



South Asia

Financial year	Regional expenditure	Percentage of total bilateral expenditure	Board target as percentage of expenditure
2003–04	\$4,018,897	15.7	10-20%
2002–03	\$3,593,919	13.5	10-20%
2001–02	\$3,004,923	12.3	10-20%

ACIAR's South Asia program expenditure has remained within the Board's defined target levels, standing at 15.7 per cent in 2003–04. India remains the main focus, with small programs in other countries being developed around projects that target major constraints to production in areas where Australia has a research advantage.

Kuhu Chatterjee is our Country Manager for South Asia



India	Page 61
Pakistan	65
Bangladesh	66
Other South Asian countries	67
Afghanistan	67
Bhutan	68
Nepal	69
Sri Lanka	70

ACIAR regional team leader for South Asia: Dr Tony Fischer.



India



Active projects in 2003–04	24
AOP budgeted expenditure in 2003–04	\$2,522,606
Actual bilateral country expenditure in 2003–04	\$2,482,097
Bilateral country expenditure in 2002–03	\$2,398,203
Bilateral country expenditure in 2001–02	\$2,080,586

Key performance indicators	Performance 2003–04
<ul style="list-style-type: none"> At least three-quarters of new projects emphasise northern or central India. 	Eight of 11 projects commenced or under design during 2003–04 focus on northern or central India.
<ul style="list-style-type: none"> Completion of independent analysis on effects of adoption of reduced tillage practices on poverty in Haryana and Punjab. 	Analysis of impacts on poverty is under way and awaiting necessary data from India.
<ul style="list-style-type: none"> Evidence that ACIAR training courses have led to better design of experimental trials of crop genotype performance in different environments. 	Two courses were run in 2003, with 28 participants, more than 75 per cent of whom reported that course objectives had been met.
<ul style="list-style-type: none"> Farmers in Gujarat purchasing protected nutrient livestock feeds produced on a commercial basis. 	The protected-feed mill is running at full capacity with all feed sold on a commercial basis. A second plant is being constructed.

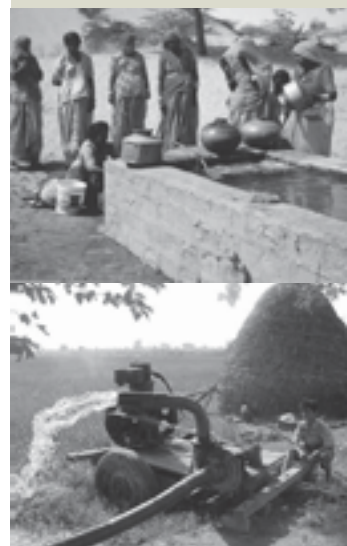
Position

ACIAR engages in projects with India that emphasise sustainable smallholder production, along with the management of scarce water and nutrient resources. Productivity of crops, livestock and aquaculture that will raise farmer incomes remains a priority. Recent research has assisted the adoption of minimal tillage approaches in rice–wheat farming systems, with significant benefits from moisture conservation and weed management in crops. India has a large and well-developed national agricultural research system that has collaborated strongly in ACIAR projects. Additional linkages with groups such as State Agricultural Universities, the National Dairy Development Board and technical NGOs have facilitated technology development and the delivery of benefits.

In September 2003 the Government of India released new policy guidelines for bilateral donors, requesting the development of jointly funded and focused projects on areas of mutual, high priority. This will also result in a greater emphasis on working with independent research organisations and NGOs, but will still aim to deliver benefits to farmers and to assist with policy development for India’s poorest regions, mainly in north and central India.

Achievements

Water resource management is vital to India. A project that reviewed water institutions involved in irrigation resourcing and water allocations highlighted the most successful management strategies. The review led to a **framework for assessing successful management practices** in



Above: Women at a water hole in Rajasthan. Below: Water pump



Training session for shepherds in Maharashtra

consultation with key Indian stakeholders. A study of degradation and desertification of arid rangelands is seeking to determine the cause of these problems. Using GIS mapping and ground-based surveys, large amounts of data have been collected and collated. These outcomes are being disseminated through discussions with village communities and relevant administrators, and researchers are also advising on how to prevent further problems.

Improving the productivity of sheep in Maharashtra continues. The Booroola gene has been found responsible for higher than average levels of multiple births in one breed of local sheep. Cross-bred **varieties incorporating the Booroola gene** are being produced and distributed to local shepherds' flocks for testing in the field. Results to date show the introduction of the Booroola gene through both rams and ewes results in progeny inheriting the gene, offering the chance for increased multiple births.

More prolific sheep—a John Allwright Fellowship

Chanda Nimbkar is studying for her PhD under an ACIAR-funded John Allwright Fellowship. The Fellowships are available for postgraduate study in Australia for scientists involved in a current or recent ACIAR project. Chanda has been working on the project *Improved productivity, profitability and sustainability of sheep production in Maharashtra, India*. The project is using the Booroola gene (FecB) identified in native Garole sheep as being responsible for increasing the incidence of multiple births, and passing this gene to other sheep. Chanda and others involved in the project are now working with local shepherds, interbreeding sheep with the Booroola gene into their flocks. The progeny of this breeding have been inheriting the gene,

increasing the likelihood of more sheep, and better livelihoods.

Chanda divides her time between study in Armidale, Australia and postgraduate research activities in India. Her work on this project and her commitment to developing a plan to improve the Deccani sheep breed, native to Maharashtra, has been recognised by the Indian Government. Chanda has been appointed to the *Government of India's Central Advisory Committee for the Development of Sheep, Goats and Rabbits*, under the Chairmanship of the Agriculture Minister. She is one of only four 'non-official' members on the council.



Garole sheep, Maharashtra, India

Treating cattle with a fungal inoculum can aid digestion in the rumen, increasing the uptake of benefits from consuming fibre. Special nutrients are added to the feed to encourage growth of the fungus. One fungus-specific nutrient trial that also added sulfur supplements has resulted in **increased feed intake** and better rumen function. Supplemental urea ensured complete utilisation of sulfur, further boosting rumen performance. Trials are now planned to determine if milk production has been enhanced.

Another project has examined the role of feed supplements, making increased protein and fat available in cattle diets. A factory producing these supplements was opened late in 2002, and trials since then continue to show **cattle fed the supplement produce more milk, offering a boost to smallholders' incomes**. This represents an increase in disposable income of between 30 and 70 per cent depending on the breed of cattle. Use of the supplement has also spread to other regions, where similar rises in milk production have been reported.

Salt used in tannery processes contaminates soil after disposal of tannery effluent. Salt preserves the hides, but other methods are being developed based on drying and using additives instead. To date these have **proven as effective as salt**, and industry trials are now planned. Recycling and reuse of tannery materials are also showing promise of reduced salt waste. This approach has no ill effects on leather for up to 100 cycles.

The use of ***Stylosanthes*, a tropical legume species**, as forage in animal production is common throughout parts of India and China. Varieties with superior agronomic performance to those currently planted and with the added bonus of resistance to anthracnose (the major disease of *Stylosanthes*) have been selected and released in both countries. Studies of pathogenic fungal groups in each country have enabled scientists to determine the genetic structure of the anthracnose causal agent and understand its virulence for the first time. A diverse population of this causal agent has been revealed in China and India, and this will allow more defined use of resistance and matching of varieties to agro-ecological conditions in future breeding and utilisation.

Breeding of chickpea for improved yield and quality traits and drought resistance has produced several crosses with improved characteristics. Glasshouse and initial field trials to **examine physiological performance**, including the ability of plants to adjust water use in drought, have shown promise. Seed yield and quality were also examined, with results influencing selection of improved breeding material.

Disease resistance in chickpea is the subject of a separate project, also focusing on faba bean and lentil. Sources of resistance to diseases (including *Ascochyta* blight) for all three crops have been identified, and **promising lines are now at the trial stage**. Management practices for faba bean and chickpea, such as the use of varieties tolerant to



Tannery project



Farming for vegetables in the Punjab



Wheat on raised beds

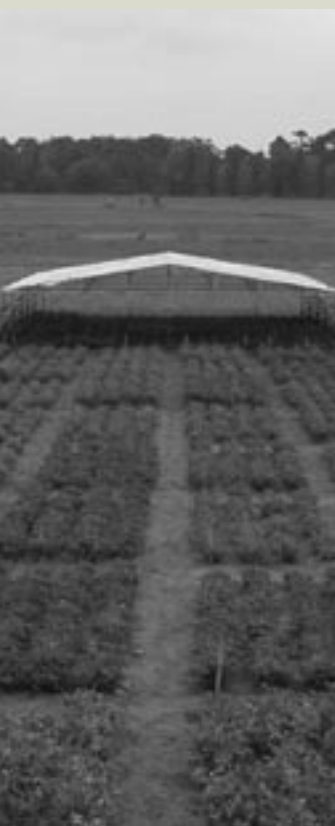
late planting and wide spacing and use of fungicides, revealed yield increases and some protection against *Ascochyta*. An integrated disease management package incorporating research from this and previous projects has provided robust control of *Ascochyta* in farmers' fields near ICARDA, in Syria.



The 'Happy Seeder' sowing mung beans into wheat stubble

The constraints faced by waterlogged wheat crops have been more clearly identified and understood. This includes the identification of two waterlogging environments and the role of micronutrient concentrations in causing seedling toxicity after waterlogging. Such **information is vital when screening for wheat varieties** suited to these environments. More than 12 wheat lines with tolerance to waterlogging have been added to those already identified. The 'Happy Seeder', a locally designed seeding machine to allow direct drilling of seed (with minimal soil disturbance), has been trialled and refinements adopted. The seeder was developed as part of a project evaluating the use of raised cropping beds for rice-wheat farming systems. Optimal approaches such as seed depth and mulch loads are being determined through trials using the 'Happy Seeder'.

Evaluation of genetic material and management technologies to improve citrus production in Sikkim continues, with trials of a range of germplasm under-way. Citrus varieties with **some level of resistance to huanglongbing** (greening) disease, prevalent in local varieties, are being assessed, and management techniques to improve productivity of existing varieties are being tested.



Breeding aflatoxin resistant peanuts at ICRISAT

Aflatoxin contamination of peanuts is being examined in a project to develop low aflatoxin risk varieties. Genotypes showing little or no infection from *Aspergillus flavus*, the fungus which can cause aflatoxin contamination, have been identified and **early field trials indicate the trait may be stable**. Physiological and biochemical mechanisms affecting aflatoxin production and their impact on contamination levels are also being examined. Drought-resistant peanut varieties with average yield advantages of 20 per cent over currently planted varieties in India's rain-fed and irrigated peanut growing regions have been identified. A new project is developing a two-stage dryer for rice and maize grains in West Bengal. Losses from storage of wet grain significantly hamper the expansion of the grain industry.

Research has shown that **nutrient application and weed control produce the largest growth responses for eucalypts** planted in Kerala State. This knowledge is being incorporated into existing silviculture programs to create more even growth responses for plantations across Kerala. Plantations based on these practices and economic analyses are also being developed to produce optimal results.

Pakistan

Active projects in 2003–04	6
AOP budgeted expenditure in 2003–04	\$514,458
Actual bilateral country expenditure in 2003–04	\$697,496
Bilateral country expenditure in 2002–03	\$212,104
Bilateral country expenditure in 2001–02	\$211,617



Discussion group

Key performance indicators	Performance 2003–04
<ul style="list-style-type: none"> Major Gemini virus diseases of cotton in Pakistan documented and molecular characterisation of strains completed. 	The cause of cotton leaf curl disease was determined and the role of a small satellite DNA particle in viral recombination identified.
<ul style="list-style-type: none"> Construction of test system for saline drain effluent management through serial biological concentration under way. 	The start of the project was delayed until early 2004 because of security issues in 2003.

Achievements

Field surveys of Gemini viruses have revealed the presence of a small satellite DNA, in addition to the DNA genome of the virus. The presence of this satellite DNA is associated with **a Gemini viral strain that has broken the resistance** of some cotton and tomato varieties to cotton leaf curl virus. The role of this satellite DNA has been linked to the recombination of virus DNA. Two major groups of satellite DNA have been identified and their role in overcoming host resistance and in the spread of cotton leaf curl disease is now being investigated. This knowledge is helping scientists to develop control methods for Gemini viruses and also to breed more stable resistant varieties.

A new project is seeking to further develop the raised bed cropping system. This has already been proven to raise maize yields in maize–wheat cropping systems by up to 50 per cent while also **using a third less water**. Despite these results the system is relatively unknown in Pakistan and work is needed to extend its use. This project is trialling a series of soil management options and machinery to develop ‘best bet’ technology and management scenarios for permanent raised beds. Groups of farmers are involved to help ensure further adoption.

A new project to **increase options for agriculture in saline environments** has recently begun. Saline effluent is often drained into river systems, polluting these for downstream users. The project is aiming to develop profitable systems for farmers based on saline drainage effluent from irrigated farms. Crop, tree and aquaculture options will all be examined, along with salt-harvesting technology.

Position

ACIAR maintains a small program that emphasises management of irrigation and drainage, and associated natural resource management. This includes agriculture and forestry on saline soils within a broader focus on overcoming biotic and abiotic constraints in broadacre crop production. Since late 2001, security considerations have hindered the development of further project work in Pakistan.





Farming chickpea

Bangladesh

Active projects in 2003–04	5
AOP budgeted expenditure in 2003–04	\$293,769
Actual bilateral country expenditure in 2003–04	\$276,729
Bilateral country expenditure in 2002–03	\$368,485
Bilateral country expenditure in 2001–02	\$310,423

Key performance indicators	Performance 2003–04
<ul style="list-style-type: none"> Information packages on sources of arsenic contamination in major food crops developed and communicated to local and international NGOs and Government. 	Information packages in local languages have been developed and distributed.
<ul style="list-style-type: none"> Impact of botrytis grey mould on chickpea production assessed in major production areas. 	Demonstrations of integrated disease management (IDM) practices with chickpea crops on 100 farms, comparing current farmer practices with IDM are under way.

Position

ACIAR's program in Bangladesh is small, given Australia's relatively limited comparative advantage to deal with this country's rice-dominated agricultural problems. Research focuses on constraints to crop production, utilising collaboration with the International Agricultural Research Centres (IARCs). Donor collaboration is encouraged, and a concluding ACIAR-funded project on analysis of the fate of arsenic from groundwater is the research component of a larger initiative on the arsenic problem in Bangladesh, which is funded by AusAID and several international donors.

Achievements

Botrytis grey mould (BGM) is a major constraint to chickpea production, a vital **source of dietary protein for poor farmers**, in Bangladesh. Current approaches to managing BGM are too expensive for Bangladeshi farmers. Cultures of *Botrytis cinerea* (the causal agent of BGM) have been collected and are undergoing DNA testing to aid in screening suitable chickpea breeding material. Almost 500 lines have been assembled and testing has already revealed differences in disease reactions. Integrated crop management trials involving farmers have demonstrated yield increases of 20–40 per cent. The use of seed from non-BGM infected areas is one example of the management practices being trialled.

Arsenic contamination of soil and crops in Bangladesh continues to exact a high human toll. Irrigation using groundwater has been revealed as a potential source of arsenic transfer to vegetable crops. Levels of arsenic accumulation in crops have also been determined. Key sites where **arsenic poisonings** have been high have been sampled, including soils and groundwater, to produce a database of accumulations. Tests on the role of organic manures have revealed no changes to arsenic accumulation in crops. The addition of high levels of phosphate has been shown to decrease arsenic accumulations, but low levels of phosphate fertiliser can increase accumulations. Information packages in local languages are being disseminated.



Other South Asian countries

Active projects in 2003–04	9
AOP budgeted expenditure in 2003–04	\$504,428
Actual bilateral country expenditure in 2003–04	\$562,575*

* The 2003–04 Annual Operational Plan grouped Afghanistan, Bhutan, Nepal and Sri Lanka together under Other South Asia, for budgeting and reporting purposes. Bilateral expenditure figures for these countries for the financial years 2001–02 and 2002–03 are reported separately in the country tables that follow. Similarly, key performance indicators for Other South Asia were grouped together and are reported against below.

Key performance indicators	Performance 2003–04
<ul style="list-style-type: none"> Implementation of fishery stock management strategies for reservoir fisheries in Sri Lanka. 	An aquaculture capability classification scheme has been developed and validated for seasonal tanks, and is being used to guide Government policy. Strategies are being disseminated through extension materials, and community meetings.
<ul style="list-style-type: none"> Adoption of control strategies for citrus fruit flies by agriculturalists in Bhutan. 	Due to a severe outbreak of citrus dieback in 2003 ACIAR agreed to put the project on hold until April 2004, as Bhutanese agriculturalists had to deal with the disease outbreak.

Afghanistan

Active projects in 2003–04	1
Bilateral country expenditure in 2002–03	\$0*
Bilateral country expenditure in 2001–02	\$0

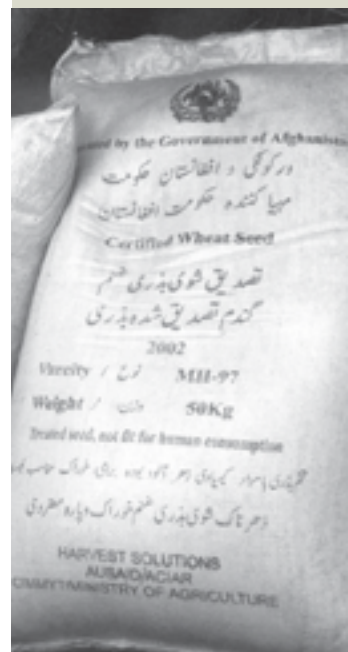
* \$650,000 in multilateral funding

Position

ACIAR's first multilateral project in Afghanistan provided short-term support to wheat and maize production, wheat being by far the most important crop and maize the third most important. Two decades of war devastated Afghanistan's food-production capabilities and depleted critical seed stocks, leaving the nation heavily dependent on food aid from international donors. Further research initiatives will continue to emphasise improved crop varieties and agronomic management of broadacre crops.

Achievements

ACIAR managed an AusAID-funded project, implemented by CIMMYT, to introduce improved wheat and maize varieties to Afghanistan. Stocks of seed of both grains were severely depleted and destroyed by years of conflict, with surviving varieties poorly suited to local growing conditions. During the project **wheat has been distributed via NGOs to 9000 farmers** in four provinces, along with fertiliser inputs provided by other international donors. These new varieties have yielded up to 5 tonnes per



Certified bag of wheat for Afghanistan



Farmer training in Afghanistan

hectare and better, almost double the yield of locally favoured varieties. Thirty-five variety trials and wheat nurseries have been established at six sites. Seed multiplication sites to ensure seed production that will support future crops have also been set up. A new winter wheat variety, Solh-02 ('Solh' means peace), was released. The Darul Aman Research Station near Kabul now supports wheat germplasm nurseries and wheat trials.

Seven varieties of open (naturally) pollinated maize seed, previously identified as suitable for Afghan conditions, were also imported, with 2.5 tonnes distributed to 500 farmers via the Ministry of Agriculture and Animal Husbandry (MAAH) and NGOs in time for the 2003 planting season. Evaluation and multiplication was also undertaken. Promising open pollinated varieties yielding up to 6 tonnes per hectare were identified, and a further 60 elite varieties were trialed at eight sites.

Since mid-2002 Afghan wheat scientist Dr Mahmood Osmanzai has been based in Kabul, and 15 researchers and agronomists from MAAH have attended CIMMYT **training courses** in Turkey and Mexico. In-country MAAH staff received a variety of on-farm training, including instruction on how to undertake surveys to identify yield-limiting factors.

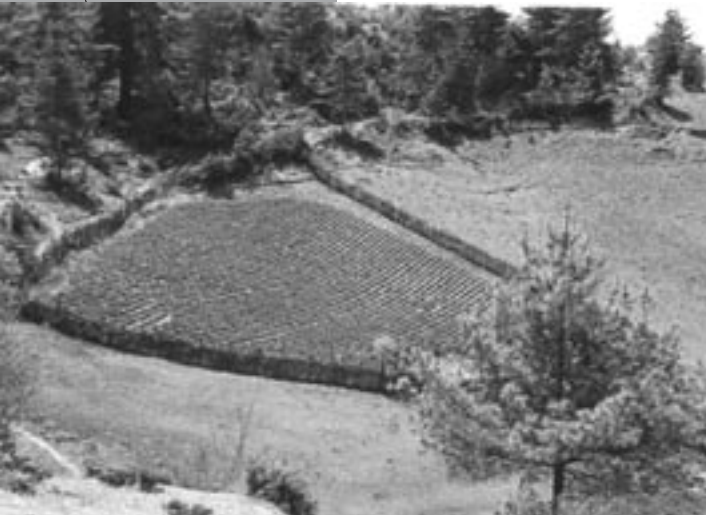
Bhutan



Active projects in 2003–04	1
Bilateral country expenditure in 2002–03	\$44,145
Bilateral country expenditure in 2001–02	\$67,575

Position

ACIAR's small program with Bhutan began in 1998. Because of Australia's relatively low comparative advantage, the program will remain very small, with a current focus on pest and disease management.



Bhutan fields

Achievements

ACIAR's single project in Bhutan was put on hold in 2003–04 due to a severe outbreak of citrus dieback, halting the mandarin fruiting season, and limiting the capacity of the project personnel to trial fruit fly control approaches in the field. The main pest species of fruit fly has been identified and trials to use protein bait sprays to disrupt breeding cycles during the fruiting season have only recently recommenced.

Nepal

Active projects in 2003–04	3
Bilateral country expenditure in 2002–03	\$188,503
Bilateral country expenditure in 2001–02	\$175,304

Position

Almost 85 per cent of Nepal's population live in rural areas and the majority of these are involved in agriculture. ACIAR has had a small program of projects in Nepal, with an emphasis on crop production and management, and on some aspects of animal health in the lowland Terai, which has most in common with Australian environments.

Achievements

Efforts to improve quality of lentil, a valuable crop for smallholders who can easily sell produce to Indian markets, have identified the importance of management to improve yields. Seed priming (soaking seeds before planting) has been shown to boost yields considerably, in some cases by as much as 40 per cent. Researchers have undertaken training in breeding and statistical analysis. Extension activities have increased farmer participation, including seed production of promising new lentil varieties for field trials. **Lentil varieties resistant to the fungal disease** caused by *Stemphyllium*, a major threat to production, were trialled, with resistant varieties showing yield increases up to 33 per cent more than local varieties. The same project also aims to improve lathyrus (grass pea), which is widely grown but potentially toxic. Varieties that have lower levels of toxicity are being sourced.



Above: Nepalese livestock.



Above: Mountains of Nepal and below—workshop in session



Sri Lanka

Active projects in 2003–04	4
Bilateral country expenditure in 2002–03	\$382,480
Bilateral country expenditure in 2001–02	\$159,417

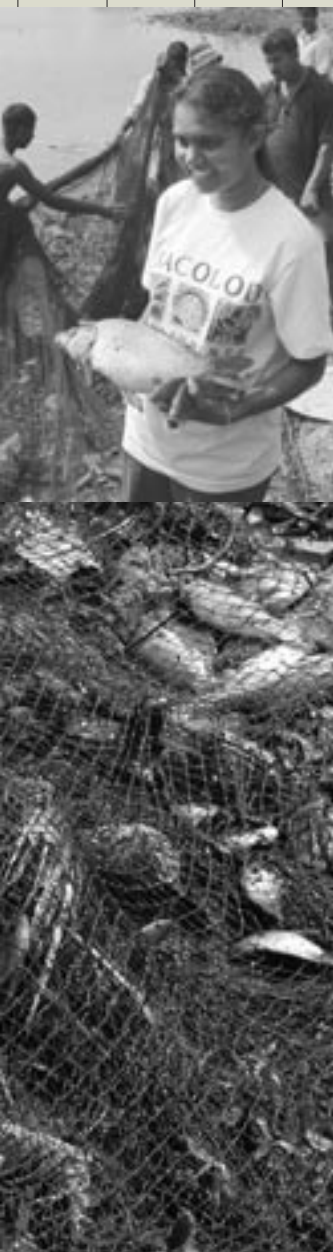
Position

ACIAR maintains a small program with Sri Lanka. Most collaboration has been in animal sciences, especially animal health. Other areas have included fisheries, farming systems economics, agricultural development policy, crop sciences, forestry and crop postharvest technology. Several past project outputs are being used in new Asian Development Bank-funded projects. ACIAR maintains a small program in Sri Lanka. On occasions, ACIAR supports Sri Lankan scientists as specialist advisers to assist in projects in the region.

Achievements

A predictive model for yields of fish in perennial tropical reservoirs, developed in an earlier ACIAR project, has been simplified for use by extension workers in Sri Lanka. The model has been validated, based on **catchment land-use patterns** and using data collected by the National Aquatic Resources Agency. Sixteen reservoirs have been chosen for studies to develop culture-based fisheries, with experiments raising fingerlings and fry underway in three reservoirs. Farmer-made feeds are being used, and initial trials are proving that cage culturing is a viable possibility.

Postharvest diseases of tropical fruits frequently cause more than 20 per cent loss—current methods do not reliably control disease during retail marketing and export, causing reliance on fungicide treatment. Improved strategies for managing losses can be developed by boosting the natural defence factors in fruit. Host defence mechanisms in mango and banana are being characterised, along with defence-boosting treatments on mango. The role of mango sap in disease resistance is being studied with the role of management practices, such as harvesting fruit with longer stems, being assessed for their capacity to reduce sap loss and enhance disease resistance. Facilities at the University of Peradeniya to undertake plant defence research have been upgraded. Natural defensive compounds identified in mango and banana species are now being characterised and investigated.



Fish harvesting