

# Twin genes to help India lift meat production

The same gene that lifted fecundity in Australian Merinos more than 60 years ago has been traced to an Indian breed and is now helping Indian shepherds improve sheep production

BY KELLIE PENFOLD

A single gene with the ability to promote twinning in sheep has attracted breeders' attention because it promises a simple genetic route for lifting production at a time of unprecedented global demand for meat. Called the Booroola fecundity, or *FecB* gene, after the Australian property on which it was discovered, the gene's origins were recently traced back to India's Garole breed.

The finding is playing a pivotal role in ACIAR-funded projects that, for 10 years, have brought together Indian and Australian scientists and shepherds in the Indian state of Maharashtra. Collaborating on the research are India's Nimbkar Agricultural Research Institute (NARI)

and National Chemical Laboratory (NCL), along with Australia's University of New England (UNE) at Armidale and the University of Melbourne.

The aim is to share genetic resources and management expertise in a quest for productivity gains for the poorer shepherd communities of Maharashtra and the Australian Merino flock, currently at its lowest level since 1924.

In India, there are about five million shepherd families running 62 million sheep and 125 million goats. Flock-owners often cooperate to raise the combined size of the migrating ewar, thereby reducing costs and improving security. Shepherds, whose income is derived from meat production, run between 25 to 100 ewes, with each ewe producing a single lamb every 10 to 12 months.

Project leader in India, NARI's Dr Chanda Nimbkar, says it is a high priority of the state and national governments of India to increase production of sheep meat and other livestock products to meet growing demand. Another priority is to increase supply of meat at reasonable prices in the rural, less affluent sections of society.

Surveys by Australian project leader, Professor Steve Walkden-Brown from UNE, found that while goats regularly produce twins, the shepherds place a high value on the rare ewes that regularly produce twins. A higher reproduction rate in ewes means the ability to run fewer animals to produce the same number of lambs, thus easing grazing pressure and maximising profits.



PARTNER COUNTRY: India

PROJECT DESCRIPTION: AH/2002/038: Improved productivity, profitability and sustainability of sheep production in Maharashtra, India through genetically enhanced prolificacy, growth and parasite resistance

CONTACT: Dr Stephen Walkden-Brown, swalkden@metz.une.edu.au

PHOTOS: STEVE WALKDEN-BROWN



Shepherds collaborating with the project team proudly display a young Deccani ram they have selected.

Professor Steve Walkden-Brown from UNE and Dr Chanda Nimbkar from NARI snack on fresh chick peas while visiting shepherds' flocks in February, 2007.

To capture the benefit to shepherds of the twinning trait, efforts were made to introduce the only fecund sheep breed in India—the Garole breed—to the Deccan Plateau of Maharashtra. The Garole breed also has better internal parasite resistance than the local Deccani breed, another desirable trait that can improve productivity.

These efforts faltered because the Garole breed is small and unattractive to Deccani shepherds, and the introduced sheep did not thrive on the plateau. The project did, however, establish that the *FecB* gene accounts for the Garole breed's fecundity. The finding confirmed earlier theories that the presence of the gene in Australia originated in the 'Bengal sheep' introduced into Australia from Calcutta in 1792–93.

The decision was then made to breed the high-fecundity and parasite-resistance traits from the Garole into the Deccani sheep, while avoiding the transfer of other, unwanted Garole characteristics. Achieving that goal meant using complex crossbreeding and selection techniques to introgress the *FecB* gene into the Deccani genome.

"Fortunately, the nature of the *FecB* gene means that, over time, it can be introduced to different strains of sheep and rather quickly be retained, while discarding undesirable traits from the breed of origin," Professor Walkden-Brown says. "The ability to express the twinning trait is then governed by whether an animal has inherited zero, one or two copies of *FecB*."

The gene's identification by three different international research groups in 2001 has meant that DNA tests can now easily determine how many copies a ram, ewe and lamb has inherited. The test provides unprecedented opportunities to select for the twinning trait during breeding. Previously, establishing its presence in ewes required examining the ovaries of sexually mature ewes while rams took even longer, requiring ovary evaluation of its daughters.

With NARI's Dr Chanda Nimbkar using an ACIAR fellowship to complete a PhD in animal genetics at UNE, the way was paved for the project to undertake large-scale DNA testing. In Australia, DNA samples were collected from Merino ewes on a southern New South Wales property. In India, Dr Nimbkar's NARI team took samples from Garole and Deccani crossbred sheep. The project also examined genetic factors controlling the inheritance of other production traits in NARI's research flock of 500 ewes.

The project amounted to the first large-scale genotyping for the *FecB* gene in flocks maintained under commercial Australian conditions. The gene was found to have no adverse effect on traits such as wool growth and quality. However, increases in litter size proved difficult to manage in Australia's extensive sheep production systems since lamb mortality was correspondingly higher. In Australia, the benefits of *FecB* were less clear than in India.

The NARI scientists, in contrast, found that the Indian ewes carrying zero, one and two copies of the *FecB*, on average, carried litter sizes of 1.02, 1.57 and 1.63 and an average number of lambs weaned of 0.96, 1.33 and 1.30 respectively.

"If the basis of the more moderate litter sizes in *FecB*-carrying ewes in India can be discovered and applied to the Australian Merino, it could revive the use of *FecB* as a way to improve reproductive rate at a manageable level," Professor Walkden-Brown says.

In contrast, the research focus in India shifted to the shepherds' flocks in a bid to evaluate the productivity of *FecB* sheep run under real farming conditions. The resulting information provides the basis for introducing genetic gain into the shepherds' flocks. Strikingly, litter sizes under shepherd management were found to be similar to NARI's results. The majority of the increased lambs survive and go on to be sold, substantially improving the profit margin per ewe.

"Genetics and the environment invariably operate in tandem and it is our feeling that to really get the most benefit out of ewes carrying the *FecB* gene, shepherds will need to modify their management slightly to provide extra nutrition to the pregnant ewes and young lambs at critical times," Professor Walkden-Brown says.

In 2007, 582 shepherds attended nine different training programs run by NARI, capitalising on one of the project's strengths—its emphasis on working with shepherds who are actually earning their living from sheep (although 582 out of 5 million is small, it is a start.)

Also critical to the project is the 'can do' attitude of the NARI partners, Professor Walkden-Brown says. "NARI is a dynamic, independent, non-government research organisation located in rural India, with good links to local farmers. Because the nucleus flock is run at NARI, under traditional herding methods, staff have great first-hand experience with the sheep and can relate easily with the shepherds."



Sheep manure and urine is a valuable by-product of sheep raising in Maharashtra and shepherds are often paid to 'fold' or camp their sheep on crop land overnight. After breakfast, which the shepherds' family can be seen preparing, when the dew has dried the flock is moved to a new grazing area. These Deccani sheep have been recently shorn and decorative unshorn tufts of wool can be seen on some sheep.



Young crossbred Deccani rams carrying the *FecB* gene at NARI.

In 2007 the value of the research was recognised by the Indian Government, with NARI and NCL being the joint winners of the Council of Scientific and Industrial Research Award for 2007 for Science and Technology Innovations for Rural Development.

Project participants are now planning to host an international workshop in Pune, India, on the application of the *FecB* gene in sheep breeding programs. It is scheduled for November 2008.

The workshop will bring together scientists from around the world to discuss their recent findings and the best ways to disseminate and use the *FecB* gene for the benefit of sheep producers in India and elsewhere. Details of the workshop can be found at its website ([www.une.edu.au/ers/hnt-workshop.php](http://www.une.edu.au/ers/hnt-workshop.php)). The proceedings will be published by ACIAR and will capture many of the results of more than a decade of ACIAR-funded work on meat sheep improvement in India. ■