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IAEA 動態報告

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WORLD SOIL DAY: MADAGASCAR COMBATS SOIL EROSION WITH TRADITION AND NUCLEAR SCIENCE

世界土壤日：馬達加斯加利用傳統和核科學對抗土壤侵蝕

An age-old agricultural method is helping to combat soil degradation and protect a source of food and income for more than 75% of the population in Madagascar. Through a study using isotopic techniques on the mountainous island, scientists working with the IAEA, in cooperation with the Food and Agriculture Organization of the United Nations (FAO), found that traditional terrace farming can reduce soil erosion and run-off in the country by up to 40% when compared to unprotected agricultural fields.

“Farming on Madagascar is a challenge because there are a lot of steep, mountainous areas and high plateaus that limit the options on how to grow food,” said Lionel Mabit, a soil scientist at the Joint FAO/IAEA Division of

報告摘要(KEY INFORMATION)

1. 原子能總署科學家發現，使用同位素技術進行輔助耕耘的傳統耕作島嶼國家與無保護的農業國家相比，可以減少該國的土壤侵蝕和徑流達 40%。
2. 醫療專家利用輻射技術促進新皮生長，拯救了一個 80%皮膚嚴重燒傷的秘魯男孩生命。
3. 原子能總署總幹事天野先生向三名年輕女性頒獎，這三名女性贏得了原子能總署第一次的論文比賽。
4. 國際原子能總署環境實驗室最近使用卡拉拉大理石製作了一種新的參考材料，與米開朗基羅用於製作他著名的大衛雕塑的大理石相同。 這將有助於改進溫室氣體（如二氧化碳和甲烷）的測量。
5. 本次核子保安國際會議強調在國家、區域和全球改進核子保安的承諾，採取具體措施防止核子或放射性物質的惡意行為。

Nuclear Techniques in Food and Agriculture. "Then when you add soil degradation and the impact of climate change, picking the right approaches to farming is essential. This project is helping them to implement optimal soil conservation strategies."

Farmers rely on soil as an essential environment for growing food. Madagascar's upland areas are particularly vulnerable to soil degradation due to challenging physical conditions, such as steep slopes and uneven ground that make soil more prone to eroding and running off. This is exacerbated by the effects of climate change like drought, floods and unpredictable rainfall that further break down soil structure and compromise its health. According to the FAO, around 30% of Madagascar's land area is degraded.

The traditional method of farming in upland Madagascar is terrace farming. A terraced field is a series of raised flat areas, or steps, cut into the side of a sloping hill where farmers can grow their crops. These steps are formed out of soil and are often reinforced with stones or trees. Little channels are typically built into the steps to allow water to flow freely down the slope while holding the soil in place.

Scientists at the Institut National des Sciences et Techniques Nucléaires (INSTN-Madagascar) in the capital Antananarivo worked with experts through the IAEA's technical cooperation programme, and in partnership with the Joint FAO/IAEA Division, to use isotopic techniques to investigate and compare soil erosion rates in terraced and non-terraced agricultural fields. These highly-sensitive techniques allow scientists to track certain atoms, like caesium-137 and lead-210, in soil to determine the soil's movement and its conditions. Watch this animation to see how this works.

" Although most farmers nowadays use modern intensive agriculture, terrace farming has been around for thousands of years," Lionel Mabit said. "We know that this traditional method can reduce strain on soil and limit its redistribution. What this project set out to determine is exactly how well it does that in Madagascar."

Their studies showed that traditional terracing systems significantly limited the loss of soil and reduced erosion by 40%, which means around three tonnes of soil are retained per hectare every year. Farmers in Madagascar are using the results of this study to develop sustainable soil conservation practices and better care for their fields, which ultimately allows them to grow more food.

"The results of this study should encourage farmers in Madagascar to revert to using traditional terracing systems to better conserve their soil," Lionel Mabit said.

A worldwide issue

Madagascar is one example of how countries are increasingly using nuclear science to help them deal with soil degradation and loss — a major global problem remembered today through World Soil Day.

World Soil Day sets out to raise awareness of the important role of soil for all people. Soil is

vital to food production, water supplies and climate regulation; though each year as much as 75 billion tonnes of fertile soil are lost globally due to soil degradation. This poses a major threat to the food security and livelihoods of billions of people worldwide.

The pressure on soil continues to increase as populations grow and along with it the demand for food and land. To help countries deal with this concern, the IAEA, in cooperation with the FAO, supports them in using nuclear science and technology to study and develop strategies to sustainably conserve and protect soil resources.

PERUVIAN BOY'S LIFE SAVED THANKS TO RADIATION TECHNOLOGY

放射科技拯救了秘鲁男孩的生命

A radiation technology method has saved the life of a 13-year-old Peruvian boy who had caught fire from a kitchen stove.

Ebert Tafur had 80 per cent of his skin severely burnt when he arrived at the Cayetano Heredia Hospital's emergency room in February this year. Using the small amount of healthy skin that survived on his body, a group of radiation specialists managed to grow enough new skin to cover his wounds and save him two months later.

"This particular technique saved the boy's life because it's fast," said Renée Herrera Taquía, a doctor at the San Borja National Institute of Child Health (INSN-SB) who treated Tafur, stressing that the time it takes a doctor to grow the skin can be of great consequence. "This is the first successful application of cultivated skin on a patient with critical extensive burns and with minimum probability of survival."

The method they used is called tissue engineering, and it consists of skin cultivation. Scientists develop new tissue from skin biopsy and use scaffolds — structures with uneven surfaces — for the new cells to grow. With the help of radiation, scientists construct these

scaffolds and sterilize them without damaging the growing skin tissue (see The Science box).

"Cultivating skin on a patient who has almost no skin can make the difference between life and death," Renée Herrera said. After having performed nine surgeries on Tafur, doctors thought he wouldn't live as they estimated only a 20 per cent chance of survival.

When Tafur was moved to the INSN-SB's burn unit, a team of specialists with radiation knowledge trained and equipped by the IAEA extracted healthy skin from his ear to grow new skin. By cultivating 2cm² of this healthy skin in the tissue engineering laboratory for three weeks, they managed to grow almost 2m² which they used to cover his chest and back.

"Skin cultivation is a resource that all of us professionals working with burns should highly value," Renée Herrera said. Other factors that contributed to Tafur's successful recovery were aggressive wound control to avoid infection, early surgeries, antibiotics, nursing care and physiotherapy.

Now, the team is trying to shorten the skin cultivation time by using acellular tissues that would allow doctors to cultivate skin on patients directly, saving even more time and reducing the risk of infection. The Peruvian Institute of Nuclear Energy and the Child Health's Institute of San Borja are planning to collaborate with universities to teach these new techniques.

In the early 1990s, Peru did not have the scientific or technological capacity to develop cells and tissue grafts for skin substitutes to treat this type of tissue loss. The demand for skin substitutes was high and imported material increased the treatment price, making it difficult for low income patients to afford it. Available treatments did not allow doctors to treat patients who suffered burns of more than 55 per cent of their total body surface area. Moreover, these treatments produced scars, which caused survivors psychological harm.

With support from the IAEA, Peru established its tissue bank at the Child's Health Institute in 1996, benefiting from training courses, expert missions, scientific visits and equipment up until today. IAEA experts guided and trained the local staff on the process of tissue engineering and quality management of cell and tissue banks. The Ministry of Health is now investing in a new tissue bank at the adult hospital, Arzobispo Loayza.

THE SCIENCE

Making tissue scaffolds is one of the first steps in tissue regrowth. "Give cells the right conditions and the right information and they will make just about anything — a new heart, a new bone, a few feet of new intestine, or part of a liver," said Oleg Belyakov, radiation biologist at the IAEA.

Scaffolds provide the framework for cells to build the necessary structures — whether blood vessels, valves, skin, nerves, cartilage, etc. If the tissue scaffold isn't 'just right', the cells will not make the right connections and the engineered tissue will die. Being 'just right' can mean scaffolding with holes large enough for cell migration during the initial stages of tissue

creation, and then holes that are much smaller when the time comes for nerves and blood vessels to be created.

Changing the shape and structure of scaffolding like this can be done quickly and effectively using radiation, which causes no damage to the growing tissue within the scaffold. Radiation technologies are also instrumental in other areas of tissue engineering, such as surface grafting, killing cells to form a 'feeder layer' for other tissues, and in sterilization.

HOW TO IMPROVE NUCLEAR SECURITY WORLDWIDE: THREE YOUNG WOMEN WIN IAEA ESSAY COMPETITION

如何提高全球的核安全：三個年輕女子贏得 IAEA 論文比賽

IAEA Director General Yukiya Amano today presented prizes to three young women who won the IAEA's first ever essay competition. Their essays contained recommendations for strengthening nuclear security through stronger border controls, closer international cooperation and public education. The competition was sponsored by the Permanent Mission of the United Kingdom of Great Britain and Northern Ireland to the IAEA.

"I am delighted that so many young people were interested in nuclear issues and chose to enter the competition," Mr Amano said before he and UK Ambassador Leigh Turner handed the prizes to the winners at IAEA Headquarters in Vienna.

The winners were Abeer Mohamed from Sudan, Noor Azura Zuhairah Binte Abdul Aziz from Singapore and Katharine Thomson from the United Kingdom.

The event took place on the sidelines of the IAEA International Conference on Nuclear Security, which is taking place this week.

Mr Amano said the quality of the entries was very high and the judges had faced a difficult task.

"I am especially pleased that all three winners are young women," he said. "Women play an important role at all levels in the work of the IAEA, but I am committed to increasing the proportion of female staff, especially in more senior positions."

Mr Amano encouraged students and young professionals to consider careers in nuclear science and technology. “It offers young people an opportunity to contribute to the well-being and prosperity of their own countries, and of the whole world,” he said.

In preparation for the conference, the IAEA invited students and young professionals to submit original and innovative essays on challenges in nuclear security. A panel of experts from the IAEA and the International Nuclear Security Education Network selected the three winners.

“These essays demonstrate a clear and compelling understanding of nuclear security and its many intricacies,” said Tim Andrews, Head of the Programme Development and International Cooperation Section at the IAEA. “They look to the future.”

Young professionals have the potential to contribute fresh and compelling insights into the future of nuclear security, Andrews said. Winners each received a 2000 euro cash prize and a certificate signed by Mr Amano. They were also invited to attend the nuclear security conference.

Community engagement for nuclear security

Abeer Mohamed, a student at Ritsumeikan University in Japan, was honoured for her essay entitled, ‘Encouraging community engagement as a strategy to strengthen nuclear security in our borders.’ It highlights the threats and challenges in developing countries with porous borders and limited nuclear security capacity because of insufficient equipment and funding. To improve border security, she suggests engaging the broader communities through education, establishing suitable domestic policies and better communication between the community and law enforcement agencies.

The importance of regional cooperation

The entry by Noor Azura Zuhairah Binte Abdul Aziz, a student at University College London, is called: ‘The future of nuclear security in Southeast Asia: commitments and actions.’ It discusses regional problems stemming from terrorism, maritime piracy and insufficient border controls. To address these challenges, she proposes closer international cooperation, especially among ASEAN countries, to strengthen capacity-building and create training programmes for all countries within the region. She also highlights the need for a comprehensive regulatory framework.

A medical physicist’s perspective

Katharine Thomson, from Musgrove Park Hospital in the United Kingdom, drew parallels between the common security challenges involving medical and other applications of radiation in her essay entitled ‘Future of nuclear security: commitments and actions, a medical physicist’s perspective’. Her proposals focused on engaging the public through education programmes, controlling access to dangerous material in order to eliminate insider threats, and enhancing cyber security by building comprehensive, usable and respected computer security systems.

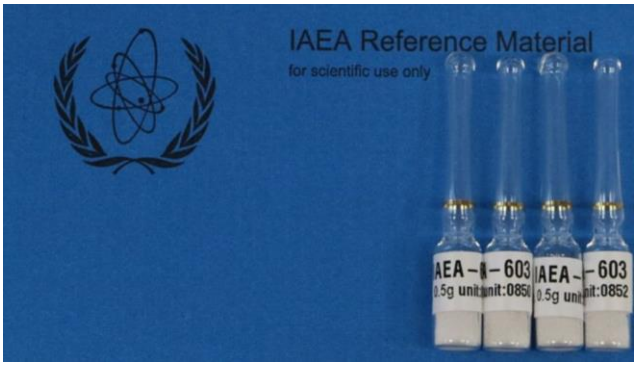
The essay competition attracted 353

submissions from 79 countries. The winning essays reflect a diverse range of areas within nuclear security, said In Young Suh, an IAEA Associate Nuclear Security Officer, who was one of the judges. “The winners have a chance to present their ideas to policymakers, senior officials and nuclear security experts attending the conference.”

The essays are available here.

NEW IAEA REFERENCE MATERIAL FOR IMPROVED MEASUREMENT AND MONITORING OF GREENHOUSE GASES

新型原子能總署材料用於改進溫室氣體的測量和監測



The IAEA Environment Laboratories have recently produced a new reference material using Carrara marble, the same marble that Michelangelo used to make his famous sculpture of David. This will contribute to improved measurements of greenhouse gases, such as carbon dioxide and methane, and provide information on their origin. A more precise understanding of these greenhouse gases can help Member States to better understand and therefore manage the sources of their emissions and work towards their Intended Nationally Determined Contributions (INDCs) as laid out in the Paris Agreement.

Why do we need this new reference material? Carbon dioxide (CO2) released during the burning of fossil fuels has a unique isotopic signature, which is similar to the isotopic signature of the plants and other organic matter from which it originates. By studying the isotopic ratio of stable carbon isotopes in atmospheric, marine, and ice core samples, scientists can assess the sources of carbon in these materials and have been able to determine that, since the industrial revolution, the increased levels of CO2 in the atmosphere result from fossil-fuel combustion. Isotopic ratios also provide valuable insight into other sources of greenhouse gases in the atmosphere such as from agriculture (rice fields, livestock) and land-use changes.

Furthermore, Greenhouse Gases such as carbon dioxide (CO2) and methane (CH4) move between different environmental compartments (the atmosphere, the ocean, terrestrial biosphere and sediments). This is known as the global carbon cycle. The reservoir of carbon stored in the deep ocean is 50 times larger than that in the atmosphere, with the ocean currently taking up about a quarter of the CO2 emitted by human activities each year. A small change in fluxes to the ocean carbon pool, such as those potentially caused by climate change and the rising temperatures, could affect the storage capacity of the ocean, which in turn could have dramatic consequences for atmospheric CO2 levels. If, for example, the biological pump in the ocean were to shut off, atmospheric CO2 could rise anywhere between 200 and 400 ppm above today's levels of ~400 ppm, reached for the first time in 2015. Accurately quantifying these fluxes and stocks of carbon is critical to constructing climate models that can be used to predict the impacts of climate change.

Models describing the global carbon cycle use the 13C/12C ratio as a fingerprint of greenhouse gas sources and related processes. "Scientists need an understanding of what is happening at an isotopic-level," said IAEA Stable Isotope Reference Material Specialist Sergey Assonov. "In order to get reliable observational data, scientists need reference materials with a low uncertainty which satisfy the World Meteorological Organization Data Quality Objectives for global monitoring."

The new reference material, IAEA-603, will be used by laboratories worldwide to reliably calibrate instruments to measure the isotopic composition of carbon and oxygen in greenhouse gases such as carbon dioxide and methane and to perform quality assurance tests to ensure the accuracy and long-term compatibility of their results. With an ultra-low uncertainty, the carbonate reference material will allow a better estimation of the sources and sinks of these greenhouse gases and ultimately improve the accuracy of global climate models. As climate change becomes a reality, decision-makers will increasingly seek such solid scientific evidence to guide their policies.

CONTINUE TO EFFECTIVELY STRENGTHEN GLOBAL NUCLEAR SECURITY: INTERNATIONAL CONFERENCE ON NUCLEAR SECURITY CONCLUDES

繼 續 有 效 加 強 全 球 核 安 全 ： 核 子 保 安 國 際 會 議

Highlighting the collective commitment to improve nuclear security at the national, regional and global levels, being vigilant about the threats to nuclear security, having concrete measures to protect against malicious acts involving nuclear or radioactive material, being cognizant of the need to support the central role of the IAEA: these were key announcements at the conclusion of the International Conference on Nuclear Security: Commitments and Actions last week.

The week-long conference provided an inclusive forum to formulate and exchange views on how to improve nuclear security globally. It attracted over 2000 participants from 139 Member States and 29 organizations - 47 Member States were represented at ministerial level.

The President of the Conference was Mr Yun Byung-se, Foreign Minister of the Republic of Korea. The Co-Chairs of the open-ended consultation process for the preparation of the Ministerial Declaration were Ambassador Song Young-wan from the Republic of Korea and Ambassador Abel Adelakun Ayoko from Nigeria.

A ministerial segment, lasting a day and a half, adopted a Ministerial Declaration by consensus. During the segment, Ministers had the opportunity to share their national perspectives related to nuclear security. Ninety national statements were delivered.

In the Declaration, Ministers announced their commitment “to continuously maintaining and further strengthening nuclear security through national actions, which may involve international cooperation, primarily through the IAEA, as well as through other relevant international organisations and initiatives, in accordance with their respective mandates and memberships.”

The conference underscored the commitment of the international community as a whole to nuclear security and the unique platform the IAEA offers to assist Member States in further strengthening a global response to a global threat.

Another important message was encouragement of the universalization of the Amendment to the Convention on the Physical Protection of Nuclear Material (A-CPPNM) which entered into force on 8 May 2016. The importance of adherence to the CPPNM and its Amendment was also highlighted.

The conference's scientific and technical sessions comprised of six high level sessions on broad themes central to nuclear security and more than 30 technical sessions on specialized scientific, technical, legal and regulatory issues concerning nuclear security.

The technical sessions addressed a wide range of nuclear security related subjects including: evolving challenges and threats to nuclear security; identifying gaps and strategies on the secure management of radioactive material; international instruments for nuclear security; nuclear forensics; computer security for industrial control systems in nuclear facilities; public engagement on nuclear security; and nuclear security education.

The global challenge in checking and preventing unmanned aerial vehicles (UAVs, also known as 'drones') from posing threats to nuclear and other radioactive facilities was discussed. Participants stated the importance of having stringent legal and regulatory controls in the use of drones. The benefits of UAV's in the nuclear sector were also highlighted, such as their use to enhance security at nuclear facilities, their role in emergency response and tracking radiation in the environment.

Another topic discussed was the threat from cyberattacks at nuclear facilities. National efforts to strengthen cybersecurity and testing computer security controls that are critical to improving security at nuclear facilities were highlighted. Nuclear power plant operators, vendors, national regulators and international organizations recognise that cyber threats are constantly evolving and that they need to proactively engage in collaborative efforts to enhance cybersecurity to prevent any unwarranted events that could lead to a nuclear or radiological emergency.

Participants also exchanged experience on how to implement effective measures against 'insider threats' to reduce the risk of the theft of nuclear and other radioactive material and possible sabotage of nuclear facilities.

A number of side events took place on the margins of the Conference, in particular an event commemorating 20 years of the International Physical Protection Advisory Service (IPPAS) service and on scaling up worldwide capacity to manage disused sealed radioactive sources.

A President's Report will be published on the conference site.