

of an effluent unit for the recovery of usable water.

4. Foam-assisted CO₂ flooding for the depleted reservoirs of Upper Assam Basin and in candidate reservoirs in Louisiana, USA.

Apart from the above, Borgohain emphasized work on the characterization of formation water. Project authorities were requested to seek R&D support, especially on water-related issues in projects and eco-friendly technology for EOR. During monitoring, it has been observed that formation water at many sites in the oil fields does not conform to the prescribed standard; so ETP needs revamping and further R&D in this aspect is needed.

D. J. Das (RFRI) stressed that though his Institute does not have collaboration with the oil sector, it can contribute in the monitoring of ecological biodiversity. The Institute has also completed a study on carrying capacity of Digboi forest and prepared a report on the impact of oil spills on biodiversity. Das has done a project with Coal India for preparing a biodiversity management plan. They have adopted villages and are training the villagers on how to avoid man-animal conflicts. They can help raise nurseries and provide native species as well. RFRI is so close to operational areas that environmental compliance, particularly related to biodiversity conservation, afforestation, greenbelt development, and socio-economic development can be sig-

nificantly improved with help of the Institute.

Finally, the project executors were advised to submit time-bound action plans to increase the compliance and inventory of oil sludge and spent catalysts, including chemical and physical composition with the help of reputed institutions. Scientists from the SPCBs were also requested to take up the issues of oil sludge for co-processing in cement kilns.

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MEETING REPORT

Fighting antibiotic resistance through unified strategies*

A one-day international symposium was held recently in Bengaluru, India to discuss strategies to reduce antibiotic resistance by adopting a holistic approach to human, animal and environmental health. The excessive and indiscriminate use of antibiotics in human, agriculture and animal healthcare has resulted in antimicrobial resistance (AMR)¹. It is estimated that, if unsolved, by 2050 AMR will cause 10 million deaths per year².

The symposium brought together expert veterinary medical professionals, dairy scientists as well as national and international representatives. Anurag Bhargava (Medical College, Mangalore) highlighted the need to work on a 'One Health' perspective. He gave examples from rural India, where human tuberculosis originating from cattle is increasingly prevalent and largely resistant to all antibiotics. He expressed his concern clearly when he stated: 'now we have bugs from hell'. Praveen Malik (Department of Animal Husbandry, Government of India) emphasized the challenge presented by the need to increase production and improve farmer income while reducing the use of antibiotics. He added that

'We are now in the post-antibiotic era and we need to focus on alternate solutions'.

As a response to this challenge, a five-layered strategy of Natural Livestock Farming (NLF; www.naturallivestock-farming.com) for reducing the use of antibiotics and other chemicals in dairy farming was presented by Katrien van't Hooft (Dutch Farm Experience/NLF Coordinator, The Netherlands). This strategy includes; (1) good animal management; (2) strategic use of local breeds; (3) use of medicinal plants and other natural products; (4) milk quality control, and (5) farm economics (cost reduction and/or improved prices).

Hari Kumar (National Dairy Development Board (NDDB), Gujarat) stressed upon the economic perspective, by citing the loss of over Rs 7000 cores per year due to udder infection in Indian cattle, the main reason for antibiotic use in the dairy sector. In order to reduce this dependence, the NDDB decided to adopt a formulation using medicinal plants – also known as ethno-veterinary practices (EVP) – developed by Trans-Disciplinary University (TDU, Bengaluru) and Tamil Nadu Veterinary Science University (TANUVAS, Chennai).

The Karnataka Milk Federation (KMF) was the first in India to venture into the

use of medicinal plants for animal healthcare. Veterinarians and farmers from KMF were trained by TDU and TANUVAS to use EVP for 15 clinical conditions in dairy animals. Krishna Reddy (KMF) emphasized how KMF sees EVP as its top priority in order to contain the spread of mastitis and other infectious diseases. He stressed that, in 2016, this experiment had resulted in 1.8 lakh litres of extra milk production despite the prevailing drought. The pilot study by TDU in villages in Karnataka, Tamil Nadu and Kerala indicated 49% reduction of antibiotic residue in the milk in just one year.

International NLF partners from the Netherlands, Ethiopia and Uganda who attended the symposium indicated that they are facing similar challenges. Emmanuel Rutamwebwa (farmer and entrepreneur from Uganda) itemized the threats facing the dairy sector in his country. He described the way ticks had become resistant to all forms of chemical control, including acaricides. He made it clear that this is becoming the main economic and environmental degradation problem facing dairy farmers in Uganda. He said he had come to India to learn more about how medicinal plants, combined with good animal management and the strategic use of local breeds could help address these problems.

*A report on One Health Symposium on Antibiotic Resistance and Natural Livestock Farming, Bengaluru, India.

Daniel Temesgen (Ethiopian Society of Animal Production and NLF coordinator in Ethiopia) emphasized that in his country there is a need to replace antibiotics with herbal treatments. He presented the community-based indigenous cattle breed conservation programme that had been developed for farmers working under low-input production conditions. Maria Groot (RIKILT Institute, Wageningen University, The Netherlands) referred to measures that could improve awareness and reduce the sale of antibiotics. She also discussed product quality control measures that could be adapted from Dutch experience, where the use of antibiotics in livestock farming has been reduced by 60% during the last five years. Fokke Fennema (World Bank, New Delhi) indicated his

support for 'One Health' and congratulated the initiative taken by TDU and NLF. He mentioned the strategy of World Bank to financially support governments in ways that would make it possible for them to develop and fund national programmes aimed at promoting agricultural diversification, more jobs in rural areas and food safety.

At the end of the symposium the Indian chapter of the NLF Network was inaugurated by Balakrishna Pisupati (TDU). In his valedictory address, Pisupati emphasized that the approach of NLF would be adopted in future, adding that 'NLF is a valuable network with a bottom-up approach developed from working with communities. This provides a practical example for One Health discussions at a global level. Moreover, animal

genetic resources are endangered, while governments have a mandate to protect them. The NLF network is developing courses targeting veterinarians and farmers at the global level. TDU is working on developing a certified 'One Health' course that includes three vital elements: human, environmental and animal health'.

1. Nisha, A. R., *Vet. World*, 2008, **1**(12), 375-377.
2. Neill, J. O., Antimicrobial resistance: tackling a crisis for the health and wealth of nations, 2014; <http://amr-review.org>

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