

STORIES OF AUSTRALIA-INDONESIA INNOVATION



Sustainable, resilient cities



What happened to Asia's lost 'elephants'?



Keeping ahead of a child killer

The little people of Flores



Building port cities



Riding the rails

Welcome to Stories of Australia-Indonesia Innovation

Indonesia and Australia have been collaborating in science and innovation for many years. And we continue to build on these partnerships: developing a better vaccine for rotavirus, the gastro-bug that kills around 200,000 children globally each year; discovering the Hobbit; helping each other in times of crisis such as the Black Saturday bushfires or Bali bombings; and predicting fires, floods and earthquakes that will affect the region.

With the largest economy in Southeast Asia and the world's fourth-largest population, Indonesia has its sights set on continued economic growth. There are opportunities for Australia both to support and learn from its neighbour—particularly in the shared challenges the countries face with infrastructure and sustainable development.

The following short stories are just a taste of the diverse projects that are engaging Indonesian and Australian scientists in research that's changing both nations.

Stories of Australia-Indonesia Innovation is written and published with the support of the Australia-Indonesia Centre and its collaborating universities.

Lydia Hales and Niall Byrne, November 2016

About the collection

Stories of Australia-Indonesia Innovation is the result of a collaboration between Science in Public and The Australia-Indonesia Centre.

The stories were selected after Science in Public put out a public call for ideas. The list is not meant to be a comprehensive summary of Australia-Indonesia research underway or completed—it is a celebration of the diversity of collaborative projects.

Science in Public and the Centre wish to thank the researchers and institutions that have made this publication possible.

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Concept

Niall Byrne
niall@scienceinpublic.com.au

Editor

Lydia Hales
lydia@scienceinpublic.com.au

Writers

Lydia Hales
Niall Byrne
Ellie Michaelides

Design

www.saltcreative.com.au

We encourage fair reporting of these stories. Contacts for stories, links, photos and more information at australiaindonesiastories.org

We welcome your feedback on the stories by email and online.



@ausscistories @scienceinpublic



ausscistories



Stories of Australian Science



niall@scienceinpublic.com.au



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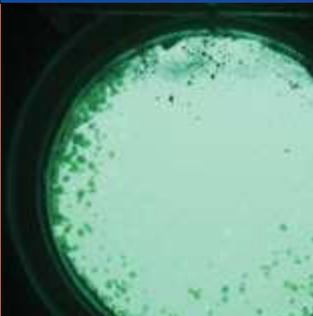
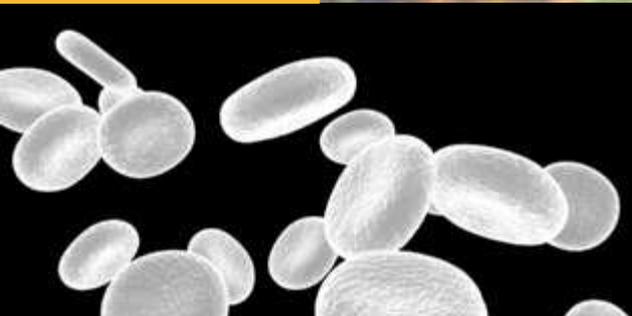
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Building port cities



Boosting vaccine performance

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Infrastructure

- Building port cities
- A safe and efficient rail system

Indonesia is undergoing massive economic growth. That's going to place huge requirements on the nation's infrastructure, including ports and transport. And a changing climate increases the risk of environmental disasters.

Take ports for example: maritime trade is vital to the island nations of Indonesia and Australia—to maintain connections between cities within and without. But ports need to work with the environment they're built into, and both countries need to improve efficiency and accessibility for goods and passengers to move between land and sea.



Building port cities

Port cities can be lively, vibrant hives of activity—the hub of a nation's economic health—if they're planned well.

Indonesia's busiest port, Tanjung Priok, has roughly two and a half times the container traffic as the Port of Melbourne. But it also has a reputation as one of the least efficient ports in Asia. Indonesian President Joko Widodo has recognised the need to transform the nation's ports and plans to develop 24 new ports by 2019. One recently established, state-of-the-art port is Teluk Lamong in Surabaya.

A team of Indonesian and Australian scientists and engineers will work with the Teluk Lamong port authorities to maximise the efficiency of links between ports, rails and roads.

Looking to become a world maritime axis

"This research, funded by the Australia-Indonesia Centre, will assist both countries in getting the most out of their ports," Dr Hera Widyastuti of the Sepuluh Nopember Institute of Technology, and Infrastructure Cluster Co-Lead of the Australia-Indonesia Centre, says.

"If our research can help improve port efficiency, accessibility and connectivity, there will definitely be positive impacts on employment, health and transportation in eastern Java."

The Port of Melbourne is being used as a case study. The port is Australia's largest city port for container trade, but is expected to quadruple in traffic by 2035 and wants to maintain its efficiency as it grows.

As a large archipelago, Indonesia relies on shipping between its many islands as well as to the rest of the world. By 2019, the country is looking to become a world maritime axis—building not just 24 new ports, but also more than 3,000km of combined intercity and urban railways, and improving transport efficiency by rehabilitating 46,770km of existing roads across Indonesia.

"Bu Hera has been instrumental in bringing government authorities who are responsible for the master plan for transportation in East Java, Indonesia, and key personnel from PT Teluk Lamong Terminal and the Java Integrated Industrial and Port Estate into this project," says Professor Wing Kong Chiu, Australia-Indonesia Centre Infrastructure Cluster Co-Lead, of Monash University.

The team also includes Professor Sigit Priyanto of Gadjah Mada University in Indonesia, Mr Ravi Ravitharan of The Institute of Rail Technology, Monash University and Associate Professor Colin Duffield of the School of Engineering (Infrastructure Engineering) at The University of Melbourne.





Riding the rails to an efficient freight system

From 2016 a specially-equipped standard railcar will be rocking and rolling along the tracks of East Java. It will have carefully positioned sensors to detect its movement during normal operation, including its displacement and vibration.

The railcar instrumentation has been designed by Monash University's Institute of Rail Technology to provide data on the condition of the track. This will allow engineers to accurately estimate safe loads and running speeds.

It's part of a project to facilitate safe and efficient movement of freight across the rail network, and particularly to improve the movement of goods into the new container port terminal at Teluk Lamong (Lamong Bay), Surabaya.

"There are many trucks and buses jamming up roads at the moment," says project co-leader Dr Hera Widyastuti, of the Sepuluh Nopember Institute of Technology.

"If we don't start getting this under control then it will bring about many issues. Improving the railway systems would reduce congestion and have economic impacts way into the future—we could transport goods much more smoothly, and reduce pollution and accidents."

The project was initiated by the Australia-Indonesia Centre's Infrastructure Cluster with the support of the Government of East Java, PT Kereta Api Indonesia, Java Integrated Industrial and Port Estate, the Lamong Bay Terminal container port, the Australian Rail Track Corporation, Public Transport Victoria, and Monash University.

Facilitate safe and efficient movement of freight

Building sustainable, resilient ports and cities: The Australia-Indonesia Centre Infrastructure Cluster

The Australian and Indonesian governments have recognised railways, roads, and ports as important areas for investment over the next 20 years.

The Australia-Indonesia Centre has developed a suite of projects that will help the country create the resilient infrastructure it needs to grow.

The Infrastructure Cluster is asking questions like:

- How can goods and passengers travel efficiently between land and sea?
- How can one make the best use of existing infrastructure? Do we need to build new ones?
- Is the best information available to inform policies?

Read more about the Cluster at: australiaindonesiacentre.org/clusters/infrastructure



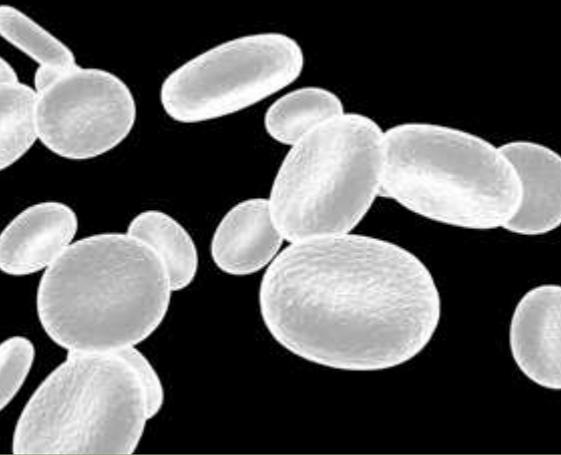
Photos: The railcar will provide information on the state of the tracks as it travels, credit: Institute of Railway Technology

Health

- New and improved vaccines for rotavirus and other childhood killers
- A universal flu vaccine
- Breeding mosquitoes to eliminate dengue
- Helping Javanese children hear

These are just some of the areas in which Indonesian and Australian researchers are innovating for better health in our two nations.

Read on for more about these and other health innovations.



Boosting vaccine performance

Vaccines work best when they include an adjuvant, something that boosts your immune system's reaction to the vaccine. University of Melbourne researchers have recreated a fragment of a bacteria protein that activates white blood cells. In 2012, they signed a research agreement with Bio Farma to help them turn their idea into a novel vaccine platform that could enhance vaccines for hepatitis, diphtheria, tetanus, whooping cough, and other diseases.



A universal flu vaccine

A broad-spectrum flu vaccine is being developed to give better immunity to seasonal influenza strains and increased protection against future influenza pandemics. The technology was created by researchers at the Australian National University and the University of Adelaide, who set up Gamma Vaccines to commercialise their ideas. In 2013, Gamma Vaccines signed a three-way development agreement with Bio Farma and SOHO Industri Pharmasi to develop, manufacture, trial, and distribute the vaccine in Indonesia and other Association of Southeast Asian Nations (ASEAN) countries.

Keeping ahead of a child killer: stopping gastro from birth

A new rotavirus vaccine should soon be available thanks to a collaboration between PT Bio Farma and researchers in Melbourne and Yogyakarta. The new 'RV3' vaccine is aimed at protecting babies from birth, improving protection and simplifying delivery.

The current vaccine, available in Australia and only on the private market in Indonesia, can only be administered from six weeks of age.

Diarrhoea is the leading cause of death in children under five years of age in Indonesia, and rotavirus has been found to be the most common cause of diarrhoea in these children admitted to hospital with gastroenteritis.

The vaccine is saving millions of lives

But the cause was unknown until Ruth Bishop and her colleagues, working with babies at Melbourne's Royal Children's Hospital and The University of Melbourne, found the rotavirus. The discovery triggered a global effort to fight the disease. Today GAVI, the global vaccine alliance, are getting rotavirus vaccines to over fifty million children in the poorest countries.

The vaccine is saving millions of lives, but it's hoped that the new version, RV3, will take protection a step further. Developed through a collaboration between Universitas Gadjah Mada (UGM), Bio Farma, and the Murdoch Children's Research Institute (MCRI), RV3 has been through clinical trials in New Zealand and Australia.

"The rotavirus vaccine RV3 trial in Indonesia is one of outstanding and long collaboration between UGM and the Rotavirus Group at MCRI/Royal Children's Hospital and The University of Melbourne which has been established for almost 40 years, involving academic exchange, research and training," says Dr Jarir At Thobari, of Universitas Gadjah Mada.

"We hope the success story will continue in future."

An Indonesian trial started in 2013 with two regional hospitals, 23 primary healthcare clinics, and more than 35 doctors and 300 midwives. Bio Farma hopes to licence the vaccine in Indonesia in 2019.

Identifying the Bali bombers; testing for bird flu; and better selection of anti-malarial drugs

Testing for flu, malarial drug resistance, and identifying the Bali bombers are all outcomes of an Australia-Indonesia medical research initiative that began in 1997 and continues today.



The original Australia-Indonesia Medical Research Initiative agreement between the Walter and Eliza Hall Institute of Medical Research (WEHI) in Melbourne and the Eijkman Institute for Molecular Biology in Jakarta was conceived and funded by the Indonesian Minister of Research and Technology and the Australian Government, and designed to boost the capacity of the Indonesian labs while enabling more transfer of ideas and skills between the two countries.

Search for better anti-malarial drugs

The work of the Eijkman Institute in identifying the Bali suicide bombers, and in diagnosing infectious diseases such as bird flu, has emphasised the key role of molecular biology in responding to threats to national biosecurity and safety. Currently, they're collaborating with WEHI researchers collecting field samples to search for better anti-malarial drugs.

International collaborations for the Eijkman Institute have now extended to Monash University, Universitas Indonesia, University of Queensland, and Utrecht University in the Netherlands, as well as opening opportunities for masters and doctoral exchanges.



Helping Javanese children hear

Hearing-impaired children in East Java will have better access to services thanks to a collaboration between the University of Western Australia (UWA) and Universitas Airlangga. They're working on audiology education and research with a long-term goal of establishing a Master of Clinical Audiology—Indonesia's first audiology education program.

Other projects the team has worked on have included:

- developing a speech test for preschool children that helps identify hearing loss,
- providing a mentoring and support program for hearing health workers using tele-health and other technologies,
- establishing a baseline epidemiological database for hearing loss in children in East Java,
- and developing training resource packages for teachers who are supporting hearing-impaired children.

"Hearing impairment without early identification and intervention not only impacts a child's speech and language development but also their educational and employment potential," says Dr Helen Goulios of UWA, the Australian lead of the program.

Helen and her UWA students are working with Benny Sampiwanto, Head of the Bureau of International Cooperation in the East Java Government; and Dr Nyilo Purnami, Ear, Nose and Throat Surgeon at the Dr Soetomo Public Hospital and Universitas Airlangga.

Indonesia's first audiology education program

"The key is to detect the child's hearing loss as soon as possible and provide appropriate education and technologies," Helen says.

"This project has also given our students the opportunity to learn on the ground while working in East Java."

The work has been supported by the WA-based non-governmental organisation HearingAID-East Java through the Sister-State relationship between the Governments of East Java and Western Australia; and by the Regencies of Gresik, Sidoarjo, Pasuruan, and Surabaya in Indonesia.

A five-in-one vaccine for all Indonesian children

Indonesia is rolling out a five-in-one vaccine that they plan to deliver in a single shot to every Indonesian child to protect them against diphtheria, tetanus, whooping cough, hepatitis B and Haemophilus influenzae type B (Hib). The rollout is supported by the Australian Government through GAVI, the global vaccine alliance. The vaccine is manufactured by Bio Farma, who also hope to add rotavirus to the vaccines in the future.

New targets for tuberculosis vaccine

Better vaccines are needed for the global fight against tuberculosis (TB) with nine million new cases annually. Indonesia had more than 320,000 reported cases in 2014, while Australia's reported cases were just over 1,000. But the rise of drug-resistant TB poses a threat to all countries.

Two proteins from the tuberculosis bacterium have shown promising results in investigations for a new vaccine in mice. Scientists from Universitas Gadjah Mada (UGM) in Yogyakarta, with colleagues from the Centenary Institute and the University of Sydney in Australia, have found that the injected proteins can prime the immune system to induce protection against TB in mice.

Better vaccines are needed

The team hopes the proteins could provide support for the Bacille Calmette-Guérin (BCG) vaccine—which is 90 years old and the only vaccine currently available for TB. BCG's effectiveness varies geographically between zero per cent and 80 per cent, and tends to be lower in the tropics.

They will be testing 40 tuberculosis patients in Yogyakarta and another 40 people who do not have tuberculosis. The team, which has received funding from the Australia-Indonesia Centre, has already established a laboratory and immunological techniques to test if the two proteins from the tuberculosis bacterium can be used as the basis for the vaccine.

About PT Bio Farma

Bio Farma was established in 1890 and is a state-owned business that provides all the vaccines on Indonesia's immunisation schedule. That's 1.7 billion doses a year. Bio Farma is also a major supplier to UN agencies and global health initiatives, producing, for example, 1.4 billion doses of polio vaccines of which about 20 million doses are for Indonesian use. The company is based in Bandung about 100 km east of Jakarta.



The future of Indonesian mental health

Scientists are bringing together the knowledge from 300 mental health experts in a multi-disciplinary project to reimagine the future of mental healthcare in Indonesia.

Conducting interviews about policy, key challenges, case studies and patient groups, they're looking to understand how new practices can fit into the historical, sociological and anthropological aspects of psychiatry in Indonesia.

A growing amount of attention from overseas in recent years has focussed on the poor treatment of Indonesian patients with psychosocial disabilities—which has sometimes included shackling of those suffering from schizophrenia.

But some local programs are making progress in supporting those with mental health issues through innovative thinking—despite their limited resources.

One example is a walk-in house in Lombok for patients with schizophrenia, where patients whose condition has been stabilised with medication can meet during the day and work, for example preparing salted duck eggs for sale. It's part of a comprehensive mental health program developed by psychiatrist Elly Wijaya.

The program includes after-care and follow-up visits to patients and their families by mental health nurses—approaches which have proven essential to prevent relapse.

The researchers, from Universitas Gadjah Mada, Harvard University and The University of Sydney, will incorporate their findings into a text on the future of Indonesian mental health.

The work is funded by the Australian Research Council.

The impact of rotavirus

Before the rotavirus vaccine was introduced in Australia in 2007, rotavirus caused about 10,000 hospitalisations among children under five years of age each year. Globally, rotavirus is the leading cause of diarrhoea-related hospitalisations and deaths among young children.



Ultra-sensitive dengue detection



“Dengue has a significant impact on both Australia and Indonesia—the disease is hyper-endemic in Indonesia and affects the daily life of people living in the country,” says Dr Tedjo Sasmono of the Eijkman Institute for Molecular Biology in Jakarta, where researchers have been working with The University of Queensland to create a new way to screen blood for dengue virus.

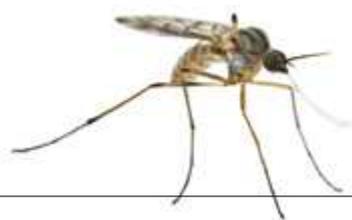
It's the result of a joint-research project on dengue diagnostics, initiated in 2015 and funded by an Australian Research Council (ARC) Linkage grant in collaboration with the Australian Red Cross Blood Service.

A team led by Dr Andrea Ranzoni, Professor Matthew Cooper and Professor Paul Young at The University of Queensland developed a way to look for multiple natural markers of dengue fever in the blood, to screen donations for potential infection.

The test was then transferred to the Eijkman Institute, where Tedjo led the work to validate the test in the laboratory using dengue clinical samples. PhD student Sanjaya KC travelled to the Eijkman Institute to work in the lab for 10 days; and research staff in the Dengue Lab at the Eijkman Institute, Benediktus Yohan and Rahma Fitri Hayati, were also trained to use the new screening technique which identified 117 positive samples.

“The combined expertise of the Eijkman Institute and researchers at The University of Queensland has meant that we can work together to develop the next generation of dengue diagnostics, which can be used in dengue virus detection of a large number of samples during disease outbreak as well as for dengue screening in blood donations,” Tedjo says.

“The technology will be very useful, especially in Indonesia and surrounding countries which are endemic for dengue.”



Can sunshine help prevent pneumonia?

A link between vitamin D deficiency and pneumonia is being investigated in two studies by Indonesian and Australian scientists in Indonesia.

They're tracking the incidence and severity of respiratory tract infections in early childhood, including the common cold, asthma, pneumonia, and bronchiolitis, in hospitals and the community, in the hope of providing more information for treatment and management for respiratory diseases.

Pneumonia is the number one killer

Pneumonia is the number one killer of children under five in the country, and around six million young Indonesians suffer from it each year, according to a 2008 study. This collaboration is going to update those 2008 figures, and hopefully lower them—while trying to find the causes of it and other respiratory tract infections.

It's easy to assume people living in such a sunny country would have adequate levels of vitamin D, which forms naturally when the skin is exposed to sunlight, or is obtained in the diet.

“There are several lifestyle reasons why this may not happen,” says project coordinator Dr Vicka Oktaria of Gadjah Mada University in Yogyakarta, and the University of Melbourne.

“Foods high in vitamin D don't tend to be part of the daily diet in Indonesia. And, although the benefits of breast feeding children for the first six months are huge, breast milk is a poor resource for vitamin D. So we may need to consider some form of supplementation.”

Detecting high risk pregnancies in Indonesia

Women in Indonesia were 21 times more likely to die from childbirth than women in Australia in 2015.

Many pregnant women in Indonesia, particularly in remote areas, do not regularly visit health clinics, and so complications are not detected and dealt with early enough.

In 12 villages on Indonesia's Madura island, student midwives are accompanying pregnant women to antenatal classes and encouraging them to give birth with a skilled health provider present. Researchers from Airlangga University and the University of Sydney hope this will improve the detection of high-risk pregnancies, lead to more timely referrals, and ultimately reduce maternal mortality rates.

“There are too few trained healthcare staff in rural communities. It's frustrating when we have been referred a patient with a life-threatening condition who, if we had seen weeks or months earlier, could have been easily treated,” says Dr Budi Prasetyo, an obstetrician and gynaecologist at Universitas Airlangga. Budi is coordinating this project, which is funded by the Indonesian Directorate of Higher Education (DIKTI) and the Australia-Indonesia Centre.

Since this research started in April 2015, there has been a slight increase in early detection rates for high-risk pregnancies, suggesting the approach is working.



Fighting the new killers: The Australia-Indonesia Centre Health Cluster

Heart attacks, cancers, mental disorders, diabetes, and other non-communicable diseases (NCDs) are on the rise in Indonesia and Australia. In 2007 they caused 60 per cent of Indonesian deaths; by 2014 this had risen to more than 70 per cent.

NCDs also account for over 90 per cent of Australian deaths. More than half the country's adults are considered overweight or obese and a 2014 study found Australia's obesity rate was rising faster than anywhere else in the world.

Innovative approaches to health literacy

The Australia-Indonesia Centre's Health Cluster will tackle these issues with collaborative projects that:

- increase awareness of the need to reduce NCD risk factors in both countries
- influence both policy and practice for preventing NCDs from developing.

The Cluster's research team are tackling the following key questions:

- Tracking NCDs: how well do current health-monitoring systems in Indonesia and Australia allow for tracking NCD risk factors, and the diseases themselves?
- Infant nutrition: what are the major barriers to achieving good metabolic and nutritional outcomes in infants in Australia and Indonesia, and how can these be overcome?
- Health literacy: how might innovative approaches to health literacy better enable timely access to and uptake of health information and services?
- Medical education: how could innovative medical education help Indonesian and Australian clinicians address early NCD risks into the future?

Read more about the Cluster at: australiaindonesiacentre.org/clusters/health



Signs of the dietary environment

School-aged children are surrounded by messages about food and nutrition, from shop signs to brand advertising. Linguists from Indonesia and Australia have developed a new way of studying how this affects them, using smartphones and clever analysis.

In a project financed by the Australia-Indonesia Centre and led by Dr Sisilia Halimi of Universitas Indonesia and Professor Lesley Harbon of the University of Technology Sydney, researchers used their phones to take pictures of the 'linguistic landscape' around schools and their surrounds, in fact anywhere written text was evident.

Then they showed these images to the children—pictures of wall signs, advertising, hawker stalls, textbooks, classroom posters, and even street rubbish—and asked them to comment on what they saw. That allowed them to start a discussion on what the children knew about food, diet and nutrition.

"The findings showed that in some cases there was a contradiction between what the school expected its students to eat and what was available in the canteen," Sisilia says.

Lesley says they now have evidence to show to educational authorities that students are noticing these messages.

"We have shown the methodology works. Besides education, our results should also be of interest to agricultural authorities, and advertising and food packaging companies both in Indonesia and Australia."

Identifying victims in the Black Saturday bushfires

During the 2009 Black Saturday fires—Australia's worst bushfire disaster to date—Indonesian experts headed to Victoria to help identify the bodies of the 173 victims.

Their support came as part of a collaborative initiative between the Victorian Institute of Forensic Medicine (VIFM), and the Department of Police Medicine of the Indonesia National Police (Dokpol) which saw 20 Indonesian experts in forensic pathology, forensic odontology (which involves examining dental evidence) and DNA analysis work alongside VIFM and Victorian Police for over two months.

The bond between the departments and countries has grown

As part of the initiative, which has also involved the Australian Federal Police, the two countries have worked together to identify victims in other disasters, including the Bali bombings, the Australian Embassy Bombing in Jakarta, and the Garuda Indonesia Flight 200 crash in Yogyakarta.

"The VIFM was extremely appreciative of the work and assistance received from the Indonesian disaster victim identification teams," says Jodie Leditschke, Manager of Forensic Technical Services at VIFM.

"We've found that the bond between the departments and countries has grown considerably as a consequence of this initiative."

Healthcare for the 'missing middle'

Around 100 million Indonesians don't have health coverage, despite a bold national overhaul in 2014 of Indonesian healthcare aimed at bringing all the historically-fragmented insurance schemes together into the Jaminan Kesehatan Nasional (JKN), or National Health Insurance Programme. Indonesian and Australian researchers want to know how this can be improved.



The scheme sought to capture those who fall through the gaps, to achieve universal health coverage for all by 2019. Referred to as the 'missing middle,' they're the people who aren't destitute and receiving government help, but are still too poor to afford basic healthcare.

"There's limited information about expanding health coverage where there's a large 'informal' workforce, so I hope our work will provide valuable information for Indonesian policy makers," says Dr Teguh Dartanto, of Universitas Indonesia and co-leader of the research that's funded by the Australia-Indonesia Centre.

"Universal health coverage not only benefits Indonesia, but it's also part of an international agenda of sustainable development goals—so the Indonesian experience could be a lesson for other countries," Teguh says.

"The program works in compulsory sectors, where they have a surplus from premiums coming in compared to claims going out," says co-leader of the project Dr Robert Sparrow, of the Australian National University.

"But in the voluntary sector, the cost of paying for healthcare is more than six times what they're bringing in, because only sick people are enrolling."

Breeding mosquitoes to eliminate dengue

In 2014, residents of Yogyakarta started growing and releasing mosquitoes. It's counter-intuitive, but the mosquitoes carry *Wolbachia* bacteria, which reduces the risk of them spreading dengue fever. Over a number of weeks, mosquitoes with *Wolbachia* breed with local mosquitoes and pass the bacteria on to their offspring until almost all mosquitoes in the area carry the disease-blocking microbes.

Dengue was first reported in Indonesia in 1968 and is now endemic in many cities and towns. In 2013, there were 112,000 cases and 871 deaths. Across the world hundreds of millions of people are affected each year, mostly in the tropics.

In Yogyakarta, researchers from Universitas Gadjah Mada are planning a large-scale trial to measure the effectiveness of *Wolbachia* as a public health intervention. It's all part of the Eliminate Dengue Program, an international research collaboration that aims to reduce the impact of mosquito-borne disease. Ongoing field trials in Cairns and Townsville, Australia, are also showing positive results.

Professor Adi Utarini leads the Yogyakarta project and credits its success to the support and participation of local residents.

Reduce the impact of mosquito-borne disease

"Without community involvement and consent, it would have been impossible to achieve such positive results," Adi says.

The Indonesian team is supported by the Tahija Foundation, and is working closely with colleagues from Monash University and other organisations in Australia and around the world.

What's killing people?

Planning a nation's health is challenging when you don't have accurate information on the causes of death. The Indonesian National Institute for Health Research and Development is working with nine regional universities and the Australian National University to build capacity for a national mortality register.



Photos: School students in Indonesia inspect mosquito eggs in the traps, credit: Paulus Enggal, Eliminate Dengue Indonesia; As well as dengue, Eliminate Dengue's *Wolbachia* method has also been shown to reduce transmission of other viruses including Zika, credit: Paulus Enggal, Eliminate Dengue Indonesia

Innovation

- Giving start-ups a fair go
- Better shelters for street vendors
- Bringing science to the community

Australia isn't the only one pushing to be an "innovation nation," with Indonesia announcing a government-backed '1,000 start-ups movement' in mid-2016.

Read on for more ways that Indonesia and Australia are improving connections and opportunities within and between their countries, and the globe.



Carving out success in wooden exports

Wooden furniture companies in Indonesia have doubled their income after taking part in training courses to boost production efficiency and improve overseas opportunities.

Furniture—predominantly made from teak or mahogany—is one of Indonesia's big exports. But even in the region of Jepara, known in particular for its carved furniture, the manufacturing industry has been marked by poor production efficiency, resulting in less recovered timber and lower overall quality of furniture products.

So in 2009, eight Indonesian organisations began working with the University of Melbourne and the Australian Centre for International Agricultural Research (ACIAR) to turn this around.

They wanted to help the 15,000 small-to-medium-sized Jepara-based businesses improve the drying, treatment, and finishing processes and increase timber recovery, while exploring new manufacturing technologies and styles to boost the furniture's appeal internationally.

The 16 representative Indonesian companies involved in the project saw their income increase by half, along with a 40 per cent rise in sales.

And the benefits are expected to reach further into the future for up-and-coming designers. In a traditionally male-dominated industry, one young female winner named Oei Ria Octavilla was among four Indonesians who travelled to Australia for a week-long furniture design course at RMIT University in Melbourne as winners of a competition to find talented designers and link them with furniture companies.

The manufacturing industry has been marked by poor production efficiency

"The designers learnt about the 'Australian concept' of furniture manufacturing, which incorporates design, product development and prototyping, and smart manufacturing methods based on production optimisation, packaging and marketing," says Associate Professor Barbara Ozarska, leader of the project.

"They've already started transferring their new knowledge to other furniture designers and manufacturers through workshops and training courses held in Java."

Giving start-ups a fair go

Indonesian and Australian entrepreneurs will have more opportunities and support for collaborative start-ups, thanks to a joint-push by Austrade and technology companies telkomtelstra and muru-D announced in May 2016.

muru-D, a start-up accelerator backed by Telstra, has previously lent its support to aquatic drones and a "ride-sharing service to space" via nano-satellites. The support for start-ups includes seed funding, coaching, mentoring and access to a network of industry professionals, from their offices in Sydney and Singapore.

The Jakarta division of Austrade, the Australian Government's Trade and Investment promotion agency, worked with muru-D and telkomtelstra in encouraging Indonesian entrepreneurs to apply for the residential incubator program in Singapore and to look to Australia for potential new partners.

In August, muru-D announced that three Indonesian teams had been selected. This represents a tremendous result for innovation collaboration between Indonesia and Australia.

Citizen science recovering volcanic farmlands



An Indonesian initiative is putting science—and the laboratory—into the hands of communities; combining the arts, science, and technology with some basic science lessons for the general public.

In 2014, the HackteriaLab gathering in Yogyakarta brought 40 scientists, artists, and academics together for two weeks to work on existing local community projects.

The three main focusses were: environmental monitoring of rivers in Jogja, working with 'citizen initiative' group Lifepatch and the Jogja River Project; biodiversity conservation in Wonosadi Forest with the green technology community; and bio-recovery of Mount Merapi volcanic soil, with the microbiologist community of Universitas Gadjah Mada—where the seminar was hosted.

Speed up the fertility of the soil

The volcano Mount Merapi has erupted twice in the past 10 years, destroying local farmlands.

"Scientists in the area had been working with these local farmers to help speed up the fertility of the soil with bio-recovery methods. We invited the participants to help with this work, and encouraged them to look into generic lab equipment, and new methods and ideas that could help the scientists," says Andreas Siagian, Co-Director of the 2014 HackteriaLab.

Other projects included the creation of a DIY microscope webcam; a DIY 3D printing machine; plant tissue culturing and cloning; and mechanical sculpturing.

The Victor Chang Institute in Sydney donated supplies and supported the attendance of Dr Matt Baker, who helped with teaching and running some of the projects.

Hackteria has members in India, Spain, Switzerland, Slovenia, Singapore, Indonesia and Australia, and their efforts at bringing scientific knowledge in the community have been recorded in a documentary and book.

Trading in style: students designing shelters for Indonesia's street vendors

Indonesian street vendors are the new muses of Australian and Indonesian architecture students, who are creating sustainable shelters to help vendors keep trading in style.

Known as Pedagang Kaki Lima ('five legs'), the travelling street vendors not only play a crucial role in Indonesia's economy, they've also become an icon of resilience and bravery following the January 2016 Jakarta terrorist attacks—where photos of vendors and the meme "keep calm and BBQ satay" were shared widely on Twitter.

Designs could also be useful in Australian marketplaces

But when these roving stalls become more 'permanent' and encroach on public space—particularly in busier streets—they're often moved on by authorities.

A new exchange program allows students in Sydney before travelling to Bandung (Indonesia's third largest city) to build and test the designs.

It was initiated by Dr Rizal Muslimin of the University of Sydney, in collaboration with Dr Aswin Indraprastha and Dr Andry Widjowijatnoko of the Institut Teknologi Bandung, and is supported by the Department of Foreign Affairs and Trade and the Consul-General of the Republic of Indonesia.

In January 2016 eight students from Bandung and six from Sydney took part in the program, with the brief to create attractive but user-friendly shelters. The designs included portable, versatile shelters for serving food during the day and selling clothes at night—all taking into account local costs and readily-available materials, such as bamboo.

Their easily-portable designs could also be useful in Australian marketplaces, Rizal says.

"For example Sydney's great creative events and markets are normally sheltered by standard, permanent structures. It would be great if these temporary designs could be equally attractive and integral to similar events in Australia."



A new exchange program allows students to spend a week designing new shelters

Environment and conservation

- Using mangroves to fight climate change
- Clever spending for orangutans, elephants, and people
- Lemons to keep elephants out of trouble

Indonesia and Australia both enjoy biologically rich and diverse natural environments, on land and in their surrounding waters. Despite their unique species and ecosystems, the two countries face many similar environmental challenges—which is why researchers are working together on ways they can be conserved.



Rehabilitating mangrove forests may help combat climate change

Twenty hectares of old, abandoned fish ponds have been rehabilitated into mangrove forests in Tiwoho, in Indonesia's North Sulawesi.

Their efficiency in capturing and storing carbon from the atmosphere is being put to the test by researchers, in the hopes the rehabilitation process can help mitigate the effects of climate change and restore the provision of ecosystem services, such as fisheries, provided by healthy mangroves.

"The issue of climate change is very real, and mangroves play an important role in ecosystems as absorbers of carbon," says Rahman Dako, Head of the Multi-stakeholder Mangrove Management Working Group (KKMD) in Gorontalo, Indonesia.

Carbon stocks are changing year-by-year

Mangrove ecosystems are able to capture and store more carbon per unit area from the atmosphere than most other forests. They also keep sediment in place, protect populated areas from wild weather systems, and provide essential habitat for many valuable fisheries species.

"We want to come up with an economic value of how much carbon this area has sequestered and stored since rehabilitation," says Clint Cameron from the Research Institute for the Environment and Livelihoods at Charles Darwin University.

"We'll then compare the rehabilitated mangrove areas with old fish ponds that haven't been rehabilitated, to see the difference in the amount of carbon in the soil between the two sites."

Because the team knows when the old fish ponds were first rehabilitated, they can also work out how the carbon stocks are changing year-by-year as the mangroves regrow and carbon in the soil is buried.

This is the first ecological mangrove rehabilitation project in Indonesia, according to Rio Ahmad from Blue Forests, an Indonesian non-governmental organisation (NGO) that has been monitoring and researching the structure of mangrove forests alongside Charles Darwin University.

The rehabilitation involves partners from Indonesian universities, NGOs, and the local community.

Conservation that works for governments, communities, and orangutans

The three nations that share the island of Borneo—Indonesia, Malaysia and Brunei—could retain half the land as forest, provide adequate habitat for the orangutan and Bornean elephant, and achieve an opportunity cost saving of over \$50 billion.

The findings, by a research team led by The University of Queensland with members in Indonesia, Malaysia, and Europe, were published in *Nature Communications* in 2015.

Borneo's forests are denser than the Amazonian jungle, and home to more than

14,000 plant species and 1,640 vertebrate animals. The researchers showed that by integrating economic and conservation targets across political borders, the governments could make substantial savings while meeting conservation and economic targets.

The team is also working with Erik Meijaard and the Borneo Futures Initiative, which works with communities and over 70 agencies including the Center for International Forestry Research, the Indonesian Institute of Sciences (LIPI), and Flora and Fauna International.

Their ultimate goal is to demonstrate that the people of Borneo have a choice about whether or not to clear land indiscriminately, and that they can live at peace with the forest while still benefiting economically. Lead author Rebecca Runting was awarded the best student paper prize at the 2016 Society for Conservation Biology Oceania conference. Senior author Associate Professor Kerrie Wilson received one of Australia's Prime Minister's Prizes for Science in 2016 for her work.

Manta rays munching on micro-plastics



More than a million tons of plastic are thought to enter Indonesia's oceans every year.

Much of it is in the form of micro-plastics, and that could be harming iconic oceanic filter feeders such as the manta ray.

Murdoch University researcher Ellie Germanov is working to assess the impact of the plastics on manta rays and explore ways to reduce plastic waste, with Dr Gede Hendrawan and his Universitas Udayana team (Ayudian Swarry, Bintang Gustavina, Rai Ayu Saraswati and Surya Risuana).

She's tracking the levels of micro-plastics (pieces with a diameter of less than five millimetres) in the feeding grounds of manta rays and whale sharks around the coastline of Nusa Penida and Komodo National Park in Indonesia, as well as fisheries in the Philippines, with plans for future research in the West Australian Coral Bay reefs.

Ellie hopes to use the information on plastics in feeding grounds and potentially in the guts of these animals to determine the effect micro-plastic may be having on reproduction and the success of the populations overall. The work is supported by the Marine Megafauna Foundation and the Ocean Park Conservation Foundation. "Micro-plastics absorb toxins from the environment and concentrate them in much higher levels than in the surrounding waters—once these toxic plastics are ingested by filter feeders such as manta rays and whale sharks, toxins can build-up in the animals' bodies," Ellie says.

Explore ways to reduce plastic waste

The team, along with recycling advocate Kennedy Diaz, have been interviewing more than 120 stakeholders and business owners to get an understanding of local attitudes towards management of plastic waste. Ellie says reducing waste is clearly a priority in the communities.

"While the waters of Southeast Asia are some of the worst affected in terms of plastic waste, plastics are still entering Australian waters—for example via plastic beads in facial scrubs and toothpastes, which are too small to be filtered during water treatment," Ellie says.

What roles do women play in fishing communities?

Opportunities for alternative livelihoods in fishing communities in Indonesia are being investigated by a team of Indonesian and Australian scientists. They're working to understand fisheries and the options for women in coastal areas, while reducing the pressure on targeted marine resources.

Small-scale fisheries are an important source of food security and income in developing countries. Many are also growing into international exporters, but they can place a huge strain on fish populations.

The team is reviewing past projects that encouraged alternative livelihoods for coastal communities—such as nature-based tourism or aquaculture—and whether change continued after these projects and their funding ended. They want to know how livelihoods from fisheries might be improved, as well as looking at alternative livelihoods.

The Australian lead researcher, Professor Neil Loneragan of Murdoch University, says that often women are balancing the household income and wellbeing of the whole family, along with gathering small shells for ornaments from reefs ('gleaning'), seaweed and fish preparation in factories, and buying and collecting fish for sale and transport.

But little information is currently available in government statistics on the number of women working in small-scale fisheries, so it's unclear whether attempts to diversify options have been successful.

Dr Budy Wiryawan of Institut Pertanian Bogor is the Indonesian leader of the work, which is a collaboration with Associate Professor Natasha Stacey of Charles Darwin University and also involves a number of Indonesian researchers from government and not-for-profit organisations.

Neil, who's also Chair of the Board of the Asia Research Centre, says the work will help Australians to better-understand Indonesian perspectives on fisheries, and will be shared with the Indonesian Ministry for Marine Affairs and Fisheries. It's due for completion in December 2016 and is supported by the Australian Centre of International Agricultural Research under the Fisheries Program, led by Dr Chris Barlow.



The work will help Australians to better-understand Indonesian perspectives on fisheries

Lemons to keep elephants out of trouble

Rows of lemon trees will be trialled as a deterrent for elephants wandering into rice fields, in a bid to reduce conflict between humans and the giant mammals.

The work is in Lampung Province, Sumatra, on the border of Way Kambas National Park in Indonesia, and forms part of a broader approach by an international group of organisations to help the Sumatran rhinoceros, the Sumatran tiger, the sun bear, the Sunda pangolin and the Asian elephant.

As part of its 100th birthday celebrations, Taronga Zoo in Sydney is working with several organisations including Yayasan Badak Indonesia (the Rhino Foundation of Indonesia) and wildlife trade monitoring network TRAFFIC, raising \$500,000 for conservation programs in Sumatra, Indonesia.

These species of rhino, tiger and pangolin are all listed as critically endangered on the IUCN Red List of Threatened Species, meaning they're considered to face "an extremely high risk of extinction in the wild".

The Asian elephant is listed as endangered, and the sun bear as vulnerable.

Aside from keeping animals out of crops, the projects will focus on veterinary support, community work (in eco-tourism), and demand reduction—one example of this is the Wildlife Witness smartphone app, created by TRAFFIC and Taronga Zoo, to encourage tourists and locals to easily report wildlife trade with a photo in the exact location it takes place.



Is the Bali ocean sunfish tourism sustainable?

Researchers are diving deep to find out more about the ocean sunfish, the Jabba the Hutt of the fish world, that hang out on the reefs off Bali for just three months each year. They've become an intriguing tourist attraction for divers, but is this tourism sustainable?

The sunfish head to the reefs from July to October to seek out cleaner fish—such as longfin bannerfish and emperor angelfish—which help them remove skin parasites and clean up skin lesions.

"It's a bit like a spa for these gentle giants, which can weigh over 2,000kg," explains Marianne Nyegaard, a PhD candidate from Murdoch University.

They've become an intriguing tourist attraction

Marianne has spent three consecutive seasons diving with the sunfish, studying their movements. She wants to make sure the diving tourism isn't disturbing for the fish and that it's sustainable.

"We've deployed eight satellite tags in Bali and sampled 30 fish from the local area for their genetics," Marianne says.

"Local dive operators have logged thousands of dives enabling us to look at temporal and spatial occurrence patterns of sunfish in the Nusa Penida Marine Protected Area. Our temperature logger array has recovered more than two million data points."

While Marianne is currently working through her data, she suspects the sunfish are probably more vulnerable to climate change than to the effects of curious onlookers.

The research has involved collaboration between Murdoch University, Aarhus University, the Coral Triangle Center, and RISTEK-DIKTI; and was funded by Seaworld Sea and Rescue Foundation Australia, Graduate Women WA, the PADI Foundation, and the Australian Government.

Lessons in conservation from traditional indigenous practices

What can we learn about contemporary conservation from indigenous practices? A West Papuan PhD candidate at James Cook University in Cairns is finding out.

In the Bird's Head Peninsula region of Indonesia, Freddy Pattiselanno is researching how indigenous peoples' traditional hunting patterns have adjusted in the face of societal changes.

He's also investigating how natural resources have been used and protected in traditional practice, in the hope of identifying lessons that can be incorporated into Indonesian environmental policies.

"To date, there hasn't been much research on wildlife and human activities in the large tropical forests of West Papua, particularly how animals are hunted for food and what this means for biodiversity and local food security," Freddy says.

So far, he's found a great variety of traditional approaches and knowledge regarding hunting, which need to be considered individually when looking to incorporate them into modern

conservation or natural resource management programs.

Freddy is looking to extend his approach, to utilise the knowledge of indigenous Australians and apply this to the management of other protected areas, particularly in northern Australia.

He completed his Master's degree at Universitas Negeri Papua before travelling to Australia to undertake a PhD with the help of the Indonesian Directorate of Higher Education and an AusAID scholarship.

Better ways to conserve the Coral Triangle

Six Southeast Asian countries are working together to better conserve the world's centre of marine biodiversity, the Coral Triangle, with the hope that this will lead to a more collaborative approach to sharing coral reef resources in the area.

The Coral Triangle sits between Malaysia, the Philippines, Indonesia, East Timor, Papua New Guinea, and the Solomon Islands, a group of countries that have formed the Coral Triangle Initiative. It is home to 76 per cent of the world's known coral species, 2,500 reef fish species, and the largest area of mangroves in the world.

Establish marine protected areas

The team at the ARC Centre of Excellence for Environmental Decisions (CEED) worked with the Coral Triangle Initiative to develop conservation strategies that the six nations could apply together to achieve common goals, which include managing biodiversity on the coral reef, making fisheries sustainable, and improving food security.

These strategies were determined using several objectives for identifying places where it would be beneficial to establish marine protected areas.

These included: representing all habitat types; protecting fish spawning aggregations; improving the status of threatened sea turtles; maximising the connectivity for coral trout and sea cucumber larvae to disperse, both regionally important fisheries species; and protecting places that are less affected by climate change.

These strategies will support a fair, appropriate, and collaborative conservation effort for the Coral Triangle.

Leapfrogging towards water sensitive cities: The Australia-Indonesia Centre Urban Water Cluster

How can cities grow and thrive in an era of climate change? This is a challenge faced by both Australia and Indonesia. With ever-increasing population shifts towards urban environments, it is crucial to make cities sustainable.

Australian cities are adopting water sensitive approaches. Melbourne Water, for example, has created over 10,000 raingardens. But progress is slow, in part because of the existing massive traditional water infrastructure.

Indonesian cities have an opportunity to leapfrog certain stages in building core urban water infrastructure. For example, rather than investing only in a centralised sewerage system, such as those of Melbourne and Sydney, Indonesian cities can implement treatment and recycling systems that also integrate decentralised infrastructures at the neighbourhood scale, increasing their efficiency and cost-effectiveness and accelerating the path to water sensitive cities.

In this way, developing Indonesian cities would avoid repeating the mistakes that Westernised cities made, through being technologically and institutionally locked into less resilient and less sustainable water management solutions.

The Australia-Indonesia Centre's Urban Water Cluster imagines cities in which the water cycle is managed to protect and enhance the health of waterways, mitigate flood risk, and create public spaces that harvest, clean, and recycle water. Integrated water management will support biodiversity, public green space, healthy waterways, connected communities, and cultural significance. Ultimately, these cities will use water sensitive planning and design to create connected, vibrant and liveable communities.

The Cluster's core activities will focus on Indonesia's second largest city, Surabaya, as well as Bogor, a sub-city of Greater Jakarta. Associated activities will translate the Cluster's findings for cities in northern Australia and for other Indonesian islands.



Read more about the Cluster at: australiaindonesiacentre.org/clusters/urban-water

Energy

- Putting a figure on the cost of algae to ships
- Better, safer lithium batteries
- Designing the coolest tropical houses

The geography of Indonesia and Australia—one a densely populated network of many islands, the other a vast continent containing remote and rural communities—can make energy a challenge. Both countries are working towards cleaner, more efficient energy.



Designing the coolest and most efficient tropical houses

Traditional buildings in Indonesia make use of ‘passive’ cooling techniques.

Being well ventilated, raised off the ground, and with shady verandas, their design allows them to stay cool in a tropical climate without air conditioning. The classic timber ‘Queenslander’ house also follows a similar design.

Now architects and engineers from both countries are getting together to compare notes on such designs and materials in a collaborative project funded by the Australia-Indonesia Centre.

One of the biggest problems is incorporating these design features into high density urban areas. But housing construction in very high density urban areas is needed, says Jatmika Suryabrata of Universitas Gadjah Mada, who is leading the Indonesian end of the project.

Much of this housing is high-rise and a huge amount of this sort of construction is planned in coming years.

“Cross-ventilation in these buildings is a challenge. So creating more porous building masses for low income vertical housing will be critical. And ceiling fans could significantly improve thermal comfort,” Jatmika says.



Lasers and a window in a ship’s hull: scientists work to improve shipping efficiency

Every shipping manager wages an endless battle against fouling—the bacteria, seaweed, barnacles and other marine life that take residence on the hull of ships.

This biofouling is thought to add more than 20 per cent to the fuel costs of commercial shipping—that’s a big cost for the maritime trading nations of Australia and Indonesia.

Using lasers and a window in a ship’s hull, a team of scientists from both countries will assess how quickly the efficiency of the ship declines, then how to balance fuel efficiency and the cost of putting a ship in dry dock to clean it.

“Essentially we’ve built a laboratory worth thousands of dollars inside the hull of the ship,” says Professor I Ketut Aria Pria Utama from Sepuluh Nopember Institute of Technology (ITS).

“Once we clearly know how things are growing on the bottom, and the effect this has on fuel efficiency, we can suggest more informed anti-fouling strategies, saving time and money for boat operators and passengers.”

The team combines the maritime experience of engineers from ITS with fluid mechanics expertise at the University of Melbourne and the University of Southampton, along with protective coating group Hempel.



Shading and building orientation are also significant factors

“Research discussions with ship operators all go well until we say ‘and now we just need to put a small hole in the side of your ship,’” says Associate Professor Nicholas Hutchins of the University of Melbourne.

“But our Indonesian collaborators persuaded the PT Dharma Lautan Utama line to allow us to install a 30cm window in the hull of one of their inter-island ferries, the 71 metre Dharma Kencana IX, which transports people between Java and South Sumatra.”



Joining the race for better, safer lithium batteries

Commercialising the technology for the next generation of lithium batteries is the target for a team of Indonesian and Australian scientists, who are backed by battery manufacturer PT Nipress Tbk.

Lithium batteries allow for a large amount of energy to be packed into a small space. But they're costly compared to single use 'disposable' batteries, and have special requirements for transportation and storage.

Organisations around the world—including Airbus Defence and Space, Imperial College London, and Sony—are working on the next generation of lithium batteries, which use a silicon-carbon compound anode instead of the commonly-used metallic lithium, and replace the cobalt cathode with one of sulphur. These have the potential for more power at less cost, but currently the technology hasn't been commercialised, and the batteries tend to have a shorter cycle life.

Australian and Indonesian scientists are now hoping to create cheaper, safer, and more energy-efficient lithium-sulphur batteries, and bring the technology right through to commercialisation. A team from the University of Wollongong and Indonesian battery manufacturer PT Nipress Tbk has received over \$210,000 dollars for research from 2016-2019 as a 2016 Australian Research Council Linkage Project.

The next generation of lithium batteries

Aside from boosting the countries' international profiles as leaders in energy storage technologies, they want to improve the batteries' safety and increase overseas demand for the raw materials used.



An end to Indonesia's hospital power blackouts? Sensing reductions in energy use

A team from Universitas Gadjah Mada (UGM) and the Australian National University (ANU) are planning to use thousands of sensors to monitor heat, noise, human activity and power usage in commercial buildings in Yogyakarta. This data will help them design a real-time monitoring system that saves energy and can be used in commercial buildings across Indonesia.

Energy demand in Indonesia has grown by 150 per cent over the last 30 years. Electricity supply is struggling to keep up—blackouts are common in hospitals, hotels, offices, shopping centres and university laboratories.

"Our research is helping the building codes have real impact. But to have an even bigger impact we need to retrofit existing buildings," says Sentagi Sesotya Utami from Universitas Gadjah Mada. He is co-leader of the research, funded by the Indonesian Directorate General of Higher Education (DIKTI) and the Australia-Indonesia Centre.

"Indonesia simply doesn't have enough electricity. Reducing energy use is a much cheaper way to meet demand than building more power stations," says Tom Worthington, Adjunct Lecturer at ANU's Energy Change Institute and co-leader of the project.

The project also has implications for ANU, Tom says.

"We're experiencing the same problem—the electricity feeders to campus are maxing out. It costs a lot of money to buy more power so we're hoping this project can also help us learn how to best to manage the load."



Affordable, sustainable energy for all: the Australia-Indonesia Energy Cluster

Access to affordable, reliable energy transforms communities. For most Australian and Indonesian families and businesses, that energy still comes from national grids—the networks of power lines that connect users to power suppliers.

But about 67 million Indonesians—almost a third of the country's population—are not on the grid. They either rely on expensive, non-renewable sources of power—often diesel—or they have no access to power at all. That poses a critical challenge for sustainable development of Indonesia—a nation of islands. To meet the Government's goal of 90 per cent electricity coverage by 2020 the country's electricity generation must grow by nine per cent per year.

Australia also has many remote indigenous communities, island communities and remote mine sites that rely predominantly on electricity generated locally from expensive to deliver, and CO2 emitting diesel.

So what are the best ways to transform energy supply in the two countries? The Australia-Indonesia Centre has created an Energy Cluster of applied research projects to explore:

- Local area microgrids: rolling out sustainable energy access for all communities
- Energy system transformation pathways: what is the right balance between centralised electricity transmission and local area microgrids?
- Choosing the right technologies: energy technology and cost assessment for Indonesia and Australia.

Read more about the Cluster at: australiaindonesiacentre.org/clusters/energy

Agriculture

- Sharing expertise, not pests
- International demand for Indonesian coffee
- Safer farms for poultry and people

Ways to improve the sustainability and productivity of various forms of agriculture are being approached in many ways by Indonesia and Australia.



Making biosecurity profitable for Indonesian poultry farmers

Domestic poultry, farmers, and consumers will all benefit from the work of a research team in improving the understanding, and use, of biosecurity measures in Indonesian farms.

Making sure poultry stay healthy is important not only for the welfare of the birds, but also the lives of people interacting with them. Highly pathogenic avian influenza (HPAI) is extremely contagious, and control of the disease is essential to reduce the risk of a global outbreak, improve livelihoods of everyone involved in the poultry industry, and prevent further human deaths.

But when there's low traceability and little price difference between healthy or sick birds, it can be difficult to encourage biosecurity measures on farms.

The four-year project was completed in 2013 and involved non-industrial, commercial poultry farms in Bali, West Java, and South Sulawesi. The researchers ran a range of training courses for more than 500 farmers, commercial company farm advisors, farm biosecurity auditors, and other stakeholders. They also set up a bio-secure farm of the year competition, and produced training videos.

Trained farmers who implemented Indonesian Poultry Biosecurity Centre-approved farm biosecurity plans then participated in a trial selling their product under the 'Healthy Farm' logo in supermarkets. They found consumers were prepared to pay 10 per cent premiums for these products.

Improve livelihoods of everyone involved

Better understanding of how disease moves and implementation of low cost biosecurity measures has helped convince both contract companies and their partner farmers of the economic benefits of biosecurity. It's now these contract companies in Indonesia that are encouraging further adoption.



Island nations sharing expertise, not pests

Biosecurity research, training and education in Indonesia and Australia are set to benefit from a bilateral research agreement between five Indonesian research organisations and the Australian Plant Biosecurity Cooperative Research Centre (PBCRC), announced in April 2016.

The first project in the partnership is the development of a virtual diagnostic network using the Pestpoint software developed by the PBCRC.

Pestpoint is a social networking tool that allows groups of people to pool their expertise to collectively identify pests and diseases. The project will couple the Pestpoint software with a range of digital tools, including portable

wireless microscopes, mobile devices, and the Centre's remote microscope system.

This Remote Microscope Diagnostics Network will be set up in the four Indonesian universities, and will help collect data on the occurrence of pests in different areas, without the need for on-the-ground experts in all cases.

As a country made up of many islands, Indonesia must deal with the risks of invasive species that may tag along with trade and tourism. And any efforts to minimise the movement of unwelcome species within a country will also be beneficial to neighbouring countries—so the collaborative work of Australia and Indonesia on the project is hoped to benefit the wider Southeast Asia region.

The network—including Universitas Mahasaraswati Denpasar, Universitas Kristen Satya Wacana, Universitas Nusa Cendana, Universitas Sam Ratulangi, the Pacific Institute for Sustainable Development, and Australia's PBCRC—will also facilitate the exchange of researchers, students, and research ideas between Indonesia and Australia.

Saving Indonesia's cocoa

Supporting farmers and improving crop sustainability are the focus of collaborative work to save Indonesia's ailing cocoa bean yields.

Production of cocoa beans for chocolate-making is big business in Indonesia, especially in Sulawesi—where from the 1970s to 1990s, production grew from almost nothing to around 1.5 million hectares of smallholder plantings, and the third-largest production output in the world.

The farmers in the study have increased their cocoa yield

This 'cocoa boom' is now threatened by pests and diseases, aging trees, declining soil fertility and poor farm maintenance, which have contributed to a decline in production over the last decade. There is a serious drive in Indonesia to improve the yield per hectare on existing farms, particularly without the need to expand into forested areas.

This drive has included a two million dollar Australian Government project aimed at improving crop sustainability by testing and promoting better cocoa varieties, maintaining soil fertility, and new farming techniques and pest and disease management.

The work, which ran from 2011 to 2016, was led by the Australian Centre for International Agricultural Research (ACIAR), the Assessment Institute for Agricultural Technology, Indonesian Coffee and Cocoa Research Institute, Universitas Hasanuddin, La Trobe University, and The University of Sydney.

Chocolate company Mars Inc. was also a key contributor, and are continuing the project in Sulawesi. Initial reviews suggest that the farmers in the study have increased their cocoa yield—results which have spread beyond those directly involved.



Getting the most out of Indonesian specialty coffees

Coffee processed on the Indonesian island of Flores has gained popularity in the international specialty coffee scene, as a result of efforts to improve revenue for small coffee farmers in regional areas.

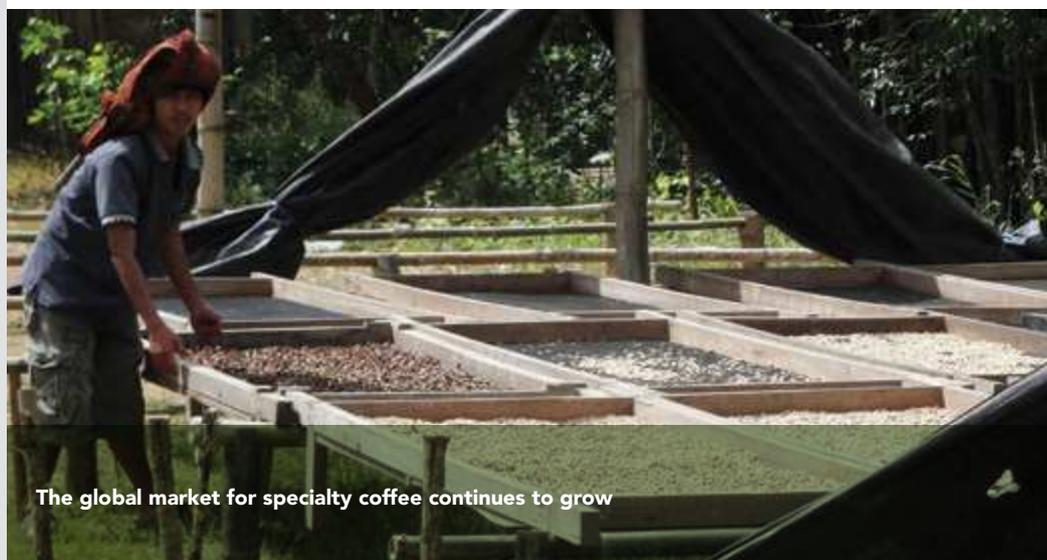
The global market for specialty coffee continues to grow, but that demand is increasingly paired with a call for traceability, enhanced quality demands, and evidence of environmental and social standards throughout the production chain.

While this demand is an opportunity for smallholder farmers in regional Indonesia, they haven't always been able to meet the requirements. A collection of Indonesian and Australian organisations wanted to fix this. In 2008 they began a project to facilitate relationships between international coffee buyers and Indonesian farmers—but they recognised that coffee roasters connecting directly with growers doesn't always guarantee a benefit to the farmers. Their work has identified bottlenecks in developing successful relationships, assessed their impact on farmer livelihoods, and helped Indonesian agencies support relationships that benefit farming communities.

To develop 'taste profiles' and promote local regions on the specialty market, part of the work involved coffee sampling and assessment by more than 50 Indonesian, Australian and American coffee experts. They found that a processing method used on the island of Flores ('Pulped-Natural' or 'honey' coffee) wasn't only preferred by farmers, but also buyers—resulting in a boost in commercial production of this unique specialty coffee.

Their findings are being shared with industry representatives across Indonesia. And their activities are expanding from the districts in South Sulawesi and Flores, and being applied in North Sumatra and West Java.

The team includes researchers from the Indonesian Coffee and Cocoa Research Institute, The University of Sydney, the District Estate Crops Agency of Indonesia, and is funded by the Australian Centre for International Agricultural Research.



The global market for specialty coffee continues to grow

Earth sciences

- Searching for hidden gold and copper
- Finding the Hobbit and more
- Making artificial tsunamis

Indonesian and Australian teams are digging, sifting, and scanning the earth to discover treasures, secrets of the past, and the hazards of the future.



Homo floresiensis are descended from *Homo erectus* who were castaway on the island, and shrank due to a phenomenon known as Island Dwarfing

The little people of Flores

The 2003 discovery of a fossil of a small, human-like creature, *Homo floresiensis* (nicknamed 'Hobbit'), in Indonesia by the late Professor Mike Morwood and Professor Raden Soejono shook up palaeoanthropologists worldwide. But there was more to find.

In 2010 Mike and his team returned to the island of Flores. With researchers from the Geology Museum Bandung, Geological Survey Institute of Indonesia and Pusat Penelitian Arkeologi Nasional, and with the help of 120 trained field workers from the Ngada and Nage Keo districts, they initiated one of the largest fossil digs in Southeast Asia. They found pygmy elephants, Komodo dragons, giant rats, and stone tools.

One of the largest fossil digs in South-East Asia

Mike passed the Australian leadership of the project to Dr Gert van den Bergh, who, together with Iwan Kurniawan, had been undertaking excavations in Mata Menge (50km east of the Hobbit site) for over 20 years.

In 2014, local Flores field worker Andreas Boko excavated a small human tooth which was identified by Indonesian PhD student, Mika Puspaningrum.

In the ensuing weeks more teeth were found, together with skull and jaw fragments. These human fossils are from at least one adult and two children who lived more than 700,000 years ago. Surprisingly, they are smaller than *Homo floresiensis* of 2003, and could be the ancestors of the Hobbit.

The research, published in *Nature* in 2016, suggests *Homo floresiensis* are descended from *Homo erectus* who were castaway on the island, and shrank due to a phenomenon known as Island Dwarfing, where large-bodied animals gradually become smaller over time.

"The knowledge and field skills of our Indonesian colleagues—geologists, archaeologists and palaeontologists—have underpinned the success of our research, and will continue to do so into the future," says Dr Mark Moore of the University of New England, who assisted in analysing the stone tools.

The search for fossils continues.





What happened to Asia's lost 'elephants'?

Why did *Stegodon*, the elephant-like animals that were once widespread throughout Asia, decline and eventually disappear?

Stegodon were a group of trunked mammals, related to (but not the ancestors of) modern elephants. As they dispersed to many of the Southeast Asian islands with scarcer food resources, they evolved to become 'dwarfed'.

PhD candidate Mika Puspaningrum, an Indonesian woman studying at the University of Wollongong, has used chemical clues from the outer coating (enamel) of *Stegodon* fossil teeth, to reconstruct changes in the diets and habitats of these animals over the last eight million years.

The work is part of Indonesian-Australian research piecing together the evolution of elephants and humans, co-led by Iwan Kurniawan from the Geology Museum Bandung, and includes scientists from the Indonesian National Research and Development Center of Archaeology with international collaborators.

"*Stegodon* teeth from the Indonesian island of Flores show that from one million years ago, they became almost exclusively grass-eaters," says Dr Gerrit van den Bergh, the Australian lead researcher who is Mika's supervisor.

They suspect that as the forested areas gave way to savannahs, *Stegodon* may have helped maintain the grasslands—which they shared with 'the Hobbit' *Homo floresiensis*, a relative of modern humans, for almost one million years.

Stegodon may have helped maintain the grasslands

Despite evidence that baby *Stegodon* were on the Hobbit menu by 60,000 years ago, apparently this didn't lead to their extinction. The debate now continues as to why both *Stegodon* and *Homo floresiensis* eventually went extinct around 50,000 years ago, and whether it had anything to do with the arrival of the only remaining species of human—*Homo sapiens*.



A *Stegodon* skeleton assembled by Iwan Kurniawan from the fossil bones of multiple adult individuals excavated at Mata Menge



Predicting where gold and copper lie

Indonesian and Australian scientists are searching for buried treasure: using the movement of tectonic plates to predict when and where giant deposits of gold and copper should form, while building an understanding of the conditions these deposits are created in.

The project, which began in 2013 and is due for completion in 2016, is using Southeast Asia as a 'natural laboratory' to explore these natural processes and their products.

Knowing when and how deposits formed can help us understand geological processes occurring today.

Searching for buried treasure

To 'go back in time,' the researchers have to know the exact age of the deposit, then use satellite data to infer present-day rates of movement of the earth. They then run analyses to see what the specific conditions were at the time that deposit formed.

It's not certain whether giant ore deposits are formed in a special way and under unique conditions, or if they're simply large accumulations formed in the same way that deposits of all sizes are. Knowing whether distinct geological conditions are needed for these giant deposits of metal to form could help with exploration.

The researchers will also produce a toolkit, which will allow four-dimensional virtual exploration of how to apply their search methods.

The project involves collaboration between the Bandung Institute of Technology; the Australian National University's Satellites, Seismometers and Mass Spectrometers initiative; AngloGold Ashanti Australia; Agincourt Resources; Vale Australia; Utrecht University in the Netherlands; the South East Asia Research Group Royal Holloway University of London; and Aberdeen University in Scotland.



Reassessing Jakarta's seismic risk

The work of Indonesian and Australian scientists is resulting in re-evaluation of Jakarta's seismic risk by Indonesian Government agencies.



The team is scanning the Earth from thousands of kilometres in the air, right down to chemical traces found in rocks, as they hunt out telltale signs of future earthquakes and the damage they might do. They've highlighted a major new seismic threat for East Java as well as the tsunami threat to Bali, Lombok, Nusa Tenggara, and other coasts along the Flores Sea; and have identified active faults in the Nusa Tenggara region of Eastern Indonesia, measuring the rates of strain building up.

Dr Achraf Koulali, a Moroccan scientist based at the Australian National University, is conducting the data analysis and modelling, as part of a broad research team bringing the range of information together.

They're using: Global Positioning System (GPS) satellites orbiting 20,000 kilometres above the Earth, which are continuously monitoring millimeter movements of the Earth's crust; seismometers, which measure minute vibrations in the Earth as tectonic plates grind against one another; and mass spectrometers, which use chemical analysis to find the histories in rocks from the past.

The team is now focusing their attention westward, to the Indonesian island of Java, to uncover which of the many mapped faults are accumulating energy—and whether it could one day be released in a devastating earthquake.

The team involves researchers from the Institute of Technology Bandung, Australian National University, and the Indonesian Government department Badan Informasi Geospasial. It's funded by an Australian Research Council Linkage grant that began in 2012, to improve understanding of Indonesia's earthquake hazards and the country's resilience to future seismic events.

Find the histories in rocks from the past

Predicting fire, flood, and food shortages

In lands 'of droughts and flooding rains,' predicting the weather means saving both lives and livelihoods.

The work of Indonesian and Australian scientists, which began with a visit to Jakarta in 1981 by climate scientist Professor Neville Nicholls, has given the countries the ability to forecast rain in the dry season, and during the lead up to the wet season. This means the fires, haze, and food shortages that often go hand in hand with droughts can be predicted—and planned for.

During the initial four-month trip, funded by the United Nations Development Programme, Neville met with colleagues from Badan Meteorologi, the Indonesian Bureau of Meteorology. They worked to investigate how the El Niño–Southern Oscillation was related to Indonesian rainfall, leading to methods for predicting seasonal rainfall variations. This cyclic weather pattern brings droughts and floods to Australia, Indonesia, and other nearby countries.

We can predict its behaviour, months in advance

Knowing how much rain is likely to be on the way can be particularly invaluable in areas of big population growth—for example when fires are used during Indonesia's dry season to clear land ahead of crop planting, the beginning of the monsoonal rains can be used to help extinguish or keep them under control. And with reports of increased extreme fire weather and a longer fire seasons across many areas of Australia, earlier warnings for potential bushfires are relied upon by many. "The El Niño–Southern Oscillation has been causing droughts, fires and haze in Indonesia for hundreds of years," says Neville, previously of the Australian Bureau of Meteorology and now of Monash University.

"Now, with modern methods of monitoring the phenomenon, we can predict its behaviour, months in advance, allowing effective action to reduce the worst impacts."



Making waves: artificial tsunamis to prepare for the worst

Ninety-nine per cent of all tsunami-related deaths have occurred in the Asia-Pacific region, according to the United Nations Economic and Social Commission for Asia and the Pacific. Indonesian and Australian scientists have been working to reduce this figure—by creating artificial earthquakes and tsunamis.

Building off more than 15 years of research from Indonesian, Singaporean, American, and Australian scientists, the team created a collection of scenarios, for earthquakes of different magnitudes and the resulting tsunamis that would affect West Sumatra, Indonesia.

The work involved studying trends in coral growth and death in the Mentawai Islands of Indonesia, along with the magnitude of past earthquakes. Large earthquakes can raise the sea floor, exposing and killing off corals.

Create realistic scenarios for future disasters

The corals start to grow again as the islands settle back down, and these patterns have helped the scientists to understand the magnitude of earthquakes throughout the centuries, allowing them to create realistic scenarios for future disasters.

The research was used to inform an international disaster response exercise in 2014, the Mentawai Megathrust Disaster Response Exercise, which was held in West Sumatra and organised by the Indonesian National Disaster Management Agency.

The research involved scientists from Geoscience Australia; Bandung Institute of Technology; the Australia-Indonesia Facility for Disaster Reduction, Jakarta; the Agency for the Assessment and Application of Technology, Yogyakarta; Geology Agency of Indonesia; the Meteorology, Climatology and Geophysics Agency; the Indonesian Institute of Science; and the National Disaster Management Agency, Jakarta; and was supported by the Australian Department of Foreign Affairs and Trade.

Large earthquakes can raise the sea floor, exposing and killing off corals

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Our thanks to the Australia-Indonesia Centre for their support.

The Australia-Indonesia Centre was established by the Australian Government in late 2013 to facilitate research-driven innovation and build stronger relationships between Australia and Indonesia.

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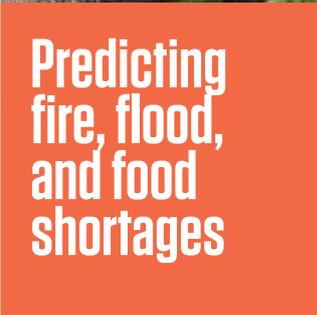
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