Annual Report 2018

ศูนย์วิจัยเห็ด ดอยปุย
(เชียงใหม่)

ศูนย์ถ่ายทอดเทคโนโลยี
และนวัตกรรมอาหาร
แปรรูป (แพร่)

โรงงานบริการ
นวัตกรรมอาหาร

ศูนย์ความเป็นเลิศ
ด้านสาหร่าย

อาคารทดสอบและพัฒนา
ระบบขนส่งทางราง

ศูนย์ทดสอบการสลายตัว
ทางชีวภาพ
(เทคโนธานี ปทุมธานี)

อาคารเทคโนโลยี
การเกษตรเสมือนจริง
เฉลิมพระเกียรติฯ
(นครราชสีมา)

โรงคัดบรรจุสับปะรด
(ประจวบคีรีขันธ์)

สถาบันวิจัยวิทยาศาสตร์และเทคโนโลยีแห่งประเทศไทย (วว.)
กระทรวงวิทยาศาสตร์และเทคโนโลยี (วท.)

Content

Message from the Governor

The policy on "Science Builds the Nation" of Dr. Suwit Maesincee, Minister of Science and Technology (MOST), who clearly announced the ministry's working guidelines in driving Thailand 4.0 through science, technology and innovation with 4 strategies as follows: science solves poverty, science builds people, science strengthens efficiency, and science meets the region. Concerning these, Thailand Institute of Science and Technology Research (TISTR), as a state enterprise under MOST with a mission in research and development (R&D), innovation, and science and technology services provided to the industrial sector, has implemented the policies by setting guidelines as a main operational framework focusing on 4 areas: 1) Bio-based research – to conduct R&D on biological resources covering missions related to the target clusters of the country such as agricultural clusters and biologicalchemistry, comprehensive medicine, etc. as well as being a learning center in the Biosphere Reserve that supports both domestic and international researchers and experts. 2) Appropriate technology - the development of appropriate technology for utilizing in any problematic areas or satisfying the needs of users. These appropriate technologies should be designed to be effectively used within the context, usable, suitable for the environment both economically, socially and environmentally, promote careers and raise quality standards for entrepreneurs. 3) Total solution provider – R&D services provided to entrepreneurs, both SMEs, OTOP manufacturers, community enterprises, and farmers who need product innovation, add value or finding solutions for product problems, for example, R&D, development of prototypes and solutions, services in analysis, testing, and calibration, scale-up from the laboratory to commercial production, a product & management system, and commercialization. Outstanding achievements of TISTR included Innovative Center for Production of Industrially Used

Microorganisms: probiotics and prebiotics, and Food Innovation & Service Plant: FISP - a standard pilot plant for beverage production and dried fruit production, etc. 4) Community area- based development – projects and activities that can fulfil the needs of communities and people in various areas together with agencies and educational institutions in those areas with an objective to strengthen communities with the goal to develop the areas in 77 provinces across the country. In fiscal year 2018, TISTR has been successful in concretely utilizing research results and innovations in many areas of Thailand, such as the project to increase the value of important substances in tamarind seeds - "From waste to wealth" in Phetchabun province, the development of new chrysanthemum species having high potential in disease resistance - the first species of Thailand, in collaboration with the Khun Wang Royal Project, Chiang Mai Province and other relevant agencies, development of Sangkalok products, Sukhothai Province, development of a prototype factory for the production of rubber floor mats for the community enterprises group of rubber product processing industry, Wang Chan District, Rayong Province, development and network strengthening and business potential development of the organic rice network community enterprise in the Organic Agriculture Learning Center, Rai Chontawan, Chiang Rai Province. In addition, there is outstanding bio-based research, namely, Nano-serum products to nourish facial skin and slow down wrinkles from Centella Asiatica extract.

In the aspect of industrial services, analysis, testing, calibration and system assurance can be described as follows: Material Biodegradation Testing Laboratory, certified as a standard laboratory of ISO/IEC 17025 (Chemistry, Degradable Plastics), Proficiency Testing (PT) Program according to ISO/IEC 17043 standards, certification of service provider of a testing program in PT (temperature) to control the quality of the laboratory in accordance with ISO/IEC 17025, thus creating confidence and recognition to laboratory users. Moreover, another success case in 2018 was the expansion of service scope to include the analytical testing and engineering consultancy project for the development of components of rail system up to international standards.

As mentioned above, these performances are the success and delight of TISTR in 2018, with both work expansion in the research areas that are beneficially used countrywide, and our services that can strengthen Thai industrial sector with quality systems up to international standards. We have fulfilled our resolution, "TISTR...a partner to your success."

Luxsamee Plangsangmas

Governor of Thailand Institute of Scientific and Technological Research

Board of TISTR

TISTR Executives





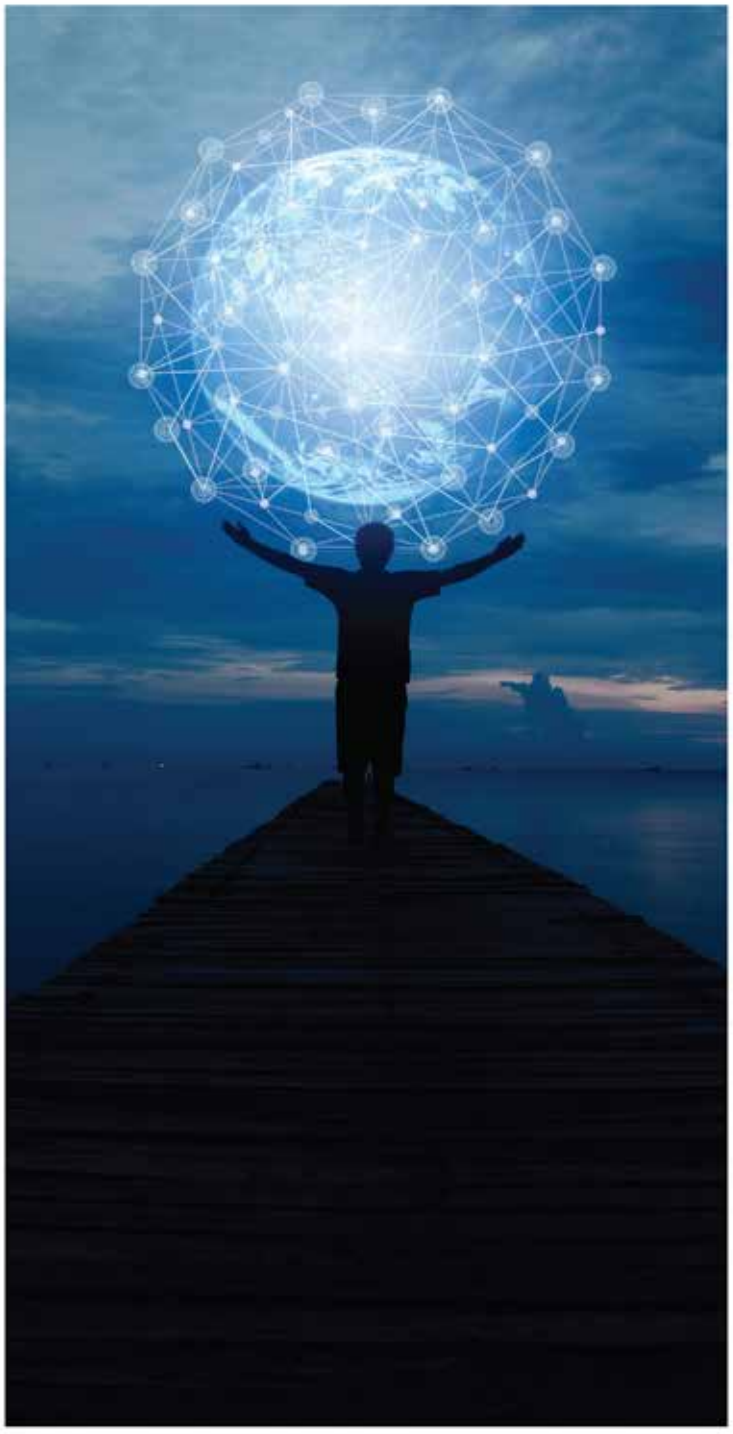

Industry and Future Trends

The ranking of International Competitive ness Institute (IMD) and the report of World Competitiveness Center 2018 showed the overview of Thailand's STI Industriesat the 30th place of the world competitiveness. It fell from the 27th ranked in 2017. It wasconsidered by various S&T factors e.g. 1) science infrastructure that stepped up from the 48th in 2017 to 42nd in 2018, and 2) technology infrastructure that remained at 36th. Besides, by the ranking of the World Economic Forum 2017-2018 and the Global Competitiveness Report (GCR) 2017 – 2018, it found that Thailand was ranked at 32nd out of 137 countries/special economic zones (4.7 score points out of 7). It was 2nd steps higher comparing to the year 2016 – 2017. With that, the GCR usedit as the criteria to rank the STI competitiveness performance e.g. 1) efficiency enhancers which the sub-factor was the technology readiness where was at the 61st from the previous 63rd, and 2) innovation and sophistication factors which the sub-factor was the innovation that ranked at 50th from 54th.

Meanwhile,the technology trends in 2018 were surveyed and analyzed by the world's leading organizations to address the social, business or digital economy.For examples, TBM: Tech Breakthroughs Megatrend from PwC orPricewaterhouse-Coopersinformed that daily life, business practices, and industrieshave been influenced by the digital innovation.It may result in employment reduction.

Presently, there are 8 important types of technology (Essential Eight) that the businesses around the world are keepingtheir eyes on e.g. artificial intelligence, semi-virtual world, blockchain, drone, robotics, internet of things – IoT, 3D printing systems and virtual worlds. This information wasconsistent to the study of WEF that indicated ASEAN Member Countries including Thailand would be affectedby the 5 changes namely- IoT : internet of things, AI : artificial intelligence, advanced robotics, wearables, addictive manufacturing like 3D printing. Meanwhile, the direction of the country's industry during 2017-2018 is, not only the S-Curve and New S-Curve, but the governmental policy driven on Bio-base economy, and Bio-base industry for the value added to the existent resources and higher-valued products by technology and innovation. This would promote the competitiveness of industrial sector as well.

Factors affecting the organization



The factors affecting TISTR can be described in this following way. Firstly, there has been the Government's 2016 policy to drive the reform of the scientific system, technology and research for innovation in 2 main areas: reforming the research system to become the country's intellectual infrastructure, and reforming the Science, Technology and Innovation (STI) to be the country's innovation infrastructure. Secondly, during the year 2018, the Ministry of Science and Technology has modified and reformed the bureaucratic system of the Ministry focusing on operations with the public sector, regulation reform especially about innovation and reform of the budget system which focuses on research. The Minister of Science and Technology has proposed the draft Act to establish a ministry to the Cabinet and the Cabinet has a resolution to accept the principle and approve the draft Act concerning the restructure of the Ministry, Bureaucratic systems, De partment (No...) B.E.... to establish the Ministry of Higher Education, Research and Innovation. The goal is to meet

the needs of Thailand 4.0. This requires the driving mechanisms for the country through the innovation-based economy and preparing Thai people for the 21st century by developing research systems in parallel with innovations. The connections and mechanisms for utilizing research results to benefit the targeted industries as stated in the national strategy and strengthen the country's economic competitiveness. It is expected that the National Legislative Assembly (NLA) will pass the bill in early 2019.

From the context of such changes that has some impact to TISTR's operations, TISTR's executives and team have reviewed and set the guidelines to accommodate the changing roles and future directions of TISTR. Also, the discussions have been organized to make a conclusion among TISTR's executives and the Minister of Science and Technology on June 26, 2018. The Minister agreed on the roles and missions of TISTR, focusing on the main operational directions in 4 areas as follows:

• Bio based research is a research and development conduct based on biological resources. It covers missions related to the country's target clusters, such as agriculture and biotechnology clusters, food processing, biofuels and biochemicals comprehensive medicine, etc.

• Appropriate technology is the development of technology for utilizing in any problematic areas or satisfying the needs of users. These appropriate technologies should be designed to be effectively used within the context of both cost and complexity, usable and suitable for the environment economically, socially and environmentally,

• Total solution provider is R&D services provided to entrepreneurs, both SMEs, OTOP manufacturers, community enterprises, and farmers who need product innovation, add value or finding solutions for product problems, for example, R&D, development of prototypes and solutions, services in analysis, testing, and calibration, scale-up from the laboratory to commercial production, a product & management system, and commercialization both in terms of marketing and financial support.

• Community (area based) comprises projects and activities that can fulfill the needs of communities and people in various areas together with agencies and educational institutions in those areas with an objective to strengthen.

Highlighted Achievements

Products Enhancement for Tamarind Cluster Development in Petchabun

TISTR conducted research and development to increase value added on sweet tamarind in Phetchabununder the concept 'From Waste to Wealth'. The prototype of herbal and beauty products from tamarind seedwas developed such as 'Tamarina Sport Drink' for those sport person, skin serum extracted from tamarind seed, product from the extracted tamarind seed powder to protect mouth wound, facial mask sheet, and toothpaste.

Many units of Phetchabun and the Tamarind Cluster Network interested in this value added products which such innovation could drive the identity to the province's products. By that reason, there were provincial SMEs, entrepreneurs, and investors interested to participate in TISTR's implementations to drive their busi ness forvalue creation from waste, and products enhancement by STI.

Nano Facial Serum from Asiatic Extract for Anti-aging

TISTR succeed on its research and development of innovative "nano" facial serum 20-nm sized of Asiatic extract. The transmission of ingredient to the skin is enhanced dramatically. The type-I collagenis activated foranti aging wrinkles, and not toxic to human skin cells. The cell testing found that the product stimulated morethan 70 percent of cell growth. Thestimulation was close to the stimulation by vitamin C. Based on the efficacy and safety tests in 20 volunteers, the product was very effective in reducing the appearance of aging wrinkles, and did not cause skin irritation. TISTR transferred thistechnology to Herbornic Company Limited to support Thai entrepreneur to the local and international markets.

New Chrysanthemum Varietyhaving Potential of Plants Disease Resistant.

TISTR launched the new variety of chrysanthemum having potential of disease resistance. It promotedan economic crop with the aim to reduce the piracy problem and increase the export competitiveness of Thai flowerstothe world market. It was a comprehensive work bymany agencies namely KhunLuang Royal Development Project, Kasetsart University, Rajamangala University of Technology Thanyaburi Under the Royal Patronage, National Institute of Nuclear Technology, Flower Council of Thailand Under funded research funded by Office of Agricultural Research Development.

The Improvement of Sangkhalok Ceramic Ware, Sukhothai

TISTR and the Special Development Area for Sustainable Tourism (DOTA), facilitated STI to Sukhothaiin qualitative improvement of Sangkhalok ceramic ware. The improvement was to increase production efficiency, and outstanding packaging. The aim was about market opportunity and area-based tourism, including to exploreboth new country and oversea markets.

Pilot Plantfor Rubber Sheets Production

TISTR and the community enterprises in Rayong has cooperated in development of rubber processing products.Besides thepilot plant of rubber sheets production for the community enterprises was constructed.The value-added rubber product like floor-rubber sheetswere that meet the industry standards were promoted to enhance the knowledge transfer to enterprises and network establishment. As a result, this provided the career to local people and enhance the life quality sustainably. The project was financial support byThailand Research Fund (TRF) and the National Research Council of Thailand (NRCT).

Rai ChernThawan Learning Centre, Chiang Rai

Rai ChernThawan Learning Centre is one of TISTR's achievements in network strengthen among the community enterprises particularly those related organic rice. It was supported by the Office of Small and Medium Enterprises Promotion (OSMEP) that selected the School of Buddhist Economic Farmer, Rai ChernThawanas an area base for project's implementations. The local farmers in the area learnedto conduct pure agriculture by utilizing TISTR's technologies e.g. 2-in-1 rice milling machine, dehumidifier machine for grains, vacuum sealer and gas filling machine, soil analysis for cultivation, and downstream potential development. TISTR has also cooperated with the partners in public and private sectors to promote the products distribution for the sustainable outcomes.

Material Biodegradable Testing Laboratory, TISTR

Asia is the largest region in bioplastic producer in the world.Most of plastics used as packaging. Therefore, bioplastics industry is becoming the new wave of business in Thailand and focusing on the environmental friendly properties by biodegradable. The concerns are reduction of plastic waste, and global warming problems which also related to the trade barriers and environmental concern requirements by many other countries. With that,the development the biodegradable products and international label obtained for environmental concern is required by the entrepreneurs.

The MaterialBiodegradable Testing Laboratory of TISTR is a unit to provide services on research, analysis, testing the properties of biodegradable products. The laboratory has been certified ISO / IEC 17025 (chemical decomposition plastic) by the Thai Industrial Standards Institute (TISI) and ISO 17088 by the DIN CERTCO, the Federal Republic of Germany in 2017 and 2014, respectively. In addition, it has just been registered as a testing laboratory in the scope of Compostable Plastic Test (ISO 17088) in 2018 under TGL – 44–12 requirements with the Green Label Project of Thailand Environment Institute. This laboratory therefore is especially useful for those manufacturers or suppliers who are requiring the international environmental label to their products and export to the world markets.

Testing Services According to ISO / IEC 17043

The Industrial Metrology and Testing Centre (MTC) of TISTR has been certified its ability as a service provider for the proficiency testing program in temperature, including (1) Digital Thermometer with PRT Probe 0°C to 200°C,(2) Liquid bath 0°C to 44.55°C and (3) Autoclave 121° Caccording to the international standard ISO / IEC 17043: 2010 (Conformity assessment - General requirements for proficiency testing) from the Bureau of Laboratory Accreditation, Department of Science Service on 15 August 2018. The Proficiency Testing, PT) is for the quality control for laboratoriesand their performance to obtain confidence and acceptance by the users. Besides, it is to be in accordance with the requirements of ISO / IEC 17025 “General Requirements for Testing Competence and Calibration Laboratories”, as well as the requirement of the Laboratory Accreditation Body.

Railway Transportation System Testing Centre (RTTC)

RTTC is operating and providing testing and analysis services, including engineering consultant to those projects of railway related parts development to meet the international standards. The services are safety testing, approval on the meeting of TOR requirements including the maintenance projects of rail track e.g. double-track rail and metro rail. The projects must pass the test in accordance with safety reason and according to the standards of railway in the country, such as industrial standards (TIS), SRT requirements or national or international standards such as EN, AS, AREMA, UIC, AAR etc.

RTTC can support the rail system testing service for the rail route construction over 15 projects of the Ministry of Transport. It resulted the econo-mic impact more than 300,000 million baht. The materials and parts for testing services are such as concrete, steel bars, rubber, composite materials. Theproducts for testing aresuch as concrete pillows, wrenches pillows, rail traction, welds and joint. RTTC is extending its services tothose foreign operators.Currently, over 8 operators from the 6 countries namelySingapore, Malaysia, Myanmar, Australia, Germany and Austria used to get its services, andresulted the revenueor economic impactmore than 100,000 million baht. Besides, there was a signing of cooperation on academic teaching programmeamong TISTR and those 5 universities in Thailand including 1 uni versity in China, and CRRC Qingdao Sifang Co., Ltd. With that, TISTR aimed to be Thai representative agency (Focal Point) to push forward the learning courses of high-speed train engineering in the country.

Achievement Awards 2018

R&D Category

'Silver Award' for academic presentation on value-added rubber products at 'Thailand Research Expo 2018'

Expert Centre of Innovative Materials (InnoMat) of TISTR received 'Silver Award' at 'Thailand Research Expo 2018' for academic presentation on value-added rubber products by using science, technology and innovation (STI) for commercialization in domestic and international markets. On 13 August 2018, Dr. Siriporn-Larpkiattaworn, Director of InnoMat, received the Award from Prof. SirirurgSongsivilai, M.D., Ph. D., Secretary-General, National Research Council of Thailand (NRCT), at Centara Grand and Bangkok Convention Center at Central World Bangkok Hotel.

'Cosmetic Product from Jellyfish Collagen Extract Win 'Award in Innovative Cosmetic Category'

Expert Centre of Innovative Herbal Products (InnoHerb) of TISTR in cooperation with Adiya Marketing Co. Ltd. successfully developed cosmetic product from jellyfish collagen extract and received the first place of 'Award in Innovative Cosmetic Category 2018' or 'Thailand Cosmetic Contest 2018', organized by Thai Cosmetic Cluster, and supported by Department of Industrial Promotion, Ministry of Industry. On 12 July 2018, Dr. UbonRerk-Am, Senior Researcher of InnoHerb received the Award at Bangkok International Trade and Exhibition Centre (BITEC) Bangna.

Individual Category

'Best Paper Award'

Dr. RewadeeAnuwattana, Senior Researcher of Expert Centre of Innovative Clean Energy and Environment (InnoEn) of TISTR, received 'Best Paper Award' for research paper on 'Conversion of 3A Zeolite from Bagasse Ash and Aluminum Hydroxide Sludge' at the 7th International Conference on Advances in Civil, Structure and Environment Engineering, held during 18 – 19 August 2018, in Kuala Lumpur, Malaysia.

'Award for Presentation on e-Registration System and e-KPI System'

'e-Registration System for Meeting and Seminar Registration' presented by Dr.Patharawut-Saengsiri, Director of Digital System Development Division of TISTR, and 'e-KPI System for Annual Individual Performance Evaluation' presented by Mr. AnusornKarpukdee, Assistant Information Technology Officer of Digital System Development Division of TISTR, were selected assuccessful projects for working procedure improvement and good practice models for other organizations, by 'the Foundation for TQM Promotion in Thailand', at Thailand Quality Conference and the 19th Symposium on TQM-Best Practices in Thailand2018, atThailandSciencePark,Pathumthani Province.

Important Activities in 2018

The Opening Ceremony of the Buildings Commemorating HRH Princess MahaChakriSirindhorn (Greenhouse No. 1 and Greenhouse No. 2)

On 31 July 2018, HRH Princess MahaChakri-Sirindhorn attended to the Opening Ceremony of the Buildings Commemorating HRH Princess MahaChakriSirindhorn (Greenhouse No. 1 and Greenhouse No. 2), at Lam Takhong Research Station, Nakhon Ratchasima Province. Assoc. Prof. SoranitSiltharm, Permanent Secretary to Ministry of Science and Technology, Dr. LuxsameePlang-sangmas, Governor to TISTR, TISTR's Executives and staff, and more than 200 representatives from public and private sectors came together at the ceremony.

HRH Princess MahaChakriSirindhorn attended the 1st miracle plant exhibition at Greenhouse No. 1, planted 'Magnolia sirindhorniae Noot & Chalermglin' at the Buildings Commemorating HRH Princess MahaChakriSirindhorn, and visited museum conservation of tropical insects and plant evolution at Greenhouse No. 2. The event continued by the special lecture 'A Seed Bank in Thailand' by Dr. Kate A. Hardwick,Conservation Partnership Coordinator (Asia), Department of Conservation Science, Kew Royal Botanic Garden, United Kingdom, and botanic garden school exhibition by Khongpaiwittaya School, Nongnam-saipittayakom School, Pakchong School, including-exhibition by TISTR.

'SilapacheepPrathip Thai OTOP KaokaiDuaiPhraBarami 2018'

On 13 August 2018, TISTR joined the event 'SilapacheepPrathip Thai OTOP KaokaiDuaiPhra Barami 2018' at IMPACT Challenger hall 2 to present research achievement to develop OTOP products by science, technology and innovation and present ready-to-use technologies to develop quality of life.

On this occasion, General Prayut Chan-o-cha, Prime Minister of the Kingdom of Thailandkindly presided over the opening ceremony. After that, the Prime Minister was escorted to visit TISTR's exhibition booth byMr.PermsukSutchaphiwat, Chief Inspector General, Ministry of Science and Technology and Dr. ChutimaEamchotchawalit, Deputy Governor Strategies and Innovation Management Group, TISTR.

TISTR Research on Development of organic fertilizer production from sugar industry wastes instead of chemical fertilizer.

On 11 June 2018, Dr. SuvitMaesincee, Minister of Science and Technology and delegation went to Nong Pho, Takhli District, Nakhon Sawan province to follow up overall outcome of the research and development project for organic fertilizer productionfrom sugar industry wastes and downstream industries. Research and development of organic fertilizer productionproject aimed to produce organic fertilizer for soil improvement and chemical fertilizer replacement. The result of project implementation shown that the cost of sugarcane cultivation decreased by 30 percent and also improved and created sustainable soil fertility in the area ofsugar cane promotional zone around 500,000 acres which owned by Kaset Thai International Sugar Corporation Public Company Limited.

MOST, Thailand and Network Organizations Launching "Mahakam Wit SarngArchip Yok RadapPhumiphak" (Science Fair for Career, Raising Regional Quality Level)

On 20 – 21 April 2018, Assoc.Prof.Soranit Siltharm, Permanent Secretary of Minister of Science and Technology presided over the opening ceremony ""Mahakam Wit SarngArchipYok Radap-Phumiphak" (Science Fair for Career, Raising Regional Quality Level) at Center for Learning and Academic Services, the Network of Chulalongkorn University, Pha Singh Research and Technology Transfer Station, Pha Singh, Mueang Nan, Nan.

The project was caused by collaboration among network agencies including Thailand Institute of Scientific and Technological Research (TISTR), Department of Science Service, Geo-Informatics and Space Technology Development Agency (Public Organization), Hydro and Agro Informatics Institute, National Science and Technology Development Agency (NSTDA), National Innovation Agency (Public Organization) (NIA), The Community Development Department and PrachaRatana Power Project who would like to work together to drive science for economic and social foundations.

The Opening Ceremony of "Food Innovation service plant (FISP)"

Dr. ApichaiSomboonpakorn, Advisor to the Minister of Science and Technologyattended the opening ceremony of Food Innovation service plant (FISP), TISTR on 22 June 2018 at TISTR technopolis. TISTR has established the FISP to support new vegetable and fruit processing enterprises and strengthen the existing entrepreneurs. FISP has production capacity as 1,000 liters per day which can reduce risks and provide business opportunities.

Rai ChernTawan Organic Farm Learning Center

PhraMahaWutthichaiWachirametee, founder of Cherntawan International Meditation Center (Chiang Rai) presided over the opening ceremony of Rai ChernTawan Organic Farm Learning Center on 20 April 2018 at Rai ChernTawan, Chaing Rai. TISTR has applied science, technology and i nnovation knowledge to develop this area concretely in aspect of economy, society and environment.

In this occasion, Mr. WirachChantra, Deputy Governor Industrial Services, TISTR, TISTR executive and TISTR staff also attended the event.

Transforming SMEs through Innovation

DR. SuvitMaesincee, Minister of Science and Technology presided over the opening ceremony of "Transforming SMEs through Innovation: From Local to Global Player in Bio-Economy" during 4 – 5 June 2018 at Grand Ballroom, Queen Sirikit National Convention Center. In the event, there were lectures from both Thai and foreigner qualified speakers and research and development exhibition. Besides, TISTR and affiliate network both in Thailand and abroad showed Industrial Services technology, provided technology consulting and support as well as business matching for entrepreneurs.

National Science and Technology Fair

TISTR participated in the exhibition of National Science and Technology Fair under the concept of “NawattakamKhayaPlianLok” (Waste Innovation....Changing the World). TISTR communicated the idea through the “Recycle Railway” which was driven to 4 stations, namely station 1: Know the garbage separation, station 2: Travel of the garbage, station 3: Marine Safeguardand station 4: Recycling station. The exhibition was held during 16 – 26 August 2561 at Hall 4, Impact Arena Muang Thong Thani.

Science Avenue 2561, National Children's Day

DR. SuvitMaesincee, Minister of Science and Technology presided over the opening ceremony of “Science Avenue” for National Children’s Day 2018. In this occasion, TISTR participated in Green Station activities “PlianKhaya Pen Khum Sap, Yim Rap LokSuai”(Tuning Garbage to Treasure, Smiling to the Beautiful World) during 11-13 January 2018 at Ministry of Science and Technology.

MOU between TISTR, Ministry of Defence,and Ministry of Industry promoting Defense Pharmaceutical

Dr. Luxsamee Plangsangmas, Governor of TISTR, Gen.NaphonSang Somwong Director – General of Defence Industry and Energy Centre, Ministry of Defence, and Mr.Kobchai Sungsitthisawad, Director -General of Department of Industrial Promotion, Ministry of Industry signed The Memorandum of Understanding in applying science, industrial technology and innovation research and development results with defense pharmaceutical and other related collaboration topics. In this occasion, Dr. AparatMahakhant, Deputy Governor Research & Development Groupfor Sustainable Development together with TISTR delegation joined this ceremony on 22 May 2561 at ITC Industry Transformation Center, Kluaynamthai.

Commercial research of anti-aging cosmetics "ACHA Snail Filtrate Serum Concentrate with Herbal Extracts"

On 17 April 2018, Dr. Luxsamee Plangsangmas, Governor of TISTR and Miss Worranan Phattaratuwanan, Executive Director of Aden Farm and Aden International Co.,LTD. signed Memorandum of Understanding in research project on anti-aging cosmetics “ACHA Snail Filtrate Serum Concentrate with Herbal Extracts” for commercial use at Aden Farm, NakornNayok province. With this signing ceremony, there were Ms. PraneeNakanat, Nakorn Nayokvice Provincial Governor and Mr. SayanTanpanich, Deputy Governor Research & Development Groupfor Bio-industries, TISTR as witnesses.

MOU Signing on Sustainable Technology Development to Solve Municipal Solid WasteProblem

Mr. Bundit Dheviewarak, Saraburi Provincial Governor, Dr. AparatMahakhant, Deputy Governor Research & Development Groupfor Sustainable Development, TISTR and Mr. MongkolSuksala, Mayor of TandeawSubdistrict Administrative Organization signed the Memorandum of Understanding in the project ofenvironmental problem-solution and plastic waste in the community for sustainable integration on 26 June 2561 at the 60th year auditorium, Kaeng Khoi School, Saraburi province. The project aimed to drive Clean Province project for solving municipal solid waste problem by using research results in science, technology and innovation (STI) and sustainably integrate of all sectors in Thailand.

TISTR and Rubber Authority of Thailand Collaboration in Resource Sharing in the Areas of Training, Research and Development, and Innovation for Sustainable Development

r. Luxsamee Plangsangmas, Governor of TISTR signed the Memorandum of Understanding with MrYiamThawarorit, Acting Governor of the Rubber Authority of Thailand on resource sharing in the areas of training, research and development, and innovation for sustainable development on 14 June 2561 at TISTR technopolis.

Press Conference "Health and Beauty Products Prototype, PathumThani Province

On 28 August 2018,TISTR held press conferencefor health and beauty product prototype in PathumThani province, at TISTR Technopolis. The products haveused agricultural crops that are the identity of the province, active ingredient from lotus leaf, banana leaf, and golden guava developed to be cosmetic products. Those products consisted of 5 products from lotus leaf, 8 products from Gros Michel banana, and 7 products from guava.

TISTR's Outstanding Projects in 2018

Bio – Resource Bank and Material Research Biotechnology Project

According to urgent policy of Ministry of Science and Technology (MOST), TISTR has implemented activities in order to be a leading center of bio-resources that has fully integrated services with international standards. Furthermore, the activities of this project included preserving and providing biological resources, selecting and classifying of biological resources, research and development in the conservation and utilization of biological resources, research in DNA Fingerprint and Gene Sequence Analysis for new and rare species of biological resources, and research and development of technology to preserve / propagate / increase productivity in bio-resources for conservation and utilization.

Project Implementations from the beginning to the fiscal year 2018 as follows:

- Completed 6,015 Bio-resource database.
- 266 species of bio-resources that were utilized in research included plants, animals and microorganism.
- 4 prototypes and processes/methods in utilization of bio-resource such as prototype of recipes for microbial culture in astaxanthin production and prototype for astaxanthin extraction.
- 2 networks of collaborative projects for information sharing (KCTC, WDCM).
- Development of research collaboration with private sector that has common interests namely Bio-wealth limited company.

Algal Excellent Center (ALEC)

Algal Excellent Center (ALEC), TISTR specializes in basic resource for algae. The center hasstored of more than 1,000 small fresh water algae species. ALEC is considered as the third largest algal centre in Asia, follows Japan and China. Moreover, ALEC is only one algal centre in Thailand that operates in accordance with international standard (ISO, ESPREL) such as;

• Services in algae species for exploitation and development on production of food, agricul-

ture, pharmaceutical, high valued bio-product, and environment.

• Services in analysis, test, and investigation on algae and toxic from algae.

• Emulsion-resistant exterior paint testing

The above mentioned international standards were developed by TISTR and those are also as a part of Thai Industrial Standard 2321 - 2549. Besides, the centre has operated research, technology transfer development, product manufacture, technology and innovation process, and provided services about algae to serve both public and private sectors such as PTT Public Company Limited, SCG Chemicals Co., Ltd., Bangchak Corporation Public Company Limited, Male Group Public Company, IHI, and DENSO.

Standard Pilot Plant for producing products derived from research output. (Beverage Processing Line and Dried Fruit Processing Line): FISP

TISTR has developed a food and beverage manufacturing plant that certified by GMP standard under the name FISP (Food Innovation and Service Plant) which included standard research and development laboratory and quality in spection laboratory in beverage processing line and dried food processing line. Machines in the processing lines were designed and installed to be served as business incubator for new entrepreneurs and learning center for community enterprise as well as SMEs and big entrepreneurs.

FISP has researched and developed on many new products such as energy drinks and low energy dried fruits (mango, guava, and Roselle) for transferring knowledge to entrepreneurs. Furthermore, there was technology transfer in processed food to community enterprise 827 persons in total.

Improvement on Food Processing Technology Accessibility for SMEs in the Remote Area

TISTR has supported development of Thai processed food products to be unique in the area by utilized area infrastructure together with science and technology in order to create value added products and increase ease of food technology development accessibility for entrepreneurs. The project intended to promote SMEs entrepreneurs in food processing field who had readiness and need to improve and develop their ability to compete with the international level. Furthermore, TISTR established food processing infrastructure center (Technology Transfer and Innovation Food Processing Center, Mae Chua sub-district,

Den Chai district, Phrae Province) and created network of cooperation with service providers in businesses related to the food industry. Development and promotion of infrastructure utilization in the area were also implemented under this project.

Outputs from the beginning of the project until fiscal year 2018 are as follows:

- 847 SMEs entrepreneurs in food field received technology transfer.
- Creating innovations in processed foods those are valued through science and technology as 68 cases.
- Creating networks of cooperation with service providers in businesses related to the food industry as 13 networks.
- Providing infrastructure services to entrepreneurs in the trial batch production such as Central Food Intertrade Company Limited, TPT Intertrade Company Limited, Baicha – Aromdee Company Limited, and ThanyaIntertrade Partnership Limited.
- Supporting technology development and increase product value such as energy drink, ready-to-drink mango juice, ready-to-drink coconut, ready to drink milk tea, coffee mixed with ready-to-drink tea, sugar free lemon grass juice for health and sugar free butterfly pea juice for health.

From implementation outputs, led to increasing of productivity in production, building up readiness and potential in competition with science and technology for community enterprises and SMEs in processed food field in Phrae Province and nearby areas, and generating more income for entrepreneurs.

Establishment of Packaging Design Innovation Center for Small and Medium Enterprises (SMEs)

TISTR has integrated scientific and technological knowledge and packaging innovation for collaboration among public sector, private sector, packaging designer, and academic institution that have packaging technology courses in order to create a network of new packaging designers to have the potential ability in packaging design services and jointly support packaging design for SMEs and community enterprises. Packaging Design Innovation Center for Small and Medium Enterprises (SMEs) was aimed to be incubator of packing technology learning, design, and packaging label

printing which lead to develop, upgrade the standards and enhance the design and packaging capabilities for entrepreneurs to be able to rely on themselves and compete in foreign markets through various activities. TISTR hosted the activity in technology transfer and in-depth consultation for 482 entrepreneurs. The purposes of this activity were transferring knowledge and understanding in marketing before starting business, finding and understanding target customers and marketing channels, packaging design principles to reflect the differences and brand model, and the concept of improving packaging to be ready for applying the associated standards in order to be accepted and able to compete in the world market.

According to the project, the entrepreneurs have increased revenue by 10 percent and the value of product exports increased by the use of developed packaging as 10 million baht per year.

One Tambon One Product Innovation Development Project (OTOP)

TISTR applied "STI Coupon for OTOP Upgrade" strategy to supported community enterprise and OTOP entrepreneurs by holding Roadshow activity in 14 target areas included Uttaradit, Mae Hong Son, Tak, Nakhon Si Thammarat, MahaSarakham, Sakon Nakhon, Narathiwat, Chanthaburi, Phatthalung, Ayutthaya, Nakhon Pathom, Nakhon Sawan, Nakhon Ratchasima and Phetchabun. The project began with recruiting entrepreneurs to join the project, then matching tasks for TISTR researchers and researchers under the research cooperation network. Besides, the potential OTOP entrepreneurs who had their own innovative concepts were supported in development of competitive capabilities.

This project also encouraged OTOP entrepreneurs in applying science, technology and innovation to increase value, solve business problems and expand opportunities from producing innovative products that are ready to be commercialized by supporting development in 6 aspects included (1) product innovation development, (2) packaging design and development, (3) production process design and development, (4) standard system development, (5) machinery design and development, and (6) upstream quality raw material development.

In fiscal year 2018, there were 2,842 people interested in OTOP Roadshow activity and 420 entrepreneurs were selected to join the project.

Patents and Petty Patents

• Patents submitted for filing 37 items

No	Title
1	Downdraft ceramic kiln using firewood
2	The reactor for production of synthetic diesel fuel by increasing the internal temperature with copper
3	Hair tonic products using clear nano-emulsion containing extracts of safflower and Yanang leaves for hair nourishment
4	The nanoparticles contained Yanang leaf extract and safflower.
5	Hair serum with clear nano-emulsion containing extracts of safflower and Yanang leaves for hair and scalp nourishment
6	Oil-absorbing material from rubber foam containing iron oxide nanoparticles
7	Production of methanol and other alcohols from crude glycerol from biodiesel production
8	Methanol production from carbon dioxide and hydrogen gas through a Reverse Water - Gas Shift (RWGS) process on a copper zinc oxide alumina catalyst (Cu/ZnO/Al2O3)
9	A compound rubber formula that uses waste material as the original substance
10	Process and extraction of coenzyme Q10 from Gluconobacter japonicas by liquid carbon dioxide extraction method
11	The spray dryer powered by heat from the cooking gas
12	Formula and production method for anti-microbial nanofiber patch containing cinnamon oil used for skin disease
13	The hot air generator powered by cooking gas
14	A mixture of nanoemulsions containing cinnamon oil for fungal infection at skinfolds and production method of antifungal nanoemulsion products containing cinnamon oil for skinfolds
15	Process of preparing fibers from natural rubber without the use of organic solvents
16	Kaplan aerator with ribbed ridge on the impeller surface
17	Transverse air gasifier reactor combined with a copper foam heat exchanger
18	Bioreactor for volatile product recovery

No	Title
19	Concrete formwork from water hyacinth fibers and production process
20	Melatonin drop test kit
21	A DNA primer used to identify pigs for halal food quality assurance
22	Plastic Tubular Photobioreactor (PTPBR) for low-cost commercial algae production
23	500 L Tubular Photobioreactor (TPBR) for algae production using CO_2 in a closed system
24	Automatic Palm Fruit Separator
25	Magnetic particle immobilized cellulase enzyme for enzyme recovery
26	Drying-by-shaking vacuum fryer with semi-automatic oil condensing device
27	Process of coating fertilizer pellets with chemically modified natural rubber with chitosan together with irradiation
28	Process of producing Pozzolan plaster and prefabricated building materials from ashes
29	Pretreatment equipment using steam blasting for lignocellulose raw material
30	Method for producing zeolite 3A from bagasse ash
31	Method for producing composite catalyst with polyaluminum silicate chloride zeolite
32	Semi-automatic production machine for crisp rice sheet (Khao Tang)
33	Agricultural raw material sampling device on pickup trucks with adjustable quantity of raw materials
34	Electrolyte production set
35	Automatic papaya slicer
36	Tray
37	Shock-proof container for fresh produce

• Petty patents submitted for filing 18 items

No	Title
1	Sound-absorbing material made of para-combined natural fibers
2	Formulation and production process of natural rubber compounds containing aromatic compounds
3	Production process of probiotic microorganisms genus Lactobacillus In dry powder cell protectants by vacuum freeze-drying method
4	Anti-ageing facial serum product with micro emulsion from lotus leaf extracts
5	Seaweed culture using cage system for commercial algae production
6	Formulation for the preparation of phase change materials by adding crystallization agent to the microcapsule to reduce supercooling
7	Formulation and production process for cream products having liposome particles containing extracts and polysaccharides from the Khon Noi mushroom (Coprinus fimetarrius) for skin moisturizing and anti-ageing
8	Formulation and production process for serum products having liposome particles containing extracts and polysaccharides from the Khon Noi mushroom (Coprinus fimetarrius) for skin whitening and dark spots reduction
9	Iron chromium aluminate Infrared reflecting pigment
10	Formula of culture medium and pectinase production process from Lentinuss quarrosulas Mont.
11	Formula and production process of oral ulcer patch from polysaccharides extracted from tamarind seeds
12	Process for producing crude extracts from Ma Lod fruit (Elaeagnus latifolia L.) using two or more enzymes with different properties.
13	Process for producing tamarind extract in powder form by spray drying process
14	Process and formula for the production of asphalt mixed with plastic waste (PMA)
15	Process for producing ammonia pellets from biomass ash for wastewater treatment
16	Powdered synbiotic product from the probiotic Lactobacillus rhamnosus TISTR 2443 combined with a prebiotic from Lactobacillus fermentum TISTR 1971
17	Formula and production process of clear phlai (Zingiber cassumunar) balm gel to control the release and enhance delivery of important substances for anti-inflammatory and pneumonia effects.
18	Formula and production process of nanoemulsion containing tamarind seed extract as a cosmetic component

National/International Publications

• National publications – 16 articles

No	Article Title	Journal Title
1	Effect of Tamarindus indica seed coat extracts on stress-induced melanogenesis.	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp. 93-97
2	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp. 93-97	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp. 120-123
3	In vitro Propagation of Vanilla planifolia Andrew	Agricultural Science Journal 49: 1 (Suppl.) 2018, pp.280-283
4	Effects of packaging materials on postharvest quality of Elaeagnus latifolia	Agricultural Science Journal 49: 1 (Suppl.) 2018, pp. 590-593
5	Development and validation of HPLC method for Luteolin-7-glucoside in Chrysanthemum flower capsules.	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp. 32-36
6	Morphological Changing of Lindernia sp. in Ploidy levels Variation	Thai Journal of Science and Technology, (7)1 (January-April 2018), pp.21-31
7	Mutation Breeding of Gomphrena Hybrid by Gamma Irradiation	Thai Journal of Science and Technology, (7)1 (January-April 2018), pp.48-57
8	Microstructural and compositional analyses of segmented YBa2Cu3O7-xNayCoO2 oxide thermo-electric ceramic prepared by hot-pressing method.	SNRU Journal of Science and Technology (2018), 10(2), pp.130-137.
9	Anti-oxidant activity of accelerated solvent extraction from different fractions of Thai Gac Fruit (Momordica cochinchinensis Spreng).	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp.37-40
10	Biological activities and phytochemical constituent assessments of Thai Russula mushroom extracts.	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp. 46-50
11	Mulberry improved operant behavior impairment in atropine rats possibly involved beta-amyloid accumulation.	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp. 51-54.
12	Preliminary anti-onychomycosis efficacy study of the selected oil loaded polyurethane nanofiber.	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp. 64-67.

No	Article Title	Journal Title
13	Cardiovascular effects of the ethanolic extract of Ipomoea aquatic Forsk. In rat.	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp. 72-75.
14	Topical application of Ya-Samarn-Phlae ointment promote wound healing in spontaneously diabetic rats (GK/Jcl): A preliminary study.	Thai Journal of Pharmaceutical Sciences (2018), 42, supplement, pp. 76-79.
15	The Ratio of Germinated Brown Jasmine Rice, Brown Jasmine Rice and Riceberry Affecting the Active Compounds of Snack Bar with Tom-Yum Flavour	Agricultural Science Journal, 49: 2 (Suppl.) 2018, pp. 249-252
16	Preparation of bacterial cellulose powder for medical materials: Part I	SWU Sci. J.,34(1), pp.278-286

• International Publications – 53 articles

No	Article Title	Journal Title
1	Preparation of bilayer YBa2Cu3O7-x-NayCoO2 Thermoelectric ceramic by solid-state sintering method.	Chiang Mai Journal of Science (2018), 45(3), pp.1543-48.
2	Organic acid production from potato starch waste fermentation by Rumen microbial communities from Dutch and Thai dairy cows.	Biotechnology for Biofuels (2018) [online], Available at:http://doi.org/10.1186/s13068-018-1012-4
3	Characterization and in vitro release studies of oral microbeads containing thiolated pectin-doxorubicin conjugates for colorectal cancer treatment.	Asian Journal of Pharmaceutical Sciences (2017), 12, pp.509-520.
4	Effect of carboxymethyl cellulose as edible coating on postharvest quality of rambutan fruit under ambient temperature.	International Journal of Agricultural Technology (2017), 33(7.1), pp.1449-1457.
5	Enhancement of moisture protective properties and stability of pectin through formation of a composite film: effects of shellac and plasticizer.	Journal of Food Science (2017), 82(12), pp.2915-2925
6	Development and characterization of microemulsions containing Tiliacora triandra Diels as an active ingredient for antioxidant and melanogenesis stimulating activities.	Journal of Applied Pharmaceutical Science (2018), 8(3), pp.46-54.

No	Article Title	Journal Title
7	Sulfitobacter aestuarii sp. nov., a marine bacterium isolated from a tidal flat of the Yellow Sea.	International Journal of Systematic and Evolutionary Microbiology. (2018), 68(5), pp.1771-1775.
8	The inhibition of Caco-2 proliferation by astaxanthin from Xanthophyllomyces dendrorhous	Journal of Medical Microbiology. (2018), 67(4), pp.507-513.
9	Effect of wildfire on the occurrence of three squirrel species in a dry dipterocarp forest in northeastern Thailand.	Mammal Study. (2017), 42(4), pp. 259-263.
10	Upgrading of waste gypsum for building materials.	Key Engineering Materials. (2018), 766, pp.211-216
11	Preparation of near-infrared (NIR) reflective pigment by solid state reaction between Fe2O3 and Al2O3	Key Engineering Materials. (2018), 766, pp.127-132
12	Pyrolysis of palm oil in a continuous flow microchannel reactor	Key Engineering Materials. (2017), 757, pp.166-170
13	Plasticization of biodegradable poly(lactic acid) by different triglyceride molecular sizes: A comparative study with glycerol.	Journal of Polymers and the Environment. (2018), 26(3), pp.1160-68
14	Centipede, Scolopendra dawydoffi (Chilopoda: Scolopendridae), predation on an egg-laying snake, Sibynophis triangularis (Squamata: Colubridae), in Thailand	Journal of Insect Behavior. (2017), 30, pp.563-566
15	Development of microemulsion comprising ethanolic leaf extract of Yanang as an active ingredient for antioxidant and melanogenesis stimulating activities	Proceedings of International conference on Pharmaceutical Sciences and Technology. (2018), 24-25 January 2018, Bangkok, pp.113-120
16	The onion extract fortified into herbal tea drink and its properties	Proceedings of the 15th ASEAN Conference on Food Science and Technology, 14-15 November 2017, Ho Chi Minh City, pp. 237-243
17	Increased carotenoids accumulation in green microalga Chlorococcum sp. 8367RE under stress conditions.	Proceedings of the 29th Annual Meeting of the Thai Society of Biotechnology and International Conference, 23-25 November 2017, Bangkok.
18	Salt stress induced lipid accumulation in green microalga Chlamydomonas reinhardtii (137c).	Proceedings of the 29th Annual Meeting of the Thai Society of Biotechnology and International Conference, 23-25 November 2017, Bangkok.

No	Article Title	Journal Title
19	The production of isomalto-oligosaccharide from rice starch using two-step enzyme hydrolysis.	Proceedings of the 29th Annual Meeting of the Thai Society of Biotechnology and International Conference, 23-25 November 2017, Bangkok.
20	Bioactivities in the tamarind seed extracts: a preliminary study.	Proceedings of the Irago conference. 2017, published by the American Institute of Physics, pp.1-11.
21	Comparison of Yanang (Tiliacora triandra) leaf extracts obtained from maceration extraction and batch stirring extraction methods.	Proceedings of International conference on Pharmaceutical Sciences and Technology. (2018), 24-25 January 2018, pp.81-83.
22	Evaluation of cytotoxic, cyto-protective and phagocytic activities and phytochemical component of Thai Russula mushrooms.	Proceedings of the 5th Current Drug Development International Conferences & the 3rd International Conference on Herbal and Traditional Medicine. 2018 (CDD&HTM2018), Prince of Songkla University, Songkla, 23-25 May 2018. pp. 178-180
23	Tamarind seed coat extract reduces oxidative stress on hydrogen peroxide-induced HaCaT keratinocytes.	Proceedings of the 5th Current Drug Development International Conferences & the 3rd international conference on Herbal and Traditional Medicine. 2018 (CDD&HTM2018), Prince of Songkla University, Songkla, 23-25 May 2018. pp. 198-200.
24	Anti-inflammatory activity of Thai indigenous Russula alboareolata mushroom extracts on lipopolysaccharide-induced RAW 264. 7 cells.	Proceedings of the 5th Current Drug Development International Conferences & the 3rd international conference on Herbal and Traditional Medicine. 2018 (CDD&HTM2018), Prince of Songkla University, Songkla, 23-25 May 2018. pp. 206-208
25	Alpha-tocopherol screening from different parts of Thai gac fruit by thin layer chromatography.	Proceedings of the 5th Current Drug Development International Conferences & the 3rd international conference on Herbal and Traditional Medicine. 2018 (CDD&HTM2018), Prince of Songkla University, Songkla, 23-25 May 2018. pp. 239-240
26	Potential of emulsion from Adlay milk and tea seed oil on osteogenic effects	Proceedings of the 5th Current Drug Development International Conferences & the 3rd international conference on Herbal and Traditional Medicine. 2018 (CDD&HTM2018), Prince of Songkla University, Songkla, 23-25 May 2018. pp. 249-251

No	Article Title	Journal Title
27	The antioxidant and neurochemical activity of Apium graveolens L.and its ameliorative effect on MPTP-induced Parkinson-like symptoms in mice	BMC complementary and alternative medicine, 18, pp. 103-114
28	Ginger extract and [6]-Gingerol inhibit contraction of rat entire small intestine.	Journal of Evidence-based integrative medicine, 23, pp. 1-9
29	Effect of decaffeination methods on coffee bean properties, antioxidant activity, and aroma profile.	Proceeding of the 20th Food Innovation Asia Conference. 2018 (FIAC2018), 14-16 June 2018, Bangkok, Thailand. pp. 158-165
30	By-products of the rice processing obtained by controlled debranning as substrates for the production of probiotic bacteria.	Innovative Food Science and Emerging Technologies, [online], Available at: https://doi.org/10.1016/j.ifset. 2018.05.009
31	Preparation and physical properties of segmented thermoelectric YBa2Cu3O7-x-Ca3Co4O9 ceramics.	The 2nd International Conference on Functional Materials and Metallurgy 2017, 28-30 November 2017, Malaysia. Published online 30 January 2018, Volume 303.[online], Available at: https://doi.org/10.1088/icfmm/2017303012010
32	Effect of drinking water treatment sludge on the properties of rubber compounds.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. PO52-PO56
33	The Effect of nucleating agent (paraffin) on the supercooling in encapsulated microcapsule for building application.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. MN33-MN38
34	Development of natural rubber based composite foam containing magnetite nanoparticles for oil spill removal.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. MN39-MN43
35	Effect of natural fibers on morphology and acoustic properties of natural rubber foam composites.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. MN54-MN59
36	The methanol synthesis from glycerol in a one-step over basic oxide catalysts.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE45-EE49

No	Article Title	Journal Title
37	The improvement in the properties of fatty acid methyl ester using partial hydrogenation reaction in a continuous fixed-bed reactor.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE95-EE98
38	The effect of contaminated gases in syngas on bio-methanol production.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE104-EE109
39	The utilization of biomass waste from the palm oil industry using hydrothermal carbonization process.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE115-EE120
40	Production of biofuels in Fischer-Tropsch synthesis using mono- and bi-metallic Fe-based catalysts.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE149-EE154
41	Influence of minerals in crude glycerol from bio-diesel production on products distribution of bio-oil via co-pyrolysis with palm oil residues.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE165-EE169
42	Methanol to gasoline conversion over ZSM-5 zeolites: influence of catalyst property and operating conditions.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE207-EE212
43	Effect of operating conditions on synthesis of methanol and dimethyl ether from syngas over solid catalysts.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE213-EE217
44	Investigation of the operation parameters affected on biofuel production via Fischer-Tropsch synthesis in milli-tubular reactor.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE223-EE228
45	Bio-oils from palm oil residue via hydrothermal liquefaction process in the environmental impact aspect.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE229-EE233
46	Enhancement of biodiesel properties via hydrogenation process: a pilot plant study.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE254-EE259

No	Article Title	Journal Title
47	Reforming of residue gas from CBG process to synthetic gas for bio-methanol production.	Proceeding of the Pure and Applied Chemistry International Conference 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. EE296-EE300
48	Electrospun Tamarind seed polysaccharide combined with polyethylene glycol-based nanofibers development.	Proceeding of the Pure and Applied Chemistry International Conference. 2018 (PACCON2018), 7-9 February 2018, Songkhla, Thailand. pp. PO117-PO122
49	Behaviors of hydrogen sulfide removal using granular activated carbon and modified granular activated carbon.	The 4th International Conference on Engineering, Applied Sciences and Technology. 2018 (ICEAST2018), Phuket, Thailand. Published online volume 192. [online], Available at: https://doi.org/10.1051/ matecconf/201819203037
50	Product classification for cold storage warehouse: a case study.	Proceeding of the 21st AFBE International Conference. 2018, Phuket, Thailand. 15-16 January 2018. pp. 436-445
51	Effect of temperature and packaging films on quality of Pun Sib SaiPla Dessert during storage.	Proceeding of the 20th Food Innovation Asia Conference. 2018 (FIAC2018), 14-16 June 2018, Bangkok, Thailand. pp. 440-444
52	Failure analysis of crew boat shaft strut.	Proceeding of the 11th International Conference on Fracture and Strength of Solids, 26-29 August 2018, Yogyakarta, Indonesia. pp. ABS 61-67
53	Cellular enzymatic anti-oxidants of fractionated mucus proteins from Eudrilus eugeniae (African Night Crawler) and Perionyx excavatus (Blue worm) in MC3T3	European Review for Medical and Pharmacological Sciences, 22, pp. 4375-4391

Science & Technology Services

Industrial Services Group underthe Thailand Institute of Scientific and Technological Research (TISTR) is an agency that provides science, technology, and innovation services to enhance the quality of the country's industrial sector to international standards and compete in the global market. Overall results in the fiscal year 2018 areas follows:

Overall,2,594users of industrial services, of whom 356 users of quality assessment and accreditation services and providedanalysis, testing, and calibration in total169,420 items.Moreover, staff of private sectorshave been enhanced theircompetitivenessvia 47 training coursesin total 2,244 persons.

TISTR is an agency that provides comprehensive science and technology services and has been accreditedin accordance with ISO/IEC 17020, ISO/IEC 17021-1, ISO/IEC17025,ISO/TS22003,covering all 6 areas of industry needs as follows:

1. Analytical/Testing Services

• Testing of materials, products, and equipment focuses on metals in physical, chemical, mechanical, stress, vibration, corrosion, wear, microstructure and macrostructureanalysis Durability test of engineering parts and railway system

• Failure analysis ofmaterials, equipment, structure and machinery including suggestions for improvements

• Product testing for accreditation of Thai Industrial Standard (TIS)

• Industrial colourtesting

• Food, beverage, cosmetics, and agricultural products tests in the field of chemistry, biochemistry, andmicrobiology

• Medical instrument testing/verification

• Testing of packaging materialssuch as

packaging for retail purposes,packaging for transportation,and packaging for the export of hazardous goods

• Biodegradabletest,services for the Green World

• Bioremediation services for water sources contaminated with pesticides

2. Tool/Equipment Calibration Services

• Calibration of meters, testers, standardized and electrically quantified equipment, frequency, sound, light, temperature, humidity,force and torque, mass, length, pressure, volume, density, wind speed, and flow rate

3. Quality System Assessment and Ac-creditation

• Assessment services and internation-al standards accreditation such as ISO 9001, ISO 14001, TIS/OHSAS 18001, ISO 22000

• Food establishment assessment service for issuance of certificate and inspection to renew food production licence registered with the FDA

• Productioncriteria and good methodology assessment services in medical devices registered with the FDA

• Assessment services and accreditation for GMP and HACCPsystems for using Q-Mark

• Plant factory assessment service,which was registered with the Department of Agriculture

• Verification and inspection services on greenhouse gas reduction, which wasregistered with theThailand Greenhouse Gas Management Organization (TGO)

• Assessment services and accreditation for products made of biodegradable materials and tourism activities services

• Assessment services and accreditation for tourist attractions and activities

4. Inspection and Assessment

• Products testing according toThai Industrial Standards (TIS) lighting branches, electric power, electrical appliances and electronic appliances, rubberandrubber products

• Inspection of boilersand pressure vessels

• The remaining lifetimeassessment of the boiler,pressure vessels, engineering structures, and machinery

5. Academic Training/Seminar and Quality System

6. Academic Consultant and Laboratory Quality System in accordance with ISO/IEC 17025

Commercial Technology Transfer

TISTR is an innovation organization that answers country's solutions, under the Thailand 4.0 policy, committing to research and development in science, technology and a broad range of innovations. In 2018, TISTR has carried out commercial technology transfer of 94 contract research in the following examples:

Research and development on riceberry snack bars to members of the Koh Kok community enterprise, which is a model of healthy community in the Thailand Healthy Lifestyle project by producing healthy rice in the last rice-field area of community in Map Ta Phut district, Rayong province. The community group has also processed the rice into snack bars mixed with cereals, which are distributed in nearby areas. In this project, the group needs the development of product recipes that can be stored at room temperature and use of raw materials with reasonable cost for launching new products into the market, carried out by Expert Center of Innovative Health Food (InnoFood).

Safety evaluation of leaf extracts of Hoya kerrii to Srisaket Rajabhat University. With its beautiful flower and heart-shaped leave, this hoya plant has been shown in several research as herbal remedy and medical uses such as anti-diabetic, antioxidant and anti-inflammatory. In lack of safety evaluation study, there is no toxicology information for reference and to make use of this plant extract. Accordingly, this project was developed and carried out by Expert Center of Innovative Herbal Products (InnoHerb).

Study on Probiotic bacteria for animal foods to Nutrichems Co., Ltd. Currently, use of probiotic microorganisms in animal feeding is an alternative that has widely received attention and plays important role to livestock industry. This has been a guideline to conducting research on strain selection of probiotic bacteria for use in promoting the growth and preventing pathogenic bacteria in gastrointestinal tract of animals, carried out by Biodiversity Research Center.

Design and construction of a semi-automated, ganty robot type, cassava sampling machine, to Sui Heng Lee Warehouse Co., Ltd. Since TISTR has designed and developed various agricultural machines, TISTR was entrusted by the company to construct a semi-automated cassava sampling machine, which can collect sampling thoroughly all positions of dump truck. This machine will not only benefit the reduction in foreign currency loss, but also promote the development of equipment and machine in the country, as well as reduce reliance on foreign technology, which strengthen Thai industry sustainably, carried out by Expert Center of Innovative Industrial Robotics and Automation (InnoRobot).

Feasibility study on value addition of gases emitted from a coal-fired power plant, together with the by-product hydrogen to produce methanol to BLCP Power Limited. The company is an electricity generating producer by coal, resulting in emitted gases affecting to the environment. By converting carbon dioxide to a value-added such as methanol for use with emitted gases will not only reduce carbon dioxide emission to the environment, but also add value those gases into methanol. The study helps increase opportunity and competitiveness in electricity generating business, awareness of environment care and leads to energy security from coal, carried out by Expert Center of Innovative Clean Energy and Environment (InnoEn).

Production of foot imprinting bag from natural rubber to Miss Jean Herman. According to the research contract signed with TISTR to develop a custom insole molding machine to substitute the more expensive imported machine and develop a business in shoe insoles for a customer group who is health-conscious, the project was successfully completed. The entrepreneur wanted to continually expand the market, while the insole molding machine is necessary to have foot imprinting bag. Continuation of the project with TISTR in foot imprinting bag production was carried out by Expert Center of Innovative Materials (InnoMat).

Development of trademark and graphic structure of packaging according to Management Executive Development Program and Eastern Fruit Marketing for the fiscal year of 2018 to Office of Commercial Affairs Rayong. The eastern province group has the potential and suitable geography for growing a variety of fruits, which can be sold both in the domestic and international. Also in order to link through the value chain with development of human, goods and services according to Thailand 4.0 model, it is needed for one-stop service packaging design for upgrading processed fruit products from the Eastern region being modern and commercially able to communicate with customers, carried out by Thai Packaging Center (TPC).

In addition, TISTR has a network and integrated collaboration with government and state agencies as well as private sector in order to bring scientific research and development, transfer technology quantitatively with international standards, leading to capacity building of Thai SMEs entrepreneurs, of which can actually implement as well as expediting the process of action plans and driving forward mechanisms, tools and infrastructure systematically. As for technology transfer and adoption of science, technology and innovation outputs for commercialization, there are a total of 5 projects as follows

- Technology transfer for production of freeze-dried strawberry and pineapple incorporated with probiotics (Profruit) to Greater Pharma Co., Ltd.

- Technology transfer for commercial production of Tamarina NaNo Serum from tamarind seed coat extracts to Research X Co., Ltd.

- Licensing for production of Musacid tablets in treatment of gastric ulcer to Greater Pharma Co., Ltd.

- Licensing for production of Plygersic gel in treatment of degenerative joints and muscles to Greater Pharma Co., Ltd.

- Technology transfer for production of from cosmeceutical peptides from pigeon pea (Cajanus cajan L.) to Super Seyo Co., Ltd.

Social Technology Transfer

TISTR carried out social technology transfer to community enterprise farmers as well as people in bringing science, technology and innovation (STI) to utilize in supporting careers of community enterprise farmers, creating value added products, developing production process to meet the requirements of applicable standard by expertise of TISTR, transferring technology in various areas as developing raw materials, products, production process, standards, packaging and machines into quality, standard goods and be able to sell in both domestic and international markets to meet the demands of people and business sectors, creating good quality of life to people, creating value added to Thai economy. In 2016 there were a total of more than 15,000 beneficiaries from high-impact big projects, as follows

Project for upgrading OTOP in the country's 10 poorest provinces

TISTR prepared the project of science-driven program for local economy and society (upgrading OTOP in the areas of 10 poorest provinces) to bring about knowledge in science, technology and innovation that was developed through R&D and knowledge organisation to transfer to entrepreneurs in the country's 10 poorest provinces, namely, Mae Hong Son, Narathiwat, Kalasin, Nakhon Phanom, Chai Nat, Tak, Buri Ram, Amnat Charoen and Nan. By implementing in collaboration with Department of Service Science (DSS), Ministry of Science and Technology, through work mechanisms of civil state and regional educational institutions such as Rajamangala Univerisity of Technology, Rajabhat University, vocational institution, experts, local advisors to develop OTOP entrepreneurs together, which was opportunity expansion and wealth equity for people in the country. As for the implementation outcomes, there were 200 OTOP entrepreneurs that received leadership capacity development, resulting an average income increased by 10%. Developed OTOP products were such as food, drinks, non-food herbs, clothing and apparel, accessories and souvenirs by bringing about ready-to-use technology of organization including network agency, local educational institution, to drive together for upgrading OTOP by science, technology and innovation.

One Tambon One Agricultural Innovation Project

TISTR in collaboration with National Farmers Council recognize the importance of developing skills and technology application for farmers to append to their product systems, which is competency enhancement in adaptation to economy and society changes at present. The project of One Tambon One Agricultural Innovation was prepared in order to improve problem-solving skills for farmers by principle of science and selection and application of technology, which can lead to extension for creating innovation in community systemically to areas at Tambon level by focusing on participatory research mechanism between farmers and researchers from R&D agencies to create local innovations that can be used practically and promptly, achieving concrete results that meet local needs and contexts, creating jobs, income, and quality of life for the local people and creating Thai society to a continuous knowledge base, resulting in a higher country's competitiveness and reducing inequality in society.

The implementation outcomes resulted in technology/innovation used in problem solving and participatory development for 200 innovations including machinery, production process and agricultural product processing. There were surveys, collection and analysis on 912 kinds of local wisdom and farmers that received capacity development and knowledge transfer for more than 12,000 participants in total covering 878 tambons across the country, creating perception in science and technology to farmers by a 70 percent increase.

Project for development of the processing industry and one stop food industry

TISTR brought technology and innovation in adding value and processing to agricultural products into food products through upgrading products by packaging design and prototype packaging for processed agricultural products to community enterprise group, farmers and entrepreneurs in order to support market trial and commercial sale in both domestic and international markets. There were a total of 514 interested participants in the project from 5 provinces, namely, Nakhon Phanom, Udonthani, Buriram, Kalasin and Ubon Ratchathani. A total of 45 developed products were such as turkey sausage, ready-to-make Pak Wan Pa (Meliantha suavis Pierre) tea, Pak Wan Pa crispy sheet snack, sun-dried tilapia fish.

Project for increasing the competence on production of certified jasmine rice/organic rice

TISTR brought technology and innovation in adding value and processing to agricultural products by focusing on processed products from jasmine rice and organic rice into foods, health and beauty products to community enterprise group, farmers and entrepreneurs in order to support market trial and commercial sale through product upgrading by packaging design. There were a total of 772 interested participants in the project from areas of Nakhon Phanom, Udonthani, Buriram, Kalasin and Ubon Ratchathani, leading to one stop development of processed rice products totaling 60 products, such as germinated Khao Hang rice,

Khao Luem Pua (black glutinous rice) ice cream, sunscreen cream, rice extract balm ointment, cosmeticsfrom rice powder, facial soap and pineapple jam.

Project for Development of Health Tourism

TISTR brought technology and innovation in health and beauty products to transfer technology for developing innovative new products. By extraction process of bioactive compounds from agricultural produce, herbs, and then study on activities, safety and development of product formulation to health and beauty products so that tourists gained confidence and good and quality services in tourism. The project implementation covered the area of 10 southern provinces (cluster of gulf of Thailand and Andaman cluster), namely, Surat Thani, Nakhon Si Thammarat, Phatthalung, Songkhla, Chumphon, Krabi, Trang, Ranong, Phuket and Phang Nga. There were 190 entrepreneurs joined the project and developed products were such as skin scrubs from mangosteen, Hom Thong banana peels, body scrub from coconut husk, skin care products from turmeric and rak sam sip, mole removal product.

Project for improvement of the quality of fruit produce and unique plants

Project for improvement of the quality of fruit produce and unique plants was aimed at training to strengthen knowledge of entrepreneurs in Yala, Pattani and Narathiwat provinces, and to develop entrepreneurs as community enterprises and SMEs role model such as Deep South Co., Ltd. In carrying out the project, TISTR aimed at collaborating with local network, namely, Community Development Office, Provincial Industry Office, Provincial Agricultural Extension Offices of 3 southern border provinces, Prince of Songkla University, Princess of Naradhiwas University, including Southern Border Provinces Administration Center (SBPAC). As for performance of fiscal year 2018, TISTR brought STI into the entrepreneurs development by transferring knowledge on shelf life extension of agricultural produce, such as longkong (Lansium domesticum) and value added processing to longkong juice, jam and jelly, as well as packaging development.

International Collaborations

In fiscal year 2018, TISTR conducted various kinds of international collaborative projects as follow:

International collaboration under the Memorandum of Understanding

In 2018, there were totally 29 projects included bilateral collaborations which has been collaborated with ASEAN Member States, Dialogue Partners in ASEAN +6 countries, European countries such as France and United Kingdom including Multilateral collaboration under the framework of collaboration among the members of The Asia - Pacific Metrology Programme (APMP)

Institute of Microbiology, Chinese Academy of Science, (IMCAS) China.

TISTR, NSTDA, and IMCAS, China had collaborated on Biotechnology and Microbiology. On 19 October 2018, TISTR incorporation with NSTDA and IMCAS China hosted the opening ceremony " Thailand - China Joint Laboratory on Microbial and Biotechnology at Swiss Hotel Bangkok.

CRRC Qingdao Sifang Co., Ltd., Beijing Jiaotong University, China and the 5 universities of Thailand

TISTR and CRRC Qingdao Sifang Co., Ltd., Beijing Jiaotong University together with the 5 universities of Thailand signed the Letter of Intent to initiate the academic teaching program on high speed train in Thailand in order to prepare personnel skill and knowledge for high speed rail technology that will be used in Thailand in the near future.

Japan Analytical Instruments Manufacturers' Association (JAIMA), Japan

TISTR signed the Memorandum of Understanding with Japan Analytical Instruments Manufacturers' Association (JAIMA). The two institutes agreed to be partner in facilitating and promoting public relations channels on TISTR portfolio and analytical instrument technology of Japanese entrepreneurs who are JAIMA members. The significant activities under the collaboration included academic conference, exhibition on common interested technology among both institutes such as food technology, analysis of food safety testing, cosmetics and cosmeceutical respectively.

Collaboration with other key partner The World Association of Industrial and Technological Research Organizations (WAITRO)

TISTR has been a member of The World Association of Industrial and Technological Research Organizations (WAITRO) since 1985. Dr.Luxsamee Plangsangmas, Governor of TISTR on behalf of the Acting Regional Representative for Asia and the Pacific of the World Association of Industrial and Technological Research Organizations (WAITRO) during 2015-2016, has participated in WAITRO board meetings throughout the year 2017-2018, as well as a brainstorming session between the Executive Committee and the Secretary General of WAITRO in shaping the image and direction of operations in 2019 - 2022 to modernize and sustainability.

Partner for your success

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