




The Interdisciplinary Research and Education Fund of Wageningen University

Journey into Interdisciplinarity

Ten years of INREF experience

WAGENINGEN UR
For quality of life

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Foreword

In 2000, Wageningen University took the bold decision to establish an innovative university-wide framework for development oriented research and education based on the concepts of interdisciplinarity and science for impact called INREF. The aim of the initiative was to produce research results that 'make a difference' by addressing complex problems through the design and implementation of interdisciplinary PhD research programmes. This year, INREF is celebrating its ten year anniversary. Over this period twelve research programmes have been launched of which half have been completed. In each of these programmes 6 to 12 PhD students from developing countries and emerging economies conducted the actual research supervised by a joint team of researchers from Wageningen University and partner institutes.

This booklet highlights all twelve INREF programmes showing concrete, sometimes unexpected results thanks to their innovative approach. Their success is also illustrated by the fact that most INREF programmes managed to attract external funding from interested institutes and organisations. After completion many programmes have been followed-up by new research programmes or by initiatives applying the newly found insights.

From its early stages the INREF programme has gradually evolved into a rich and lively research platform in terms of topics, working methods, paradigms and background of researchers. It effectively brings together scientists from within and outside Wageningen UR with different disciplinary, geographical and cultural backgrounds and opens new venues of thinking needed for an increasingly complex world.

The success of the INREF programme is confirmed by approval of the third phase of the programme by the Board of Wageningen UR in March 2010. New programmes will start in 2011.

Through this booklet we would like to share these experiences with you. We hope it will give you inspiration and a pleasant reading.

Dr. A. Huijsman
INREF Programme leader

Wageningen, April 2010.

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1 INREF: sowing the seeds for out-of-the-box thinking

How to capture reality in one (scientific) discipline? The answer is simple: this is impossible because reality is multi-faceted. Strangely enough, though, most scientific research continues to be monodisciplinary. Scientists like to go in-depth. They work to become experts in their own domain. This means, however, that all other realities that impact on their research qualms and queries, remain hidden from their scientific gaze. That need not be a problem for research that is purely 'curiosity driven'. And let's be honest: some of the most spectacular scientific breakthroughs are the result of the pure curiosity of brilliant minds working in relative isolation. But the results achieved by monodisciplinary researchers are rarely fit for solving real world challenges. Real life problems are complex without exception, and their study can therefore not be confined to one discipline only. Whether it concerns problems with sanitation in Africa's fast growing cities, nutrient deficiencies in staple food in China and Africa, or the competing claims that different stakeholders lay on valuable natural resources; these are all challenges that need to be addressed – simultaneously – from multiple angles, by experts who appreciate the essential input that other disciplines can provide. For example, it is relatively easy to design a state-of-the-art urban sanitation system fitted to the circumstances in western countries. But implementing such a system in developing countries is bound to fail if ownership of the land where the pipes and installations are to be located is unclear or disputed. Moreover, sanitation systems need managing; and management systems will only deliver if they are fitted to local institutions and (informal) power structures. Proper maintenance will only happen if local institutions are held accountable, and if both managers and end users feel ownership over the project. And, last but not least, even cultural traditions or religious beliefs can make or break the successful implementation of a 'perfect' sanitation system.

In the course of many decades of development cooperation, donors, researchers and other stakeholders have become aware of the need to adapt technologies to local circumstances. Nevertheless, white elephants (expensive projects that are not really useful) still abound. Almost without exception, such white elephant development projects are the unfortunate result of specialists and consultants who turned a blind eye not only to specific local circumstances, but also to potentially useful knowledge from other disciplines. Similarly, in the academic world, it is still the exception rather than the rule for researchers to team up across disciplines to tackle real life challenges. It is, moreover, often considered 'un-scientific' to engage in the relevant and applied research which necessitates such a cross-border approach. The entire academic infrastructure, not just in Wageningen, is to a large extent grafted on disciplinary demarcation and isolation.

In 2000, the Board of Wageningen University established the Interdisciplinary Research and Education Fund (INREF), a university-wide framework for development oriented research and education. INREF is an innovative attempt to join forces across the borders of scientific disciplines (natural and social sciences) in order to find answers to development related problems. Now, almost ten years after INREF was set up, twelve research programmes have been approved. Half of them have been completed, the other half are well underway. Each of these programmes is a joint effort of researchers of Wageningen University and the partner institutes; 6 to 12 PhD students from developing countries and emerging economies conduct the actual research in each programme. These doctoral students already have a position in one of the partner research institutes or universities in the South. This is to ensure that the research programme matches the national research priorities. The PhD students take courses and write their research proposals in Wageningen, then conduct the research in their home countries, and finally return to Wageningen to write and defend their thesis. This is called the sandwich model. After graduation, they return to their institute and their formal position. In most cases the new doctors soon get promoted and establish themselves in influential positions in their institute. Hopefully there they can sow

the seeds of interdisciplinary research and creative out-of-the-box thinking.

The objective of INREF is to produce research results that 'make a difference'. This fits perfectly with the culture of Wageningen UR, which mission includes to 'make essential contributions to the quality of life with pioneering research and innovative teaching programmes'. The INREF team believes that academics have a responsibility (shared with others) to ensure that when they generate relevant knowledge, it will be used in the real world.

A second important objective of the INREF programme is to conduct and trigger innovative, interdisciplinary (beta-gamma integration) and comparative research and to contribute to the development of new, interdisciplinary and innovative research methodologies. The complex problems addressed in INREF's research programmes ask for interdisciplinary approaches. The researchers and PhD students involved in the programmes try to develop a common understanding of the focal problem, of its complex causes, and perspectives for improvement. Such an interdisciplinary approach does in no way obviate disciplinary progress. Rather, the two should go hand in hand.

Lastly there is the issue of context. INREF encourages research that connects different contexts, either North-South or South-South, because this can broaden our view on the processes behind (under)development.

Take the programme 'From Natural Resources to Healthy People', for example. The interdisciplinary approach of this programme, which was completed in 2008, allowed the researchers to study the complete 'chain' of staple food production: from soil to stomach. Especially in Africa many people, mainly women and children, are anaemic because their diet is limited to staple foods like sorghum or rice. These products are low on micronutrients like iron and zinc. Researchers established that a fivefold increase of micro-nutrients in sorghum is possible, but only if, throughout the production chain, several techniques are applied. But even that

is no guarantee for better health. The enhanced levels of micro nutrients must be absorbed by the human body. And exactly that element was the topic of another researcher in the programme. This chain wide tactic was one of the advantages of the INREF programme; the interdisciplinary approach, which characterizes all INREF programmes, allowed the researchers direct access to the results of their colleagues working on other parts of the chain.

Another example is the ongoing 'Competing Claims' programme. Competing claims on natural resources are becoming increasingly acute everywhere. As populations grow, an increasing number of people lay claims on available resources. The programme focuses on the situation in and around the trans-frontier nature reserve covering parts of South Africa, Mozambique and Zimbabwe. In this area, the claims of local communities compete with the ideals of nature conservationists, national economic interests and even the 'claims' of lions and elephants on their habitat. These conflicting claims can only be reconciled based on thorough understanding of their nature, the strategies of the concerned partners, and the identification of alternative resource use options. Furthermore, the programme focuses on the support that 'science' can provide to facilitate the negotiation processes between the different stakeholders. The 'Competing Claims' programme investigates the situation in Southern Africa, but the programme's approach is so innovative that it has attracted the attention of Dutch policy makers, who believe it to be useful for their own challenges regarding multiple land use on the banks of Dutch rivers.

These are just two examples. This booklet describes all twelve INREF programmes. The twelve programmes – which have certainly not been without their challenges – show concrete, sometimes unexpected results thanks to their innovative

INREF phase I programmes

- From natural resources to healthy people: food-based interventions to alleviate nutrient deficiencies.
- Regional food security policies for natural resource management and sustainable economies (RESPONSE).
- Convergence of Sciences: inclusive technology innovation processes for better integrated crop and soil management (CoS).
- Optimization of nutrient dynamics and animals for integrated crop-fish-livestock farming systems in Southeast Asia and Sub-Saharan Africa (POND).
- Agro-industrial transformations towards sustainability. Southeast and East Asia in global perspective (AGITS).
- From vegetable production to healthy food: vegetable genomics research for the production of healthy food for China's growing population (CAAS).

INREF phase II programmes

- Rebuilding Resilience of Coastal Populations and Aquatic Resources: habitats, biodiversity and sustainable use options (RESCOPAR).
- Competing Claims on Natural Resources: Overcoming mismatches in resource use through a multi-scale perspective.
- Tailoring Food Sciences to Endogenous Patterns of Local Food Supply for Future Nutrition (TELFUN).
- Partnership for Research on Viable Environmental Infrastructure Development in East Africa (PROVIDE).
- Co-Innovation for Quality in African Food Chains (CoQA).
- Terra Preta do Indio Recovering the Past, Regaining the Future of Amazonian Dark Earths.

approach. This success is also illustrated by the fact that most INREF programmes manage to attract external funding from interested institutes and organisations. Many programmes are, after completion, followed-up by new research programmes or by initiatives to apply the newly found knowledge.

But there is more to INREF than innovative and applicable research outcomes. INREF contributes to boosting the institutional capacity of partner universities and research centres in the South. The six completed INREF programmes have resulted in 53 PhD theses, and hundreds of scientific publications and papers in proceedings of (international) conferences, and many more are expected. But that's only paper. More importantly, after graduating the INREF students form a unique network of policy makers and researchers that extends beyond national borders - and which is made up of people dedicated to cross disciplinary boundaries too in their study of real life problems. For Wageningen University, it is highly rewarding to be at the heart of this network.

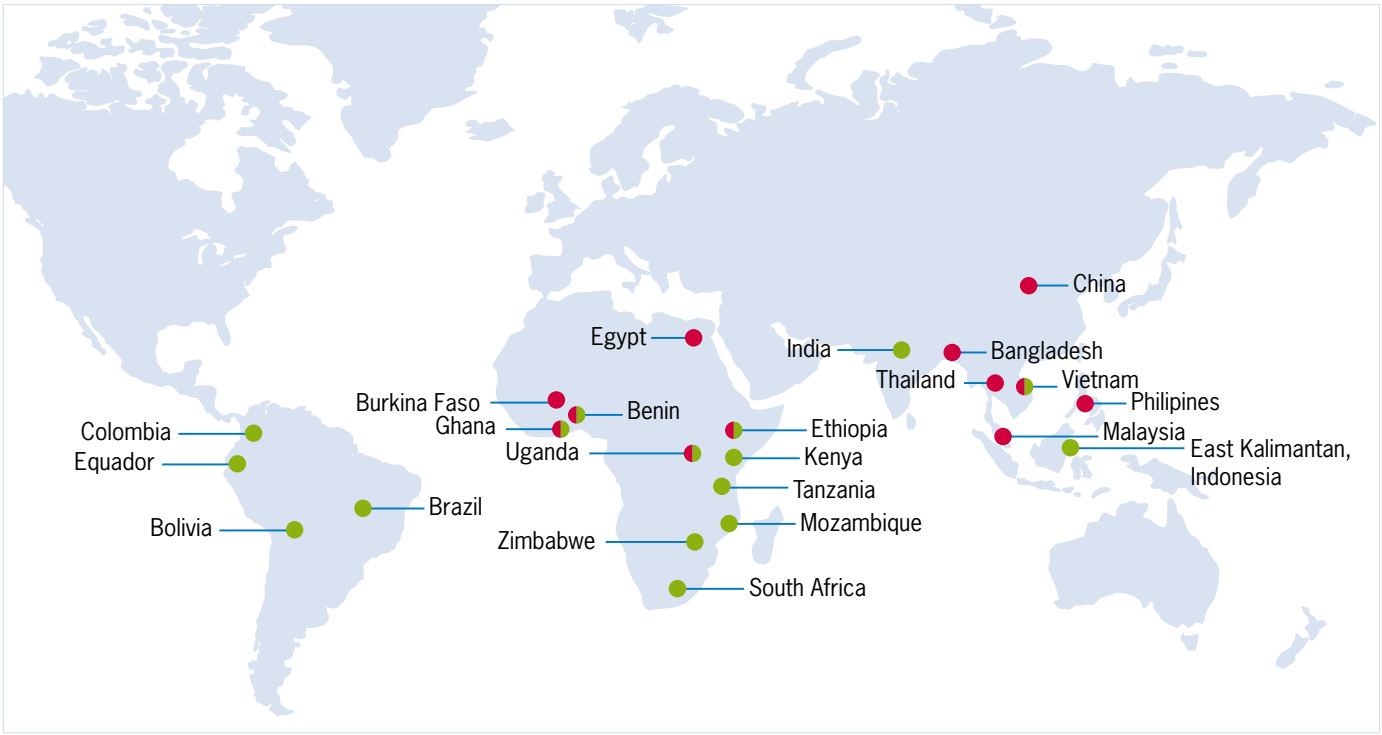
Location of INREF programmes

INREF phase I

- 53 PhD students defended a PhD thesis.
- 48 students obtained a Wageningen University PhD degree.
- 5 students obtained a CAAS PhD degree in China.
- 66 MSc students did their MSc study or their MSc thesis work within one of the INREF programmes.
- The 6 INREF programmes conducted activities in 12 different countries in Africa and Asia.

INREF phase II

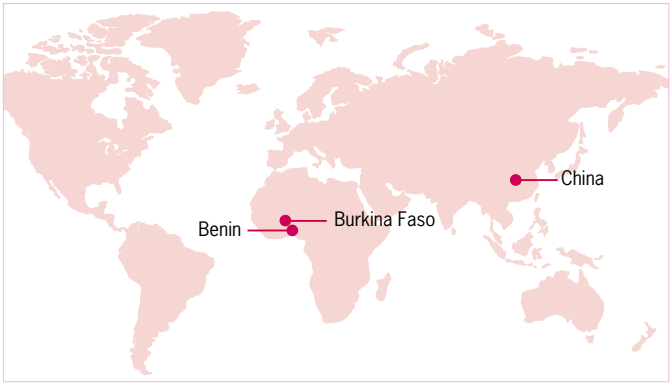
- 56 PhD students are actually conducting their research within the INREF programmes.
- Another 9 PhD candidates will be recruited in 2010.
- The six INREF programmes conduct activities in 16 different countries in Africa, Asia, and Latin America.



2 Research programmes INREF phase I

2.1 From Natural Resources to Healthy People

Getting the iron and zinc in



Malnutrition is one of the most serious consequences of underdevelopment. Contrary to common belief, a lack of food – low energy and protein intake – is not the main cause of malnutrition. Micro-nutrient deficiencies – mainly vitamin A, iron and zinc – contribute to more than half of child mortality in sub-Sahara Africa. So it's not so much the amount of food that is problematic, but rather what it contains. Better crops, with higher concentrations of micro-nutrients, could result in major health improvements.

The INREF programme 'From Natural Resources to Healthy People' conducted research into micro-nutrients in sorghum and rice in Benin, Burkina Faso and China. Eight PhD students – four from Africa and four from China – investigated the complete production cycle of these staple foods; from soil to stomach.

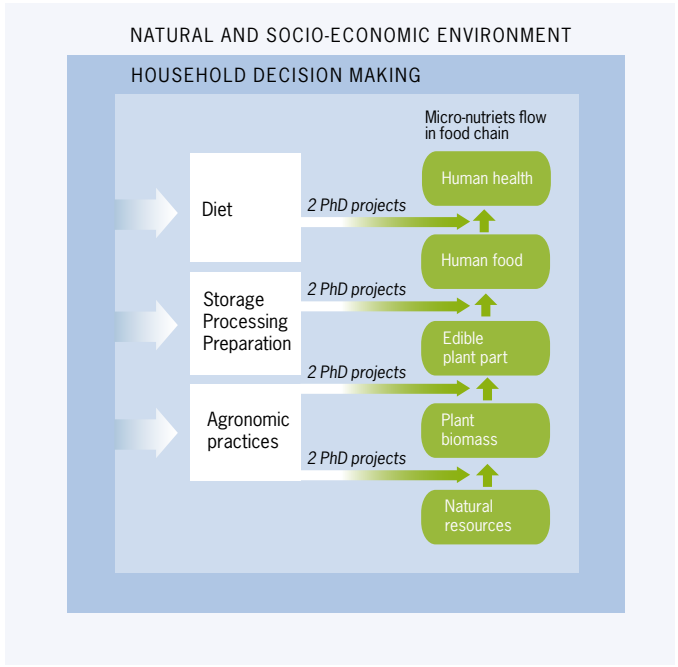
The choice to conduct research into staple foods, like sorghum and rice, was a deliberate one. Food groups such as meat and vegetables certainly contain more micro-nutrients, but the people most vulnerable to malnutrition are women and children, whose diets consist mainly of staple foods. Adult men eat more meat and vegetables.

One of the unexpected (but exciting!) results of the research is that adding zinc to the soil not only enhances the concentration of this micro-nutrient in the sorghum, but also increases crop yields in semi-arid areas such as those in West Africa. Plant scientist Tjeerd-Jan Stomph explains enthusiastically: "It would be hard to convince farmers to use fertilizers with the sole argument that this will enhance zinc concentrations and thus food quality. Farmers are not paid for this type of quality. Increased yields are a much more convincing argument! Our unexpected finding makes the introduction of zinc enriched fertilizers much more feasible." A lucky circumstance is that today, in contrast to several years ago, fertilizers containing zinc are becoming available in West Africa. This is thanks to the commercial, large-scale growth of cocoa and cotton, two crops that also have zinc deficiency problems and which make the West African countries an interesting market for agro-industrial producers of fertilizers. Adding iron to the soils in West Africa is, contrarily to zinc, not a solution. This is because the soils are already rich in iron. Research into how the iron uptake from the food crops can be increased therefore concentrated on the food processing stages.

The research done by the INREF students established that a fivefold increase of micro-nutrients in sorghum in Benin and Burkina Faso is possible, but only if several techniques are applied simultaneously. The trick is to not just concentrate on the soil, but to also develop new breeds of sorghum based on existing variation, and improve uptake of micronutrients by the human body by changes in food processing, food preparation and diets. "That's an important lesson", Stomph emphasizes, "don't put all your money on just one strategy in one part of the production chain, but work on interventions throughout the entire chain."

This chain-wide approach was one of the advantages of the research programme. The interdisciplinary approach allowed the researchers direct access to the results of their colleagues working on other parts of the chain. For example: enhancing the concentration of micronutrients in sorghum is only worthwhile if these higher concentrations are absorbed by the human body; in other words, the micronutrients must be bio-available. One researcher focused on exactly that topic.

Also the middle part of the production chain – where food processing and food preparation take place – is important. It is an established fact that polishing rice reduces the concentration of micronutrients. But at the same time, polishing rice strips the grain of phytic acid. Phytic acid blocks the bioavailability of important minerals such as iron and zinc and can therefore contribute to mineral deficiencies in people whose diets rely on these foods for their mineral intake. In other words: methods of food processing can both seriously enhance and reduce availability of micronutrients in staple foods. That makes interventions in



food processing and preparation an interesting strategy to reduce malnutrition.

As the 'From Natural Resources to Healthy People' programme involved researchers from both West Africa and China, the scientists were able to make comparisons between the two areas. Stomph: "The scale of food processing in China and Benin is completely different. In China even people in rural areas buy their staple food – mainly rice – in stores. The processing is done centrally, and on an industrial scale. But in Benin, food processing in rural areas is mainly done at the household level. People grind and process sorghum themselves. This means that strategies to alter their way of processing foods should be small scale in Benin, and target the family level. Introducing big machines, for example, serves no purpose." Adding micro-nutrients in the stage of processing the food, for example by incorporating nano sized particles of zinc and iron, a fortification technique developed by researchers in Switzerland, will be much easier to accomplish in China, where rice is polished in large factories. A follow-up study is now testing such fortification techniques. The researchers relate it to the bio-fortification techniques developed within the 'Healthy People' programme in order to compare efficiency in uptake of the micronutrients in the human body.

The interdisciplinary character of the programme came to the fore especially during meetings attended by all students. Most of these meetings happened in Wageningen, as students from both regions at times worked there. But the African researchers also visited China and got to know the work of their Chinese colleagues first hand. Unfortunately a visit of the Chinese researchers to Western Africa didn't materialize. Nevertheless contacts between the two groups of researchers have grown. Stomph: "As time progressed, the students stepped up their communication. They came to understand the different viewpoints emanating from the different disciplines involved in the programme." The programme has changed those involved. They have opened their windows towards other disciplines and viewpoints. "The change we've accomplished in these researchers will, without a doubt, in the longer run have a positive impact on the institutions where they work. Institutional development always starts with the people; they are the drivers of change."

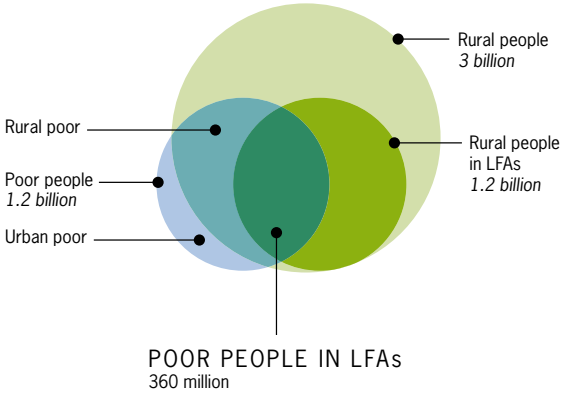
2.2 Regional Food Security Policies for Natural Resources Management and Sustainable Economies (RESPONSE)

Getting LFAs higher on the agenda

Less Favoured Areas (LFAs) are territories where nature and man haven't been kind to the inhabitants. You can find them everywhere: Africa, Asia, the Americas and even in Europe. These are areas where the climate is rough, where the slopes are steep or the soil is rocky, infertile or too wet. Roads are bad or absent, education is poor and medical services of low quality. LFAs are the habitat of some 40 percent of the rural poor, about 360 million people, making it a relevant research topic! Yet amazingly, the world's Less Favoured Areas have been largely neglected by both researchers and policy makers, Wageningen emeritus professor Arie Kuyvenhoven explains. The INREF initiative provided an excellent opportunity to analyse the challenges in developing these areas.

For Wageningen, the study of LFAs was not new. What was innovative though, was the interdisciplinary approach that was taken. Kuyvenhoven: "Agricultural and animal science experts from Wageningen always complained that, when studying LFAs, they stumbled on difficulties beyond their own scientific scope. For example, technical researchers who try to introduce innovative agricultural methods are faced with the fact that poor farmers cannot access credit facilities: banks won't lend them money. Knowledge of local markets is an essential precondition before you start working on scientific improvements of soils, crops or farming methods." The RESPONSE programme brought together knowledge on resource management, livelihood strategies, markets, risk management, and trade. The idea was that only by taking the entire production chain into consideration, can research support informed policy decisions for LFAs.

The RESPONSE programme initially resulted in ten PhD theses. In the course of the programme several more were completed. The INREF evaluation committee judged that most of them have 'made very significant contributions to the stock of knowledge on



Shuyi Feng

Associate professor at the College of Public Administration, Nanjing Agricultural University in China

"Most researchers study their research problems from their own disciplines only. My research, however, required a interdisciplinary approach. I set out to investigate the effect of farmers' participation in the land rental market on their investments, the productivity of their land and the soil quality. This complex question brings together economics, agronomy and soil science. The RESPONSE programme trained me in the basics of all these different subjects. My current research into sustainable impact assessments of land use policies is once again a multi-disciplinary challenge, seized in close collaboration with Wageningen and other universities worldwide. With my colleagues from Ethiopia, I discuss research questions and methodologies. For all of us it is interesting to discover the many similarities between China and Ethiopia in terms of land institutions. We learn from each other and I have learned how to do teamwork in a multi-cultural environment."

agricultural and rural development in developing countries.' The theses were grouped around four levels in the production chain:

1. Resource Management, Productivity and the Environment,
2. Livelihood Strategies, Poverty Alleviation and Food Security,
3. Markets and Risk, and 4. Global and Regional Trade. Research was conducted in Ethiopia, China, Bangladesh, The Philippines and Uganda.

Kuyvenhoven explains the impact of the RESPONSE programme in terms of agenda setting, rather than technological innovations. "The main success of the programme – although this clearly cannot be solely attributed to us – is that today LFAs are much higher on the international agenda than before. Institutes like the World Bank have neglected agriculture in developing countries for a long time, but this is now changing. In 2008, the Bank dedicated its Annual Development Report to 'Agriculture for Development'. This comprehensive report refers to several of the outcomes of the RESPONSE programme."

Fredrick Bagamba

Researcher at the Banana Research Institute in Uganda

"Agricultural productivity in Africa is stagnating due to poor infrastructure and education and the limited access that farmers have to credit and capital. As a result, farmers have a lower adoption of fertilizer and improved seed, and rely more on rainfall agriculture. This limits the competitive advantage of African agriculture, especially compared to the West, where the sector is heavily subsidized. But the effects will be felt globally: people will have to pay more for their food if the nutrient depletion in Africa is not arrested in time.

The INREF approach enriched our research into this important global problem through interaction with scientists from other disciplines and continents. For instance, by incorporating biological issues into economic theory, we broke with the tradition of depending solely on economic theory to analyse rural development issues. While traditionally prices are used as proxy variables to capture production constraints and opportunities, in our research these constraints (e.g. nutrient stress, crop pests and disease and water stress) were included directly into the modelling."

The current financial and economic downturn forces both policy makers and investors to rethink the nature of growth. Especially in China, the less favoured areas outside the coastal provinces are looked at with renewed interest. One of the driving forces behind this policy change is Shenggen Fan, at the time Director of the Development Strategy and Governance (DSG) Division at the International Food Policy Research Institute (IFPRI). IFPRI was the most active partner of the RESPONSE programme. In China, development of the LFAs is now one of the strategies used to curb the economic crisis. The rationale is that because of the untapped potential of LFAs, much higher growth, employment creation and poverty reduction can be achieved in the lesser

developed areas in Central and Western China. According to Kuyvenhoven this also goes for parts of Latin America and Africa.

The LFAs approach is based on the assumption that rural poverty is mainly a matter of an unequal – some would say: unfair – distribution of assets. “In that sense our programme is also idealistically motivated”, says economist Kuyvenhoven. “Engineers can build a road; that is an improvement of local infrastructure. But whether this really leads to development depends on who will benefit from this new infrastructure. Will the road strengthen the existing status quo, or will it lead to change and to more equity? These questions go back to the teachings of Dutch Nobel laureate Jan Tinbergen. You have to look for fair distribution, because if you don’t, economic growth will bring about more problems.”

Kuyvenhoven chose a pragmatic, enterprising approach to implementing the RESPONSE programme. For instance, after the programme had already started, another PhD candidate presented herself and proposed to do research on the textile industry in Bangladesh. Though this was outside the previously determined research areas, and strictly speaking not even a Less Favoured Area, she was taken on board. The rationale was that the prime materials of the textile industry are produced in LFAs. Several other PhD research projects too were commissioned outside the chosen geographical areas. The result of this pragmatic approach was that the shared conceptual framework had to be fitted around the individual research proposals. Moreover, the interdisciplinary potential of the programme was perhaps not used to the fullest. The RESPONSE programme was part of the first phase of INREF, which meant that Kuyvenhoven and his colleagues had to find out firsthand the possibilities and limitations of an interdisciplinary approach.

Kuyvenhoven defends the choices his team made at the time: “We did try to get all the PhD students on the same track. They arrived in Wageningen as one cohort, and we offered them a joint programme. This was to make sure they would learn from each other’s expertise. At first this worked excellently and we noticed that the PhD students were truly fascinated by the knowledge and approach of the others in their group. But along the way, inevitably, they started to narrow their work down to their own research topic and discipline only. That is symptomatic for PhD students. They are monomaniacs par excellence. If we want people who keep an open mind all the time, we should involve more post-doc researchers. But that was not the choice INREF made in the first phase.”

2.3 Convergence of Sciences: inclusive technology innovation processes for better integrated crop and soil management (CoS)

Investments in interaction

Agricultural research has had too little impact on the livelihoods of poor farmers in developing countries. This observation was the raison d'être of the Convergence of Sciences (CoS) programme. Many technologies to improve soils, reduce pests and diseases, and increase yields were developed and introduced by scientists over the past few decennia. But only rarely do farmers take up the proposed innovations. "One explanation for this must be that we, researchers, ask the wrong questions. Questions that are often irrelevant to the daily reality of the farmers," says professor Arnold van Huis, tropical entomologist and coordinator of the CoS programme. "That is why we invested a lot of time in formulating the research priorities and the relevant questions."

The CoS programme, which involved nine PhD students and some 15 organisations between 2001 and 2006, used two methods for that purpose: so-called 'technographies' and diagnostic studies. The first focus on the national level and look at technological histories, institutions and markets in order to explore realistic opportunities for innovation for various crops. These studies for instance pointed at the fact that devoting research time and money to rice improvement may not be the best choice when national markets are swamped with subsidized, imported rice. Aiming for higher productivity can be irrational from the point of view of farmers, who know that they will be stuck with a surplus if they get twice their usual yield. Such concerns were reconfirmed in the 'diagnostic studies', which zoomed in on the farmer's level. Together with the farmers, the PhD students from Ghana and Benin analyzed and prioritized their main obstacles to earning a decent living.

They then designed experiments in which all relevant stakeholders were involved. The importance of interdisciplinary research – the first meaning of 'convergence' in the CoS programme – was very evident during this process. For instance, students working on soil improvement in Benin discovered that the existing land tenure arrangements were a major obstacle to effective soil fertility management. The migrant farmers from the dry North felt little incentive to invest in improving the soil; the limited tenure of 1-3 years gave them too little security to do so. Alternative land tenure arrangements were negotiated resulting in longer lease periods, motivating the migrants to invest in soil improvement.
Researchers of the CoS programme strongly feel that a mono-disciplinary focus on technology improvement won't do the job. Answers to the problems that poor farmers face need technical and social scientists to come together. Much of it has to do with malfunctioning or unfair institutions. No matter how much and how promising the technological development, sooner or later this is what farmers will stumble upon. In most African countries, farmers have no political clout, can count on very little institutional and policy support, while at the same time their governments prey on them for revenue. Van Huis: "To tackle such issues requires a mentality change on the part of academia. We need multi talented people: soil specialists with an eye for social relationships and political hierarchies, or anthropologists with knowledge of the history of technology." This is why the CoS students each had four supervisors – one natural and one social scientist in both Wageningen and their home organisations. "For the students this was not always easy," says Van Huis. "But we put in tremendous effort to ensure a common perspective across the sciences." He adds, with a smile: "And the students proved very good at supervisor management."

The real challenge for the students was to design, together with the farmers and other local stakeholders, technologies that match the small windows of opportunity that characterize African farmers' lives. Grand technologies are often simply incompatible with their reality. Cocoa farmers in Ghana, for instance, are faced with the problem of capsids, a pod-sucking insect. In the past, farmers relied on predacious ants, which eat the capsids. But the government started spending vast amounts on annual mass spraying of the cocoa trees with pesticide. This not only kills the capsids, but also the ants. One CoS study showed that a locally available botanical pesticide proved to be equally effective, while conserving the ants.

Black pod disease is another serious problem in cocoa; the pods infected by the fungus infest healthy pods. Removing the diseased pods from the farm requires an enormous labour investment. After discussing this problem, neighbouring farmers decided to collectively clean one farm after the other from all diseased pods. This new, collective labour arrangement made it possible to triple their production.

Suzanne Nederlof

Senior advisor sustainable economic development at the Royal Tropical Institute in the Netherlands:

"In my current work I still benefit tremendously from the years I lived and worked in West Africa for the Convergence of Sciences Programme. In this programme we experimented with combining biological and social sciences and with combining the producers with the scientists' knowledge. We learned that innovation to occur not only needs a technology that works, but also an appropriate organization and rules and regulations. This raised the need for helping producers articulate their demand for appropriate research and the need for researchers to develop technologies that not only work but are also appropriate for the producers involved. It is during this project that I developed my skills to stimulate so-called institutional innovation and that I learned tools on how to strengthen appropriate agricultural services for producers and their organizations."

The term ‘convergence’ also points at the strong belief of the CoS team in so-called ‘democratization of science’. In short: not just academic knowledge, but local and indigenous knowledge too is crucial to come up with innovative and workable solutions. That includes first and foremost the farmers, but also extension workers, local NGO’s, policy makers and consumers. “Only if the theories and perceptions of all stakeholders are valued equally, does knowledge become truly inclusive”, says Van Huis. “In our research programme, therefore, professors didn’t exist. Everyone was a student and an expert at the same time.”

Incidentally, this principle of equality led to some very unusual PhD defence ceremonies. In October 2006, within the course of just one week, all nine CoS students were awarded their PhD degrees. This happened not in Wageningen, but in Ghana and Benin. It was the first time in the university’s history that a Wageningen PhD defence took place outside the Netherlands. All Wageningen supervisors together with the university Rector flew to Ghana, and later travelled over land to Benin. They acted together with the local experts as supervisors and opponents during the ceremonies. “It took us a lot of negotiating and lobbying to make this happen,” Van Huis reminisces, “but battling the bureaucratic and administrative hurdles definitely paid off. Sometimes you have to be innovative to really achieve, and express, equality.”

The CoS team has always been clear that ‘investing in interaction’ is the key factor for success in any cross-cultural and transdisciplinary research programme. “We just had another international workshop in Ghana. It costs heaps of money, but it’s a sine qua non for our programme.” In the CoS programme, methodology is central. That is, participatory, experimental, and interactive science that leads to the co-construction of knowledge. And this knowledge must be practical: to help overcome both the technological and institutional barriers to improving farmers’ livelihoods. Such an approach depends a lot on people. On the ability of researchers to dare think outside the box – and a similar willingness on the part of the funders. Van Huis says: ”We are a process-driven project. Sometimes that is hard to explain. We don’t work with pre-givens, or with the detailed logical frameworks that funders like to see.” Nevertheless, the CoS team has managed to communicate its importance and successes. The second phase of this unconventional programme, funded by DGIS, is now well underway.

2.4 Project for Optimisation of Nutrient Dynamics and Animals for Integrated Farming (POND)

Feed the pond, not the fish

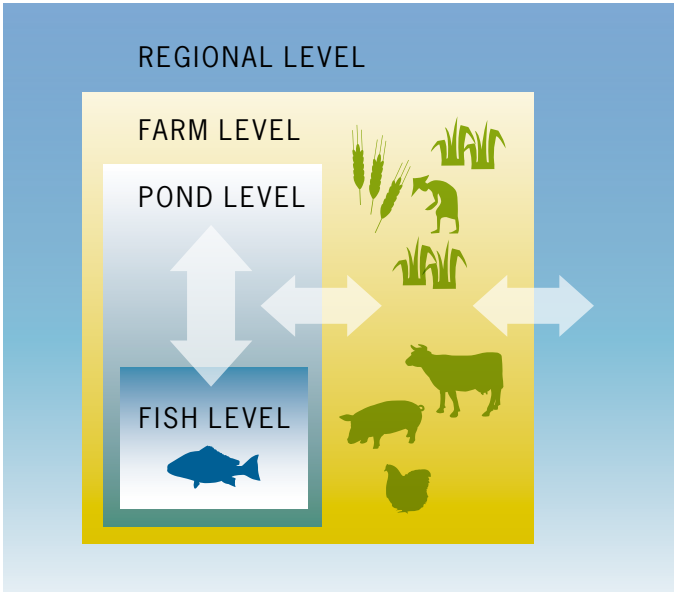
Short and simple? Yes, in many parts of Africa the integration of a fish pond in the farming system would be highly beneficial. It's all in the nutrients. To secure sustainable food production for an increasing population, available nutrients in the soil must be used more efficiently. Especially in Africa (but in other regions too) essential nutrients are lost or are used inefficiently. Fertile soils lose their value due to erosion and natural fertilizers are disregarded. To suggest solutions for more efficient nutrient use, the POND programme (Project for Optimisation of Nutrient Dynamics and Animals for Integrated Farming) focused on farms in Southeast Asia where integrated aqua-agriculture farming systems guarantee a high degree of efficiency in the use of nutrients. Introducing fishponds in the farming system not only leads to more efficient nutrient use, but also to poverty reduction: more reliable income for farmers and better nutrition for them and their families.

Together with partner institutions, such as the World Fish Centre (WFC) in Egypt and Malaysia, and the Can Tho University in Vietnam, POND researchers tried to find answers to a set of related questions concerning: the resources available at the farm; the role of fishponds and fish strains; the nutrient dynamics in integrated fish-agriculture farming systems; the methods to match the components of the system; and finally the socio-economic context in which integrated fish-agriculture farming systems develop. A lot of the fundamental research was done in Egypt, at the premises of the World Fish Centre, where circumstances to do scientific research were ideal. But the PhD students involved in the POND programme also investigated integrated farms in Vietnam, Thailand and Bangladesh. This 'real life' research, focused on farmers' experiences, established

the linkages that exist between the various production levels on integrated farms. Actively involving all stakeholders in the research is one of the characteristics of all INREF programmes.

The multi-disciplinary character of the programme was highlighted mainly in the multi-level approach. The POND researchers not only conducted biological research into fish, or the attributes of the fishpond, but also looked at the complete fish-livestock-crop farming system. They even took the regional level into account. However, the individual PhD studies were to a large extent mono-disciplinary. Programme manager Roel Bosma, researcher at the chair group Aquaculture and Fisheries of Wageningen University, admits: “Doctoral students always suffer a bit from tunnel vision: they want to delve deep into their subject. But through contact with fellow researchers and thanks to their supervisors’ guidance they become aware of the bigger picture. That is an important part of the entire programme.”

The research found that an important factor determining the feasibility of introducing fishponds in countries such as Uganda, Mali and Cameroon, is the genetic characteristics of the fish. Commercially most interesting are fast growing species, such as Catfish and Tilapia. The commercially produced seed of Tilapia used by farmers in fishponds today are selected while being fed with commercially produced pellets. This yields excellent economic results, but this feed is too expensive for most small-scale farmers. But if they don’t use the commercially produced pellets, their fish grow more slowly and the advantage of using the improved strains of fish is lost. Introducing nutrients and other agrochemicals in fish ponds that use improved fish strains may moreover harm the environment, and result in inefficient nutrient use. Unfortunately, commercial fish breeders have up till now focused on the development of fish strains that feed and grow well on the commercially developed feed products. Hardly any effort was put into fish strains adapted to less optimal growing environments. Bosma: “One of our PhD students investigated



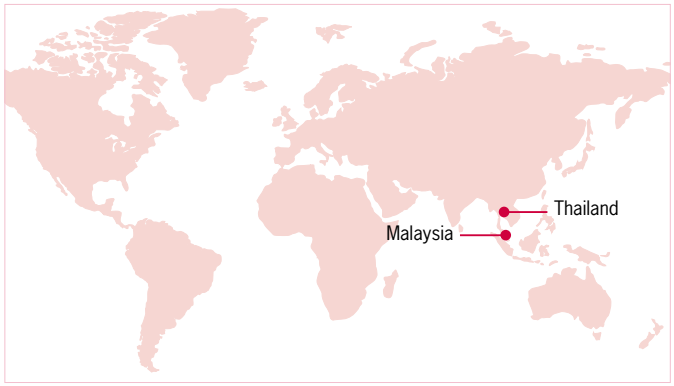
new breeds of Nile Tilapia that do well in low input environments. We hope that the industry will further investigate these new breeds and develop them commercially in order to make them available for small farmers."

The POND programme produced excellent scientific results, discussed in the book Fish Ponds in Farming Systems, as well as in numerous papers and presentations. Eight researchers earned a PhD degree based on their work, and an additional ten students completed their Masters degrees through the programme.
EU funding of the related 'POND-live' project ensures a follow-up of the programme. The main goal of this follow-up is to make the step from research results on paper to actual policy recommendations to improve the livelihoods of farmers.

Roel Bosma sums up some of the practical results of the research programme that promote the efficiency of nutrient use and, subsequently, the returns on investments in fishponds. The first recommendation is that farmers use several types of fish in one pond. This guarantees that different kinds of nutrients throughout the pond will be utilised. Secondly, for a healthy nutrient balance at the farm level, farmers are advised to use available dung from cows, poultry or pigs, to fertilise their ponds. Moreover, both the pond water and the mud accumulating at the bottom can be used as fertilizer. For its easy use, it is a good idea to plant fruit trees or lay out vegetable gardens alongside the fish ponds. Finally, sticking, for example, bamboo canes in the water will expand the surface for algae to attach to, which in turn leads to more feeding possibilities for the fish. Bosma: "Our central message to farmers is that it is vital to keep a healthy nutrient balance in the fishponds. A healthy pond will feed the fish. So: feed the pond, not the fish."

2.5 Agro-industrial Transformations towards Sustainability. Southeast and East Asia in global perspective (AGITS)

Tailored policies for small entrepreneurs

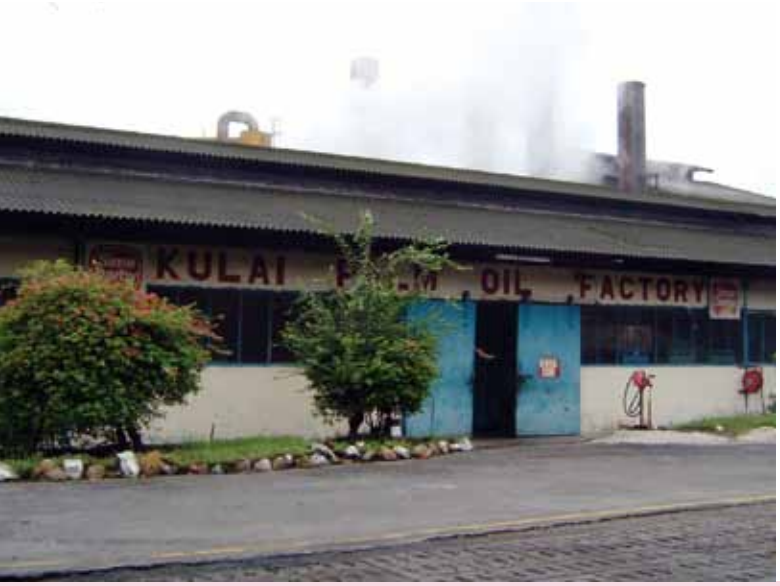


Until some decades ago, most Southeast and East Asian countries were primarily rural economies. But this has been changing fast. As part of ongoing industrialisation, the processing of agricultural products – to add value to primary commodities for export – is a high growth sector in both Thailand and Malaysia. These rapid economic developments inevitably impact the environment. Asian industries, therefore, are under increasing international pressure to meet environmental product and process standards. The AGITS research programme (2001 – 2008) meant to contribute to the design and realisation of more sustainable agro-industrial production systems. Alongside technological improvements, better management of production processes as well as effective governance have a part to play in this. Six PhD students looked into the opportunities

for cleaner production for small and medium sized rural agro-industries, as well as the challenges of sustainability for large agro-industries, such as palm oil. The number of palm oil plantations keeps growing at the expense of the natural forests. The drive to implement environmental standards for palm oil production, which moreover uses a lot of water and generates much waste, is therefore particularly strong.

The theoretical framework that guided the AGITS research projects is summed up with the term 'Ecological Modernisation Theory'. Peter Oosterveer, senior lecturer in environmental policy and coordinator of the AGITS programme, explains: "In plain terms, this entails the notion that economic and industrial development need not be contradictory to sustainability. We need not retreat to small-scale or de-technologisation to be able to keep on caring for our planet."

In Wageningen, environmental sciences (analysis, technology and policy) go back some thirty years. But in Thailand this approach



to studying environmental problems was a novelty. PhD student Warit Jawjit researched the environmental problems of eucalyptus forestry in Thailand, where fast growing plantations, which already cover an area one tenth the size of the Netherlands, threaten the natural forest. He conducted an environmental systems analysis of the pulp and paper industry. Pulp production requires fertilizers and biocides, and generates dirty waste water and emissions of pollutants such as carbon dioxide and sulphur-containing gases. Covering the entire production chain, Jawjit analysed the options for reducing the worst emissions. His research showed that structural changes, such as improving pulp washing, increasing the solid content of 'black liquor' (a by-product of the pulping process that is used as fuel to run the paper mills) and spillage control, are more cost-effective than the usual end-of-pipe technologies, which include activated sludge (a method for treating wastewater) and scrubbers for air pollution control.

Not only in the paper industry are end-of-pipe technologies expensive; this is also true for most small and medium-sized enterprises (SMEs) in the agro-industry. Agro-food chains are rapidly globalizing, which often is problematic for the SMEs. International trade, with its regulatory systems and environmental regimes, increasingly dictates how production is to be organised. Manufacturing practices in Thailand and Malaysia have been impacted by the food safety inspections carried out for foreign customers. Europe takes the lead when it comes to food safety and quality requirements. However, these requirements are often hardly joined up with the reality of the producers. For instance, while the production of chicken-meat and pineapple in Thailand is rather capital intensive, prawn farming is typically done by thousands of small farmers. They have a very hard time complying with the high standards set in Europe, which inevitably entail high investments. These costs may even be a reason for small enterprises to stop producing for export altogether. Others look for different export markets. For instance, Japanese importers are much less focused

on standards and certification. Oosterveer: “They attach more value to trust and a personal relationship with the individual producer.” A conclusion of the AGITS programme is that SMEs need their own policies. These policies should be tailored to the SMEs’ general lack of money, specialized knowledge and time. Currently, SMEs receive very little attention at all from ministries of industry, departments of environmental affairs, insurance companies and banks, or environmental monitoring agencies in their own countries. The AGITS researchers propose all sorts of support policies to remedy this situation, including demonstration projects, participatory research programmes, tax incentives and lending and insurance facilities.

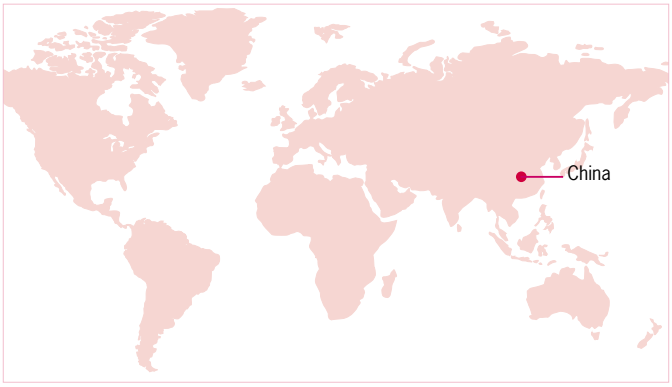
At the same time, a lot remains to be done on the European side. “The discussion in Europe is often not well informed,” says Oosterveer. The Thai frozen shrimp industry has been at the heart of debates on not only food safety, but also biodiversity loss. But many people are unaware that a law prohibiting marine or brackish water shrimp farming in mangrove areas was passed in Thailand already years ago (thanks to international NGOs, such as the Mangrove Action Project). The general question of how to best solve the environmental impact of shrimp farming, however, remains unanswered. Environmentalists tend to argue in favour of more extensive production, that is, fewer ponds per area. But it may well be that technological progress has better solutions to offer. Intensifying production in closed systems, which can be better controlled, may serve the environment better. “It is the role of academic research to come up with unbiased, scientific arguments for an objective public debate,” says Oosterveer. “Unfortunately, as academics we have very little time to actively engage in such debates.”

The AGITS team had technologists, anthropologists, economists and environmental system analysts on board. Yet the research projects were individually formulated. Oosterveer: “In all fairness, it was only during the course of the programme that we developed an eye for the interdisciplinary opportunities. The students started to share their knowledge and methodologies, but mere exchange alone does not merit the label ‘interdisciplinary’. Our follow-up programme, PROVIDE, emphasizes this much more.”

The AGITS programme contributed considerably to local capacity building. Most of the PhD students received promotions within their universities; two of them became vice dean, and one a tenured professor. Furthermore, the Environmental Research Network Asia (ERNASIA), which brings together environmental scientists from many different Asian countries, has grown thanks to the AGITS programme. Members of the network helped organise four regional conferences. The last one in particular, which took place in Bangkok in 2006, was very successful. It brought together an interesting mix of researchers and representatives from governments, the FAO and private sector companies. Oosterveer: “This event definitely contributed to a more progressive perspective on agro-industry and the environment in the region.”

2.6 From vegetable production to healthy food (CAAS)

Chinese pragmatics for cabbage genetics



Today China is 'hot' in development, business and academic circles. Not so though in the early 1990s, when professor of plant breeding Evert Jacobsen was already in contact with Chinese researchers, some of whom sent promising students to Wageningen to pursue their PhDs. The wish for a more structural relationship, not least on the part of these Chinese colleagues, led to the CAAS programme. This borrows its name from the main institutional partner: the Chinese Academy of Agricultural Sciences.

Guusje Bonnema, who received her doctorate in molecular genetics in the US, became the programme's scientific coordinator. She had spent the year 1985 in China as MSc student, which didn't mean though that all cultural bridges had been crossed. Effective cooperation remained an issue of concern – and at times frustration – throughout the five year programme. The Chinese Academy of Agricultural Sciences is a national agricultural research institute, affiliated to the Ministry of Agriculture of China, and with at least forty specialised research institutes. The Institute for Vegetables and Flowers (IVF) in Beijing is one of these. Bonnema: "IVF at the time was more like an enterprise for plant breeding and selling plants and seeds. Research was done too, but rather randomly, it was not an academic environment."

However, establishing an academic research culture was the very ambition of the then director of the IVF, Qu Dongyu, who himself had received his doctoral degree from Wageningen University. He sought to strengthen the bonds between the two institutions, and as a result, in 2001, the CAAS programme took off as one of the first INREF-funded programmes. An important goal of

the programme was to develop institutional capacity in China for research, training and extension in the areas of vegetable genomics and food production. A joint Sino-Dutch vegetable genomics laboratory was to be set up at CAAS. Over the course of five years, thirteen PhD students worked on different research projects in the so-called sandwich construction. Their research was concerned with producing healthy food for China's growing population, mainly through genetic research on crops that may lead to improved varieties.

In China, just like in large parts of Africa, a high proportion of the population suffers from malnutrition due to deficiencies of zinc and iron (Zn and Fe). Both micronutrients are found in meat, which thanks to the rapid economic growth is increasingly being consumed in China. However, meat remains too expensive for most ordinary Chinese. Cabbage, on the other hand, is a much consumed staple crop which can potentially increase the population's consumption of essential micronutrients. Several of the PhD researchers therefore focused on increasing the bio-availability of Zn and Fe in Chinese cabbage *(Brassica rapa)*. This meant finding ways of genetically improving the cabbage to achieve the optimal balance between Fe/Zn and phytic acid, which is the natural inhibitor of the uptake of zinc and iron.

To complement this genetic research, another student used data from the China National Nutrition and Health Survey to establish actual consumption and dietary patterns. The information from this country-wide population survey, which is conducted every ten years, turned out to be too general to answer some of the crucial questions. For instance, in terms of micronutrient intake, it makes a big difference which exact type of cabbage people grow and eat. The student therefore travelled to various rural areas to obtain this information. Efforts were then made to combine the different data sets, that is, the micronutrient composition of the 169 Brassica accessions studied and the Brassica varieties consumed in the different Chinese regions.

Another PhD project focused on disease resistance. Bonnema: "Chinese consumers too are becoming better informed. For instance, many Chinese have stopped drinking chrysanthemum tea, because of the pesticides that are used for the cultivation of this flowering plant." This research looked at possibilities for a combination of biological control and transgenic approaches to reduce insect pest damage. "In the Netherlands this would be considered a contradiction in terms – proponents of organic methods will never embrace genetic modification – but the Chinese take on this is much more pragmatic."

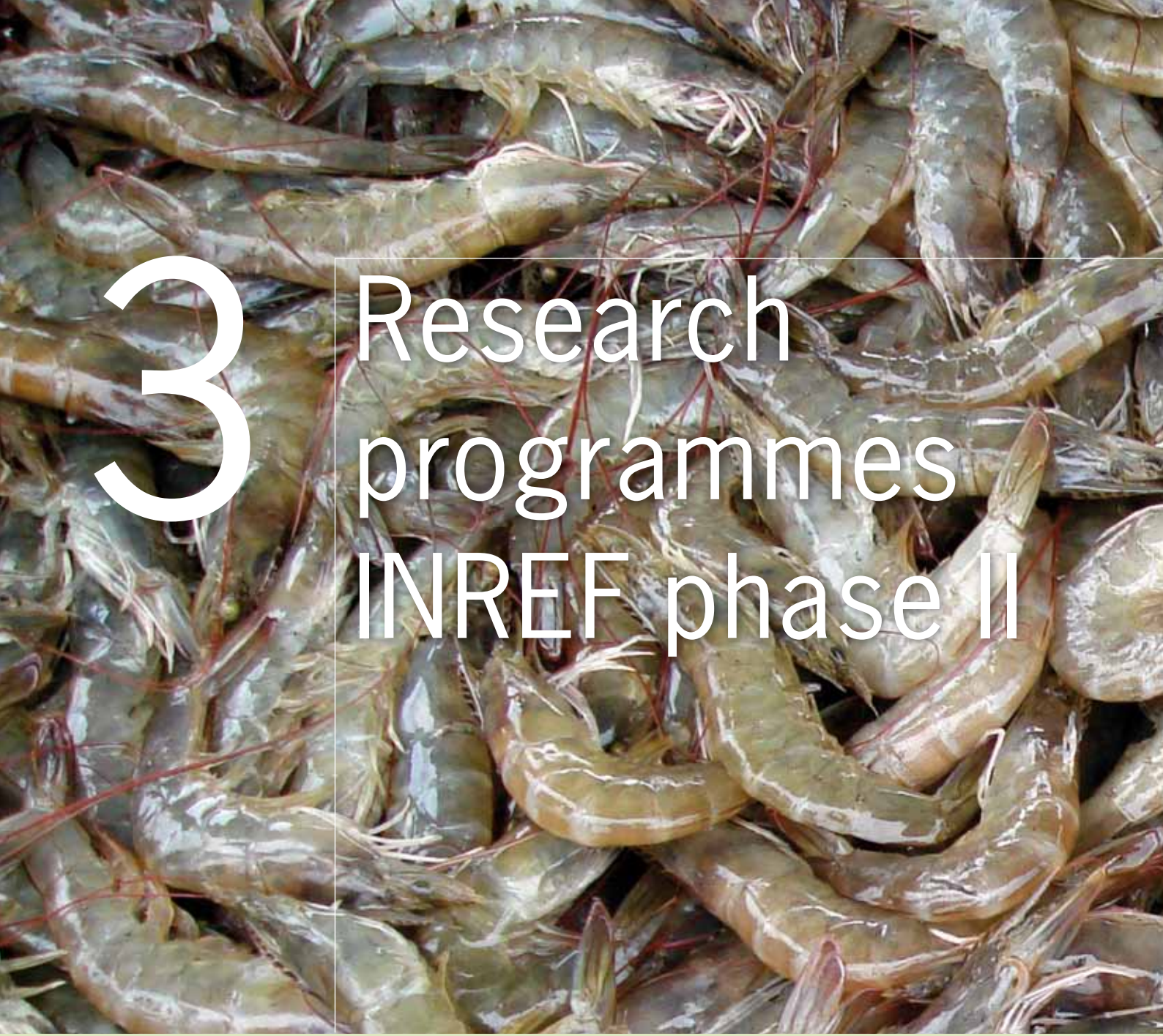
What about institutional differences and cooperation? According to Bonnema, the supervision at CAAS left a lot to be desired. Once they had returned from their training in Wageningen, the PhD students were more or less left to rely on themselves. They had little opportunity to table their concerns and complaints given the hierarchical environment of their university and the fact that the projects had been defined in Wageningen. In the end, only eight students were awarded their doctoral degrees in Wageningen; the other five received their titles at CAAS. "That's a pity", says

Jianjun Zhao

Post-doc researcher in Plant Sciences at Wageningen and professor at Hebei Agricultural University in China:
"The CAAS programme has been very important for me. When I started the research on the genetics of the (anti)-nutritional food components phytate and phosphate, I already had a position at Hebei Agricultural University in China. After receiving my PhD degree from both Wageningen and my home institution, I was promoted to professor. The research networks that were established thanks to the CAAS programme help to expand international collaboration. Even colleagues in China who were not part of the programme, now have better opportunities to exchange their research plans and findings with scientists abroad. The sandwich programme helped us gain new knowledge and research skills, and added to our creativity in designing and conducting the research. But the cultural differences between The Netherlands and China at times caused difficulties in communication between us students and our supervisors. I believe that investing in communication is essential in this kind of cross-cultural programme."

Bonnema, who would propose a different approach next time. "This time, the content of the projects was already decided on. The Chinese supervisors will probably feel much more ownership if next time they write the research proposals together with their Wageningen counterparts."

Nevertheless, contacts are well established and collaboration continues. "The Institute for Vegetables and Flowers has changed beyond recognition," says Bonnema. The lab has been transformed into a true research lab which enjoys an international reputation. The CAAS students have certainly contributed to this. The IVF now works on elaborate and very advanced research projects, including the sequencing of genomes of crops such as potato, cabbage and cucumber. Bonnema points at a clear difference in approach in both countries. In China, researchers more easily get funding for proposals that are large-scale, very advanced and based on the latest technologies. In the Netherlands, instead, a large-scale research programme such as the one that IVF now conducts in the field of genomics would only get funding if it were crystal clear what purpose its results could serve. Bonnema: "The Chinese tendency to go for the most cutting-edge, unfortunately also means that research is often not conducted properly. Because people no longer invest time to master the basics of genetics. People who really know the craft of plant breeding are becoming scarce – and that is an alarming development, not only in China but also in Africa." The scientists working at IVF, however, are plant breeders by training and their research is likely to yield interesting results.



3 Research programmes INREF phase II

3.1 Rebuilding Resilience of Coastal Populations and Aquatic Resources (RESCOPAR)

Sustainable shrimps for global markets

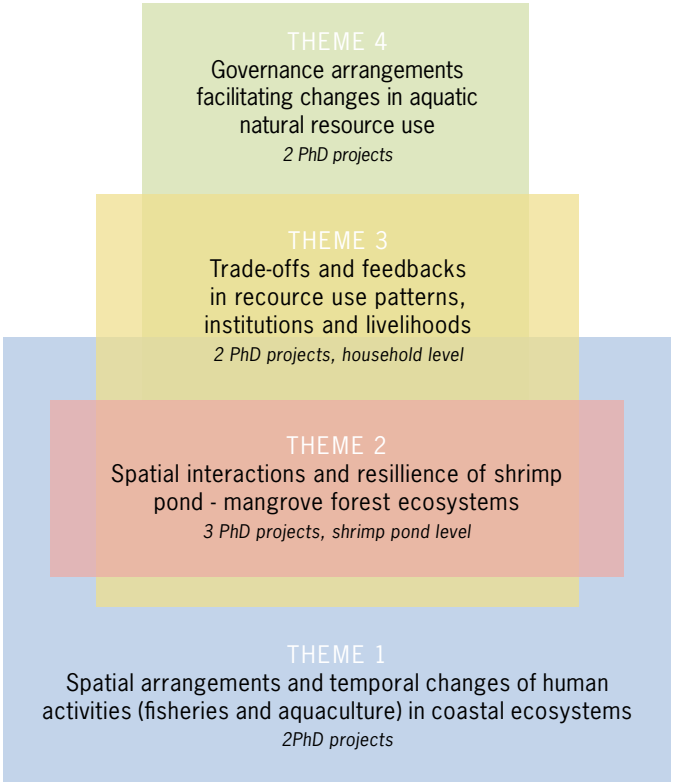
From rags to riches – that has been the lucky fate of quite a few enterprising people in the shrimp culture industry in Indonesia. From poor parts of the country, such as Sulawesi, they migrated to East Kalimantan, attracted by the money to be earned in the palm oil industry in the vast forest of Borneo and as a result of the shrimp boom. 'Some came to cut trees to construct ponds in the mangroves and within a few years they were selling shrimps on the market in Brussels,' says Paul van Zwieten, assistant professor of Aquaculture and Fisheries. Indonesia was heavily affected by the Asian financial crisis of the late 1990s, but since shrimps are paid for in dollars, its trade remained lucrative. Not for everybody though. Thousands of workers in shrimp culture have a hard time earning a decent living. At the same time, the area where they work and live is undergoing rapid change. Shrimp culture contributes significantly to the loss of mangroves. In East Kalimantan, as much as 70% was cleared over the past 30 years; today the mangroves continue to disappear at a rate of 1 to 2% per year. It is clear that ecosystem changes resulting from shrimp production are a key driver of biodiversity loss, decreasing pond productivity and, subsequently, the increased vulnerability of coastal people's livelihoods.

Studying these developments, and investigating solutions, is the goal of the INREF programme 'Rebuilding Resilience of Coastal Populations and Aquatic Resources' (RESCOPAR), which started in 2006. A multidisciplinary group of PhD students compares developments in East Kalimantan in Indonesia and in Ca Mau province in Vietnam. Their challenge is to identify socially and ecologically sustainable economic activities in the coastal zones, balancing the interests of poverty reduction (social resilience)

on the one hand with the sustainable use of natural resources for coastal fishery and mariculture (ecological resilience) on the other hand. This is by all means a tricky balance, and one which reflects changing relationships between the global trade in shrimp and local livelihoods.

At the local level, it is not only the shrimp farmers themselves who are concerned. Mangrove areas are nurseries for a wide variety of fish. Indonesian fishermen, who depend on catches in near-shore seas, complain that the advancing shrimp culture – which leads to loss of habitat complexity and biodiversity of the mangroves – threatens their trade and livelihoods. Two students therefore focus their research on the linkages between the mangrove ecosystems and estuarine fisheries. Three others zoom in on the technical management of the ponds and how this can be improved to reduce shrimp disease and enhance the sector's sustainability. The productivity of shrimp ponds typically declines over time as a result of acidification, pollution and infectious diseases. This forces farmers to abandon their ponds within 5 to 15 years and to open new culture areas (or, if that is not possible, learn to live with highly uncertain shrimp production). The result is the ongoing loss of mangroves and a deterioration of the productivity of a shrimp farming area. Much is therefore to be gained if the ponds could retain their productivity longer. The students investigate, by means of epidemiological studies, the transmission modes of the diseases, in particular the White Spot Syndrome Virus. They look at how better spatial planning of the ponds in relation to mangroves could have a positive influence on disease occurrence as well as on coastal fish production.

Yet acquiring the technical knowledge to improve pond management alone will not suffice. Ultimately, it is the decision making processes – from local to global – which affect the use and management of the ponds and the conservation of the mangrove ecosystems. Governance issues are therefore an important area



of research. As the demand for shrimp in international markets is unlikely to abate soon, decision makers at all levels of government, industry and society are faced with the challenge of steering a highly lucrative industry away from its now well established problems of social welfare and environmental destruction. The RESCOPAR programme seeks to involve local governments with its research. In Indonesia this has been welcomed by the provincial authorities, who realise that the productivity of the coastal areas is falling. They have a clear interest in the sustainable exploitation and protection of the mangroves. But governance issues extend beyond the authorities in Indonesia and Vietnam. Uncertainties

associated with changing international market conditions, such as food safety and quality standards, also play an important part. The eco-labels and production standards introduced as a result of – mainly – lobby by environmentalists, development NGOs and concerned consumers in the West, have a strong impact on how production can, or should be, organised locally.

Essentially, Van Zwieten explains, there are two opposing scenarios emerging over how best to manage shrimp production in order to ensure both social and ecological resilience. The first is extensification, or finding the right balance between the size of a mangrove area and the number of ponds. In this scenario, shrimp aquaculture is integrated into inter-tidal landscapes so that the ecological functions of coastal mangroves are maintained. Diseases are controlled and production is kept in the hands of poorer small-scale producers who make up the majority of production. The second scenario proposes the opposite: intensification. The aquaculture system will be closed from the surrounding environment, thereby eliminating the flow of effluent and spread of disease. Production will be located behind the inter-tidal zone, thus avoiding alteration of mangrove habitats. However, given the high capital investment needed for this second option, small-scale producers will be unable to participate.

Most environmental organisations put their cards exclusively on the first, ecological, option. But different circumstances and contexts ask for different approaches. Van Zwieten: 'Aerial photographs visualize this perfectly. Vietnam's shrimp culture is highly regulated and strictly planned geographically, with a structured layout of rectangular ponds. This is very different from Indonesia's unplanned pond expansion.' The two situations probably demand different solutions when it comes to sustainability. The RESCOPAR research aims to contribute to both.

3.2 Competing Claims on Natural Resources in Southern Africa

Scientific contributions to stakeholders' negotiations

It seemed a great idea: create an enormous nature reserve that connects the famous Kruger Park in South Africa with the Limpopo National Park in Mozambique and the Gonarezhou National Park in Zimbabwe. Open the gates and let the 'big five' and other animals roam freely in an area more than twice the size of the Netherlands. This Peace Park, a dream shared by people like Nelson Mandela and the Dutch Prince Bernhard, became reality in 1997. The website reads: "Peace Parks are about co-existence between humans and nature, about promoting regional peace and stability, conserving biodiversity and stimulating job creation by developing nature conservation as a land-use option."

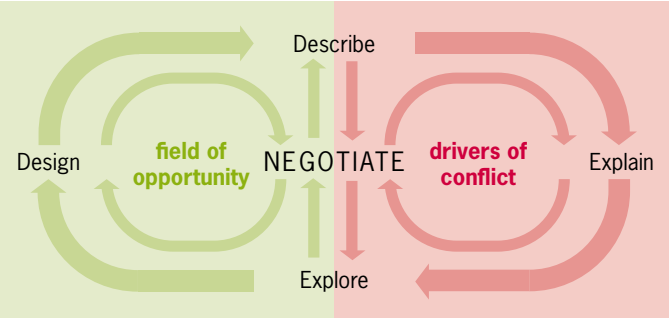
In reality, however, the competing claims of wild animals and local farmers on the land and its natural resources are not so easily reconciled. As the gates of the nature reserves are opened, lions are a threat to farmers and their families and elephants trample the crops. Especially in the fertile areas alongside the rivers, the interests of local people, animals and conservationists collide. According to the zoning strategy designed by the Peace Park management, entire villages – home to as many as 7,000 people – will have to be relocated to other areas within or outside the park.

The INREF programme 'Competing Claims on Natural Resources' addresses the issue of multiple land use in the Great Limpopo Trans Frontier Conservation Area (GLTFCA) and the Mid-Zambezi Valley in northern Zimbabwe. The research programme focuses on three aspects: identifying alternative resource use options; understanding the competing claims and the negotiation strategies used by stakeholders; and providing scientific support for these negotiation processes.

The added value of this research programme is that it approaches these issues from several angles. Ken Giller, professor of plant production systems at Wageningen University: “A scientist can determine the fertility of farm land and compare this to the soil quality of alternative stretches of land assigned to the farmers, but he may overlook the fact that the value of their land is also based on the fact that their ancestors are buried there. In other words, because the problems are not monodisciplinary, the solutions cannot be either.” One PhD student of the Competing Claims programme is living in one of the communities in the Limpopo National Park to assess the value of their agricultural and grazing lands. “Her mere presence has strengthened the bargaining position of this local community”, Giller comments, showing that in his view science isn’t – and shouldn’t be – value free.

Giller believes that science has an important role to play in contributing to negotiations and re-negotiations on the competing claims between stakeholders operating at different levels – local, national, regional and global. The aim of the programme is not to deliver technical ‘silver bullet’ solutions, but rather to evaluate what unforeseen consequences these solutions may have in the real world. An example is the method of ‘conservation agriculture’ introduced for farmers in the national park area. With this type of agriculture farmers need less land to yield the same amount of crops, thus strengthening their economic position. This sounds excellent, but will their success not attract farmers from other areas, resulting in increased pressure on the available resources? Giller: “Conservation farming works well on the individual farmer’s level, but our task is to assess possible effects on other levels; in this case the pull factor of increased wealth on region.” Win-win solutions are extremely rare, Giller concludes, “It’s always a matter of ‘negotiated understanding’.”

Competing claims on natural resources are becoming increasingly acute everywhere. As the world is getting smaller a growing



Chrispen Murungweni

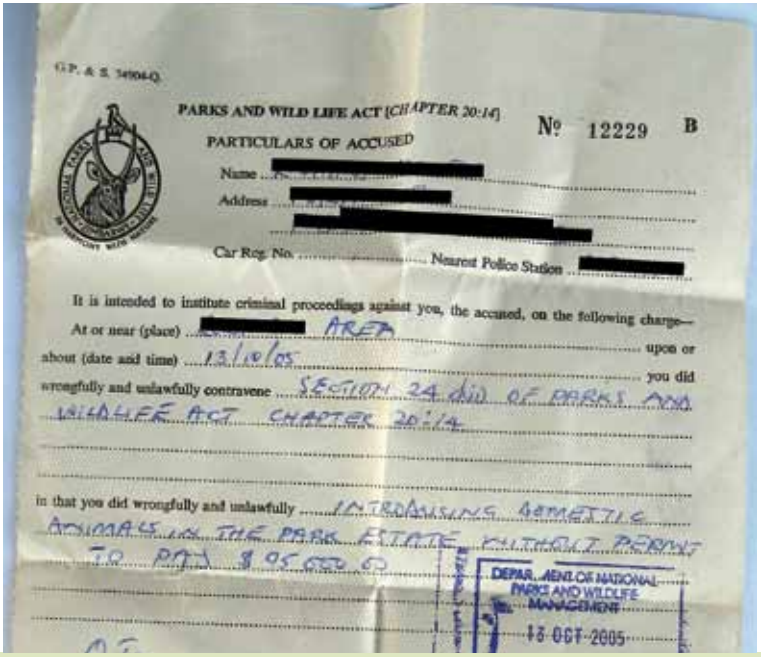
Animal scientist at the Grasslands Research Station in Zimbabwe:

“The added value of the INREF approach is that it includes local peoples’ participation in scientific assessments. This enhances the chances for identifying workable and acceptable management and policy interventions. The INREF programme offered me a unique opportunity to adapt science to practice and to put my scientific research tools to a real test. The training I received in Wageningen was great. I loved the freedom we had to select courses relevant to our research interests and the free access to a wide range of research material. The interdisciplinary supervision created many opportunities to learn (if only all supervisors would have had the time to closely read and understand our work before meetings!). Unfortunately, due to the tight schedule and sometimes due to cultural differences, learning from my fellow students from other countries was limited. But the multi-cultural set up certainly widened my perspective on science and taught me that different contexts demand different solutions.”

number of people lay claims on its resources. Examples are found everywhere, not only in Africa or in other underdeveloped regions, but also in the West. The Dutch programme 'Ruimte voor Rivieren' ('Room for Rivers') is a clear example of the way in which governments and other stakeholders try to reconcile the claims of farmers, conservationists and ordinary citizens on the riverbanks, while at the same time protecting the lowlands from flooding. The interdisciplinary approach of the Competing Claims programme has attracted the attention of Dutch policy makers, who think it may provide useful insights for the challenges regarding multiple land use that they are faced with.

Another recent example is the growing interest in biofuels, which has significantly increased the pressure on arable land in developing countries. This has complex consequences for the environment, the livelihoods of farmers, the local economy and biodiversity. Answers and solutions to these competing claims will also require an interdisciplinary approach.

For the PhD students involved in the 'Competing Claims' programme the interdisciplinary character of the work is challenging. Giller: "When they start with us, many of them are stuck within the boundaries and biases of their own disciplines. We try to lure them away from that and introduce a synthesis between social and natural sciences and, in some cases, between several natural sciences." At first it was hard to get the interdisciplinary papers published in peer reviewed magazines, but this is now changing rapidly. Editorial boards increasingly recognise the value of an interdisciplinary approach and adjust their policies accordingly. Giller: "INREF is all about breaking the barriers, that's what makes it so exciting!"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PARKS AND WILD LIFE ACT [CHAPTER 20:14] Nº 12229 B

PARTICULARS OF ACCUSED

Name [redacted]

Address [redacted]

Car Reg. No. ..... Nearest Police Station [redacted]

It is intended to institute criminal proceedings against you, the accused, on the following charge—

At or near (place) [redacted] AREA

about (date and time) 13/10/05 upon or

wrongfully and unlawfully contravene SECTION 24 (iii) OF PARKS AND WILDLIFE ACT CHAPTER 20:14 you did

in that you did wrongfully and unlawfully INTRODUCING DOMESTIC ANIMALS IN THE PARK ESTATE WITHOUT PERMIT TO PAY $ 05 000 0

DEPARTMENT OF NATIONAL PARKS AND WILDLIFE MANAGEMENT 13 OCT 2005

3.3 Tailoring Food Sciences to Endogenous Patterns of Local Food Supply for Future Nutrition (TELFUN)

Food sovereignty: from traditional crop to mungbean burger

Tailoring Food Sciences to Endogenous Patterns of Local Food Supply for Future Nutrition – it is an elaborate name for a similarly ambitious programme. The TELFUN programme, which involves twelve PhD students, started in 2007. It was triggered, firstly, by the observation that young people in Benin increasingly reject their traditional diet. And secondly, by the concerns of professor Guido Ruivenkamp about the impact of globalisation on people's connection with their local environment. Global value chains increasingly disconnect production from consumption. As a result, agricultural knowledge about local foodstuffs is being lost. This is an undesirable development.

"Not that we suggest everything should stay as it is, or oppose progress," says professor in Food Science Tiny van Boekel. "In fact, we encourage the idea that traditional, local crops are used for new purposes." But the TELFUN team believes it is vital that people secure their position as food producers and do not become dependent on 'foreign' food. This is called 'food sovereignty', the rationale behind the TELFUN programme, which hopes to contribute to strengthening the re-connection between agricultural practices and natural ecosystems.

The PhD students, whose backgrounds include plant breeding, food technology, human nutrition and sociology, carry out their projects in three multidisciplinary cohorts. "Integration of the different disciplines is our foremost goal and concern," says van Boekel, who is the scientific coordinator of the programme. "That is not common in agricultural research, but we strongly believe in the merits of interdisciplinarity." It is not always plain sailing though. The plant breeders must learn to not only have the higher

productivity of a crop in mind. With the human nutritionists, they must discuss the nutritional aspects of the cultivars. And together with the sociologists, they are taught to reflect on how a higher yield will benefit the people. The sociologists moreover look into the possibilities for new local markets for farmers, or local processing opportunities for agroproducts. That is another aspect of the emphasis on food sovereignty: to strengthen local social structures.

The TELFUN research takes place on three continents, in Ecuador, Ghana, Benin and India. The focus is on three crops – lupine, cowpea and mungbean – which are all genetically indigenous to these areas. In Ecuador, one student is looking into ways of shortening the long preparation time of lupine-derived products, which is due to the high alkaloid content of lupine. The current practice is to soak the beans in water for days on end to get rid of the toxic glycoalkaloids. But the high use of water makes this an unsustainable method, which moreover has the risk of infection by micro-organisms present in contaminated water that is used in the process. The food technologist experiments with higher water temperatures and better contact between water and beans to speed up the process and make it more sustainable. Others investigate how the content of iron and zinc in lupine can be increased. Deficiencies of these essential micronutrients cause many people, and especially children, to suffer from anaemia. “This problem is certainly not limited to Africa,” says van Boekel, “I was quite disturbed to discover how many school children in Ecuador are malnourished.”

But improving the processing or enhancing the micronutrient content of the beans alone will not do the job. The crucial issue is that people must want to eat these crops. Again, the food

Maria Elisa Herrera

Nutritionist from Ecuador:

"It is certainly a big challenge to work in an interdisciplinary group, but at the same time it is very rewarding to unite our knowledge for one and the same objective: to improve the nutritional status of our population. I think it is important that the researchers from the four disciplines involved in the TELFUN programme first of all are given their own space to get a clear picture of what questions and methodologies are important for their research projects. From there, the key shared interests will come to the surface and the different disciplines will enrich and complement each other's insights and approaches. We have learned that it is important to talk with our colleagues openly and to share our problems. Sometimes the research problems encountered in the different countries are surprisingly similar. Discovering this and discussing possible solutions makes me smile and boosts my energy to continue with this huge labour."

technologist comes into the picture. The functional properties of the lupine bean can be tinkered with during processing. For instance, certain fermentation processes can reduce the effect of flatulence, or improve the taste to better meet the sensory preferences of local consumers. Or, to connect with current changes in dietary patterns, the food technologist can design a new product, such as a mungbean burger.

Tiny van Boekel is enthusiastic – about the programme and about the students. "One of the most important spin-offs is that we are educating people to think outside of the box. We're quite literally sowing the seeds for that." Both the interdisciplinary way of working and the action-oriented science – with its political goal of food sovereignty – are unusual in the countries where these young scientists get their education. But they are highly motivated. This is what inspires van Boekel most: the idea that TELFUN is educating scholars-to-be who think critically, who know what's what, and who will start setting the tone at their home institutes in terms of research agenda's. Van Boekel: "And despite the fact that our Product Design and Quality Management group here at Wageningen has been working along these lines for quite a while, we too learn an enormous deal from this international adventure."

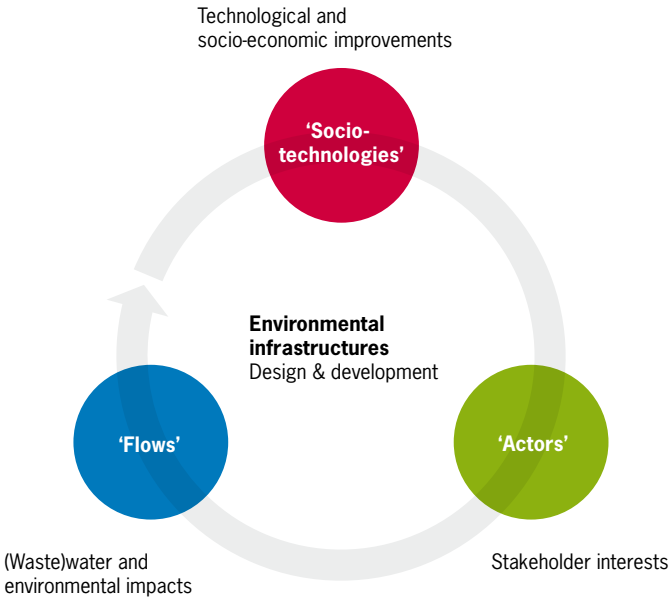
The only unfortunate fact is that interdisciplinary research is sometimes difficult to get published. Journals judge article submissions on their disciplinary merits, and often give the feedback that interdisciplinary work is not sufficiently in-depth. Van Boekel: "Recently a very interesting article on lupine was rejected on the grounds of it being a 'local' problem, which would better fit a local journal. It's a pity that this is still the mainstream approach to academic work. A challenge for us to seize!"

3.4 Partnership for Research on Viable Environmental Infrastructure Development in East Africa (PROVIDE)

From 'one size fits all' to 'Modernized Mixtures Approach'

Africa is experiencing the most rapid rate of urbanisation in the world today. This confronts urban areas with huge challenges regarding water supply, sanitation and solid waste management. The PROVIDE programme, started in 2007, faces up to these challenges in the Lake Victoria Basin. The trick is to develop decentralised systems using the best of both worlds, Gert Spaargaren, professor of environmental policy, explains.

Gert Spaargaren: "Thanks to INREF seed money we were able to make a detailed plan on the direction the PROVIDE programme should take. Key words were: Africa – technology – environment – policy. It had to be Africa, because the challenges on that continent are particularly formidable. We focused our research on the Lake



Victoria Basin, including the capitals of three countries bordering the lake: Kampala in Uganda, Dar-es-Salaam in Tanzania and Nairobi, the capital of Kenya.

We started planning with only one premise: that centralized, high tech sanitation systems do not work in Africa. This is certainly not a popular position with African counterparts. Most African policy makers and practitioners in the field of sanitation and solid waste management frown at such a claim. They fear that the only alternatives to centralized systems are small-scale and 'eco-friendly' solutions, such as the Ecosan toilet. They say: 'Why should we use these small-scale solutions, while you in the West have state of the art technology? If small is beautiful, why don't you go small yourselves?' And they are absolutely right in saying so. Therefore, our goal is to come up with decentralised sanitation systems that aren't backward. If we can contribute to the introduction of such systems, we effectively contribute to reaching Millennium Development Goal 7: to halve, by 2015, the proportion of the population without access to safe drinking water and basic sanitation.

The last thing African cities and rural areas need is a one-size-fits-all approach. Instead, what is needed is a mix of scales, strategies,

technologies, payment systems and decision-making structures that match the physical and human environment for which they are designed. We dubbed this eclectic way of tackling the challenges of sanitation in Africa the 'Modernised Mixtures Approach'.

After an initial visit to Africa, we had to re-evaluate some of our assumptions. Dr. Mgana from Ardhi University in Dar-es-Salaam, who is a leading sanitation expert in Africa, shared the results of some experimental projects, which convinced us to reshape our plans. Sometimes his comments involved obvious local circumstances; for example the low quality of electricity systems, which is a disaster when sanitation systems are based on pumps and other machinery that rely on electric current.

During the initial visit to Africa, we identified possible candidates for the various PhD research projects. This was no easy task, because sanitation is not a very popular subject among African academics. People don't study political science – to name just an example – to take on a research project that involves human excrement. So we worked against some odds there. Yet we were successful in making firm deals with our partner institutes about allowing the PhD students to spend enough time on their research. We wanted social sciences to be part of the PROVIDE programme.

Sammy Letema

Researcher at Wageningen University, Sub-Department of Environmental Technology:

"Sanitation services in East African cities are in a dismal state. We need engineers who get familiar with environmental policy, and environmental planners who take an interest in environmental technology.

To me the multi-disciplinary approach was, at first, confusing. What was I – an urban planner – supposed to do with technological challenges? Luckily, the training we received in Wageningen prepared us for the new challenges, in terms of both theory and methodology. In the end, I managed to develop a middle ground where a mixture of technology, planning and policy converged as one 'grey' area for research. PhD research is like a disease: the moment you start, you become a captive to it and there will be no more rest. Interdisciplinary research can be confusing in the beginning, and keeps one going back and forth from illusion to disillusion – but all these are necessary ingredients for the emergence of new solutions to multifaceted problems."

Sanitation and solid waste management are clearly interdisciplinary topics. However, many of the interventions in these fields are both top down and technology biased. There has never been much focus on the management and policy side of things. If we want to come up with workable solutions, social scientists must start to involve themselves with this field. For instance, before one can do anything useful in slum areas about sewage or waste disposal problems, one has to know who owns the land, and what local, both formal and informal, power relations look like.

At the same time, we learned that there is a limit to the amount of interdisciplinary research that individual researchers can get to grips with. At the end of the day, PhD students should best focus on their own discipline if they want to guarantee the academic quality of their work. Nevertheless, the interdisciplinary character of our programme was assured through the joint conceptual framework and the ongoing interaction between the students. It is interesting to see, for example, a sanitation technologist and a specialist on waste policies exchange their expertise and comment on each other's findings.

Early on in the programme we gathered all the students, from Uganda, Tanzania and Kenya, in Wageningen 'to synchronise their watches', and to fine tune the Modernised Mixtures Approach. They also had the opportunity to work on, and present their individual research proposals. Once their research projects were underway, we organized meetings in the three countries, in Kisumu (Kenya), Arusha (Tanzania) and Kampala (Uganda). These meetings helped to make the students understand the different challenges in other countries. For example: Uganda has decentralised much of its public sector; this has huge implications for sanitation and solid waste management. These meetings strengthened the contacts among the PhD students, which is essential for the institutionalization of the Modernised Mixtures Approach, and for the interdisciplinary way of thinking that we try to inspire these young academics with."

3.5 Co-Innovation for Quality in African Food Chains (CoQA)

High quality is not the best solution for everyone

"Just as important as improving the quality of agricultural products is the realisation that differences in quality will always exist. The trick is to find different markets for products of different quality." Jos Bijman, assistant professor of management and organization, and coordinator of the 'Co-Innovation for Quality in African Food Chains' (CoQA) programme, tells it with a twinkle in his eyes. The CoQA programme, which was initiated after the 2007 call for proposals, will study quality management and quality improvement in supply chains for pineapple, citrus and potato. The objective of the programme is to design innovations for small farmers to tailor their products to the demands of the available markets. Bijman: "Of course most producers are tempted to try and export their products to rich markets in Europe or the US, but this is not the best solution for everyone. We can't all strive for the highest quality. It is just as important to cater to local or regional markets, where quality demands, perhaps, are different." The CoQA programme is supposed to result in eight PhD theses. Research will be conducted in Benin, Ethiopia and South Africa.

An important goal of the CoQA programme is to train and educate local scientists. Better scientists will result in better institutions, Bijman believes. Institution building is actually one of the important overall goals of the INREF programme. "What is called 'institutional development' evolves entirely around people: people getting better educated and people learning to work together." Already in this early stage of the programme Bijman witnesses networks developing between the students and their supervisors, especially after the two workshops held in Wageningen. "The creation of networks is mainly an informal process. We encourage students to work together, to write papers jointly, to conduct interviews together. The success of these stimuli depends mainly on cultural traditions. In Benin it is easy to get people working together. In

Interdisciplinarity in the CoQA programme

Level of analysis	*Main disciplinary perspective*
Crop	Agronomy
Household	Development Economics, Business Economics
Product	Food Technology, Post-harvest Physiology
Firm	Management, Business Economics
Chain / Network	Management, Organisation, Logistics
Market	Marketing and Consumer Behaviour
Institutions	Development Studies

Ethiopia this is much harder." Bijman predicts that these networks will, after four or five years, form the basis of institutional development.

Besides better scientists and better institutions, the CoQA programme hopes to result in valuable answers to hard questions that the agricultural sector in Africa is currently faced with. Bijman: "We are a development programme, so we don't do research only out of curiosity." One of the PhD researchers, for example, will focus on the citrus-industry in South-Africa. Interestingly, the existing agricultural policies differ quite a bit between the South African provinces. Different regulations regarding land distribution and ownership, different levels of support to farmers, different focus on the importance of export, different approaches to farmer's education. These diverse contexts provide an ideal opportunity for making comparisons. It may be possible to answer the question of which policies are most favourable to improving the

quality of the products and the economic position of the farmers on household level. The research will also investigate the effect of the support that local NGOs give to small farmers. This makes the project interesting for development organisations. No wonder that Dutch NGOs Hivos and Oxfam Novib support the programme.
The inter-disciplinarity of the programme is essential, Bijman stresses. Merely improving the quality of the agricultural products, without considering other elements in the supply chain, is useless. "When working on quality improvement, you must look at elements such as conservation techniques, transport, food technologies, but also management at the farmer's level and last but not least, the institutional setting and existing regulations and policies on, for example, export. For instance, there is little value in designing a product for export purposes if the existing rules and regulations make export all but impossible." The disciplines of the PhD students include agricultural economics, horticulture, food technology, agronomy and business administration. Bringing the disciplines together is the biggest challenge of all, Bijman admits. "We try to lure every PhD candidate to look beyond his or her own discipline. Each student has supervisors form different disciplines, so the input is there, but in practice it is difficult. There is always one supervisor whose pull is stronger than that of the others.
It is my task as programme coordinator to safeguard the inter-disciplinary character of the research projects. But my hold on students or supervisors is limited." Interdisciplinarity is important because it helps students see the limitations of their own discipline as well as the potential for answers in others.

There is another reason why interdisciplinary science is difficult for the INREF students: their workload is much heavier than that of the average doctoral student. Bijman: "On top of having to conduct research and write a thesis, the INREF students have teaching jobs in their home institutes. Moreover, when they come here, they leave their home and families behind for several months. During

this time, they have to learn about other disciplines and integrate that knowledge into their PhD proposals. No wonder it was hard to find suitable candidates for the programme." Language can sometimes be an obstacle when recruiting good PhD students. In Benin, some excellent candidates unfortunately were not proficient enough in English. In Ethiopia, we were lucky that the Chancellor of Hawassa University, who is himself a graduate of Wageningen University, promoted the INREF programme and helped to find the best candidates. Lastly, there is the problem of resources. Bijman: "INREF is a 'poor' programme. The scholarships we offer are rather low compared to the offers other universities make. Good African PhD students are in high demand. We only pay for the time the students spend in The Netherlands. Once they are back conducting their research at home, they are on their own, financially speaking. We presume that 'their' institute pays their salaries while they do research for us. This is not very realistic. The institute will expect them to pull their weight."

Bukelwa Grwambi

Agricultural economist at the Department of Agriculture, Western Cape Province, and PhD student at Wageningen University and Fort Hare University, South Africa:
"In my view, the added value of the INREF programme CoQA is that, because of its interdisciplinary approach, it looks at a problem holistically, unlike conventional research which ignores other disciplines and the solutions they may offer. The INREF approach influenced my research profoundly. It broadened my scope of thinking and of addressing development problems. The training received at Wageningen opened up my mind and it especially strengthened my quantitative skills, which was lacking from my previous education. It has been a great pleasure to interact with colleagues from other countries and to learn about their cultures and religions, and their approach to science."

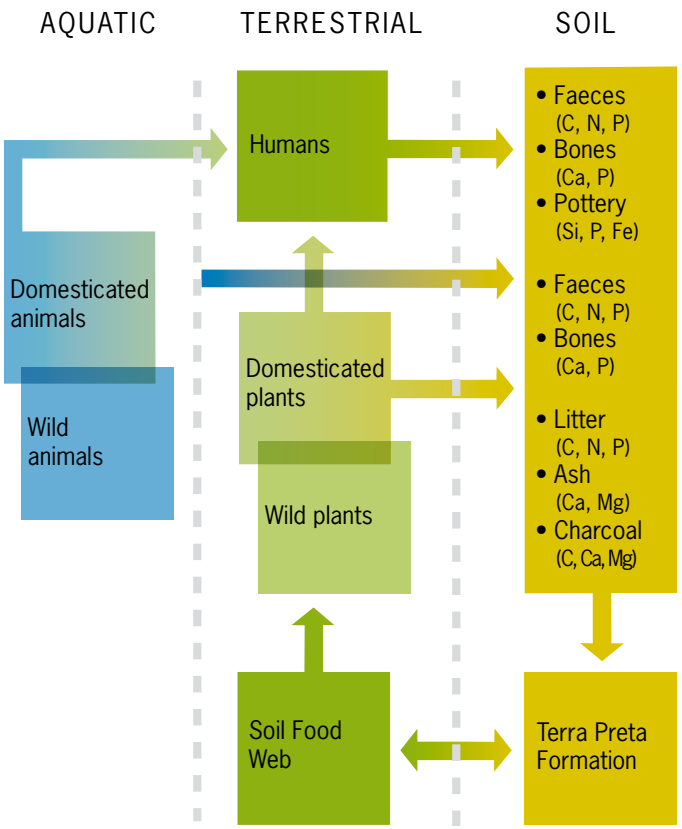
3.6 Terra Preta do Indio: Recovering the Past, Regaining the Future of Amazonian Dark Earths

There goes the notion of a pristine, untouched forest

In 1966, the Wageningen-based soil scientist Wim Sombroek wrote the very first scientific publication about Terra Preta, the fertile Amazonian Dark Earth, first mentioned by the explorer Charles Orton in 1870. With the Terra Preta research programme, scientists in Wageningen start looking into this special inheritance of their predecessor. They will do so together with colleagues from Brazil, Colombia and Bolivia. “This is a very exciting programme,” says scientific coordinator professor Thom Kuyper, “our programme can throw a new light on Europe’s colonial history and at the same time our research engages with current controversial debates on solutions for sustainable land use in the tropics and climate change.”

Terra Preta, or black earth soils, are mainly found on bluffs near the Amazon and its tributaries, while smaller patches have also been localised in wider areas of the Amazon forest. These soils are characterized by their abundant presence of charcoal, high amounts of phosphorous and calcium, and consequent high fertility. The fact that fish bones and pottery remains are found in these soils shows that they are so-called anthropogenic soils – created, or transformed, through human labour. Archaeologists and soil scientists determined that these soils are remnants of ancient, pre-Columbian societies, created between 3000 and 500 years ago. This throws up all kinds of questions about human history in the Amazon. The prevalent idea still has it that – apart from some small, primitive Amerindian groups – the large forests were not affected by humans. Kuyper: "The Amazon supposedly was without history until 1492! Now we may have to add another few thousand years of history to that – history of people and civilizations that have vanished, or were extinguished." There goes the notion of a pristine, untouched forest.

Considering their geographic extent and properties, the Terra Preta soils cannot possibly have been created by a few small and dispersed groups of Indians. Apart from this pedological proof, there are reports by early travellers about the existence of big cities, but these were generally discarded as being delusions of Europeans suffering from tropical frenzy. Nevertheless, some estimates today say that up to 50 million people may have inhabited the Amazon at some point in time. One remarkable fact is that the Amazon forests are home to a high proportion of useful tree species, for instance with edible fruits. Some forest ecologists consider this too as evidence for centuries of interaction between humans, soils and vegetation. Kuyper: "This concrete example of the Terra Preta soils allows us to reconceptualize the relationship between 'man' and 'nature'. The notion of soil as 'social artefact', and in particular of the Amazonian landscape as a nature-culture hybrid, may help to devise adequate policies towards its conservation, use and development."



The Terra Preta programme has two practical goals. First, improving the livelihoods of small holders in the Amazon. If the programme successfully seizes the scientific challenge of finding out how exactly these fertile soils can be re-created, this could benefit the farmers, and as a consequence the forest. The lowland Amazonian area is threatened by high rates of environmental degradation, which is mostly caused by deforestation for agricultural expansion. The poverty-driven slash and burn

agriculture of small farmers – which continues at a high rate due to the low fertility and therefore productivity of most Amazonian soils – threatens the forest's ecosystems. And so do large-scale agricultural practices such as soy and rice agro-industries and cattle. The potential impact of creating Terra Preta Nova is thus considerable. The productivity of Terra Preta can be up to three times higher than the surrounding soils, allowing up to six maize harvests annually. Perhaps even more importantly, these soils can be cultivated continuously – often without external inputs – for at least 100 years, which theoretically could put a stop to poverty-driven deforestation.

The second goal of the programme is to contribute to critical research on a currently highly relevant subject: the possibility of sequestering carbon in the soil to mitigate increasing atmospheric CO_2 levels. "Optimists speak of a triple win in these forests", says Kuyper. That is, generate energy from pyrolysis ('burning' biomass under oxygen-poor conditions); sequester carbon to mitigate climate change; and improve the productivity of soils all at the same time. "But I'm rather suspicious of any supposed triple win. We must look very carefully into the inevitable trade-offs." The fact that the indigenous inhabitants, over the course of probably many centuries, have added carbon to these soils by partial burning of the forest and agricultural residues, and that these soils partly as a result of this practice have become so fertile, does not guarantee that we can, today, successfully imitate this process on a gigantic scale and within just a couple of years. In search for solutions to our waste problems, it may seem an appealing idea to dump our carbon in South American soils – and we may even be willing to pay carbon credits for this. Kuyper: "But my gut feeling tells me this activity cannot be scale-neutral. We must experimentally establish what could be the consequences of such large-scale dumping for the forest soils." Their large-scale use as carbon sinks may well prove contradictory to enhancing the productivity of these soils. "The claims of proponents of biochar have, I think,

Regular tropical soil

Man-made Terra Preta

a pretty thin empirical foundation and are based on selective interpretation." Moreover, ethical questions that also accompany the debates on biofuels and their potential threat to poor people's food security, must be raised as well: are we really going to use large stretches of potential agricultural land for sequestering carbon if this does not lead to enhanced soil fertility?

One of the most interesting aspects of this programme, according to Kuyper, is that the subject at hand forces us to consider the role that science plays, or should play, in socio-political processes and decisions. The interdisciplinary programme – which apart from soil scientists, foresters and agronomists, also involves economists, historical anthropologists, archaeologists from Brazil and paleobotanical specialists from Colombia – may come up with new findings concerning the early presence of civilisations in the Amazon. If it does, it will have repercussions on the arguments of environmentalists on the one hand – 'the Amazon was devoid of human influence and should stay that way' – and the logging industry on the other hand, which will for their own profit seize upon the notion that for thousands of years people have been cutting down trees in these forests.

Kuyper: "Due to all sorts of administrative hiccups the start of this programme was delayed, but we are now ready to select the nine PhD students from our partner universities in Brazil, Bolivia and Colombia. I know for a fact that Wageningen is going to benefit from this scientific cooperation."

4 The opportunities and challenges of interdisciplinary research

Within the development oriented research programmes, INREF brings together scientists from within and outside Wageningen UR with different disciplinary, geographical and cultural backgrounds. Its research programmes open new avenues of thinking needed for an increasingly complex world. Interdisciplinarity is INREF's catch word. Achieving this with PhD students, who are 'monomaniacs par excellence', has proved no easy task. Similarly challenging has been another feature that distinguishes INREF from other research funds: its focus on societal relevance and producing results that make a difference for the end-users. INREF started as an experiment. In fact, with this innovative fund Wageningen UR embarked on an exciting journey through uncharted territory. In the past ten years many valuable lessons were learned. The formal evaluations and international workshops that were organised for this purpose highly contributed to this learning process about cross-cultural and interdisciplinary research[1]. With some changes to the initial set up of the programme, INREF will continue to leave its innovative mark on both Wageningen University and partner institutes in the South.

Relevance

The INREF programme aims at relevance; relevance in terms of addressing complex societal development problems and in terms of producing results that make a difference for the end-users, whether they are universities, policy makers, NGOs, farmers or small entrepreneurs. Addressing complex real life problems requires the crossing of disciplinary boundaries. The interdisciplinarity of research groups was therefore strongly emphasized from the start. Proposals had to be submitted by a combination of Wageningen Graduate schools, and all PhD students had to have at least two supervisors, each with a different disciplinary background. Application of the so-called cohort approach ensured that all students within one programme started at the same time with their coursework and with developing their research protocols in Wageningen. Working in cohorts proved to be an excellent model to tackle complex societal issues in an interdisciplinary and holistic way. It enhanced mutual learning and created coherence within the research programmes. It also improved the cross-disciplinary communication skills of both students and supervisors.

During the actual research, many PhD students worked together and used or validated each other's results. For example: one PhD student of the 'Healthy People' programme discovered that the zinc (Zn) content in sorghum can be increased fivefold by using proper fertilizers, while another student discovered that the processing of the improved sorghum needs to be adapted to make the higher Zn content bio-available for humans. But not only the PhD students profited from this approach; their supervisors underwent a valuable learning process of their own.

Addressing complex societal problems cannot be done in a university or research station environment only. All different stakeholders who are part of the complex problem addressed by an INREF programme will for sure be part of a solution. To enhance the relevance, in all programmes the important stakeholders are involved at different levels of intensity in the research activities. As such, the programmes applied aspects of transdisciplinarity methods in their programme approach. Within the POND programme the PhD students who focussed on the development of the fish strains for low-input environments executed their activities on a research station in Egypt. But the new fish strains were tested and the integrated fish-pond systems improved in Vietnam in the real world, i.e. on-farm, with strong participation by the small-holder farmers. Within the 'Convergence of Sciences' programme, interdisciplinarity evolved into transdisciplinarity, with its emphasis on the democratisation of science and the recognition of farmers as co-researchers.

To generate knowledge that really makes a difference for the end-users is still a challenging issue. Using the INREF approach is not a guarantee that the results produced by the PhD students can be used directly by the end-users. A certain tension exists between

achieving scientific excellence (i.e. PhD thesis level) on the one hand and producing practical and directly applicable results for innovation on the other hand (like new technologies, models or policies). Also the relatively short period of time (four to five years) within which the INREF research programmes must be completed does not enhance the production of direct applicable results. Most INREF programmes have been completed with a summary paper or book, which presents key findings as well as policy options and recommendations. But these scientific findings and recommendations still need more validation and testing before an active distribution of applicable results can be communicated within the community of potential end-users.

The INREF programme, in its initial set-up as a PhD research programme, focussed on the scientific results. At the end of the first phase, however, a few programmes came up with scientific results with a high potential for application. The only step to be executed was the validation of the "theoretical or laboratory" results in the "real" world. The INREF board decided to introduce the so-called "post-programme operationalisation" facility. Funds are budgeted for teams who, after completion of their research programmes, can apply for funding to translate the more fundamental research results into applicable results. This can be policy recommendations, simplified models to be used by non-scientists, or testing technologies developed in a laboratory or at experimental scale at field and industrial level. In this way, scientific outputs become applicable outcomes. Actually, two post-programme projects are being executed, both validation results of the Healthy People project. In Benin, the sorghum milling techniques to increase the micro-nutrient content in the staple food as developed in the research programme is tested at village level. In China, the rice milling and parboiling techniques are being introduced and validated at industrial level.

Interdisciplinarity

The INREF programmes started without a clear shared definition of what interdisciplinarity means. In the course of the years the following definition has evolved:

"Interdisciplinarity is defined as collaborative work between scientists, each from different disciplines, each with its own concepts, methods and epistemology, working together on ***the same*** *research question,* ***mutually influencing*** *each other and needing some shared concepts and methodologies."*

A key issue was whether INREF was aimed at the training of interdisciplinary PhD students and/or was interdisciplinarity the goal to be achieved at the level of the research programmes, and as such providing an interdisciplinary environment for the individual PhD students? Most PhD students in the INREF programmes are young scientists at the beginning of their scientific career, who may not yet have the capacity to work across disciplines. Besides, they need to specialise because they are expected to contribute to the

[1] These included formal evaluations of the INREF programme (mid-term evaluation INREF phase 1 in 2004 and the external scientific evaluation in 2007) as well as workshops that brought together all staff and PhD students of the INREF programmes (2006) or European and INREF partners involved in interdisciplinary PhD programmes (2008).

'body of scientific knowledge'. After finishing their PhD research they will be active in the national research systems as 'specialists' in their home countries. For their career opportunities they need a recognised "profile".

The concept of T-shaped profiles, a concept already applied in the regular BSc and MSc education programmes of Wageningen University, for the PhD students active in interdisciplinary research programmes proved to be very useful. In this profile, the width of the horizontal line of the "T" stands for interdisciplinarity, while the height of the vertical line represents the disciplinary depth. The INREF programmes aim at widening the horizontal line, while maintaining sufficient height of the vertical line to meet the requirements of the PhD thesis.

The INREF experience shows that PhD students may follow different T-shapes. It is very well possible that the subject of the research programme requires a few PhD students who conduct disciplinary research, in combination with other students with a wider T-shaped profile. A second issue is also that the capacities of the PhD students determine the width of their T-shaped model. In summary, within one large INREF programme, PhD students with different degrees of interdisciplinary can be active.

The role of staff members involved in the INREF research programmes, and thus the time to be invested, is much more crucial than was anticipated at the start of the INREF programme. This is true for supervision, but also for time to be invested in integrating the research results of the PhD students. Initially, the financial resources for the necessary integrating activities were quite limited. From 2007 onwards, new INREF programmes may allocate a larger share of the budget to staff time for these important activities.

Enhancing scientific cooperation

As for the scientific aspects, for organisational aspects to enhance the interdisciplinary character of the programmes, the last ten years were a learning journey, too. At the start of the INREF programme

in 2000, the choice of which model to be used was left to the programme teams. They experimented with different models of scientific cooperation. The models were chosen taking into account the particular research subject, the expected results, and the level of interdisciplinarity aimed at. As a result, the research programmes achieved different levels of interdisciplinarity and different degrees of integration of the PhD results.

In literature, several models for interdisciplinary research organisation are described. The main difference between them is whether the integration takes place at the start of a research programme during the formulation of the proposal (basic integration), during the execution of the programme (exchange of knowledge), or at the end of the programme (results integration).

The external scientific evaluation committee strongly recommended putting more emphasis on developing a Common Conceptual Framework at the start of each research programme (basic integration). Such a framework, developed together with all programme partners, is the main instrument to integrate and bind together the individual research efforts. Teams are required to define a common set of hypotheses underlying the theoretical framework, with the hypotheses of individual PhD projects closely relating to these. All involved staff must adhere to the common framework and thus the hypotheses. For new INREF programmes, from 2007 onwards, developing a common framework is a must. It counts as an important criterion for the proposal assessment.

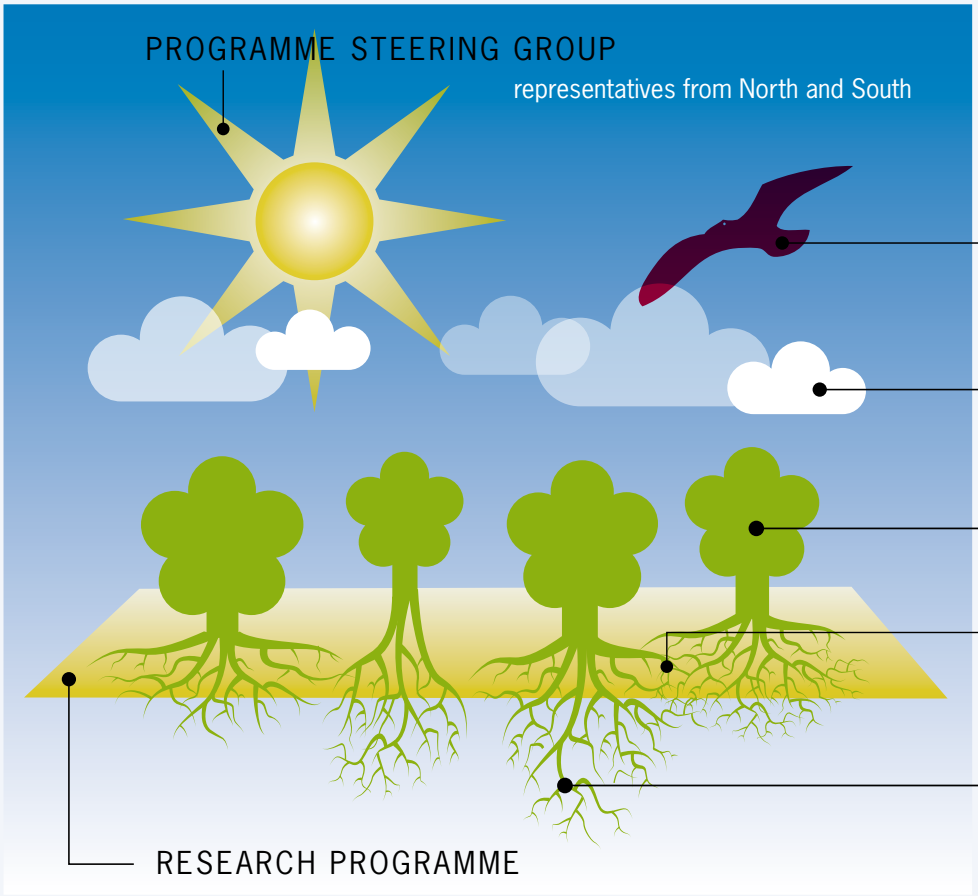
People make it work

Interdisciplinary research is much more time consuming than monodisciplinary research and in many ways more challenging. It is therefore important to have sufficient financial means, an effective organisational model and a common analytical framework for programme coherence. The key success factor for interdisciplinary research programmes, however, are the people involved. They must be individuals who are willing to always keep an open mind and they must have some modesty: prioritizing your own knowledge over that of others is not a useful attitude for interdisciplinary programmes. As Wageningen Professor Ken Giller, coordinator of the Competing Claims programme puts it: “The desire to learn must be greater than your ego.” When the new PhD students arrive in Wageningen, the biggest challenge for their supervisors is to get them together and teach them how to communicate with each other. Only if the students learn to appreciate each other’s scientific backgrounds, concerns, methods and challenges, can interdisciplinarity be reached. For most PhD students this is difficult because they tend to narrow down their field of study. Supervisors, too, have to learn to think across disciplines and accept that a relatively large part of the thesis research of ‘their’ student is covered by other disciplines.

To enhance team building and create more understanding, all students and supervisors come together when the students are in Wageningen. Use of scientific jargon is minimised during such team meetings. All researchers should be committed to develop and speak a common language, which is a sine qua non for mutual understanding. Typical for all INREF programmes are the annual programme meetings, where all PhD students and supervising

Model for interdisciplinary research

A 'one size fits all' model for interdisciplinary research programmes does not exist. During the learning workshop of 2008, after one and half days of discussions with European colleagues involved in interdisciplinary PhD programmes, one of the participants drafted this organisational diagram, as a synthesis of the discussions. Most participants to the workshop recognised the main outcomes of the discussions in this diagram.



staff from Wageningen and partner institutions come together to discuss progress, plan for the coming period, and integrate results.

It works: most people involved in the INREF programmes have learned and enjoyed working in these complex environments. Not everybody, of course, prefers working in an interdisciplinary environment. Some staff members in Wageningen focus on 'their' PhD students and not so much on the programme coherence. Others will return to the more disciplinary research after their INREF programme has been completed, and also some PhD students returned after their thesis defence to the more monodisciplinary oriented research. But generally speaking, the critical mass of 'interdisciplinary' researchers did grow over the last ten years, both in Wageningen and at the partner institutes.

Creating capacities

Personal and institutional capacity building in the South is one of the objectives of INREF. After the students have successfully defended their theses in Wageningen, they return home to continue their careers at their institutes. Brain gain is the goal, not only by improving the skills and knowledge of the students, but also of their local supervisors. Many successful PhD students made a major career step after graduation. To mention just a few: the four PhD students of the 'Healthy People' programme in Benin obtained senior positions at the University Abomey-Calavi; several PhD students from the CAAS programme are now professors heading large research groups at their University in China; and an AGITS PhD student is now a well-respected policy advisor in Thailand. They will capitalise on their knowledge gained through the INREF experience in research innovations in their respective countries.

But let's not forget the gains for Wageningen. The new doctors, who have an interesting future ahead of them at their home institutions, remain strongly connected to Wageningen, thus contributing to the university's international visibility. In addition, these contacts will be a base for future interdisciplinary research collaborations.

Challenges ahead

The INREF approach demonstrated from the beginning its strengths in tackling complex development related problems, and to build a community of researchers who are better skilled

in conducting interdisciplinary, and sometimes transdisciplinary research. In addition to contributing to the scientific knowledge base, within the INREF programme, a large group of young researchers are trained in looking over disciplinary boundaries, applying the system concepts in their research. They are better equipped to implement research that can contribute to the solution of complex problems. Over the past years, INREF has evolved into a rich and lively research platform in terms of topics, working methods, paradigms and backgrounds of researchers, a feat to be rightfully proud of.

In due course, several changes have been introduced in the execution of the INREF programmes, needed for stronger programme coherence and enhancing the interdisciplinarity. Still, several challenges are ahead of us.

Integration of the results of the individual PhD studies remains an activity to be enhanced at the programme level. Such integration may lead to new scientific knowledge which could not be produced by more disciplinary research oriented programmes. Another issue to address is whether intensive cooperation between disciplines is not only lowering the barriers between disciplines (improved understanding and communication), but also changing the limits of disciplines. Will interdisciplinary research force existing disciplines to evolve into broader domains, or may new disciplines evolve, required to contribute to solutions of complex societal problems? The programmes well underway in the second phase of INREF may yield more insights on these issues.

A vast amount of methodological and scientific knowledge is gained by the INREF programme and will be gained in the near future. Wageningen University and partner institutions make an effort to incorporate these results and knowledge into their regular university BSc and MSc training programmes. By doing so, interdisciplinarity will be mainstreamed in the scientific training of a much wider group of young up and coming professionals.

In 2000, INREF started as a pioneer programme, and it was a bold step by Wageningen University to invest a substantive amount of funds in these new ways of tackling complex development related problems. During the last decade, it is more and more recognised by research institutions, donors, and development organisations, that the most challenging problems society is actually facing (climate change, food security, etc.) connect the developed world, the developing countries and emerging economies in their quest to find solutions. It is not questioned anymore that there is a need for more integrative, participative, and interdisciplinary research approaches to tackle these issues, which have to be executed in international partnerships. The challenges on how to conduct and organise interdisciplinary research remain important issues to address in the near future. Wageningen University will continue to play its role as a leading institute in interdisciplinary and transdisciplinary research by launching the third phase of the INREF programme in 2010.

5 Facts and figures

5.1 Programmes INREF phase I

phase I

5.1.1 From natural resources to healthy people: food-based interventions to alleviate nutrient deficiencies

Location

Benin, Burkina Faso, and China

Main partner institutions

In Benin: Université d'Abomey-Calavi (UAC), Cotonou;
In Burkina Faso: Institut de l'Environnement et des Recherches Agronomique (INERA), Ouagadougou;
In China: Chinese Agricultural University (CAU), Beijing; Jiangsu Provincial Centre for Disease Control and Prevention, Nanjing;
In the Netherlands: Wageningen University, Graduate School for Production Ecology and Resource Conservation (PE&RC) and Graduate School for Food Technology, Agro-biotechnology, Nutrition and Health Sciences (VLAG).

PhD students

In Benin: Polycarpe Kayode, Evariste Michikpe.
In Burkina Faso: Karim Traore.
In China: Gao Xiaopeng, Wen Jiang, Jiangfen Liang, Qin Yu.

Contact persons Wageningen University

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Dr. M.A. Slingerland, Programme manager,
e-mail: maja.slingerland@wur.nl

Selection of publications

PhD theses

Gao, X.P., 2007. Bioavailability of zinc to aerobic rice.
Jiang, W., 2007. Physiology and modelling of zinc allocation in aerobic rice.
Kayode, A.P.P., 2006. Diversity, users' perception and food processing of sorghum: implications for dietary iron and zinc supply.
Liang, J., 2007. Iron, zinc and phytic acid in rice from China: wet and dry processing towards improved mineral bioavailability.
Mitchikpé, E.C.S., 2007. Towards a food-based approach to improve iron and zinc status of rural Beninese children: enhancing mineral bioavailability from sorghum-based food.
Traore, K., 2006. Effects of soil amendments and drought of zinc husbandry and grain quality in Sahelian sorghum.
Yu, Q., forthcoming. Determinants of human zinc intake and status in Jiangsu Province, China.

International refereed journal articles

Doka, O., D.D. Bicanic, M.H. Dicko, M.A. Slingerland, 2004. Photoacoustic approach to direct determination of the total phenolic content in red sorghum flours. *Journal of Agricultural and Food Chemistry 52*: 2133-2136.
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Jiang, W., P.C. Struik, H. van Keulen, M. Zhao, L.N. Jin, T.J. Stomph, 2008. Does increased Zn uptake enhance grain Zn mass fraction in rice? *Annals of Applied Biology 153*: 135-147.
Kayodé, A.P.P., A. Adégbidi, A.R. Linnemann, M.J.R. Nout, D.J. Hounhouigan, 2005. Quality of farmer's varieties of sorghum and derived foods as perceived by consumers in Benin. *Ecology of Food and Nutrition 44*: 271-294.
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solubility of iron and zinc in opaque sorghum beer. Food Science and Technology/LWT 40: 834-841.
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Kayodé, A.P.P., A.R. Linnemann, D.J. Hounhouigan, M.J.R. Nout, M.A.J.S. van Boekel, 2006. Genetic and environmental impact on iron, zinc and phytate in food sorghum grown in Benin. *Journal of Agricultural and Food Chemistry 54*: 256-262.
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Stomph, T.J., W. Jiang, P.C. Struik, 2009. Zinc biofortification of cereals: rice differs from wheat and barley. *Trends in Plant Science 14*: 123-124.
Traoré, K., L. Stroosnijder, 2005. Sorghum quality, organic matter amendments and health; farmers' perception in Burkina Faso, West Africa. *Ecology of Food and Nutrition 44*: 225-245.

5.1.2 Regional Food Security Policies for Natural Resources Management and Sustainable Economies (RESPONSE)

Location

Ethiopia, Bangladesh, Uganda, China, and the Philippines

Main partner institutions

International partners: International Food Policy Research Institute (IFPRI), USA; International Livestock Research Institute (ILRI), Ethiopia.
In Ethiopia: Mekelle University, Tigray.
In Bangladesh: Bangladesh Institute for Development Studies, Dhaka.
In China: Nanjing Agricultural University (NAU), Nanjing.
In Uganda: National Agricultural Research Organisation (NARO), Banana

Research Programme.
In the Netherlands: Wageningen University, the Mansholt Graduate School of Social Sciences (MG3S), the Graduate School Wageningen Institute for Animal Sciences (WIAS), and the Graduate School Production Ecology and Resource Conservation (PE&RC).

PhD students

In Ethiopia: Assefa Abegaz, Girmay Tesfay, Moti Jaleta Debello.
In Bangladesh: Ahmad Ali, Nazneen Ahmed.
In Uganda: Fred Bagamba.
In China: Le Chen, Shuyi Feng.
In the Philippines: Aimee Milagrosa, Julia Roa.

Contact persons Wageningen University

Prof. Dr. R. Ruben, Scientific co-ordinator (till 2006),
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Prof. Dr. A. van Kuyvenhoven, Scientific co-ordinator (from 2006),
e-mail: arie.kuyvenhoven@wur.nl

Selection of publications

Book

Ruben, R., J. Pender, A. Kuyvenhoven (Eds.), 2007. Sustainable Poverty Reduction in Less-favoured Areas. CAB International, Wallingford, UK and Cambridge, MA, 472 pages.

R. Ruben, J. Pender, A. Kuyvenhoven. Sustainable poverty reduction in less-favoured areas: problems, options and strategies.

Part I. Development strategies for poor people in less-favoured areas

S. Lopez, H, van Keulen, K. Giller. Designing and evaluating alternatives for more sustainable natural resource management in less-favoured areas.
J. Brons, T. Dietz, A. Niehof, K. Witsenburg. Dimensions of vulnerability of livelihoods in less-favoured areas: interplay between the individual and the collective.
N. Ahmed, J. Peerlings, A. van Tilburg. Market imperfections.

Part II. Resource management options

A. Abegaz, H. van Keulen. Soil nutrient dynamics in integrated crop-livestock systems in the Northern Ethiopian highlands.
H. Jansen, J. Pender, A. Damon, W. Wielemaker, R. Schipper. Rural development and sustainable land use in the hillsides of Honduras.
G. Tesfay, R. Ruben, J. Pender, A. Kuyvenhoven. Resource use efficiency on own and sharecropped plots in Northern Ethiopia: determinants and implications for sustainability.

Part III. Livelihoods and food security

J. Roa. Food security through the livelihood lens: an integrative approach.
A. Ali, A. Niehof. Changing gender roles in household food security and rural livelihoods in Bangladesh.
A. Milagrosa, L. Slangen. Does social capital matter in vegetable markets? The social capital of indigenous agricultural communities in the Philippines.

Part IV. Markets and institutional development

E. Gabre-Madhin. Making markets work for the poor: the challenge in the age of globalization.
F. Bagamba, K. Burger, R. Ruben, A. Kuyvenhoven. Market access, agricultural productivity and allocative efficiency in the banana sector of Uganda.
S. Feng, N. Heerink, R. Ruben. Land and labour market participation decisions under imperfect markets: a case study in North-East Jiangxi Province, China.
M. Jaleta Debello, C. Gardebroek. Land and labour allocation decisions in the shift from subsistence to commercial agriculture.
L. Chen, J. Peerlings. Effects of deregulation of the rice market on farm prices in China: a marketing channel model.
N. Ahmed, J. Peerlings. Consequences of the abolition of the multi-fibre arrangement import quotas on the apparel industry of Bangladesh: a computable general equilibrium analysis.

Part V. Strategies and policy priorities

M. Kuiper, R. Ruben. Poverty targeting with heterogeneous endowments: a micro-simulation analysis of a less-favoured Ethiopian village.
L. Lipper, P. Pingali, M. Zurek. Less-favoured areas: looking beyond agriculture towards ecosystem services.
A. Dorward. Livelihood strategies, policies and sustainable poverty reduction in LFAs: a dynamic perspective.

PhD theses

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Ahmed, N., 2006. Bangladesh Apparel Industry and its Workers in a Changing World Economy.

Ali, A., 2005. Livelihood and food security in rural Bangladesh: The role of social capital.

Bagamba, F., 2007. Market Access and Agricultural Production: The Case of Banana Production in Uganda.

Chen, L., 2007. Grain Market Liberalization and Deregulation in China: The Mediating Role of Markets for Farm Households in Jiangxi Province.

Debello, M.J., 2007. Econometric analyses of horticultural production and marketing in Central and Eastern Ethiopia.

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Abegaz, A., 2008. Indigenous soil nutrient supply and effects of fertilizer application on yield, N, P and K uptake, recovery and use efficiency of barley in three soils of Teghane, the Northern Highlands of Ethiopia. *African Journal of Agricultural Research 3*: 688-699.

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Ruben, R., M.H. Kuiper, J. Pender, 2006. Searching Development Strategies for Less-favoured Areas. *NJAS Wageningen Journal of Life Sciences 53*: 319-342.

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Special issues of scientific journals

Food Policy, 2004, vol. 29 (4): Less Favoured Areas. Editors: R. Ruben, J. Pender and A. Kuyvenhoven.

Arie Kuyvenhoven, John Pender, Ruerd Ruben. Development strategies for less-favoured areas.

Ruerd Ruben, John Pender. Rural diversity and heterogeneity in less-favoured areas: the quest for policy targeting.

Anke Niehof. The significance of diversification for rural livelihood systems.

John Pender. Development pathways for hillsides and highlands: some lessons from Central America and East Africa.

Stein Holden, Bekele Shiferaw, John Pender. Non-farm income, household welfare, and sustainable land management in a less-favoured area in the Ethiopian highlands.

Christopher B. Barrett, Winnie K. Luseno. Decomposing producer price risk: a policy analysis tool with an application to northern Kenyan livestock markets.

Arie Kuyvenhoven. Creating an enabling environment: policy conditions for less-favored areas.

Shenggen Fan, Connie Chan-Kang. Returns to investment in less-favored areas in developing countries: a synthesis of evidence and implications for Africa.

A.J. Oskam, M.H.C. Komen, P. Wobst, A. Yalew. Trade policies and development of less-favoured areas: evidence from the literature.

Agricultural systems, 2006, Volume 88, Issue 1: Heterogeneity and Diversity in Less-Favoured Areas. Editor: Herman van Keulen.

Herman van Keulen. Heterogeneity and diversity in less-favoured areas.

Ken E. Giller, Ed C. Rowe, Nico de Ridder, Herman van Keulen. Resource use dynamics and interactions in the tropics: Scaling up in space and time.

Thomas Berger, Pepijn Schreinemachers, Johannes Woelcke. Multi-agent simulation for the targeting of development policies in less-favored areas.

Crammer K. Kaizzi, Henry Ssali, Paul L.G. Vlek. Differential use and benefits of Velvet bean (Mucuna pruriens var. utilis) and N fertilizers in maize production in contrasting agro-ecological zones of E. Uganda.

Atakilte Beyene, David Gibbon, Mitiku Haile. Heterogeneity in land resources and diversity in farming practices in Tigray, Ethiopia.

Gideon Kruseman, Ruerd Ruben, Girmay Tesfay. Diversity and development domains in the Ethiopian highlands.

Hans G.P. Jansen, Angel Rodriguez, Amy Damon, John Pender, Jacqueline Chenier, Rob Schipper. Determinants of income-earning strategies and adoption of conservation practices in hillside communities in rural Honduras.

5.1.3 Convergence of Sciences: inclusive technology innovation processes for better integrated crop and soil management (CoS)

Location

Benin and Ghana

Main partner institutions

In Benin: Université d'Abomey-Calavi, Cotonou.
In Ghana: University of Ghana, Legon.
In Wageningen: Wageningen University, the Graduate Schools Production Ecology and Resource Conservation (PE&RC) and the Research School for Resource Studies for Development (CERES)
International Partner: FAO, Global IPM Facility, Rome, Italy.

PhD students

In Benin: Aliou Saidou, Pierre Vissoh, Afio Zannou, Antonio Sinzogan.
In Ghana: Godwin Ayenor, Emmanuel Dormon, Samuel Adjei-Nsiah, Comfort Kudadjie.
In Ghana and Benin: Suzanne Nederlof.

Contact person Wageningen University

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Selection of publications

PhD theses

Adjei-Nsiah, S., 2006. Cropping systems, land tenure and social diversity of Wenchi, Ghana: implications for soil fertility management.

Ayenor, G.K., 2006. Capsid Control for Organic Cocoa in Ghana. Results of participatory learning and action research.

Dormon, E.N.A., 2006.From a technology focus to innovation development. The management of cocoa pests and diseases in Ghana.

Kudadjie, C.Y., 2006. Integrating science with farmer knowledge: Sorghum diversity management in north-east Ghana.

Nederlof, E.S., 2006. Research on Agricultural Research. Towards a pathway for client-oriented research in West Africa.

Saidou, A., 2006. Converging strategies by farmers and scientists to improve soil fertility and enhance crop production in Benin.

Sinzogan, A.A.C., 2006. Facilitating learning toward sustainable cotton pest management in Benin.

Vissoh, P.V., 2006. Participatory development of weed management technologies in Benin.

Zannou, A.S.A., 2006. Socio-economic, agronomic and molecular analysis of yam and cowpea diversity in the Guinea-Sudan transition zone of Benin.

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Adjei-Nsiah, S., T.W. Kuyper, C. Leeuwis, M.K. Abekoe, K.E. Giller, 2007. Evaluating sustainable and profitable cropping sequences with cassava and four legume crops: Effects on soil fertility and maize yields in the forest/savannah transitional agro-ecological zone of Ghana. *Field Crops Research 103*: 87-97.

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learning from ambiguous social dynamics and self-organized institutional innovation. *Agriculture and Human Values 25*: 389-403.
Adjei-Nsiah, S., T.W. Kuyper, C. Leeuwis, M.K Abekoe, J. Cobbinah, O. Sakyi-Dawson, K.E. Giller, 2008. Farmers' agronomic and social evaluation of productivity yield and N2-fixation in different cowpea varieties and their subsequent residual N effects on a succeeding maize crop. *Nutrient Cycling in Agroecosystems 80*: 199-209.
Adjei-Nsiah, S., A. Saïdou, D. Kossou, O. Sakyi-Dawson, Th.W. Kuyper, 2007. Sécurité foncière et gestion de la fertilité des sols: études de cas au Ghana et au Bénin. *Cahiers Agricultures 16*: 402-412.
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Diagnostic studies: a research phase in the Convergence of Sciences programme. Guest editors: D. Hounkounou, S.K. Offei, N.G. Röling, R. Tossou, A. van Huis.

Röling, N.G., D. Hounkonnou, S.K. Offei, R. Toussou, A. van Huis. Linking science and farmers' innovative capacity: diagnostic studies from Ghana and Benin.

Dormon, E.N.A., A. Van Huis, C. Leeuwis, D. Obeng-Ofori, O. Sakyi-Dawson. Causes of low productivity in cocoa in Ghana: farmers' perspectives and insights from research and the socio-political establishment.

Ayenor, G.K., N.G. Röling, B. Padi, A. van Huis, D. Obeng-Ofori, P.B. Atengdem. Converging farmers' and scientists' perspectives on researchable constraints on organic cocoa production in Ghana: results of a diagnostic study.

Sinzogan, A.A.C., A. van Huis, D.K. Kossou, J. Jiggins, S. Vodouhè. Farmers' knowledge and perception of cotton pests and pest control practices in Benin.

Vissoh, P.V., G. Ghèhounou, A. Ahanchédé, T.W. Kuyper, N.G. Röling. Weeds as agricultural constraint to farmers in Benin: results of a diagnostic study.

Adjei-Nsiah, S., C. Leeuwis, K.E. Giller, O. Sakyi-Dawson, J. Cobbina, T.W. Kuyper, M. Abekoe, W. van der Werf. Land tenure and differential soil fertility management practices among native and migrant farmers in Wenchi, Ghana: implications for interdisciplinary

action research.

Saïdou, A., T.W. Kuyper, D.K. Kossou, R. Tossou, P. Richards. Sustainable soil fertility management in Benin: learning from farmers.

Kudadjie, C.V., P.C. Struik, P. Richards, S.K. Offei. Assessing production constraints, management and use of sorghum diversity in north-east Ghana: a diagnostic study.

Zannou, A., A. Ahanchédé, P.C. Struik, P. Richards, J. Zoundjihékpon, R. Tossou, S. Vodouhè. Yam and cowpea diversity management by farmers in the Guinea-Sudan transition zone of Benin.

Nederlof, E.S., R. Tossou, O. Sakyi-Dawson, D.K. Kossou. Grounding agricultural research in small scale farmers' needs: a comparative analysis of diagnostic studies in Ghana and Benin.

International Journal of Agricultural Sustainability, 2007, volume 5, no 2-3. A special double issue about the achievements of the Convergence of Sciences project. Guest editors: A. van Huis, D. Hounkounou, N. Röling.

Huis, A. van, J. Jiggins, D. Kossou, C. Leeuwis, N. Röling, O. Sakyi-Dawson, P.C. Struik, R.C. Tossou. Can convergence of agricultural sciences support innovation by resource-poor farmers in Africa? The cases of Benin and Ghana.

Saïdou, A., R. Tossou, D. Kossou, S. Sambieni, P. Richards, T.W. Kuyper. Land tenure and sustainable soil fertility management in Central Benin: towards the establishment of a cooperation space among stakeholders.

Adjei-Nsiah, S., C. Leeuwis, O. Sakyi-Dawson, K.E. Giller, and T.W. Kuyper. Exploring diversity among farmers for orienting inter-disciplinary action research on cropping system management in Wenchi, Ghana: the significance of time horizons.

Vissoh, P.V., R. Mongbo, G. Gbèhounou, D. Hounkonnou, A. Ahanchédé, N.G. Röling, T.W. Kuyper. The social construction of weeds: Different reactions to an emergent problem by farmers, officials and researchers.

Sinzogan, A.A.C., J. Jiggins, S. Vodouhé, D.K. Kossou, E. Totin, A. van Huis. Cotton industry institutional linkages in Benin: stakeholder analysis and actor perspectives.

Ayenor, G.K., N. Röling, A. van Huis, B. Padi, D. Obeng-Ofori. Assessing the effectiveness of Local Agricultural Research Committee in diffusing sustainable cocoa production practices: the case of Capsid control in Ghana.

Dormon, E.N.A., C. Leeuwis, F.Y. Fiadjoe, O. Sakyi-Dawson, A. van Huis. Creating space for innovation: the case of cocoa production in the Suhum-Kraboa-Coalter District of Ghana.

Kudadjie, C.Y. P.C. Struik, S.K. Offei, P. Richards, I.D.K. Atokple, P. Atengdem. Understanding variation in sorghum through with-farmer learning experimentation.

Zannou, A., R.C. Tossou, S. Vodouhè, P. Richards, P.C. Struik, J. Zoundjihékpon, A. Ahanchédé, V. Agbo. Socio-cultural factors influencing and maintaining yam and cowpea diversity in Benin.

Nederlof, E.S., N. Röling, A. van Huis. Pathway for agricultural science impact in West Africa: lessons from the Convergence of Sciences Programme.

5.1.4 Optimizing of nutrient dynamics and animals for integrating farming (POND)

Location

Egypt and Vietnam

Main partner institutions

In Egypt: World Fish Centre (WFC), Regional Research Centre for Africa and West Asia, Abbassa.

In Vietnam: Can Tho University (CTU), Cantho City.

In the Netherlands: Wageningen University, Graduate Schools Wageningen Institute for Animal Sciences (WIAS), Production Ecology and Resource Conservation (PE&RC) and the Research School for Resource Studies for Development (CERES).

PhD students

In Egypt: Yonas Fessehaye, Harrison Charo-Karisa, Patricia Nduku Muendo, and Sharif Uddin.

In Vietnam: Dang Kieu Nhan, Roel H. Bosma, Tran Duy An, and Le Thanh Phong.

Contact persons Wageningen University

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Dr. R.H. Bosma, Programme manager,
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Selection of publications

Book

Zijpp, A. van der, J.A.J. Verreth, Le Quang Tri, M.E.F. van Mensvoort, R.H. Bosma, M.C.M. Beveridge (Eds.), 2007. Fish Ponds in Farming Systems. Wageningen Publishers, 311 pages.

PhD theses

An, T-D., 2008. Modelling the effects of dietary carbohydrate and ambient oxygen concentration on feed intake and growth in fish.

Bosma, R.H., 2007. Modelling the composition of mixed farms in the Mekong Delta with fuzzy logic.

Charo-Karisa, H., 2006. Selection for growth of Nile Tilapia (Oreochromis niloticus L.) in low-input environments.

Fessehaye, Y., 2006. Natural mating in Nile tilapia (Oreochromis niloticus L.). Implications for reproductive success, inbreeding and cannibalism.

Muendo, P.N., 2006. The role of fish ponds in the nutrient dynamics of mixed farming systems.

Nhan, D.K., 2007. Improving the efficiency of nutrient use in fishponds.

Phong, L.T., 2010. Comparing Nutmon, Ecopath and LCA to assess the sustainability of mixed farming systems in the Mekong Delta.

Uddin, M.S., 2007. The production and use of periphyton in fishponds.

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Charo-Karisa, H., J. Komen, S. Reynolds, M. A. Rezk, R. W. Ponzoni and H. Bovenhuis, 2006. Genetic and environmental factors affecting growth of Nile tilapia (Oreochromis niloticus) juveniles: Modelling spatial correlations between hapas. *Aquaculture 255*: 586-596.

Charo-Karisa H., J. Komen M.A. Rezk, R.W. Ponzoni, J.A.M. van Arendonk and H. Bovenhuis, 2006. Heritability estimates and response to selection for growth of Nile tilapia (Oreochromis niloticus) in low-input earthen ponds. *Aquaculture 261*: 479-486.

Charo-Karisa, H., H. Bovenhuis, M.A. Rezk, R.W. Ponzoni, J.A.M. van Arendonk, H. Komen, 2007. Phenotypic and genetic parameters for body measurements, reproductive traits and gut length of Nile tilapia (Oreochromis niloticus) selected for growth in low-input earthen ponds. *Aquaculture 273*: 15-23.

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Fessehaye, Y., Z. El-Biakly, M.A. Rezk. R. Crooijmans, H. Bovenhuis, J. Komen. 2007. Effects of inbreeding on survival, body weight and fluctuating asymmetry (FA) in Nile tilapia, Oreochromis niloticus. *Aquaculture 264:* 27-35.

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fertilized and feed-driven tilapia culture environments using multivariate analyses. *Aquaculture Research 37*: 151-163.

Nhan, D.K., A. Milstein, M.C.J. Verdegem, J.A.J. Verreth, 2006. Food inputs, water quality and nutrient accumulation in integrated pond systems: a multivariate approach. *Aquaculture 261:* 160-173.

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Nhan, D.K., M.C.J. Verdegem, A. Milstein, J.A.J. Verreth, 2008. Water and nutrient budgets of ponds in integrated agriculture–aquaculture systems in the Mekong Delta, Vietnam. *Aquaculture Research 39:* 1216-1228.

Phong, L.T., H.M.J. Udo, M.E.F. van Mensvoort, R.H. Bosma, L.Q. Tri, D.K. Nhan, A. van der Zijpp, 2007. Integrated Agriculture-Aquaculture Systems in the Mekong Delta: An Analysis of recent trends. *Asian Journal of Agriculture and Development 4*: 51-66.

Rahman, M.M., A. Yakupitiyage, S.L. Ranamukhaarachchi, 2004. Agricultural use of fishpond sediment for environmental amelioration. *Thammasat Int. J. of Science and Technology 9:* 1-10.

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Rahman, M.M., M.C.J. Verdegem, M.A. Wahab, Y. Hossain, Q. Jo, 2008. Effects of day and night on swimming, grazing and social behaviours of rohu labeo rohita (hamilton) and common carp cyprinus carpio (L.) in simulated ponds. *Aquaculture Research 39*: 1383-1392.

Rahman, M.M., L.A..J Nagelkerke, M.C.J. Verdegem, M.A. Wahab, J.A.J. Verreth, 2008. Relationships among water quality, food resources, fish diet and fish growth in polyculture ponds: A multivariate approach. *Aquaculture 275:* 108-115.

Rahman, M.M., M.C.J. Verdegem, L.A.J Nagelkerke, M.A. Wahab, A. Milstein, J.A.J. Verreth, 2008. Effects of common carp cyprinus carpio (L.) and feed addition in rohu labeo rohita (hamilton) ponds on nutrient partitioning among fish, plankton and benthos. *Aquaculture Research 39*: 85-95.

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Uddin, M.S., S.M. Shamsul Rahman, M Ekram Azim, M.A. Wahab, M.C.J. Verdegem, J.A.J. Verreth, 2007. Effects of stocking density on production and economics of Nile tilapia (Oreochromis niloticus) and freshwater prawn (Macrobrachium rosenbergii) polyculture in periphyton-based systems. *Aquaculture Research 38*: 1759-1769.

Uddin, M.S., A .Farzana, M.K. Fatema, M.E. Azim, M.A. Wahab, M.C.J. Verdegem, 2007. Technical evaluation of tilapia (Oreochromis niloticus) monoculture and tilapia–prawn (Macrobrachium rosenbergii) polyculture in earthen ponds with or without substrates for periphyton development. *Aquaculture 269:* 232-240.

Uddin, M.S., A. Milsten, M.E. Azim, M.A. Wahab, M.C.J. Verdegem, J.A.J. Verreth, 2008. Effects of stocking density, periphyton substrate and supplemental feed on biological processes affecting water quality in earthen tilapia–prawn polyculture ponds. A*quaculture Research 39:* 1243-1257.

Verdegem, M.C.J., R.H. Bosma, J.A.J. Verreth, 2006. Reducing water use for animal production through aquaculture. *Water Resources Development 22:* 101–113.

Verdegem, M.C.J., RH Bosma, 2009. Water withdrawal for brackish and inland aquaculture and options to produce more fish in ponds with present water use. *Water Policy 11:* 52-68.

5.1.5 Cleaner agro-industries: agro-industrial transformations towards sustainability; Southeast and East Asia in global perspective (AGITS)

Location
Thailand and Malaysia

Main partner institutions
In Thailand: Environmental Research Institute (ERIC), Chulalongkorn University, Bangkok; Department of Sociology and Anthropology and Department of Environmental Engineering, Chiang Mai University, Chiang Mai.
In Malaysia: National University of Malaysia (UKM), Bangi Selangor; the University Malaysia Sarawak, (UNIMAS), Koto Samarahan; the Asia-Europe Institute (AEI) of the University of Malaya, Kuala Lumpur, Malaysia.
In the Netherlands: Wageningen University, the Graduate School Wageningen Institute for Environment and Climate Research (WIMEK) and Mansholt Graduate School of Social Sciences (MG3S).
International partners: Institute of International Studies, University of California, Berkeley, and the Department of Economics and Management, Hood College, Frederik, both in the USA.

PhD students
In Thailand: Thanes Sriwichailamphan, Orathai Chavalparit, Ajchara Wattanapinyo, Warit Jawjit, Kanang Kantamaturapoj.
In Malaysia: Er Ah Choy.

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Prof. Dr. A.P.J. Mol, Scientific co-ordinator,
e-mail: tuur.mol@wur.nl
Dr. P.J.M. Oosterveer, Programme manager,
e-mail: peter.oosterveer@wur.nl

Website
www.ernasia.org

Selection of publications
Book

Mol, A.P.J., J. van Buuren (Eds), 2003. Greening Industrialization in Asian Transitional Economies. Lexington Books, Lanham.

PhD theses

Chavalparit, O., 2006. Clean Technology for the Crude Palm Oil Industry in Thailand.
Choy, E.A., 2007. A Quantitative Methodology to Test Ecological Modernization Theory in the Malaysian Context.
Jawjit, W., 2006. An Environmental Systems' Analysis of the Kraft Pulp Industry in Thailand.
Kantamaturapoj, K., forthcoming. Emerging sustainable food consumption in newly industrializing economies: the case of Thailand.
Sriwichailamphan, T., 2007. Global Food Chains and Environment: Agro-Food production and Processing in Thailand.
Wattanapinyo, A., 2006. Sustainability of Small and Medium-sized Agro-Industries in Northern Thailand.

International refereed journal articles

Hermann, B.G., C. Kroeze, W. Jawjit, (2007). Assessing environmental performance by combining life cycle assessment, multi-criteria analysis and environmental performance indicators. *Journal of Cleaner Production 15:* 1787-1797.
Jawjit, W., C. Kroeze, W. Soontaranun, L. Hordijk, (2007). Options to Reduce the Environmental Impact by Eucalyptus-based Kraft Pulp Industry in Thailand: Model Description. *Journal of Cleaner Production 15:* 1827-1839.
Liu, Yi, A.P.J. Mol, J. Chen, 2005. The Environmental Industry in Transitional China: Barriers and Opportunities between State and Market. *International Journal of Environment and Sustainable Development 4:* 269 – 289.
Mol, A.P.J. and Yi Liu, 2005. Institutionalising cleaner production in China: the cleaner production promotion law. *International Journal of Environment and Sustainable Development 4:* 227 – 245.
Mol, A.P.J., and Dieu, T.M., 2006. Analysing and governing environmental flows: the case of Tra Co tapioca village, Vietnam. *NJAS, Wageningen Journal of Life Sciences 53:* 301-318.

Oosterveer, P., 2006. Globalization and sustainable consumption of shrimp: consumers and governance in the global space of flows. *International Journal of Consumer Studies 30:* 465-476.

Special issues of scientific journals

International Journal of Business and Society, 2004, vol. 5 (1). Guest editors: Arthur P.J. Mol and Peter Oosterveer.

Mol, A.P.J., P. Oosterveer. Greening agro-industries in Thailand and Vietnam: an introduction.

Oosterveer, P. Greening small and medium-sized food processing enterprises in Northern Thailand.

Pham Hong Nhat. Environmental pollution and reform of Vietnamese small and medium-sized agro-industries.

Sriwichailamphan, T. Global Food Chains and Environment: A case study of Canned Pineapple Industry in Thailand.

Tran Thi My Dieu, Arthur P.J. Mol and Wim H. Rulkens. Environmental Reform of Food-processing Industry: An industrial ecology approach on Bien Hoa 1 Industrial Zone, Vietnam.

Environment, Development and Sustainability, 2006, Vol. 8. (2). Guest editors: Peter Oosterveer, Somporn Kamolsiripichaiporn, and Rajah Rasiah.

Chavalparit, O., Rulkens, W.H., Mol, A.P.J., and Khaodhair, S. Options for Environmental Sustainability of the Crude Palm Oil Industry in Thailand through Enhancement of Industrial Ecosystems.

Nhat, P.H. Environmental Performance Improvement for Small and Medium-Sized Slaughterhouses in Vietnam.

Oosterveer, P., Kamolsiripichaiporn, S., and Rasiah, R. The 'Greening' of Industry and Development in Southeast Asia: Perspectives on Industrial Transformation and Environmental Regulation; Introduction.

Tran Thi My Dieu. Greening Food Processing Industries in Vietnam: Opportunities and Constraints.

Warit, J., Kroeze, C., Soontranun, W., and Hordijk, L. An Analysis of the Environmental Pressure Exerted by e Eucalyptus-based Kraft Pulp Industry in Thailand.

Journal of Environment and Development, 2006, Vol. 15 (2). A Review of International Policy. Guest editors: David A. Sonnenfeld and Arthur P.J. Mol.

Sonnenfeld, D.A., A.P.J. Mol. Environmental Reform in Asia.

Sonnenfeld, D.A., A.P.J. Mol. Environmental Reform in Asia: Comparisons, Challenges, Next Steps.

5.1.6 From vegetable production to healthy food: joint PhD programme for vegetable genomics between CAAS and Wageningen University (CAAS)

Location

China

Main partner institutions

In China: The Chinese Academy of Agricultural Sciences (CAAS), Beijing; China National Seed Group Corporation (CNSGC), Beijing.

In the Netherlands: Wageningen University, the Graduate Schools Experimental Plant Sciences (EPS) and Food Technology, Agro-biotechnology, Nutrition and Health Sciences (VLAG).

PhD students

Chengwei Li, Limei Yang, Miqia Wang, Jun Guo, Liying Yan, Qing Liu, Jianjun Zhao, Jian Wu, Guanshen Ma, Yongyan Qi, Yehong Liang, Aiguo Zhu, Junming Li.

Contact persons Wageningen University

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Dr. A.B. Bonnema, Programme manager,
e-mail: guusje.bonnema@wur.nl

Selection of publications

All 13 PhD students obtained a CAAS PhD degree and 8 students obtained a WU PhD degree.

WU PhD theses

Li, C., 2005. Transcriptional microscopic and macroscopic investigations into monogenic and polygenic interactions of tomato and powdery mildew.

Guo, J., 2008. Phytophthora infestans avirulence genes: mapping, cloning and diversity in field isolates.

Li, J., 2010. Exploration of tomato wild relatives for enhanced stress tolerance.

Wang, M., 2007. Diversity and evolution of resistance genes in tuber bearing Solanum species.

Ma, G., 2007. Iron and Zinc deficiencies in China: existing problems and possible solutions.

Wu, J., 2007. Paving the way for genetic improvement of zinc accumulation in *Brassica rapa*.

Yang, L., 2008. Integration of host plant resistance and biological control: using Arabidopsis-insect interactions as a model system.

Zhao, J., 2007. The Genetics of Phytate Content and Morphological Traits in *Brassica rapa*.

International refereed journal articles

Bonnema, A.B., Zhai Lin, Liang Qu, E. Jacobsen, 2006. Developing institutional collaboration between Wageningen University (WU) and the Chinese Academy of Agricultural Sciences (CAAS): the joint WU-CAAS sandwich PhD Program. *NJAS Wageningen Journal of Life Sciences 53:* 369-386.

Guo J., R.H.Y. Jiang, L.G. Kamphuis, F. Govers, 2006. A cDNA-AFLP based strategy to identify transcripts associated with avirulence in Phytophthora infestans. *Fungal Genetics and Biology 43:* 111-123.

Guo, J., T. van der Lee, D.Y. Qu, Y.Q. Yao, X.F. Gong, D.L. Liang, K.Y. Xie, X.W. Wang, F. Govers, 2009. Phytophthora infestans isolates from Northern China show high virulence diversity but low genotypic diversity. *Plant Biology 11:* 57-67.

Li, C.W. Y. Bai, E. Jacobsen, R. Visser, P. Lindhout, A.B. Bonnema, 2006. Tomato defense to the powdery mildew fungus: differences in expression of genes in susceptible, monogenic- and polygenic resistance responses are mainly in timing. *Plant Molecular Biology 62:* 127–140.

Li, C.W., A.B. Bonnema, D. Che, L. Dong, P. Lindhout, R. Visser, Y. Bai, 2007. Biochemical and molecular mechanisms involved in monogenic resistance responses to tomato powdery mildew. *Molecular Plant-Microbe Interactions 20:* 1161–1172.

Li, Y., G. Ma, E.G. Schouten, X.Q. Hu, Z.H. Cui, D. Wang, F.J. Kok, 2007. Report on childhood obesity in China (5) Body weight, body dissatisfaction, and depression symptoms of Chinese children aged 9-10 years. *Biomedical and Environmental Sciences 20:* 11-18.

Li, C.W., D.L Pei, W.J. Wang, Y.S. Ma, L. Wang, J.L. Liu, W. M. Zhu, 2008. First report of powdery mildew caused by Oidium neolycopersici on tomato in China. *Plant Disease 92:* 1370-1370.

Li, Y., X. Yang, F. Zhai, F.J. Kok, W. Zhao, J. Piao, J. Zhang, Z. Cui, G. Ma, 2008. Prevalence of the metabolic syndrome in Chinese adolescents. *British Journal of Nutrition 99:* 565-570.

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5.2 Programmes INREF phase II

phase II

5.2.1 Rebuilding Resilience of Coastal Populations and Aquatic Resources: habitats, biodiversity and sustainable use options (RESCOPAR)

Location

Vietnam and Indonesia

Main partner institutions

In Vietnam: Can Tho University.

In Indonesia: Mulawarman University, the Indonesian Institute of Sciences (LIPI), Bogor Agricultural University, and World Wildlife Fund.

In Thailand: Network of Aquaculture Centres Asia.

In the Netherlands: Wageningen University, Graduate Schools Wageningen Institute for Animal Sciences (WIAS), Production Ecology and Resource Conservation (PE&RC), Wageningen Institute for Environment and Climate Research (WIMEK), the Research School for Resource Studies for Development (CERES), and Mansholt Graduate School of Social Sciences (MG3S).

PhD students and their topics

The RESCOPAR programme started with 9 PhD students. These are, per research theme:

Theme 1: Spatial arrangements and temporal changes of aquaculture and fisheries activities in coastal aquatic ecosystems

Nguyen Huu Nghia. Trade-offs in coastal fisheries production, mangrove structure and extent and shrimp-culture in Ca Mau Province: a spatial modelling approach, Vietnam.

Audrie J. Siahainenia. Marine protected areas, shrimp farms and coastal fisheries in the Berau Delta, East Kalimantan: linkages through cascading effects, Indonesia.

Theme 2: Spatial interactions and resilience of shrimp pond – mangrove forest ecosystems

Tran Thi Tuyet Hoa. Spatial spread and virulence development of White Spot Syndrome Virus in cultured shrimp, Ca Mau, Vietnam.

Ngo Xuan Tuyen. Disease transmission of White Spot Syndrome Virus in cultured shrimp, Ca Mau, Vietnam.

Desrina Haryadi. Mechanistic analysis and (possible) optimisation of management measures on pond level and adjacent mangrove forest in East Kalimantan, Indonesia.

Theme 3: Trade-offs and feedback in resource use patterns, institutions and livelihoods

Tran Thi Phung Ha. Decision-making and change in coastal fish-based livelihoods in Ca Mau, Vietnam.

Rini Kusumawati. Coastal governance between decentralisation and trans-national forces in Eastern Kalimantan, Indonesia.

Theme 4: Governance arrangements facilitating change in aquatic resource use

Tran Thi Thu Ha. Global and local governance in Coastal Zone Management in the Mekong Delta, Vietnam.

Bambang Gunawan. Decision-making and livelihoods in East Kalimantan, Indonesia.

In addition to the INREF funding, 2 scholarships for PhD projects on themes related to RESCOPAR were acquired. Their names and topics are:

Bui Thi Minh Dieu. Molecular epidemiology and evolution of white spot syndrome virus (WSSV) in shrimp, Vietnam.

Eleonor Tendencia. The relation between pond management, mangrove ecosystem and disease outbreaks in shrimp (Penaeus spp.) farms in the Philippines, with particular reference to white spot syndrome virus WSSV.

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5.2.2 Competing Claims on Natural Resources: Overcoming mismatches in resource use through a multi-scale perspective (Competing Claims)

Location

Zimbabwe, South Africa, Mozambique and the Netherlands

Main partner institutions

In Zimbabwe: University of Zimbabwe; CIRAD-Zimbabwe office.
In South Africa: University of Witwatersrand, Johannesburg; University of KwaZulu Natal, Durban; Rhodes University, Grahamstown; Agricultural Research Council (ARC), Pretoria; University of Pretoria.
In Mozambique: Eduardo Mondlane University, Maputo.
In Botswana: University of Botswana, Gaberone.
In the Netherlands: Wageningen University, the Graduate Schools Wageningen Production Ecology and Resource Conservation (PE&RC), the Research School for Resource Studies for Development (CERES), Institute for Animal Sciences (WIAS), Mansholt Graduate School of Social Sciences (MG3S), Wageningen Institute for Environment and Climate Research (WIMEK); University of Twente, the Faculty of Geo-Information Science and Earth Observation (ITC).

PhD students and their topics

The division of the PhD students over the programme research sites and their topics are:

South Africa, Limpopo province

Yves van Leynseele. Competing claims, competing discourses – case studies of land claims in the Soutpansberg area.
Petronella Chaminuka: Balancing eco-tourism and livestock production: Implications for livelihoods and the environment in Limpopo province.
Abel Ramoelo: Predicting consumption of resources along the gradient of nutrients and moisture (regional study).

Mozambique, Gaza province

Jessica Milgroom. The role of social and technical innovations in resolving competing claims for natural resources.
Nicia Giva. Analysis and modelling of people–conservation interface: Simulating alternative futures using modelling tools on natural resources management negotiations. The case of Limpopo National Park (LNP).
Armino Cambule. Soil carbon distribution and change as an indicator of land quality, sustainability and viability of land use in southern Africa (regional study).

Zimbabwe, Southeastern lowveld

Chrispen Murungweni. Vulnerability and resilience of competing land-based livelihoods in South-eastern Zimbabwe.
Xavier Poshiwa. Redressing asymmetry in resource allocation through co-operation among livestock & wildlife systems.
Edward Mufandaedza. Forest and People interactions: Who is at risk?
Edson Gandiwa. Human effects on tropical savanna multi-species wildlife communities, southeast lowveld, Zimbabwe.
Chaka Chirozva. Knowledge encounters, power and participation in governance of natural resources: experiences from communities in the Great Limpopo Transfrontier Conservation Area.

Zimbabwe, Zambezi Valley

Steven Matema. Livestock and concerted action in the face of competing interests.
Frédéric Baudron. Integrated evaluation of conservation agriculture (CA) technologies using multipurpose grain legumes (MGL) to improve productivity and sustainability of cotton-cereal systems.

Linked PhD projects (Competing Claims site(s) as case study)

Dirk van Apeldoorn. Modelling resilience of agro-ecosystems: Transformability in the Great Limpopo Transfrontier Park.
Marc Schut. Mobilization of knowledge in Competing Claims contexts: Enhancing the contribution of science to resource-use negotiations.

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5.2.3 Partnership for Research on Viable Environmental Infrastructure Development in East Africa (PROVIDE)

Location
Kenya, Uganda and Tanzania

Main partner institutions
In Tanzania: University college of Land and Architectural Studies, Dar es Salaam; ILO-East Africa.
In Uganda: Makerere University of Environment and Natural Resource, Kampala; National Environmental Management Authority.
In Kenya: Kenyatta University, Nairobi; Practical Action, Nairobi; UN-Habitat.
In The Netherlands: Wageningen University, the Graduate Schools Wageningen Institute for Environment and Climate Research (WIMEK) and Mansholt Graduate School of Social Sciences (MG3S); WASTE advisers on urban environment and development, Leiden.

PhD students and their topics
Maurice Owino Onyango. Transitions in solid waste governance in East Africa.
Christine Lucy Majale. Developing an integrated conceptual and methodological approach to develop mixed-modern urban environmental infrastructures that fit in the conditions and needs of communities in East African cities.
Mesharch Walto Katusiimeh. Assessing national policies in East Africa on urban environmental infrastructure and the consequences of different types of public-private partnership-based management systems for urban waste and sanitation on access for the poor.
Richard Oyoo. Multi-scale integrated modelling of environmental flows of solid waste and wastewater in medium-sized cities of East Africa.
Judith Tukahirwa. Assessing the (potential) roles of NGOs and CBOs in public-private arrangements in urban sanitation and waste management.
Thobias Bigambo. Designing and testing of innovation systems for excreta collection, treatment and disposal for urban low income communities in East Africa.
Frederick Salukele. What are the current practices of waste collection, treatment and recycling in East Africa communities with respect to their environmental, technological and institutional resilience?
Aisa Oberlin. Review the socio-technical systems for solid waste, excreta and waste water collection, treatment and re-use at urban level in East Africa.
Sammy Letema. Urban environmental governance: review the implementation of national policies on sanitation and solid municipal waste management at urban level: institutions, regulations and practices.
Frederick Owegi. The economics of sanitation in Kibera slums, Nairobi, Kenya.

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5.2.4 Tailoring Food Sciences to Endogenous Patterns of Local Food Supply for Future Nutrition (TELFUN)

Location
India, Ghana/Benin, Ecuador

Main partner institutions
In India: Haryana Agricultural University.
In Ghana/Benin: Crops Research Institute, University of Legon, Science and Technology Policy Research Institute (all three in Ghana); Université d'Abomey-Calavi (Benin).

In Ecuador: Escualea Politechnica National.
In the Netherlands: Wageningen University, the Graduate Schools Food Technology, Agrotechnology, Nutrition and Health Sciences (VLAG), and C. T. de Wit Graduate School for Production Ecology and Resource Conservation (PE&RC).

PhD students and their topics

Four generic research themes are defined, which will be addressed in all 3 countries by the groups of PhD students. The themes are:
Theme 1: Strengthening the reconnection of agriculture and natural ecosystems for legumes within the Vavilov Centres to strengthen local food networks;
Theme 2: Technological options for the production of enriched, mungbean, cowpea, and Lupine-based foods geared to consumer sensory preferences;
Theme 3: Improvement of nutrition through improved legume-based products in India, Ghana/Benin and Ecuador;
Theme 4: Tailoring of science and technology to the needs of three local food networks and to enhance food sovereignty in India, Ghana/Benin and Ecuador.

In India

Renu Boora Singh. Development of iron/zinc enriched mungbean varieties with MYMV resistance.
Pradeep Dahiya. Technological options for the production of Mung bean based food geared to consumer preferences.
Varsha Dangi Rani. The efficacy of local vitamin-C rich fruit (Guava) in improving iron absorption from mundal and its effect on iron status of rural Indian children.
Shweta Singh, Tailoring food sciences to endogenous pattern of local food supply for future nutrition.

In Ghana/Benin

Kwadwo Adogo. Participatory breeding for local food network: the role of the Ghanaian cowpea genetic diversity.
Yann Madode. Technological options for enhancing the nutritional status of West African population using local cow-pea-based foods.
Abdul-Razak Abizari. Improving nutritional status of school children through consumption of cowpea – an opportunity for strengthening food sovereignty in Northern Ghana?
Wilhelmina Quaye. Tailoring food sciences to endogenous pattern of local food supply for better future nutrition.

In Ecuador

Cesar Falconi. Lupinus mutabilis in Ecuador with special emphases on anthracnose resistance.
Francisco Carvajal Larenas. Technological options for the production of enriched lupine-based foods geared to consumer sensory preferences and nutritional status.
Maria Elisa Herrera Fontana. Improvement of iron absorption from "Mi Papilla formula", a fortified complementary food using natural phytase as a complementary cereal.
Flores Luz Alexandra Martinez. Networking food sovereignty in Cotopaxi, Ecuador.

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5.2.5 Co-Innovation for Quality in Agrifood Chains

Location

Benin, Ethiopia, South Africa

Main partner institutions

In Benin: Université d'Abomey-Calavi, Cotonou.
In Ethiopia: Hawassa University, Hawassa.
In South Africa: University of Fort Hare, Alice.
In the Netherlands: Wageningen University, the Mansholt Graduate School of Social Sciences (MG3S), Graduate School Food Technology, Agrobiotechnology, Nutrition and Health (VLAG), and C.T. de Wit Graduate School of Production Ecology and Resource Conservation

(PE&RC); Radboud University Nijmegen, Centre for International Development Issues Nijmegen (CIDIN); AgroFair; Oxfam Novib; Hivos.
International partners: International Institute of Tropical Agriculture (IITA, Benin-office); International Food Policy Research Institute (IFPRI); International Potato Centre (IPC, Sub Sahara Africa regional office).

PhD students and their topics

In South Africa

Bukelwa Grwambi. Innovations in structure, coordination and support services in the South-African deciduous fruits supply chain to improve market access for emerging entrepreneurs.
Misery Sikwela. Citrus export standards, chain structure and smallholder welfare in South Africa.

In Benin

Vodjo Nicodème Fassinou Hotegni. Using agronomic and logistic tools to improve the synchronisation, quality and uniformity of pineapple in Benin produced for local and international markets.
Adémonla Alamou Djalalou-Dine Arinloye. Creating value-adding co-innovations in local, regional and export pineapple supply chains.
Harold Menouwesso Hounhouigan. Processing and marketing of pineapple – a case study on quality performance in the pineapple chain in Benin.

In Ethiopia

Adane Hirpa Tufa. An integrated economic and agronomic analysis of potato seed supply chains in Ethiopia.
Temesgen Mangule Olango. Developing ware potatoes with improved quality in Ethiopia.
Gumataw Kifle Abebe. Quality coordination in the Ethiopian potato chain: The impact of different governance models.

Postdoc

Dr. Annie Royer. The effect of institutional conditions on macro and meso level on the development and introduction of integrated quality solutions.

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5.2.6 Terra Preta do Indio – Recovering the Past, Regaining the Future of Amazonian Dark Earths (CoQA)

Location

Brazil, Bolivia, Peru, Colombia

Main partner institutions

In Brazil: Empresa Brasileira de Pesquisa Agropecuária; Universidade Federal do Amazonas; Instituto Nacional de Pesquisas da Amazônia; Universidad Federal do Pará; Universidade de São Paulo.
In Bolivia: Instituto Boliviano de Investigación Forestal.
In Peru: Instituto de Investigaciones de la Amazonía Peruana.
In Colombia: Universidad Nacional de Colombia.
In the Netherlands: Wageningen University, the C.T. de Wit Graduate School for Production Ecology & Resource Conservation (PE&RC), Research School for Resource Studies for Development (CERES), Wageningen Institute for Environment and Climate Research (WIMEK), and Mansholt Graduate School for Social Sciences (MG3S).

PhD students and their topics

The PhD students will be recruited in 2010.

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Journey into Interdisciplinarity
Ten years of INREF experience

In 2000, the Executive Board of Wageningen University, part of Wageningen UR, established the Interdisciplinary Research and Education Fund (INREF) as a university-wide programme for development-related research and education. The initiative ensued from the evaluation of an earlier university-wide programme, the Satellites Programme, in the 1980s-90s and a reflection on the university's role in a changing world.

The international developments made clear that a more far-fetched interdisciplinary approach was needed to tackle the world's pressing development related problems. While launching the INREF programme, it was decided that the projects funded out of it should: (i) embrace a systems approach combining all disciplines required to tackle the development problems at which they were aimed; (ii) involve activities in several regions of the world to allow comparison of major differences in conditions that affected development; (iii) co-operate right from the start with partners in the countries concerned, with a view to local capacity building; (iv) involve cohorts of PhD projects of the 'sandwich' type to enhance interdisciplinarity and mutual learning; and (v) pay adequate attention towards relevance of results obtained.

From 2000 onwards, twelve INREF programmes have been approved for INREF funding, of which six are completed. This booklet describes all twelve INREF programmes. The individual programmes – which have certainly not been without their challenges – show concrete, sometimes unexpected results thanks to their innovative approach. In addition, lessons learned and challenges ahead concerning interdisciplinary research, based on ten years of INREF experience, are highlighted.



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