhla Province.

The operating of agricultural experiment stations in conjunction with the three primary school agriculture teacher training schools proved to be an excellent model of the interplay between research and education. The first experiment-station-head-cum-headmasters were Luang Ingkhasikasikan at Non Wat, Luang Suwan Vajokkasikij at Khor Hong, and Phra Chuangkasetsinlapakan at Mae Jo.



In 1935, agricultural education policy changed once again. The government, concerned that the numbers of agriculture teachers graduated would be in excess of needs, decided to close the three new primary school agriculture teacher training schools. In response, Luang Ingkhasikasikan, Luang Suwan Vajokkasikij, and Phra Chuangkasetsinlapakan together proposed a project whereby the Mae Jo school was retained as a secondary-level agriculture technical school. This was later elevated to become the College of Agriculture, with the status of a division in the Department of Agriculture and Fisheries. The person appointed to serve as the first director of the College was Phra Chuangkasetsinlapakan.

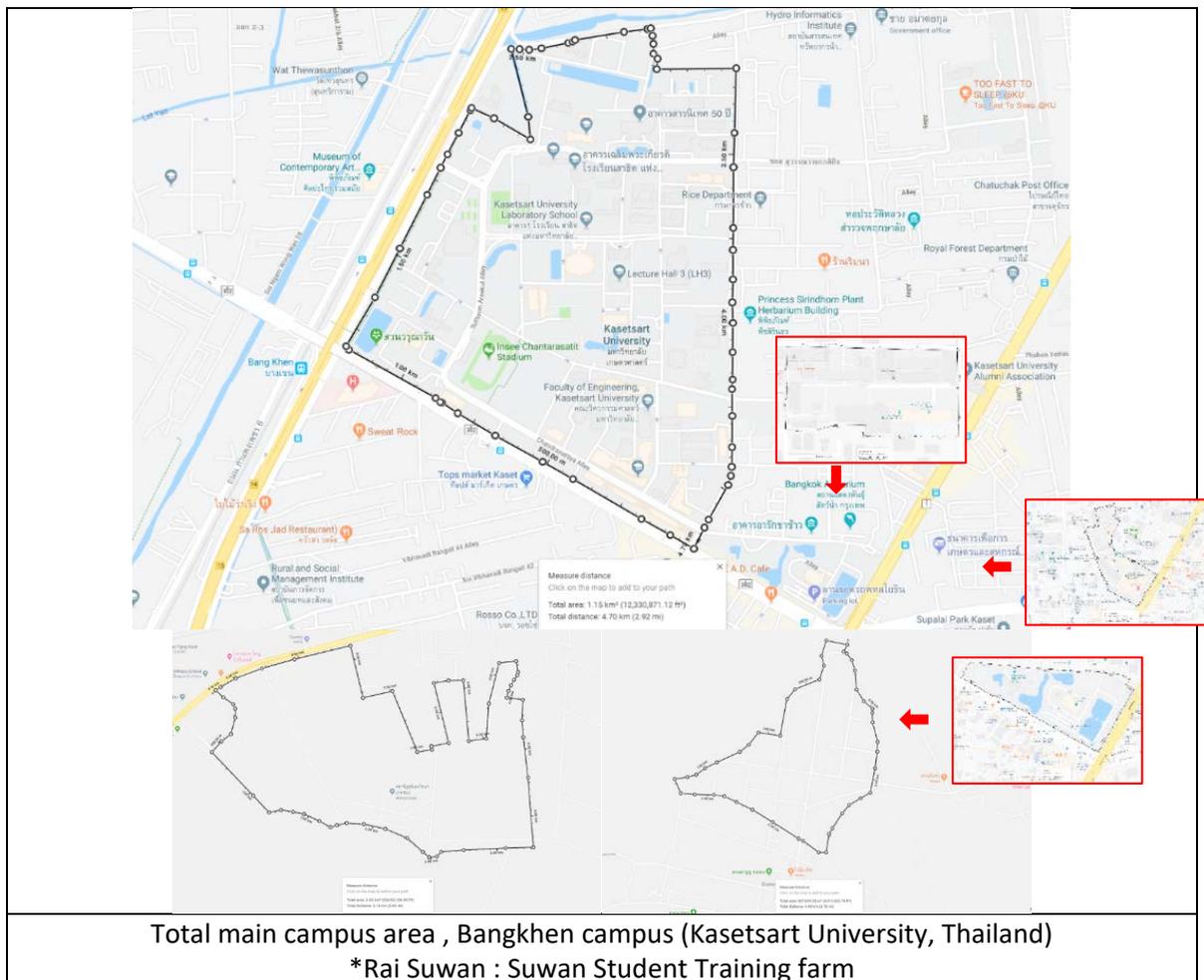


Also in 1935, the Ministry of Agriculture established in Phrae Province another technical school, namely the School of Forestry, which offered a two-year program, and shortly later, this was made a part of the College of Agriculture.

In 1938, the Ministry of Agriculture established the Central Agriculture Station, or Kaset Klang, in Bang Khen District of Bangkok, the area in which the main campus of Kasetsart University is located. The College of Agriculture was moved from Mae Jo to Bang Khen, and Luang Suwan Vajokkasikij became the director. The College offered three-year certificate programs in three fields: agriculture, cooperative science, and forestry. Students of the agriculture program studied all three years at Bang Khen, while students of the cooperative science program studied their first two years at Bang Khen and their third year at the Department of Cooperatives at Tha Thian in order to facilitate their practical training. The forestry program was conducted at the School of Forestry in Phrae Province.



[1.3] Total campus area (m²)



Description : Kasetsart University

location 50 Ngam Wong Wan Rd, Lat Yao Chatuchak Bangkok 10900 Thailand

Longitude = 13.84725 Latitude = 100.57157 www.ku.ac.th

Total area: = 1,281,600 + 4,142,400 = 5,424,000 m²

Total distance: 4700+687+1110+1330+13640 = 21,467 m

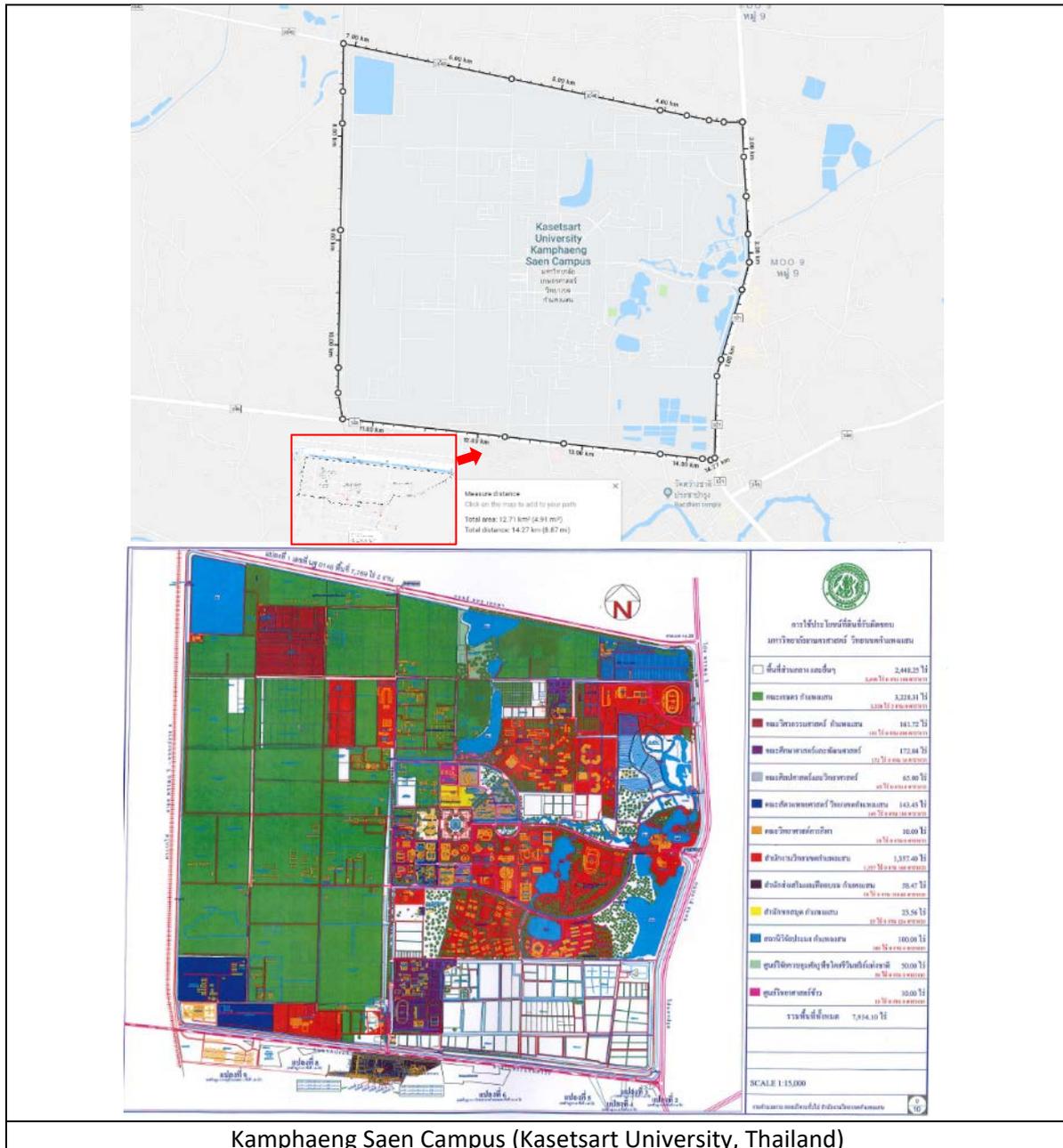
Rai Suwan : Suwan Student Training farm Is a unit of Kasetsart University Bangkhen campus under the Faculty of Agriculture With a total area of 4,142,400 m²

Conduct research on corn, sorghum and other crops involved in a complete corn and sorghum production system to support the teaching and research of Kasetsart University. And applying the results of research to benefit society By formulating a policy for research production that is new body of knowledge to develop academic strength And basic knowledge in the field of plant science continuously Including increasing the competitiveness of the country To the international level

Is an internship for students of Kasetsart University And students from various educational institutions Both domestic and international in the field of corn, sorghum and economic crops, by establishing a training plan and policy for students in accordance with the curriculum. To increase knowledge and experience by taking action

Providing academic services to society By transferring technology in all forms In order to reach the users and maximize benefits By formulating a policy of continuously transferring technology to the community Both domestic and international

Is the location of the seed and log plant To provide services to farmers, private companies and the general public By determining the policy of producing good quality seeds and logs Providing services to farmers, private companies and the general public. As appropriate for the situation in each year Including providing seed conditioning services to various organizations Both public and private



Kamphaeng Saen Campus (Kasetsart University, Thailand)

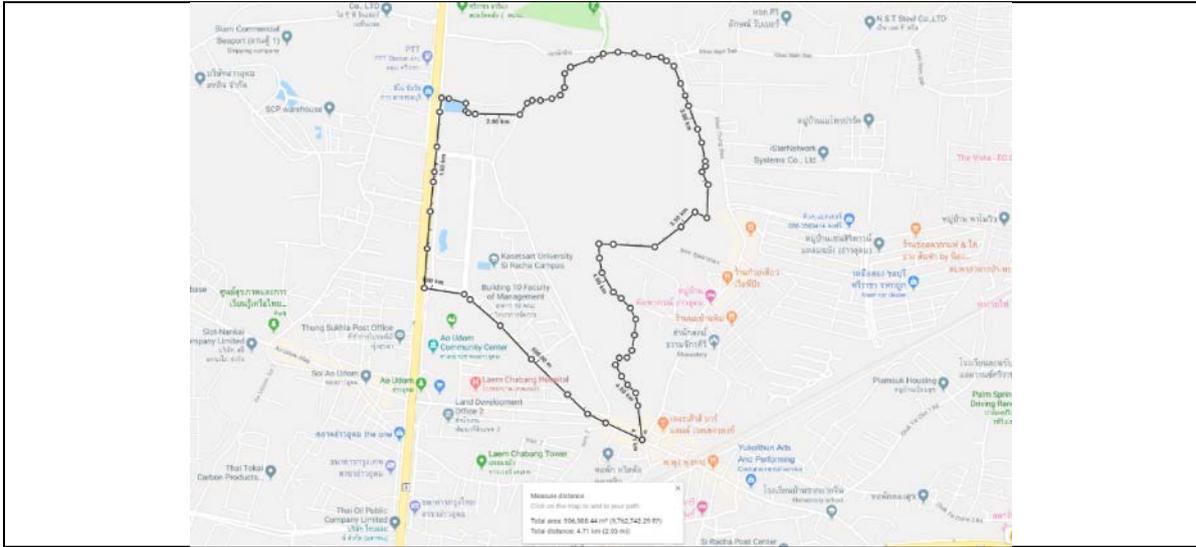
Description : Kamphaeng Saen Campus

1 Moo 6, Malaiman Road, Kamphaeng Saen, Kamphaeng Saen District, Nakhon Pathom 73140 Thailand

Longitude = 14.02372 Latitude = 99.97487 <http://kps.ku.ac.th/v8/index.php/en/>

Total area: = 12,726,560 m²

Total distance: 12,710+1,550 = 14,260 m



Sriracha Campus (Kasetsart University, Thailand)

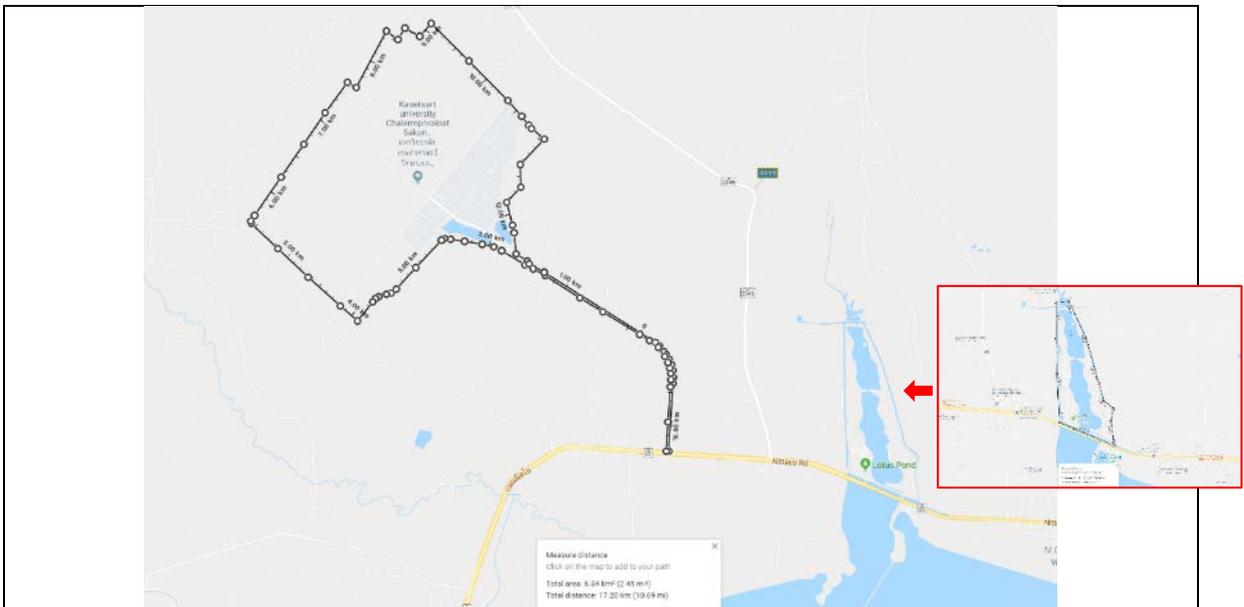
Description: Sriracha Campus

199 Moo 6 Sukhumvit Road, Tung Sukla, Sriracha District, Chonburi, 20230 Thailand

Longitude = 13.12089 Latitude = 100.91940 <http://www.src.ku.ac.th/index.php?Lg=en>

Total area: = 862,592 m²

Total distance: = 47100 m



Chalmphrakiat Sakon Nakhon Province Campus (Kasetsart University, Thailand)

Description : Chalmphrakiat Sakon Nakhon Province Campus

59 Moo 1 Tambon Chiang Khrua, Muang district, Sakon Nakhon Province, 47000, Thailand

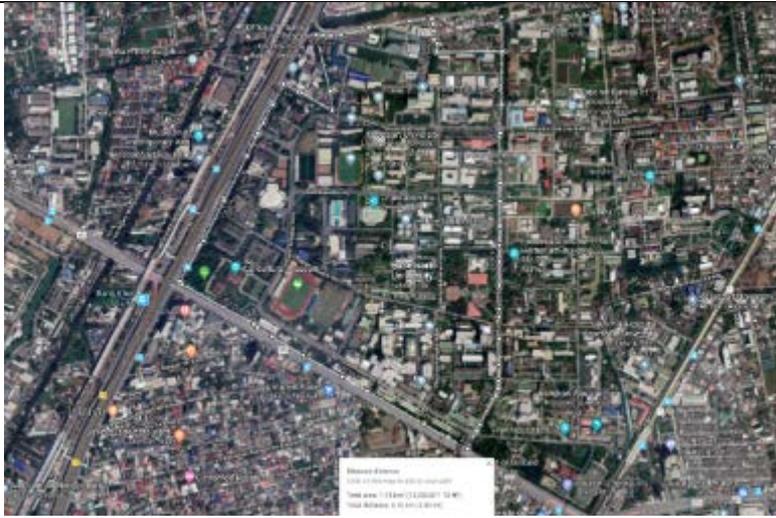
Longitude = 17.29016 Latitude = 104.10856 <http://www.csc.ku.ac.th/en/>

Total area: = 7,730,464 m²

Total distance: 17,200+5,270 = 22,470 m

Campus	m ²	
Kasetsart University , Bangkhen	=5,424,000	
Kamphaeng Saen Campus	12,726,560	
Sriracha Campus	862,592	
Chalermphrakiat Sakon Nakhon Province Campus	7,730,464	
∴ Total	26,743,616	

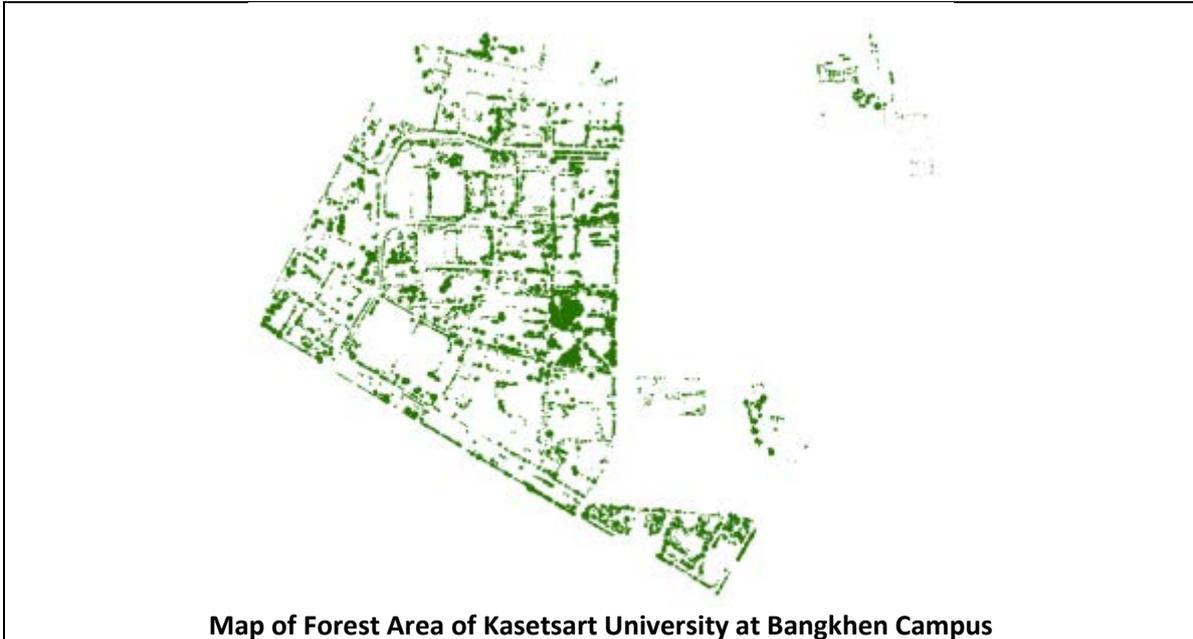
[1.4] Total area on campus covered in forest vegetation (m²)



Map of Forest Area of Kasetart University at Bangkhen Campus



Identified Forest in KU



Map of Forest Area of Kasetsart University at Bangkhen Campus

Definition of “Forest”

The Food and Agriculture Organization of the United Nations (FAO)

- 0.5 hectares for minimum area
- 5 meters for minimum tree height
- 10 percent for minimum crown cover

The United Nations Framework Convention on Climate Change (UNFCCC)

- 0.01-1.0 hectares for minimum area
- 2.5 meters for minimum tree height
- 10-30 percent for minimum crown cover

Our Definition

- 0.01 hectares for minimum area
- 5 meters for minimum tree height
- 10 percent for minimum crown cover

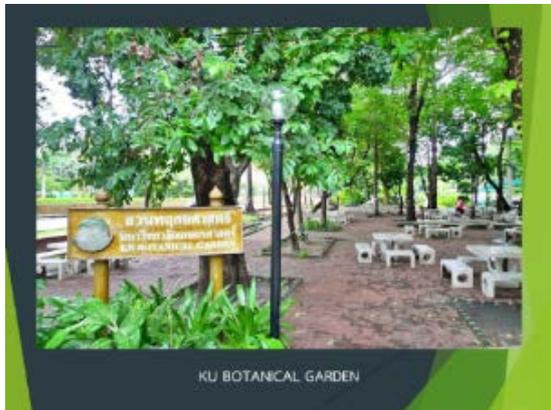
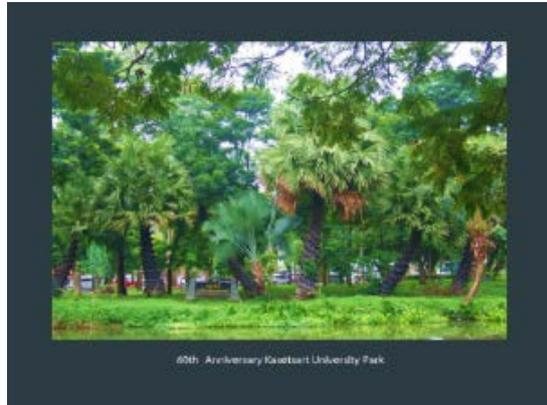
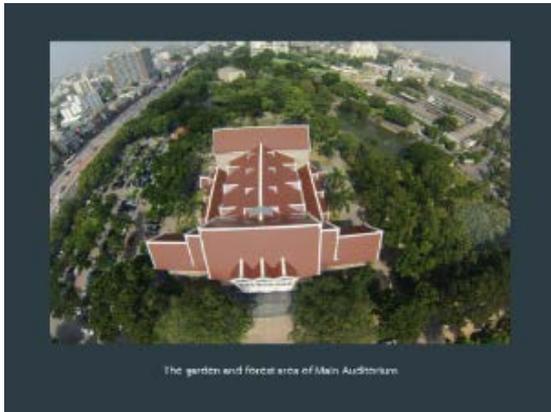


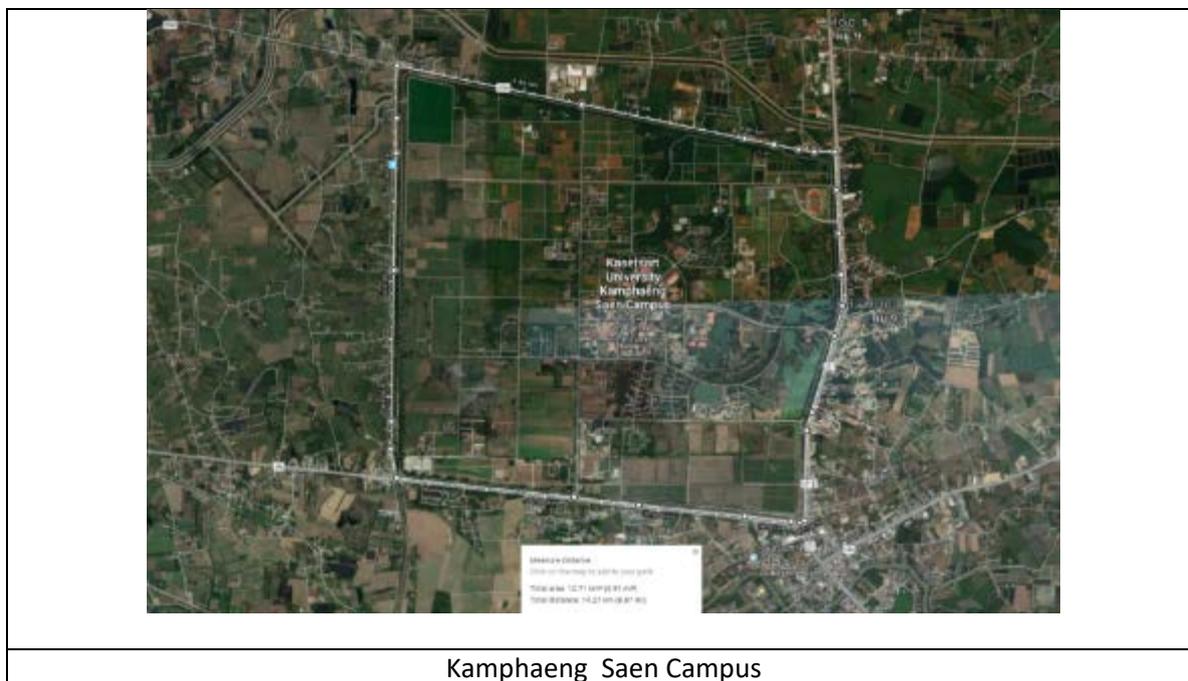
Description:

Total area: 273,177 m²

Total distance: 4.84 km

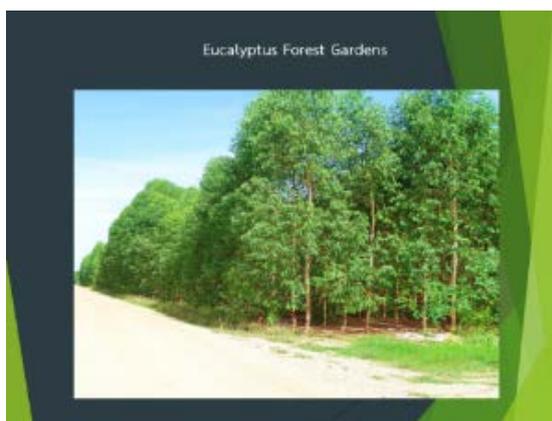
Bangkhen Campus





Description:
Total area: 1,357,159 m²
Total distance: - km

Kamphaeng Saen Campus





SriRacha Campus

Description:

Total area: 555,955 m²

Total distance: 3.88 km



72ndYear HM Queen Sirikit Chalermprakiat Dry Dipterocarp Park
Chalermprakiat Sakon Nakhon Province Campus

Description:

Total area: 2,351,984 m²

Total distance: 13.23 km

Area on campus covered in forest vegetation	Distance (km)	Area (m ²)
Main campus , Bangkhen campus	4.84	273,177
Kamphaeng Saen Campus	-	1,357,159
Si Racha Campus	3.88	555,955
Chalermprakiat Sakon Nakhon Province Campus	13.23	2,351,984
Total		4,538,275

Total area on campus covered in forest vegetation. 17 percentage

[2] Energy and Climate Change (EC)

[2.1] Energy efficient appliances usage (Figure 2.1-1)

Lesson: Best Practice

Kasetsart University announced the guideline of electrical energy conservation policy for all departments in the university. The principle to use electricity efficiently, cost-effective, and has the greatest benefit which must start from the method of choosing electrical appliances that are effective and suitable for use. As well as, knowing how to use that electric appliances. This is not only helping to save energy but also having a good impact on the public, in terms of preserving nature and the environment.



Figure 2.1-1 Proactive policy of approach on Green University

1. Changing of LED and T5 light bulbs at many offices in the campus (Figure 2.1-2)



Changing of LED and T5 light bulbs



Automatic dim light control equipment



Automatic optical sensor equipment



LUX Sensor (The area connecting the building)

Figure 2.1-2 Changing of LED and T5 light bulbs

Automatic movement sensor set to turn on the light when in use.



Energy consumption monitor



Energy measurement system

Figure 2.1-2 (Cont.) Changing of LED and T5 light bulbs

The information from the EIS system, which installed in the University Library, were used to assess energy consumption of the Library. Using of machinery, energy, and air system within the Library. The meter was installed on the 4th floor of Debaratana Vidhayachote Building. There was a project to set up an EIS energy information promotion point on the 1st floor of the building. So that students can study various energy information Including air quality data of the 4th floor of the building.

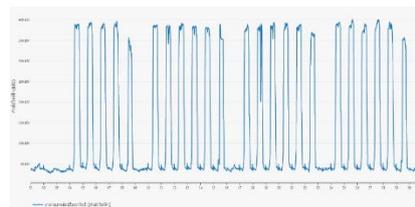


Figure 2.1-3 The graph shows the power consumption

2. Energy-saving labels number 5 air conditioner with Inverter system can save 20-30 % of electrical power. (Figure 2.1-4)



Energy-saving labels number 5 air conditioner



Temperature, humidity and carbon dioxide measuring system



Air ventilation system to control carbon dioxide and increase Good air circulation / ventilation

Figure 2.1-4 Energy-saving labels number 5 air conditioner with inverter system can save 20-30 % of electrical power.

3. Changing of LED street lights

Kasetsart University conducted a project on changing of LED street lights. It is brighter and saved 50 – 70 % of electrical consumption. (Figure. 2.1-5)



Figure. 2.1-5 Changing of LED street lights

Challenges:

Kasetsart University is a higher education institution that pays more attention to the use of energy-saving electrical devices. The University encourages all departments to use LED bulbs instead of traditional bulbs. At present, more than 105,397 bulbs were changed, which is 88.34 % of all bulbs in the University. In addition, 19,009 of energy saving air-conditioners were changed. It is 80 % of all air-conditioner in all campuses. The University set a goal to change to energy saving electric appliances in 3-5 years.

Therefore, challenge proving is collaboration between students and staff to reduce energy consumption and a promotion on efficient using of energy with 5-10% a year reduction.

Opportunities:

At present, ENCOM LED is a technology for producing energy-saving light bulbs. It is an innovation for efficient lamp production. It does not emit UV rays and heat when operating and safe from mercury, it is more than 40,000 hours of lifespan and help reducing environmental problem. Many forms of innovation and production of energy-saving electrical appliances have operated in the country. This is an opportunity for Kasetsart University to use technology, from the development of efficient electrical appliances, to be useful and suitable for each location. Besides, it is concurrence to the university's electricity saving policy.

[2.2] Smart Building implementation

Kasetsart University renovated buildings into ‘Smart Building’ by using Building Automation System (BAS). The BAS will automatically control air conditioning, lighting, fire control, access control, security and elevator control system. (Figure 2.2-1)



Figure 2.2-1 Building Automation System (BAS)



Figure 2.2-2 Light, temperature, humidity automatic control system



Staff have to pass the finger print for scanning access system before enter to the Data Center at the Office of Computer Services, KU.

Figure 2.2-3 Finger print scanning access system with identification card



Setting of online CCTV system, it can be monitor anytime, anywhere via internet.

Figure 2.2-4 Online CCTV system



Gas extinguisher for automatic fire protection



Automatic fire engine system runs by gasoline in case when electrical power is disruptive or cut off.

Figure 2.2-5 Automatic fire engine system runs by gasoline/diesel.

Electrical consumption management via the Internet of Things application

The Faculty of Sports Science has installed devices for electrical consumption management via the Internet of Things application.



Figure 2.2-6 Electrical consumption management via the Internet of Things application

Challenges:

Kasetsart University is aware of the design of the new construction, with the objective of being a smart building. The important thing is that the building must respond to the user as completely as possible. Choosing the right technology for users, there are three principles for consideration, namely: economic worthiness, social needs and environmental friendly. Therefore, it can be considered that the smart building is designed appropriately.

Kasetsart University has a goal of designing of smart building by using the capabilities of the entire building system, to meet the needs of users for more convenient, having a better overall environment, and be able to maintenance very well and efficiently. In response to, today's rapidly changing of technology and environment.

Opportunities:

Indoor energy management systems will be more required in the future. In order to meet the increase of energy efficiency even more. Kasetsart University uses the Building Automation System (BAS) together with raising awareness for students and personnel to save energy. Resulting in 5-10% reduction in electric power usage. Currently, there is an Internet of Energy system. The application of IoT-Internet of Things, and energy conservation systems, will help increase energy efficiency, according to the changing environment. The Internet of Energy system consists of a network of smart devices, which has sensors, transceiver, and micro [Artificial Intelligence](#) (AI), which can communicate among themselves through communication systems such as the internet and automatically perform operations.

[2.3] Please specify renewable energy sources in campus and provide capacity produced in kilowatt hour

There are 5 kinds of renewable energy which Kasetsart University set a policy for consumption namely: bio diesel, clean biomass, solar power, wind power and combination of heat and power (biogas). The usage of renewable energy is 148,403 kilowatt in 2019.

1. Solar energy which is a project for teaching and learning of the Faculty of Engineering, Sriracha campus, with a size of 30 kilowatts and 13 kilowatts.



Figure 2.3-1 Solar Power

2. Biodiesel production station

Kasetsart University produced biodiesel by BTC-150 machine. The BTC-150 has a capacity of 150 liters/ time and develops consecutively to KUB-200 which has a capacity of 200 liters / time, with a capacity of 700 liters / day.

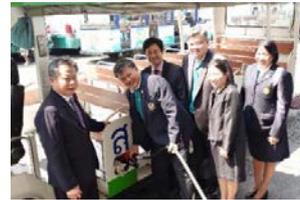


BTC-150



KUB-200

Kasetsart University joined the pilot project on testing the use of B10 biodiesel under the project "Support the Increasing Proportion of Biodiesel Usage" with the National Metal and Materials Technology Center, National Science and Technology Development Agency. The biodiesel will be used with no less than 10 common cars and welfare buses of Kasetsart University, in order to jointly assess the use of B10 from biodiesel that has been actually increased in the field. Before pushing for the use of B10 biodiesel as a tangible alternative fuel. Also in line with the Green University Project of Kasetsart University, to raise awareness of the biofuel using and reduce pollution caused by operated buses on campuses, especially the nano dust PM 2.5 (Environmental Nano-pollutants: ENP).



A 100-kw.- farm generator powered by integrated fuels of synthesized gas from a 3-stage and diesel oil gasifier powered by fuel of paddy husk and diesel oil compressed bar charcoal on process of production

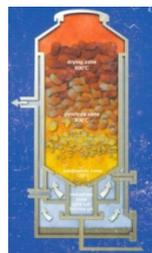


3. Biogas production station

Biogas production station of Kasetsart University produced gas from food waste 400 kg. /day and converted into heat energy from a gas tank of 15 cubic meters to use in the canteen.



4. Gasification Stove has a diagram of Figure 1, which is heated to the neck at about 1200 ° C. This hot gas is heated to about 5,000 kilojoules (kJ)., which can be ignited. The composition of the biomass consists of Carbon Monoxide 18-25%, Carbon Dioxide 5-10%, Hydrogen 13-15%, Methane 3-5%, Nitrogen 45-54%, and Steam 10-15%. There is also a hot gas fired furnace with charcoal and biomass as shown in Fig. 1 and Fig 2.



Picture 1 Diagram of Gasification Stove
Waste

2 gasifier stove with charcoal fuel Source:
Waste to Energy Ltd.

5. Usage of wind power



Challenges:

Kasetsart University has set a goal to manage renewable energy concretely in the next 2-3 years. The University will construct the roof of the parking lot, which is a solar power generation system. This system will be used for 15 welfare electric buses of the University for student and personnel transportation services and general public around the university. Apart from installing a solar roof system for electricity generation, the other challenge is establishment of a solar farm on various campuses. This will be a source of learning about clean energy for students and surrounding community.

Opportunities:

At present, the government has a policy to promote more alternative energy for energy security and to reduce rely on energy from petroleum of the country. As a result, these energy sources are expanding a lot. Solar energy, wind energy, and bio-fuels are classified as alternative energy with the highest growth. It is expected that alternative energy will expand, due to better production technology and lower costs. It is an environmental friendly energy. Therefore, it is the reason that the country's policy focuses on the development of energy from these sources.

[2.4] Electricity usage per year (in kilo watt hour)

Table 2.4-1 Overall electrical consumption in 2016 – 2019

Year	Electricity Unit (KWH)	Population (people)	Area (sq.m.)	Proportion	
				KWH/person	KWH/m ²
2016	79,936,201	77,730	1,945,920	1,028.38	41.08
2017	78,716,665	78,077	2,105,665	1,008.19	37.38
2018	74,780,832	76,512	2,105,665	977.37	35.51
2019	74,630,066	82,962	2,302,030	899.56	32.42



Figure 2.4-1 Electrical consumption for library research

Challenges:

Kasetsart University aims to reduce 5-10% per year of energy using. Departments have to implement specified policies, such as selection of energy-saving electrical devices, organizing training program on energy conservation, raising awareness and participation for students and personnel, and using of various technologies to control electrical system, lighting, air-conditioner for energy saving.

Opportunities:

Nowadays, the overall economy of Thailand is continuously growing. Demanding of electricity of the country is increasing steadily. But the power generating capacity is still not sufficiently responsive. Therefore, the country has to rely on the import of energy from foreign countries. While the energy price in the world market has continuously increased, until affecting the domestic energy situation inevitably. The government, therefore, considered the need to increase the ability to be self-reliant. Additionally, with the current awareness of global warming that requires reducing greenhouse gas emissions, new forms of alternative energy such as solar, water, wind, biomass and biogas are being developed to replace fossil energy. By focusing on clean energy and environmentally friendly.

[2.5] Elements of green building implementation as reflected in all construction and renovation policies

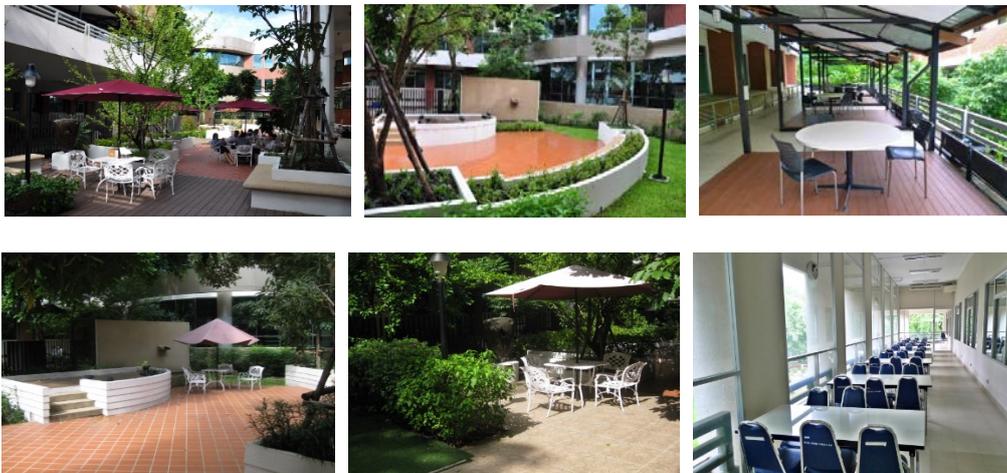
1. The design of the building for ventilation and natural light. (Figure2.5-1)



Figure2.5-1 The interior design of the university emphasize on the ventilation and natural light.

Library in the Park

The Office of the University Library created area between buildings as “Library in the Park” 1so that students can sit and relax in natural site.



To respond to the “Green Campus” policy, the Office of the University Library renovated 475 square metres of space (which was damaged from mega flood incident in 2011) within the office to be “Library in the Park”- reading area in natural atmosphere and saving energy for student and staff. Moreover, the Office separated space within the Library in the Park as a site of special event such as “Music in the Park” among variety of botanical garden which comprised of 2 species of plant: Acanthaceae and Bignoniaceae.

2.The Faculties/Offices of Kasetsart University appointed a sub-committee on energy management to set a policy and plan of energy conservation approach that follow the university's overall plan and appointed managers of building who can conduct efficiently the plan. (Figure 2.5-2)



Figure 2.5-2 Energy Conservation Committee

Kasetsart University Library/Learning Center (KULC) wins the Thailand Energy Awards 2018

Kasetsart University Library/Learning Center (KULC) wins the Thailand Energy Awards 2018 for concept of energy efficient building. Dr. Anamai Damnet, Vice President for Special Projects and Suphan Buri Establishment Campus Project, received the award plaque from Deputy Prime Minister of Thailand Air Chief Marshal Prajin Juntong, The library representative including Dr. Aree Thunkijjanukij and staff of library participated in the award ceremony.

Kasetsart University Library/Learning Center (KULC) has been promoting the energy conservation in the library building since 2015-2017, such as installation of paper pulp roof insulation, replacing LED lamps, installing pull-chain light fixtures, installing air exchanger & ventilator equipment. Overall it helps saving the energy up to 501,973 kWh.

In addition, the 7S Model for Organization Improvement and the transferring of technology and knowledge among 10 members of the Green Library Network have also been implemented. The Thailand Energy Awards 2018, the Department of Alternative Energy Development and Efficiency organized the contest to honor those who have outstanding performance in energy conservation and alternative energy development. It promotes awareness of energy conservation and promotes the development of alternative energy. It also creates awareness for those who are involved in applying for sustainable development.



Kasetsart University Library Office organized the training on energy and environmental management project for library’s personnel and users, according to UI Green Metric criteria. This program was held to promote various activities related to energy and environmental conservation, in accordance with the ranking criteria of the UI GreenMetrics Ranking.



Figure 2.5-3 Training Activity on Internal Auditors of Energy, Library

3. The building was rewarded which related to the design as the energy conservation building. The design of a new building of the Faculty of Engineering at KamphaengSaen received award from the Department of Alternative Energy Development and Efficiency (DEDE). This design passed the Building Energy Code (BEC), standard criteria for efficient energy consumption building evaluation which accredited by DEDE. (Figure2.5-4)



Figure 2.5-4 Lecture Building of the Faculty of Engineering at KamphaengSaen

4. Bidyalankarana Learning Center building, Faculty of Economics, Kasetsart University received "BEC Awards 2018". This is the label for energy efficiency standard of new building design.

The Department of Alternative Energy Development and Efficiency (DEDE) offered the "BEC Awards 2018" to 18 buildings that met the Building Energy Code (BEC) design standard for energy conservation. In 2018, there were only 18 buildings out of 114 buildings from 33 organization were inspected and certified from DEDE.

Bidyalankarana Learning Center building of Faculty of Economics, Kasetsart University is a -13storey building. It has an area of 22,979 square meters, with a height of 69.5 meters and WWR 20% of ratio. This building can save 54% of energy and received a very good building rating.



Figure 2.5-5 Bidyalankarana Learning Center building of Faculty of Economics, Kasetsart University

5. Kasetsart University has a policy on increasing green area inside and outside of the building



Figure2.5-6 Office of Academic Resources, the Office of Extension and Training Building designed to use natural light.



Figure2.5-7 Green Building of the Faculty of Economics and a part of the Institute of Food Research and Product Development

Challenges:

According to a criteria of Thai Green Building, Kasetsart University has a policy to preserve green spaces by requiring new building size 1,000 square meters or more to have a green roof, green wall or install solar energy, at least 50% of the green roof area totally. All buildings in the university will have natural ventilation system, using a translucent roof, using of shading materials to reduce heat entering the building, and planting trees on the roof. As for the master plan of the university, the buildings that was constructed before, will be renovated. It is another challenge to improve the building to meet the green building criteria.

Opportunities:

Demanding of energy-saving and environmental friendly buildings is increasing in all parts of the country as of the support, promotion and supervision of the government. According to a policy on energy conservation promotion and the Ministerial Regulations on the design of energy conservation buildings issuing in 2009 until reissuing in 2013, the Department of City Planning and Urban Development, Bangkok Metropolitan Administration has issued a new city plan. Which clearly requires that the new building will have to build as environmental friendly in both energy and water saving, as well as increasing green space. This is an opportunity for Kasetsart University to issue regulations on building construction which must be environmental friendly, electricity saving, and remain natural in the area. In addition, using all resources in the building worthwhile and to be a source of learning a

[2.6] Please provide total carbon footprint (CO₂ emission in the last 12 months, in metric tons)

table 2.6-1 Calculation of carbon footprint

NO.	Description	CO ₂ emission (ton CO ₂ eq.)	Proportion (%)
1	Electricity	62,689.26	92.9879
2	Transportation-bus	0.21	0.0003
3	Transportation-car	3,326.82	4.9347
4	Transportation-motorcycle	1,400.26	2.0770
	Carbon Footprint (ton CO ₂ eq.)	67,417.55	100
<p>Kasetsart University with total area of forest 1,426.89 rai, absorbs carbon dioxide of 1,353.15 tons per year.</p>			

Kasetsart University Forests

Kasetsart University Forests plays an important role in the production of research. student Internship and academic services to the society as well as providing the ecosystem service for students, staff and visitors, as the source of greenhouse gases, water sources, conservation of plants and animals, etc. For the economy and society, it is the food banks, and the hiring place of local workers for distributing of the ecotourism to the community.

No.	Area	Area (Rai)	CO ₂ (Ton)
(1) Campus		1426.89	1,355.24
1	Kasetsart University Bangkhen Campus	24.89	223.25
2	Kasetsart University Kamphaeng Saen Campus	131.00	124.45
3	Kasetsart University Chalemphrakiat Sakon Nakhon Province Campus	931.00	884.45
4	Kasetsart University Sriracha Campus	340.00	323.00

Kasetsart University Forest plays an important role as a recreation area and a source of carbon dioxide. Kasetsart University Forest at Chalermphrakiat Sakon Nakhon Province Campus is a community food bank for people to collect forest products.

1. Kasetsart University Bangkok Campus with total area of forest 24.89 rai, absorbs carbon dioxide of 21.25 tons per year.

- 1) Varunawan Park, 6 rai, absorbs 5.7 tons of carbon dioxide per year.
- 2) Thai Commemorative Garden, 4.6 rai, absorbs carbon dioxide absorbed 4.37 tons per year.
- 3) 100 years garden of Luang Suwan Vajokkasikij, 5.25 rai, absorbs carbon dioxide 4.99 tons per year
- 4) 60-year garden, 6.52 rai, absorb carbon 6.19 tons of carbon dioxide per year.
- 5) Arokaya Utthayan..2.5 rai., absorb carbon 2.09 tons of carbon dioxide per year.



2. Kasetsart University Kamphaeng Saen Campus

His Majesty the King's 80th Birthday Anniversary Park, the area of 131 rai absorbs 124.45 tons of carbon dioxide per year.

3. Kasetsart University Chalermphrakiat Sakon Nakhon Province Campus

H.M. Queen Sirikit's 86th Birthday Anniversary Natural Park and Dipterocarp Forest with the area of 931 rai including of variety of species of the plants such as dipterocarp forest, Shorea siamensis Miq., Shorea obtuse Wall., Terminalia alata Heyne ex Roth., Buchanania latifolia Roxb., Aporosa avillosa Baill., Xylia xylocarpa (Roxb.) Taub. , absorbs 884.45 tons of carbon dioxide per year.

4. Kasetsart University Sriracha Campus

Khao Nam Sap, 340 rai of a dry evergreen forest with notable species include Wrightia tomentosa Roem., Lagerstroemia floribunda Jack., Nephelium hypoleucum Kurz, absorbs 323 tons of carbon dioxide per year.

Assist. Prof. Dr. Ratchot Chompunich, Vice President for Strategic Development and Organizational Communication, Kasetsart University, participated in the event on "Hundred Hearts Unite to Reduce Global Warming" which organized by the Greenhouse Gas Management Organization (Public Organization), and received a certificate from Mr. Thaneadpon Thanaboonyawat, Secretary to the Minister of Natural Resources and Environment, which gave to Kasetsart University for organizing the carbon neutral events from the KU President Forum: Celebration of the 76th Anniversary of Kasetsart University. The special event was organized by the Office of the President of Kasetsart University.



Assist. Prof. Dr. Rattanawan Mungkung, Director, along with researchers of the VGREEN team of the Faculty of Environment, Kasetsart University joined the event "Hundred Hearts Unite to Reduce Global Warming" organized by the Thailand Greenhouse Gas Management Organization (Public Organization), and received a certificate from Mr. Thaneadpon Thanaboonyawat, Secretary to the Minister of Natural Resources and Environment. Which is given to "Thai People Carbonless Heart (carbon-neutral man)", from assessing the annual greenhouse gas emission from daily activities, and buying carbon credits to compensate all to zero. This showed responsibility to society and environment, and helped reduce global warming.



The Green Library Network and the VGREEN team of the Faculty of Environment, Kasetsart University received a certificate of the "Thai People Carbonless Heart (carbon-neutral man)" from assessing the annual greenhouse gas emission from daily activities, and buying carbon credits to compensate all to zero. The "Hundred Hearts Unite to Reduce Global Warming" event was organized by the Greenhouse Gas Management Organization (Public Organization).



A training activity for internal energy auditors and the Carbon Footprint training course, under the Energy and Environment Management Program, in accordance with UI Green Metric criteria was organized by the Kasetsart University Library. The objective of the activities was to promote various activities related to energy and environmental conservation for personnel and users of the Kasetsart University Library.



Figure 2.6-1 Carbon Footprint training course



Figure 2.6-2 The Office of the University Library, KU was the very first carbon neutral library of Thailand.

Kasetsart University is the first certified Thai university by Thailand Greenhouse Gas Management Organization (Public Organization), under the Thailand Voluntary Emission Reduction Program in forestry and green area category.

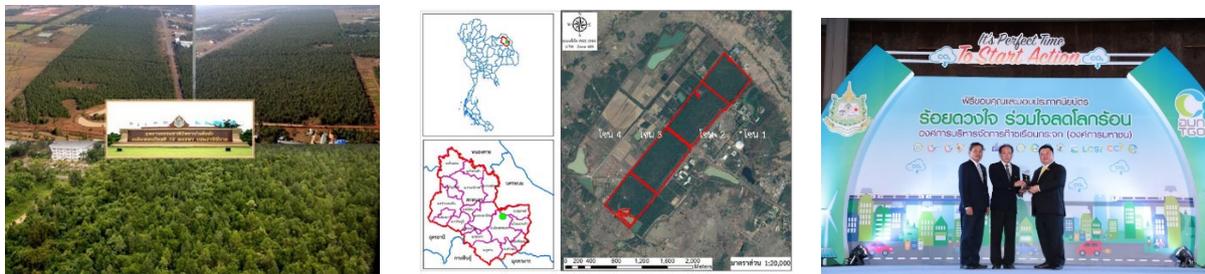


Thailand Greenhouse Gas Management Organization (Public Organization) organized an event on “Hundreds of Hearts to Reduce Global Warming” on 19 September 2018 at Vibhavadee Ballroom, Centara grand at Central Plaza Ladprao Bangkok. In this regards, H.E. General Surasak Kanchanarat, Minister of Natural Resources and Environment of Thailand presented a Plaque to Assoc. Prof. Dr. Trin Saengsuwan, Vice President for Kamphaeng Saen Campus for his achievement on KU Eco Green Campus project.

The project is registered as one of Thailand Voluntary Emission Reduction Program or T-VER. Owing to Kamphaeng Saen Campus separated area of 235.77 rai within the campus into 3 zones for difference purposes as follows: Zone 1 – 100 rai of forest area Zone 2 – forest area Zone 3 –Yangna tree (*Dipterocarpus alatus Roxb.*) planting area

KU Forest for Life

Chalermphrakiat Sakon Nakhon Province Campus, Kasetsart University received a certificate of the event "Hundred Hearts Unite to Reduce Global Warming" which organized by the Thailand Greenhouse Gas Management Organization (Public Organization), in the category of Thailand Voluntary Emission Reduction Program (TVER).



What is T-VER?

Thailand Voluntary Emission Reduction Program or T-VER was developed by Thailand Greenhouse Gas Management Organization (Public Organization) or TGO. The purpose is to promote and support all sectors to engage in greenhouse gas reduction voluntarily in order that the carbon credits obtained from the program can be trade. Credits obtained from the program are mainly used for CSR purposes and voluntary carbon offsets of organization and companies in Thailand. The TGO has defined rules and methodology to register and certify for the program that must be contributes to reducing / absorbing greenhouse gases in Thailand.

The number of 352 Pink Trumpet trees (*Tabebuia rosea*), or Chompooh Pantip in Thai, at Kamphaeng Saen Campus, Kasetsart University have been registered as the "Heritage of the Land" for the fiscal year 2019. This kind of tree was initiated grown in 1977 by Prof. Dr. Wattana Sathiensawat, the first Vice President for Kamphaeng Saen Campus at that time. He received the seed from Professor Rapee Sagarik, President at that time, which Professor Rapee brought the seeds from Singapore. Professor Wattana considered that growing of big trees would help obstruct strong wind and giving shade for the campus. Therefore, two sides of the roads within Kamphaeng Saen Campus were full of this kind of trees. Begin from the road in front of the Kasetsart University Laboratory School Kamphangsaeen Campus Educational Research and Development Center to the Chandrubeksa Gate approximately 3 km. Until now, Pink Trumpet trees are still growing and providing beautiful flowers every year in Kamphaeng Saen campus as these days.



On 14 September 2019, Dr. Chongrak Wachrinrat, Acting President of Kasetsart University, together with executive administrators, students, and personnel joined the event “KU Big Cleaning and Planting Trees Day 2019” at the area of Soi Phahon Yothin 45. The purpose of this activities was in honor of the auspicious occasion of the coronation of His Majesty King Maha Vajiralongkorn Phra Vajiraklaochaoyuhua in 2019. In addition, lead the representatives of the class of KU 79 students to planted trees at the garden of Rapee Sagarik Building. These activities managed to promote unity and raise awareness of personnel and students of Kasetsart University in taking care of buildings and locations. As well as keeping cleanliness, planting trees and looking after environment, to create a beautiful shady and a good landscape within Kasetsart University, Bang Khen Campus.



Challenges:

Kasetsart University has a policy to reduce greenhouse gas emissions into atmosphere, both direct and indirect, by supporting of library personnel to compensate for carbon credits and organizing carbon neutral events to help reduce global warming, for example, the KU President Forum: Celebration of the 76th Anniversary of Kasetsart University; the Kaset Fair, with an emphasis on the environment; and the “KU Big Cleaning and Planting Trees Day 2019, which is organized annually. The university aims to reduce greenhouse gas emission into atmosphere from both direct and indirect activities by 5 percent per year.

Opportunity:

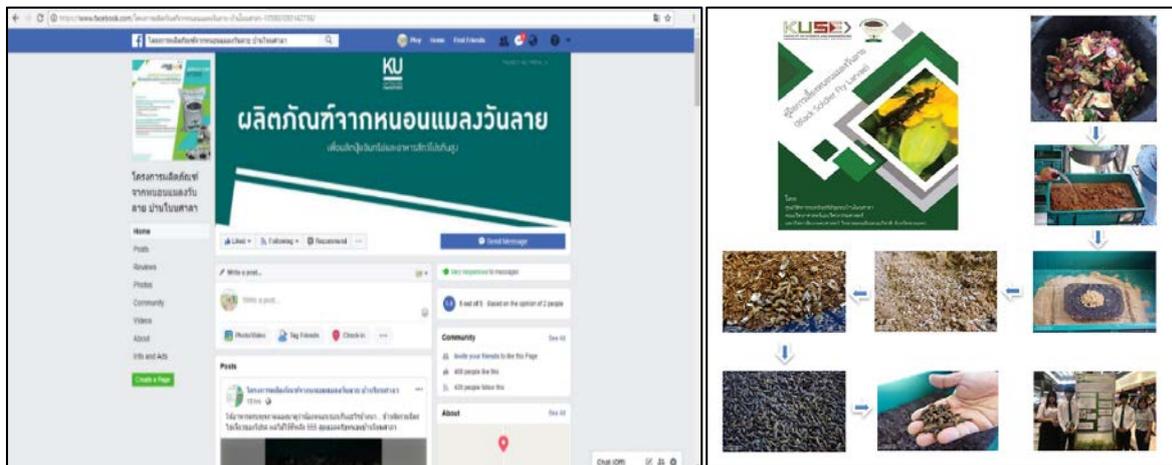
Greenhouse gas emit from various activities of human beings continuously. Including energy consumption, agriculture, industrial development and growth, transportation, and deforestation. As well destruction of natural resources and other forms of environment are all important causes of global warming day by day. The said problems became more severe from the effects of global warming. This makes countries, around the world, alert to reduce greenhouse gas emissions. The Carbon Footprint for Organization or Corporate Carbon Footprint (CCF) is a type of method to display the amount of greenhouse gases emitted from the organization's operations, which will lead to the determination of management guidelines to reduce greenhouse gas emission effectively, both at the factory level, industrial level, and national level.

[3] waste

[3.1] Best practice : The University has brought the Black Soldier Fly Larvae (BSF) to eliminate organic waste.

At present, the problem of the amount of waste is increasing and unable to immediately eliminate, often causing the accumulation of waste and environmental problems. More than 50 percent of the waste is scraps of vegetables, fruits, and weeds. Therefore, the organic waste is composted into fertilizer so that changing the burden to be valued add. As well as helping to reduce problems occurring in the waste-management system and the cost of waste management operations. Also reducing the amount of waste that needs to be disposed, resulting in less landfill. Currently, Kasetsart University has research related to bring nature to take part in organic waste treatment. The University has brought the Black Soldier Fly Larvae (BSF) to eliminate organic waste. It is also found that the Black Soldier Fly Larvae plays an important role in decomposing food waste, wet waste, and animal dung, including rotten wood chips. In this regard, more than 70% of organic waste will be efficiently removed by Black Soldier Fly Larvae. The University has transferred this knowledge to the community, so that the communities nearby to the university can apply method for waste disposal.

From this research proved that the Black Soldier Fly Larvae are not carrier of disease, not a pest, and does not cause annoyance to the community. In addition, the organic waste that has been degraded from the BSF can be used as fertilizers. This type of worm can help digest organic waste quickly. Therefore, it is a way to reduce environmental problems by transforming organic waste into compost. It is rich in nutrients that plants need and the adult Black Soldier Fly Larvae are high in protein, omega fats, dietary fiber, high calcium and lauric acid. Therefore, they are suitable to be used as animal feed. The Black Soldier Fly Larvae project is not only being able to solve the waste problem but also can solve the problem of poverty for the community. Because the BSF can make money for the communities around Kasetsart University and are also needed by many outside communities throughout the country.



[Figure 3.1]

Agricultural Innovation : The Black Soldier Fly Larvae project is a project that helps to eliminate organic waste at the source. It is also found that the Black Soldier Fly Larvae play an important role in decomposing food waste, wet waste, animal waste, including rotting wood chips. The university has transferred the knowledge to the community to apply for waste disposal in nearby communities around the campuses. This worm can help digest organic waste quickly. Therefore, it is a way to reduce environmental problems and transform organic waste into compost that is rich in nutrients that plants need.

[3.2] Best practice : Water Hyacinth Eradication

Water hyacinth is a quick-grown plant that can be adapted to be durable in all water conditions. Therefore, spread quickly along the river. Until now it has become a serious weed in the water source. It polluted water, ecosystems and obstructing water flow. Dr. Arm Unartngam from the Department of Science. Faculty of Liberal Arts and Science and Dr. Jintana Unartngam from the Department of Plant Pathology, Faculty of Agriculture at Kamphaeng Saen, Kasetsart University. Kamphaeng Saen Campus, as researchers of the project, agreed that, the elimination of water hyacinths is often preferable to manual scooping by labor with invented machinery—which requires a lot of time and budget. It had to do continuously but found that still unable to control the spread of water hyacinth. The concept of disposal is to control the propagation of water hyacinths using biological methods by using the fungus to destroy water hyacinths. This will cause abnormalities or diseases and cannot grow and propagate. It is a natural eradication to use living organisms to control other living things.



[Figure 3.2]

Social Engagement : Water hyacinth is a research that can help many communities. Currently, Kasetsart University also collaborates with various organizations and communities around Kasetsart University to eliminate water hyacinths. Which works very well And the removal area is enlarged every day, such as Don Tum Subdistrict, Bang Len District, Nakorn Pathom Province Chiang Rak Noi Subdistrict Chiang Rak Noi Subdistrict Pathum Thani Province, Bang Pa-in District Phra Nakhon Si Ayutthaya Province, Sikan Subdistrict, Don Mueang District, Bangkok Can be injected without labor or machinery for loading Which will help reduce costs And a large amount of budget.

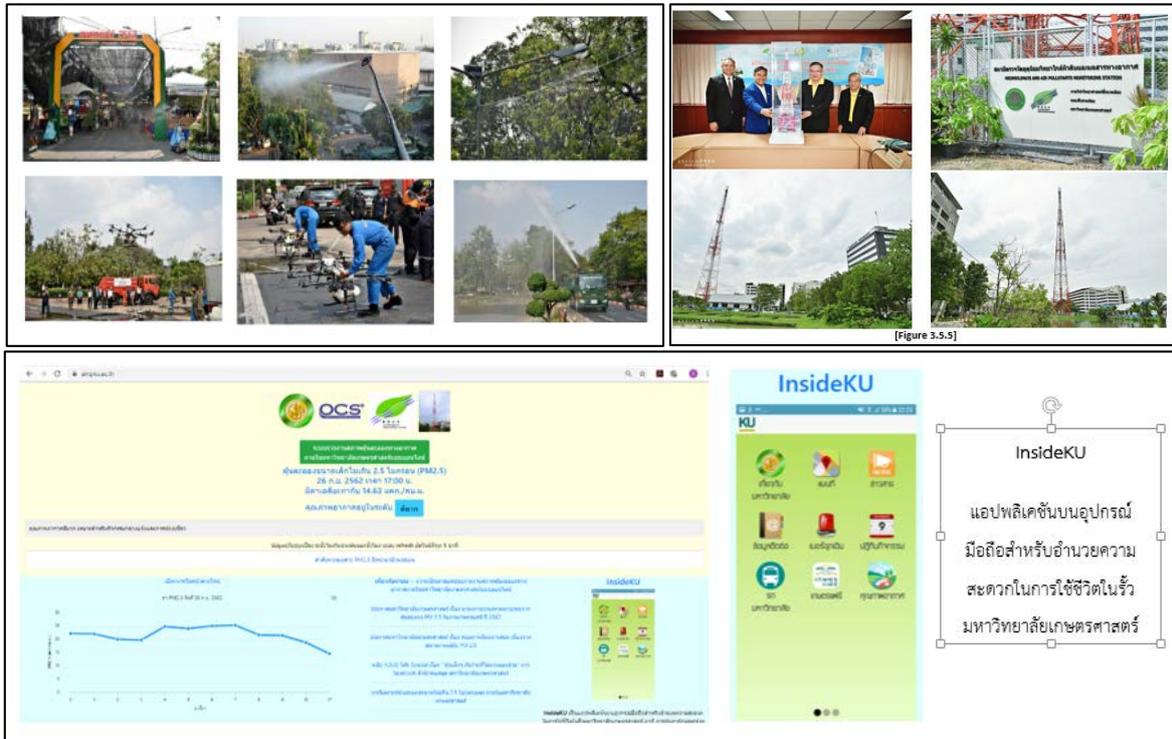
Challenge : Kasetsart University wants to encourage students and communities to learn about organic waste treatment. Organic waste can be used for many projects. Research and development can be further extended to many organic waste treatments. In addition, reducing the amount of waste, can also create more organic products. Many projects can help and solve problems for communities around Kasetsart University as well. Organic waste disposal well project was built from cement. that was the treatment of organic waste from household. If every house in the community knows this system, they will reduce the amount of organic waste in the community. Organic waste disposal well can also be a source of minerals for vegetables which grow in the household for consumption.

Opportunity : It is an opportunity for Kasetsart University to develop a project about organic waste. For example, participating activities and projects to help community outside the University such as the Black Soldier Fly Larvae Project, Dry and liquid compost bin, the Composting in a Beautiful Garden project, making of bio-fermented water from rotten fish, utilization of weeds by using weed chippers (woodworking machinery), making compost from cow excrement, biogas and liquid fertilizer production project, and organic waste disposal well. As the mentioned projects have seriously collaborated the university with community by nurturing knowledge, income and expenditure.

[3.3] Best practice : "Meteorological Station near the surface and air pollution" (KU TOWER)

Public Services : While the dust exceeding the standard values in Bangkok and vicinity, Kasetsart University received "Meteorological Station near the surface and air pollution" (KU TOWER) from the Director of the Institute of Water Resources Information (Public Organization). This is a research station for meteorological measurement near the surface and air quality. This research station occurred due to Kasetsart University signed a memorandum of cooperation for the technology development project for surveying, analyzing and processing data for water and climate management. Under the support of research funds from the Water Resources Information Institute (Public organization). The project is a collaboration between the Office of the Permanent Secretary for Science and Technology, Kasetsart University, King Mongkut's University of Technology, and Thonburi Rajamangala University of Technology Thanyaburi on 18 June 2012. Kasetsart University is responsible for developing air monitoring systems. Including meteorological features near the surface atmospheric pollution. The Faculty of Environment of Kasetsart University is responsible for establishing a research station for surface meteorological measurement and air quality, which is a 117 meters tower, continuously 24 hours at an elevation of 10, 30, 50, 75 and 110 meters for meteorological measurements. This research station is responsible for data analysis and online processing and will be a database for meteorological forecasting, in order to mitigate the effects of the said situation.

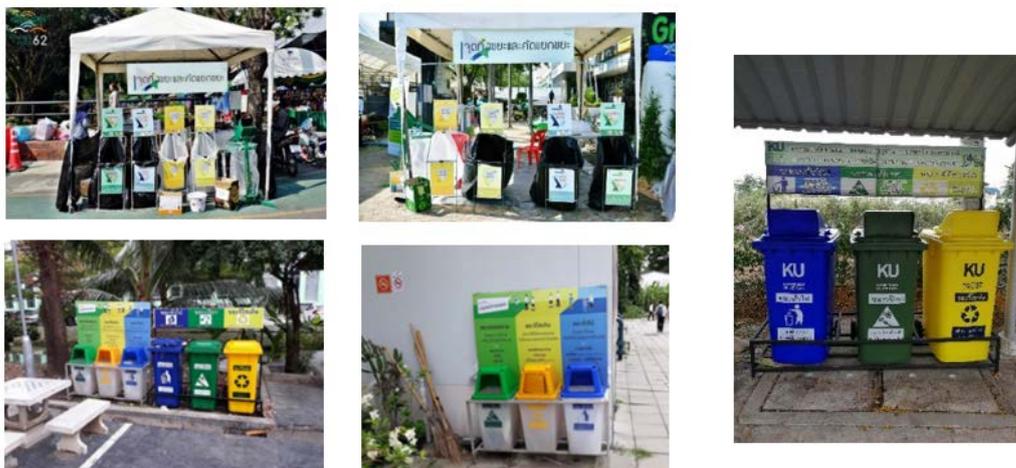
During the Kaset Fair in 2019, Kasetsart University implemented the security system to set up the traffic system within the university, for visitor of Kaset Fair to commute without interruption and flexibility. They can park on the university's parking buildings, and then get on the electric vehicle service (free of charge). Besides, the University provided misty electric fan to create a water curtain to spraying water, in order to relief heat around the Fair. Using a high-pressure spraying truck to water the plants around the campus every morning, afternoon, and evening. In addition, requesting support from Bangkok Metropolitan Administrator (BMA) to organize a drone to help spray water around the university. Kasetsart University also has an online air pollution report system on campus each day, by linking to the website of the university and the website <https://airq.ku.ac.th>, the information is updated hourly at the beginning of the hour. The system automatically refreshes every 5 minutes.



[Figure 3.3]

[3.4] Best practice : Waste separation

Kasetsart University has promoted waste separation. Waste bank project Which is an operation to promote waste separation And raising awareness for students to sort out waste at the source Establish a waste recovery mechanism To reduce the amount of waste that needs to be landfilled Campaign for proper waste separation By opening the waste separation point, in which students are instructed on how to separate waste into various parts And arrange for students to publicize the garbage disposal to the right place



[Figure 3.4]

Socials Engagement : Kasetsart University has encouraged the conscious of students and university to understand the process of sorting waste from the beginning, learn to separate the kinds of waste correctly and campaign to use cloth bags instead of plastic bags to reduce the amount of plastic bags. Organizational activities within each campus of Kasetsart has an effort in order to understand and solve problems related to global warming. The university has also invited students and staffs to donate milk boxes for the green roof project.

Challenge : Student and personnel of Kasetsart University can separate toxic waste from solid waste, knowing the correct type of toxic waste, and knowing the correct storage methods which will reduce the amount of waste. Some types of waste can be recycled before dispose. Stop to think about whether we can reduce the amount of waste and recycle waste. The idea are as follows:

1. Avoiding items or packaging that will create waste, including pollution to the environment such as foam boxes or other toxic waste.
2. Choosing to use refill products that use less packaging, less waste as well
3. Using of products that can be returned packaging to manufacturer, such as various beverage bottles
4. Repair of appliances so that it can be used further, and not to become rubbish
5. Recycling of used packaging such as cloth bags instead of plastic bags
6. The separation of waste that is still available for easy storage and processing, such as plastics, glass, cans, and beverages
7. Reducing consumption and finding ways to increase the efficiency use of various appliances.

Opportunity Kasetsart University considered an opportunity to develop more efficient and effective toxic waste management system in the future, also receiving cooperation from all sectors. There can be waste management by type of waste and harmless. In order to, restrain hazardous waste to negatively affect people and environment. This is consciousness and responsibility of the proper waste disposal and proper disposal of hazardous waste.

Remark : All activities refer to the Sustainable Development Goals (SDGs), otherwise known as the global goals, especially relating to Goal 1 : End poverty in all its forms everywhere, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters. Another important target is Goal 11 : Make cities and human settlements inclusive, safe, resilient and sustainable, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management. And relating to Goal 12 : Ensure sustainable consumption and production patterns. achieve the sustainable management and efficient use of natural resources halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment substantially reduce waste generation through prevention, reduction, recycling and reuse.

[4] Water

[4.1] Best practice for The project of water storage in different areas of Kasetsart University.

Thailand is a country that mainly engages in agriculture. Therefore, there is an area that is high level of necessary to use water for agriculture. Due to fluctuating rainfall or climate change, some areas still face the problem of water shortage.

Public Service : Kasetsart University has realized the importance of the said problem. Therefore, the University has determined a policy to build an area to store water for using of the university and nearby communities, including a campaign to use treated water or water from natural resources instead of tap water. This is in accordance with the main objectives of the energy conservation policy of Kasetsart University as for the reduction of tap water usage and increasing of proportion of reused water, and reducing water shortage problems in nearby areas. This is to ensure that water consumption is balanced with the amount of contained water in that area both present and future.

There have been drilling of 9 artesian wells scattered in various areas of the Faculty of Agriculture at Kamphaeng Saen campus for sharing to use in agricultural areas which belonging to Kasetsart University and areas of nearby communities. The artesian wells can pump 156 cubic meters per hour of groundwater and then packed into 5 storage ponds built to hold water, with a total capacity of 32,000 cubic meters.

A groundwater storage tanks were built in the area of residence of personnel and nearby communities which working within agricultural area in order to collect groundwater that is pumped from the artesian wells and distributes to the personnel building in the area of the campus, as shown in the picture.



[Figure 4.1-1]

Kamphaeng Saen Campus drills storage ponds to contain water for various uses in the area of the campus and surrounding area. The purpose is for consumption and supporting agricultural activities and raising animals around the campus. There are 7 storage ponds built to store water in Kamphaeng Saen campus area, total area of 416 rai, as shown in the picture.



[Figure 4.1-2]

The Number 1 pond is the largest pond, which a total area of 150 rai, uses to store treated water, then to produce tap water with an average production volume of 48,000 cubic meters / year for using within the campus. All tap water is used in Kamphaengsaen campus produced from pond number 1 (as shown in the picture)



[Figure 4.1-3]

Aside from producing tap water in Kamphaeng Saen campus area, there are 6 storage ponds that are used to store rainwater and treated water for other usages that support various activities of the university, such as teaching and learning activities, farming, raising animals including reserving water for use, in order to prevent water shortage in dry season etc.



[Figure 4.1-4]

7 reservoirs were drilled in the area of Chalermphrakiat Sakon Nakhon Province Campus to contain rain water for using in the campus and surrounding agricultural area, such as Sakon Nakhon, Kalasin, Nakhon Phanom, Mukdahan, Nong Khai and Udon Thani (North and South). All 7 reservoirs can contain approximately 1,400,000 cubic meters of water as in the picture.



[Figure 4.1-5]

After Kasetsart University has allocated enough water resources, then a policy to build a delivery system of treated water or natural resource water to use in different areas thoroughly and most efficiency. There is a system to deliver water from reservoirs to use in many areas as follows:

There are 2 ponds for retaining of rainwater for agricultural activities, in front of Suwanvajokkasikit Research Station, the Faculty of Agriculture in Nakhon Ratchasima province. Both ponds are used to retain the amount of rainfall throughout the year in order to use in agriculture area, including to pass through treatment system for consumption inside the station. The university has set up a system to manage the direction of the rainwater flew into drainage pipes around the area and then transported into a water storage tank built for further use.

Two drilled ponds, for retaining of rainwater in agricultural areas within the Faculty of Agriculture, Kasetsart University, were built to retain rainwater that falls each year and to be used in nearby area with a capacity of 10,000 cubic meters.



[Figure 4.1-6]

Agricultural innovation : Kasetsart University has a policy on water conservation. The rainwater tanks have been installed in various buildings for reuse. It has been divided into two categories: rainwater contained in a sterilizing tank ready to place a pipe directly from the tank for toilets using, and the one that can be used without disinfecting used in various activities, such as watering plants, cleaning areas of buildings, washing cars, etc. (as in the picture)



[Figure 4.1-8]

Office of Kasetsart University Library has installed rainwater retaining system to store water for vegetables planting inside the building. In which personnel of the Office can consume these vegetables in their households. Considered as another way to reduce household expenses, as in the picture.



[Figure 4.1-9]

There is a water pump installed on the 1st floor of Vibhavadi Rangsit Parking Building which has some cultigens on the 6th floor (rooftop). A water supply system from a storage tank to water the vegetables has been installed and also sunlight can reach to them. Therefore, vegetables can be grown and it is beneficial to personnel of the department (as in the picture).



[Figure 4.1-10]

Ngamwongwan Parking building 2 within Kasetsart University Bangkhen Campus has installed an underground tank to reserve rainwater for use. The advantage of installation an underground tank is to prevent subsidence that may occur in the area and space-saving installation as well. Also, the underground tank causes the stable temperature of the contained water because it is not exposed to the outside air directly (as in the picture).



[Figure 4.1-11]

Due to Sriracha Campus is located on the area of mountainous terrain with a high slope. The Faculty of International Maritime considered the benefits from the physical characteristics. Therefore, the Faculty had built a waterway system that transports rainwater that flows from highlands to store in wells which built within the faculty's area for using in education that require to test ships in the field of shipbuilding engineering, etc. (as in the picture).



[Figure 4.1-12]

Social engagement : The benefits of water retention are not only good result for the resource management system within Kasetsart University, but also nearby communities, both in the field of agriculture, livestock, and so on. Therefore, communities nearby and the University collaborate to look after surrounding ecological conditions. The increasing of interaction that intends to sharing problems, experiences and suggestions between personnel of the University and villagers. As mentioned above, it can develop the relationship between the university and the surrounding community (as in the picture).



[Figure 4.1-13]

Results : Building water storage and natural water resources such as rainwater, groundwater, including treated water used within these parts can reduce the shortage of water used for consumption as well as in agriculture. Also engaging with villagers–nearby areas in terms of cooperation, creating a water management system that are favorable to one another. Causing the use of water from natural sources to benefit Great value.

Challenges : Kasetsart University constructed water reservoirs to provide enough water for consumption and also plans to improve the quality of water including increasing the value of treated water in order to be able to use as utmost benefit, while plans are made to create a database of water resources for using to analyze used water situation to compare with reserved water.-As well as, the University having plans to develop the area around reservoirs as tourist attraction and to increase public relations to be a tourist attraction of the province which will help to promote occupational opportunities for nearby villagers.

Opportunities : The government has set up a master plan for water resources management to support the country's water strategy for 20 years. Therefore, Kasetsart University has implemented the policy, in accordance with the strategy of constructing reservoirs to ensure stability. In addition, increasing efficiency of water resource project. When the policy is driven as same direction as the government, the management of water storage areas will be more efficient.

[4.2] Implementation of Water Recycling Program

Water is one of the most important natural resources; Kasetsart University has therefore a policy on water management and conservation in order to uphold water resources sustainability and water use efficiency. And for the management, the University has wastewater treatment pond for recycling the wastewater for other purposes. In addition, there is nature wastewater treatment, for example, planting aquatic plants to absorb pollutants accumulated in water, providing aerators and sprinkler pump for increasing oxygen in the water, including using sunshine wastewater treatment, solar pump, and paddle wheel aerators for circulating wastewater as a solar heated energy in water recycling system, so that the water treated can be reused for other purposes such as watering plants and yard, washing trucks and garbage trucks.



[Figure 4.2-1]

Public service : Kasetsart University gives other institutes and organizations a chance for site visit in wastewater treatment system.

Agricultural innovation : Kasetsart University takes an innovation of water circulating system in growing hydroponic vegetables so as to reduce water loss; it uses a bit of water when comparing with general irrigation system. In addition, there is a wastewater treatment innovation with solar pump for reducing electrical energy.

Remark : All activities refer to the Sustainable Development Goals (SDGs), otherwise known as the global goals, especially relating to Goal 6 : Clean Water and Sanitation Substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity , Another important target is Goal 12 : Responsible Consumption and Production Kasetsart University intends to Ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.

[5] Transportation

Policy on Internal Transport System Management at Kasetsart University: Using environmental friendly public transportation will help reduce carbon dioxide emission on campus and to provide welfare bus service in accordance with the GREEN UNIVERSITY policy.

[5.1] Lesson: Best Practice for Shuttle Services

Public Service: Kasetsart University has set a policy for resource sharing within the university. To limit the number of vehicles traveling on campus and reduce the amount of emissions from vehicles. Therefore, the University provided 25-seat welfare bus services for free of charge for convenient and safe of commuting of students and personnel, as well as visitors in the campuses. In addition, the University purchased no less than 25-seat trams under the KU - Green Campus Healthy Community project from 2008 to the present.



Figure 5.1 Number of shuttles operated in your university

Utility: Kasetsart University emphasizes on students' and staff's traveling. Therefore, the University determined public transportation policies to provide and support public transportation facilities which is the basic factor in traveling at all levels. With quality, sufficiency, standards and safety, everyone can access and use public transport equally and does not discriminate against general people, disabled people and care taker, Including responsible for organizing the environment easy to access for everyone.

Challenges: Every campus provides electric vehicle to replace diesel cars for public transportation services on campus, for the transportation of students, faculty, and personnel. Confident of user on safety of using public transportation provided by the university. Obviously, satisfaction of users shows not less than 80% Besides, being a center for studying and researching the use of electric vehicles in various forms such as the construction of electric charging stations, battery replacement service by robot, comprehensive management of expired or deteriorated batteries, etc.

Opportunities: From 2015 until now, the government has set measures to support the production of electrical cars in Thailand, as a new engine of growth. As well investment promotion in the supply of goods, the stimulation of the domestic market (Demand), preparation of Infrastructure availability, The standardization of electric cars, used battery disposal management and other measures. The said policy encourages the use of electric vehicles in Thailand. To reduce dependence on imported fuels from foreign countries and increase Thailand's energy usage options. In addition, to create a good environment for people by reducing the exhaust emissions and carbon dioxide gas that will affect the greenhouse gas.

[5.2] Lesson: Best Practice for Zero Emission Vehicles (ZEV) Policy

Kasetsart University has a policy to support pollution-free traveling within the university. In addition, the University has promoted the use of vehicles that reduce carbon dioxide emissions and noise pollution for students, personnel, to avoid using various types of cars and turn to use public transportation provided by the university more. Previous operating results compare the cost of fuel used for diesel engine systems and electrical systems.

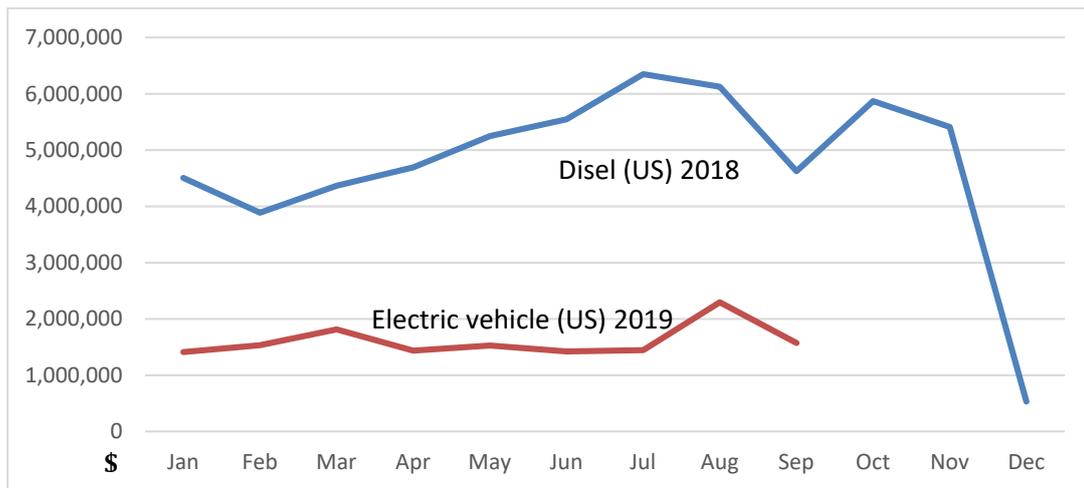


Figure 5.2 compare the cost of fuel used for diesel engine systems and electrical systems.

According to the goal of Kasetsart University towards becoming a green university, the University provided 15 electric buses with charging stations to replace diesel buses. For the transportation service for students, personnel and people who come to contact to KU’s departments, as well as various central services. The full services were operated since December 2018. And to build confidence for more safety of users by limiting the speed of the electric buses at 25 - 30 km. /hrs. with the installation of GPS to display in the application QR Code at the 74 welfare bus stop. Users can check the route and various service and current information continuously.



Figure 5.2-1 15 electrical bus service for students and staff in the University

Social Engagement: The University organized a campaign on launching KU Go Green - electric vehicle welfare service within Kasetsart University to raise awareness of alternative energy to replace high-priced diesel fuel which cause pollution. And emphasized the development policy to be a green university by proceeding to change the form of welfare bus services from the diesel engine system to a total of 21 electric vehicles

Kasetsart University supports various departments to use electric carts to coordinate within the University instead of cars or motorcycles, for example, General Affairs Division has 2 golf cars, which can be shared with another 7 agencies under the Office of the President namely: Office of the Legal; Office of Quality Assurance; Vehicle, Building and Physical Plant Division; Planning Division; Personnel Division; International Affairs Division; Office of Internal Auditing. These offices are situated at the Kasetsart Golden Jubilee Administration and Information Center Building.



Figure 5.2-2 Using of electric carts to coordinate within the University instead of cars or motorcycles

The result of using electric bus in providing public transportation within Kasetsart University

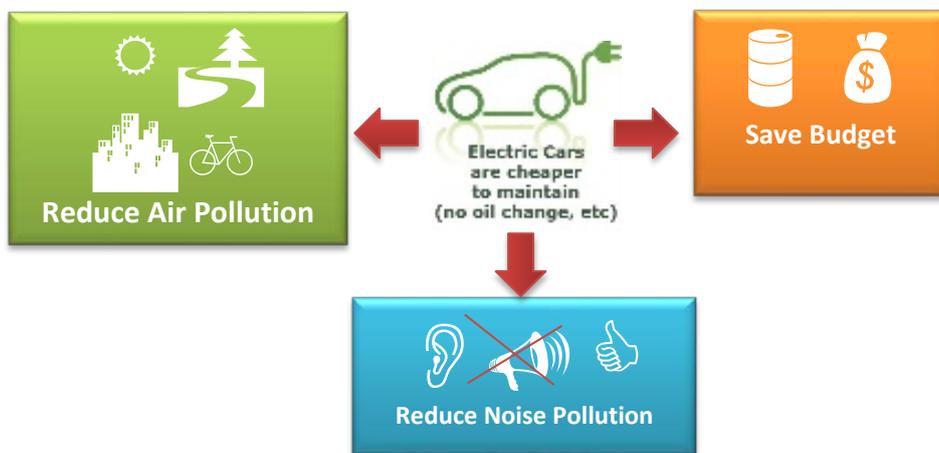


Figure 5.2-3 the result of using electric vehicles

Utility: Kasetsart University emphasizes on students' and staff's traveling. Therefore, the University determined public transportation policies to provide and support public transportation facilities which is the basic factor in traveling at all levels. With quality, sufficiency, standards and safety, everyone can access and use public transport equally and does not discriminate against general people, disabled people and care taker, Including responsible for organizing the environment easy to access for everyone.

Challenges: Every campus provides electric vehicle to replace diesel cars for public transportation services on campus, for the transportation of students, faculty, and personnel. Confident of user on safety of using public transportation provided by the university. Obviously, satisfaction of users shows not less than %80. Besides, being a center for studying and researching the use of electric vehicles in various forms such as the construction of electric charging stations, battery replacement service by robot, comprehensive management of expired or deteriorated batteries, etc.

Opportunities: From 2015 until now, the government has set measures to support the production of electrical cars in Thailand, as a new engine of growth. As well investment promotion in the supply of goods, the stimulation of the domestic market (Demand), preparation of Infrastructure availability, The standardization of electric cars, used battery disposal management and other measures. The said policy encourages the use of electric vehicles in Thailand. To reduce dependence on imported fuels from foreign countries and increase Thailand's energy usage options. In addition, to create a good environment for people by reducing the exhaust emissions and carbon dioxide gas that will affect the greenhouse gas.

[5.3] Lesson: Best Practice for Pedestrian path policy on campus



Figure 5.3-1 Pedestrian path at Kasetsart University

Organizing walking and running activities within Kasetsart University

Social Engagement: Kasetsart University regularly organizes internal walking-running activities on a monthly basis. It promotes the use of sidewalks and roads in Kasetsart University and to raise awareness of health care. Each activity has included activities to reduce global warming in order to emphasize the green campus of Kasetsart University, such as the Wednesday Hansa (Delighted Wednesday) project. The University organizes walking-running activities for students, activity personnel, organized every Wednesday from 17.00 hrs. - 18.00 hrs. The Sports Office provides drinking water for participants and campaigning to add more drinking water by using flasks, bottles or glass instead of a single-used bottles to reduce the use of plastic and it is environmental friendly.



Figure 5.3-2 Organizing walking-running activities within Kasetsart University

The result of organizing walking and running and cycling activities in Kasetsart University:

KU administrators, personnel, and students join the project in walking and running to realize and promote the importance of appropriate exercise for health and encourage the administrators, personnel, and KU students to walk, run continuously. In addition, there are additional activities related to the campaign to reduce plastic use in the university, in order to create mindful of environmental carefulness regularly. Including make the community a better environment because of walking, running and cycling are environmentally friendly.

Result: Staff and students use more pedestrian paths. The scenery around the bike lane and pedestrian paths are shady, convenient, and safe. This is not only affecting the quality of life, teaching and learning but also creating good relationships between Kasetsart University and general public in sharing space that of provided by the Univesity.

Utilities: According to the National Education Act B.E. 2542, "Section 25 : the State shall adequately and efficiently promote operation and establishment of lifelong learning of all types, namely public libraries, museums, art galleries, zoos, public parks, botanical gardens, science and technology parks, sport and recreation centres, data sources, and other sources of learning." For this reason, Kasetsart University uses public areas on the campus for many benefits, aside from working hours of students and staff, by allowing general public to use the route for walking and biking in the evening. In addition, people from communities nearby also use many common areas such as bicycle routes and pedestrian paths to carry out health activities, etc. Such actions are in response to government policy on

improving various areas within the university to be used effectively. The place is shady for walking and jogging, and suitable for promoting physical activity for students, personnel and general public. Moreover, connecting all various kind of travel and safe for pedestrian. Furthermore, the use of electric vehicles does not cause pollution in the university, reduce fuel consumption, and reduce global warming.

Challenges: Kasetsart University has set travel policies by determining to be a pedestrian street. Therefore, the University built a covered walkway to connect walkways around buildings and encourage faculty staff and students to commute by walking to various buildings more conveniently and safely, restrict vehicle types which passing through the teaching area, specifying one-way lanes for welfare bus service, dividing road space for pedestrian and bicycles, and installing a motorcycle barrier to prevent pedestrian riding. Cars and motorcycles of faculty staff, students and personnel are not allow to enter and exit the teaching and learning area strictly, in order to prevent accident and various unsafe situations that occur. In the first phase, a one-way lane has been established for the welfare buse services for students and personnel, divide the lanes for bicycles, and using traffic pole parallel to the road. Later, improve sidewalks, with a roof to cover all areas, all buildings etc.

Opportunities: When the BTS Skytrain constuction is completed. Both within and external traveling within Kasetsart University will be able to develop, improve, and connect fully. Parking spots on the campus can connect trams or electric buses. The budget allocation for the year 2020 for the improvement of walking and bike paths. Students can use bicycles safely or can follow the covered way which designed to be shady and pleasant. That will help promote a safe atmosphere for university living.

[6] Education (ED)

[6.1] Best practice : Kasetsart University provides the course “Knowledge of the Land”



(Figure 6.1)

Public services : Kasetsart University provides the course “Knowledge of the Land” aiming to build up dignity and awareness of being the Knowledge of the Land of Kasetsart University, that plays an important role for Thai and global societies. Being as a higher education institute, Kasetsart University deeply reflects on its identity, “Creating the knowledge of the land for the national well-being”. Addition to that, Kasetsart University has an intention to reinforce and develop the students to be smart, moral, and skillful to learn and work in accordance with the university’s identity as well as to further have appropriate characteristics for being the Thai and global citizens. The course contents relate to the history, uniqueness, and identity of Kasetsart University, learning from role models who created the knowledge of the land, perception of being the Thai and global citizens, reinforcing and developing learning and working skills to achieve the goals under the principles of awareness, determination, creativity, and harmony.

Additionally, the non-degree course of “Knowledge of the Land for Sustainable Development” consists of various modules, which are professional or partitional, encouraging Thai people to be knowledgeable of both theories and practices. It focuses on knowledge of performance and practical skills with learning-by-doing in the real learning sites, the development of current traditional farming to smart farming by focusing on agricultural administration and technology. This help farmers to gain more income and to shift to be entrepreneurial farmers who increase the value to the agricultural products through agricultural processing and initiate a start-up driven by the Concept of Innovation Driven Enterprises (IDE). This is the greatly important foundation for supporting Thailand to be the country with “Stability, Prosperity, Sustainability”.

The non-degree course of “Knowledge of the Land for Sustainable Development” consists of 21 modules in total. Each module has different objectives but each of them is also related and correspond to industries that are an important mechanism for driving the country’s economy. They also correspond to the national education reform and national development like the New Generation of Graduates Project which was directed by Thai’s Ministry of Education.

Twenty-one modules of the curriculum “Knowledge of the Land” are available.

1. Animal Produce Production for Food Security and Sustainability
2. Science in Environmental Management for Security and Sustainability
3. Innovation of Natural Rubber for Sustainability
4. Community Development for Sustainability
5. Gem and Jewelry for Sustainable Gem Industry
6. Agriculture for Life and Health
7. Ornamental and Economical Aquatic Animal Aquaculture
8. Analysis and Development for Agribusiness and Social Enterprise
9. Agroforestry Land Use
10. Forest Based Enterprises
11. Plant Production for Food Entrepreneurs
12. High Quality Beef Production
13. Integration of Thai Rice Production for Food Safety
14. Entrepreneurship for Vegetable Fruit and Cereal Beverages
15. Wood Product Technology for Modern Entrepreneurs
16. Young Children's Development and Rearing
17. Happy Aging Society in the 21st Century
18. Psychology for Entrepreneurship Development
19. Entrepreneurships for Fertilizer Business
20. Data Science for Business
21. Computing and Informatics

Socials engagement : The students will learn with activity-based learning or using activities in learning processes. This course focuses on creating the joint learning processes in which the students are nourished with various skills and the knowledge and the instructors of the Office of Academic Affairs and Office of Student Affairs are integrated.

Challenge : The course "Knowledge of the Land" creates learning opportunities for everyone. It is a professional, interdisciplinary, and tailor-made course which students freely create their study plan according to their needs, preferences, interests. The knowledge of this course can be applied to the real-life since the course is designed to focus on learning outside the classroom, practicing with the real situation through various learning methods i.e. active learning, project-based learning, digital base leaning and work-integrated based learning. It is also challenging for the course that it can be extended internationally by providing an international course so that international students can attend the course which English or other languages can be used. This also supports students in boosting up their language skill along with cultural learning.

Opportunity : Thai Government created the Long-term National Strategy (20 Years), the Twelfth National Economic and Social Development Plan, and the National Education Plan emphasizing the importance of the development and reinforcement of human potentials since human resources are an important factor that drives Thailand to be a developed country. One of the goals is to develop the desirable characteristics of Thai people called Thais 4.0 who have the following characteristics: the knowledge, high skills and competency, public consciousness, social responsibility, and digital literacy. To achieve that, the key development guidelines should cover changing value and culture, developing human potential, reforming education, developing and mobilizing competent personnel, focusing on the quality of education and all education levels.

To respond to the government’s policy, it is an opportunity for Kasetsart University to establish a Bachelor of Science in Knowledge of the Lands for Sustainable Development. The aim is to produce the new generation of graduates and competent personnel to match the requirements of the production sector, according to the policies on Thai higher education reform which consist of curriculums, instructors, learning process and method, research, encouraging the use of information technology for education, and evenly distributing the educational opportunity. This curriculum is at the undergraduate level. A graduate must complete all of the modules required by the curriculum. It takes a semester (four months) to complete a module. Each module is a professional course containing a complete content within, equals to twenty credits. The students will receive the certificate of the module enrolled and what they learn from the module can be applied to their work or for their start-up. Learning in each module focuses on practicing in the actual sites, work-integrated learning, and embedding various technologies and systems into learning to shift to smart agriculture.

[6.2] Best practice : Project to conserve natural resources and solve environmental problems (The project for the elimination of water hyacinth by biotechnology for sustainable clean rivers and streams)



(Figure 6.2)

Public service : Research on the elimination of water hyacinths using fungi or biological methods is a natural method that does not have any effect to the environment, that is to say, once the mold has been sprayed, water hyacinths will begin to brown then start to disintegrate and submerged. The process will take about 28 days and after that it will be naturally decomposed. In this research, the results showed that the submerged water hyacinth is bio-safe and does not affect the environment; does not cause disease to other plants and creatures . In addition, the clarity of the water after the removal of water hyacinths also showed clarity, making the scenery of the water source rehabilitate and looks better.

Agricultural innovation : This research is to find ways to get rid of water hyacinth, which is considered a weeds on the water from the idea of using organisms to control organisms themselves, by using Myrothecium roridum strain 448 to destroy the water hyacinth abnormalities or diseases, and cannot grow and propagate by putting the mold in a spray machine , then spray on water hyacinth leaves. In the area that needs to be eliminated, the fungus will destroy the tissue cells of the leaves and other tissues of the water hyacinth, causing burns within 48 hours, then submerge and decompose itself naturally, not affecting the surrounding environment. As the mentioned process above, this can be considered a good alternative to the use of chemicals for disposal.

Socials engagement - This research is the work of Dr. Arm Unartngam from the Department of Science, Faculty of Liberal Arts and Science and Dr. Jintana Unartngam from the Department of Plant Pathology, Faculty of Agriculture, Kasetsart University Kamphaeng Saen Campus, funded by the National Research Council of Thailand (FSC) from the collection of fungal samples from water hyacinth leaves in 19provinces throughout Thailand, and receive a part of the research budget from the government.

Challenge from research on the elimination of water hyacinth using biotechnology for sustainable clean rivers. With the challenge of allowing Kasetsart University to Kamphaengsaen Campus is a pilot model for the removal of water hyacinths in water sources by use of mold and expand the scope of applications to the national level in the future. Currently, water hyacinth problem in water sources is considered one of the important problems in Thailand.

Opportunity - research on water hyacinth, the removal of water hyacinth by biotechnology for sustainable clean river can support government policy that wants to reduce the number of water hyacinth in water source. This research is considered to be a sustainable eradication of water hyacinths. The hyacinth that eliminated cannot return to grow and expand again.

[6.3] Best practice : The Project on Restoring Green Areas in Bang Kobua, Phra Pradaeng, Samut Prakan or “Bang Kachao”



(Figure 6.3)

Kasetsart University Bangkok Campus implemented the Projects on Green-Area Restoration in Bang Kobua, Phra Pradaeng, Samut Prakarn, or “Bang Kachao” to conserve the green areas in this location and to develop an ecotourism site which is beneficial to the public in terms of both environmental benefits and awareness raising to cherish the forest resources. The Bang Kachao green area is highly significant in terms of being as a traditional agricultural conservation area of the Chao Phraya River Basin. In addition, the ecosystems are diverse consisting of freshwater forest, brackish forest, and terrestrial forest ecosystems. The university realizes the great importance of this area. Therefore, to improve the landscape and to develop the area to be harmonized with the way of life of the community along with the conservation of the nature and ecosystems, the Metropolitan Electricity Authority assigned the Faculty of Forestry, Kasetsart University, which has experts who are professional in ecology, reforestation and management of urban green areas. This project has started and collaborated with the Metropolitan Electricity Authority and the Royal Forest Department since 2010 and continued to the present. In 2019, the development of green areas under the project “Our Khung Bang Kachao” were implemented in collaboration with government, private agencies, and educational institutions namely Royal Forest Department, Shell Thailand, PTT Public Company Limited, Office of Natural Resources and Environmental Policy and Planning, Charoen Pokphand Group, True Corporation, Bangchak Corporation Public Company Limited, and Kasetsart University. Two working committees of green conservation groups were established at two levels: district level and Khung Bang Krachao level, in order to work with the communities preparing for the implementation of green area development.

Objectives: To make this area to be the lung of Bangkok people. Then, it is further developed to be an ecotourism destination harmonizing with its ecosystem and local livelihoods as well as the community’s acceptance by mobilizing knowledge and experts from various faculties and assisting Bang Kachao community through the Project on the Sustainable Development of Bang Kachao Community 2019, which can be also a role model for other communities.

Targets: The communities in Bang Kobua, Phra Pradaeng, Samut Prakarn or “Bang Kachao.

Outputs: The targeted communities or organizations were developed and strengthened with concrete evidence and the Master Plan for Conserving and Developing the Khung Bang Kachao Green toward Sustainability area, were made.

Public services : To relate with the community requirements, the implementation framework and the goals for community development of Bang Krachao were established covering six dimensions. The Kasetsart University’s experts who are an expertise of each field, set a plan to support the community development in various ways including the green area development, water management and riverbank erosion, waste management, career promotion, tourism, and the development of youth, education and culture. Various types of activities strengthening the community were provided as the followings:

- Teaching English to community members to be able to communicate with tourists.
- Creating a roll-up presenting the knowledge on local herbal compress ball.
- Providing knowledge under the Project on the laboratory analysis of veterinary technology
- Arranging knowledge transfer activities on plant production technology, production factor management, and value-adding.
- Arranging knowledge transfer activities on the culture techniques of black soldier fly for composting organic wastes.

- Arranging knowledge transfer activities to enhance the well-being of society and community by generating more income, reducing wastes, and adding value to agricultural materials etc.

Additionally, the community members freely participated in, acknowledged any information, and shared their ideas to develop their community in a similar direction. They also applied the knowledge derived from the project to further develop Bang Kachao Community sustainably.

Agricultural innovation : Kasetsart University tries to provide academic services as social services to all areas of Bang Krachao community using various types of academic services implemented under the financial supports from some government projects, such as Thailand 4.0 Project. Various innovations created were introduced to Bang Kachao community for improving various aspects of their livelihoods. The training was provided to educate farmers aiming to improve their quality of life or to collaborate with the private sector for innovation development. This is to elevate the potentials of competition in terms of both production and creation of various innovative products in order to add the value to the products for sales or any products that related to daily life, in accordance with the Thailand 4.0 Policies.

Socials engagement : Currently, the development of green areas under the project “Our Khung Bang Kachao” are being implemented in collaboration with government and private agencies, and educational institutions namely Royal Forest Department, Shell Thailand, PTT Public Company Limited, Office of Natural Resources and Environmental Policy and Planning, Charoen Pokphand Group, True Corporation, Bangchak Corporation Public Company Limited, Kasetsart University. Two working committee of green conservation groups were established at two levels: district level and Khung Bang Krachao level, in order to work with the communities preparing for the implementation of green area development.

Challenges : The main objective, which is the most important thing, of the development and conservation of green areas in Bang Kachao community is to make this area to be the lung of Bangkok people. Time Magazine announced the green area of Bang Kachao as "The Best Urban Oasis of Asia" in 2006. Then, it is further developed to be an ecotourism destination harmonizing with its ecosystem and local livelihoods by mobilizing knowledge and experts from various faculties and assisting Bang Kachao community to be a community with sustainable development. This can be also a role model for other communities.

As Kasetsart University is an academic institution that realizes the importance of green areas of Khung Bang Kachao, A series of research projects “Integrated Research for Sustainable Ecological Development of Khung Bang Kachao” was carried out with a research action plan which was created and corresponding to the area and geosocial conditions. The series comprises of various research projects as follows:

1) The Research Project on “Diversity and Utilization of Insect for Agro-ecological development of Khung Bang Kachao”. The main responsible institution is the Department of Entomology, Faculty of Agriculture, Kasetsart University.

2) The Research Project on “Horticulture for the Sustainable Green Areas of Khung Bang Kachao”. The main responsible institution is the Department of Horticulture, Faculty of Agriculture, Kasetsart University.

3) The Research Project on “The Physical and Biological Resources of Khung Bang Kachao”. The main responsible institution is the Faculty of Science, Kasetsart University.

4) The Research Project on “Silviculture for Ecodevelopment of Sustainable Green Areas of Khung Bang Kachao”. The main responsible institution is the Faculty of Forestry, Kasetsart University.

5) The Research Project on “Architecture”. The main responsible institution is the Faculty of Architecture, Kasetsart University.

6) The Research Project on “Development of Sustainable Creative Tourism by Khung Bang Kachao Community”. The main responsible institution is the Faculty of Business Administration, Kasetsart University.

7) The Research Project on “Economic and Social Sustainability of the Green Areas of Khung Bang Kachao”. The main responsible institution is the Faculty of Economics, Kasetsart University.

Integrated research was applied in these studies in order to cover various dimensions in the equilibrium of three main perspectives i.e. society, economics and environment. Then, apply the researches into practice in the community and achieve the project objectives and goals to maximize the benefits for the Bang Kachao Community.

Opportunities : The area development of Bang Kachao Community is an academic service that focuses on providing social services which comply with the missions of Kasetsart University on academic services for society, stated in the 12-Year Strategic Plan of Kasetsart University (2017-2028), Strategy 1: Creating the knowledge of the land for sustainable national development. Kasetsart University has provided academic services in the areas around the university and other campuses. The projects on Enhancement of Sustainable Bang Kachao was implemented in 2019 in Bang Kobua, Phra Pradaeng, Samut Prakarn. In order to comply with the ongoing policy, Kasetsart University has made the master plan for conservation and development of green areas of "Khung Bang Kachao" to maintain the sustainability of the areas based on the basis of economics, society, and environment. The goal is to use the plan as a framework for conservation and development of Khung Bang Kachao, based on three equilibrium of development principles, namely "economy, society and environment". The public participation is also emphasized in the planning process with the best available information to ensure that this master plan is responsive for creating other implementation plan and for the future application of the green area conservation and development in Khung Bang Kachao to enhance its sustainability.

Workshop of The Project “Bang Kachao”

The implementation framework and the goals for the Project on Green-area Restoration of Bang Krachao were established to correspond with the community’s requirements covering six dimensions i.e. green area development, water management and riverbank erosion, waste management, career promotion, tourism, and the development of youth, education and culture. Examples of the projects and activities are the followings:

- The Project on Providing Academic Services to Bang Kachaoa 2019

Objectives: 1. To strengthen the community by teaching them English in enhancing their communication ability with foreign tourists; 2. To create a roll-up regarding a local herbal compress ball presenting such knowledge to the clients who are foreign tourists.

Targets: Representatives of Bang Krachao communities

Outputs: The community members are able to communicate with foreigners.

- Project on Restoring and Increasing the Potentials of local plant production in Khung Bang Kachao and Value-adding of the Local Products 2019

Objectives: 1. To survey the groups and communities that need the knowledge and technology of agricultural science in order to restore and develop the production of plants and agricultural products in Khung Bang Kachao; 2. To arrange knowledge transfer activities on plant production technology,

production factor management, and value-adding; 3. To add value to the agricultural products in the community by processing and developing food or packaging.

Targets: Interested farmers and people in Khung Bang Kachao

Outputs: The farmers in the community gained the knowledge which is accordant to what they want to learn for solving and increasing their capabilities as well as paying attention to the restoration of agricultural areas to be continuously productive.

- The Project on Enhancing Bang Kachao toward Sustainability by Kasetsart University 2019

Objectives: To increase the community's capability of providing tourism services, especially the operators who have pets; To share knowledge and experiences with experts, professional institutions and; to ensure the safety of tourists regarding the negative impacts of communicable diseases caused by local animals as well as the knowledge on healthcare, vaccination, and population control of both owned and unowned dogs and cats in the community.

Targets: Bang Kachao community and nearby districts

Outputs: The community members are aware of disease prevention and the control of cat and dog populations.

- The Project on Ecosystem Restoration of Bang Krachao Green Areas Using Participation

Processes

Objectives: 1. To restore the ecosystem of the Bang Kachao green areas under the framework of the Master Plan for Conserving and Developing the Bang Kachao Green Areas; 2. To develop and to strengthen the capabilities of the community and networks for the ecosystem restoration of green areas using participation processes; 3. To create learning processes on ecosystem restoration of Bang Krachao green areas and apply the learning processes with the students and staff of Kasetsart University and the relevant agencies.

Targets: Bang Kachao Community

Outputs: Developing the community's capability for ecosystem restoration of green areas using participation processes. The students and staff of Kasetsart University learned the ecosystem restoration of urban green areas.

Remark: All activities refer to the Sustainable Development Goals (SDGs), otherwise known as the global goals, especially relating to goal 11 : Sustainable Cities and Communities that Kasetsart University intends to support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning and - Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials. Another important target is Goal 12 : Responsible Consumption and Production Kasetsart University intends to Ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature and relating to the main and relating to Goal 15 : Life on Land which Ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements

