



IAEA

Joint FAO/IAEA Programme
Nuclear Techniques in Food and Agriculture

Nuclear Applications in Agriculture Success Stories from **Latin America** and the **Caribbean** in facts and figures

The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture - key to the successful and unique FAO-IAEA partnership - helps countries develop capacity to optimise the use of nuclear and related technologies for food and agricultural development. The following facts and figures illustrate select impacts of this work in Latin America and the Caribbean.

24 TECHNICAL COOPERATION PROJECTS

ongoing in the field of food and agriculture in 2015. The Joint FAO/IAEA Division works to build partnerships, strengthen regional cooperation, and build human and institutional capacity for the sustainable application of nuclear technology for food and agricultural development.

20 countries

request and receive one or more services from at least one of the FAO/IAEA Agriculture & Biotechnology Laboratories each biennium, reflecting the importance of these services to Member States and an indication of their unique alignment with the food and agricultural issues faced by the concerned countries.

53

research contract holders benefit from the Joint FAO/IAEA Division's global network of almost 500 research institutes and experimental stations, increasing their R&D capacity as a result of coordinated research projects managed by the FAO/IAEA partnership, making it one of the largest collaborative agricultural research networks worldwide.

16 national agricultural research institutes

and extension services use isotope techniques, under a range of cropping systems and agro-climatic conditions, to quantify the nitrogen fixation potential of grain and forage legumes that have the potential globally to fix some 33 million tonnes of atmospheric nitrogen each year. The Joint FAO/IAEA Division helps to make biological nitrogen fixation a cornerstone of today's soil fertility, quality and nutrient management systems, thereby supplementing the use of chemical fertilizers worth billions of dollars annually.

94 trainees

participated in 14 training courses and workshops in 2015 and learned to apply one or more nuclear technologies in the field of food and agriculture.

7 Countries

participated in an integrated control programme to combat liver fluke parasites that seriously affect cattle and sheep as well as people. They evaluated and validated nuclear-related immunological and molecular diagnostic technologies that are now being disseminated and implemented in the region.



1

Million KM²

the area, equal to half of **Mexico's** territory, declared free or with a low prevalence of Mexican and West Indian fruit flies. This was achieved through the annual release of 5.2 billion sterile Mexican fruit flies and 1.5 billion West Indian fruit flies produced at the Metapa fruit fly mass rearing facility as part of an integrated pest management approach that combines the sterile insect technique with the release of parasitoid wasps to control Mexican and West Indian fruit flies in fields and orchards. This has substantially invigorated the horticultural industry in Mexico, generating thousands of new jobs and millions of US dollars in additional revenue.

SIX shrimp diseases

listed by the OIE as major diseases affecting shrimp farming and aquaculture, for which the BAHA PCR Laboratory in **Belize** have implemented diagnostic capabilities to enhance the local shrimp industry by providing a full certification programme to support Belize's export of live aquatic animals and products of aquatic animal origin, hence strengthening employment and income generation, especially in rural communities.

2 BILLION MALE MEDFLIES

the weekly production and release capacity of the sterile insect production centre at El Pino, **Guatemala**. The sterile insect release programme in Guatemala, as a component of an integrated pest management strategy, facilitated the establishment of medfly-free and low-prevalence areas that permit mango, papaya, tomatoes and bell pepper exports valued at over US \$50 million per year. It also forms a vital component in preventing the recurring influx of medflies into southern Mexico, protecting the Mexican US \$4.5 billion fruit and vegetable industry, as well as the much larger US horticultural industry.

50%

reduction in fodder production costs

achieved in **El Salvador** through a new legume-based forage production programme supplemented by targeted feeding of dairy cattle that increased milk production by 3 litres per cow per day and reduced feeding costs. Further benefits to the programme included better crop rotation and land management, less use of chemical fertilizers due to nitrogen fixation by legumes, and reduced energy and nitrogen leakage to the environment through manure.



the time taken for **Panama** to more than double its export of pineapple, one of its main agricultural exports commodities, to US \$26 million/year, as a result of establishing an enhanced national food control system and improving communication among concerned stakeholders. The increased confidence of farmers propelled an increase in acreage from 1400 to 2400 hectares.

1 pesticide residues analysis laboratory

established in Bogotá, **Colombia**, and now fully accredited. Following an intensive communication campaign informing farmers of the consequences of inappropriate pesticide applications and encouraging better farming practices, water entering Lake Tota is now less contaminated and agrochemicals less likely to persist for long enough to enter the food chain.

3000 kg/ha

of barley produced at altitudes 3000 metres above sea level using a high-yielding mutant variety developed at La Molina, **Peru**, up from 800 kg/ha. As a consequence, barley acreage increased from 75 000 ha to 151 000 ha and production by 142 000 tonnes/year, earning an additional US \$32 million each year to poor, high-altitude Andean farmers.

10 fold increase

by **Peru** in the export of organic, high-quality Kiwicha to Japan using a mutation induced improved variety with larger grains, high uniformity, higher yield under marginal conditions and a creamy gold colour. It is now cultivated on more than 450 ha of land by small-scale farmers, NGOs, enterprises and public and private institutions, with yields reaching 5000 kg/ha at altitudes of up to 3000 metres.

324 Million US Dollars

the value of fruit exports from **Peru**, made possible through a loan from the Inter-American Development Bank (IDB), to SENASA, Peru's Plant Protection Authorities, which facilitated the development of medfly-free and low-prevalence areas for fruit production and commercialization. This was achieved through the integration of the sterile insect technique with other control methods, including locally produced sterile male medflies.



452 USD/ha the additional economic benefit attained by resource poor farmers in **Cuba** when combining rice farming in rotation with nitrogen-fixing *Sesbania forage* legume, resulting in an increased rice yield of 1 tonne/ha while reducing inorganic fertilizer consumption by 48%.



INCA LP-7

the mutant variety of rice that increased rice yield in **Cuba** from less than 3 tonnes per hectare to 5 to 7 tonnes. Cuban farmers now plant INCA-LP7 on more than 25% of the 200 000 ha rice fields. The higher yields provide farmers with additional incomes estimated at US \$1 660/ha/year and the increased harvests have enabled Cuba cut back dramatically on rice imports.

5 laboratories form the nucleus in a holistic approach in **Honduras** to improving livestock productivity. Supported by the Joint FAO/IAEA Division, they include a radioimmunoassay laboratory to monitor cow reproductive performance in artificial insemination (AI) programmes; a semen processing laboratory to support AI and genetic improvement; a diagnostic laboratory to early and rapidly detect animal diseases; a nutrition laboratory for feed evaluation and ration formulation; and a residue analysis laboratory to verify the microbiological and chemical content of meat and dairy products for local consumption and export.

40 million US\$

the annual export revenue regained after the United States lifted a ban on the import of various fruits and vegetables, including peppers, avocado and citrus, from the **Dominican Republic**. The ban was caused by a Mediterranean fruit fly outbreak. An intense surveillance and eradication programme, including the release of sterile medflies with the goal of eradicating the insect from the Dominican Republic, resulted in a lifting of the ban in 23 of 30 provinces within only ten months.

2 Billion USD the estimated value of biologically fixed nitrogen in the annual soybean harvest of **Brazil** in terms of urea fertilizer equivalents. Biological nitrogen fixation is today a cornerstone of global soil fertility management systems, with major grain legumes biologically fixing an estimated 11.1 million tonnes of nitrogen each year worth more than US \$13.5 billion.



in the global ranking of beef exporting countries and one of the highest in beef consumption, **Uruguay's** Michael C. Rubino Veterinary Laboratory established methodology for multi-residue detection of antibiotics using mass spectrometry and proved that its methods of analysis and sampling are calibrated in compliance with increasingly stringent international protocols – crucial to retaining its top export ranking.

3,9 Tonnes of soil lost per hectare each year in commercial forest areas of south-central **Chile** due to erosion, 78 times more than in undisturbed closed forests. Using fallout radionuclides and compound-specific stable isotope techniques, it was shown that sediment sources prior to harvesting were predominantly roads and streams; during and after harvesting movement of surface material from forest slopes was caused primarily by soil disturbances during planting and harvesting activities.

82 TONNES HA

1500 samples/year

the number of residue monitoring samples handled by the Laboratory of Environmental Chemistry and Food at the Agricultural and Livestock Service in **Chile** following an institutional capacity building and enhancement programme. It now supports other countries in Latin America and beyond, including Angola and Mozambique, through training and sharing of analytical techniques.

2 Million tonnes

the amount of fruit exported annually by **Chile** to countries around the world as a result of being declared a Mediterranean fruit fly-free country. This was made possible through the eradication of the pest using the sterile insect technique and the subsequent maintenance of an effective pest surveillance system, including the operation of thousands of medfly specific traps. Chile's annual fruit exports are valued at US \$2 billion, being one of the main contributors to the country's gross domestic product.

the net annual rate of soil loss from downslope vineyard sites in **Chile**, compared to 76t/ha on terraced sites, due primarily to the lack of sufficient cover particularly during the first month of the rainy season. As one outcome of these findings, cover crops were introduced without delay in 13 vineyards covering 3200 ha.

>100 Million US\$

the value of produce now exported every year from seven countries that participated in an initiative on the area-wide integrated pest management approach, including the release of sterile insects, to establish pest-free and low-prevalence pilot areas. The initiative, generating thousands of jobs and involving governments, fruit growers, international organizations (WTO and IPPC) and the USA as a major importer, became the basis for import-export agreements that facilitated the immediate commencement of papaya, tomato and bell pepper exports to the privileged US market.

10 countries

cooperate in a regional animal breeding network to develop, adapt and disseminate molecular tools for small ruminant resistance to gastrointestinal parasites, which kills up to 50% of lambs and kids and is hampered by the emergence of anthelmintic resistant parasites on more than 60% of farms. Incorporation of such tools in sire selection would enhance growth and wool production by US \$2 per animal and prevent mortality of animals valued at US \$60 each for general stock and US \$400 for breeding sires.

22 laboratories

in ten countries worked jointly to develop and validate immunoassays for the diagnosis and epidemiology of, among others, foot-and-mouth disease (FMD) and brucellosis. The FMD antigen detection ELISA and the FMD antibody detection ELISA showed high sensitivity, and the indirect ELISA kit for the detection of antibodies to *Brucella abortus* was shown to be a good screening test in animals vaccinated with the tested 'B. abortus strain 19' vaccine.

194 methods

for analysing and reliably monitoring veterinary drug and pesticide residues in food and environmental samples have been validated by the Joint FAO/IAEA Division and transferred to Member States. The methods are made freely available and can be accessed online through the Joint FAO/IAEA database on Food Contaminant Residue Information System.

>200 growers, traders and distributors

of fresh produce have received assistance, to enhance exports, relating to food irradiation (safety and phytosanitary) through

the National Center for Electron Beam Research in Texas, USA, one of several collaborating centres of the Joint FAO/IAEA Division. Mexico has already adopted e-beam technology as a phytosanitary treatment to meet USDA-APHIS import regulations.

10 laboratories

in nine countries, in the largest ever serological validation exercise for brucellosis under field conditions, compared an indirect and a competitive ELISA *Brucella* kit with classical diagnostic tests in more than 200 000 samples from several cattle breeds. The competitive ELISA II, using lipopolysaccharides as antigen and a monoclonal antibody (Mab 84) as a competitive reagent, best differentiated infected from vaccinated animals. It is now widely used in the region.

4000 inseminations

with frozen semen from 235 sires had shown, in an extensive scrutiny of efficiency related factors associated with artificial insemination (AI) services for cattle, using progesterone radioimmunoassay, nearly half to be associated with management deficiency or human error and not with cow or bull fertility. As a consequence, seven countries issued a single set of guidelines for AI services and inseminators.

>50 laboratories

in 21 countries work together in the *Red Analítica de Latino América y el Caribe* (RALACA) network. Over the past three years, twelve national chemical residue monitoring programmes have been developed and coordinated under RALACA, fifteen laboratories worked together to monitor veterinary residues in foods and feeds and over 340 laboratory staff were trained.

6 years

and more than 300 scientists in the Bovine Genome Sequencing Consortium and the Bovine HapMap Consortium, sequenced the full cow genome. Cattle breeders are now using this genomic information to identify and utilize favourable traits such as disease resistance, heat tolerance and more and better quality milk and meat.

25-40%

the increase in calving frequency achieved in 18 countries through the use of iodine-125 labelled radioimmunoassay progesterone kits to identify factors affecting the efficiency of artificial insemination and the conception rate in cattle. This increase in calves, milk and beef represent a considerable improvement in the livelihood of farmers and the availability of animal products on local markets.



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