INSIDE
TECHNICAL CO-OPERATION

International Atomic Energy Agency

March 1996 Vol. 2, No. 1

CONTENTS:

Cattle killer meets its match

Cattle normally play a crucial role in rural economies of developing countries, providing crop manure, domestic fuel and hides, as well as meat and milk, while the bullock is the tractor in the field and the engine of transportation. But in a wide belt across central and southern Africa and on Zanzibar's main island Unguja, livestock rearing is seriously hampered because the tsetse fly spreads disease to the animals. Numerous costly efforts to eradicate tsetse - using traps, insecticides, and other conventional methods - have failed thus far. Now it seems that eradication is possible, at least on isolated Zanzibar.

Blood sampling from cattle to monitor disease transmission. (Credit: U. Feldmann)

Unguja and a few tiny satellite islands make up Zanzibar, 35 kilometres east of continental Africa. It joined the United Republic of Tanzania in 1964. A lone fly species lives on Unguja. Apart from it, the island has ideal conditions for cattle - lush vegetation, gently undulating terrain, reliable and ample rainfall. Yet some 10,000 live animals plus US$250,000 of milk products must be imported each year to supplement the low per capita intake of protein on Unguja.

Tsetse flies (*Glossina* species) live only on blood. Some species carry sleeping sickness to humans, others a similar disease, *nagana*, to animals caused by single celled

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Barley climbs the Andes

Across the high Andean plateau in Peru and Bolivia, the diets of the impoverished peasant communities remain inadequate. Staple foodgrains cannot be grown because of the oxygen-short conditions, the stress of daily temperature variations and high ultra violet exposure under cloudless skys. An early barley, perhaps introduced from Europe many centuries ago, does manage to survive. But it is poorly acclimatized and its yields are extremely low.

The plateau is mostly a flat plain, 3400-4000 metres above sea level. Local farmers cultivate protein-rich Amaranthus, Quinaoa,varieties of potatoes and faba bean which can fix atmospheric nitrogen and naturally fertilize the soil, much the same as the ancient Incas did. Soon they may well have a superior barley.

The IAEA has helped Peru develop its capability to apply nuclear techniques and these are now being used to breed new high-yielding grain varieties with built-in stress resistance. They could not only increase the food security of the high Andes, but promote sustainable grain production on a large scale as well. A mutant vari-

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Better feeds make bountiful breeds

Increasingly throughout rural areas of central and western Java, small groups of people, mainly women, may be seen mixing what appears to be large loads of unlovely and smelly muck. In fact, they are doing something both economically and scientifically sound, making Urea-Molasses-Multinutrient Blocks (UMMBs) to feed to their ruminant animals - buffalo, cattle, goats and sheep - and provide them with some essential nutrients they lack.

Cornelia Hendratno received special training in nuclear and related techniques in animal production at the Agency's laboratory in Seibersdorf, and led the BATAN research group that developed the supplemental feed block. She was responsible for the initial field trials that brought experimental ingredients to rural areas where she worked with villagers to knead bricks into forms. When early results of the feeds were clear she encouraged the Ministry of Agriculture to take over an extension role. Ms. Hendratno was also a key link with the Agency, as technical coordinator and then principal investigator in the IAEA projects. She now heads BATAN's Animal Nutrition Research Group.

Shortages of quality feed for livestock is common throughout much of Asia, where there is little land set aside as pasture and few forage crops are grown. Most cattle are kept by small farmers in herds of 2 or 3, rarely more than a dozen, in mixed-enterprises that include crop cultivation. They forage on what they can find, such grass and straw by roads and fields, and residues of agriculture and food production. Yields and quality of milk and meat are low.

Improving the quality of feed for ruminants in a way that small farmers can afford in terms of cash and labour was the task taken up in the early 1980s by scientists led by Ms.Cornelia Hendratno at the Centre for Application of Isotopes and Radiation, which is part of Indonesia's Atomic Energy Agency (BATAN). They had funds from the UN Development Programme (UNDP) and the infrastructure and skills developed over many years with help from the IAEA. The technique involves the use of benign tracer isotopes that reveal the fate of feed constituents in the digestive system of ruminants.

The multinutrient block, a mixture of feeds and vitamins, that Ms. Hendratno and her team developed after years of lab research and animal tests has been received enthusiastically by Java's villages. It has stimulated 30% increases in milk yield and over 100% increases in growth rates of beef cattle, goats and sheep. Perhaps the key to its appeal is that it uses locally available feedstuffs - straw, rice stubble and bran, cottonseed cake, waste from fish processing and even poultry litter - mixed with appropriate amounts of urea, molasses and various minerals.

The mixture is pressed into moulds and dried to make brick-like blocks. A key feature of a block is that it must have a consistency that enables an animal to lick it but prevents it from eating it all at once. This has been successfully worked out for various formulations so that once the mixture is prepared by the villagers it is not necessary to thumb-test each brick.

The urea provides nitrogen proteins for growth; the molasses gives the energy and sulphur helps utilize the nitrogen and build up microbial protein that provides amino acids. Other minerals, like calcium and phosphorus essential for lactating animals, can also be added. Each block is made large enough to avoid the labour of too frequent replenishment and enabling adequate stocks to be made. The aim is that each animal licks 500-700 grams of it per day on average.

During earlier field trials to assess the efficacy of various formulations in local animals, Ms. Hendratno and her team found that community women in particular wanted to be trained to mix and make the blocks. Farming families soon joined in cooperatives to produce and use them. In the past few years the Ministry of Agriculture has taken on the task of extension work, promoting the technique, teaching villagers to make bricks with locally available materials, and encouraging local co-operative schemes.

Under a Agency technical co-operation project launched in 1994, BATAN started training courses

Local women manufacture UMMB's in Indonesia. (Credit: C. Hendratno)

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Floating rice and soaring sorghum

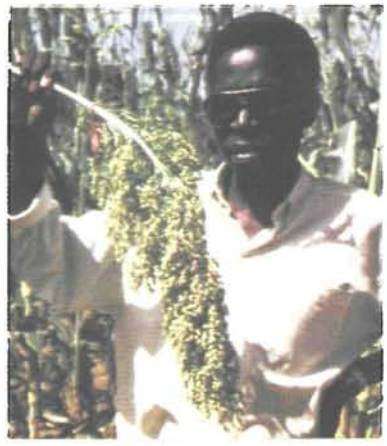
Smallholder agriculture is the backbone of Mali's economy. But yields of staples - millet, sorghum, rice, maize and fonio - have not kept up with population growth, and the rising cost of cereal imports now consumes 6.5% of GDP. Crop improvement has depended almost solely on seed selection by individual farmers, while systematic plant breeding has only recently arrived. Breeding more productive rice and sorghum is the principal challenge.

Malian scientists have now produced rice and sorghum mutants that could benefit smallholders and the national economy if widely grown. But until recently strains remained in the laboratory. Now, with new initiatives in Agency technical co-operation, the new mutant varieties will be taken to the farmers through a government extension programme that involves community participation.

In the expansive floodplains of the Niger River in Mali farmers have grown rice for many centuries. This peculiar "African rice", or *Oryza glaberrima*, evolved here before the arrival of humans. Its make-up includes genetic traits essential for survival. Its stalk grows in pace with the rising water, keeping its panicle (seed head) afloat; it can cope with dehydration stress after the waters recede; and it shatters seed when mature.

Mali's native sorghum relies exclusively on rainfall and has traits that give it resistance to drought. Farmers grow varieties that are extremely tall, sometimes 3 1/2 metres because the stalk has many economically important uses - as cattle feed and roof thatch, for making mats and even the small huts in which grain is stored.

The challenge for plant breeders is to improve productivity of these crops, while conserving their essential traits. Malian scientists Fousseyni Cisse and Al Housseni Bretaudeau led research teams to find mutant varieties of rice and sorghum at the *Institut d'Economie Rural* and *Institut Polytechnique Rural*, respectively. Under a recently completed FAO/IAEA Coordinated Research Programme (CRP) funded by Italy and designed to help **improve local and basic food crops of Africa** they irradiated traditional varieties with gamma rays according to the prescribed procedures. IAEA technical co-operation had already provided training and equipment to enable the two national scientific institutions to have the capacity to apply nuclear techniques such as mutation breeding, to improve yields and other enhanced characteristics of traditional food crops.



Unusually long seed head of sorghum displayed by Mali technician. (Credit: B. Ahloowalia)

During the five years of the CRP, Cisse's rice team was not able to identify a non-shattering variety, which was its aim, but it did develop some new types with white color characteristics and high yields. White rice in Africa fetches double the price of red; so for farmers the colour alone means an income hike, with high yield a bonus. Bretaudeau's team obtained sorghum mutants that grow tall but do not lodge, and some with increased seed; one with 50 cm panicles, twice as long as usual (see photo).

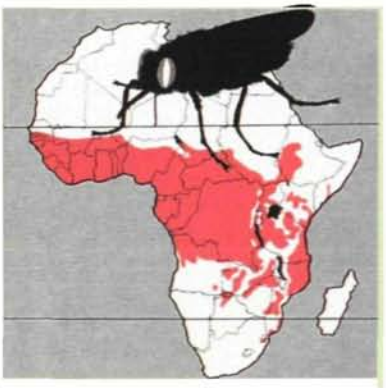
These preliminary successes prompted the Agency to launch a Technical Co-operation Model Project to continue the mutation breeding activities, to carry the achievements of the scientists out into field trials that could eventually benefit farmers and to expand related research and development capability in plant tissue culture by setting up a dedicated laboratory along with top level training in these techniques.

Within the multi-purpose Model Project, field performance trials on mutants of both rice and sorghum crops have already started. So have some soil trials, using stable nitrogen (N^{15}) isotope techniques developed by the FAO/ IAEA Joint Division, mainly to determine optimal use of fertilizer because every new genotype has its own nutritional requirements. Further soil/plant density trials will establish other parameters such as how many plants should be grown in different areas.

This effort reflects an impressive array of high technology and sophisticated training, but can it really help the poor local farmer who probably can't read? The experts think so, and the Model Project approach is intended to focus technology and its benefits on the end-user. Initial field tests show increases of 10% in sorghum production and 15% in rice, and the demonstration phase is being expanded significantly this year and next. New plant breeding techniques that merge conventional breeding with new bio-technical approaches and mutation techniques are improving the odds that the new varieties can successfully compete with native breeds. A comprehensive "package"of agronomic practices will help guide farmers to higher yields using fertilizer management techniques resulting from soil trials using stable nitrogen (N^{15}) isotope techniques. One such practice would incorporate nitrogen fixing legumes (see related story on Biofertilizer in Zimbabwe) in the cropping system for a low-cost, or no-cost alternative nitrogen fertilizer

The extension services of the Ministry of Agriculture will take these "best" practices to the farmers to train and demonstrate their benefits. With the World Bank now supporting a national facility to reproduce seeds on a commercial scale, Mali's farmers could soon begin to realize the dream of two research scientists who were inspired to push back the limitations of native cultivars and make an important contribution to the food security of their countrymen.

Cattle killer meets its match (from page 1)



ganisms called trypanosomes. The single species (*G. austeni*) on the island attacks only animals. Nagana, first reported in Unguja early this century, has restricted and ravaged the 1,650 square kilometre island's herds and until recently up to 80% of the remaining cattle were infected.

Initial efforts to eradicate the fly-using environmentally friendly methods-began over 20 years ago with a research programme in mainland Tanzania funded by the US Agency for International Development. A laboratory and facilities for mass-rearing of tsetses were introduced at Tanga. Significant experience was gained in this effort but it eventually proved unsustainable. Since then a series of activities on Zanzibar involving bilateral and multilateral assistance have used conventional methods to substantially reduce fly numbers and contain their movement.

Conditions thus seemed promising for eradication when the IAEA Model Project was launched in 1994. Fly density had been drastically reduced, in some areas to levels below detectability by trap surveys. Re-infestation was unlikely because it is far from the mainland. The tsetse fly reservoirs in Unguja were mainly in three forests in the south; and a broad enough belt of mainly rice paddies separated these from the north of the island. New techniques developed in projects against other pest insects, such as aerial release, could be introduced on Zanzibar.

The IAEA Model Project is relying on SIT, the Sterile Insect Technique, to mass-rear and release sterilized male flies in sufficient numbers to challenge the fertile wild males as mates for the wild females. SIT is well advanced and has been effectively used against fruitflies in both North and South America. But its application against other insects, such as the tsetse, is an innovation being fostered in the Technical Co-operation Programme with the support of the Joint FAO/IAEA Division.

After just two years of sterile male releases, females routinely caught in the wild already show a high ratio of infertility, expected to reach 65% in the first quarter of this year. Major advances are being made (see box) in rearing and sex identification systems. To promote the approach the IAEA convened a four-week SIT training course/seminar in Unguja late in 1995 for scientists from other African countries affected by tsetse.

The Agency first got involved in helping Zanzibar back in 1983 with the training of Tanzanian scientists at IAEA's Seibersdorf laboratory in mass rearing the Unguja

The Sterile Insect Technique

SIT involves rearing, sterilizing, and releasing male flies of the target species so that they vastly outnumber wild males in the area. The wild females they mate with will not be able to lay fertile eggs. Over time the reproduction of the wild population dwindles and eventually dies out. One common problem is re-infestation from outside the target area.

A unique challenge with tsetse flies is that they must be fed with blood. It is not possible to maintain large enough breeding colonies fed on living animals, and the flies normally do not feed on blood any way but through skin. Scientists at the IAEA lab in Seibersdorf solved the twin problem in the early 1980s with a technique that can maintain insects on a factory scale by giving them bloodmeals through an artificial membrane, thus fooling the flies into thinking they are feeding on live animals.

On the horizon is an automated computer controlled system that eliminates the labour intensive steps of chilling newly hatched flies, manually separating males and females, and then thawing them again. This procedure currently takes over 40% of the time necessary to produce sterile males. Chilling weakens both sexes. Overchilling can kill or render females sterile. Physical handling can damage individuals. The new system will sex the flies in flight, as they emerge from hatching or mating areas, and guide them into separate cages. It could be ready for use within three years. It would improve fly quality and cut time and effort from the four skilled people now needed to breed 100,000 flies, to half a person to breed a million.

Further ahead is the prospect of genetic manipulation of tsetse so that colony females would produce only males, or the two genders would react differently to temperature in the pupal stage and one or other could be killed by simple warming or cooling. Fewer females could produce more males.

tsetse species, using a *membrane* feeding technique developed there. Facilities in Tanga were systematically improved and extended so that by the end of 1995, with a colony of 400,000 females, it housed the world's largest tsetse production system. The colony will soon be 500,000, allowing for the release of 50,000 (60,000 with back-up from Seibersdorf) sterile males each week. Thanks to the support of several donors, the project is well on its way toward a successful conclusion.

To rebuild Zanzibar's herds of mixed livestock, family based farming is now being expanded. Farmers in areas that were until recently infested now have the opportunity to obtain cattle through a government programme offering very attractive loans. Government initiatives to inspire family-based herds, in a sustainable and environmental friendly manner, are based on the very real prospect of the tsetse being eradicated by the end of the IAEA Model Project in 1997.

SIT will be deployed throughout Unguja. But the early focus has been on the southern forest pockets - Jozani, Central Muyuni and Coastal Muyuni - which are inaccessible to other techniques. Therefore, since September 1994 sterile male releases have been exclusively by air. Experience, in Zimbabwe and elsewhere, shows insecticide spraying by air is often ineffective and hazardous. But the 30 milligram flies are not blown off-target by light winds and thermal currents, so the aircraft can fly at a safe height above the forest canopy, and effective air drops can be made throughout the day instead of only at night when the ground gets cool.

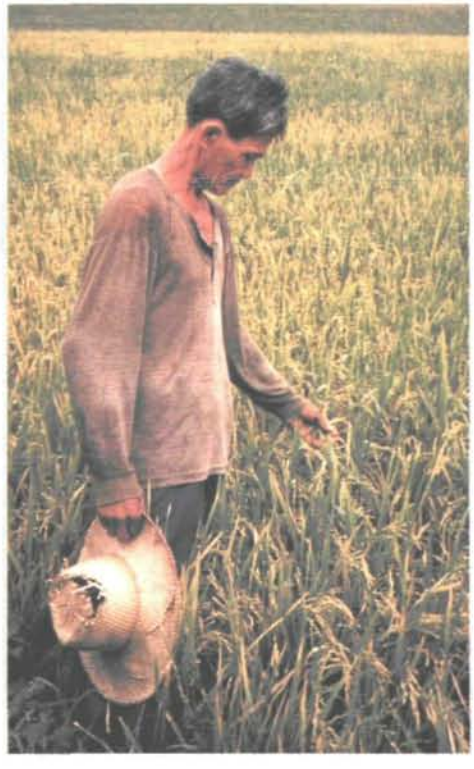
National authorities have provided scientists, technicians, infrastructure, as well as cash to the project; they also integrated it with national development plans so that its benefits reach those who will use the tsetse-free land. The Zanzibar programme is developing an integrated smallholder farm system, with help from the International Fund for Agricultural Development (IFAD), to ensure that farm families are the principal beneficiaries and that freed land is used sustainably

The atom and food production

Despite major advances and "revolutions" in agricultural production, many countries still face enormous obstacles in meeting their current demand for food. In Africa for example, projected demand will require a tripling of the current agricultural output in the next 30 years. A country's capacity to produce surplus food remains a basic distinction between developed and developing countries. As the scramble for control of global resources intensifies, the gap grows wider.

How will the developing world's farmers meet these staggering requirements for more food? What improvements in agricultural systems will permit doubling let alone a tripling of output?

These increases will only occur if agricultural resources are expanded or more productive resources become available in agricultural systems. Such "resources" include land, water, the human knowledge base, technology and institutional support. The food and agricultural programme of the IAEA is operated jointly with FAO to assist Member States in using nuclear techniques to improve both the *quality* and *quantity* of agricultural resources. The availability of agricultural land and water are being expanded through environmentally sustainable approaches that include SIT technology to biologically eradicate pests like the Tsetse fly that severely limits animal production across vast areas of Africa; and isotopic techniques to study, irrigation and ground water dynamics. The quality of agricultural resources is being enhanced through the introduction of more productive technologies: mutation breeding is a technique to create new plant characteristics such as drought resistance or higher yield. Improved farming practices such as the use of rhizobia to inoculate crops and improve soil fertility is an environmentally safe and economical alternative to conventional fertilizers. Soil moisture and nutrient management are fostered by agro-chemical techniques that improve crop yield and food quality. In the areas of animal production and health, nuclear techniques have unlocked many secrets of the biological processes responsible for growth, health and reproduction of farm animals. The growing importance of food preservation techniques such as irradiation is reinforced by the loss of one quarter of world's food production after harvest.



The IAEA's Technical Co-operation activities in agriculture play a small but increasingly catalytic role in sustainable agricultural development. This edition of *Inside TC* illustrates how a new partnership is being forged between scientists and development managers to empower farmers through a variety of specialized techniques, improved practices and agricultural knowledge systems.

ety of barley, ***UNA-La Molina 95***, began field testing last May and is now being multiplied at several sites in the Peruvian highlands.

Plant breeding is exacting. It requires persistence and care and, most of all, time. Irradiation of seeds with gamma rays can help to accelerate the process and leads to changes in the genetic traits of the plants which are inherited. The story of the new barley mutant goes back more than 15 years to when plant breeder Marino Romero Loli became head of the cereals department of the national agriculture university in La Molina. A son of the high plateau himself, Romero Loli set course to produce, by mutation, new varieties of barley and wheat that would be viable in the highlands.

His initial aim was to improve the diet, health and economy of the highland communities. But with some three million hectares of the plateau (in Peru and Bolivia) considered arable, the longer term prospect of intensive commercial cultivation was inviting too. The task may have seemed whimsical because the first essential ingredient to produce a mutant, local parent material, was missing - no wheat or oats at all and the unacclimatized barley was clearly unsuitable. But there was early support from outside and the FAO/IAEA Joint Division became involved shortly thereafter.

The breeding strategy began with field testing a wide collection of wheat, barley and oat germplasm. Over the years some 10,000 varieties provided by international and national centres all over the world were grown in tiny beds to see which did best in the inhospitable climate. From those that showed most promise Romero Loli's team produced a new barley variety using conventional breeding methods. It went through the required field growing and selecting for eight generations, and was released in 1990 under the name ***Buena Vista.***

The scene was set for mutation breeding using radiation. Peru's nuclear infrastructure, equipment and mutation breeding skills had already been systematically improved through IAEA technical assistance for more than a decade. A US donation of $1.5 million for the region enabled the Agency to help Peru beyond mere equipment and training. Plant breeding at La Molina was co-ordinated with work in other FAO/IAEA activities including a regional programme for **Improvement of Cereals through Mutation Breeding in Latin America**, and a related Coordinated Research Programme.

Inspecting a barley field near Huancayo. From left to right: C. Ampuero (IPEN); B. Radischat(IAEA); L. Gamara (IPEN); and M. Romero Loli (Agricultural Univeristy, La Molina). (Credit: M. Maluszynski)

The La Molina team irradiated *Buena Vista* seeds and obtained the mutant variety UNA-La Molina 95. The mutant has three main advantages over the parent. It matures some three weeks earlier - which will enable it to reach the seed ripening stage when the dry season arrives. It is shorter - a protection against being flattened by wind or hail. It produces a naked (huskless) grain with higher protein content which is easier to both cook and feed to animals.

The three new traits make the mutant very promising. But the proof of viability is in the growing. When the ongoing multiplication phase produces two to three tons of barley seeds (expected this year) they will be delivered to demonstration plots of selected farmers who have a good reputation in villages. They will grow it together with the previous (parent) variety. Only then can the quality of the mutant be gauged. It will take longer, 2-3 years, to demonstrate true success - after farmers have grown it on many thousands of hectares. But chances look good that the 21st Century may begin with the first cultivable Andean grain and new opportunities for agricultural development.

Meanwhile the private sector has also recognized the promise of mutation breeding. A Peruvian brewery company *Malteria Lima SA* is providing funds and managerial help to the agricultural university at La Molina to multiply the seeds of the mutant variety of barley it has developed and to distribute them to the selected farmers in the high plateau even though it has different characteristics from the barley used for beer. UNA-La Molina 95 is huskless and has a high protein content. Brewers seek barley with protein content as low as possible, and therefore always with husks. Malteria's reasoning is that the other traits - early maturation and short stature - promise intensive high-input cultivation at high altitude. If the '95' variety is successful 3000-plus metres above sea level and in other hostile conditions, then yet another variety (husked and low protein) could well be found in the same way.

In Brief: Updates of stories and news events

AGFAX: Reaching Zimbabwe Farmers

"The interview on SIT and Tsetse was a very useful eye-opener, especially considering that in Zimbabwe, the tsetse flies are very troublesome. This interview was translated into a vernacular programme broadcast on Radio 2." — Statement by Zimbabwe Broadcasting Corporation

The use of technology for development depends on attitudes and these are influenced by information and education. The Department of Technical Co-operation (TC) is increasing public awareness of its Model Projects activities through a series of contributions to the AGFAX media service. Articles for the press and interviews with IAEA staff on key agricultural issues are recorded and distributed on a monthly basis to leading radio stations and newspapers in anglophone Africa and to major European and North American organizations broadcasting worldwide. The Sterile Insect Technique (SIT) to eradicate tsetse flies, the improvement of african rice by mutation breeding and nuclear techniques analysis of nitrogen in crops are among the range of topics covered.

You or your colleagues could help us reach broader audiences. Upon request recorded copies and full transcripts of these interviews are available for use by national broadcasters free of charge. Each audio cassette comprising a five minute feature is edited and ready to broadcast. For more information, contact the IAEA TC Programme Co-ordination Section.

AGFAX is produced by World Radio for Environment (WREN), a media organization based in the UK.

Mutated Rice Gains Ground in Asia

Increasing rice yields is a key objective throughout Asia. (Credit: M. Maluszynski)

Nine varieties of early season rice, obtained by induced mutation of locally grown varieties, were officially released and cultivated on 598,100 hectares in five provinces along the Yangtze River in China last year. The mutant varieties now cover about 11% of the total 5.5 million hectares of rice growing area in these provinces. The performance of each mutant variety varied depending on the agroclimatic conditions in particular provinces. According to data collected during the multilocation trial, yield increases per hectare for the nine mutant varieties was on average 440 kg higher than for the control varieties.

The Chinese National Rice Research Institute estimates a total yield increase of 263,000 tonnes in the cultivated area. At a market price of US $200 per tonne the gain to farmers could reach over US$ 50 million. The extension process was actively supported by seed companies at the provincial, municipal and county level. Because the seed multiplication programme has been so successfully implemented, an extension area of 990,000 hectares is planned for 1996.

In Myanmar, according to recent information received from the Ministry of Agriculture, the rice mutant *Shwewartun* showed improved yield, grain quality and earliness compared to its parent variety. Over the period 1990 to 1993 the mutant variety was grown in over 2 million acres or 17% of the total rice area sown.

Close collaboration - with national institutes in both China and Myanmar made possible through co-ordinated research programmes and technical assistance projects - contributed to the development of these successful mutant varieties. The experience gained from these projects is contributing to similar mutation breeding in other regions (see related story "Floating Rice and Soaring Sorghum").

RCA Recognized for Excellence

Late last year the Joint Inspection Unit, an independent investigatory body of the UN, compared field level impacts and results of 10 U.N. sponsored intercountry projects in the Asia and Pacific Region. One of those selected was the RCA project to increase the use of nuclear technology in regional industries and encourage regional industrial competitiveness (see "Pioneers of regional cooperation" - *Inside TC*, December 1995). This IAEA-supported project was rated number one in the evaluation with a score of 96 out of 100 points, one of the best reviews ever made for a project in the field of science and technology. The strong commitment of national counterparts and the readiness of participating governments to collaborate actively with the private sector were identified as particular strengths of the project, and the RCA network of cooperating member states was viewed as a model for Technical Cooperation among Developing Countries (TCDC). This project was cofinanced with the United Nations Development Programme (UNDP) and contributions from Australia, China, Indonesia, Japan, Philippines, Korea, Malaysia, New Zealand and Thailand. RCA Members are now preparing a third generation project for submission to the Agency and UNDP that will employ isotope and radiation technologies for better management of the environment, natural resources and further promotion of industrial growth.

Zimbabwe's smallholders to benefit from biofertilizer

Many developing countries have the capability to use selected strains of legume root-nodule bacteria to produce nitrogen, the most important plant nutrient. But in most, the benefits have been reaped by larger farms growing cash crops such as soybean. Subsistence growers, who might gain most from the technology, have largely missed out. But now up to half a million smallholders in Zimbabwe will gain access to the technology through an Agency technical co-operation Model Project set to begin in 1997.

Bacteria of the rhizobium "family" have been called Nature's gift to sustainable agriculture They form nodules in the roots of legumes and convert nitrogen from the air into the form usable by plants in a process called "nitrogen fixation". It is a similar process to the chemical one used by industry to manufacture urea fertilizer, but root-nodules do it for free. Though nodulation occurs only in symbiotic relationship with legume plants, the nitrogen they 'fix' is sufficient to nourish a subsequent non-leguminous crop. In recent years the technology to mass produce specific 'inoculants' of rhizobia strains has matured. Indeed the biological route now provides more than a third of all nitrogen used in world agriculture, but nearly all of that is consumed either in developed countries or large commercial farms in the developing world.

Nearly 25 to 30 Agency agricultural projects around the world now have a rhizobial component. The first Model Project dedicated to it was launched last year in Bangladesh (see *Inside TC*, September 1995). It is developing commercial scale production of inoculant. Assisted by IAEA projects since 1988, and using the stable isotope N^{15} technique largely developed by the Joint FAO/ IAEA Division, the Bangladesh Institute of Nuclear Agriculture (BINA) has identified rhizobial strains and matching varieties of legumes that together would best fix nitrogen in local soils.

The new project, proposed for 1997/98, in Zimbabwe will use the

Pioneered by the Joint Division of the FAO and the IAEA, the N^{15} technique has proven to be a unique tool in assessing the amounts of nitrogen derived from air, soil and added fertilizer. It is relatively simple and requires growing the nitrogen-fixing crop together with a non-fixing crop. The major advantage is that it provides a quantitative and integrated measure of the nitrogen fixed - during different periods, conditions and soil types. It is preferred to non-isotopic methods because it gives detailed understanding of factors that influence the fixation in various legumes, and therefore the "yield", particularly the effects of inoculation with an elite strain of rhizobia.

N^{15} technique to screen and select efficient rhizobia to maximize yields of important legume varieties grown locally, and possibly also obtain new varieties using radiation mutation breeding techniques. Zimbabwe already has a large factory to multiply rhizobia and put them in medium for distribution to commercial farmers, and its production could be expanded to meet the needs of small-scale farmers for inoculants.

Zimbabwe's Country Programme Framework (CPF), drawn up by the IAEA and the Government, is focussed on a limited number of technical co-operation priority activities where the technologies have demonstrable value and the government is committed to developing essential infrastructure. Development of biological nitrogen fixation for subsistence farmers in the communal areas is one such activity. Levels of crop production in the small-scale farming sector of Zimbabwe are very low, mainly due to low soil fertility - particularly nitrogen and phosphorus. The CPF confirmed that the technical capability and counterpart structure to undertake this activity is strong and that previous technical co-operation work has developed data on nitrogen fixation using three locally grown legumes. A multidisciplinary research team has already been trained and prepared to undertake the task.

Given these promising conditions and drawing upon the ongoing experience in Bangladesh, the TC Department is confident that the project being formulated will make a significant contribution to food production and small farm prosperity in rural Zimbabwe.

Better feeds (from page 2)

last year in three islands (East Java, South Sulawesi and West Sumatra,) and field-testing of blocks with feed materials available in each region.

Meanwhile in West and Central Java, the Ministry has now taken the technology to villages across all districts. In addition to such extension activities, several hands-on training courses have been conducted for leaders of farmers groups One in West Java in 1995 brought together 236 farmers for three months. This course evaluated 395 dairy cows, 80 beef cattle, and 100 sheep. A similar one was completed in Central Java late last year and involves analysis of 180 animals. Cumulative results of field trials indicates that UMMB supplementation could increase monthly net income by 200% for dairy and beef cattle farmers and 100% for sheep farmers.

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