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50 Years of
The Royal Chitralada Projects



Chitralada Villa, Royal Residence in the city,
Villa of His Majesty the King,
A large palace compound to view,
A field of prosperity.
This is where he works,
His projects are sequentially aligned.
Looking at the paddy fields, one can see plants and barns,
Dairy cows and fish breeding ponds are all along.
So many different things, so hard to describe,
Examples mentioned seem to suffice.

Poem (in the Thai language) composed by HRH Princess Maha Chakri Sirindhorn,
describing the visit to Chitralada Villa: in "Phra Sri Nararat Ratchakirini Lullaby and Celebration
Stanza," Episode "Admiring the City," presented in the Welcoming Ceremony of the Royal
Elephants, held in Narathiwat province, in 1977.



Foreword

All Thais feel they are fortunate in having been born under the grace and benevolence of His Majesty King Bhumibol Adulyadej, who has not only been devoting himself to his subjects' well-being but also teaching them to make a living on the basis of his "philosophy of sufficiency economy", which has been locally and globally publicized and adopted.

The Royal Chitralada Projects are "the sources of knowledge" graciously conferred on farmers as well as the general public by His Majesty the King. These projects have been implemented on the grounds of Chitralada Villa, which is the King's residence. Unlike other palaces in the world, Chitralada Villa – according to Mr. Amphon Senanarong, a privy councillor – is also the site of royal experimental projects on agriculture, livestock, fishery, forestry, biodiversity, and environmental conservation, with a rice mill, a dairy farm, as well as organic fertilizer, agricultural and food processing plants. Through these royal projects, which have been carried out

for 50 years, His Majesty has made all Thais tacitly understand that people's hope for sustainable well-being can be fulfilled on the basis of scientific research.

The publishing of this book, "50 Years of The Royal Chitralada Projects", has been accomplished with various agencies' cooperation in providing and compiling the information about the background, vision, initiatives and all steps of the royal development projects initiated by His Majesty the King, most of which for rural residents. This book is produced to express the gratitude and reverence to His Majesty the King's great intelligence and ability to be known to all Thai people and others across the world.

Department of Medical Sciences
Ministry of Public Health
Thailand, 2010

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“We shall reign with righteousness for the benefits and happiness of the Siamese people.”

The accession oath taken by His Majesty the King upon coronation in the Phaisan Thaksin Throne Hall, Friday, 5 May 1950.

His Majesty King Bhumibol Adulyadej returned to live permanently in Thailand in 1950. Following the coronation ceremony in the Phaisan Thaksin Throne Hall in the Grand Palace on Friday, 5 May 1950, His Majesty has constantly been performing his duty for the benefits and happiness of Thai people for 60 years.

His Majesty the King began to perform his significant duty by visiting his subjects in the provinces around the country, particularly in the remote areas where there was no infrastructure. The visits to his subjects made him very well aware of the problems

encountered by poor farmers. In consequence of this, in 1961 His Majesty aspired to work hard to solve such problems by initiating growing rice and yang na (dipterocarp) trees on the grounds of Chitralada Villa in Dusit Palace, which is his residence. That was the beginning of the Royal Chitralada Projects which have constantly been implemented for 50 years.

With his profoundly far visions, His Majesty then studied the root causes of the problems and realized that Thailand, while at the early stage of implementing the Royal Chitralada Projects, was being influenced by Western ideas to be an industrialized country, which affected the traditional livelihood of Thai farmers in various aspects. The best thing to help those people adjust their lifestyle to be compatible with the global mainstream is wisdom.

The Royal Chitralada Projects, as a result, were initiated to undertake research studies to find out the root causes of the problems as well as create a practical knowledge base.

The majority of Thai people are rice farmers, and they grow rice in the traditional way they have learnt from their ancestors. His Majesty compiled the body of knowledge about rice growing, and had it integrated with simple technology and modern machinery. He systematically collected data about climate, water, soil, and seeds, and then improved them on a scientific basis. Apart from this, the King realized how important the improvement of life quality was; and how to utilize local resources properly. Also, he developed alternative energy to make people self-contained. As time goes by, Chitralada Villa, compared with other palaces in the country, has become relatively distinct since there are rice fields, fish ponds, a rice mill, a dairy plant, and a scientific laboratory in its compound.

Not only using the knowledge about efficiently increasing agricultural productivity of the country, His Majesty the King also promoted their integration into socio-economic activities such as agricultural cooperatives like community rice mills and dairy cooperatives. This can considerably strengthen farmers' capability to manage their farms as well as increase their bargaining power for agricultural products.

All the activities of the Royal Chitralada Projects, as a result, are consistent with the Projects' aim of turning the palace into an accessible learning centre with the practical knowledge which is based on authentic traditional Thai wisdom. His Majesty the King,

with his advanced, profound, and comprehensive vision, had a variety of solutions integrated to tackle the country's problems. Other development projects in the country, meanwhile, were implemented with the aim of increasing productivity, and making full use of resources without paying attention to any environmental impacts that would probably occur. His Majesty also used the Royal Chitralada Projects as a model of making full use of domestic resources like raw materials and remnants rather than imported ones.

Rice was experimentally grown in the compound of Chitralada Villa to select rice seeds, and find out the appropriate way of growing rice. The rice or paddy was husked in the royal rice mill, and the rice husk or chaff was pressed to make charcoal. In the meantime, the thermo-energy derived from burning chaff was used to generate electric power for the palace's air-conditioning system.

The Chitralada dairy farming was started with only a few cows. The larger the number of cows is kept, the more the amount of milk is obtained. The milk is processed through simple technology to manufacture a variety of dairy products. Later, the royal dairy plant has enhanced its operation until it can purchase raw milk from dairy cooperatives to produce UHT milk which can be kept without refrigeration for a long time. In addition, cow dung is utilized to generate biogas, and to produce organic fertilizer to nourish the plots of forage grass grown for milk cows.

Realizing global petroleum run-out some day, and Thailand's dependence on imported energy, His Majesty the King initiated an in-depth study on alternative energy like wind power, solar energy, and bio-energy. His specific study on bio-energy included growing sugarcane as raw material for experimental alcohol production.

It is noticeable that His Majesty the King applied only simple but efficient technology or even local wisdom to his Projects while imported high technology was used in other development projects in the country. The application of local Thai wisdom can also help to conserve the traditional way of Thai agriculture.

Even though the technology applied to the Royal Chitralada Projects is simple, it is internationally accepted. His Majesty the King has been honoured with several awards for his Projects.

The integration of Thai traditional wisdom and scientific principles needs to be based on a profound understanding of science and existing local philosophy. This is the King's vision that contributed to turning Thailand into an agro-industrial country with traditional identity and profound wisdom inherited from ancestors.

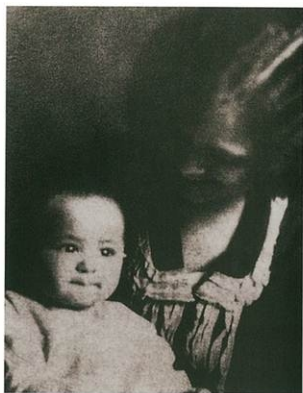
The Royal Chitralada Projects have been recognized and supported by all sectors in Thailand and foreign countries. Moreover, the Projects have inspired all sectors in the nation to join hands in solving the country's problems in various aspects. This has contributed to all sectors' unity in developing the country.

The achievements of all the Royal Chitralada Projects bear the evidence of His Majesty the King's aspiration to reign with righteousness for the benefits and happiness of Siamese (Thai) people as well as the King's devotion to his duty. It is thus lucky for all Thai people that they can live a joyful life under the King's grace.

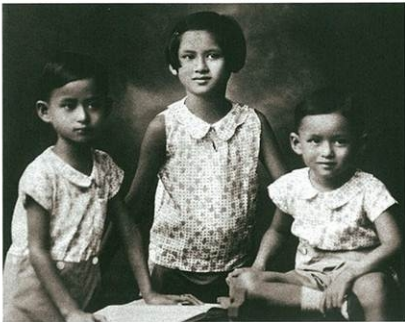
**The Great Monarch:
King Bhumibol the Great of Siam**



His Majesty King Bhumibol Adulyadej was born at Mount Auburn Hospital in Cambridge, Massachusetts, U.S.A., on Monday, 5 December 1927.

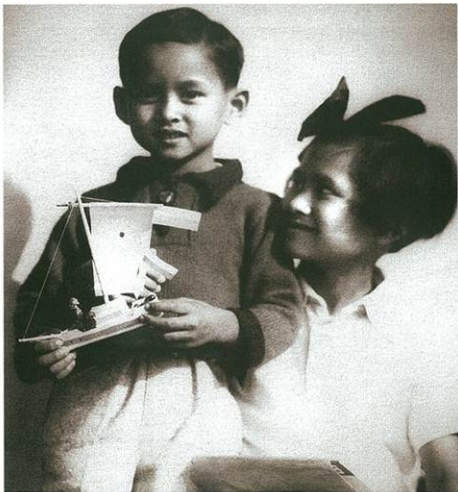


His Majesty the King is the third child of Prince Mahidol Adulyadej (Prince of Songkla) and Princess Srinagarindra.



His Majesty the King has one elder sister,
Princess Galyani Vadhana (Princess of Naradhiwas)
and one elder brother, King Ananda Mahidol.

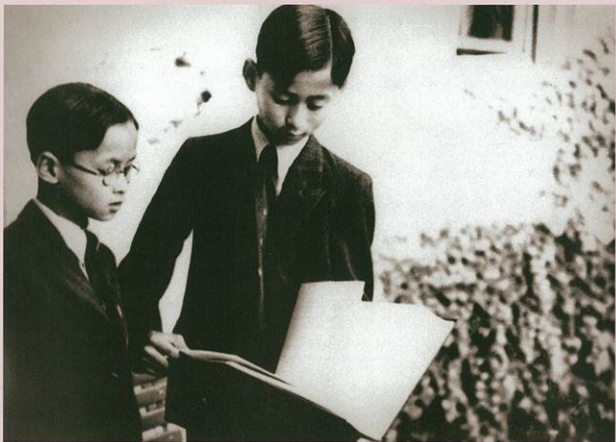




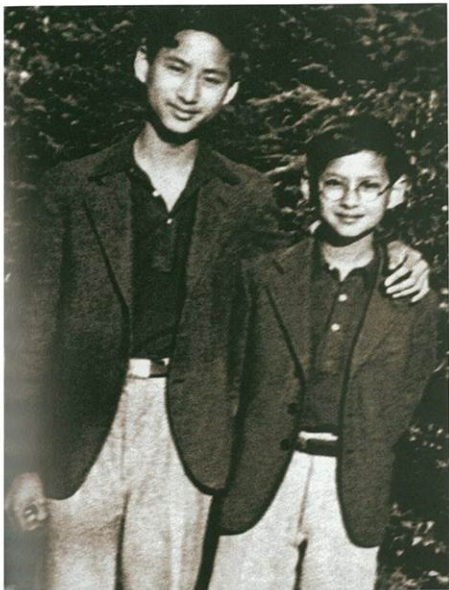
When His Majesty the King was young, he was conferred a title of nobility as "His Royal Highness (HRH) Prince Bhumibol Adulyadej", and nicknamed "Lek" by Her Royal Highness (HRH) the Princess Mother. He was graciously named "Bhumibol Adulyadej" through a telegraph by King Prajadhipok on 14 December 1927.



The word "Bhumibol" means "strength of the land" and the word "Adulyadej" means "incomparable power". So his name means "person with incomparable power of the land".



When HRH Princess Bhumibol was four years old (1932),
he studied at Mater Dei College (in Bangkok). Later in May 1933,
he went to live in Lausanne, Swiss Confederation.



HRH Princess Bhumibol continued his primary education at Miremont School in Lausanne in September 1934, and then moved on to study at Ecole Nouvelle de La Suisse Romane, a secondary school in Chailly sur Lausanne.



HRH Princess Bhumibol was conferred the title of nobility as HRH Prince Bhumibol Adulyadej, the King's Brother, on 10 July 1935 as his elder brother, HRH Prince Ananda Mahidol, ascended to the throne as King Ananda Mahidol (King Rama VIII) of the Chakri Dynasty.



His Majesty King Bhumibol got engaged to Mom Rajawongse (M.R.) Sirikit Kitiyakara on 19 July 1949, and later graciously made arrangements for the royal wedding as well as bestowed the title of Queen upon her.



On 5 May 1950, the traditional coronation of His Majesty King Bhumibol Adulyadej took place in the Phaisan Thaksin Throne Hall. His name, as engraved on the gold plate, says Phrabat Somdej Phra Paraminthara Maha Bhumibol Adulyadej Mahittalathibet Ramathibodi Chakri Naruebodin Sayamminthrahirat Borommanatbophit. After being crowned, His Majesty the King took the oath of accession, saying "We shall reign with righteousness for the benefits and happiness of the Siamese people".



His Majesty the King was ordained a Buddhist monk as well as given a monk name of "Bhumibalo Bhikku" in the Ubosot (Chapel) of Wat Phra Si Rattana Satsadaram or the Temple of the Emerald Buddha. From 22 October to 5 November 1956, he stayed at Panya Palace in Wat Bowonniwet Vihara, a royal Buddhist monastery.





His Majesty the King is well rounded in almost all the fields of art, language, and music; he can play a number of musical instruments.



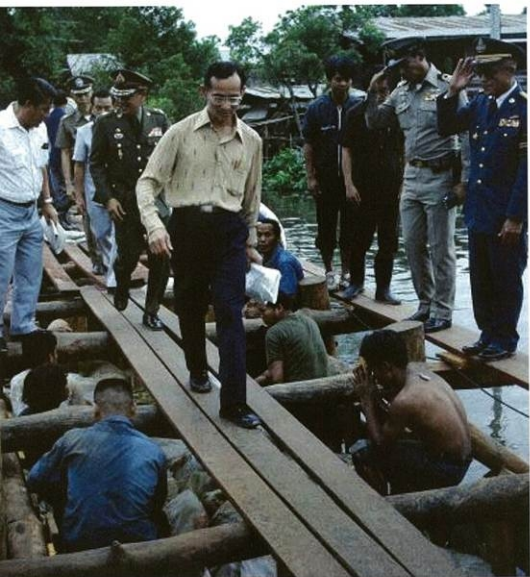


His Majesty the King is very good at sports, particularly sailing. Representing Thailand to take part in the 4th SEAP Games hosted by Thailand on 9-16 December 1967, he won a gold medal for sailing. Also, he himself designed and built various models of sailing boats.

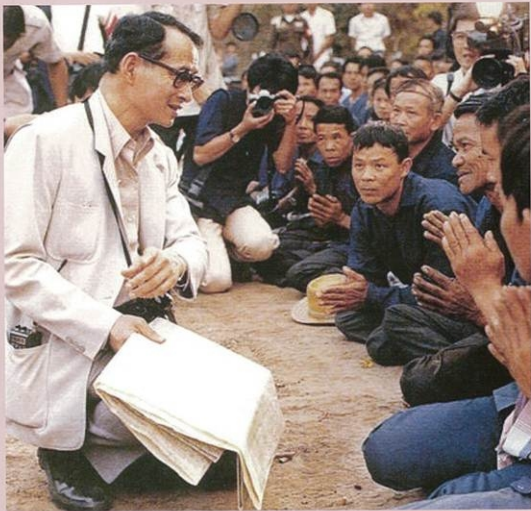




Since the accession to the throne, His Majesty the King has always been consistent in monarch integrity. He has restlessly been performing his duty, visiting his subjects in every corner of Thailand in order to learn about their problems as well as provide them with solutions for the sake of their benefits and happiness.









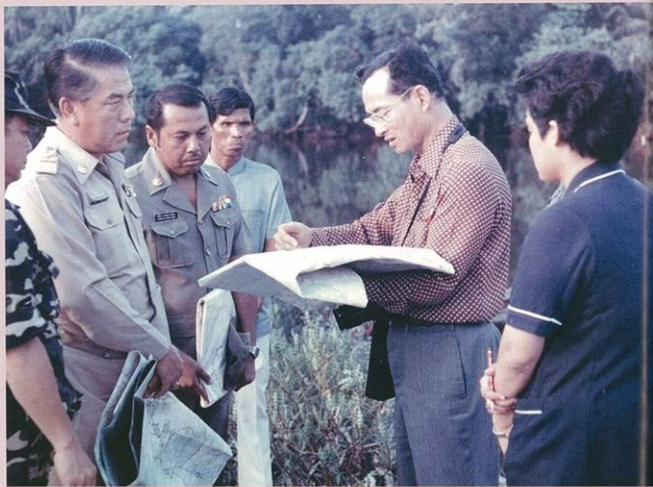






His Majesty the King's merciful actions have inspired all other royal family members to devote themselves to follow his footsteps for the benefits and happiness of Thai people.















Long Live the King! Long Live the King! A great number of people wearing yellow shirts with the embroidered emblem of the 60th Anniversary Celebrations of His Majesty the King's Accession to the Throne crowding the Royal Plaza and Ratchadamnoen Road, Bangkok, as well as acclaiming the King in unison, waving the national flag to express their loyalty and reverence to their Monarch.



*The Royal Assembles At The Austin Convention Center Hall On The Occasion Of The Sixty Anniversary Celebration Of His Majesty's Accession To The Throne
June 12, 2004 (Royal Chitralada)*

Kings, queens, and royal representatives from 25 out of 29 countries worldwide, each with a monarch as the head of state, attending the 60th Anniversary Celebrations of His Majesty the King's Accession to the Throne.



Agriculture: His Majesty's Solutions for Entire the Country

"...Agriculture is regarded as the foundation and life of our country since most Thai people are farmers. I have always had views that the most appropriate way of developing our country is to improve all branches of farming to elevate the living standards of all the farmers."

The royal address graciously given in the graduation ceremony at Kasetsart University, Bang Khen Campus, 23 July 1998.





His Majesty the King, holding HRH Prince Vajiralongkorn on his lap, driving an "iron buffalo", or khwai lek (plough tractor), in the Royal Chitralada Projects experimental rice field, 1961.



His Majesty the King inspecting local farmers' paddy fields.

Agriculture, in fact, is the science that is based on research, experimentation, and implementation.

His Majesty the King is well aware of this fact and has been trying to have it disseminated for the sake of national interests for more than 60 years.

Owing to the association between Thai agricultural ways and local tradition

and beliefs, any new concepts of country development need to be consistent with traditional lifestyles as well as based upon scientific evidence from experiments.

While visiting his subjects in remote countryside, His Majesty the King has a sound understanding of their poverty and its root causes. As a result, he has been determined to improve the life quality of those people since then.

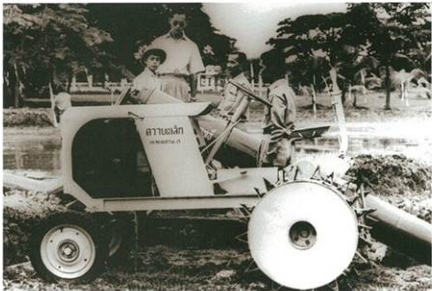


His Majesty the King and HRH Princess Maha Chakri Sirindhorn visit the rice field (or paddle field) and water resources in the rural area.

His Majesty the King realizes that Thai farmers really have knowledge about planting and farming handed down from their ancestors to descendants. However, they are not encouraged to adapt such knowledge to suit the rapid changes in global trends in order to develop the country on a sustainable basis.

Despite the fact that all of the Royal Chitralada Projects have encouraged farmers to use modern farming methods, which, as realized by His Majesty the King, have actually been incorporated into farmers' local wisdom in terms of teachings passed down from one generation to another. Consequently, the Royal Chitralada Projects have demonstrated how to make traditional farming more systematic.

*His Majesty the King and
HRH Prince Vajiralongkorn
observing "iron buffalo"
(khwai lek) or a plough
tractor at work.*



Apart from doing agricultural research, His Majesty the King graciously issued a royal edict of holding "Phithi Tham Khwan Khao", a ceremony to worship Mae Phosop (the goddess of rice) in the experimental rice field (on the grounds of Chitralada Villa) since the ceremony did not conflict with the new concept of agriculture.

The results of the experiments carried out under the Royal Chitralada Projects have been utilized in harmony with the genuine lifestyle.

Additionally, self-reliance by means of utilizing local resources, which are easily accessible, is the aim of the Royal Chitralada Projects.



His Majesty the King sowing rice seeds in the Royal Chitralada Projects experimental rice field, 1961.

His Majesty the King's work on agriculture not only includes seasonal cultivation but also agricultural problem-solving in a fashion that is consistent with the Thai social context.



His Majesty the King presiding over a ceremony to worship the rice goddess in the Royal Chitralada Projects experimental rice field.

The Experimental Rice Field: It is not Merely an Experiment

While visiting his subjects in the north-eastern region of the country in 1955, Their Majesties the King and Queen made an observation tour at the Phimai Rice Experiment Station (which is currently Nakhon Ratchasima Rice Research Centre) in Nakhon Ratchasima province, which was then conducting a study to find out which kind or variety of rice seeds was suitable for growing on salty land in that region. Their Majesties were welcomed by Mom Chao (M.C.) Chakrabhand Pensiri Chakrabhand who was then the Director-General of the Rice Department (Mom Chao or M.C. is a class of the Thai royalty). Their Majesties spent an hour attentively listening to the briefing about rice, especially the rice seed development that was the subject of the study, as well as graciously expressing useful opinions about the research project.

His Majesty the King has deemed that community-based development and rice farming development to get sufficient yield for consumption are extremely important.

Nobody anticipated that after visiting the Phimai Rice Experiment Station, His Majesty the King himself performed experiments on growing rice on the grounds of his residence in order to acquire his subjects' common knowledge of soil and plants.





His Majesty the King conversing with the King of Belgium in front of the Chitralada Royal Projects paddy field, 24 November 1994.



Accompanying King Ananda Mahidol (Rama VIII) to sow rice seeds in the experimental paddy field at Kasetsart University, Bang Khen Campus.

In addition, the King was also inspired to conduct rice growing experiments as he (while being King Ananda's brother) accompanied his elder brother, King Ananda Mahidol, to sow rice seeds on the experimental rice plot of Kasetsart University, Bang Khen Campus, on 5 June 1946.

Despite the fact that His Majesty the King conducted studies on rice based on scientific principles, he realized the importance of the royal rituals of rice growing as well.

Consequently, His Majesty the King instructed the Royal Household Bureau to revive the Royal Ploughing Ceremony (*Phra Ratchaphithi Phuetchamonkhon Charot Phra Nangkhan Raek Na Khwan*) in 1960. Since then the Ceremony has been performed every year to boost the morale of farmers.

In 1961, His Majesty the King initiated the development of "royally bestowed rice seeds"; and on 1 May of that year, His Majesty commanded that M.C. Chakrabhand Pensiri Chakrabhand,



The Royal Ploughing Ceremony actually covering two royal ceremonies (Royal Auspicious Vegetation and Ploughing) has been performed according to ancient royal traditions.



who was the performer (*Phraya Raek Na*) of the Royal Ploughing Ceremony in that year, take *Hom Nahng Mon* rice seeds to grow in the Chitralada Villa experimental rice field. Thus, it may be said that that was the beginning of the Chitralada Royal Projects.

Initiated by His Majesty the King, the experimental rice field on the grounds of Chitralada Villa was first ploughed with "iron buffalo," or *khwai lek* (ploughing tractor), invented by Mom Rajawongse

(M.R., a Thai royal title lower than Mom Chao) Thepparit Devakul who was then the Head of the Rice Department's Engineering Division.

Khwai lek is a small four-wheeled ploughing tractor with an 8.5-horsepower engine. The King himself drove *khwai lek* to prepare the soil for growing rice on the experimental rice field as well as graciously gave advice on making *khwai lek* work efficiently and more properly for Thailand.



His Majesty the King driving the plough tractor to prepare the soil before sowing rice seeds, 1961.

His Majesty the King himself not only ploughed the rice field, but also sowed rice seeds and harvested rice. In addition, he graciously granted the paddy he produced to the Rice Department to be used in the Royal Ploughing Ceremony; and he had the rice seeds put in sachets for distribution to farmers throughout the country.



Furthermore, the experimental rice field of 4.6 rai (or 7,360 sq.m.) of the Royal Chitralada Projects has also been used for students of Chitralada School to learn about rice farming since His Majesty's children were studying at the school.

In conclusion, the factors leading to the success of the experimental rice farming – according to the royal speech



His Majesty the King having a look at the transplanting, reaping and threshing of rice in the experimental rice field of the Royal Chitralada Projects.



"...I had an opportunity to experimentally do rice farming, and have realized the difficulties of growing rice. Rice growing requires good seeds and technical know-how to get considerable yield. Moreover, it is advisable to grow any plants other than rice after the rice-farming season. This will help farmers earn more income as well as cause the soil to be friable and get bio-fertilizer to the soil, making the land appropriate for the next rice-growing season."

His Majesty the King's speech given at the opening ceremony of the Third Assembly of the Leaders of Rice Farmers Groups, 19 March 1965.

mentioned above – include the technical know-how on agriculture, good rice seeds, transplanting rice in rows to let rice plants grow steadily, soil development by means of crop rotation, and the proper use of agricultural machinery.

Although His Majesty the King promoted applying technical know-how to rice farming, he was conscious of Thai tradition of rice farming as well. Accordingly, when the rice nearly formed ears, His Majesty issued a royal edict of holding *"Phithi Tham Khwan Khao"*, a ceremony to worship Mae Phosop, the goddess of rice, on 27 October 1961, in the experimental rice field to comply with the



Chitralada School's students practising rice transplanting in the experimental rice field.



ancient tradition. To hold the ceremony, a Rice Goddess shrine with a nine-tiered umbrella at the rooftop was erected, and multi-coloured paper flag poles were stuck in the ground around the rice plot to frighten birds. In the meantime, a hymn for Rice Goddess was composed, perfume for worship was prepared, and rice plants were pruned to prevent the plants with rice ears from collapsing.

Since 1961, the Royal Ploughing Ceremony has been performed at Sanam Luang or Royal Ground as well as in the Royal Chitralada Projects experimental rice field.



The rotation of crops in the paddy field

Following the harvest, His Majesty the King initiated growing leguminous plants and less water-requiring plants such as corn and sunflower. The Rice Department begged permission from His Majesty to utilize the yield of those plants in other royally initiated projects, and use it for agricultural reproduction.

In 1974, the people from Prachuap Khiri Khan province's self-reliant settlement, which is located in arid upland areas, informed His Majesty the King that the yield from their upland rice crop was not enough for consumption. His Majesty

"Upland or less water-requiring rice will become significant in the future since it needs little water and merely relies on rain water."

His Majesty the King's speech given on the occasion of visiting San Pa Tong Rice Experiment Station, 13 February 1966.

thus initiated growing upland rice – both *khao chao* or non-glutinous rice and *khao niao* or glutinous rice – on a trial basis on another experimental paddy plot of the Royal Chitralada Projects by means of putting rice seeds into the pits dug in rows on an elevated plot of land with no stagnant water. This experimental rice growing yielded 20 litres of rice grain per rai (1,600 sq.m.) on average. His Majesty, as a result, encouraged rice farmers to grow less water-requiring rice in different areas around the country as appropriate, especially the highlands where the hill-tribes live with the problems of slash-and-burn farming as well as opium poppy cultivation.



His Majesty the King viewing the exhibition of rice seeds held by the Bang Khen Rice Experiment Station at the Rice-farming Experiment Building, Royal Chitralada Projects, 1985.

Although the less water-requiring rice grown on the highlands was not considered significant for the country's economy, it was essential for an increasing number of poor hill-tribe people. Owing to the insufficiency of rice for consumption, those hill-tribes extended their cultivation areas through deforestation. The research and development on how to increase rice crop yield could therefore solve this problem.

Apart from "Hom Nahng Mon" rice seed variety that was first grown in the



His Majesty the King viewing the demonstration of operating a rice transplanter, a rice harvester, and a rice thresher in the Royal Chitralada Projects experimental rice field, 2001.

experimental rice field, several other good rice varieties, by the royal command given to M.C. Chakrabhand Pensiri, were grown as well.

At present, 49 selected rice seed varieties are grown in the paddy field of the Royal Chitralada Projects; and part of the harvested seeds will be used as the main seeds for the next season's cultivation. Nine types of principal rice seeds and another nine types of less water-requiring rice seeds are used in the Royal Ploughing Ceremony.

Moreover, His Majesty the King was also interested in farmers' quality of life especially in terms of crop selling and post-harvesting management. In 1968, His Majesty the King assigned M.R. Thepparit Devakul to build a rice mill as well as various types of granaries in the compound of Chitralada Villa to find the proper way of storing rice grain. This is the learning centre for farmers; and it promotes mobilization among farmers in terms of cooperatives, which can enhance the potential of production and distribution.

"Brown rice is good for health if we eat it every day. White-milled rice is less nutritious than brown rice because its nutrients have been polished off. Somebody says only the poor eat brown rice. However, we are poor; we must eat it because it's good. Nowadays, I eat brown rice instead of white rice; it makes us robust."

His Majesty the King's speech given to the mass media on the occasion of visiting Bang Taen Royal Project in Prachin Buri province, 18 November 1998.

A crankshaft rice huller was first used in the royal rice mill in Chitralada Villa, and was later replaced by Pinkaew rice huller which mills 150 kilograms of paddy per hour. The royal rice mill is supplied with jasmine paddy bought from north-eastern region farmers.

The rice paddy is hulled only once by the royal rice mill and then cooked to serve His Majesty the King according to his speech given to the public in 1998. This has encouraged many more Thais to eat brown rice in their daily meals.



Silo for storing Hom Mali Rice, or jasmine rice, purchased from farmers.

After hulling rice paddy, a large amount of chaff, which is not easily perishable, is left over. To solve this problem, some chaff is compressed into fuel bars while the remainder is used for generating electricity for the air-conditioning system of the cold-climate mushroom nursery and Sala Maha Mongkol, a reception hall for visitors. This is the real prototype of utilizing agricultural remnants for the maximum effect.

The knowledge acquired from the Chitralada Royal Projects has been



The Royal Chitralada Projects' model rice mill

applied in other rural development projects initiated by His Majesty the King like those in the northern region of Thailand, which put emphasis on experiments, learning, and career promotion in the same way as the Chitralada Royal Projects. Besides, the King graciously established royal development study centres in arid areas around the country in order to find ways to solve the specific problems of individual communities. This led to the establishment of other royal projects initiated by Her Majesty the Queen and other royal family members.

Somebody may wonder why the King is so keen on the knowledge about rice despite the fact that it is not his duty; it really is farmers' job. This is probably because the King is well aware that "*rice is not only a principal diet but also the life of Thai people*".



Polished rice from the model rice mill

The Royal Ploughing Ceremony

Cultivation has constantly been recognized and supported by Thai monarchs since the Sukhothai period. In ancient times, the Royal Ploughing Ceremony purely was a Brahmin rite. The performer or *Phraya Raek Na* of this ceremony also performed the Brahmin rite of playing on the giant swing or Tri Yampawai and Tri Pawai rites.

Later, King Rama IV commanded holding the Buddhism ceremony together with all the royal Brahmin ceremonies. The Royal Auspicious Vegetation Ceremony as well as the Royal Ploughing Ceremony, therefore, was first held during the reign of King Rama IV.

These ceremonies are aimed at setting an example and boosting farmers' confidence in growing rice. Rice has been considered as one of the national security factors since the ancient times because it affects people's living conditions and the national economy. Rice growing has been relying on a great amount of water from seasonal rain showers which are unpredictable. In case it never rains, rice farmers will surely become disheartened. The ceremonies may possibly console them anyway. Also, these ceremonies reveal that His Majesty the King becomes





His Majesty the King presiding over the ceremony of sowing rice seeds in the Royal Chitralada Projects' experimental rice field.

well aware of the importance of agriculture. It is hopeful that the actual rice cultivation will have a good yield; however, this is related to the wish and prediction, based on the costume worn by Phraya Raek Na, the ceremony performer, and the type of food chosen by the ceremonial cow.

The Royal Auspicious Vegetation and Royal Ploughing Ceremonies are usually held in the sixth lunar month of each year. This time span of a year is the beginning of the rainy season and growing rice. The specific date of holding the ceremonies, however, depends on the propitious time determined by the Brahmin priests.

The Royal Auspicious Vegetation and Royal Ploughing Ceremonies were given up in and after 1937 owing to the social and political changes in Thailand. Until 1960 such ceremonies were revived by the royal command. The Royal Auspicious Vegetation Ceremony was held in the chapel of the Emerald Buddha Temple in the Grand Palace on the first day while the Royal Ploughing Ceremony at Sanam Luang on the second day.

Previously, the director-general of the Rice Department, Ministry of Agriculture and Cooperatives (MOAC), was appointed Phraya Raek Na *ex officio* while the four ladies were recruited from the wives of senior MOAC officials. Later, the MOAC Permanent Secretary



The Royal Ploughing Ceremony at Sanam Luang



Phraya Raek Na, accompanied by a couple of ladies carrying golden baskets on their shoulders and another couple of ladies carrying silver baskets on their shoulders, having an audience with His Majesty the King.

was appointed Phraya Raek Na *ex officio* while the four ladies were recruited from single female 2nd class officials of the Ministry. His Majesty the King constantly presided over the ceremonies; until recently, the King has assigned HRH Crown Prince Vajiralongkorn to represent the King himself at the ceremonies.

In 1966, the Royal Ploughing Ceremony Day was proclaimed the National Farmer's Day by the cabinet's resolution to recognize the agriculture of the country. In the ceremony, His Majesty the King conferred awards and certificates of honour on outstanding farmers of the nation including rice growers with highest yields in the past harvest season.

Yang Na Trees:

The Convergence of Economic and Ecological Values

"In the next 50 years, we'll see this Yang Na Forest together."

His Majesty the King's talk, disclosed by Mr. Keokhwan Vajarodaya, Lord Chamberlain and Director of the Royal Chitralada Projects, indicates His Majesty's interest in economically valued *yang na* or dipterocarp trees (*Dipterocarpus alatus*). *Yang na* trees were planted on part of the grounds of Chitralada Villa by His Majesty's initiation in July 1961.

The year 2011 will be the 50th anniversary of the *yang na* trees planted by His Majesty the King. Today, the *yang na* seedlings have become big trees which are more than 20 metres in height, shading the ground with their branches and moisturizing the small area in the centre of the capital city of Bangkok.

Yang na trees are large shady plants which local people have been familiar with for a long time. The wild plants are commonly found near rivers, or close to Buddhist temples and communities, among the most valuable plants in Thailand. *Yang na* extract, or dammar oil, is widely used as wood-glazing oil or a leak-sealing compound for household containers. The wood is used to make firewood and for building houses because of its durability and weatherproof quality. *Yang na* trees can be seen everywhere throughout the country from northern to southern regions.

However, *yang na* is a slow-growing plant although germination rate of new seed is relatively high. When the demand increases each year, it is hard for nature to regenerate the same number of plants. In the meantime, dry evergreen forests and tropical lowlands, where *yang na* trees are usually found, have been invaded and become agricultural areas. For these reasons, His Majesty the King expressed his concern in 1961, excerpted:



His Majesty the King, together with Her Majesty the Queen and HRH Prince Vajiralongkorn, planting yang na trees in the Demonstration Forest, on the grounds of Chitralada Villa, 28 July 1961.



Yang na forest.

"More and more yang na trees in Thailand have been cut down for home use and making different products each year. It is worrisome that if the plants are not taken care of properly and cannot regenerate in time, the amount of yang na wood can be reduced tremendously. Research on growing yang na trees should be carried out and the findings from the research can be practically applied."

Since *yang na* is a common plant for local use, His Majesty's far-sighted vision reflects his concerns in every aspect of people's livelihood. Most importantly, His Majesty emphasizes the value of "knowledge transfer" from "research study" to real practice, which is the key principle for sustainable development in Thailand while the country is moving into the future.

Lord Chamberlain Keokhwan Vajarodaya told us the story behind His Majesty's interest in *yang na* trees. It began in 1951 after His Majesty the King had returned permanently to Thailand. Every summer, Their Majesties the King and Queen, as well as their children would reside at Klaikangwol Palace, Hua Hin district, Prachuap Khiri Khan province. In the early period, railway was the transportation for the Royal Family. Later on, the reconstruction of the southern road made the highway safer to travel, the Royal Family then shifted to travel by car.

Along the way on Phetkasem Road, while the car was passing Tha Yang district, Phetchaburi province, His Majesty saw a beautiful cluster of huge *yang na* trees.

In 1961, His Majesty proposed that the government should alter this natural *yang na* cluster forest into a public park as one way to mark the area for Natural *Yang Na* Forest Conservation. However, as many villagers had been using the land area for their living, the government was not able to implement the plan.



*His Majesty
visiting the site
prepared for
yang na tree planting,
26 July 1961.*

His Majesty the King was interested in *yang na* situation not only in terms of natural conservation but also knowledge findings such as its growth cycle and its roles towards people's life. *yang na* wood has a significant value for local people as the main material for building a house, one of the four basic human needs, with growing demand over time. The situation will gradually worsen and *yang na* will be at risk of becoming extinct if no one establishes a *yang na* reforestation programme.

In the summer (April) of 1961, *yang na* seeds were blown from parent trees. His Majesty told his royal guards to collect

the seeds in the forest and then he divided the seeds into two groups. One group was planted in the pots on the roof of Piamsuk Villa, Klaikangwol Palace. The other group was grown and looked after in the plant nursery under the shade of vegetable hummingbird tree, or *khoe-ban* (*Sesbania grandiflora*), on the grounds of Chitralada Villa.

Very soon, after the sprouts sprang up, selected individuals were moved for growing in earth pots in the plant nursery; and then the cultivation started when the seedlings were four months old as His Majesty allocated a plot of land on the grounds of Chitralada Villa for *yang na*



Yang na planting on 28 July 1961

cultivation and research and development. The cultivation was undertaken with modern agricultural techniques.

His Majesty the King planted *yang na* seedlings together with Her Majesty the Queen and HRH Prince Vajiralongkorn as well as relevant government officials on 28 July 1961, which was the Prince's birthday anniversary.

There were a total of 1,096 *yang na* seedlings planted, 432 of which were selected for research study. They were carefully cultivated with a spacing of 2.5 metres between each plant and their growth data were recorded. Later, this plantation turned out to be the Yang Na Forest Research and



Study Project, undertaken by the Faculty of Forestry, Kasetsart University. Professor Thiem Komkris, Dean of the Forestry Faculty at that time, was the chief responsible for the Project.

Every year after that, lecturers and students from the Faculty of Forestry, Kasetsart University, would come to the Villa to measure the *yang na* trees on the different research plots. Each plot had different conditions of shade and amounts of fertilizer applied, to compare the growth rate. Later on, His Majesty graciously permitted various plant species both deciduous and evergreen



His Majesty talking to students from the Faculty of Forestry, Kasetsart University, while they were measuring and recording the sizes of yang na trees in Chitralada Villa's compound.

to be cultivated on the Villa's grounds. It has now become a tradition for forestry students and faculty members to plant trees every year in Chitralada Villa's compound on the National Tree Day.

The fundamental knowledge gained from the research indicates that the seedlings grow well in moderate shade and grow fast at the early stage. The seeds should be allowed to germinate in the nursery plot and after that the sprouts should be moved to earth pots until the seedlings are strong enough, and then they should be relocated to the planting site in the rainy season.

The study of *yang na* growth cycle under the Royal Chitralada Projects has led to a further study of *yang na* growth cycle in natural forests. The research results from the two locations were compared, leading to the establishment of a database for botanical studies so that the knowledge would be widely publicized among the Thai people.

Some of the *yang na* trees under the Project, when reaching the age of 5-10 years, were relocated to other planting areas within the compound of the Villa. Some were distributed to Buddhist temples or public areas elsewhere.



A natural ecosystem in the Royal Chitralada Projects; behind is the demonstration forest.

In 1965, His Majesty graciously permitted growing other plant species, including rattan using young plants derived from tissue culture until the plot has become an experimental forest where various local plants from different regions throughout the country can be found. They are all flourishing in the Villa's compound, like a small tropical forest.

His Majesty the King once stated that:

"When agricultural students need to learn more about species of plants, they can learn from here, in the compound of Chitralada Villa."

Today, this is actually happening and not only limited to those interested in plant species.

One could say that, seeing the *yang na* trees, lining up with the tips piercing into the sky, reminds us of the early days of the Royal Chitralada Projects. Those large trees are not only giving us shade, protecting us from the heat of the sun, and nurturing other creatures around them, but also reflecting the valuable insights, the important means of thinking process and scientific practices where small details should never be



Large trees and various kinds of plants under the Demonstration Forest Project.

taken for granted. These are the principles of His Majesty's initiatives for each of the Royal Chitralada Projects.

The results of such a practice can be compared with those of the *Yang Na* Forest

of our beloved King. They are not only a cluster of half-century-old large trees but the naturally balanced ecosystem that generates moisture and fertility to the surrounding areas, nurturing all creatures which comfortably reside under them.

Chitralada Nil Fish:

Common Protein Food from the Palace

"Have you had any meal yet?" is a simple question that clearly defines Thai culture. With a simple lifestyle, Thais consider those who can eat and sleep well as fortunate people. This brings attention to His Majesty the King to seek simple, inexpensive foods with a rich source of protein.

Within the compound of Chitralada Villa of Dusit Palace, which might be the only palace that has a real paddy field and also fish ponds to rear fish for distribution to Thai people.

In 1952, before the initiation of the *nil* (*Tilapia nilotica*) fish raising project, His Majesty the King had been raising *mor thet* (*Tilapia mosambica*) fish, presented by an official of the United Nations Food and Agriculture Organization (FAO), in the pond in the compound of Amphorn Satharn Villa, Dusit Palace. Later, His Majesty commanded that the Department of Fisheries culture and breed *mor thet* fish in the compound of Chitralada Villa as they are easily raised and fast-growing, and they normally feed on natural





His Majesty the King looking at nil fish to be given to fisheries stations.

plants such as algae and weeds. It is an easy-breeding species as well.

Later in March 1965, Emperor Akihito of Japan, then the Crown Prince, presented 25 pairs of *Tilapia nilotica* to His Majesty the King. This fish species shares common characteristics with *mor thet* fish. His Majesty then graciously had the Department of Fisheries nurture the fish in the Royal Chitralada Projects' fish pond. Apparently, the fish are fast-growing and fast-breeding and the taste is good.

A year later, His Majesty named the fish "nil" or pla nil after its species "*nilotica*" and 10,000 fries of nil fish were given to the Department of Fisheries for distribution to fishery stations throughout the country. The stations then further bred and distributed the fish to farmers.

At the same time, His Majesty had the Department of Fisheries maintain the pure strain of *Nile tilapia* in the ponds of the Royal Chitralada Projects. For this reason, nil fish cultured in the ponds along the road leading to the Royal



His Majesty the King releasing nil fish to the earth pond in the Chitralada Villa's compound.

Chitralada Projects site are called Chitralada strain of Nile tilapia. His Majesty once stated that:

"If you cannot find a pure strain of nil fish, come and get it from Chitralada Villa."

His Majesty also suggested that the Department of Fisheries conduct research to improve the *nil* fish strain so that it would have better quality: fast-growing and fleshy.

Until now, from the original *nil* fish presented by Emperor Akihito to His

Majesty the King, the Chitralada strain of the fish has been developed to the third generation, more suitable to the environment of Thailand.

To date, *nil* fish are freshwater fish commonly known by Thais as it is easy to culture them. They feed on natural plants such as algae, duckweeds, and water fleas with the supplementation of bran, broken rice, or bean fibres. With these alone, the fish will thrive. This is the reason why *nil* fish can be found in almost all markets in Thailand. With its affordable price, *nil* fish is a common dish in every family's meal.



His Majesty the King, Her Majesty the Queen, HRH Princess Maha Chakri Sirindhorn, and HRH Princess Chulabhorn releasing the fish in a natural water source.

Within this commonness of nil fish, lay the profound thoughts and kindness of His Majesty towards his people that have never declined.

Common fish found in typical villager's meal reflects the noble kindness of His Majesty the King.



Plant Tissue Culture:

Royal Initiative towards the New Concept of Conservation

A large jackfruit tree loaded with big-sized jackfruits can be seen in front of a small white building (in the Chitralada Villa compound).

Looking through the glass window of the same building, one will find hundreds of glass bottles with closed lids and tiny plants inside each bottle. These tiny tissue-cultured plants in the bottles have a miracle connection with the large jackfruit tree in front of the building.

The large jackfruit tree is a descended species from the *phaisanthaksin* jackfruit tree, which is more than 100 years old located at the back of the Phaisan Thaksin Throne Hall in the Grand Palace. It is a species that gives sweet and fleshy fruits.

When His Majesty the King presided over the opening ceremony of the Plant Tissue Culture Laboratory on 9 May 1985, he suggested that the Laboratory try to preserve this jackfruit tree. The operation on rare plants conservation was then undertaken with the tissue culture technique.

Plant tissue culture is an innovative technique that can preserve the unique plant species so they will not become extinct and can be useful in the future. The technique helps propagate plants in large numbers within a short period of time and does not cause mutations. The method includes fetching parts of the plant such as tissues, cells, or protoplasts to be cultured on the synthetic medium (which contains minerals, sugar, vitamins and growth-regulating substances) in sterile conditions to ensure that the fetched parts will grow up as new parts or plants. The culture is done in the controlled environment



His Majesty the King and HRH Princess Maha Chakri Sirindhorn observing the progress in plant tissue culture, 1987.

with the temperature of around 25°C and the light for about 8-16 hours a day depending on the type of plant.

"A story has been told that the original *phaisanthaksin* jackfruit tree was so old that it might no longer bear fruit. But in that year, the tree bore tens of fruits; some of them lay on the rim of the cement wall around the tree, as if they were waiting for His Majesty to see while passing that area. And it was told that His Majesty asked that the fruit be brought to him too," recalled Associate Professor Dr. Sureeya Tantiwiwat

from the Department of Botany, Faculty of Science, Kasetsart University.

"His Majesty once said that, for the *phaisanthaksin* jackfruit tree to bear sweet fruit, a giant should be placed beside it. That was his sense of humour because the original *phaisanthaksin* jackfruit tree in the Grand Palace compound has a sculpture of a giant standing beside it," added Dr. Sureeya.

When jackfruit tissues were cultured and became saplings, the isozyme test



His Majesty the King and HRH Princess Maha Chakri Sirindhorn opening the Plant Tissue Culture Laboratory, Royal Ploughing Ceremony day, 1985.

was done to ensure DNA matching with the parent tree.

For this reason, the magnificent *phaisanthaksin* jackfruit tree we see in front of the Plant Tissue Culture Laboratory in the Royal Chitralada Projects compound is actually the first jackfruit tree derived from tissue culture. Every year, it bears sweet, fleshy jackfruits, the same as those from its parent tree.

The plant species conservation is not limited only to *phaisanthaksin* jackfruit but also to other unique plants from the

Grand Palace grounds such as *Talauma candollei* (*montha*), *Taluama mutabilis* (*yee-hup*), crape jasmine (*phudsuan*), bullet wood (*pikunthong*), bilimbi (*taling-ping*), pomeric (*chompoo-ma-miao*) as well as ink nut (*samo-thai*) in the compound of Amphorn Satharn Villa, Dusit Palace. All feature unique quality; if it is a fruit tree, it gives fleshy and tasty fruit; if it is a flowering tree, it gives perfect flowers with nice fragrance.

In addition to the efforts of unique plants species conservation, the Plant Tissue Culture Project also had a chance



HRH Princess Maha Chakri Sirindhorn taking officials from the USA to visit the plant tissue culture activities.

to propagate and conserve natural rattan which was mostly cut down for furniture manufacturing. The increasing demand made the rattan become an endangered species while the re-plantation had not yet been introduced. Particularly, the aromatic rattan which was in high demand used for wickerwork for the Arts and Crafts Centre under the Royal Patronage of Her Majesty the Queen.

The plant tissue culture plays an important role in plant genetic conservation. In 1993, HRH Princess

Maha Chakri Sirindhorn initiated the Genetic Conservation Project focusing on conserving rare Thai plants, especially rare or endangered species such as various species of rice, Nonthaburi durians and non-cash crops. The conservation can be done by seeding culture, tissue culture, as well as exploring and collecting data on island plant species. All data have been collected and stored in the central database system with pictures and descriptions of each plant. The concept is to develop local species suitable for farmers, avoiding imports

*His Majesty the King
and HRH Princess
Maha Chakri
Sirindhorn inspecting
the experimental
soilless cultivation
(hydroponics) plot and
conserved plants, 1987.*



of plant species from abroad. This concept has been expanded and adapted to apply as a "Botanical Garden" at the school level in every region of the country. Academic and government agencies widely support the Project. It is indeed the learning process for local people on the benefits of local plants, raising awareness on preserving, cherishing, and protecting indigenous species, so they will not become extinct in the future.

On the Royal Ploughing Ceremony day in 1987, His Majesty the King and

HRH Princess Maha Chakri Sirindhorn paid a visit to the Royal Chitralada Projects and had asked about the possibility of growing crops by layering the bottom part in the plot with plastic, then sand, coconut husk, and coconut shell, one way to grow crops in poor soil. Later, this became a royal experimental project on soilless cultivation of crops. The method was later used at the Huai Sai Royal Development Study Centre, Phetchaburi province.

The Project becomes successful in producing prolific different melon species.



For more than 10 years Associate Professor Dr. Sureeya Tantiwiwat worked for the Plant Tissue Culture Project, mainly in the laboratory. Despite the fact that Dr. Sureeya no longer works on the Project, the ingenious method of His Majesty the King to find the way for his people, treat them equally, encourage them to cherish natural resources of the country, as well as conserve all the resources, and improve crop production for them, will always remind her of the notable kindness of His Majesty the King.

It could not be wrong to say that, the application of knowledge gained from the laboratory combined with the right attitude toward loving and caring for local resources is a powerful tool to change unfruitful land to the land of fertility.



Prince Akishino of Japan together with his consort and two daughters visiting the plant tissue culture site.

Phaisanthaksin jackfruit tree growing up from a sapling obtained from the tissue culture process.



Organic Fertilizer: Product from Problem-Solving

As generally known, several projects from His Majesty's initiatives have spread wings to every corner of the country; all of which are the studies to find solutions to his people's problems. For this reason, many of the projects need in-depth studies to solve specific problems which occur in a particular area. The research study must be carried out carefully before technologies are transferred to farmers.

Most of the major issues that have been discussed at the national level often had their way started in the Royal Chitralada Projects, including organic fertilizer. The story started when there were continuous efforts to use organic substances as a method to reduce peat soil's acidity level in southern provinces.

One of the things His Majesty paid attention to while residing at Thaksin Ratchaniwet Palace in Narathiwat province was to develop the peat soil areas to become cultivable land.





Lord Chamberlain Mr. Keokhwan Vajarodaya, Director of the Royal Chitralada Projects, and Mr. Wisitporn Phueanpipop, currently Director of the Royal Chamberlains Division, Bureau of the Royal Household, presenting the progress report on peat soil development and organic fertilizer production to His Majesty the King, May 1986.

*His Majesty the King
and HRH Princess
Maha Chakri Sirindhorn
watching the
experiment on mixing
organic horticultural
materials to reduce the
level of acidity in
peat soil, 1985.*



In 1985, the Royal Chitralada Projects acknowledged the obstacles in developing the peat land because of its high acidity level. The soil then was tested to adjust the acidity by using organic substances. Several Royal Chitralada Projects such as dairy farm, rice mill, and legumes farms produce tons of organic substances from wastes such as cow dung and rice husk. These materials were mixed with peat soil, lateritic soil, and lime with appropriate ratio for pH balance. Subsequently, the

Organic Fertilizer Production Project emerged, and later in 1987, the Organic Fertilizer Plant was officially established.

To date, the Organic Fertilizer Plant produces organic fertilizers from cow dung, grass, and waste from vegetable scraps and leftover fruits from the fruit processing plant of the Royal Chitralada Projects. It is indeed a full recycling process for maximum benefits.



The Project also provides demonstrations and training to groups of farmers so they will be able to replicate the process.

It can be said that organic fertilizer from the Royal Chitralada Projects is the product of efforts to solve problems, and making the most out of existing resources. This is consistent with what His Majesty the King always emphasizes and the core principles of the Royal Chitralada Projects.



Staff spreading and drying organic fertilizer

Pictures to Remember: Inspiring Impression

Early in the morning of Wednesday, 2 June 2010, four farmers departed Wang Wa sub-district of Si Prachan district, Suphan Buri province, for Chitralada Villa on a study trip to gain the knowledge they were looking for from the agricultural learning centre located at the site of the Royal Chitralada Projects.

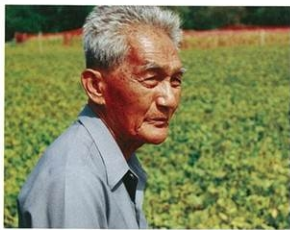
For Mr. Thanom Srisukda, the trip did not only update his knowledge around rice farming but also reminded him of what happened 26 years ago when he first entered the site of the Royal Chitralada Projects.

"In 1984, I had the opportunity to visit the Royal Chitralada Projects, on the Royal Ploughing Ceremony day, as a representative from the Wang Wa Agricultural Cooperative. I remember that within the Projects site there were sorghum plants, paddy fields and a dairy farm. At that time I thought His Majesty was a King but he was doing farming and agriculture. He wanted to set a good example for us."

"Farming and agriculture are very important to the country. You will need to help find new knowledge and expand skills, as well as disseminate the useful knowledge and skills to farmers. So they know how to do it right. This way you are bringing benefits to this society and creating prosperity to the country."

Royal guidance in the graduation ceremony, Kasetsart University, Bang Khen, 19 July 1962.





Mr. Thanom Srisakda

Everything he saw on that day, he shared it with his fellow farmers in the Wang Wa Cooperative, hoping that everyone would be able to apply what he had told them for sustainable and secure agriculture.

Today, the 76-year-old man came with his 2nd and 3rd generations of Wang Wa farmers. They still loved what they were doing. Mr. Thanom said that being a farmer is a "clean" occupation because it is an honest job. On this field trip, four of them were very keen on the idea of cultivating mung beans to add nutrients to the soil

during the rice-farming intermission period.

"What I am going to pursue is to grow mung beans. Even though there is little water, we will still have fertilizer for rice fields. If we have good water, then the beans are for sale. I will share this with my fellow farmers back home," said Mr. Thanom.

Apart from agricultural knowledge and the intention to put it into practice, in his shirt pocket, there was a plastic bag containing the Royal rice seeds. There were not many of them, definitely the seeds



Mr. Thanom Srisakda and his second and third generation farmers visiting the Royal Chitralada Projects, in front of the mung bean experimental plot.



Mr. Thanom Srisakda, with the portrait of His Majesty in his arms, and his family in Suphan Buri, pictured with their iron buffalo (plough tractor).

were not enough to grow even on a paddy plot, but they carried something meaningful to him.

"I will keep the seeds as an auspicious sign and as my inspiration."

And during this field trip, Mr. Thanom witnessed an "iron buffalo" or the first 4-wheel diesel tractor designed by M.R. Theparit Devakul. The iron buffalo was the prototype of his family's iron buffalo he used 40 years ago.

"The first iron buffalo belongs to the Royal Chitralada Projects, my iron buffalo is the 6 1st. I bought it in 1967. It is really a versatile tractor. It saves time, energy, and money for ploughing. You can use it in the threshing season too. I am touched every time I see the pictures of the King driving this tractor, exactly the same type as mine."

"..It gives us inspiration, knowing that we have the King who cares for us and our occupation."

Royal Initiative: "Thai Dairy Cows"

"...In the beginning when we started a dairy farm in Chitralada Villa's compound, we limited the number of cows and tried to find out which breeds or which methods were most useful. It has been proven, though, that dairy farming can be done in Thailand..."

*Royal speech given to the Committee on Milk Powder
Factory Construction in Nong Pho sub-district of
Ratchaburi Province, at Chitralada Villa,
11 September 1970.*





His Majesty the King grew up in the country where its people consume milk and dairy products, and its dairy business is excellent. This might be one of the reasons why His Majesty wanted Thai people to drink milk for health.

The Father of Thai Dairy Industry

The Royal Visit to various countries in North America, Europe, and Asia was His Majesty the King's effort to strengthen ties with such countries. Not only that, it was also a part of His Majesty's steadfast attempt to develop the country and improve the quality of life of Thai people. With this particular objective in mind, during the Royal Trip to the Kingdom of Denmark in 1960, a visit to a dairy cattle farm and a milk processing plant was put in His Majesty's itinerary. The purpose was to study the possibility of establishing a milk farm and milk industry in Thailand.

After His Majesty had returned to Thailand, King Frederick IX of Denmark, the Danish Government, and the Danish Farmers Association presented the Thai-Danish Dairy Farm, an agricultural training centre in Muak Lek district, Saraburi province, to His Majesty the King.





Not only having advanced manufacturing and processing technology, the Thai-Danish Dairy Farm has an organized training system providing training to officials from the Department of Livestock Development as well as farmers, instructed by experts from Denmark.



His Majesty observing dairy farming in Denmark

His Majesty presiding over the Opening Ceremony of the Thai-Danish Dairy Farm, 1962.



On 16 July 1962, His Majesty the King and King Frederick IX of Denmark presided over the Inaugural Ceremony of the Thai-Danish Dairy Farm and Training Centre. Later in 1971, the Royal Thai Government endorsed the operation of the Thai-Danish Dairy Farm and Training Centre as a state-owned enterprise, under the supervision of the Ministry of Agriculture and Cooperatives. The name was changed to "Dairy Farming Promotion Organization of Thailand".

One can say that the Royal Trip to Denmark in 1960 was a historical move of dairy farming in Thailand. However, His Majesty never stops learning. He consequently started many experimental projects in his residence within Chitralada Villa, Dusit Palace. Many operations took place there as a precedent for dairy farmers.

For this reason, dairy farmers proudly mention dairy farming and processed milk industry as the "Royally-Granted Career".



From the First Step to Present

- 1962** His Majesty presided over the Opening of Suan Chitralada Dairy Farm.
- 1969** His Majesty presided over the Opening of Suan Dusit Milk Powder Plant, the first milk powder plant in Thailand.
- 1973** Started the accounting system and the official operation of Suan Chitralada Milk Collection Centre.
- 1984** Milk tablet production was developed until Suan Dusit Milk Tablet Plant was officially opened for operation.
- 1985** Originated drinking-water plant from the process of milk production.
- 1987** Started to produce cheese, low-fat milk, condensed milk in tube containers, yogurt, and ice cream.
- 2000** Started production of fluoridated milk for preventing tooth decay at Suan Chitralada Milk Collection Centre.
- 2003** Suan Chitralada UHT Milk Plant started its operation.

Suan Chitralada Dairy Farm: Where the Learning Begins

Fifty years ago, Thai people were unaccustomed to drinking milk and it was not as prevalent as it is nowadays. However, the young King's vision has brought the major changes to Thailand.

From Phra Jenduriyang's donation of 32,886.73 baht to His Majesty the King, this income from publishing/selling a Music Theory book turned to be the start-up capital for the Suan Chitralada Dairy Farm. His Majesty presided over the Opening Ceremony of the Farm on 12 January 1962.

The Suan Chitralada Dairy Farm started with six cows (four pregnant and two heifers), presented by the Department of Livestock Development and private companies.

In those days, the courtiers in Chitralada Villa were the first group of Thais who had a chance to drink fresh milk regularly. Apart from milking training, the Suan Chitralada Dairy Farm also sold cow milk in 8-ounce glass bottles at a price of 1.50 baht each. It was high quality milk sterilized by the heating process.





*Royal visit to the
Farm*

Later on, the Farm was able to produce more milk because of the increasing number of cows. It was the beginning of milk selling. Milk was delivered to households and schools near Chitralada Villa by a motorbike carrying an aluminium tank of pasteurized milk.

Currently, dairy cows are of Holstein-Friesian strain, the mixed breed with a local breed obtained via artificial insemination. The breeding was done under the supervision of the Department of Livestock Development and the original cows' owner.

The farming operational policies prescribed by His Majesty the King concentrate on setting examples for farmers, studying emerging disciplines in the area of dairy farming, disseminating knowledge to dairy farmers for cattle farm upgrading, and selecting and breeding dairy cows that are suitable for Thailand.

Dairy cows in the Royal Chitralada Projects will be left free in stables. They will be milked twice a day, in the morning and evening. The farming has been done according to dairy farming standards.



That is, the cows will be fed with coarse feed such as fresh grass and hay as well as other forage crops and supplements made from condensed animal feed in moderate quantities. Data will be collected in a systematic way.

The farmers early on faced problems of planting forage crops because it was new for them. With His Majesty's support, the demonstration of growing forage crops was held at the Royal Chitralada Projects' site using the techniques similar to planting rice in paddy fields. By using the





Demonstration of forage crop planting under the Royal Chitralada Projects using rice planting technique.

method that all farmers had known very well, they soon were able to plant forage crops on their own.



Mixing the fertilizer



Biogas produced from cow dung

The remaining cow dung and grass are fermented and used as stable manure (manure fertilizer). The rest is used for producing biogas, which is used as fuel in the Dairy Farm. Literally saying, the Royal Chitralada Projects have pursued the



Suan Chitralada UHT Milk Plant

efficient use of resources for many decades before the current trends people nowadays are following.

The Suan Chitralada UHT Milk Plant not only supplies high-quality milk but also disseminates the knowledge of dairy farm management and integrated dairy processing, and serves as a learning centre for actual dairy farm practice to farmers. Most importantly, it is a source of practical

knowledge and a career builder for many people.

Fifty years have passed; currently, the dairy product market in Thailand has expanded to be a 40-billion-baht industry. In consideration of this tremendous growth, what has grown more than the number are the new knowledge and better quality of life of Thai people in terms of nutritional status.



Suan Chitralada Milk Collection Centre

Suan Dusit Milk Powder Plant

"... This is an important day, because this plant is a model for dairy plant and will provide examples in conducting dairy processing in Thailand for farmers and any other interested persons. This is the first dairy plant in Thailand, designed and built by Thai people, which we should be proud of. We consider this as a model plant where anybody who wishes to learn or be successful in dairy business, whether for their own achievement or the country's economy, can come to visit at any time..."

Royal speech at the Inaugural Ceremony of Suan Dusit Milk Powder Plant in Chitralada Villa's compound, 7 December 1969.

Suan Chitralada Milk Collection Centre:

A Lesson of Quality

"...If we encourage producing more milk to make fresh milk or canned milk like other big companies, we must be very strict with the quality. The milk that does not meet the quality standard needs to be thrown away. In the meantime, we need to teach or explain to them that quality is an important issue."

King's speech given to the Committee on Milk Powder Plant Construction in Nong Pho Subdistrict of Ratchaburi province, at Chitralada Villa, 11 September 1970.

Not only that, His Majesty also had confidence that the dairy industry can become successful although dairy farming was a new business for most Thais. Moreover, dairy farming can be done without any need to make it a big business investment. These depend on farmers and entrepreneurs whether they have interest and strong determination. All the patterns and disciplines have been laid down for everyone to see at the Royal Chitralada Projects.

When there were increasing numbers of dairy farmers, the oversupply of raw milk became a problem. In 1969, the crisis





His Majesty the King presiding over the Inaugural Ceremony of Suan Chitralada Milk Collection Centre.



*His Majesty
visiting Suan
Chitralada Milk
Collection Centre*

reached its peak, most farmers fed pigs with milk, and still the raw milk supply was excessive. The producers decided to pour away the remainder of raw milk. This crisis occurred because dairy farmers did not have the knowledge and understanding of raw milk quality control and collection process.

His Majesty provided a solution to the farmers by introducing heat treatment or pasteurization.

Today, apart from getting raw milk from the Suan Chitralada Dairy Farm, the Suan Chitralada Milk Collection Centre also purchases raw milk from Dairy Cooperatives, to produce pasteurized-homogenized milk, and sell it to members and schools. This is to promote good health and to expand the milk market to resolve the problem of raw-milk oversupply. In the past, revenue received from this part would be transferred to support the operation of the Suan Dusit Milk Powder Plant.



HRH Maha Chakri Sirindhorn presiding over the Opening Ceremony of Suan Chitralada Milk Collection Centre after its renovation.

The oversupply of raw milk, which occurred several times, was partly caused by the lower cost of imported milk powder. However, the more important factor was the quality of the milk itself. The production process that is substandard will result in the milk being contaminated with *Lactobacillus* bacteria, which exist around the breast areas of cattle.



School milk truck

Therefore, after milking, milk should be left in a cold place for a while to prevent the propagation of bacteria that are harmful to humans. If the milk is left at room temperature for too long, the bacterial reaction will create lactic acid which will form milk separation. For this reason, a strict standard operation procedure undertaken by the Suan Chitralada Milk Collection Centre is a good example for farmers to learn proper routines. The Milk Collection Centre will purchase only milk that meets the standard.



Amid market competition that is so intense, standard quality control is the utmost important factor, especially in the near future where there will be a free trade zone. It is not a drawback for a small manufacturer; rather, the good quality will help sustain the business.



Milk pasteurization

Nowadays, the Suan Chitralada Milk Collection Centre produces pasteurized milk that is different from that sold in the market. It is pasteurized fresh milk from dairy cows without skimming or taking any fat out of the milk.



UHT Milk Production

The market share of dairy products sold from the Royal Chitralada Projects is not much, only less than 1% of the total market. However, this small market share is the pride for people who know what is happening, all of which stems from the love and care of our beloved King for his people.

Suan Dusit Milk Powder Plant: From Innovation to Solutions

"...Having a Milk Powder Plant on Chitralada Villa's grounds is not meant for business. It has been used for tests and trials including data collection. The plant is not for supplying milk to the market, which will never be enough. It serves only one purpose, i.e. as experiment resources for farmers, not for business."

Royal speech given to the Committee on Milk Powder Plant Construction, Nong Pho sub-district, Ratchaburi Province, at Chitralada Villa, 11 September 1970.

A milk oversupply crisis occurs periodically. As dairy farming was a "new thing" for farmers, they need to pay attention to quality control and management, including the appropriate use of technology suitable for different locations. For these reasons, enhancing collaboration among farmers is a sustainable solution because it will help them stand on their own.

When Mr. Chai Chantpiwat, Nong Pho villager from Photharam district, Ratchaburi province, and his fellow farmers presented a petition to His Majesty the King on the oversupply of milk problem, His Majesty provided them with financial support





His Majesty the King presiding over the Opening Ceremony of Suan Dusit Milk Powder Plant, 7 December 1969.



*His Majesty the King
presiding over the
Opening Ceremony of
Suan Dusit Milk Powder
Plant, 7 December 1969.*

*Chai Chantpiwat, Nong Pho
villager, Ratchaburi province,
and fellow farmers
presenting a petition to
the King.*

and a piece of land, and then encouraged them to group together. Later, the group became Nong Pho Ratchaburi Dairy Cooperative Limited (under Royal Patronage). As one cooperative unit, they then had the capacity to improve the quality of raw milk and further advanced themselves as a manufacturer producing ready-to-drink milk. The milk oversupply problem was then gradually solved.

To work as an innovative development worker, the most risky part is to use your initiative. For this reason, most people

are discouraged and choose to do what has always been done.

For His Majesty the King, innovation is his enthusiasm. Through careful experiments, research and analysis, the new concept will become useful to solve critical problems. Thus, His Majesty is not only the world's "Development King" but also the forefront innovator with ingenuity and creativity. The Opening of the Suan Dusit Milk Powder Plant was another example of His Majesty's innovations.



His Majesty the King presided over the Inaugural Ceremony of Suan Dusit Milk Powder Plant on 7 December 1969, one channel for solving the problem of milk oversupply.

More importantly, the Suan Dusit Milk Powder Plant is the first milk powder plant in Thailand. During that period of time, Thailand had not yet invested in manufacturing milk powder. Therefore, the plant and production technologies had to be designed and constructed by M.R. Theparit Devakul for His Majesty.

His Majesty's method for finding a succinct solution was to analyze the root cause of the problem. The milk oversupply issue that caused farmers to pour away their milk was the result of the impact of price mechanism. Major domestic manufacturers purchased imported milk powder because of its lower price in some seasons. Using milk powder dissolved in water instead of fresh milk helped reduce the cost of their milk production.

Unfortunately, this affected the farmers' milk supply. His Majesty also

*His Majesty the King presiding
over the Inaugural Ceremony of
Suan Dusit Milk Powder Plant,
7 December 1969.*



found that the quality of domestic raw milk was not up to standard. For example, some, which had a high level of lactic acid produced by bacteria which caused a solid layer in the pipeline, had terminated the production.

A small milk powder plant like the Suan Dusit Milk Powder Plant was an alternative channel to support and distribute processed milk. At the same time, the plant functioned as an experimental unit through the process of learning and scientific methods, set to standardize milk production. The aims were to further develop dairy product manufacturing and processing technologies.

Milk powder from the Royal Chitralada Projects may not be widely available in the market. This is in accordance with His Majesty's policy that the plant is for experiment, not for profit making. The most beneficial of all, which makes the Suan Dusit Milk Powder Plant a significant project among other Royal Projects, is the integration of scientific methods and innovative ideas in the efficient use of resources. This brought about the emergence of the well-known Suan Dusit Milk Tablets from the Royal Chitralada Projects.



Suan Dusit Milk Powder Plant today

In the beginning, the concept of producing milk tablets was to maximize the use of existing resources from the milk powder production process. That was, during the spray drying, some milk droplets formed big particles, which had to be discarded even though they were highly nutritious. The first trial was to produce milk toffee, but it was not successful. Then the milk tablet experiment began in 1969, with the help from Devakam Apothecary Hall Co., Ltd. in compressing the tablets.

That was carried on only for a short time period and was discontinued.

Later on, the Royal Chitralada Projects restarted producing milk tablets since there were large amounts of powder milk with clumps. The unique features of the milk tablets are: being produced from the existing resources and easy to store; and children love them because of their candy-like taste, but containing more nutritive value than other types of sweets.



Suan Dusit Milk Tablet Plant

"Having seen the benefits of milk tablets, in 1984, the Director of the Royal Chitralada Projects started reproducing them using a manual tablet press, on an experimental basis, and made adjustments to find the suitable formula. Several parties came to assist such as M.L Arkanee Nawarat, Dr. Promote Theerapong from Faculty of Pharmacy, Mahidol University, Pharmacist Mongkolsilp Boonyen and Mr. Panya Burapasheep (the then owner of

Burapha Oso Company). The tablet size should be big so that children don't think that it is a medicine tablet. Then we took them over to Chitralada School students to taste first," Dr. Rosalin Smithapindhu told us about the background.

From a manual tablet press that makes one tablet per punch, the production was expanded, using a rotary tablet press that could produce 20 tablets per punch.

Milk tablet production

"People started to know more about milk tablets during the Royal Funeral Ceremony of Her Majesty Queen Rambhai Barni in 1985. At that time, the Director of the Royal Chitralada Projects distributed milk tablets to people who came to pay homage to the Royal Remains on both sides of the street. There were hundreds of thousands of people. Since then Suan Dusit Milk Tablets have become publicly well-known."

Suan Dusit milk tablets are also included in the "Royal Survival Kits" His Majesty provides to disaster victims.

The beginning of the effort to utilize big milk powder clumps has now turned out to be one of the major products from the Royal Chitralada Projects that helps promote good health for Thai people.

This represents what His Majesty always emphasizes: small businesses can produce quality products and that is the way to compete in the free market system.



The Demonstration of Efficient Use of Resources: A Variety of Products from Raw Milk

In general, raw milk from cows contains 87% water and 13% milk substance, which will be used as raw material for producing various processed milk products such as cheese, yoghurt, sweetened condensed milk, and milk tablets.

In the process of milk powder production, milk needs to be condensed by using an evaporator and a spray drying until it contains only 4-5% moisture.

The water vapour from the evaporation process will be condensed as pure distilled water, which can be used for auto batteries and as drinking water. Although the Royal Chitralada Projects now produce drinking water using the reverse osmosis method and disinfected with ozone and ultra-violet to cope with the demand. However, in the beginning, pure water came from the milk powdering process.

Not only that, the Suan Dusit Milk Powder Plant is also the original model for those who are interested in pursuing a career on the industrial scale. In the past, this technology was also used to produce powder of other agricultural products such as egg powder, fruit powder, and salt. It was another important step in expanding the knowledge base to the agricultural industry sector by using the technology initiated and designed by Thais.





Another product resulting from the expanding body of knowledge, directly related to the dairy industry, is cheese. Starting from a commercial cheese making machine, which could produce 200 litres of cheese, presented to His Majesty the King by C.C. Freezland Company, on the Auspicious Occasion of His Majesty the King's 5th Cycle Birthday Anniversary in 1987, it was the first step of Gouda and Chedda cheese production in Thailand as well.



National Research Council helps improve the production of distilled water from milk powder production process.

*His Majesty
presiding over the
opening of the
Cheese Plant*



Initially, the production of cheese was made on an experimental basis. The cheese gradually developed into "Maha Mongkol Cheese" (literally auspicious cheese), the name conferred by HRH Princess Maha Chakri Sirindhorn, which is one of the well-known products from the Royal Chitralada Projects. The cheese was made from the two original types of cheese produced by the Plant.

Research and experiments have never stopped, in addition to producing cheese, the Plant also produces thick

yoghurt in cups and drinking yoghurt in many flavours as well as affordable high-quality ice cream. This is in response to His Majesty's intention especially for children to have quality foods to eat at reasonable prices.

All kinds of products are processed from one significant ingredient, which is high-quality, high-nutritious milk, purchased from dairy farmers and obtained from dairy cows under the Royal Chitralada Projects.



Student trainee making ice cream

Cheese ripening room

Milk Fluoridation: Fixable Karma

HRH Princess Maha Chakri Sirindhorn once remarked that people mistook toothache and tooth extraction for an impact of bad karma (action or deed). After listening to the talk on oral disease prevention from the Ministry of Public Health, the Princess uttered:

"This bad *karma* can be fixed."

The 2001 survey of the dental health situation in Thailand revealed that 87.5% of children aged 6 had tooth decay or dental caries in baby (deciduous) teeth and 57.5% of children aged 12 had tooth decay in permanent teeth. This trend is increasing in urban areas. One way to help prevent tooth decay, apart from oral hygiene, is to get a proper amount of fluoride.

Thus, when His Majesty the King supported the idea of milk fluoridation for protecting against tooth decay in children, the production of pasteurized/fluoridated milk by the Milk Collection Centre of the Royal Chitralada Projects began on 15 May 2001, the Royal Ploughing Ceremony day. The fluoridated milk was distributed to 35,000 students in Bangkok's 68 schools. The





*HRH Princess
Maha Chakri Sirindhorn
presiding over the
inauguration of
fluoridated milk
production of the
Royal Chitralada
Projects.*



production has continued for 10 years. The second phase beginning in 2010 has been expanded to various provinces across the country, targeting at more than 500,000 students.

The milk fluoridation of the Royal Chitralada Projects is an extension of His Majesty the King's initiative that began 40 years ago in producing high-quality milk for Thai people. Producing fluoridated milk



Drinking fluoridated milk in school

requires good milk production standards, quality control at all steps, and good manufacturing practice (GMP). A safe amount of fluoride has to be carefully added to milk as required by the World Health Organization; otherwise, too much fluoride may cause a negative effect to oral health.

That is a 200-ml bag of pasteurized milk, containing 0.5 mg of fluoride or 2.5 parts per million, which is the proper amount and causes no adverse effects.



Over the past 10 years, from the production of the first bag of fluoridated milk, students in five school districts around the Royal Chitralada Projects have been helped to “fix their *karma*”. However, there are many more schools in Bangkok that have requested fluoridated milk from the Royal Chitralada Projects. But with the limited capacity, the amount of milk produced is insufficient, compared with the demand.



To solve this problem, the Chitralada Milk Collection Centre and the Quality and Production Control Unit of the Royal Chitralada Projects have to play an additional role as a training centre. The training is open to operational staff from other manufacturers so that they will be able run their fluoridated milk production plants according to the international GMP standards.

Thus, fluoridated milk production not only helps resolve the tooth decay

problem among children in low- and middle-income families, but also sets a standard of quality milk production in Thailand. The standard focuses on the fact that "dairy science" can check any foreign particles or contamination at every production stage.

Hygienic production in accordance with the standard is the only way to make the dairy industry develop further in a sustainable manner, which will really benefit all concerned.



Milk Products: From the King's Palace

The only major reason why Dr. Rosalin Smithapindhu, Plan and Policy Analysis Specialist, Bureau of the Royal Household, who has been responsible for the Royal Chitralada Projects for more than 30 years, never fails to place importance on the quality control and checking of dairy products from the Royal Chitralada Projects, is His Majesty the King's remarks on the issue of quality.

"The most important thing that the Royal Chitralada Projects have firmly adhered to is the product standards. We absolutely will not tolerate a large volume of production with low quality. It is because we don't sell only products, we act under the name of His Majesty the King as well. This is what the staff in the Quality Control Unit and other staff involved with the GMP standards have kept in mind."





"If, 50 years ago, His Majesty had neither initiated these dairy farming and production activities nor visited the Kingdom of Denmark in 1960, This might not have been as healthy as they are today."

The most interesting thing is that an extensive body of knowledge has been developed from His Majesty's dairy farming initiative in Thailand starting with just a few milk cows.

A Good Career for Thai People

“...Dairy farming is a good career for Thai people and suitable for the country. With appropriate technology, it will make you prosperous and create a good income...”

Royal speech given to representatives from Agricultural Cooperatives, Settlement Cooperatives, Fishery Cooperatives, and Young Farmers Clubs, and fresh milk recipients, on the occasion of having an audience with His Majesty the King at the Royal Chitralada Projects, 11 May 1988.



As the living condition of Mr. Somsuan Saeng-athit, a dairy farmer from Chiang Rai province, has improved, he never forgets that it all came from the far-sighted vision of His Majesty the King.

“My life today is far better than before because of dairy cows.” For Mr. Somsuan, “better life” means owning 30 cows starting from 2, a larger paddy field (triple in size), a larger house, and a pickup truck, but most importantly is the improvement in health status and quality of life of everyone in his family.





Dairy farmers waiting for an audience with the King



Somsuan and his family at the Royal Chitralada Projects

Mr. Somsuan and his wife started dairy farming 24 years ago. Although the work is tiring and hard with no days off, both of them have never been discouraged. One of the reasons is that it gives a fair income, though not as much to become a millionaire, but enough to live a comfortable life.

Most importantly, it is one of a few careers that you can proudly call a "Royally-Granted Career".

"Now, I am living a comfortable life because of the King. So no matter how many obstacles we face, we have to fight, because we are very proud of this occupation.

Complete Cycle of “Food”: Thais Can Rely on

“...Although the world today prospers with technology advancement, food is still important and necessary for human life; nothing can replace it. Everyone needs to eat food, to alleviate hunger and enhance body growth...”

Royal remarks for the World Food Day, at the United Nations Food and Agriculture Organization, Regional Office for Asia and the Pacific, 16 October 1995.



Variety of processed foods
from Royal Chitralada Projects



Mushroom:

Nutritious Values from Wastes

In each agricultural production process, it is normal that product yields are not the only outcome; residues left from the process are inevitably included.

However, what is left does not mean that it is worthless, as His Majesty the King's initiatives emphasize the reuse of excess materials from any production process. Wastes from one process could mean raw materials for another process.

This becomes obvious for the Mushroom Culture Plant under the Royal Chitralada Projects. The mushroom culture was first experimentally done using leftover rice straw. In 1988, the mushroom was cultivated in the barn with bags containing oyster mushroom and grey oyster mushroom spawns. Then *lingzhi* mushroom culture was tested using a mixture of rubber wood sawdust, rice bran, lime, gypsum, Epsom salts, and brown sugar.

The reuse/recycle process has not ended yet. After harvesting mushrooms, the ingredients used for mushroom culture can be reused as compost for other plants.

Although the Royal Chitralada Projects has experimented with several types of mushroom cultivation, among all the mushrooms that are cultured, *lingzhi* mushroom (*Ganoderma lucidum*), commonly called "*hed muen pee*", or literally "ten-thousand-year mushroom," seems to be an incomparable protagonist in its health properties.



His Majesty the King looking at mushroom beds

In China, *lingzhi's* health benefits have been widely recognized for hundreds of years. China was the first country that used *lingzhi* as a herbal medicine. However, in Thailand, the number of people who really know of *lingzhi* mushroom is very small, only among agricultural technical officers or seriously interested persons.

Thai people started to learn more about *lingzhi* mushroom, with government agencies and private sector's ambitions on conducting *lingzhi* mushroom culture. The

Royal Chitralada Projects were interested in cultivating *lingzhi* mushroom also because of its outstanding health benefits. *lingzhi* mushroom contains polysaccharide, triterpenoid, and geranium, all of which help reduce cancer cells, stimulate the immune system, reduce severity of diabetes, and balance the blood pressure. Apart from these, the possibility of generating extra income for local villagers was considered. The market price of *lingzhi* mushroom is much higher than any other mushroom types.



His Majesty observing mushroom culture

Although the Royal Chitralada Projects have done many experiments on mushrooms, *lingzhi* is different in terms of breeding, nursing, and harvesting details. Cultivating *lingzhi* requires circumspection, from selecting perfect mushrooms, cutting pieces of their tissues to culture on agar plates, to nurturing young mushrooms until harvesting. *lingzhi* takes three times longer to cultivate than common mushrooms. The first *lingzhi* mushroom strain cultured in the Projects site was G2 and then moved to G9, up until now, because G9 has higher medicinal properties than G2.

With support and knowledge exchange between the Royal Chitralada Projects, Chulalongkorn University, and Aranyik Mushroom Farm, one of the first privately-owned farms pioneering *lingzhi* mushroom culture in Thailand, the Chitralada Mushroom Culture Plant under the Royal Chitralada Projects successfully cultivated *lingzhi* mushroom. Many farmers contacted the Mushroom Culture Plant for mushroom spawns; so they were provided with *lingzhi* spawns in agar plates including cultivation techniques. This way, farmers can maintain

*His Majesty the King
and HRH Maha Chakri
Sirindhorn visiting
lingzhi mushroom farm.*

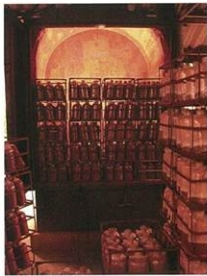


mushroom's quality and steadily earn income.

Although *lingzhi* can be successfully cultivated, this kind of mushroom has a bitter taste and sticky texture; therefore, it cannot be used as an ingredient in cooking. To get the most value out of this kind of mushroom, a food processing method was developed to make the mushroom easy to consume while still maintaining its nutritional value. The

first stage was producing dried *lingzhi* mushroom. Later on, a wide range of *lingzhi* products was developed.

Apart from dried *lingzhi* which can be infused in boiling water and drunk like tea, the other products include ready-to-drink sterilized *lingzhi* tea mixed with Chrysanthemum or honey in cans, instant beverage *lingzhi* tea extract in different flavours, and *lingzhi* candy using a similar method as the milk tablets.



Lingzhi mushroom
culture





Packing *lingzhi* mushroom extract in capsules

The final leading product is *lingzhi* extract in capsules. It is the process that can maintain most of the mushroom medicinal properties. Dried *lingzhi* mushroom will be put in boiling water for 4-5 hours to concentrate the mushroom active ingredients. Then the same process of making milk powder is applied, starting with evaporating and spray-drying using the original milk spraying device received from the Danish government. The device was removed to the *lingzhi* Processing Unit because the Suan Dusit Milk Powder Plant has expanded its production.

However, a little problem occurred during the trial stage. The product obtained from spray drying was very little; and the powder was very delicate. Several experiments had to be done to solve the problem and then the research team found that if the mushroom was boiled together with maltodextrin, *lingzhi* concentrate would form a proper size of powder when spray-dried. This solves the problems and brings to sufficient yield quantities. Also the medicinal properties received from this method are better than ground dried *lingzhi* mushroom, because it produces larger amounts of cellulose.



When the product was launched, the name of "Ten-Thousand-Year Mushroom" began to spread to a small group of people, mainly those who were health conscious. Until one day, one event made the Chitralada *lingzhi* extract capsules well known.

"At that time, Privy Councillor Gen. Phichit Kullavanijaya gave an interview on television that he brought *lingzhi* extract capsules from the Royal Chitralada Projects to a Thai military diplomat in the United States who had cancer. After taking the *lingzhi* extract capsules, the military diplomat's health improved. After the interview had been broadcast,

many people called us and wanted to buy them."

Mr. Wisitporn Phueanpipit, Director of the Office of Lord Chamberlain, who was once responsible for the Mushroom Culture Plant of the Royal Chitralada Projects, recalled the event that contributed to *lingzhi*'s high demand and caused a shortage of supply.

"Personally, I don't think everybody who consumes *lingzhi* extract capsules will get the same results. However, taking *lingzhi* extract regularly can improve the health condition. To cure diseases, especially cancer, requires a combination



Monkey's head mushroom in the temperature control room

of many factors. But as a manufacturer, especially under the brand of Royal Chitralada Projects, at least hearing people say that our products make them healthy makes us feel happy and really pleased with them."

Apart from *lingzhi* mushroom products, which are known as healthcare products, the Royal Chitralada Projects also culture monkey's head (*hed hualing* or *hed pui-fai*) or lion's mane mushrooms (*hed phumala* or *Hericium erinaceum*). This type of mushroom has therapeutic properties on

the nervous system and gastric ulcers. It is a cold-climate mushroom; therefore, the experiment was done in an air-conditioned room using a water cooling system from thermal energy produced by burning leftover rice husks from the demonstration rice mill. This project was run in parallel to the experiment of water cooling system using thermal energy from rice husks between 2002 and 2005. With the continuous efforts, the Royal Chitralada Projects are now able to culture and extract monkey's head mushroom, which is used for producing health-promoting supplement capsules, a kind of alternative product for those who are health conscious.

One could say that, this mushroom cultivation was the primary answers to the integrated production processes from which the target outcome is not only product yields but also the contributions from wastes as yields per se. Wastes that many people do not appreciate can be reused as source materials that complement final outcomes. In this case, they are foods that have both nutritional and medicinal values.

Spirulina platensis:

Valuable Food with Reasonable Price

Upon hearing the name "sarai kliao thong" in Thai, literally "gold spiral algae" (*Spirulina platensis*), one can mistake it as a yellow gold algae. In fact, this type of algae is neither freshwater algae nor seaweeds that we like to consume. This is a small creature called blue green algae. When scanning through the electron microscope, you will see cells connected to each other like a long twisted block. The word "gold" is derived from its nutritional value which can be compared to gold. The name in Thai has been patented and the patent-holder is Ms. Jiamjit Boonsom, the lecturer/researcher on spirulina who permits the Royal Chitralada Projects to use this name on a special case basis.

The beginning of the research on *Spirulina platensis* was similar to other initiatives of His Majesty the King that the preliminary objective was not only to produce quality food supplements but also to invest in all possible efforts to maximize the resources.

In 1986, a feasibility study was done on reusing digested cow-dung slurry (*nam kark mun mak*) obtained from the biogas digester-production process using cow dung from a lot of dairy cows of the Royal Chitralada Projects. The digested cow-dung slurry is rich





An experimental pond for spirulina culture.

in minerals; so it was first used in the experimental spirulina cultivation. The spirulina was then mixed as an ingredient in fish feed because it had a high protein content and it helped make the colour of fish look beautifully bright, particularly carp, which were very popular at that time.

However, according to the recorded research data, the quality of spirulina

was unstable, probably due to the use of different types of forage as animal feed which directly affected the quality of digested cow-dung slurry. Thus, in 1989, the aim of the research project was changed to study the feasibility of culturing spirulina in clean water and its use was changed from producing fish feed to producing dietary supplements for human consumption instead.



Spirulina is a living creature that can be found in natural freshwater sources and easy to culture. For this reason, the project tried using tap water, but the residual chlorine had to be eliminated by exposing the tap water in the sun until the residual chlorine was reduced to the required level. However, the water characteristics especially acidity (pH levels) and contamination needed to be regularly examined because the water condition affects the growth rate and amount of algae obtained. This also

includes the intensity of light which affects the process of algae photosynthesis. All of which need to be strictly monitored to yield high-quality spirulina, ready for manufacturing process which normally takes 10-15 days.

To harvest, the water with algae cells will be pumped out through a fine cloth filter. The algae will be washed to neutralize the pH level and then put in the 60 °C oven for 8-10 hours. This is to dry and disinfect the algae at the same

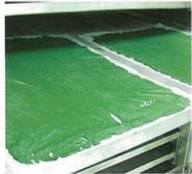


time. Then the spirulina will be ground to powder and processed to make different products.

Results from research conducted domestically and overseas show that spirulina contains high protein, the type that is essential for human health. The body can absorb the protein from spirulina more easily than that from meat or eggs. The average protein content is as high as 65-71%. Apart from these nutritional qualities,

spirulina also contains fatty acids that help burn fat cells, and vitamin B12 that nourishes the brain. This type of vitamin can be found only in some plant species, but is abundant in spirulina.

According to His Majesty the King, it is important that his subjects be able to consume affordable good-quality foods produced in the country. Hence, the Applied Algae Science Unit under the Royal Chitralada Projects conducted research on processing spirulina as food



Steps for processing spirulina as food products



products that are easy to consume, suitable for people of all ages and genders. Both adults and children should be able to equally get nutritional values from spirulina.

Therefore, apart from spirulina powder in green capsules which are used as adult's dietary supplement, the Research and Development (R&D) Unit also develops spirulina crackers in assorted flavours. This kind of snack is both scrumptious and nutritious.

With the aim of providing maximum nutritional benefits from spirulina to the public, the Royal Chitralada Projects continue to conduct research and produce different forms of spirulina processed to reach different groups of consumers. Every product should retain spirulina's nutritional benefits; spirulina cream soup was one example. It is an attempt that never disregards what is most important to His Majesty the King, i.e. the delivery of nutritious foods, whose values are equal to gold, at the most reasonable price.

Fruit Processing: The Relief of Fruit Growers' Suffering

Fruit juice: The beginning of a sustainable solution

With His Majesty the King's determination for the well-being of his people, many of His Majesty's initiatives emerged from the quest to find holistic solutions through the process of experiments. By investigating the root causes of problems, instead of solving problems on a piece-meal or short-term basis, one at a time, the applicable and long-term solutions were found. His Majesty also emphasized the need to look into the value of many things that many people thought that they were no longer useful.

In 1984, the year that fruit juice production was initiated, the Milk Collection Centre purchased a new pasteurization machine to upgrade its production capacity. The original 10-year-old machine which still worked well was transferred to the Chitralada Fruit Juice Pasteurisation Plant for experimentally producing pasteurized fruit juice. Then, the first processed fruit production at the Royal Chitralada Projects commenced.

This initiative was consistent with the economic situation at that time. The fruit growers had to struggle with falling fruit prices. The Royal Chitralada Projects purchased fruits and processed them as pasteurized fruit juices, creating value-added products and increasing income for fruit growers as well.





His Majesty the King and HRH Princess Maha Chakri Sirindhorn observing the production of pasteurized orange juice.

*His Majesty the King
and HRH Princess
Maha Chakri Sirindhorn
looking at pictures of the
pasteurized orange juice
production room.*



The first two pasteurized fruit juices produced under the name of the Royal Chitralada Projects were orange juice and sugarcane juice. In the beginning, they were packed in plastic bags similar to milk in plastic bags delivered to schools; later they were changed to clear plastic bottles.

Despite the problem of ingredients' inconsistent quality by which regular monitoring was necessary during the operational process, the simple fruit juice processing as pasteurized fruit

juice was carried on smoothly, particularly pasteurized sugarcane juice that was ordered for being served aboard Thai Airways' flights.

Because there was a need to expand production capacity, the fruit juice production site which was originally located at the Milk Collection Centre was relocated to a new separate building in 1990.

Apart from the high possibility of being affected by fruit prices slump, the Royal



HRH Princess Maha Chakri Sirindhorn taking officials from the US National Defense College to visit the Fruit Juice Pasteurization Plant.

Chitralada Projects experimented with the production of juices from seasonal fruits such as mangoes as concentrated juices and refrigerated juices for use in producing pasteurized juices for sale throughout the year even outside the season of such fruits.

The pasteurized fruit juices from the Royal Chitralada Projects need to be stored at low temperatures, lower than 8°C, under which the products can be kept fresh for 8-10 days because there is no added preservative. Thus, in order

to further improve storage treatment and fruit juice processing, in 1992 the Royal Chitralada Projects sought advice from the King Mongkut's Institute of Technology Ladkrabang on canned fruit juice production.

The advice obtained was to use the sterilization system under steam pressure and high temperature, which can extend the shelf life of fruit juice up to two years at normal temperatures, without any preservatives.



HRH Princess Maha Chakri Sirindhorn presiding over the Opening Ceremony of the Cannery Fruit Juice Plant.



HRH Princess Maha Chakri Sirindhorn observing canned fruit juice's production.

The Cannery Fruit Juice Plant of the Royal Chitralada Projects started its operation on 14 May 1992; its Opening Ceremony was presided over by HRH Princess Maha Chakri Sirindhorn. The first product was canned mango juice, subsequently the plant also produced canned pineapple juice, canned passion fruit juice, and canned lychee juice, all produced from fresh fruits.

The Cannery Fruit Juice Plant's contribution goes beyond merely adding value to the fruits; it also serves as a small prototype plant, welcoming those who are

interested in starting fruit processing as a small business. It is a place to learn all the techniques for producing sterilized canned fruit juices.

Since Thailand is a country well-known for its variety of fruits, the Royal Chitralada Projects produces assorted pasteurized and sterilized canned fruit juices. All of the production processes are strictly controlled to maintain international standards. The outcomes from both plants are not only fruit juices, but also full-scale knowledge of fruit processing, which helps resolve problems for fruit growers in Thailand.



HRH Princess Maha Chakri Sirindhorn observing the production of canned rice porridge.

*HRH Princess
Maha Chakri
Sirindhorn splashing
holy water on the
drying oven from
Germany.*



After four years of operation, the R&D Unit and the Cannery Fruit Juice Plant of the Royal Chitralada Projects launched a new product in addition to fruit juice, i.e. canned rice porridge. The main raw material used was broken rice from rice mill. This process is really a systematic integration of knowledge development and extension.

Dried Fruit: An Alternative for Fruit Processing

Fruit processing is not limited to only pasteurized or sterilized fruit juice. Almost at the same time as the fruit juice pasteurization initiative, HRH Princess Maha Chakri Sirindhorn graciously presented a drying machine to the Royal Chitralada Projects. The Projects' R&D Unit, together with support units, conducted a study and improved the drying device so that it was more practical. Finally in late 1985, the production



of bottled dried garlic was launched.

Ten years later, the Dried Fruit Plant received a new device, a solar-powered wind drying tunnel, presented to His Majesty the King by Silapakorn University and an institute from the Federal Republic of Germany. The Royal Chitralada Projects used the tunnel to dry vegetables and fruits. The project functioned as a model for fruit drying industry, which was a public trend at that time, especially the use of renew-



Garlic drying machine

Wind tunnel drying oven using solar energy

able solar energy, which is appropriate to Thailand's climate condition.

A technological advances and research on fruit processing had been carried on continually, many groups of philanthropists presented many improved versions of dryers. For example, Hohenheim University and private sector agencies from Germany presented a drying oven using solar hot air in 1997. And in 2000, they presented an electric hot-air dryer and a solar-powered



Bakery products made from jasmine or Hom Mali rice flour

hot-air generator for the drying process.

These new devices have higher production capacity; and the new building for dried products was also completed in that year. In 2005, Silapakorn University presented a solar-powered "greenhouse" drying oven. The device was developed for high production efficiency and it was suitable for producing dried products on a commercial scale. The Royal Chitralada Projects' Dried Fruit Plant has become comprehensively equipped with new innovations and technologies, thus,

ready to be a learning centre of dried agricultural products since then.

Later on, the Dried Fruit Plant expanded its capacity to include various bakery products. The primary objective was to use bits and pieces of dried fruits that have good quality but too small for the dried fruit production line. The small-size dried fruits can be used as raw materials for fruit cakes or cookies. The bakery line was then expanded to produce a variety of bakery products. The R&D Unit also developed



Solar-powered greenhouse dryer

bakery products by substituting wheat flour with rice flour, delivered from the Royal Chitralada Projects.

From the initial product which was fruit juice, followed by dried fruits and canned rice porridge, as well as assorted bakeries and pastries, all of them seem to have no identity linkage in the eyes of people outside the realms of production. However, for a group of people who work for His Majesty the King, every single product represents comprehensive and sustainable agricultural solutions.



This is the key to success in providing security for all units in society. As His Majesty the King once gave remarks to the committee members of Agricultural Cooperatives, Community Cooperatives, and Fisheries Cooperatives, and recipients of home milk delivery, 8 May 1987, at the Royal Chitralada Projects, excerpted:

"...Therefore, this was actually a network of comprehensive activities, from start to finish, i.e. producing, processing, distributing, and consuming. Every agricultural activity has the same pattern, involving production, modification, distribution and consumption. If all goes well, everybody works with honesty, good intention, and good knowledge, they will benefit; whoever they are producers, manufacturers, or consumers they all benefit and create overall security to our society..."

Bee Products: Everything is Valuable

On the occasion of the Royal Ceremony held to pay tribute to King Chulalongkorn the Great (King Rama V), while His Majesty the King was placing a wreath in front of the statue of King Rama V, the royal candles arranged by courtiers hours prior to the ceremony started to bend down due to the heat accumulated from the sun.

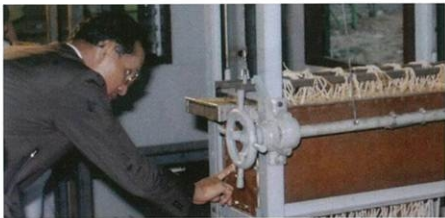
"Lord Chamberlain Mr. Keokhwan Vajarodaya told us that when His Majesty the King saw the candles, His Majesty uttered 'these candles bowed too'. The Lord Chamberlain then asked me and working groups from the Royal Chitralada Projects to find a way to fix this problem," Mr. Sanchai Tiamtaweasin, Advisor of the Royal Household Bureau, told us the story about the Royal Candle Factory.

The Royal Candle Factory started its operation in 1986, one year after the "bowing candles" incident. Since then the Royal Chitralada Projects have purchased beeswax from northern beekeepers cooperatives to produce royal candles, replacing previously hand-made candles which were spun by craftswomen in the Grand Palace. This hand-made production could not catch up with the more numerous royal ceremonies, not to mention the dissimilar shapes of the products.

The operation of the Royal Candle Factory under the Royal Chitralada Projects offers many key contributions. Firstly, it promotes beekeeping as a career for farmers. Secondly, the Royal Candle Factory gets a genuine wax which is tough and has a natural fragrance as raw material. Thirdly, the Royal Household Bureau gets good-quality candles to craft Buddhist Lent Candles His Majesty graciously bestows to royal Buddhist temples all over Thailand every year, thus, preserving the beauty of ancient royal traditions for royal ceremonies.



His Majesty the King at the Opening Ceremony of the Royal Candle Factory.



*His Majesty
anointing the
Candle Casting
Machine making
candles for royal
ceremonies.*



*A plug of wax from a honeycomb and
beeswax used for producing candles.*



*His Majesty the King observing the candle
production.*

Lastly, purchasing beeswax leads to purchasing honey for producing two new products (honey in tubes and honey in

bottles) from the Royal Chitralada Projects, launched in 1991, prior to producing honey in small glass jars in 1997.



His Majesty casting the Buddhist Lent Candles for distribution to royal Buddhist temples.



Honey is nectar that bees take from the nectaries of flowers. Within bees, there are special enzymes that can digest complex sugars in the nectar that is stored in the hive to feed the colony of young bees.

To harvest honey, beekeepers will keep the queen bee from mating and laying eggs during that period. When the honey is spun out of the honeycomb, the beekeeper will reduce the moisture in honey with hot steam to 21% or lower.

Although honeybees from the Royal Chitralada Projects are domestic honeybees, they suck nectar from longan flowers which are well-known for its taste and fragrance as well as its slow-to-crystallize quality. This is different from wild honey where nectar comes from a variety of flowers.

Purchasing honey from beekeepers will expand the market and increase income for the farmers directly.

On the other side, this is the product that offers an alternative method for health care to the consumers because honey has valuable nutrients for the body, such as vitamin B, vitamin C, phosphorus, calcium, and other minerals.



Prince Akishino visiting the Product Quality Control Room

More importantly, the sugar from honey is monomolecular, which can be directly absorbed by the body, whereas the sugar from sugarcane has two molecules and needs to be broken down into single molecule sugars before being absorbed into the body.

In order to guarantee product quality under the brand of Royal Chitralada Projects, although honey purchased from farmers has good quality, all needs to go



through the product quality control process, including checking for its purity such as sugar content, humidity, contamination with pathogenic microorganisms, and a sampling check throughout the packaging process. These have been done according to the Good Manufacturing Practices (GMP) and the Hazard Analysis Critical Control Point (HACCP) standards. These two systems are guidelines that allow the food production to maintain its high quality and safety for consumers. Both GMP and HACCP systems are adopted by

all major plants in the Royal Chitralada Projects, not only the Honey Plant.

No one would imagine that the efforts to resolve the problem of bending candles caused by overheating 26 years ago, although got to the point as desired, could lead to the production of another product, i.e. a fragrant sweet product with a high nutritional value from northern beekeepers, which is not only beneficial for consumer's health, but also for improving the quality of life of the farmers.

"Energy": His Majesty's Inventions and Experiments

"...While the world economy today is being turbulent, all of us know when we run the machines or tractors and we need to buy/ use fuel. Or even if we don't need to buy fuel because we rent the machines or tractors, the rental prices are increasing. High oil prices definitely make things more expensive. Industries around the world will collapse; and some have actually collapsed..."

Royal speech given to the members of the Ratchaburi Dairy Cows Cooperative, the Ratchaburi Farmers Group, and the Ratchaburi Livestock Group in the Royal Chitralada Projects' area, Thursday, 11 May 1978.





His Majesty the King splashing holy water at the first Alcohol Distillation Tower, built with His Majesty's funds, 1986.

Alternative Energy: Power of Wisdom

Apart from the efforts to resolve farmers' poverty, His Majesty the King also focuses on the issue of energy. His strategy is to always comply with the local actual details, using alternative sources of energy from what already exist. Analyzing this strategy, one will be able to see the philosophy behind his initiatives. His Majesty has a strong belief that agriculture is crucial for Thailand, but it needs to be managed properly. The farmers need to group together to enhance their capacity. Any initial idea evolved should be based on the existing resources, not dependent too much on imported resources. At the same time, His Majesty also realizes that initiating new things require perseverance, patience, and strong determination, not being misled by the trends, if the goal is the public benefits.

This has proven itself over time, as His Majesty's initiative on producing alternative energy from sugarcane. No one at that time paid attention to this concept, thinking that the production cost is too high, relies too much on technology, and is hard to achieve. However, his vision has finally been realized, when the world entered the era of expensive oil and severe fluctuations.





Dr. Pienpak Tasakorn of the Department of Chemical Technology, Faculty of Science, Chulalongkorn University, reporting to His Majesty on ethyl alcohol production from sugarcane, 1986.

However, the substance which is important for the Royal Chitralada Projects in the area of renewable energy is not merely the tangible product, but also a profound thinking principle. As His Majesty

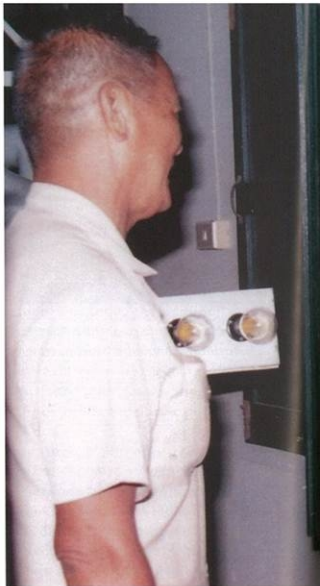
always mentions about appropriateness, sufficiency, and moderation (neither too much nor too little) that: "It's all right if we can't run fast, we should not rush. Our lives shouldn't be too much in a hurry".

Mr. Prasit Jiamsamai, a farmer from Suphan Buri, presenting a report to His Majesty on a gasifier engine using the fuel from rice husk, outside the steam generator using risk husk briquette as fuel.

Living in the modern world where everything has outpaced the capacity of resource generation, the search for alternative sources of energy may mean nothing if human overconsumption behaviour does not change.

In a way, the efforts and commitment of His Majesty the King reflects his confidence in the country and his people, i.e. they can pass through various crises if only they use wisdom.

This is similar to the search for alternative energy, which in fact reflects the power of his wisdom.





The Wind Mill: The Power from the Sky and the Outcome of His Majesty's Far-sightedness

The use of natural energy and the building of natural energy-generating systems are His Majesty the King's areas of interest. He has done studies continually on natural energy because of its unlimited capacity, no environmental impact, and applicability to the agricultural sector in different ways.

His Majesty is interested in wind energy as well as other alternative energies. The wind mills were installed on the grounds of the Royal Chitralada Projects and Klaikangwol Palace. The wind mill changes kinetic energy from wind into mechanical energy, giving limitless energy to use.



Wind mill water pump for use in exchanging the water in the nil fish ponds in the compound of the Royal Chitralada Projects.

In 1972, Mr. Sanit Waitehakul, before getting his royally-bestowed surname "Rojanasaroj", the owner of the Thai Industry Co., Ltd., which is now USA Economic Development Co., Ltd., presented a wind mill water pump designed/invented by himself to His Majesty the King. The pump was installed at the *nil* fish pond of the Royal Chitralada Projects to study the performance of wind energy for pumping water. The pump was used to pump water from the central canal in the Chitralada Villa's compound to the *nil* fish pond. Up until now, the wind mill water pump is still in use and is a symbol of the Royal Chitralada Projects.





Mr. Sanit Rojanasaroj presenting his report on wind mills to His Majesty the King.

"My father told me that while His Majesty was in a helicopter on his trip to visit his subjects, he saw a wind mill painted in the national flag colours. His Majesty asked the royal pages to find out about that wind mill," Vanida Rojanasaroj, daughter of Mr. Sanit, told us the story of the Royal Chitralada Projects' first wind mill.

The wind mill water pump presented to His Majesty has a diameter of 18 feet

and 45 blades; it is 15 meters tall and can pump water at the rate of up to 20,000 litres per hour at the wind speed of 4-50 km/hour. The wind mill can get wind from any direction and can stop itself when the wind speed exceeds 60 km/hour to prevent damage in the event of severe storm.

From a simple wind mill water pump, in 2007 on the Occasion of His Majesty the King's 80th Birthday Anniversary, a private business operator dealing with

wind mills presented an electricity-generating wind mills made in Germany to His Majesty the King, together with a building for electricity storage battery system control. The wind mill has been used to conduct a study on wind energy in generating electricity. It was the first wind mill generator using a stand-alone system in Thailand, capable of generating a maximum of 7.5 kilowatts of electricity.

All the renewable power generating systems the private sector presented to His Majesty for the Royal Chitralada Projects have been used in a real situation, emphasizing the research achievement in developing alternative or renewable energy. In the meantime, the actual use of the electricity generated from alternative energy sources in the production line of the Royal Chitralada Projects demonstrates the integration of energy efficiency. The reason is that, in the future, we can no longer rely on only one energy source.

Therefore, for long-term effectiveness and most efficient performance, energy consumption must come from various energy sources on an integrated basis.



Wind mill generator producing electricity using stand-alone system.

Solar Energy: Treasure from the Sun, An Endless Energy Source

The demonstration of solar energy application in the Royal Chitralada Projects started with the processed agricultural products. In 1995, the Department of Physics, Silpakorn University, together with the Institute of Agricultural Engineering for Tropical and Semi-Tropical, Hohenheim University, and a private sector agency from the Federal Republic of Germany presented a solar cell-powered drying oven to His Majesty the King. The oven was used for drying agricultural products, ranging from various grains to vegetables, fruits, herbs, and meat. Later, it was developed for drying bananas and is still in use. It also serves as a prototype for actual production processes.

The demonstration of solar energy to generate electricity for the Royal Chitralada Projects began one year later. During the 50th Anniversary Celebrations of His Majesty the King's Accession to the Throne

in 1996, the Defence Energy Department, Defence Industry and Energy Centre, presented a solar energy house including equipment for conducting research on renewable solar energy. Later, the Electricity Generating Authority of Thailand (EGAT) together with a private company connected a solar cell electricity generator to the power line of the Metropolitan



*The first solar energy house
of the Royal Chitralada
Projects opened in 1996.*

Electricity Authority (MEA), which bought the excess electricity. This generates income for the Royal Chitralada Projects as well as reduces the costs for battery system maintenance and procurement.

Ten years later, during the 60th Anniversary Celebrations of His Majesty the King's Accession to the Throne, the Defence Energy Department in collaboration with a private sector enterprise presented a new solar energy house to further solar energy research studies as well as to provide a reception facility and an exhibition area for visitors of the Royal Chitralada Projects.

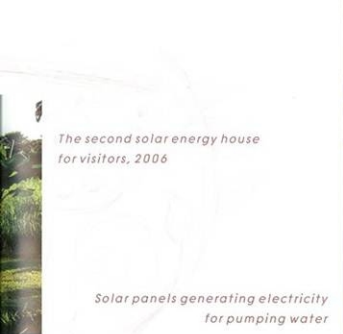




The solar cells were manufactured with high quality silicon and coated with a special oxide to increase the efficiency in solar energy absorption and electricity conversion.

A total of 18 solar panels were installed on the roof of the house, having the capacity to generate up to 128 watts of electricity per panel, totalling 2,250 watts. This system, therefore, saves space, and generates an efficient amount of electricity per unit area. It has 25 years of working life.

This system is also consistent with the principles of energy saving because it does not use any electricity storage batteries. When the rays from the sun are converted as direct current, which will go through the adapter to be converted into 220 volts of alternating current and directly connected to the power transmission cable of MEA. In case there is a power surplus, the electricity will flow to the MEA's transmission system automatically. This process helps reduce electricity costs for the Royal Chitralada



*The second solar energy house
for visitors, 2006*

*Solar panels generating electricity
for pumping water*



Projects. It can be used as a prototype for reducing fuel consumption from non-renewable energy sources such as coal, oil, and natural gas.

There is also a research study on a solar-powered water pumping system which was presented to His Majesty the King by a private enterprise. The reason is that water pumping systems generally consume a lot of fuel. Thus, the solar water pump is one way to demonstrate the use of alternative energy. The solar

power system is connected to a 750-watt submersible water pump that can draw up to 20–30 cubic meters of water per day. The water is used for watering the vegetation around the solar energy house.

What needs to be mentioned here is not the grand appearance of the building or project but the great value of sustainable utilization of natural energy that exists around us and never runs out.



Energy from Rice Husk: Implication of Sustainability

“...The rice that we consume is important. Broken rice and rice bran are also useful. Rice bran can be used as animal feed. Milling rice at a rice mill can be a loss to us as the rice mill will normally retain broken rice and bran. Even rice husk is useful in many ways; one way is to use it as fuel for cooking...”

Royal speech given to leaders of Agricultural Cooperatives, Settlement Cooperatives, and Fishery Cooperatives for across the country, at the Dusidalai Hall, Chitralada Villa, 14 May 1980.





His Majesty the King and HRH Princess Maha Chakri Sirindhorn passing by the Rice-husk Grinding Plant amidst greeting crowds in the experimental rice field, 1985.



Their Majesties the King and Queen, together with the King and Queen of Belgium, visiting the Rice-husk Grinding Plant.

The extremely important elements in the operation of the Royal Chitralada Projects are the easy, simple, and practical linkages of technologies. His Majesty the King's initiative on the Rice-husk Grinding Plant to produce rice-husk briquette is an unambiguous solution cross-linking the rice cultivation and the production of low-cost, alternative fuel.

When the demonstration rice mill started its operation in 1971, as a result of His Majesty's support to farmers in establishing their own cooperatives by having their own rice mills, the by-products were tons of rice husks which increased through time. Milling 1 ton of rice will produce 200 kg of husks. The milling capacity of the demonstration rice mill was 1 ton per



hour, for approximately 8 hours per day, therefore producing 2,000 kg of rice husks per day.

For this reason, managing husks for maximum benefits was the main consideration. Thus, the Rice-husk Grinding Plant was opened in 1975, using existing materials with simple and economical construction approach.

Originally, His Majesty the King initiated the use of husks to make the soil more pervious. However, rice husk is

not easily biodegradable as it contains silica, a mineral from the soil that is needed for the rice plant to grow and stored on the outer layer of rice seed. The husk also contain cellulose, plant fibres derived from the connection of glucose and lignin, which is a complex polymer binding all the cellulose fibres. Therefore, to let the husk biodegrade by itself is very difficult. However, these substances can be fused to become a binding compound at suitable levels of heat and pressure. Therefore, rice husks can be compressed, and because of their low humidity and easy ignitability, they can also be used as fuel.

In 1980, an electric rice-husk grinding and compressing machine was installed. The rice husks from the demonstration rice mill were sent through the pipeline directly to the Rice-husk Grinding Plant, helping resolve the problem of rice-husk dust dispersion. Rice husks then were transported to the compressing machine with the heat of 250o C. This level of heat will melt all organic and inorganic substances in the husks, joining the husks into a bar, ready to be used as fuel replacing firewood.

*The rice-husk
compressing
machine re-
invented according
to HRH Princess
Sirindhorn's idea.*



The United Nations bought these rice husk briquettes during the Cambodian War for use in refugee camps in order to minimize the cutting of firewood.

In 1998, HRH Princess Maha Chakri Sirindhorn suggested using broken briquettes to heat the briquette's cylinder instead of electric coil. That even makes the production processes more comprehensive. To reduce the problems occurring from smoke, the exhaust hood was developed to draw back the smoke for re-combustion in the stove, thus, elevating the heat level in the stove and reducing

pollution in the Rice-husk Grinding Plant at the same time.

However, the husk briquette's weakness is that it will soften and break into pieces if exposed to moisture. The rice-husk charcoal was then developed by burning husks in a closed stove system. The result is a fuel rod with 70% less weight, providing sufficient thermal energy, though not as good as wood charcoal, but yielding more consistent heat and less smoke. The husk charcoal can also be mixed with soil to add more nutrients and reduce acidity, thus, achieving the

HRH Princess Maha Chakri Sirindhorn taking lecturers from Johns Hopkins University to visit the Rice-husk Grinding Plant.



original objective of using husks for improving the quality of soil.

Huskbriquette, a by-product from rice, was used as fuel for alcohol production between 1985 and 1994 and also for steaming mushroom cubes for the Mushroom Culture Plant initiated in 1988.

Rice husk is a biomass fuel, and popularly called "green fuel". Green fuel is usually made from twigs and leaves which provide sufficient thermal energy. It is a source of energy for the future because it is derived from agricultural wastes,

fuel from plants using the sunlight and carbon dioxide in the air. So it is considered renewable energy. Unlike their non-renewable counterparts such as oil and coal which can run out, and need a long time to regenerate.

Using husk as fuel instead of firewood helps reduce the amount of lumber to be used as firewood or make charcoal.

Apart from making briquette, rice husk can be used as a primary fuel source for a cooling system in a building. The operation was developed and launched during

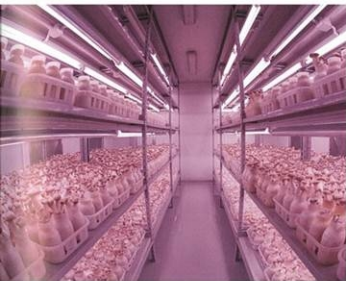


HRH Princess Maha Chakri Sirindhorn presiding over the Opening Ceremony of the Environmental Control Building using thermal energy from rice husks.

2002–2005 using the hot water absorption chiller system releasing cool air from cold water. It is used in the environmental control building to culture cold-climate mushrooms, which is the agricultural R&D project under His Majesty's initiatives. This cooling system is also used for air-conditioning at Sala Maha Mongkol, a reception hall for visitors. It has been proved that biomass fuels can become a major energy source for modern industry as they are economical and renewable and do not create more environmental problems.

This cold water production technology was initiated and developed by the Electricity Generating Authority of Thailand (EGAT) using thermal energy from rice-husk fuel developed by the Royal Chitralada Projects. The technology has three major parts: a rice-husk double cyclonic furnace, a hot water generator, and vapour absorption chiller.

The rice-husk double cyclonic furnace is highly effective in turning biomass fuel into thermal energy. First, the furnace burns rice husks by spinning



Environmental Control Room using cool water from the husk-fuelled water-cooling system to culture cold-climate mushrooms.

husks to the main combustion chamber which is a closed burning system. The gas from incomplete combustion, smoke and ash will be sent to the secondary combustion chamber, which will burn them all together, generating 300 °C odourless and smokeless gas. The gas is piped to hot water generators, which are the heat exchangers, diffuse hot gas to water in the tank by increasing the temperature to 88 °C. The hot water will



The rice-husk furnace and the absorption chiller air-cooling system



Sala Maha Mongkol

be circulated in the vapour absorption chiller. The principle is that the water vapour from hot water which has high pressure will be absorbed by the vapour absorption chiller, controlled by a condenser, which releases the heat and pressure out of the system, thus, converting vapour into liquid. When the pressure is released, the temperature will decrease.

The water flowing back from the cooling system in the Environmental

Control Building and Sala Maha Mongkol with the temperature of around 13°C will be cooled down to 7°C and re-circulated to the air-cooling systems in other buildings. This method of air-conditioning is to draw the air to pass by the cold-water pipes, or in other words, blowing cool air through cold water.

This cold-water production system can be applicable to a variety of fuels such as agricultural wastes geothermal heat, solar energy, natural gas, and excess hot water from an industrial process,



Rice-husk Grinding Plant within the Royal Chitralada Projects' compound

etc. It can help reduce electricity consumption and does not cause noise pollution as it is less noisy than the generally used vapour-compression air-conditioning system. This is because it has fewer moving parts; so the system is simpler and more environmentally friendly, and requires less maintenance.

The water-cooling system using rice-husk fuel that has been studied and developed in the Royal Chitralada Projects,

therefore, reflects the integration and practical utilization of the output from the farm, proven by its 8 years of operation. This technology has been disseminated to the enthusiasts, so they can apply it in their production processes. That was the beginning of renewable energy campaign in communities, for self-reliance, which is the essence of the philosophy behind His Majesty the King's initiatives, starting with rice and stretching far into a sustainable future.

Biogas: Simplicity that Actually Works

Using biogas as fuel has been studied and developed for real use under the Royal Chitralada Projects since 1978. The biogas produced at the capacity is 2–6 cubic meters per day is used as fuel for boiling water for washing milking machines and mixing with milk powder for feeding calves. The digested cow-dung sludge obtained from the biogas digester tank can be used as fertilizer in growing forage grass for milk cows.

The development of biogas production process is based on simplicity and practicality. In the cement digester tank, the 1:1 mixture of cow manure and water will be digested by microorganisms, yielding flammable gas consisting mainly of methane. Then, the biogas will be ducted and stored in a closed airless container under low pressure, and thus is safe for household use such as cooking.

Biogas production technology is simple and it can be easily transferred to rural farmers as they have got manure or food wastes as raw materials. In practice, the farmers can store biogas





Biogas digester tank in front of the old dairy cow barn

in car tires. Apart from being economical, using biogas also helps reduce firewood cutting as well as household's expenses on cooking gas.

When HRH Princess Maha Chakri Sirindhorn visited a border patrol police school in Wang Nam Yen district, Sa Kaeo province, she saw local people fermenting food waste in a jar and connecting it with a pipe for the biogas to be used as cooking

gas. The farmer who generated the local biogas told the Princess that he had seen the biogas digester tank in the Royal Chitralada Projects' compound; so he got an idea and applied the method using a jar instead.

It has become clear that simple knowledge can bring real benefits to the farmers.

Gasohol:

The Result of Two Decades of Perseverance

"...Suppose we use our Thai products, as we have plenty of good ones. For example, sugarcane; many people grumble that it's too plentiful and hard to sell, and its prices are falling. So we purchase it at a reasonably good price for making an alternative fuel. Both the grower and the producer get money, in baht not dollars or euros. Then we will be able to use gasohol as fuel without spending any foreign currency..."

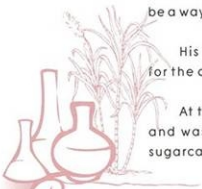
His Majesty the King's remarks on the Occasion of His Birthday at the Dusidalai Hall, Chitralada Villa, 4 December 2000.

In 1985, when His Majesty the King visited the Royal Chitralada Projects, he said to Mr. Sanchai Tiamtaweasin, currently an advisor to the Bureau of Royal Household:

"...Try producing alcohol from sugarcane because in the future fuel oil will be expensive and there will be an oversupply of agricultural products. So, use sugarcane in producing alcohol on a trial basis; it will be a way to solve the problem. Next year I'll come and see the progress..."

His Majesty also contributed 923,500 baht as a start-up capital for the construction and procurement of necessary equipment.

At that time Thailand had just overcome the 1983 major fuel crisis and was facing the problem of produce price slump, especially the sugarcane prices that continued to fall. But because the oil prices were





His Majesty the King and HRH Princess Maha Chakri Sirindhorn observing the preparation of fermenting yeasts for producing alcohol as reported by Mr. Suthisak Suknaisilp, a lecturer from the Department of Chemical Technology, Faculty of Science, Chulalongkorn University, 1986.

still lower than the costs of alternative fuels, the experiments on renewable energy were not seriously conducted, despite the fact that it is an area that His Majesty the King has always been interested in.

On 9 May 1986, His Majesty the King and HRH Princess Maha Chakri Sirindhorn presided over the Opening Ceremony of the

Alternative Fuel Research Building. This reflects an uncompromising commitment of His Majesty in the study of ethanol production from sugarcane, starting from selecting suitable species to milling the canes.

For this reason, in the beginning stage, sugarcane was cultivated, harvested, and

"...It has been 20 years since I first experimented with gasohol, but it was not a success because at that time other people didn't pay attention to it; they said that gasohol would be more expensive than the gasoline at the petrol station. However, I didn't give up because I knew that one day there would be less fuel. And when the amount is less, it will be expensive..."

*Royal speech given by His Majesty the King at
Klaikangwol Palace, 16 August 2005.*

milled in the Royal Chitralada Projects' area. There were data recorded on the sugarcane species that have appropriate juice or sugar for producing ethyl alcohol.

The sugarcane mill was a second-hand machine bought from a sugar production plant in Chon Buri province. Sugarcane would be squeezed and the quantity of juice from each species would be recorded. The juice was fermented with yeast to produce ethyl alcohol, the process being the same as that for liquor fermentation. The alcohol was obtained from the fractional distillation of the fermented liquid at the distillation tower. The machine was small so the production capacity was not large, using rice husk briquettes as fuel for the boiler.

The sugarcane juice fermentation or digestion process needs to be free from contamination so as to get the fermented liquid with high alcohol content (at least 10% alcohol) so that it could be passed on to the alcohol distillation stage. However, in the beginning, under the constraints of technology and experience, the project did not succeed in producing alcohol at the desired purity level.

Even several years after that, the cost of 99.5% alcohol for motor vehicles was much higher than the price of gasoline. Thus, the concept of producing alternative fuels received little attention. However, His Majesty the King was determined to make the gasohol project successful; thus he reiterated to Mr. Keokhwan Vajarodaya, Lord Chamberlain and Director of the



His Majesty the King and HRH Princess Maha Chakri Sirindhorn observing alcohol distillation process, 1987.

Royal Chitralada Projects that:

"...Keep on doing it; don't give up, even when others are giving up. Do not stop..."

Until a decade later after His Majesty the King presided over the Opening Ceremony of the Experimental Alcohol Production Project building, the research project could produce 95% alcohol for the first time which was the purest alcohol it could produce. Though it was not pure

enough for making gasohol to be used with a benzene engine, which needs 99.5% alcohol, it was the first achievement after the initial effort of growing sugarcane.

The 95% alcohol produced in the first stage was manufactured as solid or gelled alcohol fuel for use in heating food. It is easy to keep and safer than liquid alcohol. Later, the alcohol was further used as an ingredient in producing cleansing gel, perfume, insect repellents, etc.



His Majesty the King together with HRH Princess Maha Chakri Sirindhorn taking a look at solid alcohol products.

Normally sugarcane can be purchased from sugar factories once a year during the harvesting season, thus the sugarcane supply as raw material in the alcohol production/distillation process was not enough. So the project had to use molasses for this purpose instead. Later, the Thai Bev Group presented a new distillation tower for replacing the old experimental one which was very small.

However, as producing 99.5% alcohol was still a major goal, a number of research studies had to be carried out to find alternative ways. The team found that by using conventional distillation in normal atmospheric pressure, 95% alcohol was

the purest alcohol they could produce.

Technically, to extract the almost 5% water out of alcohol is very difficult, but it is possible if appropriate technology is used. At that time, there were fluctuations in oil prices as an impact from the Gulf War and the world economic crisis. As the oil prices were shooting up, alternative fuels started to gain more attention.

In 2001, a private sector enterprise presented His Majesty the King with a water absorption filter using the "molecular sieve" system, which works by using synthetic substances that can absorb moisture efficiently under low relative humidity. The filter can absorb 22% of moisture by weight. With the special structure of molecular sieve, it provides a surface of approximately 700–800 square meters per gram and can





HRH Princess Maha Chakri Sirindhorn leading officials from the US Defense College to observe the Alcohol Production Plant.

absorb much of humidity. It can absorb the remaining water in the 95% alcohol until the alcohol content reaches 99.5% as per the established standard.

Using this system with the Project's 95% alcohol was successful. Eventually, the Project can produce 99.5% alcohol which can be blended with 87 octane benzene in the gasoline-to-alcohol ratio of 9:1, the result is Gasohol 91. When the production of 87 octane benzene was

discontinued, the alcohol can be mixed with 91 octane benzene to become 95 octane gasohol (or Gasohol 95), which is now widely used. However, alcohol is stable at 95% in normal atmospheric pressure. Therefore, when water is removed to get 99.5% alcohol, the alcohol then needs to be stored in a cool, dry tank with a moisture detection system. Otherwise, it will absorb humidity in the air resulting in degraded quality.



HRH Princess Maha Chakri Sirindhorn presiding over the Inaugural Ceremony of Gasohol Station in the Royal Chitralada Projects' compound, 1996.

Some of the Royal Chitralada Projects' vehicles were used for the gasohol experiments. After several trials, it showed that the cars performed well. The 99.5% alcohol from the Royal Chitralada Projects also helped contribute to the efforts of PTT Public Company Limited (PTT) and Bangchak Petroleum Plc (BCP) in their initial stage of the gasohol station promotion policy.

Nowadays, more than 4,000 petrol stations nationwide have gasohol

available for motor vehicles. The gasohol consumption rate in 2009 was up to 12.2 million litres representing 60% of the total gasoline consumption. There have been efforts to promote the use of gasohol with higher alcohol contents, i.e. Gasohol E20 and E85.

It took more than two decades to prove that gasohol-powered vehicles can become common in everyday life. This shows us His Majesty's virtuosity and broad vision, as well as his understanding

Mr. Keokhwan Vajarodaya, Lord Chamberlain, presiding over the Opening Ceremony of the first gasohol petrol station of PTT, 11 January 2001.



in overall problems of the country. He also shows us his strong beliefs in the efficiency and resources of the country. Most of all, His Majesty shows us his firm determination and untiring commitment to quietly pursue the experiments on what he believes under the Royal Chitralada Projects without quitting or flowing with the trend, despite all the problems and obstacles throughout the period of more than 20 years.

Using gasohol over the past 10 years

has provided lots of benefits. Crop prices for both sugarcane and cassava are stable, and the air quality, as regularly monitored, has improved.

Perhaps the production of alcohol may be only one example of His Majesty's obligations to his people, but what is worth mentioning here is, through his action, His Majesty's strong confidence in the fatherland and untiring perseverance in coping with all difficulties and resolving problems.

Biodiesel:

The Philosophy of Life, Not Just a Fuel

"...When (petroleum) oil is getting more expensive, people are getting worried because the oil helps them make a living. If oil prices are higher but their income remains stable, that means higher expenses but lower income, it's impossible for them to live. So, we must look for alternative low-cost fuels. I'm not saying producing fuel, but the fuel is more expensive than oil purchased from foreign countries..."

Royal remarks given to Thai Ambassadors and Thai Consuls-General from around the world at Klaikangwol Palace, 16 August 2005.

Developing a sustainable way of living by using locally grown or produced resources is His Majesty's focus. For this reason, the integrated approach is his excellent vision and guidance for having insight into problems and their solutions.

When His Majesty visited an oil palm plantation at the Southern Developmental Self-help Settlement in Khuan Ka Long District, Satun province which was among the first oil palm plantations in Thailand, on 9 September 1975, he was very interested because it had more value to the growers than merely selling palm fruit. At that time, oil palm was not widely known.





Royal vehicle, using 100% palm oil, when His Majesty the King went to perform the foundation stone laying ceremony at Khlong Tha Dan Dam, Mueang district, Nakhon Nayok province, 2 June 2001.



His Majesty the King observing the small-scale palm oil factory at Prince of Songkla University, Hat Yai Campus, 1983.

HRH Princess Maha Chakri Sirindhorn observing the use of palm oil with a low-speed cycle engine, the results of the experiment conducted by the Electricity Generating Authority of Thailand, 2002.

His Majesty's interest brought about a small project of Palm Oil Industry Promotion Initiative, carried out by Prince of Songkla University, Hat Yai Campus, in collaboration with the Office of the Royal Development Projects Board. The construction of a demonstration-scale plant for palm oil extraction started in 1983, not only for consuming but also for studying the feasibility of oil palm plantation as an energy crop. In the presence of crude oil price fluctuations in the global market, the plantation was experimented to find renewable energy

for use in lieu of diesel.

Based on the achievement in developing and producing gasohol, a blend of ethanol from sugarcane with benzene, the development of diesel blended with plant oil, or biodiesel, was thought of because the machinery used in the agricultural as well as other production sectors such as fishing uses low-speed cycle diesel engines. For this reason, in 2000, His Majesty initiated the experimental project on planting fuel crops for use in producing biodiesel, and



asked that Prince of Songkla University start producing pure palm oil.

In the beginning, there were concerns among consumers that vegetable oils would not be practical for use with engines despite the fact that the first type of ignition engine with compressed air or diesel engine invented by German inventor Rudolf Diesel and exhibited for public viewing in Paris, France, 110 years ago, was operated with peanut oil.

That type of engine was specifically



designed to work with crude oil from crops, without any modification. That success caused the French government to have an idea to produce electricity from peanut oil to reduce coal and fuel oil imports.

Later, oil refinery industry was able to produce diesel fuel, which was formerly considered a poor-quality, cheap oil, but more translucent than vegetable oil. The engine was then developed to support petroleum oil as a primary fuel. The use of vegetable oil as a fuel for engine was gradually obsolete until now



HRH Princess Maha Chakri Sirindhorn splashing holy water at the biodiesel producing machine, 7 May 2004.

that the world is approaching the era of diminishing petroleum reserves and the adverse effect of global warming.

In 2001, when the Royal Chitralada Projects could produce 99.5% alcohol, the Petroleum Authority of Thailand proposed the initiation of "diesohol" or diesel blended with alcohol for diesel engines. However, the diesohol production process needs an emulsifier to make alcohol

coalesce with diesel fuel, using the mixing ratio of 13% alcohol, 2% emulsifier, and 85% diesel, with the expectation of reducing diesel imports.

Several trials had been done using diesohol with tractors. However, there were many limiting factors such as its higher cost due to emulsifier imports and the need to use of diesohol immediately as the diesel and alcohol would be separated

if left unused for a long time, resulting in the damage to the engine. The project was not successful as expected.

But His Majesty the King was still interested in the use of plant or vegetable oils as auto fuel. As per the royal initiative, the Director of the Royal Chitralada Projects was tasked with searching for more information and found that vegetable oils could be used with auto engines but the gum in the oils had to be removed first.

From the studies of vegetable oils as fuel, the problem of using vegetable oils is that their viscosity is greater than petroleum oil, causing poor disintegration of fuel particles in the combustion chamber which results in low performance of the



"His Majesty the King of Thailand is a development worker with noble persistence, genius and great vision. He works hard for his people, using simple technology. His inventions can be adopted or further developed for extensive use throughout the world."

Certificate of Honour presented to His Majesty the King from the International Invention Exhibition BRUSSELS EUREKA 2001 – Gold Medal for the Biodiesel Project: Palm Oil Formula.

engine. However, the viscosity problem can be resolved with transesterification with alkaline. That is, bring vegetable oil or animal fat, which has a fatty acid component, to react with alcohol, using alkaline as a catalyst.

Biodiesel, a product derived from the aforementioned process, has the viscosity of normal fuel with improved disintegration of fuel particles, thus, causes no problem in the ignition. The combustion is complete, causing no black smoke, and the fuel can be perfectly used with car engines.

The Biodiesel Project: Palm Oil Formula Initiative was one of the three works of His Majesty the King, which also include the New Agricultural Theory and the Royal Artificial Rain Project, the

National Research Council nominated and showed, with the royal permission, at the World Exhibition of Innovation, Research and New Technology: BRUSSELS EUREKA 2001, in Brussels, Belgium, and won the gold medal.

The production of pure refined palm oil for diesel auto-engines has been patented at the Department of Intellectual Property, Ministry of Commerce, patent No. 10764, by His Majesty the King.

In 2004, the construction of biodiesel building started within the Royal Chitralada Projects' compound to produce biodiesel with the ethyl transesterification process using used vegetable oil from the Royal Kitchen, sodium hydroxide and 99.5% ethyl alcohol as the raw materials.

*Special Captain Samai
Chai-in of the Naval
Dockyard Department
reporting on the process of
biodiesel production,
7 May 2004.*



The Biodiesel Project was supported, in terms of production equipment and technology, by several public and private sector agencies. It can produce good-quality biodiesel, mainly for diesel vehicles of the Royal Chitralada Projects, and the steam generators of the Alcohol Plant.

In addition, the Royal Chitralada Projects have conducted joint research

with other agencies such as the Electricity Generating Authority of Thailand and universities such as Chulalongkorn University and Kasetsart University to develop technology for biodiesel production from other energy crops. For example, biodiesel can be produced from *Jatropha curcas* (sabu-dam in Thai) oil, which is an alternative raw material from local products. Besides, a study was also conducted on biodiesel production using



Dr. Sombat Chinawong, from Kasetsart University, Kamphaeng Saen Campus, presenting report on biodiesel production from Jatropha oil to HRH Princess Maha Chakri Sirindhorn, 2006.

a solid catalyst to reduce the amount of wastewater from the production process.

For the present operation, 200 litres/day of biodiesel is produced at the Royal Chitralada Projects from vegetable oil already used for frying food in the Royal Kitchen. The demonstration of the comprehensive production process can be viewed by any interested persons, especially farmers, so they will be able to process it

by themselves in their community. Using the ethyl transesterification method, 100 litres of used vegetable oil can be produced as 90 litres of biodiesel and 10 litres of glycerine. When the glycerine is passed through the process of purification, it can be used in producing soap, or cosmetic and pharmaceutical products.

In a small production unit, glycerine can be used to make high-quality soap

"...We will use biodiesel from the oil palm that we grow by ourselves. Its amount might be rather small, we will use that small amount; don't be lavish. Using just a little of such oil, we will continue having it for use. We grow oil palm trees, from which we produce fuel oil. Palm oil is used for frying fish or other foods; and then the used oil is processed for use with diesel vehicles. After trials, it has been found useable even though the vehicle can run rather slowly, but it doesn't matter. Don't be in a hurry. Life shouldn't be too much in a rush..."

His Majesty the King's remarks on the Occasion of His Majesty's Birthday Anniversary, at the Dusidalai Hall, 4 December 2007.

or sold as a raw material (for producing something else), which is a way to create value-added benefits for a small project at the community level.

Nowadays, biodiesel has been accepted and widely used. This is one step to the exit door of energy crisis which is becoming more severe amidst the global economic growth and the fuel supply decline. However, what His Majesty the King gives us is not only the method of producing renewable energy but also the wisdom of thinking process as well as the concept. That is, to adjust

our lives in a suitable path based on the sufficiency principle. Even though we can grow renewable energy crops and if our consumption behaviour doesn't change, it will unquestionably cause another set of problems in the future.

Therefore, the rationale behind the research and experiments on biodiesel is not only the search for alternative energy that will help solve the problem of the people and develop the country in the future, but also the implied philosophy that is profound, practical, and useful for life.

His Majesty's Reputation Pervades throughout the World

Since acceding to the Throne in 1946 (B.E. 2489), His Majesty King Bhumibol Adulyadej has become the "Spiritual Centre" of Thai people. With his dedication to the country and his magnificent usual grace that always captivate all Thais, he has "Crowned with Glory, in His People's Heart", evidently for both Thais and other peoples throughout the world. He has received praise and won recognition from other nations around the world for his talents in various aspects, all of which for the purpose of relieving the suffering of his people. His Majesty has been hailed as the "Development King".

For 50 years under the Royal Chitralada Projects, many initiatives have been implemented through His Majesty's perseverance and determination. In recognition of his efforts, many international institutions and organizations presented him with honorary doctorates, honorary certificates, and various awards, to proclaim His Majesty's honour, for example:

Tuesday, 21 July 1987

The Asian Institute of Technology presented the Gold Medal of Honour to the King for his dedication in developing rural communities.



Wednesday, 4 November 1992

The United Nations Environmental Programme (UNEP) presented a gold medal in recognition of His Majesty's outstanding performance on nature and environmental conservation, recognized by many nations worldwide.

Tuesday, 24 November 1992

The World Health Organization (WHO) presented His Majesty with its Health-for-All Gold Medal for services ensuring the nation's good health.





Tuesday, 26 January 1993

The International Society of Chemical Ecology presented an Honorary Medal in recognition of His Majesty's biodiversity conservation.



Wednesday, 6 December 1995

The Food and Agriculture Organization (FAO) presented the Agricola Medal in recognition of His Majesty's devotion for the benefits of Thai people, particularly those in the agricultural sector, to conserve forests and water resources.



Wednesday, 5 June 1996

The International Rice Research Institute presented an Honorary Medal in recognition of His Majesty's devotion to the improvement of the living condition of farmers and other people.



Wednesday, 25 June 1997

The International Council for the Control of Iodine Deficiency Disorders presented a gold medal in recognition of His Majesty's leadership and guidance in dealing with the iodine deficiency problems in Thailand.



Wednesday, 8 December 1999

The Food and Agriculture Organization (FAO) presented the Telefood Medal in recognition of His Majesty's performance in agricultural development in Thailand, to enhance the well-being of farmers and food security.



Wednesday, 31 May 2000

The World Health Organization presented the WHO Plaque in recognition of His Majesty's exemplary leadership in public health.



Monday, 23 May 2005

The Asia-Pacific Rural and Agriculture Credit Association presented the Ear of Rice Gold Medal in recognition of His Majesty's devotion to rural and agricultural development.



Friday, 26 May 2006

The United Nations Development Programme (UNDP) presented an award for the highest achievement of human development in recognition of His Majesty's dedication and perseverance to bring benefits and sustainable growth to the Thai people nationwide.



Monday, 23 July 2007

The World Food Prize Foundation presented Dr. Norman E. Borlaug World Food Medal in recognition of His Majesty's dedication to improving the nutritional status of Thai people.



THE ROYAL CHITRALADA PROJECTS AND FAO

Since his coronation in 1950, His Majesty the King has continually and actively devoted himself to promoting the welfare of his people and their economic prosperity. His Majesty's concept of drawing up efficient plans based on in-depth information has successfully improved the agriculture, economy and society of his country.

Each step of implementation of each development project relies on a combination of needs and first-hand information from people related to the project, in depth-study, direct experimentation and long experience. The Food and Agriculture Organization (FAO) has had the great privilege and honour to provide information from experts and specialists as well as various other kinds of supports integral to His Majesty's projects, beginning with the first Royal Project on fish culture in 1950.

To date, thousands of royal development project have been created under the auspices of His Majesty, covering irrigation, agriculture, livestock, fisheries, forestry and rural development. Although these projects operate in every part of the Kingdom, the strategies to develop the country's agriculture often started with experiments at the Chitralada Royal Palace.

The Royal Chitralada Projects

His Majesty has made use of his private property at Chitralada Palace for various research projects and experiments. Data and research results from there are collected, analyzed and made available to farmers and other interested people. Basic scientific knowledge, modern technology and local wisdom are blended and adapted to the existing local agricultural resources and environment.

The experiments at Chitralada Palace include rice farming and milling, fruit and vegetable processing, milk production and dairy processing, fisheries, forestry and related farm research.

Each year, tens of thousand people, including farm leaders, village chiefs, school and agricultural college students, religious leaders as well as foreign experts and correspondents visit the projects.

Dr. Diouf, the current FAO Director-General, when he first visited the Royal Chitralada Projects some ten years ago, commented that it was the first time that he saw agricultural experimentation stations operating within the compound of a head of state's residence.

FAO's Participation

Fisheries: The first royal project to receive support from FAO was a fresh water fishery project to propagate *Tilapia mossambica* in 1952. The fingerlings FAO presented to His Majesty were raised at Ambhorn Palace, the royal residence at that time, so this project did not constitute the Royal Chitralada Projects. Following successful propagation, *Tilapia* fingerlings were later distributed to the public throughout the country.

Later on, in March 1965, the Japanese Crown Prince presented His Majesty with 50 fingerlings of *Tilapia nilotica*, known by its vernacular name as *Pla Nil* (pla meaning fish in the Thai language). This time, His Majesty raised the gift at Chitralada Palace. Subsequently, propagated throughout the country, the fish has become highly popular.

Livestock: A project that was experimentally undertaken by His Majesty the King in the livestock sector is related to dairy farming. In 1962, His Majesty established a dairy farm with five milk cows and one bull donated to the Project. Over the years, the dairy farm has grown and the surplus head of cattle from the dairy farm have been donated by His Majesty to farmers and various educational institutions. The objectives of the project included promotion and popularization of fresh milk consumption. This project has served as a model for several field projects undertaken by His Majesty the King (e.g. Nong Phoe Dairy Cooperative Ltd.).

A processing plant attached to the Chitralada Dairy was also developed and expanded, and the new unit was named "Chitralada Milk Centre". Its purpose was the collection of surplus milk from dairy farmers and promotion of milk consumption by school children. The Centre is now equipped with modern machinery, including an automatic packaging machine.

In 1969, another allied development took place, namely, the establishment of the Dusit Powder Milk Plant. His Majesty has received a petition from dairy farmers for assistance in disposal of surplus milk. In response, the idea of establishing a plant for manufacture of milk powder was conceived. Mr. Frank Westerdin, the FAO Dairy Development Officer from the Regional Office at Bangkok played an active role in the formulation of the detailed plans and supervised the construction of the plant. From time to time, the plant has been improved and renovated.

In 1984, FAO supported the Chitralada Dairy Projects with a milk quality control project. Under this project, three staff members of the Dairy Projects undertook a study tour to Finland, the Netherlands and the United Kingdom, and financing was provided for the purchase of equipment

Beginning with the first Royal Project on fish culture in 1951, FAO has had a unique honour of being associated with several projects initiated by His Majesty the King. Hence, this year (2010), the 60th anniversary of his Coronation, we fervently hope to be able to continue contributing to His Majesty's development projects as we have had the privilege and great honour to do in the past.



Hiroyuki Konuma
Assistant Director-General
and FAO Regional Representative
for Asia and the Pacific

30 JUN 2010



The Borrow Foundation is a UK Registered Charity, a non-profit making organization. Its primary aim is to encourage the wider use of fluorides for the improvement of oral health, with particular emphasis on milk as a vehicle for its delivery.

The Foundation has worked closely with the World Health Organization to establish an international milk fluoridation programme. Schemes have been implemented in a number of countries including Thailand where the national school milk programme has provided an excellent opportunity for such interventions to be applied by provincial health authorities, in collaboration with the Department of Health and the Royal Chitralada Projects.

The Royal Chitralada Projects is an agricultural research and development facility established by His Majesty King Bhumibol Adulyadej within the grounds of the Chitralada Palace in Bangkok. It was here that fluoridated milk was first produced in Thailand and this unique centre continues to supply to some of the participating schools in the capital city. However, its role in the programme extends far beyond this. The plant at the Milk Collection Centre is used as a working demonstration of the robust systems and standards that have been developed for the production and quality control of fluoridated milk and has provided an excellent 'model' that has been replicated in numerous dairies around the country. This has enabled the programme to be extended to more than 500,000 children for the benefit of their oral health and further expansion is planned.

Staff at the Royal Chitralada Projects continue to play a key role in strengthening and developing these systems and by using the knowledge gained from this work to provide ongoing training and guidance to all dairies engaged in the production of fluoridated milk.

It is a great honour and a privilege to have witnessed firsthand the work that is undertaken in this 'green oasis' in the heart of Bangkok and one cannot fail to be impressed by the facilities and the expertise of the staff that are committed to meeting His Majesty King Bhumibol Adulyadej's vision. The Royal Chitralada Projects is a truly special place and speaks volumes for His Majesty's great compassion for his people.

The 50th anniversary of the Royal Chitralada Projects, is a time to reflect on the success of this unique and inspirational initiative which, under the leadership of His Majesty King Bhumibol Adulyadej, has proved to be profoundly important to the development of agriculture in Thailand and greatly improved the quality of life of Thai people whose livelihoods are dependent on the land.

Mr Nigel Borrow
Trustee
The Borrow Foundation

More than two billion people in the world today suffer from micronutrient deficiencies caused largely by a dietary deficiency of vitamins and minerals. The public health importance of these deficiencies lies upon their magnitude and their health consequences, especially in pregnant women and young children, as they affect fetal and child growth, cognitive development and resistance to infection.

The World Health Organization (WHO), together with the Food and Agriculture Organization, has adopted four main strategies to improve dietary intakes through increased production, preservation and marketing of micronutrient-rich foods combined with nutrition education; food fortification; supplementation; and global public health and other disease control measures. Each of these strategies has a place in eliminating micronutrient malnutrition.

In this regard, WHO is pleased to acknowledge and salute the efforts towards public health development by His Majesty King Bhumibol Adulyadej through initiatives under the Royal Chitralada Projects, such as the Milk Fortification

Initiative, which resulted in the availability of fluoridated milk to more than 500,000 Thai children. This initiative has demonstrated the feasibility of milk fortification which is a public health intervention for further implementation in a larger scale, aimed at long-lasting oral health, strong teeth and improved nutritional status in the targeted children.

Effective use of fluoride is one of WHO's priority action areas for the improvement of oral health worldwide. Promotion of oral health is a cost-effective strategy to reduce the burden of oral diseases. It is also an integral part of health promotion in general, as oral health is a determinant of general health and quality of life.

Dr Samlee Plianbangchang
Regional Director
WHO Regional Office for South—East Asia

The Father's House.....

"When I looked back at our Father's House,
Unlike any other palaces,
Today there are streams splashing, green shrubs, and shady trees,
In the middle of the city.
For fifty years, our Father has never quit,
With his two hands, he has gradually created in country-style,
Farms, paddy fields, plots of fruits and flowers,
All Thai plants grow and flourish.
Green rice fields and all crops gracefully yield,
Livestock, birds, fish, all are breeding,
Together with rice mill, milk factory, food processing plant,
Organic fertilizer, all at our Father's House.
He lives a self-sufficient life, just like what he taught us,
With forest and water conservation, to relieve global warming,

Creating new clean energy, gasohol for solving energy problems,
Basic innovations instantly yield, Chaipattana Aerator winning an award.
His creations have been disseminated, benefiting all of us,
There are *nil* fish in the ponds and paddy in the rice fields,
Every day when I pass the Father's House, I am delighted,
Even when I see only a glimpse of the roof of his House.
He is the Father of all of us,
He is our power of creativity, his innovations are everywhere.
He is the guiding light for us all,
He is our Father with the ten royal virtues, he practises night and day.
Hail for the King and his longevity, we are joyful under his patronage,
Promise to do what he taught, living together in harmony.
Every time that I pass the Father's House, I bow wholeheartedly,
Wishing him to stay with us and be in our hearts forever.

...Be in our hearts forever



The Royal Chitralada Projects

Background

His Majesty King Bhumibol Adulyadej has travelled extensively throughout the country to see his people and listen to their problems. His determination to improve the quality of public well-being, especially of those in the agriculture sector, which is considered the main occupation of the country, resulting in the establishment of the "Royal Chitralada Agricultural Projects" located on the grounds of Chitralada Villa, His Majesty's residence in Dusit Palace, in 1961.

First year's experiments included experimental rice fields, having the Department of Rice responsible for the project and a demonstration *yang na* plantation, having the Faculty of Forestry, Kasetsart University, responsible for the project. Later, His Majesty the King provided full financial support to both projects and was involved in hands-on operations on the experiments and research. Thus, the Royal Chitralada Projects were among the first royal development programmes prior to the expansion of other royally initiated projects throughout the country.

The Project Emblem

"Phra Maha Pichai Mongkut (Royal Crown)" refers to the King, since the Royal Chitralada Projects

belong to His Majesty the King.

"Radius" indicates divine grace of His Majesty, who always supports and helps farmers.

The "green" colour represents agriculture, because the Royal Chitralada Projects are advocacy programmes that support, promote, and publicize the agricultural research and development activities initiated by His Majesty.

Operational Objectives

The Royal Chitralada Projects have three main objectives:

- They are experimental study projects conducted to find solutions to various agricultural problems.
- They are demonstration-scale projects for people to study and practise, and then take back the skills and knowledge for application in their own places.
- They are non-profit projects established to help alleviate the suffering of people. For example, when there was an oversupply of raw milk, His Majesty the King graciously initiated a Milk Powder Plant to produce processed raw milk to prolong its shelf-life, by contributing his private funds for the project's construction and establishing the Milk Collection Centre to purchase milk from dairy farmers.

Project's Activities

The operations of The Royal Chitralada Projects' activities can be divided into two categories:

Non-profit projects: They are undertaken

with supports from various public and private agencies on His Majesty the King's initiatives for agricultural development as well as natural resources conservation.

The non-profit projects include: Experimental Rice Fields, Demonstration Forest, Culture of *nil* Fish, Wind Mill, Electricity Generation by Wind Power, Solar Energy House, Solar Cell-Powered Water Pumping System, Cold Water Production System by Means of Heat Energy from Husk, *Sa Mulberry Paper Plant*, and Plant Tissue Culture.

Semi-profit projects: They undertake activities involving the processing of agricultural raw materials and the selling of products not for profit, but to encourage people to consume locally produced products, using the complete cycle approach in financial management. The income will be used for further development of the projects.

The non-profit projects include the following groups:

2.1 Dairy Farming and Dairy Product Processing: This group conducts research on and disseminates knowledge of dairy farming in Thailand. The processed dairy products include: pasteurized milk, UHT milk, milk powder, milk tablets, cheese, ice cream, and yoghurt. The group also encourages people to consume milk and other fresh milk products useful for health.

2.2 Agricultural Technology and Agro-Industry: This group conducts research on and disseminates knowledge of agricultural product processing, agricultural waste recycling and management. The projects include the demonstration rice mill, rice-husk

grinding plant, pasteurized fruit juice plant, cannery fruit juice plant, fruit drying plant, bakery plant, mushroom culture plant, *spirulina* culture plant, organic fertilizer plant, royal candle plant, honey plant, and drinking-water plant.

2.3 Experimental Fuel Production: This group conducts research on and disseminates knowledge of renewable energy production such as alcohol and gasohol production from agricultural products, processing of waste from the sugar production process, biodiesel production from used vegetable oil, and processing of excess materials from production processes for making other products such as clear soap, hand-cleansing gel, and dishwashing liquid.

The operations of the Royal Chitralada Projects focus on His Majesty the King's Concept of "Sufficiency Economy", which gives importance to improving the quality of life of farmers on a sustainable basis; so they will become self-reliant. The concept runs concurrently with the process of natural resources conservation. A variety of research studies have been conducted on local agricultural product processing to lessen the importation of such products and reusing excess agricultural materials for maximum benefits, using the simple, efficient, less time-consuming and economical methods. All research studies have been done in a scientific way by gathering data and results of studies for disseminating the knowledge to farmers and other interested parties. It is indeed a "Living Museum" that is operated on the grounds of the residence of the beloved King of Thai people.

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Prepared/Published by:	Department of Medical Sciences, Ministry of Public Health, in cooperation with the Royal Chitralada Projects
Translator:	Mr. Narintr Tima Mr. Chakrit Sirohit
Cover Design:	Mr. Suwit Khamma
Font Design:	Mr. Pairoj Thiraprapa
Poem Composer (Thai version): "The Father's House"	Ms. Pisamai Chandavimol
ISBN:	978-616-0456-6
Printed By:	Tana Press Co., Ltd.



Department of Medical Science
Ministry of Public Health



The Royal Chitralada Projects