

Current Science Reports

Karakoram Glaciers Losing Mass *Study from the Siachen*

Siachen, the largest glacier in the Karakoram Range, is located at the western end of the Himalayas. In contrast with the worldwide glacier decline pattern, the Karakoram glaciers are reported to be in a balance by some researchers. Some have reported that they are even gaining mass.

To investigate the disparities, Harendra Singh Negi and team from the Defence Geoinformatics Research Establishment, Chandigarh recently measured the Siachen glacier mass balance.

The region is hard to access, and only a few satellites cover the area. So the team adopted hydrological and temperature index-based mass balance approaches. They first generated a catchment area map using elevation and digital elevation models from the ASTER Global Digital Elevation Map data sets.

'As climate and topography vary with elevation, we divided the area into eight elevation zones at 500-metre intervals,' explains Harendra Singh Negi.

Then the team examined temperature, precipitation, evaporation and melt water flow – major factors of glacier mass balance. They collected daily near-surface minimum and maximum air temperature and precipitation data for 32 years from 1986 to 2018 from the five meteorological observatories of the Defence Geoinformatics Research Establishment's network in the Siachen region.

The higher elevation zones had below zero monthly mean temperature throughout the year. But overall monthly mean temperature ranged from -40°C to 10°C .

The middle elevation zones had the greatest snow accumulation in contrast with bottom and top zones. The total accumulation in the entire glacier showed a decreasing trend over the three decades. The team noted a significant decrease in snowfall after the year 2000.

From temperature records, the team estimated evaporation loss. The mean

annual evaporation loss of snow was about 270 millimetres. June, July and August, the snow and ice melting months, had a high number of days with positive degree temperature.

After melting, glacier water is discharged from the catchment area – a major factor in glacier mass loss. Directly measuring meltwater discharge is difficult and not possible retrospectively. So, the team used a snowmelt runoff model. After calibrating the model with available data, they estimated discharge for the past 32 years from 2018. Meltwater discharge from the Siachen catchment is seasonal – about 568 cubic metres from May to September, peaking in July or August.

The researchers compared the model's estimates with field-measured discharge, and found them reasonably reliable. The average difference in volume was less than 5%.

The annual mass balance indicated mass gains in some years before the 2000s. But the glacier has since been continuously losing mass. However, compared to other Himalayan glaciers, the Siachen glacier showed marginal mass loss in 32 years. Mass loss is more prominent after 2000, say the researchers.

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Medicinal Plants in the Himalayas *Threatened by climate change?*

The Kashmir Himalayas have hotspots of medicinal plant diversity. But the ecosystem there is sensitive to minor climatic changes which can threaten the very existence of the plant species.

How do factors such as temperature and precipitation affect the distribution of medicinal plants in this area now and in the future?

To investigate, Javaid M. Dad and Irfan Rashid from the University of Kashmir chose Indian Atees, yellow Himalayan fritillary, blue poppy and Indian rhubarb. Indian Atees is listed under globally endangered species while yellow Himalayan fritillary is endangered in the region. The blue poppy is critically endangered and the Indian rhubarb is vulnerable.

The researchers selected eight variables related to temperature, precipitation and altitude. Using species distribution models, they examined current distribution patterns.

They found that altitudes of more than 3000 metres with low temperatures and high precipitation are suitable habitats for the four species.

Temperature is more significant for the distribution of the yellow Himalayan fritillary and the blue poppy. But, for Indian Atees and Indian rhubarb, the predicted increase in temperature as well as decreased precipitation, spell doom.

As the four species respond differently to future climatic changes, Javaid suggests implementing target-based conservation strategies in crucial areas to maintain the plants.

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Transgenic Okra *Curbing virus infection*

The yellow vein mosaic virus causes severe damage to okra crops. Resistant varieties developed using conventional methods did not yield good results.

We know that the C1 protein, coded by the beta satellite single stranded DNA of the virus, is involved in the infection. If okra has a mechanism to silence this gene, the virus can be disabled.

So researchers from the Kerala Agricultural University tried to make transgenic okra using this information. They isolated total genomic DNA from infected okra samples and identified the viral beta C1 open reading frame – the DNA sequence between and including the start and stop codons.

The sequence was amplified using PCR and cloned to *E. coli* using a vector.

'The intron-free hairpin RNA transcribed from the construct is capable of silencing the target genes in the virus,' says Deepu Mathew, Kerala Agricultural University.

Now the problem was to insert the sequence into okra to develop crop cultivars with resistance to the virus.

So the team transferred the construct from *E. coli* into *Agrobacterium*

tumefaciens and cultured it in the presence of antibiotics. Antibiotics do not allow non-transformed agrobacterium to grow. But the genes inserted by the researchers have antibiotic resistance and they grow.

The seeds of the okra cultivar that is highly susceptible to the viral infection, Salkeerthi, were co-cultivated with Agrobacterium containing the plasmids. Agrobacterium species can transfer the plasmids to the plant cell and genetically transform it.

'We confirmed the transformation by isolating the silencing RNA from 15-day-old plants,' says Vipul Kelkar, Kerala Agricultural University.

'We will, of course, have to do field trials before farmers can use the transgenic plants resistant to the yellow vein mosaic virus,' says Anita Cherian.

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Mission Bamboo

For economy and environment

Bamboos are fast-growing and sequester carbon quickly. Of the 1500 species known worldwide, 136 are in India. Recently, to promote the bamboo sector, the Government of India allocated 13 billion rupees to establish one lakh hectares of bamboo plantations. But which species should we plant, considering both ecology and economy?



Image: annieo76 via Wikimedia Commons

Recently, researchers from the ICAR-Indian Institute of Soil and Water Conservation, Dehradun and the National Bamboo Mission, New Delhi collaborated with a researcher in China to identify the best bamboos to plant in the North-West Himalayan foothills.

They selected seven species of commercial importance. And grew nine plants of each species for seven years on 180 square metre plots at the ICAR

centre in Dehradun. A similar-sized plot was left barren for comparison.

'Bamboo grows vigorously and completes the growth cycle within 120 to 150 days. So it is highly efficient in carbon sequestration,' says S. T. S. Lepcha, National Bamboo Mission, New Delhi.

The researchers monitored soil carbon fractions and root biomass for all the species. Compared to the fallow plot, soil carbon under the bamboo plantations was higher by up to 30%.

'The higher carbon pool under bamboo can be due to higher root biomass and continuous leaf and twig litterfall,' explains Trisha Roy, ICAR-Indian Institute of Soil and Water Conservation, Dehradun.

The species varied in their contributions to different fractions of soil carbon. In the dry and deciduous regions of the lower Himalayas, *Dendrocalamus strictus*, *Bambusa bambos* and *Dendrocalamus hamiltonii* were most suitable for preventing soil erosion and land degradation.

'But factoring in economic aspects, we recommend cultivating *Bambusa vulgaris*, *Dendrocalamus strictus* and *Bambusa nutans* for plantations in the North-West Himalayan foothills,' says Rajesh Kaushal, ICAR-IISWC, Dehradun.

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Extracting Volatile Compounds

Using solar convection dryer

Jasmine is highly valued for its phenolic and fragrant volatile compounds. But the flower is only available in summer. Conventionally, jasmine flowers are preserved by drying in direct sunlight or shade or by air circulation. However, these techniques do not retain all secondary metabolites.

Can we dehydrate the flowers without losing essential secondary metabolites, wondered Adipuniya Mitra, IIT Kharagpur. His team started designing a convection dryer for the purpose.

They made a glass box where the sun's light heats the trapped air. The air rises and is transferred to a wooden box connected through a tube. The heated air loses its relative humidity and absorbs moisture from samples placed in the wooden box, setting up convection currents.

To check the design's performance, the team took fresh flowers of two jasmine varieties. The samples were dried in the shade, under the sun, in an oven, in a freezer and inside the customised convection dryer.

The researchers determined the total phenolic content and antioxidants in the dried samples. The total phenolic content was high in freeze-dried and convection-dried samples.

'Convection drying retained antioxidants the most,' says Adipuniya Mitra.

The team analysed the phenolic compounds in the samples. Again, phenolic compounds were higher in freeze-dried and convection-dried samples.

'Convection dryers can be cost-effective alternatives for freeze dryers,' says Monika Soren, IIT Kharagpur.

The researchers separated the volatile compounds to quantify them. Fourteen major volatiles were detected in *Jasminum auriculatum* flowers and eleven in *Jasminum sambac*.

The samples from freeze and convection dryers retained maximum volatile compounds.

'Solar convective dryers are affordable, durable and reduce operating costs,' says Chinmaya Mishra, IIT, Kharagpur.

Is the perfume industry listening?

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Canine Bufavirus

Infecting Indian dogs?

Canine bufavirus, known to cause enteritis in dogs, has been reported from Italy and China. Researchers from the PVNR Telangana Veterinary University recently investigated the occurrence of this virus in India.

They took faecal samples from about 200 dogs with clinical gastroenteritis. DNA from the samples was then screened. Eight samples were positive for canine bufavirus – a prevalence rate of more than four per cent! Seven samples had other enteric viruses also.

The researchers amplified the complete canine bufavirus genome from a sample. They compared nucleotide and amino acid sequences with other known bufavirus gene sequences and constructed a phylogenetic tree.

'The Indian strain is related to the Chinese strain,' says Kalyani Putty, PVNRTVU, Hyderabad.

Since most canine bufavirus-infected dogs have co-infections with other enteric viruses, the presence of this virus may go unnoticed. So, veterinary doctors must screen for canine bufavirus while treating canine enteritis.

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Chronic Pain Classification ICD-11 and inter-rater reliability

This year, the WHO issued the eleventh version of the International Classification of Diseases, ICD-11. The international classification used to be revised almost every decade. But the transition from ICD-10 to ICD-11 took almost three decades. The new version has more than 17,000 categories and 1 lakh index terms. To deal with this complexity, ICD-11 is made user friendly, with digital tools.

People report symptoms varyingly. A severe pain of 8 measured on a scale of 10 may be reported as 9 by another person. To introduce uniformity, we need inter-rater reliability. How reliable is ICD-11 for classifying chronic pain?

Subrata Goswami, ESI Hospital, Kolkata and Nischala Gunapati, Virinchi Hospital, Hyderabad collaborated with researchers from Cuba, New Zealand and Germany to evaluate.

Pain clinics from high-, upper-middle and lower-middle income countries administered questionnaires to more than 350 patients with chronic pain for more than three months.

From the data, the researchers calculated the global severity index as a measure of emotional stress and used Fleiss' kappa, to measure inter-rater reliability.

'For chronic pain classification, ICD-11 is clinically more useful than other classification systems,' says Subrata Goswami, ESI Hospital, Kolkata.

'As the specificity or detailing of pain increases, inter-rater reliability decreases,' adds Nischala Gunapati, Virinchi Hospital, Hyderabad.

While ICD-10 manually recorded data only from major hospitals, ICD-11 leverages the power of IT and the internet. Thus, even physicians in primary health care can record data. This will provide more accurate data on morbidity and mortality for better health care plan-

ning, resource allocation and health policy decisions.

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Detecting Malaria Hemozoin as biomarker

Plasmodium parasites infect red blood cells and digest about 70% of haemoglobin during malaria infection. This involves a series of enzymatic events that lead to the formation of several free heme moieties. Since free heme is toxic to plasmodium parasites, the parasite neutralises the heme and converts it into hemozoin.

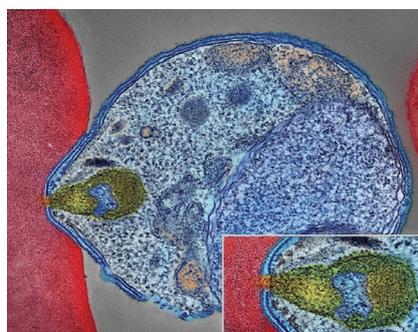


Image: Wikimedia Commons

So, in principle, malaria can be diagnosed by detecting hemozoin. Recently, researchers from IIT Delhi came up with a method to rapidly detect hemozoin.

Hemozoin and haemoglobin have magnetic properties, because they contain iron. The researchers exploited the differences in the magnetic properties.

They used surface-enhanced Raman spectroscopy, a surface-sensitive technique that enhances Raman scattering by molecules adsorbed on nanostructures of metal nanotubes. The technique can even detect single molecules.

The researchers developed a silver nanorod-surface-enhanced Raman spectroscopy substrate. They fabricated neodymium magnets at low temperature, providing the substrate with high sensitivity.

To test their substrate, the team used commercially available hemozoin crystals and human deoxyhemoglobin.

'In the presence of the magnetic field, hemozoin crystals collect on the silver nanorods and change the spectra. There was a tenfold increase in the Raman spectroscopy signal intensity,' says Sarjana Yadav, IIT Delhi.

'The prominent magnetic nature of hemozoin was due to the protein chain that is directly linked with it,' adds J.P. Singh, IIT Delhi.

This method promises faster malaria diagnosis, especially since the Raman spectrometer is now available as a portable device. Medical equipment manufacturers can make test kits for detecting malaria early.

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Pune Population Vulnerability Cold- and heat-related mortality

In recent years, extreme cold and heat waves are more frequent, longer and more severe. Fluctuations in temperature trigger seasonal rises in infections, resulting in more than five million deaths per year globally.

However, temperature fluctuations are not uniform across the globe and vary from region to region and from time to time. To investigate how the fluctuations impact mortality risk in Pune, researchers from the KEM Hospital Research Centre, Pune collaborated with universities in Saudi Arabia and the United States.

They collected daily mortality data from the Pune Municipal Corporation from 2004 to 2012. And weather data from the National Oceanic and Atmospheric Administration. They cross verified the data with weather data from the India Meteorological Department, Pune and found that both data were similar.

To estimate the association between temperature and mortality, the researchers applied the Quasi-Poisson regression model, which uses dependent variables from time-series data. And they calculated the dependence of all-cause mortality rate on non-optimal temperature.

They found that six and a half per cent of total deaths in Pune could be associated with non-optimal temperatures, with most deaths occurring on cold days. As ambient temperature increased from body temperature to about 35°C or went down to 15°C, the number of deaths increased by one and a half times. Both cold and heat were associated with a higher number of deaths in men than in women.

'This could be because men in this area engage more in outdoor activities which directly expose them to extreme cold and heat,' says Sanjay Juvekar, KEM Hospital Research Centre, Pune.

Poverty, not having properly insulated housing, lack of healthcare, and pre-existing medical conditions may put people at higher risk of mortality during days of non-optimum temperatures, say the researchers.

They suggest educating people about how heat and cold impact us and developing early weather warning systems to reduce the mortality risk.

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Dye-sensitised Solar Cells

With improved efficiency

Silicon-based solar cells are expensive and perovskite-based ones tend to pollute the environment. Dye-sensitised solar cells are much cheaper, easier to make and, generally, non-polluting. But they are chemically unstable, and have lower light conversion efficiency than other thin film solar cells.

T. Shiyani and her colleagues from the Central University of Gujarat recently compared the efficiency of natural dyes from basil, spinach, pomegranate, prickly pear and sunflower to enhance light absorption by dye sensitised solar cells.

Nano-structured zinc oxide has better chemical stability, and a large surface-to-volume ratio. So, it adsorbs more dye molecules on the surface, enabling more sunlight to be absorbed.

The researchers deposited a nano-structured zinc oxide semiconducting layer on a fluorine-doped tin oxide

substrate. Different natural dyes were then deposited on the zinc oxide layer.

The dye molecules are excited by sunlight and release electrons to the zinc oxide layer. These electrons are collected by the fluorine-doped tin oxide layer to produce current.

The researchers compared the optical and photovoltaic properties of the solar cells with different dyes. They found that the dyes improved the range of absorbed solar radiations and energy conversion efficiency. The basil-sensitised hybrid cell achieved the highest conversion efficiency of 0.1%, increasing the efficiency of zinc oxide solar cells without dye coating ten times.

'The results may prove useful to develop environment-friendly energy conversion technology,' says Charu Lata Dube, Central University of Gujarat.

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Cellulose Packaging

Consumer acceptance

Plastic wrapping of bread significantly contributes to plastic waste. Aastha Bhardwaj and team from Jamia Hamdard, New Delhi recently came up with a solution: alternatives based on natural polymers.

They selected three types of packing materials: paper made of sugarcane bagasse, paper derived only from corn husk and paper with an equal quantity of sugarcane bagasse and corn husk. The paper samples were coated with chitosan-bee wax emulsion or chitosan. And whole wheat bread loaves were packaged in these coated packing materials.

'Uncoated paper samples were also used as controls,' says Nithya Sharma, IIT Delhi.

The researchers stored the packaged bread at about 25°C and tested the bread for eight days. Bread stored at about 5°C was tested for twelve days.

'There was fungal growth in bread samples stored in non-coated papers after four days,' says Vasuda Sharma, Jamia Hamdard, Delhi.

'Plastic packed bread also lasted only four days,' points out Tanweer Alam, her colleague.

'Samples packed with paper made from sugarcane bagasse and corn husk with beeswax-chitosan emulsion coating performed best. They lasted eight days,' adds Hinna Hamid, Jamia Hamdard, Delhi.

The researchers then did a survey to check the acceptability of the cellulose packing and normal plastic packing. Consumer acceptance was high for paper with the chitosan emulsion-based coating.

'Paper made from lignocellulosic fibres with beeswax-chitosan emulsion coating can be used for packaging buns, biscuits and rusks also,' says J. K. Sahu, IIT Delhi.

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