

Science Last Fortnight

Groundwater Quality

Health risk at Ghaziabad

Ghaziabad is a fast growing industrial city. Groundwater is the major source of drinking water here. But it is polluted by heavy metals because of urbanization and industrialization.

Scientists from the State University Assam and IIT Delhi, now report the extent of the problem. The researchers selected peri-urban areas dominated by agriculture and urban areas by small scale industries. They collected groundwater samples from 18 sites in urban region and 4 sites in peri-urban areas during the pre- and post-monsoon seasons. Almost all samples showed high levels of heavy metals.

The researchers then performed principal component analysis and correlation analysis to identify possible sources of contamination. The concentrations of most of the metals near urban and industrial sites were higher than in the peri-urban areas. The contribution to heavy metal pollution by industries was quite evident.

The team assessed the potential health risk in terms of non-cancer risk and pollution level using fuzzy comprehensive assessment model. The model indicated that groundwater quality in the Ghaziabad district is not safe for human consumption. Risk analysis showed alarming risk to children.

Technological innovations and actions at policy level have to be taken immediately. Proper treatment before disposal of industrial and urban effluents must be ensured by the industrialists. Further study on other exposure pathways is also needed.

Chemosphere, **179**: 167–178

Dew for Drinking

The Kothara region of northwest India is arid. It receives very little rainfall. And surface water bodies dry up completely. Consequently, vegetation is sparse. The region faces a shortage of drinking water. Groundwater is the only source. However, as it is a coastal region, the groundwater is saline. Hence, the demand for potable water is high.

The residents of the Kothara village use tanker water which is limited. So they have started using Reverse Osmosis filtration. However, Reverse Osmosis yields only 50% of the water. The rest, with highly dissolved solids, is disposed into the surroundings. This makes the topsoil saline. Moreover, the water with more concentrated solutes may leach into the groundwater, degrading it further. Hence, it is not a sustainable solution for the drinking water problem.

Recently, Girija Sharan and team from the Dhirubhai Ambani Institute of Information and Communication Technology, Gujarat, collaborated with the University of Paris to come up with a solution: dew. Using Computational Fluid Dynamics simulation, they optimized the condensing surfaces to come up with a condenser design that could harvest 43% to 54% water from dew.

The scientists constructed a dew plant in the Kothara village. Now, the villagers can harvest atmospheric moisture – dew and rainwater – their new sources of potable water. The water thus harvested is better quality than the water from reverse osmosis. Also, the method does not require electricity. It is eco-friendly and cost effective.

This new condenser can solve water problems in villages like Kothara. But will the villagers accept and adopt the new technology? That will depend on social, cultural and economic interventions.

J. Cleaner Production, **155**: 83–92

Photoperiod in Legumes

The dolichos bean, *Lablab purpureus* (L.) Sweet, is one of the most diverse domesticated legumes, cultivated in Asia and Africa. The crop offers opportunities to improve food and forage production in semiarid areas. However, smallholder farmers frequently face low crop yield due to highly variable rainfall, lack of irrigation facilities, long duration lablab genotypes and photothermal effects.

Photoperiod is one of the most significant environmental factors influencing flowering time in legumes and the variation in photoperiod sensitivity

amongst and within legume species is high. Recently a group of scientists from ICRISAT, India collaborated with scientists in Germany and South Africa, to examine the photo-thermal response of early flowering lablab genotypes selected by Whitbread *et al.* in 2011, using a combination of field and growth chamber experimentation to impose varying day-length and temperature regimes.

The team evaluated ten most promising short-season *Lablab purpureus* accessions for their response to varying temperature and day length regimes both in field trials and in controlled conditions. They quantified photoperiod sensitivity using the triple-plane rate model. This model examines the time to flower expressed in thermal time. They found a clear positive effect of temperature on the growth and development of the accessions. The time to flowering expressed as thermal time was consistent for the tested accessions and ranged from 600°C to 800°C for day length <13 h.

The researchers also estimated the critical photoperiod above which the time to flower was delayed. They observed relatively high variation in time to flower amongst and within accessions. This ranged from 60 to 120 depending on sowing date or day length/temperature regime.

The team was thus able to identify some short duration lablab cultivars for Asia and Africa. However, to increase adoption by farmers, agricultural extension workers may need to promote these short-season lablab varieties.

Expl. Agric., **53**(3): 375–395

Cold Plasma

Control of post-harvest losses

Aflatoxins, in groundnut post-harvest stages, are a major problem faced by farmers, processing industries and consumers of groundnut. Aflatoxins are carcinogens.

In India, post-harvest losses of groundnut rise to one third of net production: approximately 20 lakhs metric tonnes in a year! If we consider losses of other grains due to micro-organisms, the total post-harvest loss is much

higher. Existing technologies to control the damage use chemicals. This raises concerns for human and environmental health.

Recently, scientists from the Institute of Chemical Technology, Mumbai came up with a solution: cold plasma. Cold plasma can be generated using electricity to ionize atmospheric gases. It creates a wide variety of molecules including ozone, nitrogen oxides, hydrogen peroxide and others that kill micro-organisms. These molecules exist for a few hours and then revert to the original atmospheric gases.

The team inoculated groundnut with *Aspergillus parasiticus*, *Aspergillus flavus* and *aflatoxins*. And exposed the contaminated groundnuts to cold plasma at 40 W and 60 W, at various time intervals. They found that cold plasma inactivates the fungal species that attack food products.

Food processing industries can perhaps adopt this technology to minimize post-harvest damages. In addition, cold plasma can be used to extend the shelf-life of packed products, even liquids. This reduces the need for synthetic preservatives. However, the feasibility of large scale use of this technology needs to be explored.

Food Control, 77: 187–191

Chewy Chapattis?

Wheat variety decides

The wheat market is dynamic, adjusting itself to the demand for *atta*, *suji* and *maida*. The demand for whole wheat *atta* precludes the production of *suji* and *maida* and changes market dynamics further. Consumers, however, get a wider choice, including ready-to-eat chapattis.

It is not only the processing of wheat grains that leads to differences in the quality of chapattis. To get the desired quality of chapatti, we need to select the right wheat variety. But which variety is best for a specific use?

Scientists from the Guru Jambheshwar University of Science and Technology, Hisar, studied several wheat varieties to understand the factors involved in the quality of chapattis. They collected 50 varieties of wheat from across India and measured the physical characteristics of the grains. They found that the hardness of the grain

determines milling properties, water absorption, baking and chapatti qualities. Severe grinding results in damaged starch and increases the moisture and sugar level in the chapatti. The water absorption level of the dough decides puffing height. Less water leads to stronger dough that produces tough chapattis.

The researchers then analysed the contents of whole wheat flour such as moisture, fat, falling number, ash, protein, damaged starch, gluten and minerals. Chapattis made from the flour of different grain varieties were evaluated using criteria such as colour, puffed height, pliability, texture, mouth feel, taste and aroma. They found that flour with high protein and gluten content produces chewy chapattis. Flour, with high gluten and stronger dough, results in elastic chapattis.

The researchers propose developing wheat varieties specific to each end-product. They stress the importance of the protein and starch fractions of flour. These and other factors identified will help us select the right variety for the desired chapatti quality. Such information on flour products will help consumers choose the right wheat flour for their purpose.

Food Chem., 226: 95–101

Indian Mackerel Populations

Regional management needed

The Indian mackerel, *Rastrelliger kanagurta*, is an important commercial sea fish. To develop sustainable management strategies for such resources, we need to understand genetic stock structures. Within species, diversity of fish populations helps develop resilience to climatic fluctuations and micro habitat alterations. However, information on open sea fishes in the Indian Ocean is limited.

Last fortnight, Sandhya Sukumaran and team from the Central Marine Fisheries Research Institute, Kochi, reported the results of their population genetic studies on mackerel in the Indian Ocean. They used mitochondrial DNA markers to find genetic variations among mackerel populations from the Indian coast, Port Blair and Thailand.

Mitochondrial markers help infer historic patterns of population distribu-

tion. The researchers used six different population specific parameters to analyse population genetic structures. They conducted a mismatch analysis for each major geographical region, separately, to elicit historic demographic patterns.



By Nithin Bolar K [CC BY-SA 4.0, via Wikimedia Commons]

They found that the population history of the Indian Mackerel, along the Indian waters and the Andaman sea regions, is stable. The expansion of the mackerel population from mainland India to the Red Sea, East Africa and Indonesia is recent, say the scientists. After the Last Glacial Maximum, the earth started warming and the monsoon intensified. This enhanced the productivity in the tropical Indian Ocean and led to the demographic expansion of the mackerel population.

Mackerel populations along peninsular India are genetically homogeneous. However, there are variations between the populations and those found in Port Blair and Thailand. Oceanographic features like eddies and gyres separate these distinct populations and prevent interbreeding. This may be responsible for the genetic differences between these populations.

Mitochondrial markers alone may fail to detect subtle variations in large populations. Thus, the scientists recommend further research, using genic and nongenic markers, along the Indian waters, to identify any locally adapted populations.

The team recommends separate management strategies for the identified genetically variant population stocks. And suggests regional specific management to maintain diversity in the population stocks of the Indian Mackerel in Indian waters.

Fisheries Res., 191: 1–9

Enhancing Marine Resources

Phytoplankton and fisheries

Fisher folk depend on the monsoon for their livelihood. During the monsoon, fresh water flows into the sea, from rivers and coastal areas. This causes inorganic nutrients and sediments to be deposited at different depths in the sea. The resulting changes, in salinity and availability of nutrients, encourage phytoplankton growth. This leads to the aggregation of marine animals that eat phytoplankton and, consequently, of bigger marine animals that feed on the smaller ones. Thus, phytoplankton creates the right environment for small fisher folk.

Recently, scientists from the CSIR-NIO, Vizag used HPLC analysis to measure the growth of marine microalgae at different depths due to river water flow into the sea. They find that the regular flow of river water into the sea reduces salinity, increases temperatures, and changes other physiochemical conditions. It encourages the abundant growth of phytoplankton groups. Thus, like the monsoon, rivers also enhance the marine food chain where they meet the sea.

Monitoring the availability of inorganic nutrients and physiochemical conditions at different depths periodically will help protect the primary production at river mouths, say the scientists. The Government and research institutes can empower fisher folk to monitor phytoplankton growth at these points of convergence.

Estuaries and Coasts, **40**(4): 1066–1081

Cuttlefish to Treat Cancer

Cancer is the second leading cause of death globally, especially in low and middle income countries. According to ICMR, India is likely to have more than 17 lakh new cases of cancer by 2020. The most common cause of death in cancer is associated with a high rate of accumulation of coagulants in blood. Heparin, an anticoagulant, is used to overcome the problem. However, heparin is costly.

Recently, a team of scientists, from the Kerala University of Fisheries and Ocean Studies, reported that the anticancer property of cuttlefish extracts could be useful in the production of

anticoagulants to inhibit the growth of cervical cancer cells. The researchers tested and optimized a process to extract sulphate glucosaminoglycan from the mantle tissue of cuttlefish, *Sepia pharonis*. Sulphate glucosaminoglycan is a linear complex of polysaccharides similar to heparin. It is used as a clinical anticoagulant.

The research team optimized the process by determining the best temperature, pH, sonication time and ideal liquid-to-solid ratio, so as to maximize the yield. They observed a yield of 1.02 g/kg sulphate glucosaminoglycan. The product showed anticancer activity in HeLa cells.



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Cuttlefish is cheap and available in all seasons. The extraction of clinical anticoagulants from cuttlefish is cost effective. Hence, it could be an alternative source of heparin. Moreover, it is stable in the human body. Adequate intake of cuttlefish enhances anticoagulant and anticancer activity. Acceptance of cuttlefish as a nutraceutical may help improve the livelihood of fisher folk.

Carbohydrate Polymers, **167**: 129–135

Pesticide Residue in Mango

India produces 40% of the world's mangoes. However, most are lost to weevils, bugs, leaf rollers and other pests. Excessive use of pesticides produces residual effects. Pesticide residue damages the endocrine, nervous and immune systems. Regulatory agencies have formulated a maximum residue level above which human health deteriorates. However, we still lack an efficient and effective system to measure pesticide residue.

The quencher method, conventionally used to detect pesticide residue,

has limitations when testing foods with high liquid and antioxidant content. So, Sivaperumal and team from the National Institute of Occupational Health, Ahmedabad tried a new technique to overcome the limitations.

The researchers bought two kilos of mangoes and one litre of mango juice from the local market. They prepared mango matrices with raw, puree, and juice at three concentration levels. The team used acetonitrile and ethyl acetate as solvent to extract sample solutions. They tested the samples for sixty-eight pesticides.

The researchers used various methods to test the samples. They found that Ultra High-Performance Liquid Chromatography coupled with Quadrupole Time-of-Flight Mass Spectrometry was most effective. This method is simple, rapid and reliable.

The method might prove a boon to food quality controllers and help ensure safer mangoes for consumers.

Food Analytical Methods, **10**(7): 2346–2357

Video Face Recognition

For video surveillance

Law enforcement agencies often use video surveillance as part of crowd control measures. Identifying individuals is essential for effective surveillance. This is achieved using face recognition algorithms. Face recognition involves matching all the frames available in the videos. Due to poor image quality or variation of expressions and illuminations, existing algorithms produce inaccurate results.

Recently, Gaurav Goswami and team from the Indraprastha Institute of Information Technology, Delhi reported developing an innovative video face verification algorithm utilizing frame selection and deep-learning based feature-representation methods. The scientists first selected information-rich frames from input videos using wavelet decomposition and entropy. Then, they extracted information from selected frames using an Unsupervised Joint Feature Learning technique. To make a verification decision, they used a feed-forward neural network by matching the information extracted from the input videos.

The team tested the algorithm using data from the Point and Shoot Challenge. Still images were recognized with over 97% accuracy at a 1% false accept rate. Videos from the YouTube Faces Database had over 95% verification accuracy.

At present, this algorithm assumes only a single subject in a video. The team plans to extend the scope to recognize multiple subjects in a single video as well.

IEEE Trans. Inf. Forensic Secur., **12**(7): 1686–1698

Preventing ID pilferage

Online social network

The use of social media is unavoidable. However, social network profiles are often hacked. Hackers take control of an account and misuse it to spread worms, viruses, and rumours as well as for other criminal activities. User profiles need to be more secure to prevent unauthorized access.

Existing authentication mechanisms such as alphanumeric passwords, privacy-based questions, SMS – email-based authentication codes, and two-factor algorithms are not enough to prevent such hacking.

Now, Milton Joe from St Jerome's College and Ramakrishnan from the S.T. Hindu College, Nagercoil, have identified a mechanism to overcome the inefficiencies of existing authentication algorithms. The researchers introduced two innovative authentication procedures: Chatting and Relationship module authentication.

The Chatting module authentication distinguishes between frequent and non-frequent users. The frequency of interaction between the users identifies their originality, preventing unauthorised access. The Relationship module

groups users into friends, family, classmates, colleagues, etc. and forms relationship circles for a user. In case of unauthorized access, the profile is temporarily blocked. The chatting module and the relationship circles are used to authenticate the user. Users satisfying authentication by both procedures will be treated as the original user.

These two authentication algorithms are more secure than the earlier algorithms. Social network platform providers can use this new authentication procedure to enhance security for users.

Peer-to-Peer Netw. Appl., **10**(4): 833–843

Challenged by Renewables?

Trading is the answer!

India is committed to base 40% of its electricity generation on renewables by 2030. Renewable purchase obligation is a policy mechanism floated to increase the share of renewables in electricity. States fix their own renewable purchase obligations and comply by either buying renewable energy or trading in renewable energy certificates – a market based instrument. However, the cash-strapped electric utility companies of the states are faced with bearing penalty costs for not buying required amount of renewable power to meet their purchase obligations. Noncompliance of renewable purchase obligation by the state utilities poses a serious challenge to India's renewable commitments.

Recently, Amrutha and team, from the Indian Institute of Science, Bengaluru, used Karnataka State's electricity systems as a case to evaluate the cost-effectiveness of the renewable policy instruments. They performed a scenario analysis, taking into consid-

eration base case, renewable policy, shortage planning and future supply planning. The analysis revealed that renewable energy certificates are cost-effective policy instruments. For Karnataka, a state with a deficit in solar energy, buying certificates is more economical than paying penalty.

Moreover, if the states can sell surplus renewables, Karnataka stands to gain from the sale of its surplus non-solar renewables, say the scientists.

Though there is a fear that creation of such markets may lead to overexploitation of renewables, given that the market for renewable certificates in India is still nascent, trading is a viable solution to help the states meet their renewable purchase obligations.

Energy Policy, **106**: 48–58

Web of Science

Shifting from West to East

The historical shifting of the ownership of Web of Science from Thomson and Reuters to Clarivate Analytics became visible to its users last fortnight. The interface of the web application has changed. What does it forebode for Indian researchers? Only the future will tell.

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