



PANGGILAN KERTAS KONSEP
PELAWAAN PERMOHONAN SKIM GERAN UNIVERSITI PENYELIDIKAN
TRANSDISIPLINARI (RUTrans) FASA 1/2020
UNIVERSITI SAINS MALAYSIA

1. PENGENALAN

Bahagian Penyelidikan dan Inovasi memperkenalkan inisiatif baharu, iaitu Geran Universiti Penyelidikan Transdisiplinari (RUTrans), sebagai satu program penyelidikan transdisiplinari atau rentas bidang yang dapat membina kerjasama keserakanan di antara penyelidik-penyelidik USM yang berlainan domain bersama rakan-rakan di Industri/Agensi Kerajaan/NGO/Universiti Antarabangsa yang tersohor.

Objektif utama geran adalah untuk mewujudkan satu program penyelidikan sinergistik yang berteraskan Matlamat Pembangunan Lestari (SDG) dan akan memberi tumpuan kepada kluster Socioeconomic Drivers yang dikenal pasti. Penyelidikan tersebut membolehkan perkongsian dan kerjasama merentas bidang dengan menggunakan Technology Drivers (Enablers) yang telah digariskan Akademi Sains Malaysia (ASM). Objektif ini sejajar dengan visi dan misi universiti yang menekankan kepentingan penyelidikan rentas bidang yang memperkasakan bakat masa depan dan mengupayakan golongan terkebahwa demi mentransformasi kesejahteraan sosioekonomi mereka. Geran ini juga menyokong empat (4) rukun utama dalam agenda Universiti Penyelidikan (RU) iaitu *Talent Development, Research Prominence, Wealth Creation and Bridging the Grand Challenge* yang akan membawa USM sebagai salah satu RU ke satu tahap yang lebih tinggi.

Jangkaan hasil daripada program penyelidikan ini akan dapat mewujudkan penyelesaian kepada pernyataan masalah yang memberi impak kepada masyarakat terutama golongan terkebahwa atau industri/agensi selain hasil kesarjanaan seperti jaringan, penerbitan, IP dan bakat. Permohonan geran RUTrans perlu mengikut panggilan kertas kerja (*call for proposals*) yang telah ditetapkan oleh USM apabila permohonan geran ini dibuka dan akan melalui beberapa fasa untuk memastikan hanya projek terpilih sahaja yang layak.

Di bawah inisiatif ini, Universiti meletakkan kepercayaan kepada staf akademik daripada Gred DS/DU/DUG 45/51/52/53/54/56 sebagai Ketua Program untuk meneraju program RUTrans. Usaha ini dilaksanakan untuk memperkasa dan membudayakan aktiviti penyelidikan dalam kalangan kumpulan

pertengahan di Universiti. Program ini juga dapat mempersiapkan mereka untuk menerajui geran transdisiplinari luar lain yang lebih mencabar.

Permohonan ini dibuka berdasarkan kepada **empat (4) “Call for Concept Papers”** di bawah **dua (2) Kluster Penyelidikan** seperti berikut:

BIL	Kluster	Niche Areas Call for Concept Papers	Pernyataan Masalah Berdasarkan SDG *	Gabungan Sekurang-kurangnya 2 enablers	Merangkumi sekurang-kurangnya 3 domain
1.	Water & Food	Local Superfood	SDG 2: <i>End hunger, achieve food security and improved nutrition and promote sustainable agriculture.</i>	1. 5G/6G 2. Sensor Technology 3. 4D/5D Printing 4. Advanced Materials	1.Sains Tulen dan Gunaan (Pure and Applied Sciences) 2.Teknologi dan Kejuruteraan (Technology and Engineering) 3.Sains Kesihatan dan Klinikal (Clinical and Health Sciences) 4.Sains Sosial (Social Sciences)
2.		Integrated Water Resources Management	SDG 6: <i>Ensure availability and sustainable management of water and sanitation for all.</i>	5. Advanced Intelligence Systems 6. Cyber-Security & Encryption	5.Sastera dan Sastera Iktisas (Arts and Applied Arts) 6.Warisan Alam dan Budaya (Natural and Cultural Heritage)
3.	Agriculture	High-value Seafood	SDG 14: <i>Conserve and sustainably use the oceans, seas and marine resources for sustainable development.</i>	7. Augmented Analytics & Data Discovery 8. Blockchain	7.Teknologi Maklumat dan Komunikasi (Information and Communication Technology)
4.		Local Agricultural Input	SDG 15: <i>Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.</i>	9. Neuro Technology 10. Bioscience Technology	

Nota:

* **Senarai Matlamat Pembangunan Lestari (SDG)** di dalam jadual di atas adalah sebagai panduan. Pihak Universiti menyarankan setiap penyelidikan yang dijalankan adalah berpandukan sasaran SDG yang boleh dirujuk dipautan <https://sdgs.un.org/goals>. Senarai dalam **JADUAL SDG KEYWORDS** merupakan cadangan dan penyelidik boleh memilih mana-mana sasaran SDG yang difikirkan bersesuaian dengan permohonan.

CALL 1

RESEARCH CLUSTER	:	WATER & FOOD
NICHE AREA	:	LOCAL SUPERFOOD
SPECIFIC CHALLENGE	:	<i>The specific challenge is to develop innovative local superfood products with bioactive compounds that have health enhancing properties destined for the vulnerable group of the society. This would include on the formation of such superfood and methods to deliver it to the vulnerable group [examples; pregnant women, elderly people, malnourished people, and people who are ill or immunocompromised]. This is as to address SDG #2: zero hunger.</i>
SCOPE	:	<i>Research and innovation will focus in addressing the nutritional needs of the vulnerable group, to produce the innovative superfood and to propose methods to enable the vulnerable group to get access to the superfood. Enablers identified are bioscience technology, advanced materials, block chain, and sensor technology.</i>
TANGIBLE OUTPUT (EXPECTED IMPACT)	:	<i>New superfood technologies with improved nutritional and easy access to the vulnerable group.</i>

CALL 2

RESEARCH CLUSTER	:	WATER & FOOD
NICHE AREA	:	INTEGRATED WATER RESOURCES MANAGEMENT
SPECIFIC CHALLENGE	:	<p>The specific challenge is to incorporate sustainable integrated management of water resources as to address on the issue of water stress, water scarcity and water quality degradation which effect the yield of paddy from paddy fields especially under extreme monsoon season. This can be achieved through the derivation of water stress index, assessment of water footprint and life cycle assessment (as to fulfil the target set by SDG #6 Target 6.4) at various paddy field locations.</p> <p>The technological challenge is to develop and demonstrate appropriate technology for enhancing water resource use and efficiency for paddy cultivation as to develop climate-smart agricultural framework for paddy cultivation practices.</p>
SCOPE	:	Scope will focus on the design, development and testing of the appropriate technology for enhancing water resource use and efficiency for high yield paddy cultivation via the use of various enablers including advanced intelligent systems, detection and sensor technology and biotechnology.
TANGIBLE OUTPUT (EXPECTED IMPACT)	:	<ul style="list-style-type: none"> i. Significant increase in paddy cultivation productivity even under extreme monsoon seasons. ii. Increase in the safety, reliability and manageability of integrated water recourses management technology as a concern for water stress, water scarcity and water quality degradation. iii. Development of climate-smart agricultural framework for paddy cultivation practices.

CALL 3

RESEARCH CLUSTER	:	WATER & FOOD
NICHE AREA	:	INTEGRATED WATER RESOURCES MANAGEMENT
SPECIFIC CHALLENGE	:	<p>The specific challenge is to reduce significantly various streams of pollution into water bodies as to improve water quality in order to preserve the environment and sustainability of the ecosystems. This can be achieved through intelligent integrated wastewater management as to fulfil the target set by SDG #6 Target 6.3 (by 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally).</p> <p>The technological challenge is to develop and demonstrate the appropriate technologies for characterising wastewater via nanotechnology, advanced materials, advanced intelligent systems, sensor technology and biotechnology.</p>
SCOPE	:	<p>Research and innovation actions will focus on the pollution source identification, design, development and testing of essential solutions to prevent water pollution from domestic and economic activities via the use of advanced materials, advanced intelligent systems, sensor technology and biotechnology.</p>
TANGIBLE OUTPUT (EXPECTED IMPACT)	:	<ol style="list-style-type: none"> i. Significant reduction of water pollution ii. A sustainable ecosystem protection program iii. Development of polluters inventories iv. Development of intelligent water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. v. A framework for developing community water strategies.

CALL 4

RESEARCH CLUSTER	:	WATER & FOOD
NICHE AREA	:	INTEGRATED WATER RESOURCES MANAGEMENT
SPECIFIC CHALLENGE	:	<p>The specific challenge is to accommodate the impact of changes in the world's hydrological pattern on water resource availability to attain water demand for domestic, agricultural, and industrial use especially during or after flood and drought. This can be achieved through intelligent integrated water resource management as to fulfil the target set by SDG #6.</p> <p>The technical challenge is to establish and demonstrate the technology appropriate to water shortage prevention and flood mitigation. Involving advanced intelligent systems, nanotechnology via advanced materials development, sensor technology and biotechnology.</p>
SCOPE	:	Research and innovation actions will focus on the design, development and testing of necessary solutions to prevent water shortage via the use of advanced materials, advanced intelligent systems, sensor technology and biotechnology.
TANGIBLE OUTPUT (EXPECTED IMPACT)	:	<ul style="list-style-type: none"> i. Sufficient water for domestic, agricultural, and industrial consumption. ii. The forecast of return periods of floods and streamflow simulation for calculating the water shortage risk during flood and drought. iii. Development of climate-smart, environmentally and socially sound infrastructure. iv. A framework for developing community water strategies.

CALL 5

RESEARCH CLUSTER	:	AGRICULTURE & FORESTRY
NICHE AREA	:	HIGH-VALUE SEAFOOD
SPECIFIC CHALLENGE	:	<p>The conventional fish-cage aquaculture will enrich the coastal waters with nutrients especially nitrogen through the faeces and the excessive feed. This results in phytoplankton death. Dead phytoplankton will accumulate and bacterial population that involves in decomposition will increase. Bacterial respiration depletes the oxygen concentration that may lead to hypoxia (low oxygen level) or anoxia (no oxygen) in the water column. This leads to fish death, eventually lead to losses of biodiversity. These low-oxygen conditions have increased recently causing huge losses in the fisheries/aquaculture. The Call is to develop a sustainable fish-cage aquaculture system including impacts of climate variability and sustainable adaptations and restoration of degraded aquaculture environments, as to fulfil the target set by SDG#13 (Climate Action) and #14(Life Below Water).</p>
SCOPE	:	<p>Design and monitoring of fish-cage aquaculture, via the use of smart sensor system, Artificial Intelligence technology, augmented analytics & data discovery and bioscience technology.</p> <p>Possible Approaches:</p> <ul style="list-style-type: none"> - O₂ Monitoring system with AI support - Waste removal system - Pollution monitoring system e.g. heavy metal, waste, VOC, dyes etc
TANGIBLE OUTPUT (EXPECTED IMPACT)	:	<p>i. Increase security, reliability and manageability of fish-cage aquaculture technology, reducing loss during the occurrence of deoxygenation of the culture area;</p> <p>ii. Low incidences of food insecurity and improvement in income.</p>

CALL 6

RESEARCH CLUSTER	:	AGRICULTURE & FORESTRY
NICHE AREA	:	HIGH-VALUE SEAFOOD
SPECIFIC CHALLENGE	:	<p><i>Land-based aquaculture is gaining importance as a cheap source of protein/lipid for inland community. Cultivation of land-based fish like catfish, tilapia, snakehead and freshwater crayfish are hampered by the several issues including lack of economical, sustainable and optimized feed for specific organisms, public perception of freshwater farmed fish having inferior flesh quality and reliable production of seed for stocking.</i></p> <p><i>The specific challenge is to produce high-quality freshwater organisms through utilization of modern farming techniques incorporating frontiers technology, as to fulfil the target set by #14 (Life Below Water).</i></p>
SCOPE	:	<p><i>Focus on improvisation of current land-based freshwater aquaculture system, through the use of various frontiers technology for culture system setup/monitoring and maintenance (sensors), integration of polyculture concept design and feed development. Capacity to market products at premium price through economics analysis and understanding of public perception are also necessary.</i></p>
TANGIBLE OUTPUT (EXPECTED IMPACT)	:	<p><i>A freshwater aquaculture system that is economically viable, addressing the following issues</i></p> <ol style="list-style-type: none"> <i>i. Cost effective and quality feed</i> <i>ii. Polyculture concept</i> <i>iii. Advanced culture design and system with frontiers sensing technology</i> <i>iv. Economics/market study</i> <i>v. Post-harvesting development</i> <i>vi. Public perception on product</i>

CALL 7

RESEARCH CLUSTER	:	AGRICULTURE & FORESTRY
NICHE AREA	:	HIGH-VALUE SEAFOOD
SPECIFIC CHALLENGE	:	<p>The blood cockle <i>Tegillarca Granosa</i> is one of the major aquaculture species in Malaysia, dominating 93% of the total shellfish species production (Department of Fisheries Malaysia). Within the west coast region of Peninsular Malaysia, blood cockle aquaculture flourishes due to the large number of juvenile cockles naturally developed in the tidal flats of this region, and many of them are collected for aquaculture. These juveniles have been supplied as seeds for aquaculture grounds. However, they have been significantly impacted by multiple stressors driven by the combined effects of a large number of environmental stressors, including pollution of coastal waters; degradation and erosion of mudflats and deterioration of shallow coastal habitats due to extreme weather events; overstocking of T. granosa seed; high ammonia concentrations in the aquaculture systems; and rapid changes in sea surface temperature.</p> <p>This call is to find solution to enhance efficiency and increasing production of cockles through application of frontier technologies (such as bioscience technology, automation, robotics, sensors, IoT, precision aquaculture and smart technologies).</p>
SCOPE	:	<p>To achieve stable production in cockle aquaculture, it is important to measure and control factors that negatively influence their growth and survival.</p> <ul style="list-style-type: none"> - Environmental monitoring system e.g. ammonia sensor, pH, temperature, pollution. - System to protect the site from direct contamination from environment especially from industrial release.
TANGIBLE OUTPUT (EXPECTED IMPACT)	:	<ol style="list-style-type: none"> <i>i.</i> Improving the environment for higher yield of cockle production; <i>ii.</i> Establishment of smart, efficient and practical technology for cockle culture in coastal environment. <i>iii.</i> Identifying typical pollutants and their sources that may effect the growth of blood cockle.

CALL 8

RESEARCH CLUSTER	:	AGRICULTURE & FORESTRY
NICHE AREA	:	LOCAL AGRICULTURAL INPUT
SPECIFIC CHALLENGE	:	<p>Fruit crops cultivation (banana, papaya, durian, mango, pineapple, dragon fruits, papaya, citrus and fig) is facing major challenges due to poor growth conditions, increasing biotic (emerging pests and diseases), and abiotic (temperature, humidity, rainfalls and salinity) stresses due to climate change.</p> <p>This can be achieved through testing and breeding of resilience fruit crops to enhance the production at lower cost and high yields to fulfil the target set by SDG #2 Target [SDG 2 (2.4)]. The technological challenge is to develop and demonstrate feasible technology that can improve growth conditions with better management of diseases or pests, greater resilience to abiotic stresses, more efficient and sustainable use of resources such as nutrients, fertiliser, water, energy in fruit crops production and postharvest management involving Bioscience Technology, Sensor Technology, Advanced Materials and Advanced Intelligence Systems.</p>
SCOPE	:	<p>Multidisciplinary and interdisciplinary approaches with focus to increase fruit crops production, efficient pest and disease management, and sustainable postharvest technology (edible coatings, nanomaterials, light spectra in the field and for the detection of ripeness, and use of generally recognised as safe compounds [GRAS]). The aim to balance agricultural production based on sustainability criteria that are associated with the capacity of higher-yielding fruit crops and sustainable management practices via the use of Bioscience Technology, Sensor Technology, Advanced Materials and Advanced Intelligence Systems. Possible collaboration and networking opportunities with various agricultural government agencies (MARDI, Department of Agriculture, FAMA) and private sectors will be established.</p>
TANGIBLE OUTPUT (EXPECTED IMPACT)	:	<ol style="list-style-type: none"> i. Significant increase in fruit crops production under optimum conditions and increase shelf life. ii. Sustainable measures to manage important emerging diseases and pests (biotic stresses), as well as abiotic stresses (temperature, humidity, rainfalls and salinity). iii. Delivering information and data on fruit crops performance and management available to growers and policy makers.

