



Sustainable Agricultural Intensification Programme (SAIP)



Today's agricultural challenges

Food production will need to increase by more than 60% by the end of the century to feed a growing global population, whilst only using currently available land, protecting our living environment and conserving natural and agricultural biodiversity. Sustainable agricultural intensification provides a platform by which food production efficiency can increase to conserve available resources, whilst reducing environmental impacts. Global food production requires the access and the promotion of a healthy and stable environment, in which the use of agrochemicals (e.g. pesticides) and the release of environmental pollutants (e.g. nitrates) and climate changing gas emissions (e.g. carbon dioxide) are controlled to acceptable levels.

How will sustainable agriculture meet these challenges?

Sustainable Agricultural Intensification (SAI) aims to increase agricultural output from the same available land area, while reducing the negative environmental impacts of agricultural technology. The rate of consumption of resources (e.g. land, water, energy, labour and minerals) needed to enhance food production cannot be increased, so the efficiency with which they are used and recycled will have to be significantly improved. Only through efficiency of resource consumption can the impacts of agriculture on the global environment be controlled and reduced so that ecosystems services are maintained. The key to meeting this food production challenge requires the adoption of SAI approaches based on our understanding and our ability to harness knowledge of ecological processes both within agricultural systems and those linking food production to the natural environment.

How will the Natural Resources Institute (NRI) help?

NRI's Sustainable Agricultural Intensification Programme (SAIP) enables farmers to solve problems of rural productivity and intensify agricultural production in a sustainable and efficient manner, through research, capacity development

and training. To achieve this we have three overarching themes:

- Integrated crop, pest and disease management practices that reduce crop losses and minimize environmental impact through reduced dependency on chemical inputs
- Farming systems that use resources more efficiently while increasing production, reducing crop losses and increasing environmental resilience
- Enhanced ecosystem services on farms for pollination, pest control, biodiversity conservation and developing resilience to climatic change



The programme uses evidence based agricultural science, with socioeconomic and value chain analysis to better the lives of rural producers. As appropriate, the programme applies system based approaches to identify negative effects of intensification. Capacity development is achieved through training and knowledge exchange with farmers, extension and research services and the private sector and NGOs.

Our key activities range from simple to hi-tech answers to problems of rural productivity:

- introduction of appropriate, environmentally-benign technologies for control of pests and diseases based on better understanding of the

ecology of these pests and diseases and their relationships with their host plants, such as plant-based pesticides, microbial control agents and semio-chemicals

- optimised exploitation of elite crop varieties that provide improved yield and quality from reduced inputs (e.g. natural resistance to pests and diseases)
- enhancement of agro-ecological factors such as natural predators and parasites of pests, plant nutrition (e.g. biological nitrogen fixation, companion cropping)
- reduced dependency on, and increased use efficiency of external inputs (chemical, energy, water etc.), including those that present possible hazards to farmers and the environment
- production of crops that are healthier to consumers with respect to the presence of nutrients including micronutrients
- developing capacity in SAI through training and knowledge exchange within farming communities, extension/technical and research services

Some examples of recent NRI work on SAI

Sustainable use of pesticides to protect crops

Crops are attacked by various insects, diseases and other pests, and suffer competition from weeds. For the foreseeable future farmers will need to use chemical pesticides to reduce losses and sustain productivity. Although modern pesticides are less toxic to humans, they must be used safely as recommended. This is particularly crucial for older pesticides commonly used in developing countries. Therefore the promotion of using pesticides safely and sustainably, and their integration into holistic cultural and biological pest management approaches enables the reliance on chemicals to be reduced. Integrated and balanced pest management is the goal of NRI's European Centre for Integrated Pest Management (EUCIPM) which acknowledges the need for pesticides, which do not harm humans, damage the viability of ecosystem, or result in illegal residues in food

www.eucipm.org/

Facilitating the uptake of pesticidal plant technologies for improved food security

Research work endeavours to consolidate existing partnerships of stakeholders from farmers to ministries to exploit the use of pesticidal plants as alternatives to synthetic pesticides. This is being achieved by providing a forum for raising awareness about pesticidal plant use, particularly the livelihood benefits to poor farmers and potential for commercial exploitation. Through the creation of an environment for cross-training, skill-transfer and capacity building, via practical workshops, demonstrations are used to show how plant based pesticidal approaches can be optimised. This research also develops policy guidelines and trial innovations to ensure validated marketing and promotion of safe and effective plant-based pesticides.

Biological control of armyworm

In collaboration with Tanzanian and other UK partners, a natural biological insecticide has been developed to combat African armyworm, which decimates eastern and southern Africa crop yields. The approach also does not contaminate the environment or affect human health and its low cost could make it affordable by poorer farmers. The preferential use of this biopesticide has been adopted as national policy in Tanzania and a local company is now establishing production of the biopesticide in Tanzania.

www.nri.org/news.2012/nri-researchers-discover-new-potential-weapon-against-crop-pests

www.nri.org/news.2011/new-armyworm-biological-control-facility-for-africa-completed



Developing varieties resistant to leaf curl

In parts of India tomato production is increasingly less viable due to tomato leaf curl virus. In collaboration with CIAT, the World Vegetable



Center and partners in India, three leaf curl-resistant varieties have been released. The farmer partnership ensures the varieties met all their relevant criteria. Commercial seed producers have taken up the rights, to multiply and distribute the varieties. Impacts show that by growing these resistant varieties, over 1 million farmers have obtained up to 10 times more profit.

Rescuing germplasm from viral infections

The research has cleaned the best 25 cassava varieties from the infections of cassava mosaic and brown streak viruses. The varieties were cured from virus infections using a combination of tissue culture and chemo- and thermo-therapies. Indexing for viruses was carried out using highly sensitive molecular techniques, which confirmed the absence of viruses in cleaned cassava plants. The plants have been shipped to eastern Africa for mass

multiplication and distribution to farmers. This healthy planting material is expected to significantly increase cassava production and farmer income in five eastern African countries that are currently affected by these viral diseases.

www.nri.org/news/2013/curing-cassava-of-deadly-virus-infections

Breeding new sweet potato varieties with farmers

This project brought together farmers and scientists to develop a sweet potato variety suited to farmers. Sweet potato seedlings rarely occur and therefore traditional plant breeding labours under a huge disadvantage working only with vegetative propagation which can facilitate the spread of viral diseases. This new selection produces large deep roots, which are protected from weevils, and is highly marketable. Farmer's now have increased income and improved livelihoods.

Rehabilitation of sustainable Robusta coffee production

Coffee production in Sierra Leone used to be a significant source of income for farmers and the government, but production is now just 10% of what it was before the civil war. Through capacity building and applied research we aim to



support 10,000 coffee farmers and 25 producer organisations in Sierra Leone to rehabilitate shade grown Robusta coffee production through planting new more productive plants, pruning and shade management. This will be complemented with assistance to obtain sustainability certification and improve quality management to enhance market access and prices to farmers.



Improving degraded landscapes for agriculture

Research is directed at trying to understand if organic derived forms of charcoal (biochar) can provide not only a long-term source of atmospheric carbon dioxide storage in soil, but also a means by which carbon storage improves soil health (physical, chemical and biological), function, sustainability and crop production. Understanding the relationships between biochar feedstock sources, its physical structure, the pyrolysis process and its function in the soil, underpins research activities looking at ways to utilise crop water and nutrients more efficiently, whilst protecting the environment.

Linking the production and marketing chain for smallholder commodities

Adopting a value-chain approach is being used to improve household income from sesame through the promotion of sustainable practice in crop production and marketing. Seed availability, to

growers, of improved sesame varieties in Tanzania has been increased from 60% to 100% using community-based seed multiplication. Tanzanian varieties have been introduced into Mozambique where they out yield local varieties. The impact of sesame flea beetle has been reduced through project negotiation with an agrochemical company to supply insecticide to treat seeds. Marketing was improved through closer engagement with trading companies and the development of Savings and Credit Co-operatives.

Improving pollination in Caribbean cocoa production

The lack of efficient pollination is limiting cocoa yields, and thus reducing the income of cocoa farmers. This project brings together researchers in the UK, Trinidad and Tobago and Jamaica to discover ways to optimise and enhance pollinator populations in the Caribbean. Insect surveys on cocoa estates have established baseline data about existing cocoa pollinators, and sampling of odours from cocoa flowers permits evaluation of pollinator attraction to the flowers. This is coupled with work on assaying different pollinator breeding substrates with a view to rearing large numbers of pollinators and releasing them at critical times, as



well as devising management plans to augment natural populations of pollinators by providing appropriate environments. www.cocoapop.eu

Agroforests: A critical resource to conserve megadiversity in Guatemala

Shaded coffee and other agroforestry systems have been shown to support greater levels of biodiversity than monocrops, and while not equal to natural forests may help maintain ecosystem connectivity where forests are highly fragmented. In Guatemala we are evaluating the biodiversity and connectivity between different forests, tree crop and agroforestry systems within largely deforested landscapes. In parallel we are exploring what measures may provide incentives for land-owners to maintain land-uses that are more favourable to biodiversity conservation, such as sustainable coffee certification, eco-tourism and reforestation incentives.

Functional biodiversity on arable farms in Kent

Introduction of environmental production practices on farms will make them more dependent on ensuring ecosystem services such as natural predator pest regulation. We are comparing ground arthropod populations and weed and margin plant biodiversity on farms under organic, conservation and conventional management practices. While organic management appears to promote high weed diversity, the no-tillage practices of conservation farming appear to promote very high populations of predatory beetles.



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