Current Science Reports

Agriculture to Aquaculture

Transformations in the Sundarbans

Farmers in West Bengal's Sundarbans Biosphere Reserve are transforming their agricultural lands into brackish water aquacultures. What are the drivers of these land-use changes? How can we make these changes sustainable?

To find out, a team from the Jadavpur University, Kolkata collaborated with researchers from the UK and Sweden.

Sugata Hazra and the team interviewed farmers from each of the 19 community development blocks in the reserve. The in-depth interviews revealed aquaculture practices, drivers behind the land-use transformations, and the economics involved.

Ninety-one per cent of the respondents had already converted their monocrop agricultural land and the rest, their multi cropland, to aquaculture.

Increasing soil salinity due to saline water inundation driven by frequent embankment breaching during cyclones and scarcity of freshwater for irrigation make agriculture unprofitable. Moreover, aquaculture provides a much higher income than agriculture.

'So, the land conversion is driven more by the profit motive than by salinity,' explains Oindrila Basu, Jadavpur University.

The responses indicated that growing the exotic white leg shrimp is more profitable than culturing tiger shrimp, a local variety.

The researchers noted that 60% of the respondents continue using traditional techniques of aquaculture. Although traditional aquaculture provides livelihood to a large number of marginal villagers, the returns are comparatively low. The farmers are apprehensive about investing in semi-intensive practices of exotic species as it requires more capital investment and there is a higher risk of financial loss. So only about 20% of the respondents have adopted semi-intensive practices.

'For the traditional culture, marginal fisherwomen collect the post-larvae of shrimps from the wild. Setting up rearing centres for shrimps can reduce the stress on wild populations,' says Sourav Samanta, Jadavpur University.

'This step, along with the promotion of improved-traditional aquaculture, can make aquaculture practices more sustainable,' suggests Sandip Giri, Jadavpur University.

However, the researchers worry that the unchecked loss of agricultural and mangrove forest lands may have adverse consequences on the fragile ecosystem. They recommend implementing policies and action plans for improving existing aquaculture practices as well as preventing illegal land conversion for aquaculture in the reserve.

Sugata Hazra emphasises the need to ensure alternate livelihoods for the post-larvae collectors and rainwater harvesting for irrigation to promote agriculture in the area.

DOI: 10.1007/s13280-022-01720-4

Indian Roselle

A source of natural dye

Indian roselle, *Hibiscus sabdariffa*, contains anthocyanin pigments. Even the calyx, the structure that holds the petals of the flower, produces the pigment.

Image: Earl Benton via Wikimedia Commons

The pigment can be used as an alternative to synthetic dye. But the application of this natural dye in the textile and dye industries has not yet been evaluated.

Recently, scientists from the Madha Engineering College and Bionyme Laboratories, Chennai, took steps to rectify this.

They used explants, plant tissue cultured in an artificial medium, to extract anthocyanins from the calyx. They ground the freeze-dried calyx with combinations of acidified ethanol solvent and absolute alcohol.

After centrifuging the mixture, they extracted the crude supernatant to get the anthocyanins. The extract was then used for dying cloth.

The researchers tested colour fastness by washing the dyed cloth with soapy water. Heat resistance was verified by keeping the cloth at various temperatures.

'We found that the pigment is retained and can be used as a textile dye,' says Leeba Balan, Bionyme Laboratories, Chennai.

'Our initial experiments show that the natural pigment can be used for making lipstick and dye-sensitised solar cells too,' adds Bharath Sankaralingam, Madha Engineering College, Chennai.

Now industries can try anthocyanins for making dye-based products.

DOI: 10.1007/s12010-022-03815-w

Diagnosing Preeclampsia

Interleukin-6 as biomarker

Preeclampsia is a condition during pregnancy that could lead to organ damage. If not managed well, preeclampsia can lead to serious complications for both mother and baby.

Early diagnosis can help design better therapeutic interventions and help clinicians manage the condition better. However, the diagnosis of the condition remains difficult.

High blood pressure and the presence of proteins in urine around the 20th week of gestation are the main symptoms of this condition.

The disorder is marked by a shift in the balance of angiogenic and anti-angiogenic proteins in maternal blood circulation. The induction of inflammatory

intermediates has also been reported. Can we use any of these proteins as a biomarker to diagnose preeclampsia?

Researchers from the University of Hyderabad and the Fernandez Hospital Educational and Research Foundation, Hyderabad recently identified one.

From patients visiting the hospital's obstetrics department for antenatal check-ups, they took blood samples at each trimester and at term.

Then they isolated serum and plasma from the blood samples. Using an enzyme-linked immunosorbent assay, they determined the maternal serum concentrations of four potential protein markers. There was a nearly 30-fold increase in interleukin-6, an inflammatory intermediate, from the third trimester to the term, in women who developed preeclampsia during delivery.

'This will help develop an effective strategy to diagnose preeclampsia,' says Athar H. Siddiqui, University of Hyderabad.

'It will also help therapeutic interventions to manage the condition,' says Nuzhat Aziz, Fernandez Hospital.

More studies are required to finalise the level of interleukin-6, to be used as a biomarker in clinical practice.

DOI: 10.1007/s11010-022-04403-6

Sports-Related Cardiac Arrest

Bystander response counts

Sudden cardiac arrest during sports accounts for only a minority of heart attack-related deaths. Yet media attention is aroused because cardiac arrest among healthy athletes is unexpected.

To prevent sports-related cardiac deaths, sportspersons are screened for cardiac conditions. Preparedness to provide basic life support in emergency situations is another strategy adopted. How have these measures impacted the incidence of cardiac arrest and related deaths?

Kumar Narayanan, Medicover Hospitals, Hyderabad recently collaborated with the University of Paris and hospitals in France to analyse data from 377 sports-related cardiac arrest incidents, during and within one hour after sports.

They examined trends in incidences of sports-related cardiac arrest and survivability among individuals aged between 18 and 75 years.

The data indicated that only 20 young individuals aged 18–35 years had experienced sports-related sudden cardiac arrest. The remaining 95% incidences were observed in those aged between 35 and 75 years. These persons had plaque build-up in their arteries. The build-up blocks blood circulation, eventually leading to cardiac arrest and death.

To examine cardiac death incidence over time, the researchers divided the study period into six successive 2-year periods from 2005 to 2018. They found that the cardiac arrest incidence rate remained unchanged over the study period. But, compared to the first two years of the study, the survival rate improved three times in the last two-year period.

Could this be because of bystander interventions such as cardiopulmonary resuscitation? The researchers examined the data.

'The improvement in survival rates is partly because of the increase in immediate intervention by bystanders who provided CPR. In the hospital, controlled electric shocks helped restore the heart's normal rhythm,' says Kumar Narayanan.

Training the public to perform basic life support could help reduce sports-related cardiac deaths. However, the incidence of sports-related cardiac arrest remained stable, suggesting that screening for heart disease among people who participate in sports needs to be stepped up.

Wearable sensors or mobile-based devices to monitor heart rate and geolocation can also help reduce deaths due to sports-related cardiac arrest.

DOI: 10.1016/j.jacc.2021.11.011

Fall-related Injuries in Older Adults

Causes and prevention strategies

Falls are a major cause of unintentional injury deaths worldwide. Thirty-eight million life-years are lost every year due to fall-related life-long disabilities.

As the Indian population ages, this problem is expected to increase. Risk factors associated with fall-related injuries need to be identified to adopt appropriate prevention strategies.

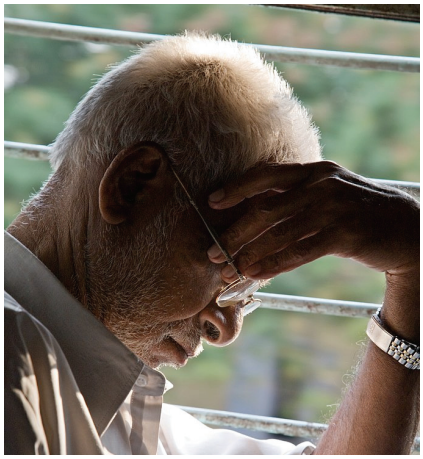

Image: George Royan via Wikimedia Commons

Recently, Shobhit Srivastava and T. Muhammad from the International Institute for Population Science, Mumbai conducted a survey of nearly 10,000 adults in seven major states in India to understand the issue.

Their questionnaire elicited data about the respondent's socio-demographics, work history, income and assets, living arrangements, social activities as well as health status and social security-related issues.

To identify risk factors and uncover the interdependency of the variables, the researchers performed regression analysis.

'More than three per cent of older adults had a fall-related injury. Older women are more prone to fall-related injuries,' says Shobhit Srivastava.

Consuming alcohol increases vulnerability to falls and injuries. Those with walking difficulties are at greater risk. Poor health and dementia are other risk factors. Fall-related injuries among the uneducated remain mostly unreported.

'To reduce the problem, the WHO recommends training older adults and addressing identified individual risk factors,' says T. Muhammad.

We may also need to assess the conditions at home. Removing clutter, installing night lights, replacing slippery tiles and so on can go a long way to reducing the chances of a fall.

DOI: 10.1186/s12889-022-12975-7

COVID-19 Post Vaccination

Breakthrough infections

COVID-19 vaccination normally leads to very mild to moderate side effects. In some, these may be more severe or last a little longer. Reports of long-lasting side effects are rare.

The vaccines in use were released as an emergency measure to tackle the pandemic. They have not gone through the usual Phase IV clinical trials. Monitoring and follow up studies have also been meagre.

So, Geetika Arora and her colleagues from the University of Delhi decided to investigate adverse events and breakthrough COVID-19 infections after the COVID-19 vaccination.

They surveyed Indians aged above eighteen using online Google forms and using a physical mode administered by trained ASHA workers. The respondents were men and women of various age-groups. More than two thousand participants provided data about their social, demographic, and general health status as well as data on SARS-CoV-2 infection, comorbidities if any, vaccination-associated adverse events and breakthrough infections.

More than a thousand respondents had taken at least one dose of either Covishield or Covaxin – mostly Covishield. Four hundred of those who were administered the vaccines experienced adverse effects.

About 80% of females and 70% of males under the age of forty reported adverse effects. Interestingly, a reverse order was observed in the age group of forty-one to sixty years: 25% of males and 17% of females reported adverse events.

As we age, our immune system weakens and immune memory cells become dysfunctional. This leads to a reduced response to vaccination. Those aged sixty-one years and above had more breakthrough infections. The total breakthrough infections among Indians were found to be slightly below 8%.

Since adverse events are an indication of rapid immune response to the vaccine, the side effects, post-vaccination, can be a good indicator of active adaptive immunity gained through vaccination.

DOI: 10.1002/jmv.27708

Bamboo Fibres for Brake Pads

Replacing asbestos

Asbestos is used to make automobile brake pads as it has suitable mechanical, physical and chemical properties. But it contaminates the environment and exposure leads to cancer.

Aromatic polyamide fibres or aramids have been used to replace asbestos in high-quality brake pads. But such brake pads create noise and dust and have a short life.

Bamboo fibres are easily available, low cost and are eco-friendly. Their mechanical properties are commendable.

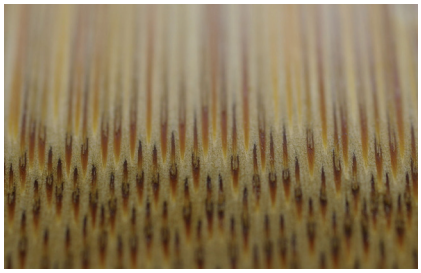

Image: tamakisono via Wikimedia Commons

Can we use bamboo fibres as a partial replacement for asbestos in automobile brake pads, wondered Naresh Kumar and other researchers from the Green Hills Engineering College, Himachal Pradesh.

They made composites with bamboo fibres and polyacrylonitrile fibres. Polyacrylonitrile fibres are synthetic, semi-crystalline organic polymer resins with high thermal resistance and are used for making high-performance brakes.

The researchers mixed the bamboo fibre with polyacrylonitrile fibre at four different proportions. The properties of these four composites were compared with those of aramid composites.

The researchers found that the 6% bamboo fibre-polyacrylonitrile fibre composite was at par with the aramid composite in most of the properties compared.

In terms of the heat generated, thermal stability and wear, the aramid composite showed better performance than the bamboo-polyacrylonitrile fibre composite.

The bamboo-polyacrylonitrile fibre composite showed better performance for frictional, thermal and mechanical properties.

'The bamboo-polyacrylonitrile composite has a higher coefficient of friction and the recovery percentage is above 100%,' says Naresh Kumar.

So bamboo fibres can be an alternative to aramid fibres for brake pads. Automobile manufacturers need to test this eco-friendly alternative.

DOI: 10.1002/pc.26584

Flexible Lithium-Ion Batteries

Using free-standing electrodes

Lithium-ion batteries are in great demand and are used in many modern devices. Lighter batteries use carbon nanotubes, fibres or graphene as current collectors instead of conventional metal foil. Though this calls for modified fabrication methods and decreases the overall capacity of the battery, the potential for use in wearable devices justified the drawback.

The next step in wearable devices is flexible and foldable batteries. Recently, Indrajit Shown from the Hindustan Institute of Technology and Science, Chennai collaborated with researchers from Taiwan to develop flexible lithium-ion batteries.

Conventional lithium-ion batteries use copper as a current collector at the anode and aluminium at the cathode. The researchers prepared a free-standing flexible electrode film from lithium iron phosphate and aluminium to replace one of the pure metal electrodes.

To reduce aluminium and thickness, they tried two aluminium etchants – chemicals used to remove layers from surfaces. The films were etched using phosphoric acid-based and tetramethylammonium hydroxide-based etchants. The etched films were then washed and dried to make a flexible electrode.

The researchers replaced the aluminium foil cathode with this flexible, free-standing electrode to assemble a lightweight coin-type cell. The electrode etched with the tetramethylammonium

hydroxide-based etchant showed the highest capacity, flexibility and stability in different charging-discharging cycles. The electrodes were also easy to fabricate and possessed sufficient mechanical strength.

'This simple etching technique is versatile for fabricating flexible free-standing anode and cathode materials,' says Indrajit Shown, Hindustan Institute of Technology and Science, Chennai.

The fabrication method for the flexible batteries is simple. And it does not compromise the capacity of the battery.

Portable and wearable device manufacturers need to explore the use of these flexible batteries to reduce the weight and size of their devices.

DOI: 10.1039/d1ra08993e

Tanjore Paintings

In-painting technique to restore

Tanjore painting is a classical style that originated in Tamil Nadu during the reign of the Cholas, more than ten centuries ago. Paintings in this style adorn the walls of the Brahadeeshwara Temple in Thanjavur.

Composed of rich colours, gold foil, gypsum with glue, glass beads and precious gems, these paintings are a part of our national heritage. But time, lack of maintenance and exposure to the environment of religious rituals have degraded the paintings.

Image: Ankushsmant via Wikimedia Commons

Can we restore them, at least digitally, to preserve and showcase the legacy of Tanjore paintings?

Faculty members from the Sathyabama Institute of Science and Technology, Chennai set out on the quest. On a bright sunny day, S. Poornapushpakala and M. Subramoniam took digital pictures of the paintings.

Back in Chennai, Poornapushpakala conferred with the other members of the team.

'Algorithms like k-nearest neighbour have been used to digitally restore Chinese paintings. But Tanjore's paintings are very colourful and full of contours and lines. So the same technique may not apply,' advised T. Vijayashree.

Ultimately, the team settled on two image restoration techniques: segmentation and in-painting. While S. Barani prepared the algorithms, the team processed the forty images that they had collected. They used the Wiener filter to remove background noise – random variations in colour and brightness. Then the two image restoration techniques were applied.

In segmentation, the researchers divided the degraded image into blocks. Then, using the algorithm, they analysed the colour, or RGB image, representing red, green and blue in each block and the colour specific to the average RGB was filled in the digital image. But the outcome was not satisfactory.

So, the researchers tried in-painting. The RGB image of the damaged area was considered a region of interest and the image was divided into structural features such as lines and edges and texture features such as pixel intensity. The researchers then interpolated the image.

The team at the Sathyabama Institute of Science and Technology, Chennai found that in-painting resulted in better restoration.

The Ministry of Culture can now apply the algorithm to restore Tanjore paintings and highlight the tradition in the digital world.

DOI: 10.1186/s40494-022-00661-1

Reports by: **Ankita Saha, K. M. Meera, M. S. Induja, K. V. Aneesh Kumar, Dhatri Madduru, Sileesh Mullasseri, G. Sharath Chandra** and **Ravindra Jadav**

ACKNOWLEDGEMENT: NCPOR, Goa for access to scientific databases.

scienceandmediaworkshops@gmail.com