Current Science Reports

Trees to Clean Jodhpur Air

Which are the best?

Jodhpur is the most polluted city in Rajasthan. Located in the Thar desert region, the city gets scant rainfall. So particulates with heavy metals hang in the air.

Trees can absorb particulate matter from the air. But which tree is most efficient for adsorbing atmospheric particulate matter in Jodhpur? Gyan Singh Shekhawat and Lovely Mahawar from the Jai Narain Vyas University, Jodhpur collaborated with researchers in Poland to find out.

They selected the leaves of 10 common trees, shrubs and climbers in Jodhpur. To collect particulate matter from the leaf surfaces, they washed the leaves with distilled water. And, to collect particulate matter trapped in the wax layer on the leaves, they washed the leaves with chloroform.

By passing these solutions through pre-weighted mesh sieves, they could calculate the weight of particles adsorbed on the leaf surfaces and trapped in the wax.

The team found that peepal, *Ficus religiosa*, is the most efficient phytoremediator of particulate matter. The Assyrian plum tree and giloy came next.

To check for the adsorption of heavy metals by the leaves, the researchers digested the dried and ground leaves with nitric acid and analysed heavy metals in the leaf extracts. The peepal tree was found to be the highest adsorber of heavy metals.

The accumulation of atmospheric particulate matter causes oxidative stress in plants. To manage the oxidative stress, antioxidant enzymes should increase in plants. The researchers checked by measuring the amount of heme oxygenase in the 10 plant species.

'There is a strong correlation between the particulate matter adsorbed and the amount of heme oxygenase enzyme,' says G. S. Shekhawat.

This research has now identified the best trees for planting along the edges of the Thar Desert. Horticulturists must include these efficient phyto cleaners when planning plantation schemes for cities.

DOI: 10.1007/s11356-022-20769-y

Arsenicosis in West Bengal

Despite treated water?

Chronic exposure to arsenic-contaminated drinking water affects many in nine districts of West Bengal. The region now has quite a few arsenic removal plants. And people there have been mostly consuming arsenic-free drinking water for at least the past two years. Even after prolonged awareness and safe drinking water programmes, why does chronic arsenicosis continue to plague the region?

Researchers from the Jadavpur University, Kolkata collaborated with the National Institute of Biomedical Genomics, Kalyani and the KPC Medical College and Hospital, Jadavpur to look into the matter.

From the severely arsenic-affected Mathpara and Eithbhata villages in the North Parnagas district, they selected seventeen males and seven females aged between 42 and 75. These chronic arsenicosis patients showed severe arsenic skin lesions due to prolonged exposure to arsenic. For one year, the team collected the daily dietary intakes from individual arsenicosis patients.

Urinary arsenic, the primary biomarker for acute toxicity, showed an overall 43% decrease in arsenic levels over six months.

To evaluate the body burden of arsenic toxicity, the team collected samples of scalp hair and nails every month for one year. In one year, arsenic accumulation decreased overall by about 41% in scalp hair and nails. A few people, however, showed increased arsenic in biological tissues. This could be due to consuming arsenic-contaminated water and food, say the researchers.

They collected samples of drinking water and raw and cooked rice as well as raw and cooked vegetables. Arsenic in domestic shallow tube well water was up to 88 times the prescribed limits! Raw and cooked foods contained high levels of arsenic. Cooked rice alone contributed 4.91 microgram of arsenic per kilogram of body weight, higher than the daily tolerable dietary intake limit of 3.0 microgram per kilogram of body weight.

People in the region consume safe, treated water. But they use arsenic-contaminated groundwater for irrigating crops and for cooking.

'The main dietary foodstuffs, rice and vegetables, are cultivated by irrigating with arsenic-contaminated groundwater,' says Tarit Roychowdhury, Jadavpur University, Kolkata.

Rice irrigated with arsenic-contaminated shallow tube-well water posed the maximum risk.

To reduce the incidence of arsenicosis in severely affected districts, it is not enough to supply treated water for drinking and cooking. Irrigation with uncontaminated water and shifting to cultivating crops that do not accumulate arsenic also need to be considered, say the researchers.

DOI: 10.1016/j.gsd.2022.100786

RNA Spray Silences Genes

Protects potatoes from late blight

Image: I. Sáček, via Wikimedia Commons

Late blight disease, caused by the oomycete, *Phytophthora infestans*, causes darker spots on leaves and stems where water or dew collects. The oomycete, or water mould, diminishes potato yield by 15%. The pathogen is not easily controlled by chemical fungicides because it evolves rapidly and develops resistance against the fungicides. Attempts to develop potato cultivars that are resistant to the water mould have also been in vain.

So S. Sundaresha and team from the Central Potato Research Institute, Shimla recently came up with a technique to control the pathogen: silencing five genes involved in the pathogenesis.

To identify the silencing RNA, they first extracted the total RNA from the pathogen and from infected potato plants. Then, they reverse transcribed the RNA into DNA to identify the five critical genes. Using silencing RNA identifier tools, they located sequences that might silence these genes. The silencing RNA sequences were then assembled into a single sequence.

The team added this sequence into a plasmid vector containing an RNA polymerase that is highly active and inserted the plasmid into *E. coli*. This transformed the *E. coli* into a mini factory for producing double stranded RNA that contains segments for silencing the five genes.

The team tested the double stranded RNAs for silencing single genes as well as combinations of genes on cultures of *Phytophthora infestans* and on leaves infected with the pathogen. Multigene silencing seemed to work better than silencing only one or two genes.

Double stranded silencing RNAs, when sprayed on plants, degrade very fast. So the researchers mixed them with nanoclay, known to protect the double stranded RNAs from degradation and to release them slowly over time.

They sprayed the double stranded RNA-nanoclay mixtures on potato plants and, after a day, inoculated the plants with the zoospores of *Phytophthora infestans.* Control plants that did not receive the spray developed symptoms in three days and started drooping. Plants that received the spray stood tall and erect even after 15 days.

'Single gene-specific host gene silencing was not as effective as observed in our earlier studies,' says Aarti Bairwa.

'So this time we targeted five genes,' adds Bir Pal Singh.

'These genes are necessary to *Phytophthora* for sporulation, protein and cell membrane synthesis, and for defence against stress, zoospore cyst formation and intracellular signal transduction,' explains Sanjeev Sharma.

Now the team plans to develop a spray product which can silence potato blight in field conditions. Since *Phytophthora infestans* infects tomato also, potato and tomato farmers can look forward to the technology.

DOI: 10.1002/ps.6949

Indian Slender Loris

Victims of folk beliefs

Illegal trafficking or killing of wild animals for body parts such as tusks, horns and bills are serious concerns worldwide. However, the trafficking of animals which does not target international markets is not well-defined and mostly remains unreported or underreported. Such is the case with the slender loris, a nocturnal animal native to India and Sri Lanka. In these countries, slender lorises are killed or mutilated for folk medicines and black magic. But we lack details about such practices and their temporal variability.

Image: K.A.I. Nekaris via Wikimedia Commons

So, a multi-institutional team led by Smitha D. Gnanaolivu, an independent researcher, and a team from the University of Mysore started collecting data on people's perception about the slender lorises. They interacted with forest officials and locals in Kerala, Karnataka, and Tamil Nadu. From black magic practitioners, the team gathered reasons for and details about rituals conducted using slender lorises.

From 2002 to 2020, they gathered information on 139 rescued slender lorises from rehabilitation centres in Bengaluru – information on the date of rescue, the sex, and weight of the animals as well as about the damage inflicted on the rescued animals. From the data, they could deduce that 58 were directly related to black magic and 58 were cases of trafficking.

The number of cases related to trafficking slender lorises for black magic is increasing every year. The numbers peaked in May, June and September, months with many festivals where animals are sacrificed for pleasing local deities.

Many folklore and black magic rituals are performed during the new moon. The team collected data on the moon phases on the rescue days using an android application. They modelled the data to understand whether injuries on the rescued animals could be traced to black magic rituals. The model confirmed the correlation between moon phase and black magic rituals.

The findings confirm that slender lorises are regularly trafficked for rituals and medicinal practices. The team did not find any evidence of the use of slender lorises for pet trade during their study.

The use of a particular sex was not very evident. The females are larger than males and the genital protrusion seen in females often causes them to be mistaken for males.

Even though slender lorises belong to the Near Threatened category on the International Union for Conservation Red List, the over-exploitation of lorises causes severe population decline and local extinction in many of its habitats.

Apart from rural areas, there is a demand for these animals even in urban areas.

'Demand-side interventions are quite difficult due to this complex combination of users,' explains Smitha D. Gnanaolivu.

The researchers caution that banning the trade could push it underground, making monitoring difficult. They suggest awareness programmes to counter folk beliefs and ensuring active participation of local communities to spot, intervene and report such practices as a strategy to curb this issue.

'The impacts of such practices on conservation are overlooked, especially among less charismatic species like slender lorises,' says Roopa Satish, Wildlife Rescue and Rehabilitation Centre, Bengaluru.

DOI: 10.1002/pan3.10336

Procyanidin to Stabilise Collagen

For wound healing

During wound healing, collagen, a protein, is deposited at the wound site. Collagen enhances the wound healing process through cell attachment, proliferation, and tissue formation. Collagen extracted from animal tissues can be used to facilitate wound healing. However, collagen fibres applied externally are degradable. To improve stability,

collagen can be crosslinked using chemicals. But the chemicals used are toxic.

So C. Shanthi and her team from the Vellore Institute of Technology thought of procyanidin, a plant derived cross linker.

Procyanidin, a flavonoid, is found in extracts of *Cassia auriculata* leaves. The team extracted procyanidin from the leaves and mixed it with collagen fibres taken from fish skin and from bovine tendons to evaluate their relative efficacy.

They examined the strength of the collagen from the two sources with and without procyanidin. Bovine collagen films had more tensile strength than fish collagen films. When combined with procyanidin, the films became stronger.

The team then tested the effectiveness of these films for wound healing. They created open incision wounds on the backs of male rats and dressed the wounds with different collagen combinations. The wounds normally become scars in 16 days. But wounds dressed with procyanidin-treated collagen healed completely by the 12th day. And there was no infection.

Bovine collagen films showed better wound healing than fish collagen films.

Clinical trials are needed before the technique can be applied for treating recalcitrant wounds in human beings.

DOI: 10.1007/s12010-022-03956-y

Diagnosing Parkinson's Disease

New gene-expression biomarker

There is no easy way to diagnose Parkinson's disease before typical signs – tremors, rigidity, slowness and lack of balance – become starkly evident. But there must be some changes in gene expression that could be detected in blood samples to help diagnose the problem in its early stages.

Jisha Augustine and A. S. Jereesh from the Cochin University of Science and Technology decided to investigate. They took blood-based gene expression datasets of Parkinson's disease and healthy controls from the Gene Expression Omnibus database. Using Z-transformation, a data merging technique, they adjusted and integrated the data from the different sources.

To select candidate genes, they performed a two-layer embedded wrapper feature selection. In the first layer, they used the embedded technique since it provides effective starting points for feature selection in large datasets. They constructed the second layer using three wrapper algorithms – recursive feature elimination, genetic algorithm, and bi-directional elimination. This reduced redundancy and produced the smallest possible set of optimal features with the least amount of computing time and complexity.

'We got a gene signature for 29 genes that differed between patients with and without Parkinson's,' says Jisha Augustine, Cochin University of Science and Technology.

To evaluate the gene signatures, the duo tested eight supervised shallow machine learning models and one deep learning model. Support vector machine-radial and deep neural networks performed best with higher accuracy.

The researchers also compared the performance of their biomarker gene signature with that of the recently identified Parkinson's disease signature by creating classification models using datasets described in literature.

'We found that our gene signature is a reliable biomarker,' says A. S. Jereesh.

The medical fraternity can now test these biomarkers for clinical usefulness. Further investigation of the selected genes may also provide clues about potential therapeutic targets for Parkinson's disease.

DOI: 10.1016/j.gene.2022.146366

Caesarean Deliveries

Status in India

Caesarean section, used in problematic births all over the world, is a life-saving procedure. In India, the rate of caesarean section deliveries has been steadily increasing over the last few decades. So has public expenditure on maternal care and institutional deliveries. And yet women continue to die in childbirth.

Rajeev Ranjan Singh and team from the International Institute for Population Sciences, Mumbai recently examined the use of caesarean section deliveries in public health facilities across India.

They took individual records from the fourth round of the National Family Health Survey of 2015–16 which used the 2011 Census as sampling frame for the data and used a multilevel stratified type of sampling, dividing the population into small clusters. Villages served as the primary sampling units and the population was grouped into aggregates. The team used census enumeration blocks in metropolitan regions following the Housing Census which counts each person residing in the house within the last six to eight months.

Image: Pippa Ranger via Wikimedia Commons

The trio could thus gather the data of six lakh homes. The data contained seven lakh married women between the ages of fifteen and forty-nine, and one lakh men between the ages of fifteen and fifty-four across India.

The researchers found that only 5% of complicated deliveries occurred by caesarean section among the poorest mothers. But among the wealthiest women, caesarean section was about 24%.

The impoverished seem to underutilize public health facilities for caesarean section deliveries, whereas the wealthy over use them.

A caesarean section in private hospitals can cost anywhere between 30,000/- and 100,000/- rupees. So even the wealthy favour using public funds for caesarean deliveries.

The findings also suggest that mothers with greater educational attainment are better aware of the facilities and subsidy benefits associated with delivery care.

'There are many programmes and schemes sponsored by the Central and State governments to encourage poor and disadvantaged women to use institutional delivery facilities. However, these schemes fail to accurately identify the intended beneficiaries of subsidies,' says Sanjay K. Mohanty, International Institute for Population Sciences, Mumbai.

'The only way to equitably distribute public health subsidies is to periodically

monitor and assess the incentive systems for pregnant women,' adds his colleague, Rajeev Ranjan Singh.

DOI: 10.1186/s12913-022-07984-6

Violation of Hypergamy

Effect on domestic violence

Hypergamy, where the husband's economic, social or educational status exceeds that of the wife, is common in most patriarchal societies. There is a general notion that hypergamy facilitates domestic violence. However, there are others who think that violation of hypergamy questions patriarchal values leading to increased domestic violence. Which is more correct?

Image: Alecska via ilo.org

Gaurav Dhamija from the Indian Statistical Institute, Delhi and Purarjith Roychowdhury from the University of Nottingham, UK investigated the question.

The duo collected information on domestic violence, health, education and labour market indicators from the National Family Health Survey of India 2015–16. The survey data provides information on women's exposures to different types of domestic violence – physical, sexual and emotional.

The team also collected the state level literacy rate and GDP per capita data from the Indian Census. They divided the data into three samples based on violation of hypergamy in terms of education, employment and earnings. In addition, they monitored factors such as the level of patriarchy at the women's natal and marital homes, as well as the women's health conditions.

From the statistical analysis of these data, the researchers found that violation of any type of hypergamy increases the likelihood of domestic violence by at least 10–14%.

They analysed the data to check whether violation of hypergamy has any effect on gender norms about decision making and spending in the family. The data revealed that hypergamy violators tend to oppose strong patriarchal beliefs about gender roles, which would increase the likelihood of domestic violence.

Policy makers need to tackle gender norms using laws and empower women.

DOI: 10.1111/rssa.12858

Human Emotion Identification

Using deep learning

We express emotions through facial muscles, speech and gestures. Research on the automatic identification of emotion focuses mostly on single modalities independently of each other. How can we automate emotion identification in a video, where the modalities are fused into one, without increasing the cost of computation?

Sarbani Roy, Asif Iqbal Middya and Baibhav Nag from the Jadavpur University, Kolkata recently designed a light weight model by fusing audio and video data to identify emotional states with greater accuracy.

They exported audio files in mono mode and extracted features from the audio spectra. Using image recognition tools, they extracted frames from the video files. To deal with spatial aspects, they used convolutional neural networks and, for temporal aspects, long short term memory. The audio and video features were then combined.

To train and validate the model, the researchers used two datasets. They evaluated the results and found that their model outperformed other emotion prediction models.

The team experimented with publicly available datasets on YouTube. The model could predict emotions independent of language.

'Only spectral features of the audio are considered in this model. Future research could include some more auditory features,' explains Asif Iqbal Middya.

'We would like to include text information along with audio-visual data for emotion recognition in our future work,' adds Sarbani Roy.

Automatic human emotion identification has many applications: lie detection, audio video surveillance, intelligent machines that respond to human emotions… So we should expect more exciting results from this field.

DOI: 10.1016/j.knosys.2022.108580

Reports by: **H. Muralikrishna, M. S. Induja, K. M. Meera, T. Anju Philip, K. V. Aneesh Kumar, Pranita Bhatele, J. Nalini, Ravi Mishra** and **Sileesh Mullasseri**

ACKNOWLEDGEMENT: NCPOR, Goa for access to scientific databases, and the 2nd online workshop on Science Writing organised by Current Science.

scienceandmediaworkshops@gmail.com