LES ACTIONS DE LA DGCD DE ACTIVITEITEN VAN DE DGOS

DGDC'S ACTIVITIES LAS ACTIVIDADES DEL DGCD

Agriculture at a Crossroads: International Assessment of Agricultural Knowledge, Science and Technology for Development

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The NGO coalition «2015 De Tijd Loopt» and the «Coalition against Hunger » organized a round table on the report 'International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), on the 1st of April 2009 in the Belgian federal parliament.
This report is an initiative of the United Nations, the World Bank and the Global Environment Facility. Four hundred experts from all over the world examined how we can make better use of agricultural sciences, knowledge and technology in the battle against hunger and poverty, and to stimulate more sustainable development. How can the conclusions and recommendations of this report also be useful for Belgian policies against hunger?
The role of Belgium in the babble against hunger was discussed by NGOs, BTC, DGDC, agricultural researchers and representatives from the cabinet of the minister for development cooperation.
The contribution by Mrs. Saartje Boutsen who works as advocacy officer for the Belgian NGO Vredeseilanden[2], is based on the '*Executive Summary of the IAASTD Synthesis Report' and 'the Global Summary for Decision Makers'.*

Summary

The International Assessment of Agricultural Science and Technology for Development (IAASTD) is a unique international effort that evaluates the relevance, quality and effectiveness of agricultural knowledge, science, and technology (AKST), the effectiveness of public and private sector policies as well as institutional arrangements in relation to AKST. The purpose of IAASTD is to assess the impact of AKST on hunger, poverty, nutrition, human health, and environmental and social sustainability, in order to formulate options for actions to use AKST more effectively to facilitate sustainable development. The IAASTD report concludes that business as usual is not an option, successfully meeting development and sustainability goals and responding to new priorities and changing circumstances would require a fundamental shift in agricultural knowledge, science, and technology.

Résumé

Agriculture à la croisée des chemins: évaluation internationale des connaissances, des sciences et des technologies agricoles pour le développement
Le rapport de l'évaluation internationale des connaissances, des sciences et des technologies agricoles pour le développement (IAASTD) est un effort international unique pour évaluer la relevance, qualité et l'efficacité des connaissances agricoles, des sciences et des technologies (AKST), l'efficacité des politiques des secteurs privés et publics tout comme les accords institutionnels par rapport aux AKST. L'objectif de l'IAASTD est d'évaluer l'impact des AKST sur la faim, la pauvreté, la nutrition, la santé humaine, la durabilité environnementale et sociale, en vue de formuler des actions pour utiliser ces AKST plus efficacement pour faciliter le développement durable. Le rapport de l'IAASTD conclut que la manière de faire habituelle n'est pas une option. Pour atteindre les objectifs de développement durables et répondre aux nouvelles priorités et changements actuels, il faut opérer un tournant fondamental dans les connaissances agricoles, les sciences et les technologies.

Introduction

The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) was initiated in 2002 by the World Bank and the Food and Agriculture Organization of the United Nations (FAO) as a global consultative process to determine whether an international assessment of agricultural knowledge, science and technology was needed. The first Intergovernmental Plenary was held in Nairobi in 2004, and the outputs from this assessment ware a global and five Sub-Global summaries for decision makers, and a cross-cutting Synthesis report with an Executive Summary. The reports draw on the work of hundreds of experts from all regions of the world who have participated in the preparation and peer review processes. The summaries for decision makers and the synthesis report specifically provide options for actions to governments, international agencies, academia, research organizations and other decision makers around the world. This contribution highlights the key findings of the report and gives an introduction to options for action.

Key findings

1. Agricultural Knowledge, Science and Technology has contributed to substantial increases in agricultural production over time, contributing to food security. This has been achieved primarily through a strong focus on increasing yields with improved germplasm, and increased inputs (water, agrochemicals) and mechanization. These increases in productivity have contributed to a net increase in global food availability per person: from 2360 kcal in the 1960s to 2803 kcal per person per day in the 1990s, at a time when world population significantly increased.

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2. People have benefited unevenly from these yield increases across regions, in part because of different organizational capacities, sociocultural factors, and institutional and policy environments. While in South Asia the percentage of people living in poverty (<US$ 2 per day) has decreased from 45 to 30%, in sub-Saharan Africa (SSA), for example, this percentage (around 50%) has remained the same over the last 20 years. Value added per agricultural worker in 2003 (in 2000 US$) in OECD countries was 23,081 with a rate of growth of 4.4% for 1992-2003. For SSA, the figures are respectively 327 and 1.4%.

3. Emphasis on increasing yields and productivity has in some cases had negative consequences on environmental sustainability. These consequences were often not foreseen as they occurred over time and, some occurred outside of traditional farm boundaries. For instance, 1.9 billion ha (and 2.6 billion people) today are affected by significant levels of land degradation. Fifty years ago water withdrawal from rivers was one-third of what it is today: currently 70% of freshwater withdrawal globally (2700 km^3 – 2.45% of rainfall) is attributable to irrigated agriculture, which in some cases has caused salinization. Approximately 1.6 billion people live in water-scarce basins. Agriculture contributes about 60% of anthropogenic emissions of CH_4 and about 50% of N_20 emissions. Inappropriate fertilization has led to eutrophication and large dead zones in a number of coastal areas, e.g. Gulf of Mexico, and some lakes, and inappropriate use of pesticides has lead to groundwater pollution, and other effects, for example loss of biodiversity.

4. The environmental shortcomings of agricultural practice associated with poor socioeconomic conditions create a vicious cycle in which poor smallholder farmers have to deforest and use new often marginal lands, so increasing deforestation and overall degradation. Loss of soil fertility, soil erosion, breakdown in agroecological functions have resulted in poor crop yields, land abandonment, deforestation and ever-increasing movement into marginal land, including steep hillsides. Existing multifunctional systems that minimize these problems have not been sufficiently prioritized for research. There is little recognition of the ecosystem functions that mitigate the environmental impacts.

5. Projections based on a continuation of current policies and practices indicate that global demographic changes and changing patterns of income distribution over the next 50 years will lead to different patterns of food consumption and increased demand for food. In the reference run, global cereal demand is projected to increase by 75% between 2000 and 2050 and global meat demand is expected to double. More than three-fourths of growth in demand in both cereals and meat is projected to be in developing countries. Projections indicate a probable tightening of world food markets with increasing resource scarcity adversely affecting poor consumers and poor producers. Overall, current terms of trade and policies, and growing water and land scarcity, coupled with projected changes in climate is projected to constrain growth in food production.

6. Agriculture operates within complex systems and is multifunctional in its nature. A multifunctional approach to implementing AKST will enhance its impact on hunger and poverty, improving human nutrition and livelihoods in an equitable, environmentally, socially and economically sustainable manner.

7. An increase and strengthening of AKST towards agroecological sciences will contribute to addressing environmental issues while maintaining and increasing productivity. Formal, traditional and community-based AKST need to respond to increasing pressures on natural resources, such as reduced availability and worsening quality of water, degraded soils and landscapes, loss of biodiversity and agroecosystem function, degradation and loss of forest cover and degraded marine and inshore fisheries. Agricultural strategies will also need to include limiting emission of greenhouse gases and adapting to human-induced climate change and increased variability.

8. Strengthening and redirecting the generation and delivery of AKST will contribute to addressing a range of persistent socioeconomic inequities, including reducing the risk of conflicts resulting from competing claims on land and water resources; assisting individuals and communities in coping with endemic and epidemic human and animal diseases and their consequences; addressing problems and opportunities associated with local and international flows of migrant laborers; and increasing access to information, education and technology to poorer areas and peoples, especially to women. Such redirection and strengthening requires thorough, open and transparent engagement of all stakeholders.

9. Greater and more effective involvement of women and use of their knowledge, skills and experience will advance progress towards sustainability and development goals and a strengthening and redirection of AKST to address gender issues will help achieve this. Women farmers, processors and farm workers have benefited less from AKST than men overall and poor women least of all. Efforts to redress persistent biases in their access to production resources and assets, occupational education and training, information and extension services have met with limited success. Many of the societal, policy-related and operational impediments to more equitable progress, as well as the private and public costs of such an uneven pattern of development, are well understood as are the factors that discourage more determined action to empower women.

10. Many of the challenges facing agriculture currently and in the future will require more innovative and integrated applications of existing knowledge, science and technology (formal, traditional and community-based), as well as new approaches for agricultural and natural resource management. Agricultural soil and biodiversity, nutrient, pest and water management, and the capacity to respond to environmental stresses such as climate change can be enhanced by traditional and local knowledge systems and current technologies. Technological options such as new genotypes of crops, livestock, fish and trees and advances in plant, livestock and fish breeding, biotechnology, remote sensing, agroecology, agroforestry, integrated pest and nutrient management and information and communication technologies (ICTs) will create opportunities for more resource-efficient and site-specific agriculture.

11. Some challenges will be resolved primarily by development and appropriate application of new and emerging AKST. Such AKST can contribute to solutions provided appropriate institutions and capacities are in place. Examples include

combating livestock diseases, e.g. vaccine development; mitigating greenhouse gas emissions from agriculture; reducing the vulnerability of agriculture to a changing climate; reducing the heavy reliance of agriculture and commodity chains on fossil fuels; and addressing complex socioeconomic issues regarding local, national and international public goods.[2, 1[3]]

12. Targeting small-scale agricultural systems by forging public and private partnerships, increased public research and extension investment helps realize *existing* opportunities. Strengthening participatory research and extension partnerships, development-oriented local governance and institutions such as cooperatives, farmer organizations and business associations, scientific institutions and unions support small-scale producers and entrepreneurs to capture and add value to existing opportunities on-farm, post-harvest and in non-farm rural enterprises. In some instances, opportunities lie in those small-scale farming systems that have high water, nutrient and energy use efficiencies and conserve natural resources and biodiversity without sacrificing yield, but high marketing costs do not allow them to harness these opportunities. The underlying principles, processes and knowledge may be relevant and capable of extrapolation to larger scale farming systems, particularly in the face of climate change effects.

13. Significant pro-poor progress requires creating opportunities for innovation and entrepreneurship, which explicitly target resource poor farmers and rural laborers. This will require simultaneous investments in infrastructure and facilitating access to markets and trade opportunities, occupational education and extension services, capital, credit, insurance and in natural resources such as land and water. The increasing market influence of large scale buyers and market standards are especially challenging for small producers necessitating further innovation in public and private training, education and extension services and suitable legal, regulatory and policy frameworks.

14. Decisions around small-scale farm sustainability pose difficult policy choices. Special and differential treatment for developing countries is an acknowledged principle in Doha agricultural negociations and it is accepted that developing countries can have this special treatment especially on the grounds of food security, farmer's livelihoods and rural development. Suitable action is considered necessary at the international and national level to enable small farmers to benefit from these provisions. New payment mechanisms for environmental services by public and private utilities such as catchment protection and mitigation of climate change effects are of increasing importance and open new opportunities for the small-scale farm sector.

15. Public policy, regulatory frameworks and international agreements are critical to implementing more sustainable agricultural practices. Urgent challenges remain that call for additional effective agreements and bio-security measures involving transboundary water, emerging human and animal diseases, agricultural pests, climate change, environmental pollution and the growing concerns about food safety and occupational health. Achieving development and sustainability goals calls for national and international regulations to address the multiple economic, environmental and social dimensions of these transboundary issues. These policies need to be informed by broad-based evidence from natural and social sciences with multistakeholder participation. Improved governance and strengthening engagement of stakeholders can redress some of the inadequacies where identified in AKST arrangements that often privilege short-term over long-term considerations and productivity over environmental and social sustainability and the multiple needs of the small-scale farm sector.

16. Innovative institutional arrangements are essential to the successful design and adoption of ecologically and socially sustainable agricultural systems. Sustainable agricultural production is more likely when legal frameworks and forms of association provide secure access to credit, markets, land and water for individuals and communities with modest resources. Creating market-based opportunities for processing and commercializing agricultural products that ensure a fair share of value addition for small-scale producers and rural laborers is critical to meeting development and sustainability goals.

17. Opening national agricultural markets to international competition can offer economic benefits, but can lead to long term negative effects on poverty alleviation, food security and the environment without basic national institutions and infrastructure being in place. Some developing countries with large export sectors have achieved aggregate gains in GDP, although their small-scale farm sectors have not necessarily benefited and in many cases have lost out. The small-scale farm sector in the poorest developing countries is a net loser under most trade liberalization scenarios that address this question. These distributional impacts call for differentiation in policy frameworks as embraced by the Doha work plan (special and differential treatment and non-reciprocal access). Developing countries could benefit from reduced barriers and elimination of escalating tariffs for processed commodities in developed and developing countries; and they could also benefit from reduced barriers among themselves; deeper generalized preferential access to developed country markets for commodities important for rural livelihoods; increased public investment in local value addition; improved access for small-scale farmers to credit; and strengthened regional markets.

18. Intensive export oriented agriculture has increased under open market operations but has been accompanied by both benefits and adverse consequences depending on circumstances such as exportation of soil nutrients and water, unsustainable soil or water management, or exploitative labor conditions in some cases. AKST innovations that address sustainability and development goals would be more effective with fundamental changes in price signals, for example, internalization of environmental externalities and payment or reward for environmental services.

19. The choice of relevant approaches to adoption and implementation of agricultural innovation is crucial for achieving development and sustainability goals. There is a wide range of such approaches in current use. In the past, most AKST policy and practice in many countries were undertaken using the 'transfer of technology' approach. A critical decision for AKST stakeholders is the selection of approaches suited to the advancement of sustainability and development goals in different circumstances.

20. More and better targeted AKST investments, explicitly taking into account the multifunctionality of agriculture, by both public and private sectors can help advance development and sustainability goals. Increased investments in AKST, particularly if complemented by supporting investments in rural development (for example, infrastructure, telecommunications and processing facilities) can have high economic rates of return and reduce poverty. AKST investments also generate environmental, social, health, and cultural impacts. More evidence is needed on the actual levels and distributional effects of the economic and non-economic benefits and costs of these investments for better targeting of future AKST investments.

21. While public private partnerships are to be encouraged the establishment and enforcement of codes of conduct by universities and research institutes can help avoid conflicts of interest and maintain focus on sustainability and development in AKST w**hen private funding complements public sector funds.** Government capacity to understand, and where necessary mediate public/private partnerships, can be assisted for instance by means of monitoring systems.

22. Achieving sustainability and development goals will involve creating space for diverse voices and perspectives and a multiplicity of scientifically well-founded options, through, for example, the inclusion of social scientists in policy and practice of AKST helps direct and focus public and private research, extension and education on such goals. Diverse and conflicting interpretations of past and current events, coupled with the under-valuation of different types of AKST limit progress in the field. Understanding the underlying sources of competing interpretations of AKST is crucial to addressing goals. Some interpretations have been privileged over others and have helped push formal AKST along certain pathways, to the neglect of other scientifically sound options. Some of the by-passed options originate in traditional knowledge or civil society experience and may be better able to contribute to poverty reduction, social inclusion, equity and generate multifunctional outcomes.

Options for Action

Many of the challenges facing agriculture over the next 50 years will require more integrated application of existing science and technology development (formal, traditional and community-based) as well as new approaches for agricultural and natural resource management. Other challenges will only be resolved by development and application of new AKST.

The question of which strategies will be best suited to advance development and sustainability goals is controversial and reflects different social and political assumptions, interests and values. In many areas of science and technology discourse, the tendency is for a single interpretation, which attributes cause and effect to some events or situations and not to others. This selectivity has important implications for projecting science in specific directions. Acknowledging competing well-supported narratives of science and technology approaches is crucial for designing effective policies. In many cases, AKST strategies that recognize the multiple functions required of sustainable agricultural systems (e.g. production, livelihoods, ecosystem services) already exist and some AKST recognizes the biophysical, socioeconomic and cultural diversity among agriculture systems that necessitate domain-specific solutions. For example, community-based innovation and local knowledge combined with formal AKST approaches, such as agroecology and agroforestry, can address issues relevant to rural poor people.

By integrating expertise from other sectors there is more potential to develop solutions that increase productivity, protect natural resources and livelihoods and minimize agriculture's negative impact on the environment. Knowledge and technology from sectors such as communication, energy and health, as well as culture and arts can enhance the capacity of agriculture to contribute to reaching development and sustainability goals. Farmers need a choice of options to respond to challenges, given their diverse needs and resources, and to address the increasing complexity of stresses under which they operate.

Creating such opportunities requires more targeted changes, such as providing poor farmers in developing countries with infrastructural and institutional support (e.g. access to land and water, transport facilities, AKST, market information, entry into higher value markets, protection from unfair competition) food stockholding policies, and agreements between consumers in industrialized economies and producers in developing countries, as well as support to farmers organizations and for farmer to farmer arrangements within and between countries.

The need is urgent to develop and retain knowledge in the agricultural sector. Local authorities, national governments and international organizations can facilitate and develop capacity by investing in education and by promoting new skills and technologies among all farming communities. Policy options include 1) reforming curricula at all levels to improve the attractiveness and societal relevance of agricultural studies; 2) increasing access to technology education and science – informed farm and agroecosystem management knowledge to all those working in the agricultural sector; 3) improving collaboration between ministries (agriculture, water, environment, education) and universities; 4) developing infrastructure to facilitate the use of information and communications technology (ICT) in informal and formal education systems; 5) mobilizing funds from a variety of sources to support agricultural education reform; and 6) encouraging university participation in recovering and recognizing traditional and local knowledge and including the participation of traditional knowledge actors in curricula design.

For the full report (available in different languages) and more information: www.agassessment.org

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Development Cooperation Prize

The Development Cooperation Prize is annual incentive prize - financed by the Belgian Development Cooperation (DGDC) and organized by the Royal Museum for Central Africa - for students and young researchers, from Belgium or developing countries, whatever their discipline. The prize is awarded to scientific works that contribute significantly to knowledge that can be applied to development in the South. Sustainable development is to be their principal aim and poverty alleviation a priority. The prizes are attributed to Bachelor's and Master's theses, postgraduate papers, Ph.D. theses, or publications in scientific journals.

In the course of the years of the prize existence, the fields represented among the participants has remained more or less stable: the majority of files represent the exact sciences - with a very large share originating from the agricultural and applied biological sciences, followed by the human sciences and biomedical and veterinary sciences.

The prize is granted to maximum 14 students and 6 researchers and consists of an award of 1,250 € for students and 2,500 € for young researchers. Since 1998 the awards have been handed over by the Minister for Development Cooperation during a ceremony in the Royal Museum for Central Africa. The laureates from abroad are invited to Belgium especially for this occasion. Many use their stay in Belgium to establish or renew contacts with the Belgian academia in thier fields of interest.

Five abstracts regarding the accomplishment of laureates from Burkina Faso, Cameroon, Belgium and Senegal awarded in 2007 are presented below.

Recovering Waste from the Slaughterhouses and Garbage Dumps of the City of Ouagadougou for Agronomic Purposes: Characteristics, Effects on Maize Crops and on the Soil in the Experimental Station

Delwendé Innocent Kiba*

Mr. Kiba's work on recovering waste from slaughterhouses and garbage dumps for agronomic purposes has the tremendous merit of tying together two fundamental concerns in developing countries in general and in his own country, Burkina Faso, in particular; that is, the management of organic waste and the crucial needs of cultivated soils. These problems are often dealt with separately, and solutions proposed as such lead down blind alleys, just the opposite of sustainable development.
What is at stake here? First of all, the management of waste, the great plague of developing countries, most of which is non-recyclable because of contamination by organic substances. The recovery of organic waste, preferably unmixed with other kinds of refuse, for soil improvement, is the solution for waste in the future. Secondly, only organic substances can improve the structure of soils subjected to gradually declining stability and fertility.
However, just putting any waste in the soil does not produce that miracle. High quality organic waste is required, and Mr. Kiba rightly recommends that waste products be composted. Indeed, if used in their crude state, those waste products do not really improve productivity and may even reduce it, owing to their phytotoxicity. Composting eliminates these problems. Mr. Kiba also clearly shows that the organic substances in waste improve plant retention of added chemical fertilizers. As Mr. Kiba so judiciously recommends, the use of chemical fertilizers should therefore be preceded or accompanied by an input of organic matter.
Enriching cultivated soil with waste products not only improves agricultural produce and stabilizes the structure of the soil, but it is also an intelligent way of managing organic wastes by returning them to the natural cycle of materials, and it therefore perfectly integrates the principles of sustainable development.

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Evaluation of the Degree of Synergy between Fractions of Essential Oils of *Cymbopogon citratus, Ocimum gratissimum* and *Thymus vulgaris* against *Penicillium expansum*

Ousman Tamgue*

Mr Ousman Tamgue has submitted a thesis in which he puts forward the use of mixtures of fractions of essential oils to prevent rotting in many fruits and vegetables and in particular apples infected with the *Penicillium expansum*. This fungus, moreover, produces patulin, a mycotoxin that is particularly harmful to human and animal health.
The originality of this study lies in that he uses common plants as a source of active substances and then observes a greater fungicidal activity in the fractions that contain oxygenated terpenes. The study also shows – and therein lies its great originality – that the fractions that have weak or strong antifungal activity can, if judiciously mixed, generate products whose activity is strongly increased. In other cases, the mixture of fractions (even the most active) can lead to negative effects.
In addition, the products preserve the original organoleptic properties in the fruit and vegetables that have been protected in this way.
The research has been extremely well carried out and the most modern methods of analysis have been judiciously implemented.

Analysis of the Free Grazing Abandonment Programme: A Case Study in a Village in Tigray, Ethiopia

Lutgart Lenaerts**

Ethiopia has the largest number of livestock in Africa. The study carried out by Lutgart Lenaerts focuses on the region of the high plateaus of Tigray, where population density is high and cattle breeding is a substantial source of income for the peasant population. Since the 1980s, however, the productivity of cattle breeding has been decreasing in the area. The land has become State property and the farmers have right of usage on very fragmented plots of land. Given these conditions, they are reluctant to invest in soil and natural resources conservation technologies.
A large-scale project entitled “Free Grazing Abandonment” has been underway since 2004 under the auspices of the Ministry of Agriculture and Natural Resources. It aims to discourage the farmer’s method of using “free access” to grazing-land resources. Overgrazing and soil degradation are, therefore, reduced, in the first instance by designating “protected” areas, which are controlled by village caretakers, and also by the reduction of free-grazing livestock, particularly during the dry season, the production of (shrub) forage and the promotion of breeding livestock in stables.
The environmental situation in the region justifies State intervention. However, Lutgart Lenaerts demonstrates that the project is proving technically inappropriate and in any case insufficiently complex to be able to accommodate all the constraints that affect the breeders’ decision whether or not to accept the innovation. Furthermore, the project, because it is obligatory and authoritative, reinforces the inequalities between families in the same village by granting resources to farmers who are considered “model” farmers, while they are in fact already the most affluent.
Thanks to a remarkably executed case study involving different breeders from one village, the author explains that, given the facts, this project is a failure. The ‘protected’ areas are not respected by the local people and when they do participate, their participation is fictitious as it is linked either to the intervention of foreign NGOs or to the hope of a per diem, food, seed, or even loyalty to the ruling party. Furthermore, the analysis of the caretakers of the “protected” areas is particularly well done and informative. It shows the ambivalence in which the project puts these people, to the extent where these farmers become a kind of police for their own brothers, in the hope of receiving a modest salary from the project organizers for this work, which they will in fact never receive.
In short, this is a remarkable case study that rests on a knowledge of zootechny, grazing management, and erosion prevention, as well as on an excellently carried out socio-anthropological analysis together with clear, lively and concise writing. A research study of a high standard, which I recommend reading.

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(report: Prof. A. Krief, Laboratory of Synthetic Organic Chemistry, Faculté Notre-Dame de la Paix, Namur, Belgium).

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(report: Prof. P.-J. Laurent, Laboratory for Prospective Anthropology, Université Catholique de Louvain, Louvain-la-Neuve, Belgium).

Pedological and Hydrological Effects of Vegetation Restoration in Exclosures Established on Degraded Hillslopes in the Highlands of Northern Ethiopia"

Katrien Descheemaeker*

Land degradation is a major problem in areas with high population pressure. Disruption of soil and natural vegetation reduces the availability of nutrients and water, endangering the sustainable use of the land area available. The northern Ethiopian highlands are an example of an area where land degradation has become a serious threat. Since the mid '70s various strategies have been tested and applied in this region to limit further degradation or to repair degraded areas. One of the measures put into effect is the creation of "exclosure" areas where burdensome activities such as grazing are restricted or prohibited, so that natural vegetation can regenerate.
Katrien Descheemaeker's study evaluates the effectiveness of the use of exclosures for soil and water conservation. The research consists of a comparison between exclosures of various ages and a further comparison between these areas and untouched zones and degraded grazing lands. A large number of relevant characteristics were determined for the selected sites. The pedological study within each lot, with particular attention for sediment deposition from erosion areas and for the accumulation and transformation of organic matter on the soil surface, shows that the chemical and physical quality of the soil is improved by exclosures. The study of the hydrological balance, with measurements for soil moisture, runoff and evapotranspiration, indicates that the infiltration of water increases in exclosure areas, increasing vegetation restoration in the area and reducing soil degradation around the area. A third part of the work demonstrates that diverting gullies to exclosure areas further optimizes the rehabilitation of degraded areas.
The author presents an extensive inventarization and analysis of the changes that result from exclosure. The quality of the research is very high in all respects, from fieldwork to data analysis. Some sections of the thesis had already been published in international journals, and are now integral parts of a coherent whole. The work concludes with practical recommendations for the creation and management of exclosures, and other parts of the work also show concern for the social relevance of the research findings. This focus and the broad applicability of the results in tropical and subtropical areas give the work high developmental relevance.

Microbiological, Biochemical and Genetic Potential of Freeze-Dried Starter Cultures of Acetic Acid Bacteria Isolated from Tropical Products Found in Sub-Saharan Africa and Intended for Use in the Production of Vinegar

Bassirou Ndoye**

In this doctoral thesis Bassirou Ndoye describes the isolation and description of bacterial strains suitable for the production of vinegar from local products under tropical conditions in sub-Saharan countries such as Burkina Faso and Senegal. Because the strains selected can grow and can produce vinegar at higher temperatures compared to traditional bacterial strains, there is less need for refrigeration and the process of fermentation is made more energy-efficient and sustainable. The selection of suitable strains is in itself meritorious, but is only a stepping-stone to the final goal of the thesis. This is to show through fermentations on a pilot scale that the concept proposed really works and is practicable for the local production of vinegar. Attention is also given to another possible problem, that of the storage and perishability of the bacterial starter cultures.
The developmental relevance of the thesis is clear and is always at the forefront of the work: vinegar is an important and much-used food ingredient in the countries of this region, but for the most part it is currently imported. The new bacterial strains and the newly developed process can reduce dependence on imported acetic acid. Given the relatively low threshold for implementation, the new process can make a significant contribution to the reduction of poverty. The work has in the meantime already led to the establishment of a production unit for mango vinegar in Senegal.
From a more fundamental scientific perspective the work is innovative and of high quality. The detailed study of the numerous microbial strains isolated produces many new insights into the qualities and the behaviour of this remarkable group of bacteria. In the framework of a doctorate with applied finality, the research carried out is of very high quality across the board, and the crown of the work is the publication of the research results in four articles in reputable international journals in the field.

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