



RESEARCH
AND
INNOVATION



Research and Innovation
NEWSLETTER

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CURIOUSMIND

Fostering Impactful Transformative Research

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Welcome to Issue 2 of the **curioUSMind** e-newsletter

For the past few years, I have seen rather impressive achievements of USM researchers. We are on the increasing trend, be it publications (in high impact journals), citation, and grant secured. Nonetheless, research productivity is not measured by only those, despite their importance. Outside scholarly output, USM researchers have been contributing in many unique ways: translational research with impact, community engagement, embarking in industry relevant projects, going global and several of our researchers have been honoured as Top Research Scientists Malaysia. In this issue, we give more insight on what our researchers have achieved, as to portray our research excellence, which has always been revolving around three trusts: curiosity-driven, people-focused and industry-driven.

PROF. DATO' IR DR. ABDUL RAHMAN MOHAMED FASc
Deputy Vice-Chancellor, Research & Innovation
Universiti Sains Malaysia



ENHANCING USM RESEARCH

ECOSYSTEM strong fundamentally, continuous improvement: quantity & quality, substantial contribution, and progressing: science, technology, innovation, economy; commercialization, and/or translational.



ECOSYSTEM SUPPORTING

Close-knit, research, development, innovation, commercialisation, economy, multiplex



**2022
STRATEGIC
OBJECTIVE
2024**

SUPPORTING NATIONAL DEVELOPMENT

Aligning with national agenda, impactful contribution, important and relevant.



ACHIEVING GLOBAL PROMINENCE

Aligning with global challenges (Sustainable Development Goals), leading changes, significant contribution, world-class university and ranking.





TRSM

TOP RESEARCH SCIENTISTS MALAYSIA

Academy of Sciences Malaysia

Our leading research
scientists. Fostering a culture
of excellence in science,
technology, innovation and
economy.



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Research Interests:
RNA Biology

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SCIENTISTS MALAYSIA

Academy of Sciences Malaysia



My View: Qualities of a Good Researcher

In my opinion, the two most important attributes of a research scientist in order to be effective include diligence and perseverance. A research scientist should always be diligent in carrying out research by persistently engaging in the development of his or her research while continuously gaining knowledge via voracious reading. Reading is crucial to keep pace with the latest developments in science. A research scientist should also be perseverant, always strive to overcome obstacles while on the research journey to reach the milestones aspired. Perseverance is a key attribute that can continuously propel a researcher forward without any thoughts of giving up.

My Research: Contribution & Expertise

My research work is mainly focused on the identification of non-protein coding RNAs (npcRNAs), which are the key players of the pathogenesis underlying infectious diseases. A plethora of npcRNAs has been translated into molecular diagnostic applications, particularly PCR assays. We are also interested in aptamers, a class of synthetic npcRNAs that could bind to a variety of targets and have vital diagnostic/therapeutic implications. We have pioneered the first aptamer laboratory in Malaysia, specialized in the development of aptamers for diagnostics and therapeutic applications.

My major research achievement is on the discovery of the short tandem repeats arrays of prokaryotes that are transcribed and processed into smaller CRISPR RNAs, which contributed to the mosaic puzzle piece in solving the questions that lead to the development of the CRISPR/Cas9-based genome editing tool. In addition, we have also discovered the target specific-synthetic molecular recognition elements known as nucleic acid aptamers. Several aptamers for diagnostic and therapeutic purposes are in-line for patent application.



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Research Interests:

Functional Polymeric Membrane,
Composite membrane for fouling mitigation,
Product recovery from waste using
membrane technology, Integrated and energy
efficient membrane technology for Water
reclamation

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My View: Qualities of a Good Researcher

Nowadays, research scientists are exposed to an ever-challenging ecosystem in which they are not only required to carry out fundamental research, but their research must be able to apply in the industry via collaboration with industry and must be able to bring significant impact to the society at large. This requirement pushes the researchers out of their comfort zone with new research philosophy that the scope of work must be transformed from fundamental research to commercialized products or processes. Researchers must be more sensitive to industrial needs and the proposed solution should take into consideration the global challenge such as energy requirements, the circular economy as well as its sustainability. Besides, time management and financial planning skills are also other crucial criteria of researchers to ensure that the research activities could achieve maximum output within the limited timeframe and shrank budget over the years.

My Research: Contribution & Expertise

My research is focused on the material and process design that enable the maximum recovery of valuable resources from waste. The material involved in the functional or responsive material could harvest the targetted molecule at a minimum expense of energy and cost. Currently, the membrane separation process with the aid of functional/responsive polymer was employed to retrieve nutrients, metal ions, and water from wastewater.

Currently, I am leading a group on resource recovery from aquaculture effluent. This research aims to convert the liable wastewater treatment process to a profit-generating wastewater re-cycling process. The research is expected to bring impact to the SDG #4 on clean water and sanitation whereby we intend to improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials to the receiving water body, and substantially increasing recycling and safe reuse of the water for the aquaculture industry.



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Research Interests:
Metallurgy/Metal Matrix Composite

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My View: Qualities of a Good Researcher

Research scientists must have curiosity about their work and able to explain how and why things happen. Curiosity will motivate scientist in finding solution or becoming creative to overcome any limitation in finding answers. Critical thinking and detail-oriented are another qualities that assists scientist to analyse data and information in developing new theories. Scientists must be patient and communicate effectively with research team to share information for correct conclusion, as the early hypothesis could be wrong. The most important, the true scientist must be humble and bias free in decision or making judgement.

My Research: Contribution & Expertise

As professional engineer trained in the field of materials engineering, I implement selection, formulation, microstructure and fabrication of novel alloys and metal composites in creating new potential advanced materials for human being. These include the advancement in orthopaedic implants based on new, safe and biocompatible titanium as well as biodegradable magnesium alloys that potentially can provide high performance medical service to the society. Intensive works in development of sustainable cutting tool material helps in eliminating the use of hazardous cobalt, which is commonly used as binding matrix in metal cutting industry. Patents are secured on severe plastic deformation techniques to produce high conductivity high strength copper nanocomposites as well as ultrafine grain aluminium alloy with high mechanical properties. Apart from that I focus on finding environmental friendly manufacturing methods and sustainable advanced material which not only will bring benefits to humankind but at the same time protecting the environment from irresponsible manufacturing process.

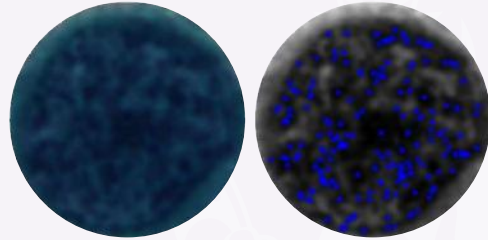


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Research Interests:
Computer Vision
Computational Intelligence



My View: Qualities of a Good Researcher

I believe in five qualities a research scientist needs: first, curiosity, wanting to know more and to learn, two is creativity, able to think outside the box and imagining things that cannot be seen, three is patient, ability to accept or tolerate failures without losing motivation, four is detail-oriented, paying close attention to details and five is critical thinking and quick to solve problem; ability to thoroughly analyze information, make critical decisions to solve research. My motto is always dream big and dare to fail, never afraid to try, dare to take risks and be fearless. It is also good to constantly review our goals, vision, progress and achievements as these would motivate us and boost our self-esteem. Moreover, it is good to find a mentor and associate with a research support group with similar interests. Finally, reward ourselves when a goal is completed and never forget to take care of physical and mental health.

My Research: Contribution & Expertise

My main interest is on the development of intelligent diagnostic systems by integrating between machine vision, image processing and/or artificial intelligence. I have explored on Cervical Precancerous Diagnostic System Based on Pap Smear and ThinPrep Images, Sperm Motility Detection System Based on Semen Sample Video, and Breast Cancer Diagnostic System Based on Mammogram Images. I have also been working on Defect Detection System Based on X-Ray PCB Solder Joint Images, as well as Defect Detection System Based on Microwave Nondestructive Testing. My interest in Artificial Intelligence have led to development of new and modified architecture and learning algorithm of artificial neural networks, deep learning neural network, unsupervised clustering, and meta-heuristic algorithms. All of these are important for the development of industrial 5.0 based automated intelligent systems.



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Electronic Materials, Nanomaterials,
Photoactive Materials

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My View: Qualities of a Good Researcher

A research scientist needs to be efficient. Efficiency measures the ratio of output to input and a scientist needs to first understand what he/she desires (the output). Set a clear direction. Science is a process of building knowledge, and a scientist is contributing perhaps to one block of knowledge that may construct a new idea or invention. The idea or invention may benefit humankind in many ways. Upon knowing the direction or what to contribute to the whole massive intricate network of knowledge, a scientist needs to work on the input. This is a process which must be seen as a journey, which ought to be enjoyed. Succeeding this journey requires certain sets of traits: intellectual qualities are perhaps the most important including ability to acquire, disseminate, and impart knowledge. A scientist may face obstacles during this journey. It is best to quickly review all choices made, construct a plan, and solve. A scientist needs to be agile and adaptive: the world is changing and has become unfair for some people. The way science is being viewed has also changed, and the relevance of a scientist is being scrutinised by many. Changes is not a choice, when something is evolving, evolve with it, if it is not possible, do not hinder others.

My Research: Contribution & Expertise

Being a materials scientist, I obviously keen in synthesising and characterising materials (specifically nanomaterials). Basically, my team and I have perfected the recipe of making various types of nanomaterials in USM. The materials have specific purpose, which is to contribute in solving many of pressing issues faced by humankind including scarcity of water, environment degradation and food security. I make (nano)materials by metal surface oxidation process, and I have been oxidising metal for 25 years perfecting the art of producing oxide nanotubes, nanowires or nanorods. The oxides such as zirconia, tungsten trioxide, zinc oxide or titanium dioxide have unique electronic properties and are rather useful due to their photoactive nature, hence can be used to remove pollutants from the environment. I study light, and what light can do to electrons within these materials. Then I venture into semiconductor junction and hybrid materials. Coupling the oxides with graphene or with metal nanoparticles would create advanced materials of unprecedented applications.



TRANSLATIONAL PROJECT

(Moving research across the
value chain from fundamental
to translational; creating impact
& human centric)

Coastal communities on oyster farming



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Research Interests:
Marine Sciences





Aileen is actively encouraging the rural coastal communities in Malaysia to culture oysters to promote “green aquaculture” as well as to create an impactful sustainable income as well as protecting the environment.



The smiling faces of the community who had been impacted by science through community engagement.

What were your proudest moments during these community projects?

I have been working with the coastal communities since 1995, starting with the womenfolk of Johor Islands on giant clam conservation. Then in 2001, I started working with the coastal communities on oyster farming.

My proudest moment was to see the smiles in the faces of the communities that I worked with, from the low-income communities in the remote coastal areas and islands. In addition to that, being accepted and a part of the community as a “family member” is of ultimate self-achievement. It feels good to have many families welcome us into their homes and care for us. It is not only us providing the impact in their livelihood but the community teaching us about how to be human in the world outside the ivory towers.

In the coastal areas, most of the womenfolk were housewives and depended solely on their husbands as the sole breadwinner and responsible for their children’s education. Creating an opportunity for them to generate income through oyster farming and take the lead in some small businesses supporting their husbands and children does make a difference in their livelihood. The smiles on their faces when the scientists were able to make a difference to their livelihood is the reward. All the tiredness, tribulations and many failures are no longer felt when we know that our science has been successfully translated to these communities and put to good use.

Seeing champions arising from the communities is like seeing our own family members “graduating” and able to have a better future for themselves, their children and their community. These champions will then be our “ambassadors” to continue translating the science to others, converting research solutions to actions.

What is the biggest challenge you faced to ensure the success of the project?

The biggest challenge that I had to face is to gain acceptance from the community. Being of different race, religion and culture had indeed posted the biggest hurdle to get up-close to the coastal communities who are mainly Malays.

As a scientist, I cannot just enter a village and told the local community what is best to do or what the scientist feels is best for the community. Working with the community is not as direct or easy as following any manual/modules/procedures/instructions/SOPs as in the laboratory. We must first gain the trust of the community through listening, observing and understanding. Trustworthiness is important to secure a long-term relationship between the scientist and community before the empowerment / engagement can be conducted. The scientist needs to secure the trust and acceptance from the communities to ensure the translational research knowledge can be done impactfully.

Being a Chinese female marine scientist can be very challenging, especially when I need to work closely with mainly Malay-male-dominated coastal communities. I have to show respect first instead of expecting to be respected. It is important to understand the community's culture, religion and beliefs. It is important to be accepted as part of the community or even better, their family members, before we can truly work with the community. We have to have an open mind to learn from the community; there are a lot of local knowledge that are amazing and should be documented. Working with the community is all about co-learning and co-production of knowledge and findings.

Working with the local community needs a lot of perseverance and patience. We have to be able to juggle and create a balance between listening to their opinion and sharing ours. We have to stay positive at all times to be able to maintain our stamina both physically and mentally.



Aileen works closely with the coastal communities, making a difference in their lives. Her main principle is to provide "hope" to the bottom billion.



What is the future direction of the project(s)?

I believe that the development of community engagement will be vital in charting the country's future on many scales. Local experiences of one community may be translated to other communities needing the same opportunities elsewhere but probably need some adjustments to be accepted and implemented. In translating the findings of the research, it is probably important to bear this in mind so that it is more applicable and accepted to the intended communities.

At the same time, the borderless nature of the ocean (since I am a marine scientist) meant that collaboration is vital. Providing opportunities and encouraging participation to 50% of the world's population, the womenfolk, is a necessity if we are going to survive the next century.

The local coastal communities now have started to enjoy the benefits from the oyster farming activities, where oysters can be sold continuously after the first 8-10 months of culture. With the income they have generated, the culturists now are able to purchase their own oyster seeds to sustain the farming. Oyster farming is a sustainable activity because it is clean aquaculture and involves minimal investment after the setup of the floating cages. The local communities can extend their farming activities in the future by building more floating cages to increase the holding capacity for the oysters.

The community will be able to expand its culture system once more income has been generated from the sales of the oysters. The local communities will be able to sell their oysters to the industries for further processing of products such as frozen oysters, dry oysters, oysters in saline water and industries dealing with food technology or pharmaceutical companies.

There is an opportunity for the local communities to be social entrepreneurs when they are taught to manage their own eco-tourism business through oyster farming. Oyster farming can be an approach to eco-tourism as well as public awareness for environmental protection (following the Model Quintuple Helix). With the involvement and commitment of local communities, the oyster industry can take off in Malaysia.

**More than 4000 stingless
beekeepers have been
trained under my
community projects.**



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Research Interests:
Comparative Neurosciences





What were your proudest moments during these community projects + implementation?

Have you ever seen insects fly and get trapped behind a car’s window? They try to escape by knocking on the transparent window and would end up dead the next day. Relatedly, I've watched the beekeeping community try to release a small bee that's trapped and the bee is back alive freely. Doing so needs one to have a great level of empathy. Yes, empathy! one feeling that connects us all and other creatures.

And this empathetic nature translation from the beekeepers symbolizes the success of the message that I am trying to convey. It is also the greatest pride in my life. Eventually, our contentment as scholars peaks when the knowledge and inspiration we bring forward are welcomed and is life-changing to other people. Alhamdulillah, to date, more than 4000 stingless beekeepers have been trained under my community projects.

For the general public, honeybee and stingless bee (kelulut) are merely insects that produce honey. However, as for me, they are the army of the Almighty Creator that are inspired to pollinate the seeds of trees that give us oxygen and food, provide natural resources, and sustain life continuity and survivability. And from the bees, honey is crafted, which grants cure for humans (AnNahl68-69). Unfortunately today, these tiny creatures are threatened with chemical pesticides and continuous rural development. This makes bee conservation and honey-upholding efforts crucial as missions to prosper humankind and mother nature.

Ladang commercial developed

The impact? A flourishing symbiosis exists between the beekeepers and bees contributes to socioeconomic well-being in line with ecological conservation. Moreover, honey that was previously marketed along the night market floor is now transformed into a premium product.

This symbiosis is a vision for the Kelulunomic project that I am now pioneering. It is my personal passion that allows me to sleep in peace. To top that, Kelulunomic has been recognized as an outstanding translational research project by the MOHE. This work has also been proudly engraved on a special national stamp and it is something that I could not be more proud of.



Dr. Zul with community

What is the biggest challenge you faced to ensure the success of the project?

"The most blessed thing in this world is the sacred knowledge; when we can learn, understand, and inspire others to do good, that is sacred".... my late father once said. Alhamdulillah, I am now in USM and this institution has a clear mission to empower the bottom-end of society in transforming their socio-economic well-being. But superior to that, as a Malaysian, I hold on the first principle in the pillars of the country, the Belief in God. Therefore, my every step in the community program is based on the goal of upholding the first pillar, besides upholding the mission of USM. The role of teaching and doing research is a responsibility as an employee, but inspiring society is an obligation for me, both as a scholar and a citizen.

Meaning, when Allah states in the Quran that honey is a cure, it is not a hypothesis, but a fact that needs to be upheld. The same applies to when we manage halal, riba, zina other issues. In the mission of upholding the honey industry, the biggest challenge is to instil adoration for bees and to change the public's perception towards honey. That means, the fundamental challenge is a change of mindset, which is difficult and can only be changed if society is rightly inspired. At the same time, the honey industry is flooded with over 90 per cent of artificial honey, unsustainable farming, and non-hygienic post-harvesting management. Hence, the industry needs a total solution.

The solution I use is a moon-shot model where a mission is to produce Natural, Clean, and Good Quality honey. This mission ensures that "real" honey can be marketed and provide income to the main stakeholders, the beekeepers. As a result, the conservation and production activities of honey will continue. This whole scenario will open for supporting innovation and allows scientists in the fields of entomology, engineering, industrial technology, medicine, chemistry together with the involvement of other agencies. The co-involvement will play a big role in the community, working in close cooperation on the same mission. This



Premium honey developed



with international collaborations

creates an ecosystem that brings together many new stakeholders and accelerates the process of raising bees and producing honey. As for me, I developed patented innovations such as the MUSTAFA-Hive and HILDA System until the birth of spin-off Brainey Sdn Bhd along with halal-certified honey factory, HACCP, GMP, and ISO2200.

Alhamdulillah, the challenge of instilling the love for bees and honey can now be overcome in line with USM's motto, "Transforming higher education for tomorrow's sustainability". And it's even more motivating for me when the inspiration entrusted by my father can be fulfilled in tandem with the first national principle of the country.

KELULUNOMIC: Execution steps

Strategic kelulut-based socio-economy and new commodity development program

STEP 1 (2014-2018):
TRANSFORMATION AT COMMUNITY LEVEL
(3000 beekeepers trained)

STEP 2 (2019-2022): COMMUNITY
TO INDUSTRIAL PARTNER & INSTITUTIONS



2022 Kelulunomic Summary

What is the future direction of the project?

I define success as the ability to bring impact and achieve life's dreams, not by rank, title nor position. My dream of life is to position honey as an approved treatment in clinical settings and to further uphold God's word that honey is the cure.

The direct impact of the Key Performance Indicator (KPI) on the community is something that can be achieved through community programs. An example is knowledge and skills (know-how) that are transferred to the villagers. However, this impact is rarely pursued by university lecturers as many fail to distinguish between community service (CS) versus community engagement (CE) and thus, causing community programs to be considered an additional burden. CE is a process of mutual empowerment for researchers and communities. I leveraged CE into a field research space and translated the scientific narrative for the direct benefit of the community and that gave me KPIs in tandem with KIP, whilst still being on track to pursue my life's dream of elevating honey reputation.

I have invested nearly ten years focusing on the aspects of kelulut farming, beekeepers development, and international certification for kelulut honey products. Now, my current focus is to streamline the traceability system of kelulut honey products where some biosensor and IoT (Internet of Things) initiations are being developed. Several clinical trials are underway where one study has been completed and the kelulut honey product is expected to be officially used at the clinical level soon.

Continuous efforts to increase the number of beekeepers are also a priority in the future to meet the growing demand. Towards this end, continuous collaboration with TERAJU and other public universities as well as farmers' associations such as the Darul Naim Entrepreneurs of Stinglee bee Society (DRONESS) and JBEES continued to be performed. In the end, my greatest idol is Prophet Muhammad (peace and blessings be upon him) who inspired me to fight to humanize myself. Other humanitarian figures such as Nelson Mandela, Mahatma Gandhi, and Mother Teresa have also proven that the struggle to empower humanity is at the core of life.

RESEARCH INFOGRAPHIC

(Building our culture of
excellence in scientific research)





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Why S - Sustainable L - Led I - Innovative M - Mee

213 calorie per serving
(lowest compared to
similar products)

Improved cooking
and **eating qualities**

Almost **zero fat**

No potential of
oxidized oil/
no calorie from fat

No alkaline salt
(thus low salt)

**No preservative /
no coloring**



10% insoluble-dietary fiber
(cellulose + hemicellulose);
one serving provides -25% of
daily dietary fiber need

Promoting regularity and
other dietary fiber-related
health benefits

Commercial requirements
(motivation to purchase)



An alternative pro-health noodle
(i.e. not a gel) that addresses sustainability (no alkaline salt,
no added oil, no color or preservative added) and conforms
to national standard MS2255:2009



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Probiotic Chicken Feed

Nutrient in this product met the requirement set by Malaysia standard (MS 20:2008).

Food Conversion Ratio (FCR) between 1.2-1.5.

Cost operation and production is lower than commercialize Chicken Feed.

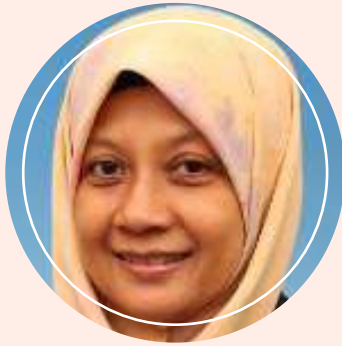
Effect to chicken meet: High protein, good Fat, carbohydrate and low moisture content.

Free from antibiotics.

100% Organic.

Ingredient: Mostly local and clean ingredient.



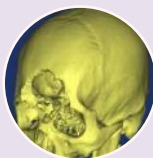


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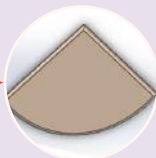
Prototype of
**3D Craniofacial Polyamide
Composite Customised
(3D CPACC) Implant**



Implant design, print and insertion



CT Scan



Implant design
utilizing
CAD/CAM



Implant
printing



Printed
implant



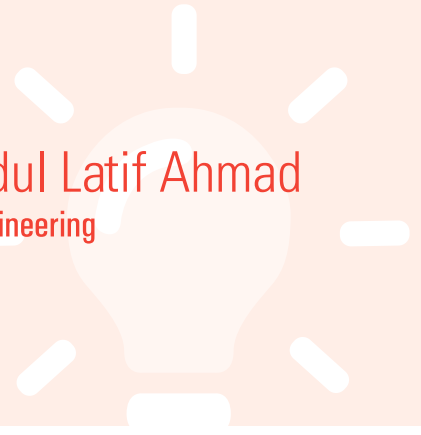
Implantation



Prof. Ir. Dr. Abdul Latif Ahmad
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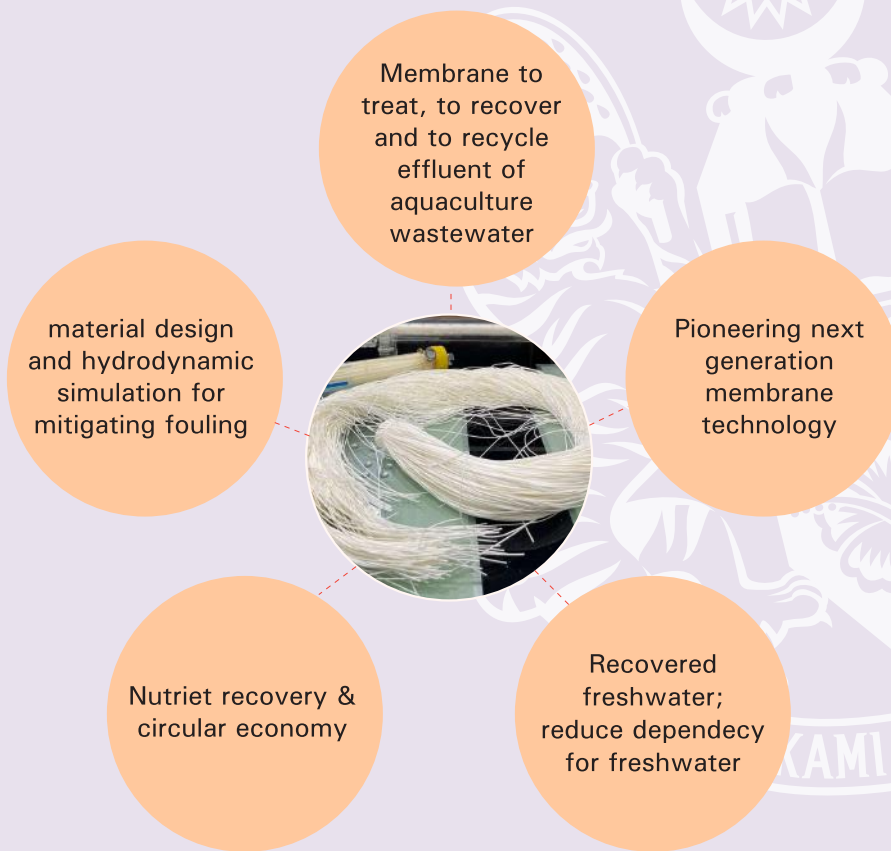
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Fostering Membrane Science

for the Sustainable Development of
Aquaculture Industries





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Blue Light Emitting Diodes





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