



# Agris Mundus Master of Science in Sustainable Development in Agriculture

## BOOK OF ABSTRACTS

*Edited by:* Stephen Onakuse, Didier Pillot, Andreas de Neergaard, Erik Heijmans,  
Luisa Biondi, Carmelo Rapisarda, José Maria Diaz Puente, Alessandro Priolo



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## **PARTNERS DELIVERING THE COURSE**

Six of the most important European universities convened into the Agris Mundus consortium to offer the Agris Mundus Master of Science:

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**Montpellier SupAgro**, the specialised training institution in France for agricultural systems in the Mediterranean, the tropics and the subtropics

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## COOPERATION WITH ASSOCIATED PARTNERS

The Agris Mundus master course is associated with 29 'Associated partners', which contribute to the extension and the execution of the programme.



Among these, 17 are universities from the third countries, who contribute to the selection and recruitment of the students, and to the execution of the course. Particularly, joint tutored master thesis research may be undertaken with these universities.

- Universidade de São Paulo / ESALQ (Brazil)
- Universidad Nacional Agraria la Molina (Perù)
- Universidad CentroAmericana (Nicaragua)
- Universidad Nacional de Costa Rica
- Universidad Autonoma de Chapingo (Mexico)
- Universitas Lampung (Indonesia)
- Institute of Agriculture, Bogor
- Kasetsart University (Thailande)
- Royal University of Agriculture (Cambodia)
- University of Pretoria (South Africa),
- University of Tribuvan (Nepal)
- University of Tamale (Ghana)
- University of Agriculture, Abeokuta (Nigeria)
- Institut Agronomique et Vétérinaire Hassan II (Morocco)

Three are specialized Research Institutes, who also offer master thesis opportunities:

- National Dairy Research Institute (India)
- Centre for agrarian systems research & development – CASRAD (Vietnam)
- Tropical Agricultural Research and Higher Education Centre - CATIE (Costa Rica)

Six are specialized networks of Universities and / or research centres, who can mobilize their members:

- Sociedad Científica Latino Americana de Agroecología [www.agroeco.org](http://www.agroeco.org)
- Southeast Asian Regional Centre for Graduate Study and Research in Agriculture – SEARCA [www.searca.org/](http://www.searca.org/)

- Regional Universities Forum for Capacity Building in Agriculture – RUFORUM [www.ruforum.org/](http://www.ruforum.org/)
- Forum for Agricultural Research in Africa - FARA [www.fara-africa.org/](http://www.fara-africa.org/)
- Global Forum for Agricultural Research - GFAR [www.egfar.org/](http://www.egfar.org/)
- Agrinatura, The European Alliance on Agricultural Knowledge for Development [www.agrinatura.eu/](http://www.agrinatura.eu/)

Finally, three are associations of professionals, NGOs working on innovation in agriculture, and Agris Mundus alumni. They can be associated to the identification and recruitment of candidates and they make sure that the orientation of the master course does respond to the needs of the development support organizations in the South.

- Young Professionals Platform on Agricultural Research for Development - YPAD (Allemagne),
- Promoting Local Innovation - PROLINNOVA,
- Agris Mundus Alumni Association.

All together, they form the Agris Mundus Alliance.

## PREFACE

### **Agris mundus / Agrinatura document about Agris mundus thesis**

It is a privilege and it is an honour to introduce this set of research works to which the students of the Agris mundus master have been able to contribute during their studies.

By restoring this work, the Universities associated with the delivery of the Master Agris Mundus master certainly want to first testify to the diversity and richness of the scientific production induced by their cooperation. Nearly 200 different works, most of them from the countries of the South, bear witness to the extraordinary diversity of forms of agriculture in the world and illustrate the challenges posed by population growth, the extension and internationalization of food markets and trade, or the growing competition for water, land or for natural capital in general.

However, beyond this academic objective, they also show their commitment to the sustainable development of our planet, socially, economically and environmentally. These researches have most often been executed in responses to problems raised by social or professional organisations, dealing and struggling day to day with strengthening food security of the rural people, mitigating poverty, struggling against losses of biodiversity and wastes of other limited resources. It is more than a wish that these researches contribute to action and respond to the needs of the concerned stakeholders.

### **Integration and multidisciplinary**

Launched in 2006, the Agris Mundus Masters Course is a two-year training programme, which focuses on the management of rural and agricultural development for developing countries. Graduates are qualified to identify and critically assess key factors shaping the development of crops, forests and animal production, the management of research and rural development projects and, finally, the sustainable use of natural resources and the environment.

The course is offered jointly by six European universities members of AGRINATURA, the network of European Universities and Research Centres that develop training or contribute to research in tropical and subtropical Agriculture. Depending on the different training tracks chosen by the students, the MSc addresses the main professional fields, which are connected with the sustainability of the development process:

- the development of cropping systems, especially for food crops, that combine the needs of economic return to the farmers and the societal needs for the preservation of the environment;

- the increase of livestock production, while preserving the quality of the products and the wealth of animals;
- the preservation of natural resources, specially land, water, forests and biodiversity, which become scarcer and scarcer, or in competition with increasing other uses;
- the development of sustainable food systems and efficient food chains;
- the capacity to integrate all these sectors into a holistic and systemic approach to agricultural development.

The approach has always been based on a joint high-quality standard in education, and on the complementary expertise between the universities that are associated within Europe, which exchange disciplines in order to address better the complexity of the problems met.

During this course, the main conditions for innovation within traditional farming systems and for rural development are reviewed, and methods for their assessment are considered. Focus is on interdisciplinary approaches, combining social and biological sciences. This combination can lead to excellent scientific capacities in order to enlighten the recent changes as well as the future prospects of local economies in this regard.

### **A specific European contribution on Agricultural Development in the world**

This set of researches also testifies the specificity of the European contribution to international Public Aid for Development. Indeed, Europe plays a key role in the different international fora and negotiations regarding agriculture, the management of natural resources, and more recently, to climate change mitigation. A strong public effort for sustainable international development is seen by EU as the best way to prevent terrorism and uncontrolled migrations that root their strength in poverty throughout the world, and agriculture is of a considerable importance in this regard, as most of the poverty lays in rural areas.

Human resources are ...

Agris mundus has been for ten years a key tool for building capacities to develop and implement these policies. More than 150 young professionals, a majority of them from the developing countries, have been trained at the MSc level. They now form an active and sustainable network of expertise on all continents, pursuing their contribution to international development from their diverse positions.

On behalf on the Agris Mundus Consortium 2006–2017

Dr Didier Pillot (Montpellier SupAgro)

and

(Partner University Coordinators special thanks to you) Dr Onakuse Stephen (National University of Ireland, Prof Andreas Neergaard (University of Copenhagen), Prof Carmelo Rapisarda (University of Catania), Prof Luisa Biondi (University of Catania), Prof Alessandro (University of Catania), Mr Erik Heijmans, Wageningen University and Research Centre (WUR), Cork), and Dr José Maria Diaz Puente (Universidad Politecnica de Madrid, Spain),

Montpellier SupAgro, France, January 2019



**BATCH 1:  
2006–2008**



# 1. Rice and water from Seila. Elements of controversy in the governance of resources in the Fayoum

AUTHOR **Abdelaziz Elgueroua**

SUPERVISORS Henning Høgh Jensen – University of Copenhagen | Stephane Fournier

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The irrigated zone of Seila, in the Fayoum, is an ancient zone of agriculture based on the cycle of the Nile's annual flooding. It became a zone of year-round irrigation after the construction of the first water-regulating dams on the Nile, initiated during the reign of Mohammed Ali. The construction of the Aswan High Dam under Nasser strengthened the water system and reinforced the possibility of permanent cropping. After more than a century of year-round irrigation, the cropping system of Seila has become one of the most intensive in the world. The farmers of Seila attain between two and three harvests per year. During the thirty years between 1965 and 1995, agricultural cooperatives created under the agrarian reform provided technical support to farmers, mandating the use of parcels for the production of crops deemed strategic by the government: wheat in winter, cotton and rice in summer. In the last 12 years, the economic opening of Egypt and liberal agricultural policies has given back to the farmer the ability to choose their crops freely. Nevertheless, the culture of rice is still subject to a double control from the agricultural cooperatives and the irrigation district. Rice is today the object of controversy. The farmers of Seils increasingly cultivate rice for its high agronomic yields and the high revenues it produces. They also argue that highly salinized parcels should be planted to rice. The water administration considers rice a water-intensive crop is trying to reduce its surface and is even considering forbidding it entirely. In a context of falling prices for agricultural products on the local market, the farmers of Seila have no other choice but to cultivate « illegal rice », which together with wheat achieves one of the highest yields of any crop. The practice of « illegal rice » and the enlargement of the irrigated zone of Seila create a high water demand in summer. This augmentation of the water demand cannot be satisfied by the irrigation district, whose resources are limited by its annual allocation of the Nile's water. At the local level, lack of water generates conflicts on irrigation water, water theft, and broken regulating equipment, which benefits the most influential irrigators and those upstream on the canals. This situation causes water shortages downstream on the canals, where a large surface remains in fallow during the summer. Despite the control of canals exercised by

the irrigation district to assure a legal access to all users along the canal, the inequalities of water supply between upstream and downstream are important. With Egypt's entry into structural adjustment, under the pressure of international organizations, a set of irrigation, improvement programs have been put into place by international cooperation projects. These projects aim for a local withdrawal of the State from water management and the introduction of participatory irrigation management. In Seila water user associations have been created during the past years on the different water distribution canals. These WUAs assume a part of the control of the canals and participate in their maintenance. Despite the partial improvement of water management, the objectives are far from being accomplished in the absence of a clear legal framework and the political will to grant real water management powers to the local level.

KEYWORDS     rice, water, governance, resource, irrigation, agricultural policy

## 2. Toward Implementation of the Geographical Indication in Indonesia

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Indonesia, which boasts of the second largest biodiversity in the world, produced many specialties well known products. While the small scale farmers relying on the products for their livelihood, the products were being claimed in other countries as their origin products or registered as the trade mark. So it becomes a priority today to generate protected Geographical Indication/GI and preserve the local knowledge. On the 4<sup>th</sup> September 2007, the Republic of Indonesia has just been starting released the protected Geographical Indication system in which the government regulation no. 51-2007 concerning GI had been signed by the President. The implementation of protected GI is followed with many constraints and generated the application for various high repute products, from the background this research highlights towards the implementation of protected Geographical Indication in Indonesia. Protected GI is to be required by the communities in which their natural and human factor influenced on specified goods such as Gayo highland coffee, Kintamani Coffee, Amed salt, and Cashew nut Kubu. Gayo highland which is situated in NAD Aceh has already an international reputation as the place where high quality Arabica coffee with specific characteristic is produced in a big quantity. A field study of the interest on GI setting up for Gayo highland coffee has also been analysed. The research also assesses the GI implementation of Kintamani Bali coffee and the feasibility study of cashew nut Kubu GI, and Amed salt. Kubu is fertile dry area with volcanic soil. Development of GI is potential for this territory. Amed is the traditional salt production practice in where tourist can visit while enjoying beautiful beach and diving in Amed coastal. The salt production practice in Amed is a traditional knowledge which local community has been doing for a long time but it's almost extinct.

KEYWORDS **geographical Indication, coffee, cashew, salt, Indonesia**

### 3. Constraints in Conversion from Conventional to Organic Farming in Thailand

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It is well recognized that organic farming is a sustainable, social, ecological and environmental solution for developing countries. Yet, small landholders in developing countries have been hesitant to convert from conventional to organic farming. This study analyses the problems of vegetable growers in Thailand in converting to organic farming using the Sustainable Livelihood Framework. The study examines A. the problems in production of organic produce from the perspective of the farmers B. the livelihood strategies and activities of the small landholders that affect the decision to convert C. gaps or weaknesses in institutional support accessible to small holders in areas like certification, training or credit availability. The study was conducted in Chiang Mai, Sakaeo and Surin provinces of Thailand where organic agriculture is getting popular among farmers cultivating vegetables and rice. Research methods include survey of organic and conventional farmers based on questionnaire, group discussions including matrix scoring and Participatory System Analysis with village residents. The results of the survey are analysed through logit regression analysis on quantitative data. Analysis of results is based on factors (natural, physical, social, financial and human) arrived at from the sustainable livelihood framework, using the factors in both planning new development activities and assessing the contribution to livelihood sustainability made by existing activities. The literature review encompassed theoretical understanding of the constraints faced during conversion process supported by reports and case studies. Natural resource indicators (land area, land tenure, availability of organic inputs), physical resource indicators (livestock ownership), financial resource indicators (availability of credit, stability in price offered for organic produce, proper marketing channel), social resource indicators (training facilities, farmer participation in collective activities) and human resource indicators (age, education, labour availability, migration trends) are the factors that enable or constrain farmers from adopting organic farming. This study has discussed these factors based on Thai experience. Some of the findings of the study are mentioned below. The results show that organic farmers mentioned that a good training package could help them identify current market trends and develop skills that even higher education does not provide. Proper training and post training guidance to farmers was considered having considerable importance. Most of the surveyed organic farmers were in the

middle age group, which contradicts the results of previous research. The study showed that small landholding is not a constraint so long as farmers have land title deeds, an irrigation source, adequate livestock for easy and cheap availability of farmyard manure needed for organic farming. However, more farmers that are conventional would be attracted to organic farming with development of market outlets and consequent price stability in sale of organic products. Interestingly, the results of logit regression analysis show active participation in research/experiments in organic farming having a negative tendency on the likelihood of conversion to organic farming. As the study is limited to a sample of 158 organic and conventional vegetable farmers only, it does not indicate market trends and opportunities. However, it can help local planners or extension agents to devise suitable programmes to enable farmers to overcome constraints in conversion to organic farming and improving their livelihood.

**KEYWORDS**      organic conversion, organic farming, participatory system

## 4. From Wastewater use to Water Reclamation: Management and Challenge

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Treated wastewater may be reused for different purposes such as landscape irrigation (parks, green areas, etc.), recreational activities, reclamation of urban streams and rivers, industrial uses, groundwater recharge or in agricultural use. Reusing effluent for irrigation can be the best way to utilize the wastewater since it removes many of the nutrients that are not removed with primary and secondary treatment processes. The feasibility of wastewater reuse ultimately depends on the cost of reclaimed wastewater relative to alternative supplies of water, and on public acceptance of the reclaimed wastewater. For social efficiency, every wastewater treatment decision must balance many variables and find the combination with greatest net benefit. This report presents an assessment of the viability of wastewater reuse in agriculture taking the Trapeang Sab commune in Cambodia as a case study. Following the definition of general guidelines for wastewater reuse for irrigation, the assessment examines the main challenges for developing water reuse, with emphasis on the choice of treatment method, economics, water quality issues, and social value of recycled water. Moreover, a field survey was conducted to identify the farmer's perception with respect to the reuse of treated wastewater in irrigation and to determine the amount of water applied in irrigation and the cost incurred. The study showed that the utilization of treated effluent in irrigation is profitable for some crops. Assuming with the worst-case scenario the benefit to cost ratio is greater than one.

KEYWORDS wastewater, treatment, agricultural reuse, cost benefit analysis

## 5. Characterizing Resource Use Strategies in selected Wetlands in Rwanda: Case studies of Cyabayanga and Rugeramigozi Wetlands

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SUPERVISORS Saskia M. Visser | Henning Høgh Jensen | Leon Nabahungu

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Wetland agriculture is becoming an important part of land use in Eastern Africa. Cultivated wetlands are more fertile than adjacent uplands and permit dry season cultivation and produce yields during droughts using residual moisture. With increasing demand to feed the increasing population and low production due to unreliable rainfall, the roles of wetlands for agriculture must be sustained by maintaining their hydrology and fertility while permitting crop production. Soil fertility management options with potential to conserve and promote production of wetlands are available for adoption. Successful implementation of these options requires their integration in the current agricultural system. Understanding the current farming systems strategies serves the potential to integrate these 'new' options into these farming systems thereby increasing its potential adoption. The study characterised resource flow strategies in the farming systems of Rwanda by analysing labour and nutrient flow between wetland and hill slopes in Rwanda using a farm systems approach. Together with small scale farmers, the study explored two case study wetlands; one in the central plateau zone and the other in the low rainfall eastern regions of Rwanda. The study found out that farmers in the wetlands differ in terms of their resource richness. The variation is not only between different agro-ecological zones but also within the zones. More labour was allocated to wetland compared to upland plots. Resource groups differ in labour allocation in both wetland and hill slope plots. Richer resource households were able to allocate more labour to their plots (up to 440 man-days per season in the wetland plots and 326 man-days per season in the hill slope plots) by hiring additional labour. N balances were negative (up to -631 kg per hectare per season) in rice fields in the wetlands. Removal of rice crop grain (a maximum of 706 kg N in grain per hectares per season) and burning of crop residues significantly contributed to this alarming rate of nutrient depletion. Only 75 kg N per hectare of inorganic and 198 kg N per hectare per season organic inputs were applied to the wetland plots. There were alarming K negative balances on hill slope plots (1216 kg per hectare per season). However, nutrients from hill slope are recycling from homestead as farmyard manure is applied back in

these plots. K is exported from wetland to hill slope (164 kg per hectare per season) especially in Rugeramigozi through collection of crop residues for feed to livestock. Apart from N, K export from wetlands raises eyebrows on the sustainability of wetland farming in the long run. poses a threat to the viability of legumes as N-fixing crops. Considering that P is an important part for N-fixation process, negative P balances can reduce the nitrogen fixing potential for leguminous crops included in the options from wetland management in Rwanda. This concern could be significant in Rwandan ferraltic soils that have low inherent available P. The study also highlights the assertion that farmers may not necessary be concentrating nutrients around homestead because of the short distance. Rather farmers apply nutrients in plots where they perceive to be fertile and secure to produce satisfactory yields. This case study highlights the importance of linking hill slope and wetlands in analysing farm household systems in wetlands in Rwanda. This should be followed by a complete analysis of household dietary patterns, labour allocation and nutrient flows for a clear understanding of the farm resources dynamics in the wetlands.

KEYWORDS     resource use, wetlands, upland, dry season cultivation, hill slopes

## 6. Community participation in Forest management with special focus on Cost Benefit sharing – In Kankali Community Forestry Nepal

AUTHOR **Bindu Antony**

SUPERVISORS Thorsten Treue | Eamon Lenihan

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Rural community in Nepal highly depend on forests as their livelihood needs are directly linked with forests. Community forestry in Nepal is recognised as a viable model in the field of sustainable forest management globally as it caters to the livelihood needs of the community and at the same timework as an effective means for resource conservation. However, this programme is not yet able to fully ensure the participation of all stakeholders equally throughout the process, which in turn resulted in the inequitable distribution of benefits. This study examines the dynamics of participation with regard to the distribution of cost benefits. A detailed analysis of level of participation of the households in accordance with the benefits they have received from the programme was done. Study was conducted in Kankali community forestry group in Chitwan district of Nepal. Analysis are mainly based on the primary data collection by using 1) interview schedule using a nested sampling of 178 households. 2) focused group discussions with the committee members of the Kankali community forestry and with beneficiaries and through 3) direct observation which is backed up with secondary data such as annual reports and operational plans etc. Chi-square tests were used to establish the link between level of participation in activities and decision-making process separately with cost benefit sharing. Descriptive statistics and graphs are used to explain the level of participation with other variables like socio economic status, geographical locations etc. Study illustrates activity based participation and participation in decision-making process separately. Here the participation of the community is high in daily activities of community forestry than in the process of decision-making. The result shows that there is no direct relation between the levels of participation in activities and participation in decision making with cost benefit sharing.

KEYWORDS community participation, forest management cost benefit sharing, decision-making

## 7. Agrarian Diagnostic in three post opium villages in Laos

AUTHOR **Carolina Torres López**

SUPERVISORS Sébastien Bainville | Ignacio de los Rios Carmenado

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This paper was written in the framework of the Agris Mundus MSc program, as part of a general investigation on Alternative Development. Alternative Development refers to rural development activities implemented in populations where some of the crops declared illicit by the UN (coca, cannabis, and poppy) are being or have recently been eradicated. This document presents an agrarian diagnostic undertaken in three villages of the province of Houphan in the north of Laos that are included in the “UNODC H98 Alternative Development Project”. Ban Kangkheak, Ban Phavan, and Ban Houyko are the three villages studied. They have in common that at least until 2000 the farmers were planting opium poppy as part of their production systems, and they have been included in Alternative Development projects. The realization of the agrarian diagnostic permitted us to conclude that in the substitution of an illicit crop it is not sufficient to propose a single productive project whose economic calculations foresee that it will generate the same income as the illicit crop (as has been the focus of Alternative Development until now). This is because the new project will enter into a productive system that functions as a whole, and will impose limitations on land, capital, and work for the new project. In this sense, the agrarian diagnostic permits us to identify one of the reasons for which illicit crops often return to a territory despite large investments in Alternative Development projects.

KEYWORDS agrarian, diagnostic, coca, cannabis, poppy, alternative development

## 8. Dinamicas local sociotecnicas of the communities of Cacao, Potrerillo and San Esteban and the use of agrochemicals and basin management practices (Ciudad Darío – Nicaragua)

AUTHOR **Claudio Valenzuela Chadwick**

SUPERVISORS Claire Ruault Gerdal | Laurent Dietsch

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This investigation analyses social networks in three communities in the Maunica sub-basin. This study stems from the demand of ADAA for gaining a better understanding of social dynamics of the Maunica basin and the behaviour of producers in order to improve the use of agrochemical products and the management of the basin. An essential feature of the project is gaining a better understanding of the social dynamics at the local level, using it as a laboratory for the production of knowledge and for fostering innovation for development. To achieve this objective, this study attempts to stress the diversity of different families within communities based on their activity and the means of work (Access to water, their crop of livestock, other economic activities that are available, other sources of income and division of labour). Lastly, this study pays special attention to the needs of the population and communities based on their social organization. This requires, in this case, gaining an understanding of the used of agrochemicals by the population and the current management of the basin as a whole.

KEYWORDS communities, cacao, producers, social dynamics, knowledge, agro-chemicals

## 9. Performance Evaluation of Participatory Irrigation Management by the Supply Chain Balanced Scorecard Approach Case Study in the Red River Delta, Cau Son – Cam Son Irrigation System, Northern Vietnam

AUTHOR **Doudou Lin**

SUPERVISORS Jens Raunsø Jensen | Doan Doan Tuan | Frans Huibers

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Water, as a public property, since it needs to be paid for usage, also has the characteristic as a private commodity. In an irrigation sector, water comes through the canal and flows into the field as required by water users can also be treated as a chain process. Therefore, certain principles in the supply chain performance evaluation system might be used and matched for designing a new evaluation system for measuring irrigation performance. In Northern Vietnam, Xuong Lam Commune in Cau Son - Cam Son irrigation scheme has been chosen for case study. This commune has its own irrigation groups for distributing water, thus it can be considered more participatory than the other communes. Field observations, 120 questionnaire survey, a pair-wise ranking discussion as well as manager's/experts interview were held in order to get an overview of the current status and gather the opinions from most of the stakeholders regarding the irrigation performance. Based on all these data collected and analysed, the problems facing the current situation can be drawn by their priority and further suggestions for future development scenario will be put forward. The research has found that by using the Supply Chain Balanced Scorecard method to evaluate the irrigation performance, a holistic view including the financial, customer service, operational and development perspectives have been considered. Different from IWMI (Irrigation and Drainage Performance Assessment - Practical Guideline) and FAO (Rapid Appraisal Process (RAP) and Benchmarking) methodologies on performance evaluation, this is a completely new means to evaluate the irrigation system. Considering all the stakeholders including water users' judgments, with a view caring for all-round aspects, the new designed framework can be a worthwhile tool for the future assessment of irrigation management performance.

KEYWORDS evaluation, participatory, irrigation management, supply chain, irrigation system

## 10. Current and Future Influence of Petrol and Fertilizer prices over the Irrigated Rice Schemes from the Sahel

AUTHOR **Valdivia Prieto, Helena**

SUPERVISORS Pilot Didier | Afonso, Ana | Luc, Jean-Paul | Barbier, Bruno

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The biggest world food crisis in thirty years has triggered during the first months of the year 2008. It has been caused by an accumulation of natural, political and market running factors, which have originated the sudden increase of some commodities prices, especially meat, milk and over all cereals like rice. At the same time a meteoric rise in the price of petrol started reaching the record price of 147 \$/barrel in July and after that starting to fall again. This variation has affected to all its derivate products from fuel to fertilizers, which incorporate the petrol in their production process. This situation has particularly affected the poorest countries of the world for which rice is the staple foodstuff. Between the countries more affected are the Sahelian West African Countries because they are not able to produce enough rice to cover their demand. Due to the climatology in the Sahel, practically the 100% of rice there is produced in irrigated areas using fuel oil or electricity to pump the water into the plot. In this context, we have tried to see the real influence that fuel and fertilizers price changes have on the rice farm margins at these irrigated areas. With this objective, we have set the relationship equations that link the fuel to fertilizers such as the urea and we have carried out two-sensibility analysis: to variations in rice price and in fuel prices. In addition, we have set some future hypothetical scenarios for trying to study the possible situations for the years to come. For all this activity, we have use the Olympe software, which allow us to organize the data and to see the effect that future hypothetical forecast would have on the economy of the studied irrigated schemes. The results showed that while the influence of fuel himself was not as significant as expected in the balance of all the charges of the farm; fertilizers prices are much more significant and the effect of changes in their prices (generated by changes in the price of fuel) have a huge importance in the economy of the farm.

KEYWORDS rice, fuel oil, fertilizers, Olympe, sensibility analyse

# 11. Analysis of agricultural water productivity of irrigation schemes in the Niger River Basin: Case studies for Mali and Niger

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SUPERVISORS Frans Huibers | Didier Pillot | Bruno Barbier | Jean-Paul Luc

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Improving water use and productivity of irrigation schemes are very important issues for agriculture and irrigation development in the Niger River Basin to ensure food security and economic livelihood for people. Therefore, system performance should be evaluated in terms of water use efficiency and water productivity in the irrigation schemes. This study analyses water productivity (WP) and water use in twelve irrigated schemes in the Niger River basin in Mali and Niger using water balance approach at the irrigation scheme level. Water productivity values were calculated for the wet and dry cropping season taken into account gross inflow and irrigated water. The results indicate that WP values for the wet season range from as low as 0.18 kg/m<sup>3</sup> to 0.41 kg/m<sup>3</sup> of paddy for gross inflow and 0.41 kg/m<sup>3</sup> and 0.87 kg/m<sup>3</sup> for irrigation water. WP values for irrigated inflow were slightly higher than the values for sub-Saharan Africa according to Cai and Rosegrant (2003). Although WP values were encouraging, the irrigated scheme demonstrated very low degree of water use efficiency resulting in water losses in seepage, percolation or remaining stagnant on the fields. During the dry season, despite the water deficit in most irrigated schemes WP values for onions, cabbages, carrots etc. were very high ranging from 0.6 to 5.2 \$/m<sup>3</sup> especially for multiple cropping schemes. It should be noted that, low WP values were not entirely a reflection of the low yield but rather due to the high amount of irrigated water supplied (the denominator) expressed in the WP equation and vice versa. The study identifies several constraints that are limiting the capacity of the irrigated schemes to use water efficiently and to maximize crop water productivity. Farmers' organization should be strengthened to adopt strict and active water management measures is to control and save water to meet agricultural demand with the aim of sustaining and enhancing water productivity in irrigated schemes.

KEYWORDS water productivity, irrigation scheme, cropping season, water balance, water management, water use efficiency

## 12. The sustainability of agriculture in the reserve of Montes Azules Biosphere: agrarian diagnosis of the EJIDO BENITO JUAREZ MIRAMAR, State of CHIAPAS, Mexico

AUTHOR **Francisco Castillo Alvarez**

SUPERVISORS Claire Aubron

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In the Sixties in Mexico, most of the rural population of the Chiapas' State is still living in a half slavery conditions and working for huge properties. The precarious conditions of the populations push them to colonize new territory "offered" by the government. Colonization steal running, the Mexican government creates, by the UNESCO, the Reserve of Biosphere Montes Azules, in 1978. These limits will be never really defined, and will be problem as for the land regularization of the local indigenous population installed in its enclosure. Several communities claiming their land title will never succeed, and it is the case of the community Benito Juárez Miramar. Their husbandries and the organization of this community remain little known institutions of the reserve. In order to set up programs adapted to the agricultural activities and to integrate the development into the conservation, we aimed to describe agrarian dynamics and the operation of this community. The adopted participative method is based on observations and discussions with the zone's actors. Results show that these peasants live of a traditional agriculture, which is the slash and burn, based on the corn's culture for subsistence farming. These unsustainable practices generate a loss of fertility of the grounds, which could be a problem in a future under the demographic pressure increasing population. Today, the bovine breeding constitutes their first income. Today, most of the family is migrating towards the United States to survive. It seems necessary to continue the diversification of this agriculture by systems ecologically interesting like the cocoa. In the same time, it seems pressing to regularize this community so that it can finally order its territory and ensure a resumption of the future generations.

KEYWORDS **reserve biosphere, titrates land, durability, Chiapas, diversification**

## 13. Developing the Sunflower Market Chain in Chunya District, Tanzania

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SUPERVISORS Kostas Karantininis | Eamon Lenihan

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The research is a thesis study conducted in collaboration with VECO-Tanzania under the Sustainable food security and agro-based economic development programme in Chunya District. The goal of VECO-Tanzania in Chunya District is to contribute to the attainment of better livelihoods by increasing food security and access to social services like clean water, education and health services as well as promoting value addition and improving accessibility to markets. Sunflower production was identified through a participatory market survey as one of the enterprises (others being paprika production and bee keeping) that could provide extra incentive for the farmers to produce commercially. The purpose of this research was to assist in the development of a sunflower market chain in Chunya District by identifying the main actors in this market chain and examining their activities, governance and constraints so as to create opportunities for collaboration among the actors. The approach used in this study was the Participatory Market Chain Approach in order to gain an understanding of the actors in the sunflower market chain in terms of their interests and ideas. Therefore, this study tested whether the approach, by creating understanding and thus promoting collaboration between and among actors would develop or increase efficiency in the market chain by lowering production and transaction costs between the actors. The variables used were the power shifts among actors in relation to asset specific investment, co specific investment in specific assets and the discount factor.

KEYWORDS sunflower, market chain, social services, market governance, efficiency

# 14. Adopting a Sustainable Livelihood Approach to Food for Work program in Tubas governorate in Palestine

AUTHOR **Haneen Ghazawneh**

SUPERVISORS Iben Nathan | Didier Pillot

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Jean Henry Casimir Faber, the French Naturalist of the nineteenth century quoted as saying, “History ... celebrates the battlefields whereon we meet our death, but scorns to speak of the ploughed fields whereby we thrive; it knows the names of the king’s bastards but cannot tell us the origin of wheat. That is the way of human folly” (Smith, 1995). This statement fits accurately to Food for Work program in Palestine. The outbreak of the second Intifada in 2000 and the Israeli closure measures including the construction of the separation barrier, have negatively affected the livelihoods of the Palestinians. Since then food insecurity has widespread among Palestinians reaching 34% in 2006. Therefore, international food aid has massively increased. Food for Work program in Palestine is a category of food aid that is aimed to preserve agricultural assets, promote self-reliance and restore livelihoods. The study applied a livelihood analysis approach to explore if Food for Work program has achieved its goals. A livelihood approach takes as its starting point the actual livelihoods assets and strategies that people use to achieve the outcomes they seek. Livelihood approach moves out of the food security perspective that is currently used by WFP as an indicator for their intervention. The results show that the top-down management has negatively affected the program. Few agricultural projects have been done. The main contribution of Food for Work program was the food basket, which offered the beneficiaries very limited options. There are potential negative impacts of the program on the local agricultural as well on culture. Different food aid modalities are increasing in the area as an accelerator; however, food insecurity status is almost unchanged. Sustainability can be achieved through: (1) promoting local agricultural production, (2) insist Israel to change their inhuman policies towards Palestinians. In conclusion, the current ability of Food for Work program in achieving its goals in preserving agricultural assets and restoring livelihoods is rather limited.

KEYWORDS sustainable livelihoods, food for work, food insecurity, world food programme

# 15. Land Use Dynamics, their Economic Performance and their Impact on Carbon Storage in the Northern Central Upland of Vietnam

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SUPERVISORS Andreas de Neergaard | Didier Pillot

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**M**ountains in the northern Vietnam have significantly lost its forest cover during the last decades due to the conversion from natural vegetation to the cultivated land. The consequences of the expansion of agricultural activities at the expense of natural forest are of global concern among policy makers and development workers. This paper examines land use dynamics, agrarian system and the impacts of land use changes on the sequestration of carbon in the districts of Quan Hoa and Ba Thuoc, Thanh Hoa province, North central upland of Vietnam. The agrarian transition analysis shows that land use in the study villages has been mainly driven by policy and socio-economic factors. The current land use system is featured by three main cropping systems: paddy-based cropping system in the bottom valley of the mountains, bamboo-based cropping system in lower slope of the mountains or along river bank and upland-based annual cropping system in the middle slope or upper slope. Before the collectivist period (1959), land use in the study area was characterized by paddy-based farming system in the bottom valley of mountains and shifting cultivation system with relatively long fallow period on the slope land. During the collectivist period (1960s-1980s), paddy-based farming system and annual crops on the lower slope were intensified. Shifting cultivation was practiced on the middle slope of the mountains. In 1973-75, bamboo has been promoted to be cultivated on the lower slope of the mountains to replace the cassava/maize and upland rice. After the crisis of the collectivisation (end 1970s), successive reforms have been made to shift the production from cooperative to individual households. As the result, paddy fields are allocated to individual households for use and management of 20 years and the forestland are allocated for use and management for a period of 50 years. Based on farming practices, two groups of farmers could be classified: a group of farmers who is moving toward bamboo cropping system and another group of farmers who is prioritising their upland for intensive cultivation of cassava/maize. The economic performance analysis of the cropping systems shows that paddy farming system provides the highest land productivity, followed by cassava/maize intercropping system, cassava mono cropping system and maize mono cropping system

while bamboo generates the lowest land productivity. However, when judging in term of labour productivity, bamboo provides twice higher labour productivity than paddy farming system and cassava/maize intercropping system. The above ground carbon stocks of bamboo and forest are comparable, of which the annual productivity is estimated of about 5 tons/ha. The comparison of SOC among the 4 land use classes: forest, bamboo, fallow and cultivated land shows that there is a tendency of the soil carbon losses in the cultivated land although not significantly. SOC in forest, bamboo and fallow land are not much different. The study found that there is no land use effect on soil carbon content beyond 70cm depth. The conversion from natural vegetation to the cultivated land has certainly resulted in the loss of soil carbon, although not significantly. Soil carbon is estimated to have lost 14% of the original amount in the 70cm depth within 20 years of cultivation. The plantation of bamboo on degraded land would result in the increase in soil carbon. The transition from annual cropping to bamboo land use has increased the soil carbon of 44g/m<sup>2</sup> annually, or 17% increase after 33-35 years of the plantation. The study concludes that bamboo has over greater interest than other land uses in term of environmental sustainability coupled with income generation. The study further found that it is not a great barrier to shift from cash short term crops to perennial cropping as the short term income could be secured by the short-term crops intercropped with bamboo. The barrier, however, occurs once bamboo is harvested and the short term crops could not be intercropped with bamboo anymore while bamboo does not provide comparable land productivity to other short-term crops. The study suggests that bamboo provides an interesting return when the cultivated land is greater than 2.5ha.

**KEYWORDS** land use, carbon storage, economic performance, carbon sequestration, inter cropping

## 16. Analysis of the strategies of farmers producing organic fresh and dry fruits in Kayunga, Uganda

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SUPERVISORS Andreas de Neergaard | Didier Pillot

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The present study investigates the determinants of different strategies adopted by fruit growers and fruit driers based upon a community level survey conducted in the two sub counties of Kayunga district of Uganda. Amount of land holdings and the type of crops grown are two important determinants for classification of farmers in the two study areas. The study further analyses separately the pros and cons of fruit growing against non-fruits, organic agriculture against conventional agriculture and fruit drying against fresh fruits. The pros and cons of each type of agriculture practice are key to the adoption of different strategies by the farmers. Due to increase in emigration and high birth rates in the study areas, land area per person has declined which has led to intensification of agriculture in the form of growing high value cash crops such as pineapples and tomatoes by many farmers. Despite this trend, almost all the farmers grow maize, beans, cassava and sweet potatoes in small plots for household consumption. It is found that pineapple growing evolve because of the decline in coffee prices, widespread coffee wilt disease, higher profit for pineapple per unit of labour and area. 82% of farmers in Nsotoka grow pineapple because of higher profit while 90% of farmers in Kigayaza grow pineapple for easy marketability. The major obstacle for growing pineapple and for converting into organic is the coffee husk required for fertilizing the pineapple plantation. It is the most important expenditure for pineapple farmers. Organic farmers are selling majority of their produce as conventional in the local market without any premium as the exporting companies are not buying all their produce. Fresh organic pineapple has premium price from the exporting company while dried organic fruits do not have any premiums yet. The important strategy practiced by fruit driers is to dry pineapples of all sizes during peak harvesting season and to dry only the small sizes during off season. 53% of the fruit driers were women and it plays an important role in reducing the economic dependency on men. Providing (better) driers at cheaper cost and premium price for dried organic fruits are needed to boost the amount of dry fruit production. In addition to increased role of women in decision making in family and fruit drying, organic agriculture has also brought more cohesion among farmers and increased saving for further investment which are the important socio-economic objectives of the villagers.

KEYWORDS dry fruits, determinants, fruit growers, organic fruits

## 17. The validation of a Development Project by considering the perspective of the direct partners: The BIP Project in Tanzania

AUTHOR **Ivette Susana Madrid Ramos**

SUPERVISORS Didier Pillot

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The Development Projects are bound, in one way or another, for the improvement of the life quality of the people they work directly with; the so called *beneficiaries* or direct partners. So that, if a development project attempts to improve the life of those with the ones it works with, why those direct partners would not be interested in working on it, on their own benefit? The present research is done with the intention of answering this question by tackling it from the perspective of the directly implicated actors: the direct partners. This research considers that most of the direct partners develop farming as an alternate activity which consumes time, work and money, but that provides important benefits for the household by providing the food, and consequently a security level. It also considers that the direct partners organize themselves in grass roots organizations for better accomplishing their different economic activities and that the Agrarian Diagnosis was the adequate interdisciplinary methodology to understand the reasons that the direct partners have to support their choices. In this frame, the success of a development project in terms of the objectives of its previewed results will basically rest in two conditions: i) in its capacity of choosing those direct partners that will participate actively in the project by founding it compatible with their already existing personal development project -the interest that the direct partners will put on it will be directly proportional to the percentage of time and income that this activity entails- and ii) by the project's capacity of strengthening the grassroots organizations in which the direct partners participate, considering that most of the development projects have the objective of promoting economic activities that would eventually mean more revenues for the farmers but also for the groups they belong to. It is believed that if a change like this is introduced, the groups will start to have access to bigger revenues and if they do not develop at the same time their managing and organizational capabilities to deliver this additional weight those additional incomes will become a menace rather than an opportunity. Within this frame the research was developed in three villages of Tanzania: Kifura, Uvinza and Chakulu where the "Development and Improvement of processing, packaging and marketing of honey Beeswax and other bee Products in Tanzania" (BIP Project) is being implemented by the Tanzanian Government and the Belgian Technical Cooperation.

KEYWORDS Development Project's pertinence, beneficiaries' perspective, agrarian diagnosis, Tanzania, honey, apiculture

## 18. Rain water harvesting in Ethiopia: Technical and socio-economic potentials and constraints for adoption in Wukro district

AUTHOR **Neguse Haile Tesfay**

SUPERVISORS Jan de Graaff | Mireille Dosso

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Since the last few decades, rain water harvesting techniques have been used in arid and semi-arid parts of the world and promising results have been achieved in terms of increasing the yield under the low rainfall conditions. However, despite the economic viability and potential of the technology for improving agricultural productivity and livelihoods, the adoption of the technology by farmers is not satisfactory. This study was undertaken in Negash and Mahbereweyni Peasant Associations of Wukro district with the objectives of determining the major technical and socio-economic factors influencing farmers' decisions on adoption for RWH techniques and of making a cost-benefit analysis for major types of RWH structures. To achieve the first objective of the study, field surveys and transect walks, structured and semi-structured interviews, farmer group meetings and interviews with key informants were undertaken. Households were categorized based on their wealth status and gender of household head and using a random sampling method a sample of 100 households were taken from the two Tabia's. A descriptive statistical analysis approach was used for assessing the real causes of low adoption rates for RWH techniques in the district specifically, the data which contain information regarding household's socioeconomic characteristics and human capital information. For the financial cost benefit analysis, the Benefit-Cost Ratio (B/C) and Net Present Value (NPV) were used as the main criteria for ranking the different types of RWH technologies based on their financial feasibility. The results obtained show that poor capital and human endowment, lack of access to credit, involvement in off-farm activities, negative perception, gender issues, seepage, sedimentation, inaccessibility of construction materials, lack of technical know-how, poor water extraction and application methodologies are among the factors that negatively influence adoption of RWH technologies. Level of education and involvement in social responsibilities were found to be positively influencing the adoption of the technologies. For a better adoption of these technologies and for improving farmers' income critical measures should be taken on creating awareness of the people, providing technical and institutional support, promoting only technology with higher financial feasibility, timely supply of construction material technologies, empowering female headed households and design and develop alternative policy instruments which are accountable to the farmers.

KEYWORDS rainwater harvesting, technical, socio-economic adoption

## 19. Oil Palm Development and Land Management in Bungo District, Indonesia

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SUPERVISORS Didier Pillot | Eamon Lenihan

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Indonesia's oil palm plantations have achieved prolific growth, making itself as the world biggest producer of crude palm oil (CPO) in 2007. Tremendous growth occurred during the Reformasi era, has not only drawn the attentions of many but also divide academicians into those against and those for. The first objective is to understand the historical development of oil palm including the history of Indonesia and its legislation. The second objective is to realize how different players are cooperating, interacting and confronting in the oil palm business. Conventional views that farmers are powerless are not withstood in the research result. Yet, the research result suggests power is a relative matter rather than an absolute one. The study shows that oil palm development is neither angel nor demon; it is the mixture of economic benefit, environment detriment and so forth.

KEYWORDS oil palm, Indonesia, Bungo District, land management, conflict

## 20. Typology of Participatory Irrigation Management and water management implications: A Case study in Cau Son-Cam Son Irrigation System, Red River Basin, Vietnam

AUTHOR **Wirat Songsri**

SUPERVISORS Jens Raunsø Jensen | Doan Doan Tuan | Frans Huibers

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Farmer organization; the second type is a shared management by a quasi-state organization and farmer organization; and the third type is management in cooperation between state agency and voluntary organization. The various forms of farmer involvement in irrigation management can be classified in a typology and the different types of PIM associated with the water management practices serve as the main hypotheses. To be able to prove these hypotheses, Y2 canal in Cau Son-Cam Son irrigation scheme (Northern Vietnam) has been chosen for the case study. With the objectives of investigation of farmer involvement and classification of stakeholder role on each PIM type, the comprehensive stakeholder analysis and stakeholder questionnaire interview were used. Many forms of farmer involvement in irrigation management were found and can be classified in typologies as 3 sub-types of the co-operation between state agency and farmer organization. They have the same stakeholder arrangement to manage water over headwork, main, secondary and tertiary canals but there are different forms of farmer involvement under farmer organization. These 3 PIM types are associated with the actual water management. The first type is the irrigation group under Co-operative and hamlet (small village) which have the main responsibility for water distribution at tertiary and on-farm canal respectively; the second type is where the hamlet leader gets request to operate water at tertiary and on-farm canal level (with the help of hired group of people); and the third type is the self-responsibility of the farmer to manage water over on-farm canal level. To be able to understand the current situation of PIM, a farmer questionnaire interview with a consideration of gender was used. It reveals that PIM is not yet fully applied at all level, it is mainly applied at tertiary canal and on-farm canal level, and there is lack of involvement in design and decision making concerning irrigation management to increase irrigation performance. Further to find out the level of farmer involvement in PIM type, a participation tool within a farmer questionnaire interview based on Pretty's (1994) classification was used. It reveals that functional participation is the highest participation level over this

study area. There are some participating groups such as Irrigation Group under both Cooperative and hamlet involved in the development of irrigation performance. The participation is associated with satisfaction and an operational function of each PIM type. A comparison between the 3 PIM types reveals that there is a difference between them. In overview, high satisfaction is associated with high participation in all main activities concerning irrigation management. However, there still is an exceptional commune having high satisfaction even though less participation due to its location at head part of irrigation system. The mapping method reveals that PIM type has less forms of farmer participation applied in head part of irrigation system than at the tail part of irrigation system where it is difficult to get water thus provoking farmers to involve in various forms of participation aspects in order to get adequate water supply. However, the research findings might not be of the best quality because of small sample size and the presence of local leaders during farmers' interview might affect the results.

KEYWORDS     participatory irrigation management, water management,  
farmer's organisations

## 21. Compared social impacts of participatory projects in four villages of Benin

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SUPERVISORS Fabrice Dreyfus | Roberta García-Marirrodriaga | Jacques Lançon

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Participation is an important part of many recent agricultural development projects, such as farmer field schools and participatory plant breeding. These projects incorporate social processes of participation to effectively accomplish technical, agronomic goals. However, the potential social effects of these participatory projects are rarely considered. This thesis puts forth the claim that participatory projects have positive effects on human capital (knowledge) and social capital (links among group members and with project implementers). To test this claim, a study based on in-depth individual interviews with project participants was undertaken in four villages of Benin. The villages were varied in terms of geographic region and ethnic group, with a farmer field school and a participatory plant-breeding project studied in the North of Benin, and one of each type of project studied in the Centre. The hypothesis was largely validated; learning and social links had been favoured by all projects, in all villages studied. An unexpected finding however was that in the two participatory plant breeding projects, which involved a higher level of participation than the farmer field schools, members were disillusioned with the seeming abandonment of the project by the researchers, while in the farmer field school villages participants were content with the projects despite their having only lasted two years. This indicates that projects that involve deeper participation can be detrimental to the attitude of participants if they do not succeed, more so than less participatory projects are. The lessons we can draw from this study regard the importance of considering the social effects of participatory projects. Positive effects of learning and strengthening of social links can be harnessed to favour local development processes. However, the risk of a so-called “participatory depression”, the disillusionment of involved participants with a failed or stalled project, means that those development specialists or researchers who wish to use a participatory methodology must be especially committed to carrying the project through to its end.

KEYWORDS human capital, social capital, participation, farmer field school, participatory plant breeding, Benin

## 22. Performance Evaluation of Participatory Irrigation Management by the Supply Chain Balanced Scorecard Approach Case Study in the Red River Delta, Cau Son - Cam Son Irrigation System, Northern Vietnam

AUTHOR **Araceli Gabaldón**

SUPERVISORS Betty Wampfler | José Luis Yagüe

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The present study takes place in the context of Bolivia, following an investigation of bibliographic sources related to food security and the decentralization, as well as from case studies and surveys of different actors in the field. Bolivia is located in the central interior of South America, the degree of ethnic and cultural plurality, which are found in its territory, the differentiation relief and its landscape, the different rates of development, constitute in itself a “decentralized” natural landscape. Most of its population lives in areas rural and poor dispersed and away from the main political centres. Agriculture self-sufficiency is the most common production, which produces the most of the food consumption and a large part of the income of households. In Bolivia have carried out decentralization processes that have been “relocated” certain powers and resources to the lower, such as prefectures and municipalities, and can thus approach different types of interventions to the needs real. However, local institutions, mostly, not have been able to assume its new responsibilities due in large part to the deficit in its capabilities. In the case particular of food security policies, development, approval and its implementation are still the responsibility of the Central Government, so his actions not they have been able to achieve the desired effects. The case study provides a relationship of lessons learned, as well as recommendations that could be applied other countries of similar characteristics.

KEYWORDS supply chain, balanced scorecard, participatory irrigation management

## 23. Alternative fertilization methods for vegetable production in tropical countries plant liquid extracts' nitrogen mineralization and fertilizing value and the use of liquid compost in Cambodia

AUTHOR **Elena Gioseffi**

SUPERVISORS Andreas de Neergaard | Cherubino Leonardi

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Vegetable production is an activity that can play an important role in improving the livelihood conditions of small-scale and resource-poor farmers in tropical countries, since vegetables constitute both an opportunity for diet improvement and a source of income. In vegetable nutrition and fertilization, nitrogen is one of the most important nutrients. N chemical fertilizers are becoming more and more expensive while organic fertilizers have a slow nutrient release, both constituting a constraint for vegetable production in developing countries. Therefore, there is a need for a quick-acting and cheap N fertilizer. In areas of some tropical countries, the use of organic liquid extracts in fertilization is a reality, but very few studies have been made to understand their utilization efficiency. In some places, an enzyme derived from papaya latex (papain) is used in organic liquid extracts with the purpose of catalysing the mineralization process, but this aspect is also under-researched. The first aim of this study was to understand the dynamics of N mineralization from organic matter (with and without papain) during the extraction process and to test some extracts on a crop to see their fertilizing value. The second objective was to better understand the relevance of the use of liquid extracts in developing countries and their actual production and application. Laboratory and greenhouse trials were carried out in Catania (Italy), while qualitative research was conducted in three provinces of Cambodia. In Catania, chemical analysis of extracts made from tomato and cabbage crop residues showed that the mineral fraction in the solutions is mainly in the ammonium form and that papain increases the amount of mineral N release. The extracts were then used as fertilisation on lettuce and different parameters were considered to establish lettuce growth and nutritional status. However, results were distorted by high levels of salinity, so it was not possible to establish whether the amount of N provided was sufficient for the crop. In Cambodia, the survey carried out highlighted the relevance of the use of organic liquid extracts as a quick-acting and cheap N fertilizer and permitted the collection of information on preparation and use of liquid compost. The use of organic liquid extracts is a potential fertilization strategy

for vegetable production in developing countries, but further research is still needed in order to clarify the aspects left unresolved by the present study.

KEYWORDS vegetable fertilization, tropical countries, N mineralization, papain, organic liquid extracts, fertigation, Cambodia, liquid compost

## 24. Potential of greenhouses wastes in ruminants feeding. Effect of substituting barley with tomato and/or cucumber on *in vitro* ruminal fermentation

AUTHOR **Hajer Khelil**

SUPERVISORS Luisa Biondi | François Bocquier

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The effects of replacing barley grain with green house fruit wastes, tomato (T) cucumber (C) and tomato plus cucumber (TC), and the level of their inclusion on the rumen fermentation pattern were determined by using two different *in vitro* approaches. Fifteen diets composed by cereal straw, wheat bran, sunflower meal, alfalfa hay, barley grain and an increasing proportion of tomato or cucumber fruits wastes, or mixtures of both, were compared to a control diet without wastes in batch cultures (Experiment 1). Diets including the highest amount of tomato, cucumber or the mixture of both fruits were also evaluated versus control diet in single-flow continuous culture fermenters (Experiment 2). In both *in vitro* approaches, ruminal inoculum was obtained from ruminally fistulated goats. Kinetics of gas production (GP) was valuated based on the exponential model  $y = A [1 - e^{-c \cdot t}]$ . There was no effect ( $P > 0.05$ ) either of waste type and level of inclusion on pH and GP. No clear trend in the concentration of total and individual volatile fatty acids was observed when comparing diets including the highest level of fruit waste to the control one with the exception of a decreased proportion of iso-butyric and iso-valeric acids with wastes inclusion ( $P < 0.001$  and  $= 0.001$ , respectively). A higher acetic/propionic ratio for tomato diet (T5) compared to the control diet (3.24 vs 2.92 for CO) was also observed. Total N, non-ammonia N, estimated bacterial N production and its efficiency were not affected ( $P > 0.05$ ) by treatments. Results from these experiments indicate that tomato and cucumber wastes can be included in diets as barley grain alternatives without compromising ruminal fermentation and bacterial growth.

KEYWORDS **barley, tomato, cucumber, wastes, gas production, ruminal fermentation, batch cultures, single-flow continuous culture fermenters**

## 25. Characteristics of Homegardens and their Importance for Livelihood: Case Study of Two Cambodian Villages

AUTHOR **Jonathan Rey**

SUPERVISORS Noman Kanafani | Giuseppina Carra

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The aim of this thesis was to assess the importance of home gardens for the livelihood of rural households. In order to do this, a field study was conducted in two Cambodian villages: Poysam ROUNG and Bang Sanay. From this field research and from secondary data, different aspects of home gardens were treated. First of all, characteristics of home gardens, such as the floristic composition, former uses and special organisation were assessed, as well as the way the home gardens are managed in terms of irrigation, fertilization and pest management. Secondly, the socio economic aspects were assessed and benefits that can be associated with home gardening in terms of food security, economy and social status were studied. Then the influence of the local environment on this practice was studied, from an economic, social and environmental point of view. The main outcome of this study is that home gardening, although it is a practice that varies a lot from one place to another and from one family to another, can provide numerous benefits. In addition, from a general point of view, it appears to be a rather sustainable practice, even if there is some disagreement on this last point.

KEYWORDS Home garden; Cambodia; Livelihood; Food security

## 26. The continuity of the projects of host population, linked to Rural Development – Sierra Norte de Madrid Plan: A proposed strategy for the GALSINMA Local action group

AUTHOR **Juan Alberto Urbina**

SUPERVISORS Didier Pillot | José Luis Yagüe

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This work is the result of research to analyse and propose strategic alternatives to work the problem of loss of population in the mountain chain in the North of Madrid, Spain. The start-up, methodology was based on the measurement of the quantitative and qualitative variables that were used to develop the former projects that the local action of the mountain in the North of Madrid GALSINMA group has developed since 1998 (1998-2002 transnational project Spain - France, for the reception of population in rural areas, and 2002-2006 the regional inter for the reception of population Abraza la Tierra project). Also there is the problem of a lack of the process of evaluation of these projects, and this is why the day of the issue was the first objective, before proposing any model of intervention. Using the criterion established by GALSINMA, to identify problems of fucking of population (“base unit the Municipium”, and “number of population total should be less a 200 inhabitants”), identified that between the year 1999 and the year 2007, there was a fuck of a 10% (19/42) in the total number of municipalities that have been loss population problems, and that 95% of these municipalities are concentrated in the sectors: Sierra del Rincón, Valle Medio del Lozoya and Valle Bajo del Lozoya. that is why it was proposed to address the issue from a localized and territorial manner. So even were developed and adapted to the context, a strategic vision, the importance lies in the transversality of the theme “population loss” has the political instruments that dédisent’s path of development in the area, specifically refers to “the Plan de development Rural of the mountainous chain of North 2007-2013”. This strategic vision is accompanied by profiles of programs oriented to the points identified in the problem three: A) habitat and these conditions, B) the agricultural / livestock / forestry and 3) the productive diversification and local services.

KEYWORDS rural development, loss of population, galsinma, action group, mountain chain

## 27. Pest control in Mexican horticulture, with special emphasis to alternatives to pesticides use under certifications schemes

AUTHOR **Haddi Khalid**

SUPERVISORS Carmelo Rapisarda | Jorgen Eilenberg | Antonio Segura Miranda

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In developing countries, agriculture has played and is still playing a crucial role both at national and farmer levels. It is a source of income, employment and a strong factor contributing to the national growth of economy. One of the most important problems faced by agriculture is the pests' attacks and damages they cause to the crops and yields. For a long time, the massive use of pesticides was the main strategy to control pests' problems with heavy negative consequences for ecosystems and human beings. Many voices rose against the massive use of pesticides and called for more controls and restrictions to chemicals applications in agriculture. This collective awareness has been generally transformed in laws and legislations and in many cases in private systems controls, which added new costs to the agriculture production process. Mexico is one of the biggest players on agriculture sector. The pesticides use issue is a problem of actuality not only due to the high quantities of chemicals used but also because of the great importance of the small farming activity in the national agriculture sector. This study was carried out in two different systems of production, small holders farming and export oriented production, in two states of Mexico, respectively Oaxaca and Guanajuato. The pests' problems and alternatives to pesticides use linked with two different systems of certification, respectively organic and Good Agricultural Practices certifications were surveyed. The results showed many differences between the two states and the two systems of certification. In Guanajuato, where the Good Agricultural Practices system is applied, the quantities of pesticides used in a market and export oriented agriculture were higher but in the same time the adoption of pesticides alternatives was more frequent. The most used alternatives are insect proof nets, traps for monitoring and mass trapping and biological control. In Oaxaca, where the organic certification is widely spread, the chemical application is almost inexistent but no alternatives were adopted for pest control except mixtures of plant extracts. The organic certification is adopted mainly to avoid the use of pesticides. It is characterized by the existence of different norms and its complicated and time-consuming process. The Good Agricultural Practices system is generally adopted to comply with the foreign partners' exigencies allowing the access to more profitable market.

KEYWORDS pest, horticulture, alternative pesticides, yield, farming system

## 28. Particle size analysis of lamb meat: Effect of homogenization speed, comparison with myofibrillar fragmentation index and its relationship with shear force

AUTHOR **Lawrens Uasenina Karumendu**

SUPERVISORS Massimiliano Lanza | Daniele Montagnacn

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The impact of speed of homogenization on Particle Size Analysis (PSA) results was examined using samples from the *M. longissimus thoracis et lumborum* (LL) of 40 lambs. One gram duplicate samples from meat aged for 1 and 5 days were homogenized at five different speeds; 11,000, 13,000, 16,000, 19,000 and 22,000 rpm. Samples of LL from 30 different lamb carcasses also aged for 1 and 5 days were used to study the comparison between PSA and Myofibrillar Fragmentation Index (MFI) values. In this case one gram duplicate samples ( $n = 30$ ) were homogenized at 16,000 rpm and the other half (0.5 g samples) at 11,000 rpm ( $n = 30$ ). The homogenates were then subjected to respective combinations of treatments, which included either PSA or the determination of MFI, both with or without 3 cycles of centrifugation. All 140 samples of LL included 65 g blocks for subsequent shear force (SF) testing. Homogenization at 16,000 rpm provided the greatest ability to detect ageing differences for particle size between samples aged for 1 and 5 days. At the 25% quantile, particle size (PS) provided the best result for detecting differences due to ageing. It was observed that as ageing increased the mean particle size decreased and was significantly ( $P < 0.001$ ) less for 5 day aged samples compared to 1 day aged samples, while MFI values significantly increased ( $P < 0.001$ ) as ageing period increased. When comparing the PS and MFI methods it became apparent that, as opposed to the MFI method, there was a greater coefficient of variation for the PS method, which warranted a quality assurance system. Given this requirement and examination of the mean, standard deviation and the 25% quantile for PS data, it was concluded that 3 cycles of centrifugation were not necessary and this applied to the MFI method. There were significant correlations ( $P < 0.01$ ) within the same lamb loin sample aged for a given period between mean MFI and mean PS (-0.526), mean MFI and mean SF (-0.382) and mean PS and mean SF (0.233). It was concluded that PSA offers significant potential for streamlining determination of myofibrillar degradation when samples are measured after homogenization at 16,000 rpm with no centrifugation.

KEYWORDS lamb, homogenization speed, ageing, particle size analysis, myofibrillar fragmentation index, shear force

## 29. Can farmers fulfil their family needs in the Yemeni context? The key role of Saberi woman in rain-fed agriculture

AUTHOR **Diaz Perez Myriam**

SUPERVISORS Frédéric Pelat | Véronique Boussou | Claire Ruault

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This study, based on an agrarian diagnosis assessment, has been accomplished for the French NGO Iddéales in order to carry out a project for the support of peasants in the Saber Mountain. Saber is a high mountain region (the top reach 3006 meters), on Taizz outskirts. This mountainous area, situated in the South- West of Yemen, has climatic and geomorphologic suitable conditions for rain fed agriculture. Too high escarpments of the area don't allow irrigation. The landscape is drawn by terraces, which can stop and store a big part of the rain water. Villages are built on the crests of the wadi (small watershed). Parcels situated around houses are cultivated in intercropping of sorghum, maize, faba beans and beans and are mainly use as fodder for the bovines. Big and flat parcels in the middle of the wadi are mainly sowed in rotation of barley, wheat and leguminous. Terraces of high escarpments are little by little being abandoned but use as natural hay meadow. Pasturelands are the base of small ruminant's flocks feed allowance. The opening of the country in the beginning of the sixties has generated a demographic explosion and an important decrease of local agricultural products. Men who have gone to the cities have little by little neglected agriculture. Women stay at the head of in the farm holding without being the manager. The main part of the farm's income comes from the livestock. Livestock is women responsibility but the social context do not let place to their recognition. The management of the farm holding is fragmented between men and women and farming systems are not sustainable economically. External incomes are essential for the family survival. Agrobiodiversity and the indigenous knowledge can give a light to this agriculture.

KEYWORDS Rain fed agriculture, women, Saber Mountain, agrobiodiversity, livestock

## 30. Climate change impacts and adaptation of rice-wheat production in Bangladesh: Case studies of Dinajpur and Southern districts

AUTHOR **Parichart Promchote**

SUPERVISORS John R. Porter | Mireille Dosso | Saifuzzaman M.

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Climate change impacts on agricultural production in Bangladesh have been emphasized by numerous studies, which have used model-based scenarios. An attempt to increase wheat production in rice based systems through improving production technologies and expanding cultivated areas to the southern regions of Bangladesh could be threatened by climate change and variability. Therefore, this study is aimed at identifying the actual impacts of climate variability and climate change on rice and wheat production (which are staple food grains in Bangladesh), and adaptation farmers have implemented due to climate changes already experienced. The study compared traditional wheat-growing areas of the north with the expanding wheat-growing areas of the south. There are three main components in the study; (1) climate change trends which are assessed from the historical records of climate data, (2) the performance of rice-wheat based systems, which are assessed comparing farm types, and (3) the farmers' perception on climate change and the actual adaptations by farmers. Over the last six decades, the variability of rainfall has trended to increase both in the traditional wheat-growing areas and the southern districts. Moreover, the temperatures have increased both in their mean (~0.025 oC per year) and variability, and the increasing rate was higher in the southern regions. The increase of temperature variability is related to increasing frequency of days with extreme temperatures (36-45 oC) which can hamper wheat growth. However, under temperature change, the productivity of wheat is satisfactory for the northern and southern farmers. The productivity of rice-wheat based systems is higher in the northern regions, and in the larger farms, and the differences relate mainly to cultivation knowledge, bio-physical resources of farms (i.e. land types, water), and superior farm management (i.e., varieties, timely planting, and application of irrigation, fertilizers and pesticides). Therefore, the lower vulnerability of rice-wheat cultivation to climate change and the higher adaptive capacity could be assumed higher in the larger farms and in the northern regions. Most of farmers from the two districts believe that the climate has already changed and agree with the historical records on the change trends. The actual adaptation by farmers related to their perception on climate changes and the performance of farms. The availability of production technologies, i.e., irrigation, high yielding and heat tolerant varieties, are limitations for adaption.

KEYWORDS Climate change, climate variability, rice-wheat system, farm performance, adaptation, farmers' perception, Bangladesh

## 31. Meat quality from goats fed in the Argan forest (Province of Essaouira, Morocco)

AUTHOR **Valeria Andronico**

SUPERVISORS Abdelilah Araba | Alessandro Priolo | Magali Jouven

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A feeding trial was conducted to assess the effects of rearing goats in the Argan forest on meat quality traits. In the frame of this trial, this thesis focuses on some basic carcass quality parameters, on meat ultimate pH, meat colour and its stability. Sixteen male young goats of Moroccan local population were divided into two groups of eight animals: group C (Control) and group A (Argan). During the 60-days experimental period, animals of group C were permanently housed in stall and fed a concentrate-based diet, while goats of group A were allowed to the Argan forest over day with an integration of Argan products in stall. At the end of the trial, goats were slaughtered and carcass weight as well as carcass yield were measured. *Longissimus dorsi* muscle was analysed for ultimate pH, meat colour after a short and a prolonged blooming time (2 hours and 24 hours, respectively) and for meat colour stability over an 8-days period of refrigerated storage. Measured carcass parameters and meat ultimate pH were not affected by the diet. There were no significant differences in any colour descriptor ( $L^*$ ,  $a^*$ ,  $b^*$ ,  $C^*$  and  $H^*$ ) after 2 or 24 hours of blooming, between meat from goats fed Control or Argan diets. Diet slightly affected meat redness stability with lower  $a^*$  values, in tendency, in meat from Argan-fed goats as compared to that from Control-fed ones after 8 days of storage. However, diet did not affect either Hue angle variation or overall colour variation ( $\Delta E$ ) which were rather stable over time in meat from both groups. Moreover, discoloration index –  $(Ra)_{580} - (Ra)_{630}$  – as well as metmyoglobin formation did not differ between A and C treatments. Taken together, these first results suggest that feeding goats in the Argan system does not worsen important aspects of meat quality and motivate further research to find out signs of typicity of this product.

KEYWORDS meat quality, goats, argan forest, meat colour, traits

# **BATCH 2: 2007–2009**



## 32. Differences in adopting and practicing the System of Rice Intensification in Banteay Meanchey and Takev provinces, Kingdom of Cambodia

AUTHOR **Elena Mihailescu**

SUPERVISORS Didier Pillot | Andreas de Neergaard

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Located in South-East Asia, surrounded by developed countries (Vietnam, Thailand), shaken by a long political instability, Cambodia relies on an agriculture dependant on erratic rain fall and low fertile soils for relieving the food shortage by increasing the production of rice, its staple food. The government of Cambodia collaborated with several international Organizations and non-governmental organizations for implementing rice productivity programs. As a result, the System of Rice Intensification (SRI), a package of cropping techniques said to significantly augment the rice yield, was introduced in Cambodia. After nine years, this system is still not wide spread, resulting in considerable diversity regarding the adoption among the rice producers and often in dis-adoption among the SRI adopters. This study aims at identifying the determining factors of the uneven SRI adoption by the Cambodian rice farmers from two provinces through assessing the compatibility of this system with the local farming systems in the area of study. A small-scale survey was carried out, during which 123 structured questionnaires, 30 semi-structured in-depth interviews and monitoring of 21 rice plots were used as tools for collecting field data. It was found that SRI adoption's dynamics depends on agro-ecological context, purposes and economic incentives of the rice farmers, nature of the main income generating activity within the local farming systems, all interrelated. These findings make us wonder about the future of SRI and of the agriculture in Cambodia, knowing that rice is the main crop grown in this country. Will SRI be wider spread in the near future or the majority of Cambodian rice farmers will stay conventional? How could be the rice production influenced in each of the two situations?

KEYWORDS rice, adoption, intensification, fertile soil, NGO, farming systems

### 33. Shifting Governance in River Basin Management Water allocation in the São Francisco basin and the role of river basin committees in Brazil

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In Brazil, since the country established the IWRM-inspired water law 9.433 in the 1990's, river basin committees have been created to include water users and civil society in decision making on water allocation and to govern water on the river basin level. This thesis shows that even when there is a legal framework in place to support river basin committees as participative deliberative bodies on water allocation, practice puts up many barriers to operationalise this mandate. It shows that a discourse on the desirability of re-scaling water governance domains and shifting basin governance is not enough to guarantee the effective existence of basin committees. The political authority needed for this has to be actively constructed by basin committees themselves. However, basin committees turned out much weaker than expected, their basin plans not always implemented or their deliberations respected by the state, while the committees have no legal means to enforce their deliberations. The state furthermore retained the authority to grant water use permits thereby greatly hampering the committees' possibilities to allocate water in practice. The challenges are largest in case of federal river basins like the São Francisco basin in the Northeast of Brazil. The São Francisco river basin committee approved a water allocation in their basin plan in 2004, the strongest instrument to manage water that basin committees have. The political-economic nature of water allocation and the non-coincidence of individual interests the committee had to deal with made water allocation difficult though. Moreover, the basin and its trajectory are profoundly influenced by hydropower generation and its infrastructural and institutional legacies. In addition, the inter-basin water transfer dominated much of the discussions, making allocation even more difficult than usual as it was used as a tool in this debate. Specifically, as the position of the committee was damaged by the way the federal government overruled its deliberation on the transfer. Yet it also helped in creating a dynamic committee with active participation of its members and supported the creation of a collective identity. Despite all the difficulties, it was the committee that deliberated on the maximum allocation for consumptive use and the minimal environmental flow. Hereby the São Francisco committee included non-state actors

like civil society organisations and water users in decision-making on water allocation and managed to influence some of the terms of the water allocation equation. Which is considering the circumstances an important achievement in the process of shifting basin governance not only in Brazil but worldwide. A challenge coming from the creation of three water governance domains, the federal, state and basin level, is that the water law did not clearly define the exact division of responsibilities, mandates and decision-making power between them. The decentralisation to the basin level is more accurately described as a re-scaling of governance domains for which a multi-directional power transfer was needed. This because the water law created a complex and interdependent institutional setup or myriad of water agencies spread over the three domains where power was transferred to from a multiplicity of separate programs, agencies, sectors and policies. However, the complexity and lack of clear division in responsibilities between the three water governance domains, each with their own rules, means, boundaries and institutional logics, problematic water allocation greatly. The difficulties of creating a third water governance domain at the basin level that crosscuts existing political boundaries and institutions that are only partly re-scaled seems to be underestimated notably in the case of federal river basins and expectations too high or results anticipated too soon.

KEYWORDS    governance, river basin management, water allocation, river basin

## 34. How *Jatropha curcas* can participate in food security: case of the municipalities of Pedro Santana, Dominican Republic and close to the Source, Republic of Haiti?

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SUPERVISORS Jean Max Milien | Anne-Laure Roy

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The present research work realized in the communes of Pedro Santana, Dominican Republic and Cerca la Source, Republic of Haiti in the frame of the Binational Project of *Jatropha curcas* of the Dominican Institute for Integrated Development (IDDI) and our project of Master ended study at the Institute of Warm Regions (IRC), SupAgro Montpellier, France has as global objective: See how the growing of *Jatropha curcas* can participate in food security of the farmer families in both communes. The obtained results from the interviews realized with the direct and indirect beneficiary farmer families of the Project according to the fixed hypothesis at the beginning have revealed that *Jatropha curcas* influences positively food security in the area of the study according to the following ways:

- It does not compete with the food crops because it has been sowed on work out soils, which, are not used to make grow plants.
- It protects food crops from the attacks of the animals for example: stray herbivorous (ox, kids) because of its bad smell and its toxicity and the animals do not eat its leaves.
- It contributes to the improvement of the soils fertility by its contribution in terms of organic material for the benefit of food crops.
- It preserves and protects soils from hydrous erosion and contributes at the same time to the improvement of the environment.
- It contributes to increase the incomes of the beneficiary families of the Project in short and long term.

However, the Project has excluded the category of farmer families that do not possess earth and also have the lowest incomes. Thus, the Project has to take in account some weakness points, which represent a threat for its success. It has to emphasize on food

security aspect that is absent at the beginning.

To make it, the following strategies can be adopted:

1. To associate the growing of *Jatropha curcas* with fruit trees.
2. To encourage the raising of the bitter Cassava having a great nutritional and industrial value.
3. To realize the nutritional education of the beneficiary families of the Project.

Furthermore, IDDI has to encourage the active participation of the beneficiary families for the sustainability of the Project and its appropriation by them and finally consider them as a subject and not an object of the Project.

KEYWORDS *Jatropha curcas*, food security, municipalities, stray herbivore, farm families

## 35. Environmental Services from Bamboo Based Cropping Systems in North Viet Nam Assessment of payment options under the Clean Development Mechanism of the Kyoto Protocol

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SUPERVISORS Didier Pillot | Iben Nathan | Patrice Lamballe | Frédéric Castell

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The consequences of climate change will affect humanity and every ecosystem on earth. Mitigation and adaptation are the world's responses. They can simply lay on two main simple pillars, i.e. conservation and development, two objectives central in sustainable development. Around and since the Brundtland report in the 1980s, two main approaches arose regarding the relations between conservation and development. The first one, the conservation oriented approach, argues that effective conservation should keep the human activities away from strictly protected areas. The second one, people oriented approach or integrated approach, states that alleviating poverty is the best way to conserve and protect natural resources. Both approaches raise the fundamental doubts about the extent to which it makes sense to forcibly link conservation and poverty reduction. At least partly, this endless debate leads to a need for a new conservation paradigm, according to which the environmental services produced by poor farmers should be recognised and valued on the market, and leads to mechanisms of *payments for the environmental services* (PES). PES hence simply means that those who produce environmental services (ES) should be paid for these services. Payers could be the direct beneficiaries of the service, when they are easy to identify, and when they are willing to encourage more service production through payments to the service producers. In the case of public goods such as biodiversity enhancement or carbon sequestration, payers could be the international community as such or those who need carbon credits to satisfy with the Kyoto protocol commitments. As PES are relatively new in terms of concept, there are a number of knowledge gaps to be investigated. For example, there is not so far any study about the possible contribution of reforestation with bamboos, to carbon sequestration, and the way these services could be a basis for PES. Therefore, this study will assess the possibility to get payments for environmental services provided by bamboo based cropping systems in the mountainous area of Quan Hoa and Ba Thoc district in Thanh Hoa province, the largest bamboo plantation area in Viet Nam. In this area, several environmental services can be identified. The most feasible

and tradable ES is carbon sequestration, and the possible impact of bamboo plantations was estimated. Based on this amount of carbon sequestered, an (afforestation and reforestation) A/R-CDM project was designed. A cost-benefit analysis for this project was calculated to assess whether the income from this ES is compensating the investment costs needed to obtain this income from the carbon market. Socioeconomic surveys, in-depth interviews, and on-site visits were employed to understand the local context and livelihood options of farmer. Land use history, land use pattern, local land use policy and reforestation activities in the studied area were also explored in order to assess the extension of land that may be eligible for such a project and to check the additionally the principle of the proposed action. Focus group discussions had been done to test farmers' reactions to the proposed project. Finally, public hearing was held to get feedback from stakeholders and to triangulate the findings. The results show that people are living in deep poverty with limited livelihood options. Insufficient rice production and unfavourable animal raising (chicken, duck and pig) remain the people 's main sources of food while income in cash is mainly coming from selling bamboo culms from the reforested lands. Increasing demand of bamboo culms is a major incentive for the poor people to struggle in reforesting. However, this driving force is not enough to overcome the poverty barrier. Thus, people keep continuing to grow annual crops on slope land, borrowing the money from the bank to raise cattle and seeking off-farm job as livelihood strategy. Poverty is hence a dominant factor distracting land use from environmental sustainability. Therefore, while degraded land and fallow land has now been allocated to farmers, reforestation happens to be very slow, even though it should be compulsory (with a limited number of supporting programs, most generally not acting in very remote areas). As a consequence farmers still continue to practice the indigenous "slash and burn" to grow annual crops, particularly maize and cassava on the slope lands. Those who have the ability will reforest on such land extensively. Those who do not this ability have to fallow the land for several years so that they can grow annual crops again with the expectation that they can fully reforest in the future. However, this rarely happens or happens in an unhealthy way. In such a context, the only way to increase the income of the poor people is to allocate available degraded land or fallow land to them and to find means to encourage them to reforest. PES hence appears as one of the only option for this. Based on land use history and land use pattern, the land is eligible to A/R-CDM. It is estimated that carbon sequestration of bamboo based cropping system in the studied is equivalent 62 tons/ha/year of CO<sub>2</sub> based on 20 years' period estimation. This does correspond to a fair high potential for an A/RCDM project. The project cost and benefit analysis calculated on an area of 369 ha with a 10 % discount rate shows that the net present value (NPV) of the project would be positive at a CO<sub>2</sub>-e carbon price of 3\$/ton. While the minimum price observed in the market is 5\$/ton CO<sub>2</sub>-e and can reach a maximum of 10\$/ton, the project seems to be able to cover overcome all costs including

the PES. Besides providing seed, fertilizer, plantation cost, and technical support, the project can provide cash from minimum 3\$ to 158\$/ha/year during a 20 years' periods. This would be the key point to lift the people out of the extreme poverty and maintain the friendly environmental practice. There would be little problems for the farmers to shift from annual crops to bamboo provided, that they can intercrop these crops for the first 3 to 4 years. The discussion with the farmers from the very indirect questions provided a valuable understanding of farmer perspectives. It is shown that the objective of GRET's project to introduce bamboo to reforest conjoins the choice of livelihood strategy of the farmer and conforms to local and national land use policy of reforestation. The minimum conditions such as "harvest culms at the sustainable rate", "do not clear out the bamboo forest when the project finishes", "have to follow technical advice" should be respected by farmers. Farmers confirm that their land is eligible to the project and they wish such project to happen very soon. While many studies pointed out bamboo would not win in getting finance due to high transaction costs, this study demonstrates the opposite. It concludes that getting finance through an A/R-CDM mechanism is a feasible option for PES in this area. The strong argument for demonstrating the additionally principle of this project would be the lifting up the people out of the poverty trap and meeting the goal of environmental sustainability through CO<sub>2</sub> removal. The most appropriate payment mode should be direct payments to the farmer organized by the GRET project, through seed and fertilizers distribution, technical support, credit system and cash payments. However, the challenge is to what extent that the project implementers can convene Carbon buyers to invest on baseline study and validation while they are interested in large-scale projects. This study argues that in the context of Viet Nam, small scale A/R-CDM should be acknowledged. If this project is successful, it will be the fifth A/R-CDM in the world and be the first bamboo PES project in the world.

**KEYWORDS** Luong bamboo (*Dendrocalamus membranacea* Munro), Carbon sequestration, Afforestation and reforestation, Clean Development Mechanism (CDM), Environmental Services (ES), Payment for Environmental Service (PES), Viet Nam

## 36. Drainage Management ... just Water Use Efficiency Investigation of Water Management Strategies in Arid Regions, San Joaquin Valley, California

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California's San Joaquin Valley is one of the world's most vital and productive farming areas. However, due to topographic, environmental and political constraints much of this highly productive region is threatened by drought, saline groundwater and drainage disposal. In 1984, State and Federal government agencies established San Joaquin Valley Drainage Program (SJVDP) to investigate drainage related problems and to develop possible solutions. The recommendations of SJVDP included: i) source control; ii) drainage reuse; iii) evaporation ponds; iv) land retirement; v) groundwater management; and vi) discharge to the San Joaquin River. The purpose of this research was to investigate how SJVDP works at institutional and farm levels, in order to draw lessons to other arid areas, in particular to Khorezm region in Lower Amu Darya, Uzbekistan. Past and current water management strategies were examined in both case areas, consequently it assessed whether these strategies enhance or constrain sustainable irrigated agriculture. To analyse and discuss of research used consequently the water management development paradigms and three dimensions of sustainability of Allan, it is consisting of social, economic and environmental – and the central mediating role of discursive hydro-politics. Despite that both cases are not same in social-economic, political and cultural context still lessons from California can be learned for Uzbekistan. Although, the water management system in California is still heading towards sustainability, it still serves as a good example for Uzbekistan to face and cope with current and future water management issues and possible lessons are learned. Long-term experiences with its mistakes as well as successes in drainage management are learned to Uzbekistan's case. Although, it should be kept in mind that the policies and strategies cannot be directly applied but rather should be translated taking into account the existing social, technical, economic, and political dimensions.

KEYWORDS Irrigation, drainage, reuse, management, shallow groundwater, efficient water use, sustainability, arid and semi-arid zone, San Joaquin Valley Drainage Program

## 37. Feasibility study of a ‘Payments for Environmental Services’ project in the influence zone of the Izta-Popo national park, Mexico

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Payments for Environmental Services (PES) projects are a relatively new phenomenon in natural resource management and development. It is a market-based development mechanism, and used in cases where other measures have failed. Wunder (2005) uses a quite strict definition of PES, he states that a PES project consists of: (a) a *voluntary* transaction where (b) a *well-defined* environmental service (or a land use likely to secure that service) (c) is being ‘bought’ by a (minimum one) service *buyer* (d) from a (minimum one) service *provider* (e) if and only if the service provider secures service provision (*conditionality, only pay when services are actually delivered and agreements are followed*). (Wunder, 2005). The four different types which are currently marketed through PES projects are carbon sequestration, biodiversity conservation, hydrological services and landscape beauty. There are different types of PES projects in the world, in developed countries they tend to be more policy-based, and thus they are not really PES projects. However, there are only few ‘real’ PES projects that completely fulfil Wunder’s definition. It is also obvious that it is a mechanism which is still under construction, and important lessons can be learned from existing projects. San Juan Cuauhtémoc is the case study village of this research. The village is located in the influence zone of the Izta-Popo national park in Puebla State. There are some serious problems with natural resource management in the area, leading to deforestation, erosion, water pollution etc. Water is getting scarce in the region, and villagers acknowledge that current practices are not sustainable and need to be improved. This research uses different tools in order to estimate the feasibility of a PES project, namely: literature research, semi-structured interviews with key respondents, cost-benefit analysis etc. There are several factors limiting the research, namely time constraints and difficulties to contact respondents. There are several organizations and policies which have an influence on the study area, and which could also influence a potential PES project. It is important to be aware of the role and existence of these organizations so that it will be possible to cooperate with them. Several factors seem to be able to make a project successful or a failure. When designing the project, it will be important to take these factors into account, in order

to make the project design as strong as possible. These factors have been derived from earlier experiences with PES projects in different countries. This clearly illustrates the necessity to plan and design the project carefully. All possible environmental services (*carbon sequestration, biodiversity conservation, hydrological services and landscape beauty*) have been taken into account to find out which service would be most suitable for a PES project in the region. From the cost-benefit analysis, which has been calculated and the other factors it becomes clear that carbon sequestration is the most feasible option for a project. This can be combined with water provision, as this is currently a very big issue in the area. The other environmental services seem less important or more difficult to market. Finally, we can say that there are possibilities to install a PES project in the region, but careful planning and design is necessary to prevent failure or wrong allocation of resources. The potential project can combine hydrological services and carbon sequestration. There are several other benefits, which will be derived from an increased forest cover, like reduction of erosion etc. Companies with large water concessions can be approached in order to financially help to set up the project, and after the initial period, the project should be able to work independently.

KEYWORDS      Mexico, Payments for environmental services, Puebla, feasibility study, carbon sequestration

## 38. Child Malnutrition and Food Security: A study among the Chepang community in Makwanpur district, Nepal

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**M**alnutrition especially related to under nutrition and food insecurity has always been a problem for the developing world. Nepal, which comes under one of the least developed countries is among the worst affected. The ethnic tribes of Nepal like Chepangs face a dreadful situation. The increase in the living standards of an average Nepalese citizen has not affected the people of this community. Even the interventions could not bring much change. Creating awareness towards the intervention programmes among the community and also adopting a community based agricultural development programme like community farming can possibly bring hope for enhancing the nutritional status of children and also food security among the Chepangs. This study was primarily aimed at finding the malnutrition rate among the children below five years of age, level of food security and the food habits of the Chepang community in Makwanpur district of Nepal. Further the study was aimed at understanding the awareness of the community towards the ongoing intervention programmes and finding the likelihood of adopting community farming as an alternative means to alleviate the child hood malnutrition and also the food insecurity prevailing within the community. Anthropometric assessment was done for 150 children (78 boys and 72 girls) from 110 households. Questionnaire was administered for 110 households. A focus group discussion was carried out with 10 participants. Four key informant interviews were also done. Demographic details were obtained through household questionnaire and secondary data from the District Development Committee and Mannahari Development Institute. Household questionnaire survey was conducted for 110 households. Anthropometric measurements were carried out in order to determine the nutritional status. Assessment was done for 150 children below five years of age from the 110 households. Weight for age, height for age and weight for height were calculated in order to find out the underweight, stunting and wasting respectively. This was based on Z-scoring of the WHO growth standards. Dietary habits of the community were described through food frequency questionnaire. Other health indications like diarrhoea and eye health was obtained through household questionnaire. Household questionnaire,

focus group discussion, and key informant interviews were used to get data regarding food self-sufficiency, coping strategy and awareness of intervention programmes and adoption of community farming Results. The underweight, stunting and wasting for boy children below five years was 71%, 75% and 47% respectively. For girl children the rates were 74%, 76% and 42% respectively. Mean household size was seven and the mean monthly income was NPR 463 (6 USD). Average landholding size was 0.17 hectare. Basic sanitation facilities were lacking in majority (90%) of the households. Frequent diarrhoea was reported among 84 percent of the children (household questionnaire). Chepang diet was inferior with less nutrients. Diet was dominated by maize and millets. Protein was almost lacking in their diet as they rarely consumed pulses and other animal source foods. Green leafy vegetable was regular part of Chepang diet. The main source of green leaves was *Urtica dioica* locally called as sishnu, which is rich in vitamins. Seventy percent of the population had a food self-sufficiency of three to six months. The main coping strategy adopted was skipping and reducing meals. The organisations involved in the intervention programmes were MDI in collaboration with WFP, Plan Nepal CCDN, NCA and praja development committee. Seventy-eight percent of households were unaware about the ongoing intervention programmes and the organisations responsible for it. Majority of the people (92%) were ready to follow community farming if the condition is favourable. The child malnutrition among the community was found to be much higher than the national average. There was no significant variation between the genders. Low household income and lack of basic resources including the sanitation facilities and health assistance made their life miserable. Situation of malnutrition was made severe by the frequent occurrence of diarrhoea. Majority of the community could satisfy only three to six months of food self-sufficiency, as the agricultural production could not meet the year round requirements. Dietary habits of Chepangs were found to be carbohydrate rich and lacked proteins and other micronutrients. The intervention programmes related to nutrition and agricultural development is so new that the results of the interventions might probably visible in the coming years. But in order to have a successful intervention, awareness among the community is essential. Community farming can be a solution to enhance the nutritional status and the food security of the community if external support is provided.

**KEYWORDS** child malnutrition, community based agricultural, food security, ethnic tribe

## 39. Enlarging existing knowledge about direct cash transfer projects in support of returnee livelihoods: the case study of Otuke County, Northern Uganda

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SUPERVISORS Elisabeth Rasse-Mercat | Nikaj Van Wees

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The present paper is based on a four-months research as intern in the Action Against Hunger (ACF) project for ‘Reinforcing returnee livelihoods and food security through direct cash transfers’. The project has started in February 2009 and is targeting one-thousand and five-hundred (1,500) vulnerable to food insecurity households. The project -funded by the Royal Norwegian Embassy (RNE) - is implemented by ACF in four sub-counties (Adwari, Okwang, Olilim and Orum) of Otuke county, Lira district, Northern Uganda. Main objective of this research is enlarging existing knowledge about direct cash transfer projects and more specifically to contribute to the success of the ACF’s direct cash transfer project in Otuke. The research approach is based on primary data collection with the use of semi-structured interviews and direct observation. Secondary data from ACF were used to complement this information. The result is a paper, which found its bases on direct experience and knowledge of the study area. Among ACF’s beneficiaries, five (5) groups of households were identified. Each group is categorised as vulnerable but levels of vulnerability vary according to access to land and agricultural inputs, capital to invest and off-farm activities. Livestock is the main form of capitalisation in Otuke. To each group of households correspond a different level of capitalisation in terms of number and type of livestock owned. In conclusion, most vulnerable groups are Group 1 and Group 2, which -two years after resettlement- appears to be still in emergency situation. Group 3 and Group 4 have undertaken a development process through capitalisation of livestock. Condition of households in these latter two (2) groups is more likely to be described as a development situation. Finally, Group 5 includes households, which do not look in-needs as others. ACF should focus particularly on households in Group 1 and Group 2. They live below the minimum threshold of survival for big parts of the year. Direct cash transfer should help households to cover their needs all year round and break the vicious circle of poverty. Group 3, Group 4 and Group 5 need to ameliorate their situation through improved sources of income. The cash transfer should provide them with ameliorated access to market and availability of agricultural inputs.

KEYWORDS Action Against Hunger, Northern Uganda, returnees, direct cash transfer, household’s livelihood

## 40. Farming systems and ecosystem services analysis: A case of Mathenjwa landscape, KwaZulu-Natal Province, South Africa

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SUPERVISORS Mireille Dosso | Andreas de Neergaard | Olivier Phillipion

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In Sub Saharan Africa, agriculture accounts to 20% of GDP, employs 67% of the total labour force and it contributes to development by acting as an economic activity, as a livelihood source and a provider of environmental services. However, 50% of the globe's agricultural land and 60% of ecosystem services are now affected by some degree of degradation. Farming affects a greater proportion of the earth's land surface than any other human activity and therefore influences structure and function of many ecosystems. The study area is found in KwaZulu-Natal Province a former homeland in South Africa that is managed under the Mathenjwa Tribal Authority. It is a traditional farming area managed in an "eco-agriculture-like" manner by villagers and surrounding a community-managed conservancy and a protected game reserve. The demand put forward by the organization was an analysis of agricultural systems (cropping, livestock and other systems within farming systems) and their influence on landscape structure to serve as a reference for other studies in the area. Hence, a research was undertaken with the purpose of studying the way people live and farm in the area and at the same time maintain the natural resources around them. This involved looking at what activities they are engaged in, the main driving factors that lead to the choice of certain farming practices, relate them to the ecosystem services obtained from nature and later explain how they influence landscape structure. The diagnosis of agrarian systems was the methodology used to understand the links between farming practices, ecosystem services and their influence on landscape. The data collection tools were questionnaires; semi structured and structured interviews, group discussions and observations. The study revealed that all the people practiced a subsistence type of agriculture that depended on drawing resources from the surrounding environment. The provisioning ecosystem services were the observed benefits obtained from nature by the people. Most of the people depended government grant (welfare) for income. Five categorizations of the farming systems were made depending on the existing social economic factors. The occurrence of the farming systems, extent of natural resource and landscape exploitation was influenced by biophysical, socio economic, institutional and historical factors. Likewise, the future

of farming, ecosystem services and the landscape structure depends on these factors. The study concluded that the socio economic factors were the most influencing factors to the choice of farming system and structure of landscape. Therefore, it is recommended that if innovations were to be made, a critical analysis on the likely impact of developments on the landscape and ecosystem services should be thoroughly assessed. Or could the local community be compensated and rewarded as stewards of the ecosystems for sustainability?

KEYWORDS     Farming systems, landscape and Ecosystem services

## 41. Characteristics and Evolution of Farmer Managed Irrigation Systems in Tsangano District, Mozambique

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**M**ultiple and multifaceted factors affect and influence the development of irrigation systems. The rising urban and rural populations, food grain shortfalls and draught have enforced the necessity of farmer managed irrigation systems (FMIS) in Sub Saharan Africa. Furthermore, the growing interest in FMIS development has been accentuated by failures of imposed large-scale irrigation systems and small-scale irrigation systems. Evidences exist that FMIS have been in place for a long period and that they can significantly contribute to food security and the promotion of commercial production for export markets. However, these FMIS are affected by many factors. In Tsangano, Mozambique, important factors include external intervention, policy changes, political instability and changing marketing opportunities. These usually lead to changes and eventually to collapse of these systems. This research answers the following two questions: 1). What are the characteristics and the evolution paths of FMIS in Tsangano District, Mozambique and how can ‘*hydraulic property*’ relations explain the productivity, equity and sustainability of these FMIS? and 2). How does external intervention affect the ‘*hydraulic property*’ relations and functioning of FMIS in Tsangano? The concept of ‘*hydraulic property*’ was used to fully and systematically understand these systems. The ‘*hydraulic property*’ Coward (1986a; 1986b; 1986c; 1990) coined concept and has been used extensively in Asia to unlock the characteristics of FMIS. The concept of ‘*hydraulic property*’, explains the relationship, which an irrigator develops with a property object (irrigation infrastructure). The irrigator produces this relationship by investments and relationships with other people who have done an investment in the property object. The overall research strategy was a combination of a “case study” and a “technography” approach. Semi structured interviews, informal interviews; focus group discussions, observations, and irrigation system technical data collection tools - Rapid Assessment Procedure (RAP) were used to collect the data. Data were analysed through meaning categorization, interpretation, synthesis and narrative. Furthermore, life cycle analysis, historical trend analysis and Uphoff’s matrix of irrigation activities were used to understand the characteristics and evolution of these systems. Three distinct eras

were identified for this research in Tsangano district, which influenced the configuration of FMIS. The first period, the Colonial period, ran from 16th Century to Independence in 1975. During this period, Portuguese farmers established canal irrigation in Tsangano. The Local people were initially forced to work without payments (*Chibalo*), but later on they were paid a little amount of money or materials (e.g. salt). After independence, it took three years for the Mozambican government to refocus its strategy in relation to agriculture. Meanwhile, the local people occupied the farms left by the Portuguese farmers. Then in 1978, the Mozambique government established a State Company called CAIA, which occupied all the farms left by the Portuguese farmers. The local people were chased off their farms. However, they continued working in the farms under the CAIA. The civil war overshadowed this period, which ended in 1992. In 1992/3, the local people returned to Tsangano and re-occupied the Portuguese / CAIA farms. At that moment, many other irrigation systems were established. From the previously mentioned periods, three categories of irrigation systems can be identified. First, Portuguese initiated irrigation systems (PIIS) – systems, which were constructed and used by the Portuguese farmers, then, seized by the local people, then by the CAIA state company and finally by the local people again. Second, Communal Irrigation Systems (CIS) – systems, which were constructed by a group of local people collectively and are used and managed collectively. Lastly, Private Irrigation Systems (PIS) – systems, which were established by one family, used their labour or their resources to hire labourers to construct an irrigation system. Analysing these systems, I discovered that FMIS development has been driven by poverty, markets, landscape characteristics, waterscape features, politics, and government policies. The Portuguese farmers brought the idea of canal irrigation in Tsangano. Forcefully, they taught the local farmers canal irrigation, which the local people continued at higher rate after the civil war. After the civil war, the local people returned from Malawi very poor, such that the only possible and secure source for sustaining their livelihoods was irrigation. The establishment of the market links with Malawi, Zambia, Tanzania, and other parts of Mozambique fuelled the growth of irrigated farming. Due to increasing demand of Irish potato, prices augmented gradually and the local people started benefiting. Furthermore, the policies in the neighbouring country, i.e. Malawi, focused on targeted input supply (TIP) and subsidised fertiliser provided cheap inputs for the irrigators in Tsangano. Technically, the FMIS in Tsangano follow unconventional (primitive) ways of irrigation. The water diversion structures are very simple, the canals are unlined, and the shape and the slope are inconsistent. The fields are steep, feed canals very small and furrows short. These features explain the logic of local people that enabled the sustainability of the systems for some time even without the support of external agencies (government or NGOs). Water conveyance efficiency is low in CIS and high in PIIS, who were using builders' level in their construction process. Whereby, water delivery equity, flexibility, and reliability are influenced by the characterisation of

ownership in the irrigation systems. Irrigation in practice in these systems exhibits different scenarios, which is a function of many factors, but the profound factor is the characterisation of ownership of the systems. The arrangement of irrigation infrastructure, planning and implementing of irrigation schedules, the setup of irrigation committees is following the ‘*hydraulic property*’ relation pattern. As much as a ‘*hydraulic property*’ relation is established by an investment in the property object, the cases studied in this research also reveal that social networks provide the support for an individual to exercise his/her ownership on the property object. The property relationship is created in CIS and PIS by construction whereas in PIIS by land ownership. Maintenance is critical in communal systems to legitimise claims on the right to use the property object whereas in PIIS physical presence is critical. The property relations are rearranged by death of an owner in private systems but it is fiercely guarded in CIS. Therefore, with these observations the following conclusion can be drawn from the study: ‘*Hydraulic property*’ explains the intrinsic issues, which make FMIS a success. Thus the aspects of FMIS, which external agencies change when they intervene eventually leading to the collapse of the system. The simple design of the FMIS is not only caused by the lack of skills of the irrigators, but it is also the reason for their durability, which leads to sustainability of the irrigation systems. External interventions (factors) affect the technical dimension by changing the design, which affects the people-to-people and people-to-object relations. They also influence the institutional set up, by altering it, and the organisation of these systems, which are locally organised along the property relations. These ultimately affect the sustainability of the systems. Finally, external interventions change the social relations, which emanate from the property object - people relation. The impacts become very pronounced with respect to specificity of the investment. On the one hand, poor farmers are locked in by big farmers whose opportunistic behaviour appropriates all the benefits from the poor farmers. On the other hand, founders, owners, *Capitões* and *Nyawkawa* in the system protect their relationship with the property object, because their investment is inscribed in the irrigation infrastructure and cannot be easily converted to another equally beneficial use.

KEYWORDS      irrigation systems, hydraulic property, *Capitões*, *Nyawkawa*,  
Portuguese initiated irrigation systems

## 42. Development of harmonized tools to assess Meat Quality and Animal Welfare in pig production systems of Spain

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SUPERVISORS Maria Angels Oliver | Luisa Biondi | Magali Jouven

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This study was carried out within the development of Q-Porkchains project of European Union (EU). Intensive Iberian pig production and conventional pig production systems were assessed in Animal Welfare and Carcass and Meat Quality. The welfare assessment system developed by EU Welfare Quality® project with some modifications was applied in five intensive Iberian and conventional pig farms. Carcass and Meat Quality assessment was divided into three experiments and carried out in the Duroc x Iberian crosses produced under intensive conditions with standard ante mortem treatment (experiment 1), with long transport (experiment 2) and in commercial pigs from conventional production system (experiment 3). Differences between Intensive Iberian pig and Conventional pig were found. For Animal Welfare they could be observed in different parameters assessed, such as bursitis, skin lesions or human-animal relationship. For the Carcass and Meat quality, the main difference was found in subcutaneous and intramuscular fat content, which is probably related to genetic type of animals and different feeding regimes. In Conventional pig's high lean meat percentage and very low intramuscular fat content was found, in Intensive Iberian pigs both intramuscular and subcutaneous fat content were high. In conclusion, in general, the Animal Welfare could be considered better in Intensive Iberian pork production system than in Conventional one, although more detailed statistical analysis would be necessary to confirm this appointment. The meat quality was different between Iberian and Conventional systems. No sex effect neither for Carcass and Meat Quality variables was found in both type of meat, except for intramuscular fat content.

KEYWORDS animal welfare, pork quality, conventional pig production system, Iberian pig production system

## 43. Collective Action of Organic Rice and Vegetable Producers Groups in Vientiane, Lao PDR

AUTHOR **Pham Thi Hanh Tho**

SUPERVISORS Henrik Hansen | Stephen Onakuse | Paule Moustier

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Forming smallholders in a group to work collectively toward a common goal is a popular objective in intervention in the developing world. A basic function of the collective action theory is to help a group of people to better their benefits or overcome difficulties. Collective action of small farmers is not new in development projects. Many lessons can be learned when small farmers produce high value products (organic) and access niche markets. This study was conducted in Vientiane, Lao PRD on collective action of farmers groups producing organic rice and vegetables by qualitative methods using in-depth interviews to analyse and compare the effectiveness and impact of collective action in two value chains (organic rice and vegetable). All groups studied are in the framework of PROFIL and the ProRice project. That helps to clarify success and failure, strength and weakness of groups in applying collective action to ensure products are organically produced and to access high-class markets. This study found that collective action in vegetable groups in ICS and marketing are more significant than in rice groups. There are key internal and external factors influencing collective action effectiveness such as group size, leadership, and market initiatives. We learned that collective action application needs to be distinguished in different value chains. Collective action is needed to obtain common goals in organic production and marketing, but it is important to motivate farmers to get involved in making an “active collective action.” Otherwise, free riding will occur which reduces the effectiveness of collective action as farmers get involved with other goals and self-interests. In a development project to help organic farmer’s groups in production and marketing, market initiatives play an important role.

KEYWORDS collective action, smallholder, organic rice, organic vegetable, niche market, market access, internal quality control, organic producers group

## 44. The centres of access to markets (CAM) they are tools to implement a set of activities that revitalize the local economy and give answers to the problems of marketing of small producers?

AUTHOR **Jairo Potoy PAIZANO**

SUPERVISORS Benoît Thierry | Frédéric Lancon

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Two-thirds of rural households in Madagascar do not have sufficient economic resources. One of the main causes of this limitation is due to the low prices they receive for their crops, especially at village level. In this context, the country's Government and the International Fund for Agricultural Development have established the Program for Promotion of Rural Incomes (PPRR). Through the establishment and operationalization of the Centres for Market Access, the program envisions to support small rural producers to develop their capacity to defend their interests in marketing their products. It is in the process of capitalizing activities PPRR that fits this research. This study aimed to understand the effects that the Centres Access to Markets has caused in the dynamics of trade-affected farmers and to assess their sustainability in time when external assistance has ceased. The study area selected is the region of Toamasina, on Analanjirofo: the east coast of Madagascar.

KEYWORDS centres of access to markets, local economy, program for promotion of rural incomes

## 45. Impact assessment of tillage systems on soil productivity in Canada, using a simple water balance model approach: A case study of oxbow creek watershed (South-Western Ontario)

AUTHOR **Joseph Nsabimana**

SUPERVISORS Jan de Graaff | Sylvain Lanau | Bonnie Ball Coelho

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This research on “impact assessment of tillage systems on soil productivity using simple water balance model approach” was carried out in Canada, in southwestern Ontario from April to August 2009. A case study of Oxbow creek watershed was chosen North West of the city of London. Bio-physical research at Southern Crop Protection and Food Research Centre was first undertaken by daily monitoring of runoff, underground tile flow or drainage and soil water content at plot scale using automated reflectometers (moisture sensors) and float/weir box systems installed in both conventional and zero tillage plots. In the end, the plots showed net differences in term of runoff and drainage in top-soil and below the root zone due to changes in soil aggregate stability created by no tillage. In addition, soil water characteristics were investigated using a water retention curve of both plots. Water retention curves showed that the soil water in conventional tillage was released at lower potentials than in zero tillage, meaning that water was retained within the soil profile of conventional tillage by higher binding forces. This condition affects water availability for root uptake. Furthermore, a socio-economic study was carried out within the watershed with various stakeholders and especially with corn growers. The study indicated that zero tillage could be the best practice for corn production for a double reason: reduced risks of erosion and sustainable soil fertility. This was in contradiction with corn growers` perceptions according to which no-till practices are responsible for germination delays, reduced plant populations and yield potential. The study was supported by a partial budget analysis in which zero tillage was found to be cost effective in terms of labour and machinery.

KEYWORDS no-till, conventional tillage, water balance, water retention, partial budget, corn yield, watershed

## 46. Media strategies of sustainable living for the case study climate change adaptation: Madriz Department, Nicaragua

AUTHOR **Julie Mayans**

SUPERVISORS Robin Bourgeois | Henri Hocdé | Alvaro Ponce

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Global warming and increasing climatic threats intensity such as inundations, droughts and mudslides have immense impacts while damaging the crops in developing countries where the population depends directly or indirectly on food crops. Climatic models derived from the works of Intergovernmental Panel on Climate Change (IPCC) predict, by 2100, an increase of 3,7°C in temperature and a reduction of 36,6% in precipitation with increasing intensity in the Pacific slope of Nicaragua, in comparison with 1990. Madriz department, located in the north of Nicaragua in the “Dry Tropic”, is in a tough situation of climatic vulnerability with risks of drought during the first cultivation phase (“*primera*”) and heavy rains during the second (“*postrera*”) which is combined with an increasing pressure on natural resources. The aim of this thesis was to study the household livelihoods in order to propose individual and public strategies for adaptation to climate change. The Sustainable Livelihood Approach was used to study the five different capitals of the household and the way they interact with the varying climatic conditions and within the political and institutional framework. In the Sabana Grande basin, the livelihood strategy most resistant to climatic vulnerability is based on the combination of agricultural and off-farm activities. This is followed by the two strategies based on small enterprises (*rosquilleria*, *ladrilleria*) and on diversified agriculture. The most vulnerable strategies include those that sell their labour work, those who cultivate for subsistence and those who are engaged in sharecropping. In order to adapt to climate change, the priority strategies are: (i) diversification of income sources, (ii) introduce different crops or varieties adapted to climatic changes using sustainable agricultural practices, (iii) strengthening of human and social capitals. For the people to reach the above strategies, the priorities at the public level are: (a) to encourage the diversification of activities through supporting the private sector as jobs creator and implementing infrastructures in the rural sector, (b) support research to build local climatic scenarios in order to propose solutions adaptable to the agro ecological and socioeconomically conditions and (c) promote the community management of natural resources (forestry, hydrology). The use of the Sustainable Livelihood Approach to design adaptation to

climate change policies allows using an integrated vision at household level in order to design, in a participatory way, adapted strategies. However, this complex and cross-sectoral methodology requires strengthened human and financial resources.

KEYWORDS     Climate Change, Sustainable Livelihood, adaptation, basin, strategy, vulnerability, public politic, environmental management

## 47. The Impact of Food Safety Standards on Commercial Beekeepers Value Chain: a case study of Chitwan district, Nepal

AUTHOR **Keerthiraj Siddapura Mallegowda**

SUPERVISORS Kostas Karantininis | Stephen Onakuse

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**B**eekeeping is one of the most potential business opportunity in Nepal due to the conducive ecological landscape, Agriculture dominated areas found all over the country and the long tradition and skill of beekeeping to the Nepalese people. But the major system of Beekeeping in Nepal is of age-old type and lacking the commercial purpose. This study was examined on the Commercial Beekeepers Value Chain (CBVC) and other traditional forest bee keepers and rock bee hunters in Chitwan. Evaluation of the effects of food safety standards on the profitability, Critical Success Factors (CSFs) and other benefits of actors in the CBVC was done using the Cost benefit analysis and analysis of CSFs change after standard compliance set-ups. The results of the analysis show that after standard compliance scenario of CBVC is more favourable than before compliance scenario of CBVC, traditional forest beekeepers and rock bee hunters. The result of the analysis also shows that both the costs and benefits of compliance with food-safety standards were significant with high gross revenues and net returns. In addition, incurring high operating costs and potential benefits with regard to the experts. The overall analysis of this study proposes the need to ensure more effective and consistent planning, in order to protect the future of the Honey sector, ensure a suitable regulatory structure, strengthen the capacity of the stakeholders to handle the resource in sustainable way. Further to ensure honey benefits and to increase development programmes by Government of Nepal and NGOs to uplift traditional forest beekeepers and rock bee hunters.

KEYWORDS food safety, beekeepers, value chain, cost benefit analysis, profitability

## 48. Export Performance and Food Standards: Case study of Moroccan Citrus Value Chain

AUTHOR **Neda Trifković**

SUPERVISORS Wusheng Yu | Stephen Onakuse | Akka Ait El Mekki

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A case study approach was chosen to investigate the export performance of Moroccan citrus sector. According to the shift of export from traditionally favoured EU market, Morocco's citrus export might be constrained by competitiveness change, trade policy and food regulation. The analysis of trade policy and food regulation impact consisted of desk study and field research in two biggest citrus producing regions of Morocco. Value chain analysis was applied to determine the structure, organisation and typology of Moroccan citrus value chain. It also allowed the analysis of the ability of value chain actors to assure compliance with foreign food regulation. Competitiveness of the sector was analysed through indices of relative unit values and export revealed comparative advantage. These indices show decline in competitiveness and specialisation. Furthermore, the constant market share analysis and price-quality competition model were applied to round up the sector's competitiveness profile. These two methods allow concluding that the loss of competitiveness can be perceived as improvement of product quality. Finally, gravity model was used to measure the effect of foreign trade and food policy on trade. Trade-deterring effect of food regulation is bigger than that of the import tariff. Even though faced with several difficulties, Moroccan citrus sector shows determination to resolve them.

KEYWORDS food standard, export performance, comparative advantage, competitiveness, specialisation

## 49. Early season rice cultivation in Nepal: Opportunities and constraints

AUTHOR **Ambavaram Vidya sagar**

SUPERVISORS Jens Carl Streibig | Stephen Onakuse | Jorgen N Christiansen |  
Hira Khaji Manadar

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Rice is cultivated in all physiographic regions in Nepal. The practice of rice cultivation differs with landscape and season. Early season (spring) and Normal season (summer) are two seasons in which rice is cultivated in Nepal. Besides these two cultivation practices, rice in some areas in Nepal is grown even in the winter season by taking advantage of residual moisture in the fields which is locally called as Boro rice. Early season rice (Chaite rice) sowings are practiced in February-march and Normal season rice sowings are practiced usually in June-July. Both the early rice and normal rice are cultivated in the lowlands while only normal season rice is cultivated in upland regions. There are some households where farmers know only rice cultivation for their survival. There are considerable differences in practices of production, storage and marketing between early season rice and normal season rice in Nepal. Early season rice cultivation is being encouraged by experts since it enables small farmers to improve their livelihoods in Nepal by means of reducing the risks involved when compare to normal season rice. Nepal is mainly divided in to three agro-climatic zones called high hills, mid hills and terai based on altitudes. Rice crop is grown majorly in terai and mid hills. This study was conducted in three different districts in terai and mid hills regions where rice cultivation is the only source of income for most of the small scale farmers. Total of 100 households are considered as samples in which small and marginal farmers are chosen. This study focused on comparative advantages of early season rice cultivation in the study area. The objective was to enhance the small scale farmers by facilitating them to adopt the practice of early season rice cultivation in Nepal. This research was under the frames of NARC (Nepal Agricultural Research Council) that is also working on Rice crop in Nepal. This study addresses that the early season rice cultivation practice has significant advantages of less pest and diseases outbreak, less cost of production and better marketing opportunities when compared to normal season rice cultivation. In contrast, there are some potential difficulties involved in early season rice cultivation with irrigation facilities, lack of suitable seed and lack of proper support from the government. Early rice cultivation practice needs an appropriate technology transfer system which was lagged behind to improve the livelihood of the small scale rice farmers in the study area.

KEYWORDS Early season rice cultivation, Nepal, Chaite rice, market access, storage facilities, small-scale rice farmers, pest and diseases in Rice, socio-economic constraints

## 50. Agricultural mutation in the Akka oasis: Analysis of production ensembles of Akka Oasis and Drâa zone in the Province of Tata, Morocco

AUTHOR **Renzo D'Alessandro Nogueira**

SUPERVISORS Khalid Belarbi | Olivier Philippon | Flip Wester

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This research analyses an agricultural system in the Moroccan Sahara composed of two production ensembles that are different and complementary: the oasis of Akka and flood-irrigated zone in the Drâa Valley. The analysis focuses on the interactions in the management of natural resources for agricultural production, with special emphasis on ways to distribute water among the social and ethnic groups. The study is multidisciplinary in that it studies the agricultural, anthropological, sociological and economic construction of the production systems to show its historical evolution. The conclusions clearly identify a mutation in the agricultural system: the emergence of a new class of farmer who depends on intensive groundwater irrigation and the proliferation of new forms of land ownership and water rights and consequently new modes of production in the flood-irrigated areas. The research is innovative because it proves the compatibility of the Socio-Technical Approach and the Agrarian Systems Evolution Theory while it proves useful as a theoretical tool for the identification of mutations in agricultural irrigation schemes within the study area.

KEYWORDS agricultural systems, mutation, production systems, Oasis, Akka, Draa valley, Morocco

# 51. Effects of exclusion from community forestry on rural livelihood strategies in Nepal

AUTHOR **Sameer Machingal**

SUPERVISORS Helle Overgaard Larsen | Stephen Onakuse

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This thesis is a study on effects of exclusion from community forestry on rural livelihood strategies in Nepal-Bandevi community forestry. Rural people depend upon forest and resources they have, for their livelihood development. Due to geographical, economic, social and technical reasons, many households are excluded from the membership of community forestry programme. The situation of non-membership/exclusion can be seen in most of the community forestry user groups and many other development projects as well. Most of these households were using the forest before the emergence of Community Forestry User Group, and their livelihoods are depending upon forest and forest products. Ban Devi Community Forestry User Group started during 2000 with around 1600 households from Ward No. 8 & 9 of Bharatpur municipality, Chitwan District, Nepal. Those households located in Wards 7 & 14 are non-members/excluded and they are denied the access and use of community forestry. Some of the households who are living in Wards 8&9 are also excluded due to one or other reasons. The overall objective of the study was to contribute towards an understanding of the consequences of non-membership/exclusion from community forestry to rural livelihood in Nepal. Specific objectives were 1) Map and compare the livelihood strategies of Community Forestry member and non-member households. 2) Analyse how coping strategies vary for households that are members of and those excluded from Community Forestry. 3) Evaluate constraints to inclusion of new members in the Community Forestry User Group. The study is based on mixed method approach, so that it helps the researcher to use quantitative and qualitative information. Concerning the local livelihood in this study, population has been classified into member and non-member group. Further all member group and non-member group are categorised based on wealth category to poor, medium and rich. Wealth ranking, 120 household surveys from three wealth categories of poor, medium and rich member and non-members, key informant's interviews with committee members, forest department officers, forest watcher, focused group discussion with member and non-member groups, were the main methods used. Results show, there are marked differences in livelihood capitals among member and non-members of community forestry. The differences in livelihood capitals are clear among poor and medium member and non-member category of households. This may

be because poor and medium are more depended on forest and forestry products. Rich category of households having other source to cop-up with the situation than poor and medium households. Non-member households are denied access to forest, training opportunities, drinking water facilities, sanitation, educational needs and other socio economic benefits from the forest user group. These have forced the excluded for finding out other strategies including daily wage labour for their livelihood. The study confirms the difference and inequalities in different livelihood assets of member and non-member households. There is need for taking initiative to include the non- members in the community forestry. Community Forestry is in the stage of livelihood development of rural people, Non-membership in the forest user group results livelihood development and disparities within the community. This study emphasise the need for future forest policies and creating awareness among the members to incorporate the non-members/ excluded members so as to show the model for all the community development projects and sustainable development of rural livelihood.

KEYWORDS      exclusion, community forestry, rural livelihood strategies, capitals, training opportunities

## 52. Relationship between consumer ranking of lamb colour and instrumental measures

AUTHOR **Saoussan Khliji**

SUPERVISORS David L. Hopkins | Massimiliano Lanza | Daniele Montagnac

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Given the lack of data that relates consumer acceptance of lamb colour to instrumental measures, a large consumer study was undertaken, in two Australian cities over a number of consecutive days, to establish the acceptability thresholds for fresh and displayed meat. 541 consumers were asked to score 20 samples of lamb loin (*m. longissimus thoracis et lumborum*; LL) on an ordinal scale of 1 (very acceptable) to 5 (very unacceptable) as well as to answer to demographic questions and questions about the purchase of lamb. Ten of the samples were for testing consumer response to fresh colour and 10 to test consumer response to lamb colour during extended display of up to 4 days. The colour of fresh meat was measured using a Minolta chromameter with a closed cone and for meat on display; a Hunter Lab Miniscan with an aperture size of 25 mm was used. The gender of the respondent was the only significant ( $P < 0.05$ ) demographic factor, which affected respondents' rankings for meat held on display, but this factor did not impact on fresh colour scores. The results suggested that for fresh meat when the  $a^*$  and  $L^*$  values are equal to or exceed 9.5 and 34 respectively, on average consumers will consider the meat colour acceptable. However,  $a^*$  and  $L^*$  values must be much higher (14.5 and 44 respectively) for a randomly selected consumer when assessing a randomly selected sample. It was also suggested, for aged meat, that when the wavelength ratio (630/580 nm) and the  $a^*$  values are equal to or greater than 3.3 and 14.8 respectively on average consumers will consider the meat as acceptable, while for a randomly selected consumer assessing a randomly selected sample the ratio (630/580 nm) must be 6.8 and the  $a^*$  value 21.7 respectively. The differences between the thresholds, for consumer acceptability on average and that for a random consumer assessing a random sample, illustrate the wide variability in individual perception. The  $a^*$  values were more representative of consumer's acceptability than the other colour parameters ( $L^*$  value and the ratio, 630/580 nm), in both fresh and aged meat respectively, thus it was concluded that  $a^*$  values are more appropriate to focus on when assessing the acceptability of lamb colour.

KEYWORDS lamb, colour, consumer acceptance, acceptability thresholds, instrumental measures, fresh meat, aged meat

## 53. Circadian influence on the equine athlete's performance capacity during a traditional early morning training regime in Thoroughbred racehorses

AUTHOR **Sarra BEN ATTIA**

SUPERVISORS Barbara A. Murphy | François Bocquier | Alessandro Priolo

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Daily time keeping in mammals depends on internal circadian clocks that temporally organize biological functions relative to each other as well as the environment. Circadian oscillation has been documented in a variety of physiological and behavioural processes that influence human performance but very few studies have been conducted in athletic horses. Overall these rhythms are primarily synchronized by the light-dark cycle but can additionally be influenced by exercise and training. We examined the response to exercise of selected physiological variables in eight 3-4 years old thoroughbreds (four fillies, four geldings). These horses were part of a traditional early morning training programme (for flat racing). Incremental exercise tests were performed on a high-speed treadmill at four times of day (07:00; 13:00; 19:00 and 01:00) over a 10-day timeframe with 3 days' rest interval between tests, according to a cyclic Latin square arrangement. The treadmill test included 8 intensities averaging (2, 4, 8, 10, 11, 12 and 13 m/s) designed to obtain gradual rise in intensity, preceded by a warm-up period at 2m/s (walk) and concluded by cool down step by walking at 2m/s. Rectal temperature (BT) was measured at rest prior to each exercise. Heart rate max (HRmax), Velocity at heart rate max (VHRmax), V200, resting creatine kinase (CKrest), recovery (4-h post exercise) CK, resting plasma lactate (LA rest), recovery (4-h post exercise) LA and VLA4 were assessed and analysed using repeated measures analysis of variance (ANOVA). There was a significant overall effect of time on BT and 4-h post exercise LA values ( $P < 0.05$ ). No effect of time was observed for HRmax, VHRmax, V200, VLA4, LA rest and 4-h post exercise CK. However, there was a trend towards a higher CK rest at 13:00 compared to 19:00 ( $P = 0.06$ ) and a peak in VHRmax at 07:00. These results indicate training time may influence the response of VHRmax and CK rest to exercise over 24 h period of time. In addition, metabolic rate and plasma lactate removal mechanisms clearly undergo diurnal fluctuations, reflected by rhythms of BT and recovery LA. Future studies will benefit from increased animal numbers and will continue to shed light on circadian regulation of equine performance.

KEYWORDS Circadian rhythms, Horse, Athletic performance, Training, Exercise

## 54. Aiding or Abating the Crisis? Livelihood Strategies to Groundwater Depletion: A case study from Coimbatore district of Tamil Nadu

AUTHOR **Urmila Balasubramaniyam**

SUPERVISORS Jens Raunsø Jensen | Gerardo Van Halsema

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**A**griculture is an important livelihood to majority of rural household in developing countries. Access to water is important in irrigated agriculture. Initially groundwater developments allow farmers to access groundwater and converting to an irrigated market oriented livelihood. This frequently leads to a boom of such livelihoods, with the consequence water over extracted. The result of over extraction directed better-off farmer able to access water with deep well technology or other alternative activities but small and marginal farmer loose out and bust. In this context, farmers may use different strategies to cope with groundwater depletion. On this background, the study was conducted to scrutinize the prevailing livelihood coping strategies and variability of adaption by livelihood to growing groundwater scarcity. It was visualized the coping behaviour could be explained by variety of interacting factors on irrigated farmer. The rural livelihood framework was selected as a backbone and mainly focusing on assets and livelihood strategies. The research looks specifically at coping strategies to groundwater depletion in two blocks of Coimbatore district, Tamil Nadu. Several districts of Tamil Nadu and Coimbatore experienced to ground water depletion. Two different levels of depleted blocks were selected to find out variety of livelihood strategies possible with depletion. For this reason, Annur was selected as over-exploited block and Madathukulam was selected as semi-critical block. In order to analyse the problem, opinion about groundwater depletion and livelihood strategies was collected from households through fieldwork conducted from March to May 2009. The sample households were classified into marginal, small and big based on land holdings. The findings show that level of depletion has huge impact on livelihood strategies. The households adapt variety of strategies like changing cropping pattern, reduction in level of irrigation, reduction in cultivated land area, deepening of well, drilling new wells, construction of surface storage tank, water saving technologies, off-farm activities and non-farm activities. The wet crops like paddy cultivation is nil and sugarcane cultivation is reduced by 75% now compare with 20 years back in over-exploited area. The area of irrigated land for crop cultivation was reduced by half in the same period. At the same time, more than 90% of bore wells were

developed in over-exploited area. Furthermore, adaption of coping strategies varies between household categorizes. The strategies to invest in crop cultivation are limited for marginal farmer household and to some extent small farmer household due to their limited assets and current rules and regulation, which also do not favour them. At the same time, they benefit from off-farm and non-farm strategies.

**KEYWORDS** livelihood strategies, groundwater depletion, extraction, drilling, wells

**BATCH 3:  
2008–2010**



## 55. Analysis of the process of formulating the policy of development: Territorial fisheries and aquaculture; Sul Catarinense coastal territory

AUTHOR **Maria Francisca Meynard Vivar**

SUPERVISORS Ademir Cazella | Claire Cerdan

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This research encompasses the analysis of the formulation process for the “Politics of Territorial Planning for Fisheries and Aquaculture” of Brazil and the development of the Ministry of Fisheries and Aquaculture in 2009. The research looks at understanding the alienation of fisheries and aquaculture from public policies and the development of these politics within a context determined by a theoretical and methodological background focused in rural territorial planning. A theoretical reference about the concept of public policies and the different forms of analysis of those was done. The concepts of territorial dynamics and cultural identity were included with the purpose of deepening the analysis of the contribution of these politics to the appreciation and reinforcement of territorial cultural identity, using the case study of the South Coast of Santa Catarina State.

KEYWORDS aquaculture, policy, territorial fisheries, coastal

## 56. Abundance and Host Preference of the Whitefly *Bemisia tabaci* (Gennadius) in Northwestern Tanzania

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SUPERVISORS Carmelo Rapisarda | Ole Søggaard Lund | James P. Legg

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Cassava, (*Manihot esculenta* Crantz), is the second most important staple crop in Africa. The fact that it can tolerate drought and adapt to marginal environments has made it very popular with African farmers and an important food security crop. However, its production is constrained by pests and diseases that cause substantial yield losses. Cassava Mosaic Disease (CMD), caused by cassava mosaic geminiviruses (CMGs) (*Geminiviridae: Begomovirus*) and transmitted by the whitefly vector *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), is the most important constraint of cassava production in Africa in the 21st century. *Bemisia tabaci* is considered to be the most economically important insect pest in the tropics and sub-tropics. A survey was conducted in 2010 in a quadrant bounded by the coordinates 3° and 5° (South) latitude and 32° and 34° (East) longitude in areas of northwestern Tanzania through which the pandemic of severe CMD is currently expanding to assess the abundance and host preference of *B. tabaci*. The number of *B. tabaci* adults and third and fourth instar nymphs was counted on cassava plants, intercrops and weeds within and in the immediate surroundings of 80 randomly selected farmers' cassava fields. Highest levels of both whitefly adults (233.5) and nymphs (599.9) were recorded from the northwestern part of the quadrant whereas the lowest levels of adults (6.9) and nymphs (15.3) were from the southeastern part. Higher abundance of adults and nymphs coincided with greater CMD incidence, as reported previously for areas affected by the CMD pandemic. Four cultivated & eight weed species, belonging to nine different families (Asteraceae, Brassicaceae, Commelinaceae, Convolvulaceae, Cucurbitaceae, Euphorbiaceae, Lamiaceae, Malvaceae and Solanaceae) were noted to be colonized by *B. tabaci*. No-choice experiments in clip-cages were conducted to determine fecundity, developmental duration and mortality of each of the developmental stages. Highest fecundity levels were recorded on Cowpea although nymphs were not able to develop beyond the first instar. *Sida cordifolia* supported the highest survival rate where 9.5% of the eggs laid developed to adulthood followed by pumpkin and *E. heterophylla*, which supported immatures up to the fourth instar and Cassava up to third instar. No eggs hatched on sweet potato or *Commelina benghalensis*. The major

factors of mortality identified in the study included inviability of eggs, dislodgement and predation of nymphs, and pest and disease attack of the supporting leaves. Finally, the co-occurrence of large populations of *B. tabaci* and high CMD incidences, coupled with the fact that *B. tabaci* may utilize a number of non-cassava hosts in the surroundings, means that there is an acute threat of the continued expansion of the CMD pandemic in Tanzania. This will seriously hamper existing efforts to use virus-free planting material to combat the pandemic. Therefore, joint efforts should be directed towards understanding the virus-vector and vector-host synergy in order to devise strategies to break this synergy. Only if this is achieved will it be possible to provide effective and sustainable control of the CMD pandemic and the whitefly vector.

KEYWORDS *Bemisia tabaci*, abundance, host preference, Cassava, North-Western Tanzania

## 57. Irrigation Systems in Changing Context: The Case of Two Management Types Irrigation System, Chiang Mai Valley, Thailand

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The irrigation systems in Chiang Mai-Lam Phun valley have been influenced by many external factors such as urbanization and industrialization, government policies and intervention, and market-led agriculture. The changes attach both opportunities and challenges to irrigation management of this valley. This study, conducted in two irrigation systems with different management domain – *muang fai* or the traditional farmer-managed irrigation system and RID or Agency-managed irrigation system, investigates how those systems perform under current changing context. This research traces farmers' experience since 1980s, in particular. Data was collected in three-month field research in Chiang Mai, Thailand, and mainly by semi-structured interviews of stakeholders, observation, and framed abductively by applying DPSIR (Driver – Pressure – State change - Impacts – Responses) approach. Experiences elsewhere showed that the traditional farmer-managed irrigation system is more effective than the agency-managed systems in mediating the challenges. Results of this study demonstrate an opposite. It is showed that the RID-managed system is more effective than the *muang fai* in mediating the challenges posed by the social-economic changes. Evidence shows that both physical condition and institutions arrangement decide the effectiveness and adaptive capacity of an irrigation system under changes. The state of the studied irrigation systems results from the continuous interaction of pressures, changes, impacts and responses within each irrigation system. For instance, the pressure on land use has changed the area from rice-dominant to half rice – half longan or longan-dominant; thus, water is supposed to be more available due to less water demand for irrigation. However, water for irrigation use in this area has become scarcer recently. Primary reason is the lack of labour, which reduced the participation of water users in system maintenance, resulted in the deterioration of system infrastructure. If this process continues, irrigation systems are at risk of collapse. However, this has not happened yet. Different strategies have been applied in irrigation systems from local to system level. One of the very first strategies is in-kind contribution in form of cash, though the tactic was not successful due to low

commitment from the water users. The decrease in social commitment in the system is mainly caused by the more independence or the thought of more independence of water users on using water. They are the increasing use of groundwater, or Opt-out strategy, diversity in irrigation application methods. Farmers have searched for more support (mostly in finance) from government and other sectors. As a result, the irrigation systems are getting more and more dependent on external resources, especially from the government. Between the two systems, although they have gone through the same sequencing of cause-result-response circle, the present condition is specific for each of them with better picture caught in the RID's system Mae Ping Kaw. The *muang fai* Phaya Kham system today is characterized by the diversity in local organizations and their capacity. Besides, the author of this report also wants to raise attention on the future potential opportunities and challenges in both systems with great effect of human factor.

KEYWORDS     irrigation system management, changing context, *muang fai*,  
Chiang Mai-Lam Phun valley, cause-result-response

## 58. The effects of Plant Secondary compounds on animal behaviour and blood cholesterol and fatty acids content in calves

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SUPERVISORS Valentina Vasta | Magali Jouven | Juan Villalba

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Three effect of three Plant Secondary Compounds (PSC) were investigated on the grazing behaviour of cattle and the cholesterol level and fatty acids profile in their blood. Three plant species, namely tall fescue (*Festuca arundinacea* variety Kentucky-31) rich in alkaloids, Alfalfa (*Medicago Sativa* variety Vernal) rich in saponins, and Sainfoin (*Onobrychis viciifolia* variety Shoshone) rich in tannins were used. Two treatments were set up, with a pasture layout of fescue, fescue-legume mixed and legume strips. The treatments being the different legume used, and there were three replicates. The feeding behaviour was evaluated by observation over a two-hour feeding bout, three times per week and fodder intake was estimated. The experimental pasture grazing was completed in 4 weeks in a first run, and 3 weeks in a second run on the regrowth. The live weight at the end of the trial was the same in both treatments, i.e. 480 kg with an average daily gain of 0.8 kg per head. Grazing behaviour showed no clear pattern in the first run, except for a pronounced preference for sainfoin with a peak of around 90% of devoted time to grazing in the first 15-30 minutes of grazing. In the second run, animals exhibit a marked preference for legume characterised by higher intake at the start of the grazing. In terms of dry matter intake, the proportion of each species in the diet was comparable for all types of fodder except for a slightly more marked intake for alfalfa (7.5 kg DM/hd/day) in the second run. In terms of cholesterol concentration, it was higher in the samples collected at the end of the second grazing period compared to the other sampling dates ( $P = 0.039$ ). The diet affected in tendency ( $P = 0.108$ ) cholesterol concentration in blood, being lower in the blood of the alfalfa-fed calves, compared to the calves from the sainfoin group. The treatment did not affect the overall fatty acid profile. An interaction between the date of blood sampling and the treatment was found for C16:1 c9, C18:1 n7t, C18:3 n3 and C20:3 n6.

KEYWORDS secondary compounds, animal behaviour, blood cholesterol, fatty acid, calves

## 59. The Determinants of the Use of Second generation market information systems in Developing countries: A Case study of KACE Kenya

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SUPERVISORS Frank Galtier | Kostas Karantininis | James K. Wekesa

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The research explored the determinants of the use of the second-generation market information systems. This insight enlisted the data on mobile phone users and non-users. The study sought to demonstrate through an examination of the increasingly dominant role of efficient markets that the second-generation market information systems are crucial. The case study was in Kenya, known for a wide range of food crops, climate, soils, and maize as its staple food crop, and its relative strength in increasingly liberalised and reformed marketing through the Kenya Agricultural Commodity Exchange-KACE, besides having a wider coverage of cell phone use. A purposive non-experimental quasi-sampling design was enlisted, and the major sources of primary data for the study through triangulation included: participatory focus group discussions; semi-structured interviews; and administering questionnaires. Secondary sources of data included agricultural dossiers, the internet, and other specialized publications. The data analysis involved descriptive profiling of the attributes of the phone users and non-users; and the determinants of the use of MIS. The STATA, SPSS and Excel software's were used in data processing. The scope of the research facilitated the examination of weakness in the MIS and set a basis for future detailed impact analysis of the determinants of the use of MIS, using the collected data. Nevertheless, by articulating these issues, alongside the findings by other researchers, the study contributed significantly by availing a reference output, which could be important for related debates regarding the determinants of the use of Market Information Systems (MIS). Sampling involved the selection of respondents who were able to respond to the questions asked; but had no prior knowledge of the questions. Detailed data on key aspects of the questionnaire was collected, and this included questions on variables about the farmers' characteristics, market performance, agricultural production, and other social aspects surrounding the farm households. FGDs, interviews, and visual observations were also enlisted in the data collection. Data was analysed using a

systematic (econometric) analysis using logit regressions to respond to the general logit model equation given as:

$$\log\left(\frac{p(Y_i)}{1-p(Y_i)}\right) = \alpha + \sum_{i=1}^n \beta_i X_i \quad \text{Where } \log\left(\frac{p(Y_i)}{1-p(Y_i)}\right) \text{ is log of odds and both } p(Y_i)$$

Where is log of odds and both  $p(Y_i)$  and

$1-p(Y_i)$  ranges between 0 and 1 and represent the dependent variables.

$X_1, X_2, \dots, X_n$  are the independent variables; while  $\beta_1, \beta_2, \dots, \beta_n$  are the estimated coefficients.

KEYWORDS      second generation MIS, ICT, maize farmers, agriculture, Kenya

## 60. Evaluation of Small-Scale Irrigation Systems and Water User Association Interventions in Eastern Madagascar: A Comparison of M&E Qualitative Strategies

AUTHOR **Levi Everlove Johnson**

SUPERVISORS Robin Bourgeois | José Maria Diaz Puentes

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One of the principal instruments for agricultural development in Africa includes the use of irrigation technologies to increase crop yields. The paradigm that currently rules the implementation of these technologies is based on water user associations (WUA) that look to ensure beneficiary participation in the design, construction and management of irrigation systems. An ever-growing emphasis is also seen with adapted monitoring and evaluation (M&E) methods to measure impact and guarantee sustainable investments. Current methods of evaluating irrigation systems and corresponding WUA performance mainly use quantitative data. Yet, these data are often immeasurable or are not applicable in the case of small-scale irrigation infrastructure where river basin management is absent, water measurement devices are rarely used and water pricing is independent of cost recovery. M&E tools also often fail to assess potential suitability of irrigation interventions. Furthermore, M&E methods are disputed, and time and financial resources available for these activities often limit their implementation. The following work investigates the applicability of qualitative indicators and variables and different data collection methods in evaluating small-irrigation system (SIS) and corresponding water user's associations (WUAs) in eastern Madagascar. The SIS/WUA intervention is part of an 8-year integrated poverty reduction program of the Malagasy Minister of Agriculture and International Fund for Agriculture Development (IFAD) that targets smallholder subsistence rice farmers. Two data collection tools and methods are compared. The first involves in-depth professional interviews with farmers accompanied by field visits, case studies, participatory observation and trained observer ratings. The second less costly tool of rapid surveys by in-field agricultural technicians is then tested. In total 152 randomly selected water users representing 12 different WUAs are evaluated. The evaluation methodology itself draws upon numerous qualitative social theories and includes among other aspects, an evolving design process that facilitates the inclusion of local circumstances in evaluation design and implementation. The holistic approach provides a high level of legitimacy in terms of selected indicators and

variables and the means by which they are measured and interpreted. A strong understanding of local conditions is considered vital in the applied evaluation methodology and as a result this research details pertinent contextual aspects of SISs/WUAs in eastern Madagascar. Further themes, including the role of SISs/WUAs in poverty reduction, agricultural water-management (AWM), water governance, evaluation methodology, and sustainability in development are also expanded upon. The first objective of this research is to propose a set of qualitative indicators and variables applicable to the reality of SISs and WUAs in order to determine potential sustainability. The six global sustainability indicators are (1) external water governance, (2) technical competence, (3) functional competence, (4) participation, (5) economic viability and (6) impact/benefit. Established variables draw upon international literature, case studies and local circumstances encountered in the field. For in-depth interviews, 63 different variables are identified corresponding to the 6 indicators. For the rapid surveys, these variables are reduced to 31. In both interviews and surveys, variable values are quantified, weighted and summed to arrive at an overall sustainability value (*s-val*). The *s-val* index is calculated for each individual, each WUA and each of the six composite sustainability indicators. Field missions to perform interviews allow participatory observation, site-visits and trained observer ratings to be carried out providing valuable data and insight. The diversity of information and ability to triangulate data proves robust in understanding a local reality and measuring SIS/WUA sustainability accordingly. The second objective of this work is to determine if data collection tools used provide comparable results and can thus be considered interchangeable. Typologies, triangulation and statistical analysis were used for this task. Typologies of beneficiaries were created and compared using a (1) qualitative method based on key variables, (2) categorization into *best* and *least* performing WUAs as a function of *s-val* and (3) an agglomerative hierarchical clustering (AHC) method. Resulting typologies and their comparison indicate *s-val* as an excellent sustainability index. Differences were found between the overall mean *s-val* for rapid surveys and interviews though both samples fit a normal distribution pattern. This discrepancy is attributed to incoherent definitions of participative electoral processes and macro-scale irrigation water-management between the evaluation team and in-field agents responsible for giving rapid surveys. Interview and survey data samples were put to a *t*-test with results indicating statistical similarity between the two methods when incoherencies between data collection teams are accounted for. Interpretation and judgment of the results of typologies and statistical analysis were triangulated with participatory observations, trained observer ratings and case studies. The first result is that the *s-val* index and associated indicators and variables hold a legitimate place in M&E practices for the given case. Its use can be justified as a monitoring tool for SIS/WUA sustainability and expanded to other aspects of the intervention. The adaptive nature in the creation of the *s-val* index provides the inclusion of participatory methods for

establishing indicators as well as their importance in measuring sustainability. Without an existing or verifiable baseline, *s-val* cannot be considered a pure evaluation instrument in determining current or probable sustainability. For this, an ideal case of a sustainable individual or WUA would need to be observed or defined. *S-val*s are, however, powerful in comparing individuals, WUAs and indicators to identify strengths and weakness and propose amelioration measures. The second result of this research validates that different data collection methods can be considered interchangeable. Surveys require less time and resources to acquire data and have the added benefit of engaging local actors in evaluative processes. The limits of indicators and variables as a sole method of M&E are also confirmed in this study. Regardless of the qualitative data collection technique, other data collection methods such as participatory observation, field missions and trained observer ratings are required for at least the initial set-up of an M&E system that incorporates indicators and variables. This work defends the legitimacy of an integrated qualitative evaluation based on sound social theories and diverse data collection and analysis tools. A qualitative approach proves applicable in evaluating the sustainability of SISs/WUAs where quantitative data is difficult or expensive to obtain and even more challenging to interpret and judge. Specifically, the use of a comprehensive *s-val* index calculated by rapid surveys is demonstrated as a pertinent M&E tool that once set-up can serve independently or in conjunction with other M&E tools to help gage project progress towards sustainability. The versatility of the qualitative *s-val* approach indicates its potential for scale-up to development interventions that differ in scope and context.

**KEYWORDS** irrigation, qualitative evaluation, participation, indicators, sustainability

## 61. Devolving resources and power in a context of land and water reform: Organising practices, resource transfers and the establishment of a WUA in the Little Thukela catchment, South Africa

AUTHOR **Linda Estelí Méndez Barrientos**

SUPERVISORS Flip Wester | Jeltsje Kemerink | François Molle

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A significant international drive for comprehensive reforms of the institutional framework for the management of natural resources, with an emphasis on devolving power and decentralizing government decision-making, has been at the core of development policies in the last two decades. The South African water and land reforms show that institutional and resource devolutions are highly complex and conditioned by contradictory economic interests. This MSc thesis research focused on identifying the challenges and difficulties in the creation of inclusive water institutions for the decentralized and equitable management of water in the Little Thukela catchment. The research focused on the main actors of the recently established Water User Association (WUA): (white) commercial farmers and two (black Africans) communities – Potshini and Amaswazi – to understand how land and water reform has been addressed, managed, circumvented, and/or delayed. Studying both sides as well as land and water reform implementation processes allowed a better understanding of the opportunities, constraints and the adequacy of the present institutional decentralization processes in the catchment. The thesis concludes that in rural communities, new hybrid institutional arrangements to manage devolved land and water resources are complex, ambiguous, conflictive and insufficient. Transfers of land and water resources have not yet transformed the livelihoods of historically disadvantaged individuals (HDIs) nor their participation in the WUA, which is dominated by commercial farmers. In short: the nature of water reform that depends on land reform and on the institutional structures for its implementation faces complex challenges that cannot be solved just by devolving resources and/or decentralizing government decision making.

KEYWORDS land, water, transfers, reform, WUA, commercial farmers, rural communities, HDIs, Amaswazi, Potshini, South Africa

## 62. The communicative dimension of consulting and business services – Case study of the PROSPERER program, Madagascar

AUTHOR **Maria Fernanda Arraes de Souza**

SUPERVISORS Emilie Coudel

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The diversification of agricultural activities and the promotion of rural entrepreneurship are strategies adopted in the framework of poverty reduction by countries in the global south. In the case of the Prosperer project, carried out by the Malagasy government in partnership with the International Fund for Agricultural Development (IFAD), the principal mechanism adopted for the implementation of these strategies is the development of business services for rural micro enterprises. The study in Haute Matsiatra Region first identifies key actors and their roles in the service sector targeted by Prosperer. An Action Learning exercise is then undertaken to diagnose the provision of service devices (multi-service counters, service provider network and entrepreneur's trainers) and their sustainability. Service provider profiles, methods and tools of the intervention, as well as the institutional framework and the service system's financial conditions are the focus of this diagnose. The analysis shows how the provision of services and their demand are simultaneously reinforced resulting in a previously absent relationship between involved actors. At the same time, the study proves that the supply of these services needs to be demand driven. Developing and strengthening relations between actors and service provision mechanisms, creating training tracks adapted to different development phases of a business, promoting understanding of payment for services, undertaking monitoring and evaluations of services and designing an exit strategy for the program are all tactics identified to improve the overall sustainability of the intervention of service provision. One service for each device offered (entrepreneur consulting, management training, technical training by peers, and apprenticeship) was selected as an analytical situation for deeper examination. At each stage of the service provision process (formulation of the request, negotiation, service provision and service evaluation), communication between and participation of service providers and users appear as the important influential factors to ensuring continuity of these business services.

KEYWORDS **business development services, rural micro enterprises, sustainability, communication, participation**

## 63. Agrarian diagnosis and ex-ante analysis of possibilities for integration of Direct Seeding Mulch based cropping systems to maize based cropping systems and farming systems in Northwest Viet Nam. Case study in Moc Chau district, Son La province

AUTHOR **Rada KONG**

SUPERVISORS Stéphane de Tourdonnet | Thilde Bech Bruun |  
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The pressure from rapid population growth and the increasing demand for food and feed from urban areas has led to an increasing scarcity of arable land. Farmers in the Northern Viet Nam have to cultivate annual crops on steep sloping land with shorter or no fallow-period. With high intensity of erosion, the soil has been quickly degraded. Such a fragile cropping management draws attention of international and national researchers to develop alternative cropping systems, which can increase the production and are environmentally sound. Along with possible technologies, “Direct seeding Mulch based Cropping” (DMC) systems are presently tested as possible innovations for a more sustainable production on sloping land. The study aims to *ex-ante* analyse possibility to integrate DMC system to current maize based cropping systems/farming systems by taking Moc Chau District in north-western Viet Nam as a case study. Landscape study, semi-structured interviews, small scale questionnaire surveys, in-depth interviews, small group discussions and public hearing are used in triangulation to (i) characterise typology of maize based cropping and farming systems; (ii) to assess changes occurring at plot and farm scales in terms of labour requirement and organisation, and economic performance after integrating DMC systems; and (iii) to propose possible scenarios that could facilitate the adoption process of DMC systems. The current agrarian systems have been strongly influenced by the reform policies in the early 1980s. Significant land reclamation for maize production had been seen in the early 1990s when the hybrid maize varieties were introduced. The agricultural production systems are more specialized in maize production in the high-medium terrain where soil is more fertile and the market is more accessible. In contrast, the production systems which are more diversified with other annual crops and/or with

perennial plant (tea) are often found in the areas with less fertile soil and less accessible market in the medium-low terrain. Maize is generally cultivated only one time per year mainly because of the shortage of farm labour and the cold weather in the winter. Modes of soil preparation and rates of fertilisation are the key parameters to characterise “maize based cropping system” (MCS-1) whereas types of agricultural production systems and sizes of ratio of total cultivated land to total active family worker (CL/AFW) are the main factors differentiating the diversity of maize based farming system (farm type). As a result, there are 7 MCS-1 types and 9 farm types currying with themselves different constraints and potentials for integration of DMC systems. The obtained maize yield is positively correlated to the rate of fertilisation as well as for land productivity and labour productivity at plot scale. The land holding per farm and per active family worker is generally large, leading to often have bottlenecks in periods of heavy work such as sowing and harvesting. Such large land holdings allow each active family worker to earn more than USD1.25 per day and even to have annual income higher than the Gross National Income per capita. Within each main farm type, the labour productivity both per year and per working day is positively correlated to the size of CL/AFW. Nevertheless, the correlation between the size of CL/AFW and land productivity is very weak. Converting to DMC systems will change remarkably the technical itinerary of conventional MCS-1, principally the ones based on ploughing either by buffalo or by hoe. Moreover, the total labour needs per hectare will be much higher especially during 1st year conversion. The high labour intensity of DMC systems will reduce considerably the labour productivity of conventional MCS-1. However, the land productivity will remain roughly the same, as the total cost is comparable. Like at plot scale, integrating DMC systems to currently practiced MCS-1 will increase significantly the farm’s total working day leading to lower notably the labour productivity. Conclusively, these reverse economic impacts will effectively discourage farmers to adopt DMC systems. In addition to the reverse economic impacts, poor germination and occurrence of residue-born disease/insects are anticipated concerns and practical problems for farmers. These concerns and expectations are a clear sign that clearly express the negative attitude of farmers to DMC systems. The adoption will never happen if all these concerns and doubts are not overcome and clarified through participatory field trials and practical experiences. Subsidies on extra labour and input cost may attract some types of farmers to adopt DMC systems. With around USD100 per ha in year 1 and USD50 per ha in year 2 as subsidies, the small CL/AFW farms are very likely to adopt whereas it is unlikely for the farms with large CL/AFW. The possibility to develop mechanised or labour-saving DMC systems is very limited due to the natural biophysical characteristics of the area. Any proposed DMC system tends to be more labour intensive than conventional systems. No matter how sustainable DMC systems are and how well natural resources and the environment are conserved, the adoption will happen only if there is financial support for the loss and

simultaneous technical support via practical experiences together with insurance on permanent availability of new inputs required by DMC system.

KEYWORDS direct seeding mulch based cropping systems, maize based cropping system, maize based farming system, *ex-ante* analysis, adoption, north-western Viet Nam

## 64. Irrigation Governance in Cambodia: Analysing the Role of Aid, Intervention Models and Institutional Traditions

AUTHOR **Jens Treffner**

SUPERVISORS Philippus Wester | François Molle | Didier Pillot

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Cambodia's irrigation governance is characterized by environmental factors of the country's freshwater floodplain hydrology and poor soil fertility, the resulting livelihood patterns based on paddy cultivation, and the aftermath of civil war, the Khmer Rouge's totalitarian regime, and the violent transformation of society and waterscapes. The international community intervenes with financial resources and development models since 1993 to heal the wounds of deportation, collectivization, and to fight rural poverty by the rehabilitation of ill-conceived hydraulic infrastructure with the aim to increase paddy farmer's productivity. This research analyses the current dynamics in Cambodian irrigation governance from the perspective of policy articulation informed by model approaches from international discourse, to the modes of intervention and local governance arrangements resulting from recent institutional reforms. It shows that through injection of aid money into the national administration and infrastructure projects, the political role and resource base of the new agency in charge of water resources and irrigation development has been strengthened. Concomitant institutional reforms for participatory management between water user associations and the state administration do not embrace new forms of political governance, to devolve power, and lack accountability, which corresponds to predominant sociocultural patterns. Single components of interventions, be they physical, monetary, of discursive or institutional nature, are used by actors in the respective governance arenas of a) policy making, b) implementation, and c) governing everyday village communities' lives and embedded into their web of resources. The articulations of institutional reforms and physical interventions do not correspond to single actor's objectives, but are an effect of the incorporation of foreign solutions in a resilient sociocultural environment. The premises of simple model approaches towards the re-ordering of national and local irrigation institutions are queried, especially because in rural areas people do not focus on a single resource's management, but the governance of everyday life's complexity.

KEYWORDS irrigation, aid, intervention model, livelihood pattern, institutional tradition

## 65. Comparison of the strain profile of *Aspergillus* section *Flavi* and identification of atoxigenic strains for use in biocontrol of aflatoxins in crops in Burkina Faso

AUTHOR **Daniel Agbetiameh**

SUPERVISORS Rosa La Rosa | Leon Brimer

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**F**ungal communities belonging to *Aspergillus* section *Flavi* in maize, groundnuts and the respective field soil samples of these crops were examined to compare the strain profile of members of *Aspergillus* section *Flavi* in terms of strain composition, distribution and their aflatoxin-producing abilities across three agro-ecological zones in Burkina Faso and to identify atoxigenic strains that could be of potential value for use in biological control of aflatoxin in these crops. In all, 1635 isolates belonging to the major taxa: *Aspergillus flavus* (L-strain), the unnamed taxon SBG, *A. parasiticus*, and *A. tamarii* of *Aspergillus* section *Flavi* were isolated, by the dilution plating method on modified Rose Bengal agar, from the four sample types collected from 28 sites in 15 provinces across three agro-ecological zones (Sudan Savannah (SS), Northern Guinea Savannah (NGS) and Southern Guinea Savannah (SGS) zones) in Burkina Faso. Among the four sample types, *A. flavus* (L-strain) was consistently the most commonly isolated member and constituted 94.2% of the community of fungi under *Aspergillus* section *Flavi* across the three agro-ecological zones. The incidence of the unnamed taxon SBG was 4.4% while the frequency of *A. parasiticus* and *A. tamarii* were each 0.7 %. 88% of *A. flavus* (L-strain) isolates produced only B- aflatoxins, with 80 % of these producing more than 1000 µg kg<sup>-1</sup> of aflatoxin B1 alone in culture. A total of 179 isolates constituting 12 % of *A. flavus* (L-strain) were found to be atoxigenic. A single isolate of *A. flavus* (S-strain) was also found to be atoxigenic. Incidence of toxigenic isolates were significantly ( $P < 0.05$ ) higher than atoxigenic isolates across the 15 provinces and agro-ecological zones examined. All SBG and *A. parasiticus* produced both B- and G-aflatoxins in relatively large amounts while isolates of *A. tamarii* produced no aflatoxins in culture.

KEYWORDS *Aspergillus* section *Flavi*, atoxigenic, maize, groundnut, Burkina Faso

## 66. Maturity, shelf life and quality of Papaya (*Carica papaya* Linn.) as Influenced by Different Postharvest Treatments

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SUPERVISORS Alberto Continella | Brian Grout

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An experiment was conducted in the Department of Crop Science, University Putra Malaysia, Serdang and Nuclear Agency of Malaysia' Bangi' Selangor Darul Ehsan, Malaysia, during the period from April to July 2010 to study the maturity, shelf life and quality of papaya (*Carica papaya* Linn.) fruits as influenced by different postharvest treatments. The experiment consisted of 4 postharvest treatments viz. control, hot water, gamma irradiation, hot water plus gamma irradiation and two maturity stages viz. maturity stage 2 (mature green colour) and maturity stage 4 (1/3 development of yellow colour). The experiment was laid out in a completely randomized design (CRD) with eight treatment combinations and five storage periods and consequent fruit characterization. The combined effect of maturity stages and postharvest treatments were significant on all the parameters under this experiment except external colour and weight loss of papaya fruit. However, at the end of the storage period, both the highest values of lightness (48.71) and chroma (39.0) with respect to internal colour were observed on gamma irradiation with maturity stage 4, whereas the lowest values of lightness (45.51) and chroma (35.0) on hot water treatment and control with maturity stage 2, respectively. The highest rate of CO<sub>2</sub> (8.5 mLkg<sup>-1</sup>h<sup>-1</sup>) and ethylene (0.194 μLkg<sup>-1</sup>h<sup>-1</sup>) was obtained from control fruits of maturity stage 4 while the lowest in gamma (6.72 mLkg<sup>-1</sup>h<sup>-1</sup>) and hot water plus gamma (0.137 μLkg<sup>-1</sup>h<sup>-1</sup>), respectively. The highest value of firmness (6.84 N) and total soluble solids (12.23%) was recorded on hot water plus gamma of maturity stage 2 while the lowest on hot water of maturity stage 4 (3.19 N) and maturity stage 2 (10.91%), respectively. The maximum titratable acidity (0.147%) was found on hot water treatment of maturity stage 2 while minimum (0.106%) on hot water plus gamma with maturity stage four. The highest value of vitamin C (47.87 mg 100g<sup>-1</sup>) was obtained on hot plus gamma, while the lowest on hot water (42.82 mg 100g<sup>-1</sup>) with maturity stage 4. The maximum disease incidence (90%) and disease severity (34.38%) was recorded on control whereas minimum disease incidence 5% and disease severity (1.88%) on hot water plus gamma irradiation of maturity stage 2. The longest shelf life (34.23 days) was recorded in hot water plus gamma with

maturity stage 2 while the shortest (21.1 days) in control with maturity stage four. The effect of maturity stages was significant on external and internal colour, respiration rate, ethylene production, firmness and disease severity except weight loss, TSS, titratable acidity (TA), vitamin C content and shelf life of papaya. Without considering maturity stages, postharvest treatments had significant effect on all the parameters studied under this experiment with the exception to external colour and weight loss of papaya.

**KEYWORDS** shelf life, papaya, postharvest, gamma irradiation, quality

## 67. *Orobanche crenata* infestation of faba bean (*Vicia faba*) in Morocco –a comparison of weed management, yield losses and related socio-economic aspects in three different regions

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SUPERVISORS G. Cucuzza | J. C. Streibig | M. Bouhache

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The parasitic weed *Orobanche crenata* in faba bean cultivations continues to be a nuisance to farmers in Morocco. Due to the particular characteristics of the weed, its management is not easy to handle for farmers. However, efficacious control strategies do exist, the most important being certain agronomic practices and chemical control with the herbicide glyphosate. Yield losses caused by this weed are very high; their extent has usually been estimated using model yield loss functions based on the number of *Orobanche* shoots found on faba bean plants. In the present study, farmers' knowledge about the weed and its management is assessed. Different control methods applied by farmers are discussed and their costs are calculated. Moreover, yields and losses caused by *Orobanche* are estimated using two model functions, the Cousens yield function and the Cousens yield loss function, and compared to estimates made by farmers. The Cousens functions are applied to weed biomass instead of weed density; the results indicate that weed density is probably just as good a measure for loss assessments as weed biomass. Using the information about the costs of weed control and about the losses caused by *Orobanche*, the economic benefits of weed control are illustrated.

KEYWORDS *Orobanche crenata*, infestation, faba beans, weed management, yield loss, socio-economic

## 68. Pesticide Use in Viticulture: Current Situation and New Conceptions (Case studies in France and Albania)

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SUPERVISORS Jean Marc Barbier | Luc Bonicel

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In a current context of agriculture activities losing the symbiosis with natural environment and evidence of the long-term unsustainability of these intensive agricultural production techniques, two seem to be the major challenges; firstly, re-conception of current production systems to more sustainable bases and secondly assuring the further sustainable development in agriculture. This study aims to estimate the possibility of implementation of innovative plant protecting strategies, reducing the usage of pesticides in French vineyards and to understand the nature of current plant protecting strategies and practices in an on-development viticulture sector in Albania. Interviews have been carried out in different grape growing farms in one vineyard region of each country, specifically on the coastal regions of Languedoc-Roussillon in France and central west region (Tirana, Durres) in Albania in order to identify the current farm characteristics that serve as barriers or driving forces on the implementation of “Processus Opérationnel de Décision” Mildium at farm scale in France and to identify the trends of phyto-sanitary practices in Albania in relation to the sustainability. Results show that French farms present both potentials and inconveniences towards adoption of POD Mildium as an innovative vineyard protecting strategy and as regards to Albania, the current phyto-sanitary strategies and practices do not transmit optimism on the context of sustainable development.

KEYWORDS environmental innovations, vineyards, phyto-sanitary practices, pesticides

## 69. The participation citizen in the context of LOCAL development: evaluation of the case study of participatory budget of the municipality of Novelda in the Valencian Community

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SUPERVISORS M. Teresa Franchini

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Citizen participation focused on local development area and the social planning, or how to improve citizen participation in local management thanks to the Governance. This work's aim is to analyse citizen participation experiences on a worldwide basis, in order to extract concepts of major importance and get them applied to the evaluation of public budgeting in Novelda, Comunidad Valenciana, Spain. To realize this work, a brief sum-up of citizen participation and governance concepts will be reviewed. Then, six "Best practices" of the United Nations program UN-HABITAT (international program aimed at selecting worldwide best practices in improving life conditions in cities and villages) chosen according to their relevance for the present work will be analysed. Importance in improving citizenship, political willingness, difficulties in matching participation processes with current administration management or coordinating new participant's networks are common trends of special interest in this study. Conclusions of the analysis will further be used to relate them with the Evaluation methodology of the OIDP (International Observatory on Participating Democracy). It will help to establish an evaluation methodology, as well as getting to know the different forms and mechanisms of public participation. On this basis will be evaluated the public budgeting process in the city of Novelda. Possible improvement measures will be presented as a result of the fieldwork, and will constitute the conclusion of the present project.

KEYWORDS citizen participation, "best practices" UN-HABITAT, governance, citizenship, political willingness, new participant's networks coordination, participatory processes evaluation methodology

## 70. Farmers' Responses to Groundwater Depletion: Changing Institutions and Farming Strategies in Minqin County, Gansu Province, China

AUTHOR **Eefje Aarnoudse**

SUPERVISORS Philippus Wester | Bettina Bluemling | Thierry Ruf

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The regulation of groundwater extraction to avoid exhaustion of the resource is a vexed question worldwide. It also arises in North China where groundwater use has developed rapidly over the last few decades, in some regions resulting in groundwater depletion. Minqin County is a remote oasis in the North West of China, confronted with increasing water scarcity as a consequence of the rapid withdrawal of groundwater resources. The county is located in the delta region of the Shiyang River basin, interlocked between Inner Mongolia's deserts. Because of extremely low rainfall, agriculture depends on irrigation. Since the 1960s, the region's irrigation water inflow diminished due to the damming of the river upstream. To compensate for the reduced inflow, the abstraction of groundwater intensified. Since the 1980s the increased use of groundwater resources led to falling water tables and caused related problems, such as soil-salinization and desertification. Through an empirical survey, the relation between aquifer depletion and changes in water institutions as well as farming strategies was analysed. Results show that to a certain extent the "changes of human behaviour" have been a response to groundwater depletion. Through the interplay of policy-making and farmers' behaviour, different types of reaction mechanisms were established. Those reaction mechanisms can be characterized according to different stages of Minqin's groundwater development over time. At the initial stage of groundwater development, both the local authorities and farmers displayed a sense of opportunism. Exploitation of groundwater was seen as a solution to the increasing surface water scarcity. When groundwater depletion started to reveal itself through soil-salinization and desertification, water users and policy makers reconsidered their strategies. Despite some attempts to privatize the groundwater economy, the farmers essentially continued their cooperation, based on the legacy of farm communes, to invest in deeper wells. At the same time, they profited from the liberated market economy to adjust the cropping system and optimize their income per water unit. However, further degradation of the natural environment motivated younger generations to migrate and search for better opportunities elsewhere. The local authorities tried to respond to the environmental

degradation by designing new policies to limit groundwater use, but did not succeed to implement them effectively until 2007. Only at this rather late stage of groundwater depletion, the actions of authorities and water users came together in a new set of rules-in-use, which enforced the restriction of groundwater abstraction. Whereas policy makers on national level initiate regulation, the local bureaucracy and communal organization of groundwater irrigation sustain it. Adaptation of the restriction policies to the infrastructural setting and institutions in place facilitated effective implementation of the policies. This case study demonstrates that throughout the development of Minqin's groundwater socio-ecology cooperation in communal settings played an important role. At first, the strategies of communities and households had a negative impact on groundwater conservation. However, eventually the communal setting supported the implementation of direct policy measures to regulate groundwater abstraction. Even though, the sustainability of farmers' livelihood in the region is not yet guaranteed.

KEYWORDS groundwater, changing institutions, farming strategies, policy making

# 71. Adoption of agricultural technology by smallholder farmers in the context of climate change: The Case of Drought Tolerant Maize in North-East Nigeria

AUTHOR **Justice Akpene Tambo**

SUPERVISORS Henrik Hansen | Robin Bourgeois | Tahirou Abdoulaye

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**N**orth-east Nigeria is drought-prone region where farming is risky for many smallholder farmers who rely on rainfall. Maize is an important staple crop in the region and is severely affected by frequent droughts leading to crop failure. Climate change is expected to worsen this situation and impact negatively on agriculture in the region. Drought tolerance maize (DTM) varieties have been recognised as one of the most important targets to reduce the impacts of climate change and are, therefore, promoted in the region. This study examined the determinants of adoption of the technology and also assessed perceptions and adaptation to climate change by smallholder farmers in the region. The study was mainly based on a survey of 200 households selected from two agro-ecological zones in Borno state. Data were analysed using econometric and qualitative methods. The study found that most of the households in the selected villages were aware of DTM, and about 58% of the sampled households have adopted the technology. Off-farm income, distance to markets, frequent extension visits, awareness of climate change and agro-ecological zone as well as perceptions of yield potential and seed availability were the major factors that influenced DTM adoption. The main constraints to adoption include fertilizer acquisition problems, lack of access to seed, high seed cost and lack of awareness of the existence of DTM. It was found that the farmers lacked knowledge on climate change but most of them perceived that the climate has become drier and hotter with unpredictable rains. The adaptation measures used by farmers in the study area include diversification of crops and crop varieties; changing the time of planting/sowing; use of irrigation; provision of shelter and shade for crops and livestock; soil and water conservation practices; and off-farm income diversification. The conclusions drawn from the study indicate that there are a number of challenges facing the adoption of DTM and adaptation to climate change, which need to be addressed. These include provision of extension services; creation of awareness on climate change; support for the provision of credit and irrigation facilities; and ensuring adequate and timely supply of seed and fertilizer.

KEYWORDS adaptation, adoption, climate change, drought tolerant maize, Nigeria, perception, smallholder farmers

## 72. A Study on genetic variability for drought tolerance in perennial trees

AUTHOR **Wanploy Jinagool**

SUPERVISORS Jean-Luc Regnard | Stéphane Herbette

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Two studies aimed to investigate feasibility of using morphological and physiological traits as criterions for a selection of two important species: apple (*Malus x domestica*) and rubber tree (*Hevea brasiliensis*) were carried out. In the first study, the possibility to observe variation in eco-physiological traits especially on leaf traits on scion of young apple trees subjected to water deficits period was investigated and their heritability were determined. The results from the study indicated differences in leaf traits among young apple progeny, these differences representing different growth and development behaviours, which can be considered as a result of different sensitivity to water deficits of young apple trees. However, the differences were not very obvious except on the total leaf area of progenies, which has an orthogonal correlation to fraction of transpirable soil water. Nevertheless, the results are encouraging and suggest a possibility to use leaf traits as an indicator for further study on effect of water deficits. Heritability values of these traits were fair, possibly leading to QTL detection for these traits. The second study is a study to investigate feasibility to use the Cavitron technique for a large-scale investigation of the xylem vulnerability to cavitation in *Hevea brasiliensis*. The Cavitron technique was found not suitable for investigate the xylem vulnerability to cavitation in samples of *Hevea brasiliensis* from Chachoengsao Rubber Research Centre in the Eastern of Thailand. This result cause by a great vessel length found in samples. These vessels were cut open when samples were prepared; they yielded abnormal vulnerability curves. Wood properties of rubber were investigated and were used in QTL detection. QTL was detected on wood infra-density but not on the other properties due to low LOD scores.

KEYWORDS **genetic variability, drought tolerance, perennial trees, physiological traits, morphology**

## 73. The extent and the time course of enteric methane inhibition by dietary nitrate and the mediating role of sulphate

AUTHOR **Diani Wiam**

SUPERVISORS Roger Hegarty | François Bocquier | Luisa Biondi

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Supplementation with dietary nitrate offers the opportunity of both increasing the productivity of ruminants consuming low quality roughage and reducing their enteric emission of methane (CH<sub>4</sub>). To determine the effect of nitrate on the methane output of sheep, four merino weathers were acclimated for 10 days to a basal diet containing 0.1% NO<sub>3</sub>-N. In experiment one, CH<sub>4</sub> production was measured over a 22h period while the sheep were given test diets containing 0.3, 0.5 or 0.7% NO<sub>3</sub>-N at 3 hours' intervals interspersed with the basal diet. These increasing levels of nitrate caused a linear decrease in CH<sub>4</sub> production by 10, 16 and 20% respectively. In experiment two, the moderating effect of Sulphur on nitrate inhibition of CH<sub>4</sub> production was assessed. The same 3h test feed period and the same measurement protocol has been used to study the effect of the basal diet containing 0.1% NO<sub>3</sub>-N, the basal diet supplemented nitrate, the basal diet supplemented by sulphate and the basal diet supplemented by both nitrate and sulphate. Experiment 2 confirmed the finding of experiment 1 that the presence of nitrate in the diet lowers enteric CH<sub>4</sub> production. While sulphate addition alone reduced CH<sub>4</sub> production, supplementary sulphate appear to influence the CH<sub>4</sub> mitigation arising from dietary nitrate.

KEYWORDS methane, nitrate, sulphate, sheep, reduction

## 74. Effect of low dietary protein and acidifying calcium salts on ammonia emission from houses of growing-finishing pigs

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SUPERVISORS A.J.A. André Aarnink | Alessandro Priolo | François Bocquier

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The objective of this study was to reduce ammonia emission in farms of growing (L, 45 kg) and finishing (H, 90kg) pig units. In each of three farms (F1-H, F2-L and F3-L), we studied the effect of lowering dietary crude protein content (CP/kgDM from DHP to DLP). While F1 was conducted traditionally (TF1), in the TF2 farm dietary Calcium Salts (Cl) were added to indirectly lower urine pH of the DLP group. In the third farm, a non-dietary treatment was tested: the housing was equipped to reduce ammonia emission (EF3). From each treatment groups, four urine samples were taken to estimate total nitrogen, ammonium concentration and urine pH. At each farm, the impingers and vessels were connected to the exhaust ventilation duct during 24 h for ammonia, odor and GHG assessment. Dietary amplitude of CP reduction differed among farms: in TF1-H, DLP was 23 g/kg lower in CP than DHP, in TF2-L, DLP+Cl was 41 g/kg lower in CP (and 6.5 g/kg higher in Cl) than DHP and in EF3-L, DLP was 31 g/kg lower in CP than DHP. The DLP+Cl treatment (TF2) was effective in reducing urine pH which was the lowest observed (pH=5.4). In all farms, ammonia emission was significantly ( $P<0.05$ ) affected by dietary CP reduction and was 41, 33 and 40% lower in the experimental groups compared to the control groups within each farm respectively. Reduction of odour emission, although not significant, was 16, 6 and 16% lower respectively. CO<sub>2</sub> emission was also not significantly affected neither by diet nor by farm. On average, CO<sub>2</sub> emission was only 4 and 7% lower in the experimental groups compared to their control groups in TF1 and EF3 respectively. CH<sub>4</sub> emission was highly ( $P<0.001$ ) affected by farm. TF1-H and TF2-L had a 523 and 649% higher CH<sub>4</sub> emission respectively than EF3-L. Diet had no significant effect on CH<sub>4</sub> emission. On average, CH<sub>4</sub> emissions were 25, 11 and 25% lowered by CP reduction within each farm. The nitrous oxide values were very low and inconsistent so that they could not be statistically analysed. From this study, even if effects of the diets changes on odour, CO<sub>2</sub> and CH<sub>4</sub> emissions could not be proven, it is concluded that ammonia emission can be reduced by lowering the CP content of the diets. Dietary Calcium salt addition has a great effect on urine pH and housing system has an effect on reducing ammonia and methane emission, but none on odour and CO<sub>2</sub> emissions.

KEYWORDS pig, crude protein, calcium salt, ammonia, odour, carbon dioxide, methane

**BATCH 4:  
2009–2011**



## 75. Trajectories of transformation of agricultural holdings in conversion to organic farming: case of viticulture

AUTHOR **Andrea Berta**

SUPERVISORS Jean-Marc Barbier | J.M. Barbier | L.BoniceL | Isabel Michel

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**N**owadays, while the lack of long-term sustainability of intensive agriculture is the more and more widely admitted, a growing number of people sees the conversion to the organic agriculture as a legitimate alternative. The growth of conversions to the organic agriculture in the case of viticulture is fast-paced, especially in the Mediterranean area, without operational tools allowing coaching this kind of innovations. The success of the conversion depends on multiple factors. It is therefore useful to create indicators to lead the phase of transition. These indicators must originate from an integrated analysis of the system (biophysical environment, operating and organizational features, decisional processes, technical practices, technical-economical results). To answer to this lack of indicators, a multi-disciplinary project was implemented which acronym is AIDY (Analyse Intégrée de la Dynamique des systèmes biophysiques, techniques et de décision lors de la conversion à la viticulture biologique, Integrated Analysis of Trends in the bio-physical, technical and decisional systems during the conversion to the organic agriculture). In the framework of this project, this work seeks to provide some considerations for the analysis of the activators and curbs, which can influence the choices of the winemakers. For this research, qualitative interviews have been conducted with a questionnaire developed during the stage. The results lead to the creation of three different typologies of winemakers, taking into account their motivations, their operational costs and the nature of the techniques they applied.

KEYWORDS transformation, organic farming, viticulture, organisation, typologies

## 76. Analysis of the impact of climate change on livestock systems of West Africa – Modelling approach

AUTHOR **Mohamed Moctar Mouiche Mouliom**

SUPERVISORS Charles Henri Moulin | Giuseppe Luciano | Nadine Andrieu

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The aims of this study is to validate a research model simulating the interactions climate-farm-environment (CLIMEX), analyse the impact of climate change on farming systems in West Africa with the help of a simulation model and to propose innovative strategies for adaptation. The type of validation adopted in this study, is conceptual validation, which consists of analysing the structure and relations between the components of the model. The surveys of producers enabled us to understand the functioning and the management mode of production systems and the interactions with their ecosystem with in order to analyse the structure of the model. CLIMEX correctly represents the different systems of productions and the interactions between them, in the agro ecological zones. A number of improvements can nevertheless be envisaged to meet the objectives of the model. Analysis of the capacity of adaptation to climate variability shows that the values of sustainability indicators chosen in this study vary depending on the climate series, the zone agro ecological and the type of producer. The impact of climate change on the sustainability of production systems increases the instability of crop yields and livestock performance. The adaptations strategies currently being implemented by the producers may not be sufficient to ensure the sustainability of production systems to climate changes. The producers will be forced to adapt to this climate change, by the introduction of innovative practices (technical change or organizational) can improve their production systems sustainably. The evolution strategies of farms tested among the breeders in our study: increase the forage storage capacities, decrease the herd size (25 %) and introduction of the forage crop show that this new strategy improve significantly the feed balance (43%). Some strategies may be considered and tested with the producer's agreement, in order to analyse their facilities for implementation. This study provides ways of thinking in terms of recommendations to improve the adaptive capacity of farms to climate variability. The policy makers, development agencies, and research institutions, must therefore, encourage and assist the groups of producers in the introduction of new practices to manage this climate variability. Modelling can be an important tool to simulate the impact of new adaptation strategies on the sustainability of farming systems under different climate scenarios.

KEYWORDS modelling, climate change, livestock systems, West Africa, mitigations

## 77. Cultivating Prospective Thinking: A Gateway into the Future for Peruvian Dairy Farmers in the Mantaro Valley: *Experimenting a Support Approach Based on the Use of Modelling Tools*

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SUPERVISORS Charles-Henri Moulin | Pierre-Yves Legal

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The Mantaro Valley is an Andean region where its dairy sector has been experiencing noticeable growth since the mid-1990s. Moreover, milk production has shown potential in improving the standards of living for farmers in the area. As a result, this study was launched aiming at improving dairy farm development through the use of a support approach, based on the use of modelling tools. This methodology does not serve as an aid for decision making per se, but rather as a means to stimulate the farmers' thought process, ultimately aiding them reflect on their foreseen projects. The experimentation of this approach was conducted with 10 dairy farmers. Results show that, despite all striving to increase volumes of produced milk; each farmer anticipated doing so in a different manner. Their journey through the support approach allowed them to explore various options to attain their objective. The participative nature of the support methodology, the outputs from the modelling tools, and the discussions that materialize during approach proved to be key factors in fostering reflection on behalf of the farmers. Developing farmers' prospective thinking may ultimately contribute to the successful implementation of improvement projects at the farm level, and to the progression of the region's dairy sector. The farmers' positive response to the support approach in this study suggests that other farmers in the valley could benefit from this type of agricultural assistance. Extending the methodology to a greater farming population would imply that the simulation tools be overhauled, and that an advisory entity be identified to implement the approach.

KEYWORDS support approach, dairy farms, Peru, modelling, prospective thinking

## 78. Alternative approaches for the reduction of major foodborne bacterial pathogens in poultry

AUTHOR **Escarcha, Jacquelyn**

SUPERVISORS Massimiliano Lanza | Danièle Montagnac | Todd R. Callaway

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The main purpose of this study was to explore the potential of two alternative approaches in reducing the population of the three key bacterial pathogens in poultry: Salmonella, Campylobacter and Escherichia coli. Two small experiments were performed; experiment 1 evaluated the inhibitory effect of natural compound capsaicin against five gram- negative bacteria models in vitro, and experiment 2 determined the effect of feeding high dietary fibre levels using dehydrated alfalfa meal on Salmonella typhimurium colonization in chicken model. In the first experiment, various concentrations of capsaicin were tested and capsaicin showed no pronounced trend of dose-and incubation time-dependent inhibitory effect on the total bacterial population in pure culture studies. Bacterial population counts response varies between isolates tested. The best immediate effect was seen on E. coli O157 from concentrations of 50 to 300µg/ml and from 200 to 300µg/ml after 6 hours of growth. Capsaicin did not inhibit CFU counts of SE and ST isolates except for the highest prepared concentration of 300µg/ml. Moreover, over a longer incubation time of 48 hours, reduction in C.jejuni and C.coli population was observed. Results were discussed in relation to possible mechanism of action exhibited by capsaicin in previous in vivo studies. This work deserves further study to arrive a more conclusive evidence that capsaicin has potential in bacterial growth inhibition in vitro. For the second experiment, three dietary treatment groups were set up by mixing dehydrated alfalfa meal to the rations: 1) standard chick starter, 2) 25% dehydrated alfalfa meal + 75% standard chick starter, and 3) 50% dehydrated alfalfa meal + 50% standard chick starter respectively. A nalidixic acid and novobiocin resistant ST was used as a challenge inoculum. The dietary treatments revealed significant impact on ST cecal populations. No ST growth was observed to the highest dietary fibre fed group. When ST colonization was evaluated in the ceca and crop organs, significant effect ( $P < 0.05$ ) compared to control were seen in both 25% and 50% dehydrated alfalfa fed treatments. Moreover, in contrast to the expected result, positive impact on the overall performance of the birds was noted. Gain in weight was observed highest in 25% dehydrated alfalfa inclusion in the ration with significant difference when compared to control group. Dietary treatments have significant effect on the overall feed consumption among groups; with highest recorded feed intake in 50% dehydrated

alfalfa. Computed feed conversion ratio was best observed in 25% dehydrated alfalfa treatment with significant difference when compared to the other groups. These data suggest that increasing high dietary fibre levels limit ST colonization without impairing overall performance of the birds.

**KEYWORDS** Capsaicin, bacterial pathogens, antimicrobial effect, growth inhibition dietary fibre, dehydrated alfalfa, *Salmonella typhimurium*, colonization

## 79. New participatory approaches for monitoring and evaluation: a case study of the monitoring and evaluation system of the PROSPERER program in Madagascar

AUTHOR **Ciro Domínguez**

SUPERVISORS Betty Wampfler | Caroline Bidault

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The use of participatory approaches for Monitoring and Evaluation (M&E) in development projects and programs has become increasingly important in recent years. However, despite the growing interest in these approaches, their implementation still faces many challenges. This study explores the PROSPERER M&E system, an International Fund for Agricultural Development (IFAD) project that supports rural microenterprises in the region of Sofia, Northern Madagascar. The analysis identified five major issues with the M&E system: deficiencies in 1) data collection, 2) data analysis and 3) data quality and reliability, 4) delay in the implementation of project activities, 4) lack of communication and 5) low levels of participation by stakeholders and beneficiaries. The results established a clear link between low participation levels by stakeholders and beneficiaries and the problems with PROSPERER's M&E procedures. This study suggests that increasing participation, among other measures, would improve its M&E system.

KEYWORDS Participation, rural microenterprises, participatory approaches, monitoring and evaluation

## 80. Feasibility study for a carbon neutral coffee value chain in North Sumatra Indonesia: Potential of a premium-based scheme to promote sustainable Arabica coffee production and transformation

AUTHOR **Axelle Bodoy**

SUPERVISORS Didier Pillot | Stephane Fournier

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The objective of this study was to assess the feasibility of a new environmental certification, based on the total carbon balance (from coffee farmer to harbour for export) of a high quality coffee product from Toba Lake area. The interest to link environmentally friendly practices with quality coffee valorisation, with the objective to get out from the commodity market to enter a niche market, goes by the current tendency to reconcile environmental conservation and development, through payments for environmental services schemes. The analysis of the current Toba Lake value-chain and the existing sustainable certifications enabled to demonstrate the difficulty to settle a system of remuneration for the production of a public good by a group of stakeholders. The main organisational difficulty is the dominant position of suppliers in the value-chain, as they have diverging interest towards coffee certifications. Premiums are not reflected downstream in the supply chain, so collectors and farmers do not see any interest in applying certifications requirements. The top-down distribution of bargaining power is increased by the lack of farmers' collective organisation and their lack of information on markets prices, added-value distribution and standards requirements. Moreover, free-riding behaviours are frequent: certified coffee leakages are observed both at collectors and supplier's interfaces. These malfunctioning in the value-chain threaten directly the traceability and the sustainability of a climate-friendly coffee project on the long run. However, certified coffee initiatives interest all stakeholders, insofar as it allows them to increase their income and to mitigate the risk due coffee prices' high volatility. Hence, an organisational innovation is proposed: the implementation of a field-based buying centre to by-pass middlemen. Moreover, this platform would increase farmers and exporter's benefit and as a consequence, their investment capacity in climate-friendly practices. At coffee producers level in particular, technical constraints are likely to impact heavily on carbon-based PES initiatives. The diagnosis of the diversity

of agrarian systems in the three areas highlighted the diversity of coffee farmers' strategies and as a consequence the diversity of technical constraints, opportunities and interests towards a carbon-certified value-chain project. Seven types were identified; whose main decisional factors towards carbon footprint certification schemes were the investment capacity and intercrops. A carbon Life Cycle Assessment led to orders of magnitude of the carbon footprint along the value chain in four scenarios, corresponding to the combination of two hypotheses - the implantation of the coffee plantations on initial primary rainforest or on former plantations, and two levels of fertilization. Results show the limited impact of fertilization practices, and the major importance of land use changes. With the current production practices, process and transport conditions, total carbon balances from farmers to harbour are 2.6, 2.4 and 3.2 tons of CO<sub>2</sub> per ton of green beans in Dairi, Simalungun and Tapanuli respectively without land use change. The values are multiplied by more than ten in the case of settlement of new plantation on former primary rainforest. Other main posts of carbon emissions are transport and energy consumption during process. The benefits made out of the PES scheme by each of the identified potential carbon neutral value-chain stakeholders are highly correlated to the premium they might receive by joining the certification. Reasoning was conducted with a 0.40 US\$.kg<sup>-1</sup> premium. In the case of a carbon neutral certification, the cost to enter the certification is equivalent to the price of VER to be bought, that is to say two US\$ cts per kg of green bean with the current VER market price. Hence this cost would be largely covered by 0.50 US\$.kg<sup>-1</sup> premium with even benefits for all stakeholders. Margins will be even higher (4.38 vs 3.67 US\$.kg<sup>-1</sup> for the exporter) in the case of implementation of field based buying platforms.

**KEYWORDS** coffee, Indonesia, carbon footprint, payment for environmental services, value chain

## 81. The effects on enteric methane when supplementing high fibre diets with lipids from canola sources

AUTHOR **Farah Ben Salah**

SUPERVISORS Karen Beauchemin | Luisa Biondi | François Bocquier

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The study was conducted to investigate the potential of canola-derived sources to reduce enteric methane (CH<sub>4</sub>) emissions using low and high fibre diets containing fibrous by-product feeds. Four donor animals were used in the experiment for rumen fluid sampling. The analysis of variance was carried out with in vitro dry matter (DM) disappearance data and gas production parameters to examine the difference between higher and lower fibre and the effect of canola sources on CH<sub>4</sub> reduction. The basal diets of donor animals consisted of barley silage (39.4% of DM), barley grain (36.2% of DM) and pellet (20% of DM). The donor animals were acclimated for 12 days to a pellet containing the feeds tested; i.e., oat hulls, beet pulp and canola meal. Adding the canola products increased the dietary fat content of the diet tested in vitro: beet pulp from 0.3% to 0.9% for beet pulp + Napus, 3.5% for beet pulp + cold press, and to 4.7% for beet pulp + oil. For oat hulls, adding the canola products elevated the crude fat content from 2.6% to 2.5% for oat hulls + Napus, 5.1% for oat hulls + cold press, and to 6.9% for oat hulls + oil. The effect of the three canola sources (oil, meal Napus, meal Cold press) using low (beet pulp) and high (oat hulls) fibre diets was studied using a batch culture incubation technique. The amount of substrates in the incubation was: 0.5g/kg DM for beet pulp or oat hulls, 0.5g/kg DM + 0.2g/kg DM with mixtures of beet pulp or oat hulls with canola meal (Napus, solvent extracted) or canola cold press and 0.5g/kg DM + 0.023g/kg DM with mixtures of beet pulp or oat hulls with pure canola oil. Effect of type of substrate and of lipid addition on the rumen fermentation patterns was evaluated with 24 h and 48 h incubations. Shifts in rumen fermentation were very small at 24 h incubation compared at 48 h incubation who there was a difference between pure canola oil and canola meal. There was a tendency in the inhibition of CH<sub>4</sub> production for pure canola oil, but not for canola meal (low and high fat). The tendency of reduction wasn't accompanied by reduction in DM or NDF disappearance when pure canola oil was added. Methane production was lower for oat hulls than for beet pulp at 24 h and 48 h of incubation. Pure canola oil was more consistent in reducing CH<sub>4</sub> compared to canola meal in diets containing low and high fibre.

KEYWORDS methane, ruminant, canola oil, fibre, canola by-products, beet pulp, oat hulls, batch culture

## 82. Water reuse development in the Llobregat Vall Baixa and Delta agricultural area near Great Barcelona, Spain

AUTHOR **Maria Guadalupe Mata Garcia**

SUPERVISORS Frans Huibers | Giuseppe Cirelli | Miquel Salgot

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**W**ater reuse in the Llobregat Vall Baixa and Delta is a need to increase the water resources available or all the uses. Different efforts have been put to promote water reuse in the agricultural area due to its vicinity to Great Barcelona. However, there are two issues that have not been sufficiently addressed: the relative high content of salts in treated wastewater effluents and the role of agriculture in the design process as the end recipient of reclaimed water. These are the two topics addressed in this thesis work. The water chain and the reverse water chain were used to map the evolution of Electrical Conductivity in water from source to end and to identify the position of agriculture within the system. Interviews with farmers in the areas of Canal de la Dreta, Rec Vell and Gava-Viladecans gave insight on the type of agricultural systems of the area as well as on their knowledge about water resources and quality. Farmers also expressed their opinions about reclaimed water and water reuse. In the path from domestic water to wastewater, water doubles its EC from 1100  $\mu\text{S}/\text{cm}$  to almost 3000  $\mu\text{S}/\text{cm}$  for treated wastewater. According to FAO, this water has a moderate degree of restriction for use in irrigation and management strategies should be done to avoid yield drops and salinity build up in soils. On the other hand, farmers are aware of the issue of salt contents in reclaimed wastewater and it makes them reluctant to accept reclaimed water for irrigation, certainly, when they have the choice. Moreover, uncertainties on reclaimed water costs and fear to lose traditional water rights are other concerns expressed by farmers. It can be concluded that the agricultural sector was not properly addressed during the planning phase on water reuse projects. As long as farmer's concerns are not addressed water reuse will remain low as it is.

KEYWORDS water reuse, treated wastewater, reclaimed water, salinity, agriculture, Spain

## 83. Intervening in the Rehabilitation of Farmer Manage Small Scale Irrigation Systems: The Case of Kérouané in Upper-Guinea

AUTHOR **Marine Tallon**

SUPERVISORS Alex Bolding | Stephane de Tourdonnet | Sandra Maury | Aurélie Vogel

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In the region of Kérouané, groups of farmers manage small-scale irrigation systems. Since 1990's several projects intervened in the development of inland valleys to increase the production of the main staple food in the country, rice. In the context of food crisis, two food facility projects rehabilitated several irrigation systems under constraining conditions. Through an exploratory case study, based on data collected from interviews and observations, the report aims at understanding the modalities of intervention of those projects and identifying the rooms to manoeuvre to intervene in the rehabilitation of farmer manage small-scale irrigation systems. The study concludes that it is essential to realise a deep study on the social organisation of farmers and more specifically water users, as well as the system in which they evolve before intervening. This in order to limit unintended effects and include the action within a long-term process.

KEYWORDS farmer manage, farming systems, food facility, intervention, irrigation, small scale irrigation system, Upper-guinea

## 84. Impacts of organic certification on organic farmers livelihoods: a case study of Luwero district in central Uganda

AUTHOR **Saheed Adebayo Ogunbanwo**

SUPERVISORS Stephen Onakuse | Myles Oelofse

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This study was undertaken to evaluate the effect of organic certification on the livelihoods of rural organic farmers in Uganda. It was taken in two villages; Bwaziba and Lusanja of Luwero district in central Uganda. In each village both the treatment and control group (the certified and non-certified organic farmers) were sampled. Exporting companies were interviewed on certification issues and their out growers. Information about organic farmers was also collected from various institutions. Participatory Rural Appraisal exercise (matrix ranking) was used to determine the reasons why farmers grow organically, the benefits and challenges the farmers faced in organic agriculture and certification. This was followed by administration of 120 survey questionnaires to the two farmer's household based on random sampling from the list of farmers provided by the exporting companies. Face-to-face semi-structured interviews with prepared interview guides were then conducted with purposively sampled study households. In addition, two certifying bodies (IMO and UgoCert) currently operating and have office in Uganda were interviewed. Data collected was analysed and some statistical tests were run to show the level of significance differences between the two households. The research shows that there are significant differences in some of the livelihood components of both certified and non-certified household before and after certification. Certified organic farmers benefit from the sales of their organically certified products, which are sold into the international market through their activity as contract farmers (out growers) to different exporting companies. High certification cost, inability of the exporting companies to purchase all the organically grown crops by farmers and the incessant changing of standards requirements are among the challenges of organic certification as observed by sampled farmers group and their exporting companies.

KEYWORDS organic certification, livelihoods, Uganda, organic farmers

## 85. Climate change impacts and adaptation of rice-wheat production in Bangladesh: Case studies of Dinajpur and Southern districts

AUTHOR **Umaskhon Kalandarova**

SUPERVISORS Roberto García-Marirrodiga | Stephen Onakuse

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Education is considered as one of the bases that lead to development, especially in rural areas. This is quite evident in some rural areas of developing countries in Africa, Asia and Latin America. The alternating system of education implemented by the formative projects of the Family Educative Centres for Training by Alternating Cycle (CEFFA by its acronym in Spanish), permits to verify these impacts on local development and sustainability of agriculture, which is increasingly diversified and multifunctional and tends to transform agricultural employment in rural non-farm employment (RNFE). This work shows some of the impacts gained from alternation cycle education in the case of a Latin American country (Colombia) and another of Asia (Philippines). After analysing the CEFFA under the approach of the International Project Management Association (IPMA), some lessons of experience about the competences were described on the cases of the studied countries. Furthermore, there have been presented some guidelines to define the teacher profile, who is the one of the main actors in the system of alternation cycle education. The document consists of four parts. In the first part, entitled “Development of rural areas, the development of people and environment” there have been analysed the problems of rural development and its relations with staff training, education and development. The second part: “A specific pedagogy: The Alternation”, issues and research methods in the global context on the toggle and the historical process of creating the CEFFO, the general characteristics of movement and an international vision of current reality. “An educational movement for the formation and rural development”, is the third part, where there have been stated the comprehensive briefing about the partnerships and the role of families, and the characteristics of the trainers in terms of responsibility for the actions of CEFFO, educational research in each country where the movement is presented. We finished with a final suggestion: analysis of educational projects in Latin America and Asia since the competences of IPMA.

KEYWORDS climate change, rice, wheat, people, environment, adaptation

## 86. Mainstreaming Wastewater Management in Urban Planning: A Case Study of Tamale Metropolis, Ghana

AUTHOR **Mekonnen Giweta**

SUPERVISORS Frans Huibers | Montpellier SupAgro | Francis Obeng |  
Gordana Kranjec-Berisavljevic

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**T**his research looks at how domestic wastewater can be put at the forefront of urban planning and management in the Tamale Metropolis, Northern Ghana. It studies with respect to wastewater management as well as the current state of art and major problems that are identified from water source up to wastewater use in agriculture. Wastewater management requires an inter-sectoral and interdisciplinary approach and there is a need for partnership by all stakeholders. However, beyond the partnership, a strong guidance is needed by the political power. Tamale Metropolis should play the leadership and coordinate the relevant institutions that are involved in urban planning. In Tamale, different institutions have been making efforts individually for achieving improved wastewater management, each in the face of the constraints that challenge them. These constraints include inadequate policy and laws, low enforcement of the existing laws, lack of logistics and funding, inadequate human resource, especially professional and technical shortages, weak institutional linkages, inadequate spatial information, low awareness of the society on sanitation, low participation of stakeholders and low conscious efforts to integrate urban and peri-urban agriculture into the city plan. In the light of these problems, institutions should interact and work together. Using this approach, agricultural and sanitation issues can be addressed in a harmonized manner.

KEYWORDS urban agriculture, urban planning, wastewater, wastewater management, sanitation, Ghana

## 87. Assessment of opportunities and stakes of grain sector in Kosovo

AUTHOR **Anika Totojani**

SUPERVISORS Jean-Pierre Boutonnet | Stéphane Fournier | Frédéric Moulin

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This study sets out the opportunities and stakes of grain sector in Kosovo, a recent and a developing country that is attempting to restructure the economy. This research analyses the role of actors involved in supplying, production, processing, marketing and distribution of food and feed grain. The governance of the chain, collaboration, integration and strategies between actors are analysed to point out their implication with the global market and how they could be better off. The research is based on qualitative methods. Primary data are carried out by conducting 68 semi-structured interviews and respondents are selected randomly. The study reveals that the country highly depends on grain imports and lacked an organized domestic grain market. Wheat is the major crop planted followed by maize. Actors are partly integrated and not very efficient in production. The existence of informal market influences the decision making of actors. They have mix governance types, and domestic relations are based on trust mechanism. The research has drawn the importance of agriculture public policies to sustain grain domestic production, create public-private partnerships to restore grain market and revise trading policies that play a crucial role to enhance fair competition between domestic and foreign traders. The opportunities of Agrobaza- the branch of Axeral grain cooperative to develop its trading chain are considered.

KEYWORDS grain sector, Kosovo, chain governance, public policies, Agrobaza

## 88. Post-harvest losses and food sustainability challenges of rural farmers in developing countries: A case study of maize farmers in Ghana, West Africa

AUTHOR **Osilamah Solomon Imhomoh**

SUPERVISORS Søren K. Rasmussen | Stephen Onakuse | Ivy Drafor-Amenyah | Margaret A. Atikpo

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Post-harvest losses in crop production are of great concern today. Resources such as labour, land, water and fertilizers/chemicals used as production inputs are wasted. An attempt was made to quantify these losses in maize production during storage and its impacts on the livelihoods of rural farmers in Ghana. Interviews were conducted among 371 maize farmers from nine districts in three regions, in order to gain the farmers' perceptions of post-harvest losses and causes. Data collection was done between March and April 2011 after the minor season of maize farming. Formal and informal interviews were conducted among experts in maize storage. A visit to some storage sites revealed poor storage facilities, which are prone to factors responsible for maize losses and low level of technical expertise among maize farmers. Some findings show that about 52% of farmers still rely on saved maize seeds from previous harvest source of planting material. Only 20% of farmers use certified seeds, while others get their seeds from the open market. Over 94% of farmers harvest maize when matured and dried on the stalk. This according to experts is a major source of pest infestation and mycotoxins contamination. The farmers store their maize in bags (55%), local cribs (33%) household metal silos (0.3%). This may account for the high losses recorded, which ranges from 10-30%. The farmers identified insects, rodents and fungal infestation as the major problems they experience during maize storage, which is usually up to a period of 3-9 months. A statistical analysis was carried out using factors that could contribute to maize losses. These factors are the site of the storage structures, either in the field or in the house; duration of storage which is between 3-9 months and methods of fumigating storage structures before storage. None of the above-mentioned factors was statistically significant to maize storage losses at  $p < 0.05$ .

KEYWORDS post-harvest losses, maize, food sustainability

## 89. Control of infestation of *Haemonchus contortus* in lambs by feeding of tannins and saponins

AUTHOR **Giuseppe Copani**

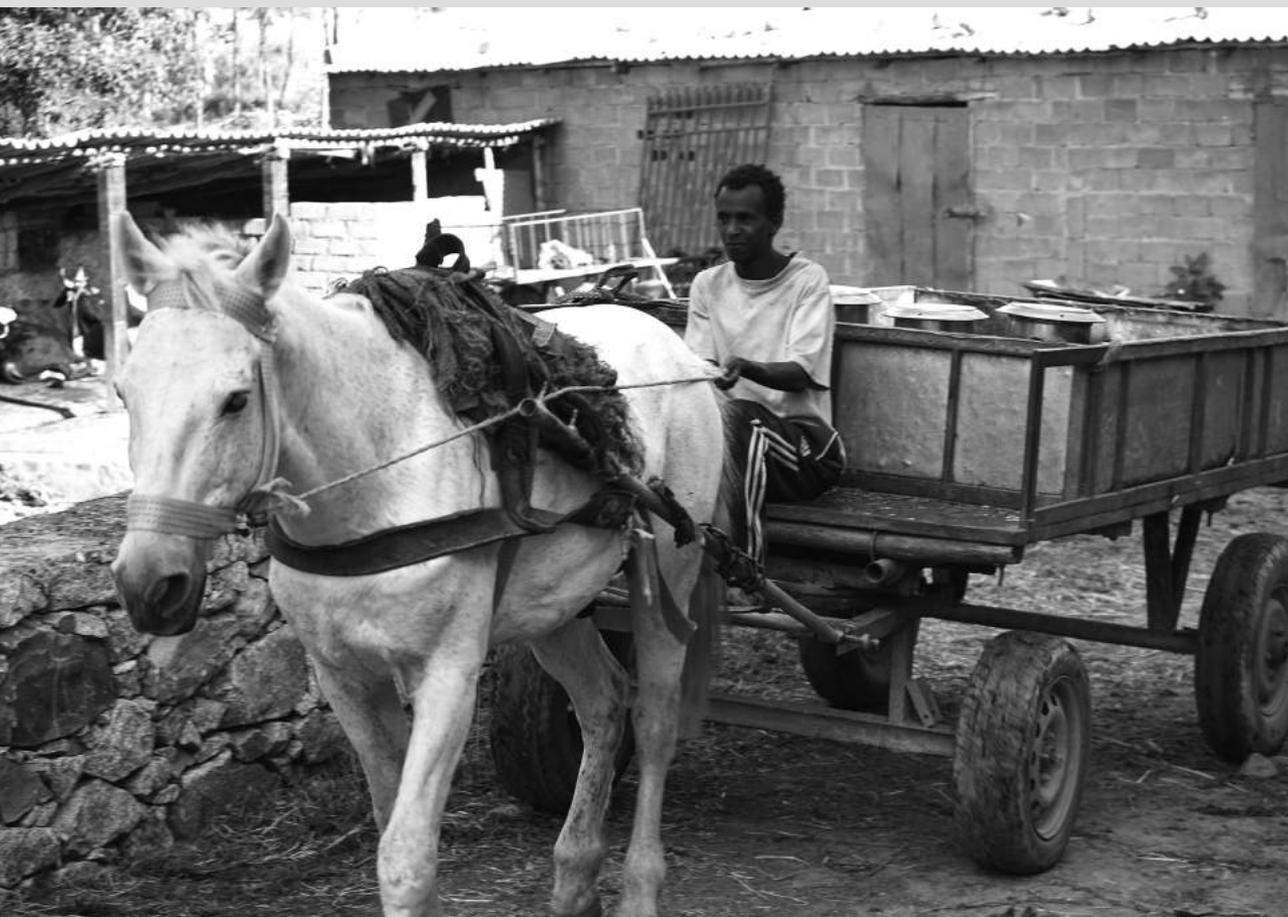
SUPERVISORS Juan Villalba | Alessandro Priolo | Magali Jouven

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Plants produce in their metabolism different compounds not involved in the primary function. These compounds are known as plant secondary compounds (PSC). Some of these plants containing PSC can be introduced in feeding animals. They can provide beneficial and negative effects depending on the dose and the type of the PSC. These compounds are being used as alternative methods to treat parasitic gastrointestinal infections instead of using conventional chemical products that enhance the resistance to anthelmintics drugs. In the last years, attention has been given to the anthelmintic effect of tannins that affect negatively parasites but tannins are not the only PSC that can act against infective parasitism. The objectives of this study were: 1) to determine the anthelmintic properties of tannins and saponins when offered to lambs separately and 2) when offered in a choice such that both PSCs are consumed in the diet. Thirty-five lambs were placed in individual pens and spread into five groups: Tannins, Saponins, Plain and Choice (parasitized or not). Animals were familiarized with the respective diets then were dosed orally with 8,000 L3 stage larvae of *Haemonchus contortus*. After exposure (during a parasitic infection) animals in the all groups received the different experimental diets and the effects on feed intake and on parasitic load were studied. Lambs offered feed without PSC (Control) or given choices between tannins and saponins (Choice) ate more feed than lambs offered just tannins or saponins as single rations ( $P < 0.05$ ) and no difference in intake and preference for saponin- or tannin-containing feeds were detected between groups of lambs (parasitized, non-parasitized) offered choices between these two PSC ( $P > 0.05$ ). Tannins group showed lowest Fecal Egg Count (FEC) compared to all groups and in particular was 51,6% lower than control group. Saponin group reduce the FEC by 38,8% compared to the control group while choice group reduce the FEC by 16,5%. This study confirmed the efficacy of tannins as anthelmintic and showed that saponins also, when given separately decrease the parasitic burden but the combination of these two PSC was less efficient. Furthermore, investigation needs to be carried out to understand better the effect of one or more PSC as alternative method to control parasitic infestation in lambs.

KEYWORDS **tannins, saponins, haemonchus contortus, fecal egg count (FEC), lambs, plant secondary compounds (PSC)**

# BATCH 5: 2010–2012



## 90. The Determinants of Intermediaries' Power over Farmers' Activities: Evidence from Adana, Turkey

AUTHOR **Orjon Xhoxhi**

SUPERVISORS Søren Marcus Pedersen | Alan Collins

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This thesis investigates the determinants of intermediaries' power over farmers' activities, in the context of developing countries. In doing so, it proposes a holistic model of intermediaries' power. The methodology used to understand the phenomenon of power in this research is a combination of quantitative and qualitative methods. The results of the quantitative analysis indicate that the power of the intermediaries' over farmers' activities can be explained from six sets of main factors: 1-product characteristics, 2-industry characteristics, 3-relationship characteristics, 4-farmers' characteristics, 5-farmers' access to resources and 6-power sources available to the intermediaries. Furthermore, the analysis of the qualitative data showed that intermediaries due to their power employ a number of supply chain practices that transfer to farmers' excessive risks and unexpected costs. These risks and costs compromise farmers' business position, who struggle to keep up a profitable business. Therefore, it is argued in this thesis that a balance of power needs to be established between farmers-intermediaries, which should lead not only to improved farmer's business position but also to increased efficiency of the supply chain. The arguments are derived by looking at the holistic model of intermediaries' power developed in this research.

KEYWORDS farmer intermediary relations, power, marketing channels

## 91. Exploring livelihoods of the urban poor in Kampala, Uganda: An institutional, community and household contextual analysis

AUTHOR **Patrick Dimanin**

SUPERVISORS Carole Lambert | Stephen Onakuse | Antoine ESCLATINE

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The urban poor in Kampala, Uganda represent a large portion of the population of the capital city, yet little is documented about their livelihoods. The main objective of this study was to gain a general understanding of the livelihoods present amongst the population of the urban poor and the context in which they exist, so as to form a foundation for future programming. Three groups of urban poor in the city were identified through qualitative interviews: street children, squatters, and slum dwellers. Slum dwellers became the principal interest upon considering the context, aims and limits of the study. Qualitative interviews with key actors at community and household levels, questionnaires at a household level, and several other supplementary investigations formed the remainder of the study. Ultimately, six different livelihood strategies were identified and described: Non-poor Casual Labourers, Poor Casual Labourers, Non-qualified Salary, Qualified Salary, Vocation or Services, and Petty Traders and Street Vendors. Each of the livelihood strategies identified held vulnerabilities, though the severity of these varies between both the type of vulnerability and group. Vulnerabilities of the entire slum population of Kampala include land tenure issues, malnutrition monitoring, and enumeration information. Those at a community and area level include the risk of persistent flooding, unhygienic and unsanitary practices, and full realisation of benefits of social networks. Finally, major household vulnerabilities included lack of urban agriculture, and lack of credit.

KEYWORDS livelihoods, urban, Kampala, Uganda, food security, WASH, nutrition

## 92. The effect of active dried and killed yeast on ruminal acidosis in Cattle

AUTHOR **Uwizeye, Aimable**

SUPERVISORS Luisa Biondi | François Bocquier | Karen Beauchemin

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Six ruminally cannulated non lactating beef heifers were used in a replicated 3 x 3 Latin square to study the effect of strain of *Saccharomyces cerevisiae* fed as active dried yeast (ADY) or killed dried yeast (KDY) on: 1) ruminal pH, temperature and fermentation, 2) modulating the severity of acidosis occurring as a result of an acidosis challenge, and 3) recovering after the acidosis challenge. Heifers were provided *ad libitum* access to a back grounding diet of 50:50 (forage concentrate; dry matter basis) as total mixed ration (TMR). Treatments were as follows: Control (no yeast), 4 g/d of ADY ( $10^{10}$  CFU/g; AB Vista, UK) and 4 g/d killed dried yeast (autoclaved ADY) directly dosed in the rumen via the cannula. The experimental periods consisted of 2 weeks of adaptation (d 1 – d 14), 6 days of baseline measurement (d 15 – d 20), 1 d of feed restriction (d 21), 1 d post-challenge (0-24h after the grain challenge; d 22), 2 d post-challenge (24-48h after the grain challenge; d 23) and the recovery periods (d 24-d 28). The challenge consisted of restricting diet to 50% or 25% of *ad libitum* intake for 24h, followed by an intra-ruminally dosage of grounded barley grain equivalent to 25% of dry matter intake (DMI) before feeding the TMR. Ruminal pH and temperature were continuously measured for 14 days using an indwelling system. During the baseline period, the DMI and body weight were not affected by the yeast treatments ( $P > 0.05$ ). The ADY and KDY heifers increased ( $P < 0.05$ ) the average daily ruminal pH mean ( $6.27 \pm 0.13$  and  $6.26 \pm 0.13$ , respectively) and nadir ( $5.64 \pm 0.08$  and  $5.66 \pm 0.08$ , respectively) compared to the control heifers (mean  $6.05 \pm 0.13$  and nadir:  $5.54 \pm 0.08$ ). Yeast supplementation reduced ( $P < 0.05$ ) the incidence of SARA measured as the duration of SARA, the bout frequency and the incidence of long bout ( $> 3h$ ) below the pH threshold 5.8 or 5.6 compared to the control. The ruminal daily mean, nadir and maximum temperature were not affected by yeast feeding. The ADY heifers reduced ( $P < 0.05$ ) the duration that the temperature was above the thresholds 38.0, 39.2, 39.5 and 40.0°C compared to control and KDY heifers. The ruminal nadir pH was negatively correlated ( $P < 0.01$ ) with the ruminal maximum temperature. Feed restriction before the acidosis increased the ruminal pH the day before the challenge. The ruminally dosed grain challenge caused the ruminal pH to plummet immediately. The ADY supplement tended ( $P \leq 0.15$ ) to increase the ruminal pH mean and decrease ( $P < 0.15$ ) the area under the pH threshold of 5.8 or 5.6. During the 2 d post-challenge,

ADY heifers returned to their baseline DMI level while heifers fed control or KDY had reduced ( $P<0.05$ ) intake. During the recovery period, ADY and KDY heifers increased ( $P<0.05$ ) the nadir ruminal pH compared to control heifers. This study shows that ADY and KDY have the potential to improve the ruminal pH of heifers fed a backgrounding diet. However, ADY tended to attenuate the severity of an aggressive acidosis challenge and promoted faster recovery following the challenge. Heifers fed ADY had shorter periods of elevated ruminal temperature, but further work is needed to evaluate the physiologic implication of this result. The rumen temperature was a moderately useful indicator of SARA. Supplementing ADY and KDY prevent the incidence of SARA in cattle but yeast may be alive to reduce the impact of an aggressive SARA.

**KEYWORDS**     acidosis, subacute ruminal acidosis, ruminal pH, ruminal temperature, active dried yeast, killed dried yeast

## 93. Multi-stakeholders Platforms for Integrated Water Resource Management

### A case study of the 'Consortio Público de la Cuenca del Rio Jubones', Ecuador

AUTHOR **Sergio Alvarez Carrion**

SUPERVISORS Thierry RUF | Ludger Niemann

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Approaches to integrated water resources management (IWRM) and consultation platforms (PC), as well as the use of watershed boundaries, have been accepted internationally and have become the dominant paradigm in the management of water resources. This paradigm is supported and promoted by Governments, multilateral organizations, NGOs, researchers and others. However, a rising tide of sceptical questions and review its role as a fool-proof rule within the sector. Despite the current debate about his involvement and implementation, your income has been imminent in Latin America and the Caribbean. So that from the Decade of the 90s several countries in the region have introduced this approach through its policy frameworks, the Ecuador is no exception. In order to implement this new approach, several initiatives have emerged in the country, and others are supported in this paradigm for its further development. An example, in the South of the country, is the "Consortium public of the basin of the river Doublets" (CCRJ), a platform for dialogue promoted by 37 autonomous governments (GAD). Despite knowledge reduced regarding the effects and the limits of this type of organization, specifically in the management of water resources in the basin of the Jubones River, has been considered both a local and international level, as a remarkable case of the implementation of the principles of integrated water resources management. Taking these factors into account, this research has been conducted to achieve a comprehensive and systematic understanding of the catalysts and constraints that they have enabled the birth, further development and current functioning of the "public consortium of the Jubones River basin "one PC 'singular' whose efforts are focused on coordination and articulation of 37 GADs and who claims to work on potential implementation of IWRM in the basin of the Jubones River. However, thanks to the study has concluded that not necessarily projects it works on this platform will according to the concept of IWRM, mainly due to the same ambiguity of the concept, difficult differentiation between what is (not) an IWRM action. However, this type of platform of concentration is interesting,

worth further study it, and learn from it, since unlike other initiatives, it attempts to coordinate a sector of government actors.

**KEYWORDS**    integrated management of water resources, river basin, consultation platforms, public consortium of the basin of the Jubones River

## 94. Analysis of communities of actors of the forest of the Grande Chaloupe, Reunion Island

AUTHOR **Ilaria Capra**

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**G**rande Chaloupe (GC) is known in Reunion to be a high-stakes historic, heritage, environmental and social territory. In the past, development projects have led to conflicting relationships between GC stakeholders. Today a biodiversity conservation project is in place: reforestation of semi-dry forest of the GC. The field survey aims to map the actors involved in the forest today, focusing on their interactions, their knowledge and their relationship to nature. Sociological methods such as participant observation, semi-structured and non-structured interviews, and questionnaire have been applied. So I identified communities of individuals involved in GC, I compared them by highlighting elements that could foster cooperation or discord. I concluded that collaboration is stronger because of cohesive elements such as brokers and boundary objects.

KEYWORDS communities, environmental, social territory, biodiversity, conservation

## 95. Innovation for Agricultural Diversification in Ayeyarwaddy Delta, Myanmar

AUTHOR **Aye Kyawt Swe**

SUPERVISORS Didier Pillot | Andreas de Neergaard | Louis Pautrizel

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The purpose of this master's thesis is to study ways for agricultural diversification in Bogale and Mawlamyaingyun townships in Ayeyarwaddy delta of Myanmar. This study was undertaken in Bogale and Mawlamyaingyun Townships in Ayeyarwaddy Delta Region, Myanmar. Therefore, the research focused on the new agricultural production systems to innovate in the study areas. To innovate new crop productions, which could contribute to diversify agricultural production, agro-ecological adaptability and economic analysis of these new production systems and institutional analysis, were undertaken. The studied ways for agricultural diversification are rice-fish culture, perennial crops such as lime, sweet orange and asparagus, and dairy farming system. Rice-fish culture was intended to study for small and medium-scale farmers and perennial crops were intended for home garden production, which can be practiced by both farmers and landless and dairy farming system is intended for landless household. The empirical research was based on the participatory method. Area transects, observations, focus group discussions, key informant interviews, in-depth interviews (Structured-interviews) were conducted to complete my required information. The findings of the study show that there is a need of diversified agricultural activities for sustainable livelihoods, while the needs can only be met by taking into consideration both the agro-ecological conditions in which the farm operates and the rural conditions of the farmers. Agro-ecological conditions in the Ayeyarwaddy delta vary much according to the topographic conditions and the wash out of the tide by fresh water and irrigation. The social condition of the farmers varies according to the land resources available for farming and the capital each of them can invest in agricultural production. This thesis proposes the innovation of new agricultural production systems, which could contribute to diversified agricultural production. The innovation of new agricultural productions is determined by the profitability and market potential of the productions.

KEYWORDS innovation, agriculture, production systems, agro-ecological, institutional analysis

## 96. Changes of lambs marketing practices by sheep farmers: analysis of sheep sector in France since 1970 and methodological approach of farm trajectories and drivers of changes

AUTHOR **Teno, Gabriel**

SUPERVISORS Charles-Henri Moulin | Iuri Peri | Marie-Odile Nozieres

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The study aims to analyse the evolution of French sheep sector since 1970 and the lambs marketing modalities by the sheep farmers. For the evolution of sheep production since 1970, the analysis was focus on sheep meat sector. Thus, in order to present the evolution of the sheep meat sector in France since 1970, several data sources were used. The collected data were used to construct graphs showing the evolution of the French sheep meat sector. These graphs were then submitted to the critical analysis of a sheep sector specialist. The study of the modalities of lambs marketing by the sheep farmers tried to respond to two questions. The first question was to determine the changes in the modalities of lambs marketing by the sheep farmers. The second question was to identify the internal drivers (evolution in terms of management of the flock) and the external drivers (changes in agricultural policy and socio-economic environment and the behaviour of downstream operators in the sector) in origin of the various changes in lambs marketing practices. The adopted approach consisted on the literature review of the different methods used for the analysis of farms trajectories. This literature review has led to propose a method of data collection and processing for farms trajectories. This method has been tested on a sample of three farms in the region of Languedoc Roussillon. The result of the evolution of sheep production in France since 1970 shows that sheep meat sector has known three major periods. The first period, from 1970 to 1980, characterized by an increasing in the overall level of consumption related to the population growth; but mainly due to the annual increasing in the level of consumption per capita. The second period, from 1980 to 1992, characterized by the massive inflows of sheep meat in France, especially from the United Kingdom and the New Zealand following the opening of the French sheep market. Finally, we have the period from 1992 to 2012 characterized by a significant decrease in the level of production, consumption and even imports, which results in a significant decrease of self-sufficiency up to 48% in 2010. For the modalities of lambs marketing by the sheep farmers, the results of this preliminary study show that changes in the lambs marketing practices

are more frequent than changes in the farm management of reproduction and feeding and occur mostly at the beginning of the activity. External drivers seem to be the main drivers of these frequent changes in lambs marketing. In sum, for the sustainable development of sheep meat sector in France and ensure income to sheep producers, it is important to better control the practices of lambs marketing. This control necessarily involves the key drivers of changes, including the evolution of agricultural policies and socioeconomic environment as well as the behaviour of the downstream operators.

KEYWORDS    lamb, market, sheep farmers, drivers of change, self-sufficiency

## 97. Viability for the creation of a Protected Designation of Origin (PDO) for mango in Santiago de Cuba – CUBA

AUTHOR **Rulian Ricardo Sasse Beade**

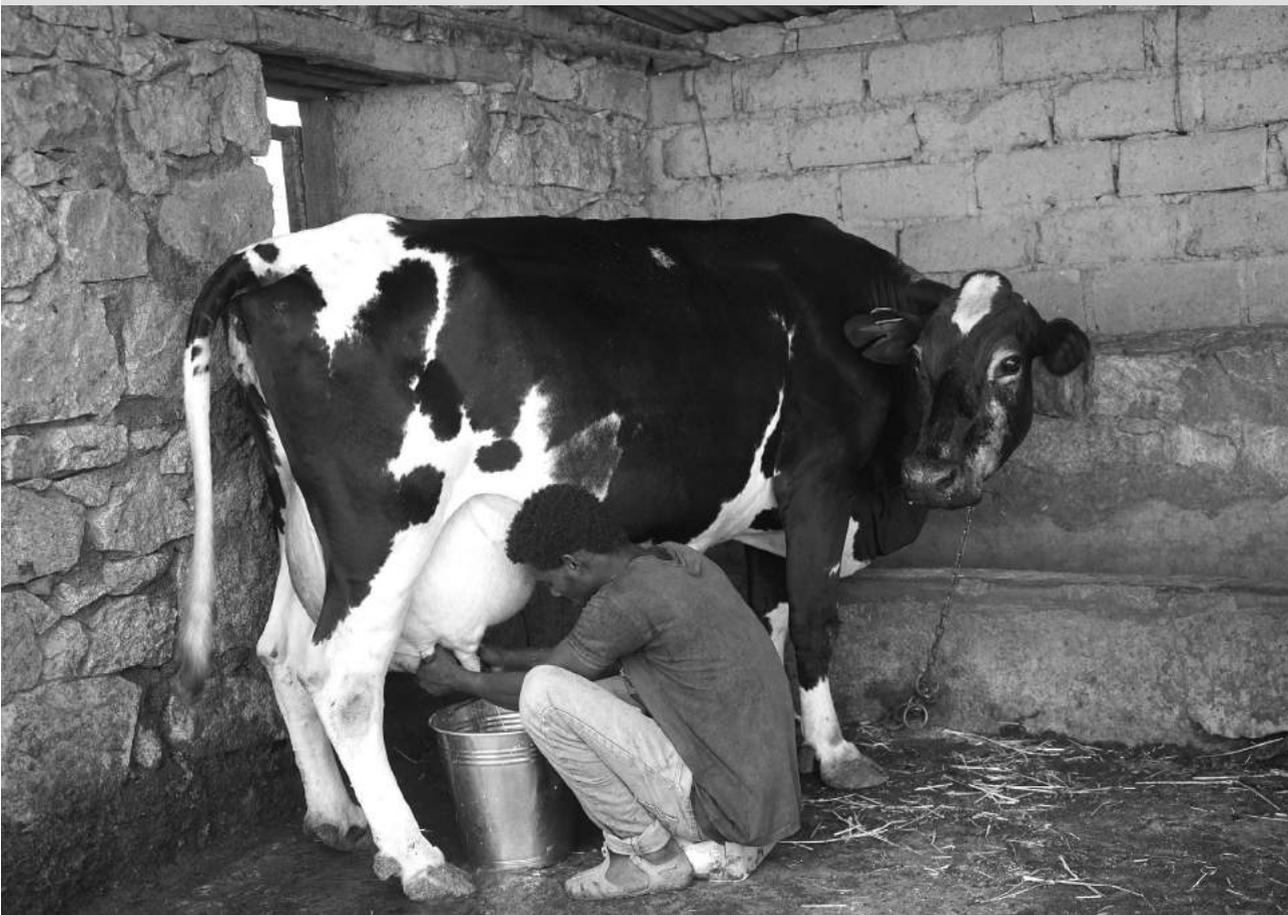
SUPERVISORS Ana Afonso Gallegos | Jean-Jacques Drevon | Tomás Marco Domínguez

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The development of agro-industrial value chains is one of the priorities of the Cuban government and international organizations to promote rural development in Cuba. The province of Santiago de Cuba concentrates approximately 45% of the national production of mango, representing much of the income of the local rural population. Protected designations of origin (PDO) are hallmarks of the national and local heritage, and can contribute to add value and to protect the most famous fruit of Santiago de Cuba. Through multi-disciplinary methods with systemic and territorial approaches, it was shown in the analysis that the province has a strong potential for the implementation of a PDO for the mango, since it has a high yield potential, and products with quality and specific characteristics, these that give it a national renown.

KEYWORDS Santiago de Cuba; rural development; protected designation of origin (PDO); value chains; mango

# BATCH 6: 2011–2013



## 98. Driving Sustainable Consumption: Determining Techniques That Have Successfully Influenced Food Procurement Choices Toward Sustainable Options

AUTHOR **Juliana Dixon**

SUPERVISORS Stephen Onakuse | Jesper Lassen | Thomas Bøker-Lund | Nick Green

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The United States and United Kingdom both have powerful agricultural lobbies that currently are maintaining a food system unhealthy for our bodies and local economies. These conventional food chains often have environmental externalities that further affect both human health and economic resources. In countries such as these that do not yet have regulatory systems to increase consumption of sustainably grown and transported foods, there are examples of other drivers that have successfully changed procurement patterns. Incredible Edible Todmorden (IET) is a grassroots movement, their actions sprouting through multiples facets of the community. IET offers education about a wide variety of issues surrounding food. They have increased the local supply of sustainably grown food, and increased the market for such products. This is a study into the methods IET used to shift food procurement. Results are aim to evaluate effectiveness and replicability.

KEYWORDS sustainable consumption, food procurement, choice food chain, transportation

## 99. Evaluation of tanniniferous tropical plants from Northeast Brazil in Santa Inês lambs: effects on methanogenesis and ruminal fermentation through in vivo and in vitro trials

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SUPERVISORS Adibe Luiz Abdalla | François Bocquier | Luisa Biondi

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The sheep livestock in Brazil is in a continuous development. In the latest years the sheep meat consumption among the Brazilian population has increased therefore Brazilian farmers are encouraged to breeding more animals of this specie. However, in northeast Brazil numerous difficulties are found during the dry season for feeding these animals. Among them, include the seasonal forage scarcity. Thus, the use of shrubs and woody plants with high levels of crude protein (CP) becomes a viable option in such semi-arid area where the family farm prevails. Hence, they represent a possible alternative for replacement of expensive classical diets. In addition to this, it is well-known that low quality feedings produce less energy available to the animal and a higher quantity of CH<sub>4</sub> emission, one of the green-house gases (GHG) and a consequent nowadays World's problematic, contributing to 35-40% of global anthropogenic emissions of CH<sub>4</sub> (Aluwong et al., 2011). The most developed countries are already pointed as the most pollutant but also countries in developing process, mainly those in the tropical areas as Brazil, are classified as well as major emitters of GHG. In this context, this study aimed to evaluate some fermentative parameters (pH, protozoa population, ammonia concentration and short-chain VFA) of two tanniniferous plants, Babaçu (*Orbignya phalerata*) and Mofumbo (*Combretum leprosum*), from the Caatinga (Northeast Brazil) in in vivo assay in 21 weaned Santa Inês lambs, the most common sheep breed in Brazil, taking Tifton-85 hay (*Cynodon dactylon*) as control and in vitro assay with alfalfa (*Medicago stiva*) as control. It was quantified in vitro the net gas production (GP) and the net methane (CH<sub>4</sub>) gas production of these two plants in addition to other tropical species as Sipaúba (*Thiloa glaucocarpa*), Caneleiro (*Cenostigma macrophyllum*) and Periquiteira (*Trema micrantha*). In general, the chemical composition of these five plants presented enough quantity of CP (ranging between 8 and 14.5% DM) and some of them high concentration of condensed tannins (CT), with a minimum value in Caneleiro (0.1%) and the highest level in Mofumbo (21%). The 3 experimental diets in in vivo trial were very similar in terms of CP content (16% DM) and showed not

significant differences regarding to pH, protozoa or VFA. On the other hand, low N-NH<sub>3</sub> values in Mofumbo emphasize the importance of tannins in this specie. When the five substrates were evaluated by the in vitro gas production technique, the 5 trial plants showed less net gas production in the presence or not of PEG, and a low production of CH<sub>4</sub> comparing to control (alfalfa), as the exception of periquiteira. The species that showed a more intense effect were Sipaúba, Mofumbo and Babaçu, due to their CT contents. The fermentative parameters in vitro suggested some changes of the fermentation routes as a low N-NH<sub>3</sub> value in Mofumbo and low VFA values in Babaçu and Mofumbo comparing with the control.

**KEYWORDS** tannins, ruminal fermentation, methane gas production, tropical plants

# 100. The function and soil Ca cycle in agroforestry development. Case study in southern Europe beech forests

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SUPERVISORS Luis Gonzaga García Montero | Olivier Philippon |  
María Inmaculada Valverde Asenjo

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Currently, existing information on the relationship between calcium cycling and soil vegetation system is scarce. For this reason, this research deals with a study of the ecological interactions between soil/plant species and ectomycorrhizas. A first literature review on Ca and metabolism and physiology of plants was performed. Moreover, another literature review was made; It showed all significant information on the cycle and the mobility of calcium in the soil and effects of liming on forest ecosystems. Then an experimental study on the dynamics of calcium in the soil and leaves of vegetation that are in close contact in mountainous areas of central Spain, beech (*Fagus sylvatica* L.) and thickets of heather (*Erica* spp) was performed.

KEYWORDS research, calcium, soil, *ectomycorrhiza*; *vegetations*

## 101. Working place integration, a challenge for empowering the youth of smallholder farming system. Two case studies from the Southwest and Northwest regions of Cameroon to contribute to the development of the integration support device developed by the AFOP program

AUTHOR **Sutera Gabriele**

SUPERVISORS Iben Nathan | Betty Wampfler

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**Y**outh's unemployment and the ageing of working forces in the agricultural sector is a debate questioning the future of agriculture. The Cameroonian government through the AFOP program is putting in place measures to renovate training and professional integration for young farmers. The training system, conceived by AFOP, is alternating theory and practice for a program lasting 2 years in total. At the end of training trainees, issue a project for the establishment of their own farms. The AFOP program ensures the trainees successful working integration through an innovative device: the integration support device. One of its functions is to partially cover the starting capital of the trainees' projects, giving them further motivation to work in the agricultural sector. This is the first time that Cameroon implements such a device at the national level. This opens a number of questions, related to the modalities of financing, and the endowment needed for it to be effective. Using an ex-ante evaluation of the trainees' projects, in two centres participating to the AFOP program, technical and economic references was designed for the financing of the projects. The tools used for the evaluation are, the Agricultural Revenue (AR), and the crops seasonal calendar. Furthermore, this study analyse which are the difficulties farmers are facing to develop and run their farms. These elements are related to the imminent trainees settling and the functioning of the integration support device. The study identified 5 different PS. Out of them only 2 appear to be able to produce enough AR after three years of activity. The main difficulties linked to integration result to be strictly linked to market access and to finance services.

KEYWORDS self-employment, youth, smallholder farming, Cameroon, integration, rural training, sustainable development

## 102. Gender Considerations in Agriculture and in the Adoption and Maintenance of Climate-Smart Agricultural Practices: A Case Study in the Cauca Department of Colombia

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SUPERVISORS Pascale Maïzi - Montpellier SupAgro | Jennifer Twyman

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The new paradigm of climate-smart agriculture, increasingly present both in the scientific literature and in agricultural development programs, promotes practices focused on the pillars of improving food security, mitigating climate change, and adapting to its effects. However, adequate consideration has not always been given to the gender differences and implications in the design and implementation of these practices. Within the framework of the Climate Change, Agriculture and Food Security (CCAFS) project, this research explores gender differences of perceptions towards new agricultural practices related to climate change, decision-making, access to information, distribution of assets and division of labour in the small-scale agriculture of Río Piedras watershed, located in the Colombian Massif. Based on semi-structured interviews with key informants, the implementation of a questionnaire and participatory rural appraisal methods in the peasant community of the area, the study concludes that perceptions of men and women differ significantly on which agricultural practices are considered more beneficial. In addition, the study identifies the roles and agricultural activities traditionally performed by men and women, observes wide gender gaps in terms of ownership of goods and notes certain inequalities, in both the method and degree, of access to information.

KEYWORDS climate-smart agriculture, gender, decision-making, division of labour, ownership of assets, access to information

## 103. A livelihood characterization of cashew farmers in Benin and critical reflection of the activities and objective of a Cashew sector development project

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SUPERVISORS Betty Wampfler | Andre Tandjiekpon | Mohamed Salifou

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Cashew is the world's second most important tree-nut crop. Cashew production in Benin has emerged and grown during the last 20 years to a point where cashew is now Benin's second most important agricultural export after cotton and is produced by approximately 200,000 farmers. The farmers independently choose to incorporate this tree-crop into their production systems in which cashew is often used as a fallow crop that generates revenue and secures land tenure. This report examines the activities of one influential actor in the cashew sector in Benin which is a project supported by international donors supports a number of activities on all levels of the cashew value chain. Their goals include an aim to strengthen the cashew value chain and increase farmer income (by USD 90) in order to reduce rural poverty. This report uses a collection of data and information obtained in the field to characterize the livelihoods of cashew producers in Benin and to critically reflect upon the activities and objectives of the project. The critiques identified include a lack of information pertaining to the farmers it targets to understand their situations and contextualize the goal of increased incomes, the lack communication channels between actors, the diverse and often surface-level nature of activities with a lack of follow-up, and inadequate measurement tools to monitor progress. The absence of a systemic approach and a basic typology to guide the project and measure progress further detract from their objectives. This is all compounded by a monitoring system that uses a yield survey questionnaire that is sub-par. This paper elaborates on these points and provides recommendations for improvement in this project but can be applied to similar development and assistance projects across the global south. The conclusions demonstrate the importance of development projects adopting larger perspectives, particularly systematic approaches, to guide and inform activities, which are further benefited by a system of communication between projects and the targeted beneficiaries.

KEYWORDS livelihoods, characterisation, cashew farmers, sector development

## 104. Impact of Residual Feed Intake and diet restriction on heifers' body composition and feeding behaviour, reproduction traits and calf performance in Artificially Inseminated Angus purebred heifers

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SUPERVISORS Carolyn Fitzsimmons | Pr F. Bocquier | FR Pr G. Luciano

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Approximately 80–90 purebred Angus heifers were used to study the relationship between Residual Feed Intake (RFI) and maternal nutrition, and their impact on feeding behaviour, fertility and various body composition measurements in growing and pregnant Angus heifers, and the impact on their calves' performance. Heifers were ranked into high and low RFI groups; and artificially inseminated (AI) to high and low RFI bulls respectively. At d 30 of gestation, heifers were stratified on the basis of their conception date, RFI measured as a heifer, sire bred to, and weight, and then randomly allotted to a low-nutrition treatment (fed to gain 0.5 kg/d ADG), or high-nutrition treatment (fed to gain 0.7 kg/d ADG). Heifers remained on these diets until 150 days of gestation, after which all the animals received the same diet. Individual DMI was recorded throughout the feeding trial. Meal duration (min/d) and meal frequency (events/d) and eating rate (kg/min) were calculated for each animal on a daily basis using GrowSafe system. Pregnancy rate and conception rate at the first AI were recorded. Weight before and after the feeding trial, and at 220 d of gestation and average daily weight gain (ADG) at the end of the feeding trial and 220 d of gestation were measured to evaluate growth performance. Body composition was evaluated by rump fat and back fat thickness measured before and after the feeding trial and at 220 d of gestation. At birth, gestation length, calving difficulty, calf weight and vigour were recorded. The data were analysed using the PROC MIXED of SAS. No interaction between RFI and diet was observed. High RFI animals showed a higher pregnancy rate (86% vs. 81%) and a higher conception rate at the first AI (81% vs. 62%) compared to Low RFI animals. With regard to heifers' growth and body composition, no significant differences were observed between high and low RFI heifers, but the dietary treatment affected these parameters. Heifers in the high-diet treatment were heavier than those allowed the restricted diet heifer at the end of the feeding trial ( $456 \pm 46$  kg vs.  $425 \pm 38$  kg,  $P = 0.04$ ) and there was

a tendency for high diet heifers to be heavier at 220 d of gestation ( $488 \pm 44$  kg vs.  $458 \pm 38$ ,  $P = 0.07$ ). The ADG was different at the end of the feeding trial ( $0.59 \pm 0.2$  kg/d vs.  $0.43 \pm 0.13$  kg/d, for high and low diet groups, respectively;  $P < 0.001$ ), but no diet effect was observed at 220 d of gestation ( $P = 0.83$ ). Rump and back fat were also different between diet groups after the feeding trial ( $P < 0.0001$ ) and at 220 d of gestation ( $P = 0.008$  and  $P = 0.02$ , respectively). Neither RFI nor feed restriction affected the length of gestation or calf performance. Low RFI animals consumed 7% feed less than high RFI animals and these two groups behaved differently on a restricted diet. These results demonstrate that RFI can reduce feed intake without affecting the main production traits. Further studies will investigate in depth the effect of RFI and pre-natal nutrition on post-natal growth and development of the calves born from these heifers.

**KEYWORDS**     residual feed intake, prenatal nutrition, feed restriction

# 105. Effects of Contrasting Temperature on the Developmental Biology of *Bemisia tabaci* (Hemiptera, Aleyrodidae) and its transmission of cassava mosaic and brown streak viruses Tanzania

AUTHOR **Firaol Taressa Ufga**

SUPERVISORS Carmelo Rapisarda | James Legg

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Tanzania, which is one of the leading of cassava-producing countries (*Manihot esculenta* C.) in Africa, produced numerous varieties and products. While, the small-scale farmers relying on cassava production lost a significant part of the production because of the whitefly, *Bemisia tabaci* and its vectored viruses. Temperature is one of the key factors driving whitefly population development. A study was conducted in Tanzania to determine the influence of temperature on the developmental biology and survival of *B. tabaci* and its transmitted viruses (CBSVs and EACMV) on cassava. This research provides comprehensive new data about survival and developmental times at four constant temperatures under laboratory conditions for insects reared on cassava. Temperature affected each of the immature development stages separately and brood development from egg to adult. Results showed that the higher the temperature, the shorter the developmental duration. The survival of each of the immature stages was also differently affected by temperature. The mean developmental time of adults of *B. tabaci* ranged from 23 days at 28° C to 35.8 days at 18° C. At 33° C, no adults were produced. In the present study the percentage of survival of *B. tabaci* varied from 55.3 at 18° C to 72.5% at 23° C. Fecundity and longevity of adult *B. tabaci* were significantly affected by the contrasting temperatures examined. Higher and lower oviposition rates were recorded at 23 and 18o C correspondingly. Temperature had a significant effect on CBSV symptom development and viral concentration. At higher temperature (33o C), the newly developed leaves appeared less symptomatic. The percentage of plants expressing symptoms varied from 32.0% at 33° C to 59.8% at 18–23° C. The present study gives basic biological information which can be used to predict the distribution range of this species and which will be valuable in anticipating potential future impacts of climate change.

KEYWORDS *whitefly, Bemisia tabaci; cassava (Manihot esculenta C.); Tanzania; temperature; virus*

## 106. Production and Reproduction of Social Practices in a Maya Tseltal Community in Chiapas, Mexico

AUTHOR **Hugo Francisco Chavez Ayala**

SUPERVISORS Eric Léonard | Manuel Roberto | Parra Vásquez

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Quantitative and qualitative research was conducted in a Maya Tseltal community in southern Mexico to assess the degree and motivations for social change. Framed in the sociology guidelines of Pierre Bourdieu's concepts of *Habitus* and *Social Field*, human life trajectories and social events were studied in an attempt to mediate between determinism and rationalism. First we found that a major social transformation occurred in the community in the past 70 years, contrasting anthropological research conducted in the 50's and the 60's with recent livelihoods research showed the old and new income generating social practices. The historical depth and development of these social practices was investigated and the findings were grouped into four themes: agriculture from subsistence to cash crops; paid labour inside and outside the community; services for the community (transportation, commerce, typewriting, etc.); and government support. We identified three major events that had a strong influence on the transformation and creation of social practices: Firstly, the arrival of Presbyterian missionaries in the 50's influenced mainly agricultural practices and community political organization; Secondly, the boom of coffee as a cash crop in the 80's, boosted by Instituto Mexicano del Café (INMECAFE), marked the debut of capitalist accumulation and the exponential diversification in income practices; thirdly, the Zapatista uprising in the 90's which seemed to be a catalyst for a new relationship between Chiapas' communities and the Mexican government marked by government transfers. The transformation intermediaries where key people whose life trajectory was analysed and were found to be important actors during the major events in the community, four were used as case studies to showcase the room for individual influence under a changing society: the peasant leader that grouped the coffee producers, the trader that used critical information to diversify his income sources, the Presbyterian "Doctor" that by learning western medicine disrupted the traditional gerontocracy, and the teacher that used his extra income to innovate in agriculture. We concluded that social change in agricultural indigenous communities is a complex process with many spheres of influence starting on the individual and scaling up to global trends. In present days' social differentiation is a reality that is specially shown through accumulation of economic and cultural capital, and although economic constraints make an important

number of adults to migrate temporarily, permanent migration seems uncommon. The identification of key historical events and actors, which had a strong influence on social change and the adoption of innovations, can give valuable information for the process of adapting development strategies for rural communities.

KEYWORDS    production, reproduction, social practices, motivation, social change

## 107. Social management in Guardaña watershed: A case study of a pilot pedagogical watershed in Bolivia

AUTHOR **Sonia Natalia Vásquez D**

SUPERVISORS Aad Kessler | Thierry Ruf | Jaime Huanca

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The Bolivian Ministry of Environment and Water, concerned for soil and water problems in the country, created the National River Basin Plan (PNC in its Spanish acronym) as a tool to implement its own approach for water management, known as Social River Basin Management. As it considers river basin as the basic management level and local capacity building as a priority, the Pedagogical Watershed Program is being implemented through pilot projects. This study was carried out in Guardaña, one of the six Pedagogical Pilot Watersheds located in Oruro Department between 3810 and 4722 meters above sea level. A case study was conducted in a four-month field work in order to understand the natural and socioeconomic dynamics as well as how the PNC watershed approach has been implemented. These two elements are combined to propose a strategy for enhancing integrated management in Guardaña. On the one hand, Guardaña has a context of strong differences in upper and lower zones; land degradation evidenced by erosion in the upper part and water pressure in the lower part led by agriculture. SWC practices have been implemented with different levels of success, being water harvesting the most recognized and adopted by farmers. On the other hand, Guardaña has developed a watershed concept with important specificities in three components discussed in river basin approach implementation: boundary definition, watershed management organization and scale issues. Based on the findings, a strategy for Guardaña watershed social management is proposed with the next components: 1) Promote motivation and capacity building for up scaling; 2) Develop the Guardaña Watershed Management Plan, 3) Articulate PNC programs.

KEYWORDS social management, watershed, pedagogical watershed, Bolivia, land degradation

## 108. Analysing farm management within mixed crop livestock systems to identify options for improvement; a case study in the upper Mara River basin, western Kenya

AUTHOR **Sjoukje Visser**

SUPERVISORS Charles-Henri Moulin | Aad Kessler

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**D**epleted soils and low resource efficiency are a risk for smallholders' food and financial security in East Africa. Soil fertility is affected by management decisions, which depend on biophysical and socioeconomic factors. Aiming at finding options to increasing farmers' efficiency in resource use, this study analyses the farm management within mixed crop-livestock systems. Carried out within the Mau-Mara-Serengeti (MaMaSe) Sustainable Water Initiative project, which aims at improving water safety and security in the Mara River Basin, we focused on the upper Mara River basin in Western Kenya. The study is done at farm scale, the unit where decisions are taken. A typology was constructed to identify the diversity of farming systems in the area. Information on farm management, inputs outputs and other farm activities was asked in a questionnaire completed by 60 farmers, from which we could identify four main farm types: 1) self-subsistent farming with low inputs in sub-humid lower highlands 2) staple crops in semi-humid lower highlands 3) cash crop strategy through coffee or tea production in humid lower highlands and 4) dairy production strategy in a mixed system in humid lower highlands. Using the MonQI Toolbox, designed to monitor and evaluate the performance of smallholder farms, the different management systems of 21 farms were analysed in more detail. Our findings showed that losses occur within farm nutrient flows underutilizing available manure for fertilizer. Due to a lack of water, plants could not uptake applied nutrients efficiently and yields remained low. Farmers who adopted agroforestry practices, a diversified intercropping system and soil and water conservation measures showed better performance. We discussed that implementation of these practices have an advantage regarding soil fertility, yields and income. Looking at the high frequency of droughts and intensity of rainfall, implementation of soil and water conservation measures is a first necessity for the future of this area.

KEYWORDS farm management, Mara river basin, mixed crop-livestock systems, MonQI tool, nutrient flows, soil and water conservation, soil fertility, western Kenya

## 109. Characterization of Manure Management Systems in the Kenyan Highlands for the Evaluation of Greenhouse Gas Emissions

AUTHOR **Victor Suarez Villanueva**

SUPERVISORS Philippe Vaast | Daniel Ortiz Gonzalo

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About 14.5% of global anthropogenic GHG emissions are coming from livestock production systems. Smallholders represent a share of it, more importantly in the Global South. Seventy-five interviews were performed among smallholders in Murang'a District, Kenya Central Highlands, to identify and evaluate the manure management systems present in the area. Four were characterized by their manure management practices, i.e. unmanaged (UM), heap (HP), pit (PT) and biogas (BG). Each of them has different manure resting times (104 days UM, 85 days HP, 108 days PT and 33-72 days BG) suggesting different farmer fertilization needs. Twenty-four manure samples, 12 fresh and 12 composted, were taken from 12 farms, 3 farms per system. Only carbon and nitrogen content was significantly different among fresh manure of HP and UM, suggesting the influence of factors such as cows' features and feeding. Sixty soil incubations with the 12-composted manures, the control, CAN, and manure and CAN were implemented to account for GHG emissions. Only N<sub>2</sub>O could be further evaluated, not showing any treatment significantly different cumulative emissions, except for Biogas<sub>2</sub> (8.7 mg N<sub>2</sub>O/Kg manure), CAN and, manure and CAN (16.9 mg N<sub>2</sub>O/Kg manure). It suggest that Biogas<sub>2</sub> shows a higher amount of emissions due to its liquid state and mixing with the soil.

KEYWORDS characterisation, manure, management systems, highlands, GHG

## 110. Study of agricultural practices, rural mobility and livelihood in the Jalapão in the Brazil State Park

AUTHOR **Margot Roux**

SUPERVISORS Olivier Philippon

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The region of Jalapão in the Brazilian savannah is known for its rich biodiversity of fauna and flora, for its rare and endangered species, as well as for its scenic beauty. It has a role of ecological corridor that connects several protected areas called Conservation Units. One of them is the State Park of Jalapão. The objective of this Park is to achieve Integral Protection of its environment: it must expel any person who lives in the area and prevent use of natural resources. For generations, traditional Quilombolas communities occupy this place, like the community of Mumbuca. They practice in shifting cultivation in smallholder family farming and live in small villages scattered in the region. In recent years, several factors have degraded the environment, including the fires. The slash-and-burn practices of local farmers are considered as a one of the causes of these fires by environmental protection institutions. Since 2012, many of these institutes have formed a partnership to develop the CerradoJalapão Project. Researchers at the University of Brasilia are involved in doing research in local communities in order to better understand and analyse farming systems and their use of fire. This study is within the scope of their research. Its objective is to study agricultural practices, rural mobility and livelihoods of the community of Mumbuca in the State Park of Jalapão. Over time, the community adopted new agricultural activities and others abandoned. However, they still practice subsistence farming family of small scale based on shifting cultivation. There was a cattle livestock intensification and growth in craft of Capim dourado, a local plant, the sale of which is promoted by the growing tourism. On the other hand, the residential system of the community is characterized by a diversity of residences, which has opened in the last years to the outside and in particular to cities. Their livelihoods have evolved over time, particularly with recent access to non-agricultural activities, diversifying the systems of activities within the community. This study presents reflections on topics for future research on the sustainable development of the region of Jalapão.

KEYWORDS Quilombola community conservation unit, state park, Jalapão, Brazil, shifting agriculture, family farming, environmental protection, livelihoods

# 111. Alliances for the strengthening of the chain of value of the ecotourism community: the case of the Comon Yaj Noptic in the Sierra mother of Chiapas, Mexico

AUTHOR **Fernanda Leopoldo e Silva Maschietto**

SUPERVISORS José María Díaz Puente | Didier Pillot |  
Obeimar Balente Hernández (ECOSUR)

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Community-based ecotourism emerges in developing countries as a strategy for environmental conservation and improvement of life of communities, if the local group has substantial control over tourism activities. In Chiapas, there have been many ecotourism community centres, but many have failed for not attracting the number of tourists needed for the expected return. This study reflects on the importance of working in partnerships to strengthen ecotourism value chain in order that the community project can be sustained in the long term. It has presented the case study of ecotourism development in the coffee cooperative Comon Yaj Noptic, through a multi-stakeholder project Rutas del Agua, which runs trips related to water conservation in El Triunfo Biosphere Reserve. Through the systematization of experiences and value chain analysis, key actors, their roles and relationships are identified, also how the local group appropriates of more activities in the value chain without compromising the established partnerships. Therewith, this case demonstrates that partnerships strengthen the value chain and local capacities and therefore are favourable for the success and sustainability of community-based ecotourism.

KEYWORDS community-based ecotourism; local enterprise; value chain; partnerships; Chiapas

## 112. Identification and typification of innovations in family farming in Ecuador: Case study from Esmeraldas

AUTHOR **Rawia Derbel**

SUPERVISORS Didier Pillot | José Luis Yagüe | Marco Moncayo Miño

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**F**amily Farming (FF) is the predominant form of agriculture for food production and the today world's challenges concentrate on its improvement to ensure global food security and economic growth. The study here focuses on the smallholder farming in Ecuador. The purpose of which is to identify innovations applied in familial agro ecosystems, to classify them by types and analyse its social problematic. A general overview of innovations has been established through investigated experts in different regions in the country. In addition to those applied in an accurate territory over a case study carried out in Esmeraldas with focus groups familial farmers' sessions. The study comes to support public policies makers with a set of innovations that could be useful to improve the sector and should be taken into consideration in any of the future strategies. Furthermore, an innovation typologies based on its classification criteria is a highly valued study's outcome enhancing such a research tool to be reproducible in any similar exercise. As a conclusion, the implication of innovations in FF requires more than action by farmers alone, it is indeed the collaboration of them with the public sector, civil society and organizations.

KEYWORDS agricultural innovation; Ecuador; typology; family farming; food security

## 113. Postharvest losses and marketing of orange: A case study of orange from Matombo Division to Morogoro urban Markets, Tanzania

AUTHOR **Frederick Horlali Tsa**

SUPERVISORS Søren K. Rasmussen | Stephen Onakuse

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The aim of this study was to investigate the marketing and postharvest losses of orange in the Morogoro region of Tanzania. A total of 70 respondents were involved in this study mainly farmers, local retail traders, village middlemen and wholesale traders of orange. Data was collected through questionnaires, semi-structured interviews, and other qualitative means including field observations. Data collection was done between February to April 2012 during minor season of orange production. The average postharvest loss from farm-gate to local retail market level was about 48%. The highest average postharvest loss of almost 18% was reported by the local retail traders and the least postharvest losses were experienced by farmers. The principal causes of losses were microbial decay and mechanical damages mainly due to abusive handling and inappropriate storage facilities. When it comes to marketing, majority of farmers (about 63%) preferred the middleman as their marketing channel due to its convenience. Transportation difficulty, unreliable buyers and prices control by middlemen were the main marketing challenges encountered by farmers, while traders in urban markets also reported lack of storage, transport difficulty and poor marketing infrastructure as their main challenges. In addition, aspects of orange production are reviewed.

KEYWORDS orange (*Citrus sinensis*), marketing challenges, postharvest

# BATCH 7: 2012–2014



## 114. Effects of weaver ants on controlling fruit fly infestation in oranges in Morogoro and Kisarawe, Tanzania

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SUPERVISORS Carmelo Rapisarda | Brian Grout | Theodosy. J. Msogoya

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The Matombo and Kisarawe districts are being part of the major regions of citrus production in Tanzania where the incidence of fruit flies is substantial. Insufficient knowledge among farmers of controlling fruit fly infestation in orange small-scale farming creates a considerable rate of fruit loss. This study analysis the damage caused by fruit flies and examines the technique of using weaver ants to reduce this pest. The data was collected through qualitative and quantitative methods like questionnaires, semi-structured interviews, field observations and lab experiment. Data collection was done between April to July 2013 during major season of orange production. Findings show that all farmers considered yield losses due to fruit flies to be the principal constraint upon orange production. Whereas weaver ants are being considered a pest due to various created nuisances. In Matombo, the average fruit fly infestation of freshly harvested oranges was about 22.9% and infestation at rural collection centres three days from harvesting was 50%. The main reasons of fruit fly infestation were the absence of using adequate management practices and inappropriate storage facilities. The role and potential of *Oecophylla* as a predator in tree crops, either used alone or integrated with other pest management methods, indicates uncertainty to control fruit flies and does not allow to generalize this conclusion to all types of citrus orchards.

KEYWORDS orange, fruit flies, weaver ants, yield loss

# 115. Institutional Constraints to Growth and Development of Micro and Small Enterprises in Wet Markets in Sub Saharan Africa – A Grounded Theory Approach

AUTHOR **Felix Ouko Opola**

SUPERVISORS Carsten Nico Hjortsø | Thai Thi Minh | Stephen Onakuse

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Though ‘modern’ retail formats such as supermarkets have gained a significant market share in the retail sector in a number of countries in Sub Saharan Africa, the ‘traditional’ retail outlets have maintained a near monopoly in the supply of fresh agricultural products. However, these ‘traditional’ formats are faced with a myriad of challenges caused by institutional bottlenecks that constrain the development of the markets in general and the small and micro enterprises that reside in them. In the case of Tanzania, poor implementation of formal laws and policies by local governments has resulted in semi-formal institutions that together with informal norms and values dominate the structure of institutions in fresh produce markets. Such an informal environment erodes the incentives for long-term investments in fresh produce markets by the local authorities that manage them as well as the private business enterprises. As a result, various actors focus on short-term benefits at the expense of longer-term investments that would yield better future returns and a sustained growth of the ‘traditional’ food supply system.

KEYWORDS modern retail, supermarkets. Norms and values, food supply systems

# 116. Enhancing the preservation of heirloom rice varieties in mountain province, Philippines: Ways and means

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SUPERVISORS Didier Pillot | Stephen Onakuse | Matty Demont (IRRI)

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**W**hile rice is an economically, socially, and culturally important crop in the Cordillera region of the Philippines, a vast range of socio-cultural diversity gives rise to a huge diversity of forms of cultivation in the region. The potential of heirloom rice as a lucrative livelihood is however, hindered by the inability of local farmers to produce these varieties in greater quantity at competitive costs, with a high seed quality and purity. Market and product development, alongside maintaining biodiversity in the region, could be crucial in encouraging farmers to continue growing these threatened rice varieties, both traditional and improved. This research was done in the Cordillera Region, Philippines under the “Heirloom Rice Project” which is an initiative under the Food Staples Sufficiency Program (FSSP) of the Philippine Department of Agriculture (DA) with the support of International Rice Research Institute (IRRI) and various agencies of the DA. Thus, this study analyses socio-economic, cultural and environmental aspects of planting heirloom rice varieties and investigates existing and potential value chains supplying heirloom rice to local, domestic and international markets. Moreover, it aims at suggesting actions that could strengthen heirloom rice value-chains. In order to organise farmers to produce and process heirloom rice for the international market, the RTFC (Rice Terraces Farmers’ Cooperative) was established, supported by Self Help Groups (SHG). However, currently these groups are not working efficiently due to the lack of organisational skills of the farmers. The organisational structure of RTFC and SHGs should be strengthened to foster collective action and to build more structured value chains supplying local and domestic markets, instead of focusing solely on the international market. Consequently, creating a continuous, profitable and stable market (both domestic and international) is required to sustain heirloom rice production on the long term. One of the ways to achieve this aim is by adopting a “value chain approach” which focuses on end-markets for the products and identifies the most efficient business models (farming, milling, processing, packaging, and delivery) that enable farmers to serve these markets and improve their livelihood. Furthermore, this approach enables farmers to respond to market opportunities and to increase competitiveness of heirloom rice on domestic and international markets.

KEYWORDS Heirloom rice, cultivated biodiversity, indigenous knowledge, value chain approach, market and product development

## 117. Analysis of behaviour dynamics in dairy cows and their potential impact on performance

AUTHOR **Ben Yedder, Mohamed**

SUPERVISORS Bahr, C. | Bocquier, F | Lanza, M.

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**M**ilk yield and activity recording of a sample of 45 dairy cows representing different levels of parity were obtained from a commercial dairy management system based on RFID [Radio Frequency Identification] technology. These data served to fit a dynamic model which main purpose was to describe daily milk yield evolution as a function of the daily evolution of the behavioural variables that was calculated from the activity records. Additional treatment based on computational techniques was also performed on both explained and explanatory variable. The evolution of the behavioural variables did not show any significant difference related to parity or to production level. The result of the fitting of the model showed a weak relationship between the milk yield variable and the behavioural variables (best R<sup>2</sup>T= 50%), this was mainly due to fact that the behavioural variables were extrapolated from an indirect evaluation based on localisation and not from a direct evaluation. Nonetheless, these behavioural data showed to be good reflectors of the associated behaviour especially in detecting out-breaking events related to daily routine of dairy cows. The additional treatment of daily milk yield variable allowed detecting breakpoints in the milking patterns of the sampled cows. Those breakpoints were associated with a potential loss in milk production mainly observed in recurrent heat animals or in animals with instable milking profile. The second treatment regarded the behavioural variables, it led to test a method of prediction based on univariate auto-regressions. This method could be helpful to set up an alert system based on the evolution of behavioural measurements in order to provide with warning for the management of dairy cows.

KEYWORDS precision livestock farming, RFID, daily milk yield, behaviour, autoregressive modelling

## 118. Prediction of Ruminal pH for Beef Cattle: A Physiological Modelling Approach

AUTHOR **Mohamed, Sarhan**

SUPERVISORS Luisa, Biondi | François, Bocquier | Karen, Beauchemin | Sarhan, M.

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Ruminal fluid pH (RpH) is an important parameter for controlling the rumen functions. The ability to predict the RpH of beef cattle fed a given diet without depending on the invasive techniques for its measurements (*i.e.*, rumen cannula) is important to avoid ruminal acidosis. The objectives of this research were to: (i) identify key variables that have a significant association with RpH; (ii) collect data points (DB) from *in-vivo* beef cattle studies to identify suitable predictors of RpH after considering the animal measures and the dietary variables from a wide range of diets that can safely be fed to beef cattle; (iii) evaluate the extant RpH models relevant to the study; and (iv) develop a new statistical models for mean RpH predictions. Therefore, feed additives (*i.e.*, monensin) were excluded from the analysis. Models tested that use physically effective fibre (peNDF) as a dependent variable were Pitt *et al.* (1996, PIT), Mertens (1997, MER), Fox *et al.* (2004, FOX), Zebeli *et al.* (2006, ZB6), and Zebeli *et al.* (2008, ZB8), and those that use rumen volatile fatty acids (VFAs) were Tamminga and Van Vuuren (1988, TAM), Lescoat and Sauvant (1995, LES), and Allen (1997, ALL). The final database was categorized into DB (1) and (2) that included a total of 232 and 95 treatment means from 65 and 26 peer-reviewed publications, respectively, spanning from the 1960s to 2014. The DB included information on animal characteristics, ration composition, and ruminal fermentation and pH, that has been used for independent evaluation and development of RpH prediction models. Missing values not reported by the authors were calculated using the sub-model Cornell Penn Minor Dairy model (CPM-Dairy©; version 3.0, Boston *et al.*, 2000) of the Cornell Net Carbohydrate and Protein System (CNCPS; version 4.0, Fox *et al.*, 1992; Sniffen *et al.*, 1992; O'Connor *et al.*, 1993). The average bodyweight was  $437 \pm 168$  vs.  $556 \pm 114$  kg, dry matter intake (DMI) was  $8.57 \pm 2.62$  vs.  $9.60 \pm 2.10$  kgd<sup>-1</sup>, peNDF (% DM) was  $20.3 \pm 17.0$  vs.  $17.2 \pm 14.6$ , and forage (% DM) was  $34.8 \pm 36.1$  vs.  $26.9 \pm 31.0$  for DB (1) and (2), respectively. The cattle used were of various ages (*i.e.*, calves, yearlings, mature) and represented various production systems (*i.e.*, back grounding, finishing, and zero grazing). RpH across the studies was positively ( $P < 0.01$ ) related to the dietary forage, acid detergent fibre (ADF), peNDF, neutral detergent fibre (NDF), forage NDF, lignin, sugar, ash, and ruminal concentrations of acetate (AC) and ammonia (Am) ( $r = 0.200-0.680$  vs.  $0.400-0.885$ ) in DB (1) and (2), respectively. RpH was

negatively correlated ( $P < 0.01$ ) to DMI, propionate (PR), and starch (correlation of -0.330 to -0.750), and between total VFAs and organic matter (OM,  $P < 0.05$ ) for DB (1) and DB (2) with the exception of non-structural carbohydrates (NFC), as well as metabolic DMI ( $P < 0.01$ ) with a correlation between -0.274 to -0.851. Thus, ruminal [total VFAs, (mM), (PR, %), butyrate (BU, %), (AC, %) and (Am, mM)] and dietary variables (% DM basis) [DMI, ether extract, lignin, forage proportion, forage NDF, NFC, OM, sugar, peNDF, and starch] were considered in the development of mean RpH prediction models from DB (1) and (2). The main difference between the data sets was in how RpH had been measured. Ruminal pH measurements (RpHms) was broadly classified as continuous that use indwelling submersible pH electrodes or non-continuous described by sampling the rumen fluid once or at timed intervals. Both of RpHms were assigned for DB (1) whereas; only continuous RpHms were included in DB (2). Prediction equations were derived using the mixed model regression analysis, with a random effect for the study and fixed effect for the trials. The cross-validation (CV) approach was used to evaluate the new prediction equations. Assessments of models adequacy were performed as described in Tedeschi (2006). The Akaike's information criterion (AICc), the Bayesian information criterion (BIC), coefficient of model determination (CD), concordance correlation coefficient (CCC), modelling efficiency (MEF), root mean square error (RMSE), mean square prediction error (MSPE), root MSPE (RMSPE), and multiple coefficient of determination (R<sup>2</sup>) were used to determine variables of the best-fit-equations, and to evaluate the predictability of equations developed in the CV analysis. Mean centered and linear biases of prediction were also determined (St-Pierre, 2003). The following 4 best-fit-equations resulted in the lowest RMSPE, the highest CCC and MEF, moderate CD, and explained (0.44 to 0.82) of the variations in RpH from the total of the 16 newly developed models tested on DB (1) and (2). The linear Eq. (E):  $\text{RpH} = 3.32 (\pm 0.96) + 0.09 (\pm 0.004) \times \text{forage (\% diet DM)} + 0.02 (\pm 0.01) \times \text{OM (\% diet DM)} + 0.006 (\pm 0.003) \times \text{Am (mM)}$  [AICc = 7.81, BIC = 17.4, RMSE = 0.24, R<sup>2</sup> = 0.90]; the cubic Eq. (F):  $\text{RpH} = 5.36 (\pm 0.04) + 3.48 \times 10^{-6} (\pm 2.26 \times 10^{-7}) \times \text{AC3 (mol/100 mol)} + 3.76 \times 10^{-5} (\pm 1.47 \times 10^{-5}) \times \text{Am}^3 \text{ (mM)}$  [AICc = 40.4, BIC = 48.0, RMSE = 0.32, R<sup>2</sup> = 0.80]; the cubic Eq. (G):  $\text{RpH} = 5.43 (\pm 0.04) + 3.37 \times 10^{-6} (\pm 2.287 \times 10^{-7}) \times \text{AC3 (mol/100mol)}$  and linear Eq. (H):  $\text{RpH} = 5.72 (\pm 0.018) + 0.009 (\pm 0.0005) \times \text{forage (\% diet DM)}$  [AICc = 71.9, BIC = 79.3, RMSE = 0.34, R<sup>2</sup> = 0.78]. The magnitude of these models performance after evaluation on DB (1) and (2), respectively, was as follows. For Eq. (F): CCC of 0.64 vs.0.90, CD of 1.21 vs.1.55, MEF of 0.37 vs.0.81 and RMSPE of 2.18 vs.5.34% with (94.9 to 99.6% of MSPE) errors from random sources. For Eq. (H): (CCC of 0.61 vs.0.90), (CD of 1.16 vs.1.60), (MEF of 0.37 vs.0.81), and RMSPE of 2.24 vs.5.56% and 98.5 vs.99.4% of which was random error. For Eq. (G): CCC of 0.64 vs.0.87, CD of 1.27 vs.1.79, MEF of 0.43 vs.0.77, and RMSPE of 2.38 vs .5.32% with (98.5 to 99.4% of MSPE) errors from random sources. For Eq. (E): CCC of 0.55 vs.0.90, CD of 1.1 vs.1.48, MEF of 0.25 vs.0.82, and RMSPE of

2.21 vs. 5.75% with (87.5 to 96.6% of MSPE) errors due to random variations. The using of extant models for mean RpH prediction, on average, was inadequate ( $R^2 < 0.50$ ) and showed variability depending on DB sources with mean and linear biases ( $P > 0.001$ ) for all models, except ZB8 that had no linear bias either for DB (1) or (2) ( $P = 0.343$  and  $0.281$ , respectively). Of all the extant models evaluated over DB (1), the greatest CCC were from both LES and TAM (0.58), followed by PIT and FOX, with the highest MEF (0.30 vs. 0.29), and the lowest RMSPE (5.87 vs. 5.90% of MSPE), and ALL and ZB8 with the highest CD (2.56 vs. 3.92), respectively. For DB (2) the highest CCC was from PIT and FOX (0.72 vs. 0.71), followed by ZB8 and PIT, with the highest MEF (0.51 vs. 0.44), and the lowest RMSPE (3.61 vs. 3.84% of MSPE), and ALL and ZB8 with the highest CD (6.85 vs. 2.17), respectively. As a conclusion, the new equations largely confirmed those obtained on dairy cows. The originality of our work is to provide for the first time effective coefficients that are better adapted to beef cattle production. The external validation remains to be done to confirm the effect of the integration of environmental, nutritional, and microbial factors on the RpH fluctuations, using a resilient data source, because of their vitality in accurately predicting the animal responses.

**KEYWORDS** beef cattle, modelling, meta-analysis, prediction, pH, rumen, ruminal acidosis

## 119. Coffee farmers' strategies to improve their livelihoods and insure food security: the case of Murang'a County in Kenya

AUTHOR **Clélia Roucoux**

SUPERVISORS Isabelle Michel | Stephen Onakuse

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This study is a contribution to the European project ASF4Food that, aims to enhance food security and well-being of African rural households via the association between food crops and agroforestry systems. This study was conducted in Kenya, in the district of Murang'a. The objective is to characterize and compare the different coffee-based farming systems. The research framework is based on farm and plot analyses. We conducted fifty semi-structured interviews with farmers and took measurement of every plot in the farms. The analysis of socio-economic and agrarian evolution in the area showed that systems evolved from a coffee-based farming system to complex agroforestry systems where coffee is associated with other production like food crop, fruit trees, horticulture and livestock. Five farming systems were identified and analysed: three are more or less intensive coffee-based farming system, one is a livestock-based farming system, and the last one is a horticulture-based farming system. The study of these agroforestry systems revealed contrasting performances. To explain these differences, we conducted a detailed analysis of the cropping systems. We, in the end, tried to highlight the different strategies of farmers to meet food and income security.

KEYWORDS Kenya, coffee, livestock, food crop, agroforestry system, farming system, family farming

## 120. Setting up marketing farmers groups for smallholders in Cambodia: a participatory approach to sustainably improve market access

AUTHOR **Aline, Braunsteffer**

SUPERVISORS Betty Wampfler | Stephen Onakuse

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The context in which Cambodian farmers are thrown does not provide an efficient access enough to the market to ensure their development. Yet, vegetable production for example presents a real potential in so far as the offer doesn't cover the demand yet; however, the value chain still lacks a strong structuration. Hence many NGOs' are setting up farmer's groups, which are considered a good mean to provide service that farmers need regarding this issue. It is one of the objectives of the Food Security Project implemented by the French Red Cross in partnership with the Cambodian Red Cross. Its results require improving access to water in order to improve farmers' production in 17 villages of Oddar Meanchey province, thus promoting households' food security. The implementation of farmers groups oriented towards market access is the backbone of this project; however, in order to promote sustainable organizations, it is essential to understand the local context as well as to explore available development tools on the subject. The methodology that arises implies a participatory approach through the involvement of the project partners as well as by consulting farmers supported by the implemented activities. In order to set up sustainable groups within the time span allocated to the project, this approach rests on a context that is determined through different diagnoses, which have allowed the identification of locally accepted practices. Furthermore, from forming groups to supporting them in terms of capacity building, several phases succeeded one another with meetings and trainings that were designed with an intention to ensure a fluid and logical approach. Finally, a step back necessary to any development project completes this work. After observing limits of the implemented intervention, an analysis of literature on development project allows to identify questions. Eventually, propositions are explored in this thesis in order to question development intervention practices and offer paths for ensuring sustainability of farmers group.

KEYWORDS Cambodia, market access, farmers group, implementation and support to groups, participatory approach, transfer of skills, sustainability of development projects

## 121. Agro-ecology and organic mechanisms and practices: Participatory Guarantee Systems of Organic Quality in the case of Natural Agriculture Association of Campinas and region in Brazil

AUTHOR **Paula Martínez Cortés**

SUPERVISORS Antonio Damián García Abril | Stephen Onakuse

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The main objective of this article is to analyse the challenges and possibilities of Participatory Guarantee Systems for organic products in the experience of the Natural Agriculture Association of Campinas and region –ANC– in Brazil, in relation to the agro-ecological theory. To do so, the following research moments were pursued: i) a documentary phase where relevant literature was revised, which resulted in the theoretical and contextual reconstruction of the agro-ecology proposal –in other ecologically based agricultural movements– in Brazil; ii) the revision of the ANC’s files and databases, and the visits to some of the producers that belong to the organization, as the two main sources of primary information; iii) the selection and systematization of 56 (or 54 in some cases) answered “peers’ visit guidelines” formats which had been applied and answered collectively in peers visits conducted between July 11th of 2011 and August 6th of 2014 by the ANC members. These visits are one of the constituent methods of the Participatory Guarantee Systems –PGS– as control mechanism for organic quality. All this material permitted to analyse and discuss the conceptual tensions between agro-ecology and the organic collective, and through the ANC’s implementation of PGS it was possible to see that PGS can be a useful mechanism to advance in the collective construction of an ethical rural development paradigm, as long as the achieved market valuation of agricultural production goes hand-by-hand with profound social, economic and political transformations demanded by the ecologically-based agricultural movements in Brazil. In other words, organic certifications cannot only be useful to get a premium price, but also to reinforce the alternatives that are building on a daily basis the transformation of food systems.

KEYWORDS participatory guarantee systems, social, economic, political transformations

## 122. The influence of payments for ecosystem services on the land use decisions of farmers along the new agricultural frontier – The case of the communities along the river Bartola, Rio San Juan, Nicaragua

AUTHOR **Mara Lindtner Academic**

SUPERVISORS Sébastien Bainville | Gert Van Hecken

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Between 1990 and 2010, Nicaragua has experienced a loss of 70,000 hectares of forest per year, which corresponds to a net decrease of 2.11% of its forest area. The main cause is the conversion of forest areas for agricultural use (FAO, 2010). To restrain deforestation various instruments are being implemented, one of which is payments for environmental services. Given this framework, the selected study area is a zone of new agricultural frontier in the limit of the Indio-Maiz Reserve, in the municipality of El Castillo, Rio San Juan department. In this area a Danish NGO is paying a selection of producers to preserve a defined area of forest within their property for 5 years. The objective of this paper is to identify the influence of these payments on land use decisions in farms in the area. The methodology used is the agricultural diagnosis, which aims to identify and understand both agricultural and historical dynamics and agricultural practices of farmers, in order to explain their motivations in relation to changing (or not) the use of their land. The study of the agrarian history identifies two dynamics that enhance deforestation in the area. Firstly, the migration from the poorest stratum of the Nicaraguan population to the agricultural frontier in search of land or to increase their quantity of land. This is due to the unequal distribution of land in Nicaragua, given that only 6.8% of farmers occupy 56.67% of the agricultural land. To resolve this, issue a land reform would be necessary. Secondly, the evolution of farm-based polyculture towards livestock production as the main cause of forest conversion to pasture. Payments for environmental services have been unable to stop this increased specialization in livestock production for three reasons. Firstly, the amount of 518.7 Córdobas / manzana (\$ 28.5 / hectare) does not cover the opportunity costs of a farm. Secondly, farmers who receive payments only commit to the conservation of forest that they will not need during the five years of their contract. On the one hand, they have enough forest outside the program to continue installing pastures at the same speed as the cattle herd increases. On the other hand, farms do not have enough labor available

currently to handle a larger herd of cattle than they already have. However, this may change in the future. Thirdly, converting the remaining areas of forest to pasture and using it for livestock production provides the possibility of significantly increasing agricultural income per active worker in the family. To reduce deforestation on the farms, it is recommended to combine two strategies. On the one hand, provide greater value to forest areas through sustainable timber harvesting and non-timber forest products use. On the other hand, increase sustainability while enhancing production systems by establishing silvopastoral and agroforestry systems.

KEYWORDS    payment, ecosystem, silvo-pastoral, agroforestry

## 123. Simulating farm water pollution by nitrogen and phosphorus from a large survey of Dutch dairy farms: An implementation of the European Water Framework Directive

AUTHOR **Laura Code**

SUPERVISORS Aldse Hoving | Bocquier | Simona Consoli

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Intensive agriculture has a potential to pollute the environment. Mixed and intensive livestock systems are requiring a growing demand for fodder and grains, thus increasing the competition for water resources. Characteristically, intensive livestock production has a strong impact on pollutant loads. The European Water Framework Directive has determined the need to protect water sources, essentially taking a top-down approach. When applying this directive at the level of a dairy farm, the focus is on aspects of surface water and groundwater quality and quantity. As part of a developed protocol for a dairy farm water assessment, a wide dataset of Dutch dairy farms from the existing tool for annual nutrient cycling in the Netherlands was used. Nitrogen and phosphorus surpluses and efficiencies were analysed at the farm, soil and herd levels. A simulation was used for how these nutrient surpluses translated into water pollution by runoff and leaching. Of the three main soil types (clay, peat and sandy soils), sandy soils were found to have the greatest influence on nitrate leaching. Sandy soils were put into subcategories based on the mean highest groundwater table were analysed. Five different farm management factors (total N and P fertilizer applied, relative area of grassland, grazing intensity, intensity of milk production, and crop yield) were analysed by ANOVA and linear regression models to determine if and to how great of an extent they influence nitrate leaching. Recommendations were made based on these management factors to decrease nutrient surpluses and thus water pollution. These simulations are expected to help further develop the farm water assessment for farmers to improve awareness and management of water resources, working from the ground up and becoming part of the solution by lessening their environmental impact to ensure clean and safe drinking water for future generations.

KEYWORDS water quality and quantity; intensive dairy farming; nutrient cycling; runoff; leaching

## 124. The contribution of post-farm milk supply chains to GHG emissions intensities from cattle production systems in east Africa

AUTHOR **Valentin, Mujyambere**

SUPERVISORS Timothy Robinson | Michael MacLeod

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The contribution of post-farm is not well investigated especially in cattle production systems. This study was from milk selling point (at farm) to consumption point for boiled milk and whole sellers for packaged milk. The main objective was to determine the milk market channels and analyze the associate Global Warming Potential from cattle production systems in East Africa. Pastoral, Agro-pastoral dairy and mixed dairy systems were studied. The data were collected from 270 farmers of Laikipia County and North Rift Valley in Kenya. 14 co-operatives, chilling plants, and 3 processing plants were surveyed. This study showed that the milk consumed at home was 40% ( $\pm 33\%$ ) for Pastoral, 35% ( $\pm 31\%$ ) for Agro-pastoral system and 35% ( $\pm 32\%$ ) for Mixed. There was no significant difference between the cattle production systems ( $p \geq 0.664$ ). The milk from pastoral, Agro-pastoral and Mixed systems sold to neighbors and retailers was 2% ( $\pm 12\%$ ), 3% ( $\pm 15\%$ ) and 7% ( $\pm 20\%$ ) respectively. At this channel, the systems were different ( $p \leq 0.023$ ). The respective milk sold to co-operatives and chilling plants was 49% ( $\pm 33\%$ ), 50% ( $\pm 35\%$ ) and 46% ( $\pm 34\%$ ). The systems were not different ( $p \geq 0.642$ ). The respective sold to traders was 9% ( $\pm 23\%$ ), 12% ( $\pm 27\%$ ) 12% ( $\pm 29\%$ ) respectively. The systems were not different as well ( $p \geq 0.725$ ). Channel 1 (from farmers-consumers and retailers immediately), channel 2 (farmers-cooperatives and chilling plants consumers and retailers) and channel 3 (farmers-cooperatives and chilling plants-processors-whole sellers) were analyzed. The new percentages according the milk sold without traders were calculated for three channels; channel 1 (45%), channel 2 (1.65%) and channel 3 (53.36%). To analyze the GHG emissions from these three market channels an allocation of 1000 kg of milk common to all channels was used. During transport, the channel 3 was the highest emitter with 2.8 kg CO<sub>2</sub>-eq kg<sup>-1</sup> of protein. The channel 1 there was no transport and the EI for channel 2 was 0.2 kg CO<sub>2</sub>-eq kg<sup>-1</sup> of protein. The channels 2 and 3 during processing had 8.7 and 9.4 kg CO<sub>2</sub>-eq kg<sup>-1</sup> of protein respectively. The channel 1 was the lowest with 8.4 kg CO<sub>2</sub>-eq kg<sup>-1</sup> of protein. The EI of 2.3 kg CO<sub>2</sub>-eq kg<sup>-1</sup> of protein associated with packaging material was observed only in the channel 3. Comparing the EI from pre-farm, on-farm and post-farm across all systems, the EI of

post-farm were very low and the similar to all systems (10 kg CO<sub>2</sub>-eq kg<sup>-1</sup> of protein). The infrastructures improvement, the use of appropriate vehicles respecting the average load and their age were proposed as the mitigation option for reducing the GHG emissions from transport. The substitution of 10% of charcoal by 10% of natural gas in channel 1 and channel 2 reduced their EI by 1.9 kg CO<sub>2</sub>-eq kg<sup>-1</sup> of protein (22.6%) every one. In addition, the substitution of all fire wood used in factory for milk pasteurization by furnace oil in channel 3 reduced its EI by 1.8 kg CO<sub>2</sub>-eq kg<sup>-1</sup> of protein (19.1%). Considering the farm level, the mitigation options should be proposed taking into account the production systems individually because the emissions sources are different up-stream and on-farm from a system to another. In conclusion, this study showed the contribution and the influence of the post-farm milk supply chains on the GHG emissions. The results are useful for further research and for all post-farm milk supply chains stakeholders to improve their operations in order at the same time to reduce their expenses and GHG emissions associated with the chain inefficiency.

**KEYWORDS** post-farm, milk market channels, Cattle production systems, GHG emissions, mitigation options, East Africa

**BATCH 8:  
2013–2015**



## 125. Resource orchestration in agribusiness incubators: A comparative analysis of two case studies in Africa

AUTHOR **Ingrid Cravioto**

SUPERVISORS Søren K. Rasmussen | Stephen Onakuse

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The evolution of the business incubators (BI's) value proposition has opened the discussion of the BI's management process. In this study, we evaluate the process of how BI's orchestrate its resources. In particular, we look at how BI's strategize to acquire, bundle, and leverage the resources that are critical to creating value for their tenants and competitive advantage for the firm. We illustrate this by comparing two cases in Africa. Insights gained suggest that greater focus on many critical aspects of incubation, such as governance and control and management and leadership required increased attention to improving efficient management processes and ultimately desired outcomes.

KEYWORDS resource, agribusiness, incubators, leadership

## 126. Conversion to organic farming – Constraints and opportunities for organic farming among small-scale farmers in Zanzibar

AUTHOR **Ivancho Kmetovski**

SUPERVISORS Myles Oelofse | Stephen Onakuse

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The organic agriculture (OA) play major role in the sustainability of the agriculture, allowing long-term use of natural resources and enhanced human's health and well-being. In addition, it has the potential to contribute to poverty reduction and improved food security. Therefore, farmer acceptance of the concept of organic production is widely acknowledged as key success factor for improvements of farmers' livelihoods in Sub Saharan countries. However, the conversion to OA is not straightforward process, often accompanied with numerous challenges for the small-scale farmers. This study strives to outline the constraints and opportunities for conversion to OA among small-scale farmers in Zanzibar. Based on semi-structured interviews and focus group as a data collections tools, data was gathered about farmers' motivations for conversion to OA; the barriers they face before, during and after conversion process and about the associated benefits from the conversion to OA. The study revealed that farmers' personal beliefs in terms of health and environment concern, as well as the economic factor are main drivers in farmers' decision for conversion to OA. Additionally, farmers' decision is facilitated by the influence of Non-Governmental organizations (NGOs) and through membership in agricultural associations, and by the technological and market possibilities of OA. On the other side, lack of government support, insufficient technical knowledge in terms of diseases and pest management, water and land availability, and underdeveloped organic market are the main constraints for conversion to OA. The study confirm that OA positively impacts over the farmer's livelihoods. However, collective action by the institutions, NGOs and the other stakeholders in the organic sector in Zanzibar is necessary for the existing issues to be improved and barriers to be overcome. This can lead to conversion at higher rate among the farmers in Zanzibar.

KEYWORDS **organic, conversion, organic farming, small-scale, constraints, opportunities**

## 127. Role of Drainage in Managed Agro-systems Affected by Technical Changes: Case Study of Gharb's Irrigated Area, Morocco

AUTHOR **Hayet Djebbi**

SUPERVISORS Olivier Philippon | Bernard Vincent

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The drip irrigation technique is currently spreading at high speed around the world, including the Maghreb. This dynamic is observed among farmers outside irrigated areas as for those in the large irrigation schemes, with strong state's financial support for farmers to access these facilities (grants for collective or individual conversion). The drip irrigation, unlike the surface flow irrigation, brings a small and regular amount of water at the foot of the plant, and thus requires more drainage system to drain excess water. However, drainage as designed in large irrigation schemes also played a role in the mastery of salinity on irrigated soils. Thus, the monthly monitoring of land (climate and water parameters) with the modelling of hydrosaline balance (SALTIRSOIL) highlights the interest of the drainage in semi-arid areas for the control of salinity, and the interest to equip some drained plots with a measuring device. Our study analyses the role of drainage on soil quality, agricultural production and the surrounding ecosystems in irrigated or remediated systems under constraints related to technical changes: the state of knowledge, practices and perceptions of farmers in the plain of Gharb in Morocco. The research aims primarily a review of literature on traditional techniques on alternative drainage, to take advantages of alternative practices, and failures related to absence or unsuitable drainage design. For the investigation open-ended interviews, surveys, PRA methods and natural science methods such as soil salinity detection were carried out between 20th April 2015 and 15 August 2015 in Gharb zone, Morocco. The initial findings show that, in a food resource security context, the question of the re-engineering of former hydraulic schemes that control the ion and water balances in agro-hydrological systems seems major to ensure equitable sharing of natural resources, and the preservation of biodiversity. Geographical information on the biophysical environment and irrigation practices may help to identify risk areas. The objective is to characterize salinity processes and to propose technical methods of land segmentation and water management according to the risk factors involved.

KEYWORDS drainage, farmer's perception, food security, Gharb irrigated area, irrigation practices, managed agro-systems, Morocco, salinity, technical changes

## 128. Conditions and feasibility of collective action in agricultural value chains in Azerbaijan

AUTHOR **Anastasiia Pylaieva**

SUPERVISORS Didier Pillot | Stephen Onakuse

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The present study took place in Ganja, Azerbaijan during April – July 2015. The main objective of the research was to indicate whether there is a niche for social organisations of farmers and for collective actions in agriculture in the context of the rapidly growing economy of Azerbaijan. During the study period, a range of interviews was carried out with a variety of actors: leaders of informal farmer groups, individual farmers and key informants presented by workers of the host NGOs. Farmers interviewed are involved mainly in the chains of vegetable and hazelnut production. The results aided an exploration of the presence and forms of collective action in Azerbaijan. Moreover, it was shown which benefits farmers currently receive from joint activities. Factors which are hindering group formation in Azerbaijan were illustrated as well. Findings from the research would be useful in order to see if there is a basis for the future efforts of the government of Azerbaijan for organisation of agricultural cooperatives.

KEYWORDS collective action, farmer groups, cooperatives, hazelnut, vegetable

## 129. Assessing the contribution of *Grevillea robusta* trees to farm-scale carbon fluxes in the Central Highlands of Kenya

AUTHOR **Pin Pravalprukskul**

SUPERVISORS Claire Marsden | Philippe Vaast | Andreas de Neergaard |  
Todd Rosenstock | Daniel Ortiz Gonzalo | Philippe Vaast

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The lack of empirical data on tree-related carbon fluxes on smallholder farms is an obstacle to evaluating the greenhouse gas balance and climate change mitigation potential of agroforestry systems. Consequently, it precludes smallholders from benefiting from carbon-offset schemes. The objective of this study was to provide farm-scale estimates of carbon fluxes related to trees in agroforestry systems in Murang'a County of Central Kenya, where *Grevillea robusta* is the dominant tree species on farms. It used one-time measurements as a basis for estimating carbon sequestration fluxes into and carbon removal fluxes from aboveground tree biomass. The intensive use of the aboveground component of *G. robusta* trees in the livelihoods of smallholders in Murang'a was found to contribute to climate change mitigation in multiple ways. A typical farm sequestered 2.0 – 5.2 Mg C ha<sup>-1</sup> yr<sup>-1</sup> in aboveground tree biomass. Removal fluxes from aboveground biomass contributed to harvested wood product carbon pools at rates of 510 – 860 kg C ha<sup>-1</sup> yr<sup>-1</sup>, while the burning of fuel wood harvested from *G. robusta* branches was equivalent to the displacement of around 240 kg C ha<sup>-1</sup> yr<sup>-1</sup> (880 kg CO<sub>2</sub> ha<sup>-1</sup> yr<sup>-1</sup>) of fossil fuel emissions. The addition of leaves from branch pruning to manure for crop application transferred around 60 – 130 kg C ha<sup>-1</sup> yr<sup>-1</sup> to soil carbon pools, some of which may be sequestered in long-lived pools. One-time measurements combined with the rapid flux appraisal tool developed for this study reduce the amount of time and resources required for farm-level tree carbon flux assessments, and provide useful empirically based estimates that reduce the uncertainty on much-needed carbon flux data for smallholder farms.

KEYWORDS assessing, *Grevillea robusta*, farm-scale, carbon fluxes, carbon sequestration

## 130. The agro-ecological approach to rural development: grassroots initiatives for resilient rural communities in Spain and Nicaragua

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SUPERVISORS Stephen Onakuse | Carlos Gregorio Hernandez Diaz-Ambrona

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**T**his paper analyses the role of socio-cultural relationships in agro-ecosystems. Assuming that the transformation towards more sustainable, sovereign and healthy food systems requires adoption of ecological principles in agriculture—agro-ecology—and the empowerment of rural communities, it is argued that these two need to be reflected in rural development policies and practices. So far, the agro-ecological approach is being undertaken by various grassroots initiatives in a response to their local needs and global context. Analysing two distinct projects—a village based agro ecological collective production in Spain, and a regional campesino-a-campesino movement in Nicaragua—we analyse their collective organisation and draw key elements that these initiatives have in common and that are crucial for the food system transformation. Both are based on building strong social and human capital that empower the individuals and leave their communities more resilient and sustainable. The fundamental principle is participative and egalitarian approach to decision-making, which is incorporated in new forms of horizontal organisation and education.

KEYWORDS agro-ecology; food system; collective organisation; social capital; social empowerment

## 131. Application of Urea-Molasses Blocks in the Peruvian Andes: Formulation, Management and effects on Criollo Heifers

AUTHOR **Sgroi, Salvatore Antonio**

SUPERVISORS Magali Jouven | Carlos Alfredo Gomez Bravo

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Peru is a country that is experiencing a rapid economic development and with it also an increase of inequality between the urban population and that in rural areas. Livestock farming is of great importance to the entire country, and animal breeding in the Andean plateau is, above all else, the main activity of the majority of communities. This study, which is developed in two phases, analyses some of the aspects of the possible introduction of nutritional blocks of urea and molasses into the Andean livestock system. The focus is on the formulation of nutritional blocks and their management in the field, and the effects of such supplementation on the physiology and growth performance of a group of heifers reared on a farm in the region of Junin in Peru. This study concludes by highlighting the positive effects of supplementation with urea molasses blocks on the growth performance of the supplemented group, without causing any danger of death due to urea toxicity. The monitoring of urea in the blood confirmed urea values within limits physiologically sustainable. Furthermore, the quantity of salt included in the formulation of urea-molasses blocks maintained the consumption within a safe range, avoiding excessive consumption that might cause urea toxicity, and allowing for a more manageable way of administration to animals. The positive effects and the ease application may lead to a potential adoption of this innovation by farmers. Further studies in this field will be needed to evaluate the many aspects of the application of urea-molasses blocks in the Andean context. Finally, integration between quantitative and qualitative methods is suggested in order to gain further understanding of both production and social dynamics, which may come into play with the introduction of this innovation.

KEYWORDS rural development, livestock systems in Peru, feed supplementation, effects of feed-blocks, formulation of feed-blocks

## 132. Effect of once daily milking in fat tailed dairy ewes on the milk yield and composition in four commercial farms

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SUPERVISORS X. Such | F. Bocquier | Luis Biondi

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The effect of once (ODM) vs twice (TDM) daily milking at early to mid-lactation on milk yield, milk composition and somatic cell counts (SCC) were studied at four commercial farms namely Tuda (A), Carro-SAT (B), H. Canseco (C) and Palomar (D), found in Castilla –León region of Spain in 126 Awassi and 552 Assaf dairy sheep in total of 678. Ewes were assigned at three months of lactation in to two treatment groups: once daily milking (ODM) at 9:00 am (N=315), or twice daily milking at 9:00 and 19:00 (N=363), milk yield, milk composition and SCC were evaluated for each individual animal and was recorded monthly. ODM resulted in lowering by 39%, 2%, 12% and 70%, in farm A, B, C and D respectively during first month. Factors such as shift of milking frequency, farm and time were all significant ( $P < 0.001$ ). The response to milking frequency also varied according to the production level with ewes producing greater than 1.58 l/day suffered more milk losses during ODM than lower producing ewes. These shows that the milk losses depend on the production level of ewes. Milk of ODM ewes contained similar percentages of total protein, cheese potential and milk fat to ewes milked TDM. However, milking fat percentage did not differ between treatments because milking frequency factor were not significant. Yields of total solids, protein and cheese tended to be higher in second month for farm A and D ODM than TDM (4.8% and 1.2% resp.). Milk SCC did not differ between treatments. We conclude that application of once daily milking in fat-tailed dairy sheep moderately reduced milk yield without negative effects on milk composition and udder health. Losses in milk yield would even be reduced if ODM is practiced during mid or late lactation and in low producing ewes. An increase in labour productivity and a higher farmer's standards of living is also expected.

KEYWORDS milking frequency, milk yield, milk composition, lactation, fat tailed ewes, farm management

### 133. Back to the future: Dynamics of external enablers and internal management problems leading to the abandon of the pre-historic technology of raised field agriculture in the Lake Titicaca Basin: A case study in Caritamaya, Puno, Perus

AUTHOR **Oumaima DRIDI**

SUPERVISORS Sven-Erik Jacobsen | Thiery RUF | Sébastien Bainville

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**R**aised field agriculture used to outline the landscape of the Lake Titicaca Basin being a remarkable technology created and managed with success by pre-Hispanic Andean farmers before being abandoned. Despite the success of most efforts to re-introduce the system into rural indigenous communities, it is again, threatened of disappearing. In order to understand the enabling environment of this abandon, this study has been carried out in Caritamaya, a rural Aymara community southern the Peruvian side of the Lake Titicaca Basin, using mainly qualitative methods. Results have shown a weak institutional implementation of policies, together with lack of capital and trainings that promote the use and protection of traditional agriculture. Besides, a loophole for exploitative behavior of the common space was identified. Whilst the majority of farmers is still committed to the Aymara culture and commandments, trying to preserve the heritage of their ancestors, a new spirit of individualism is taking over the rest, who now, prefer to either leave to find jobs in the cities or call for privatization of community lands to be managed within individual families. Ignoring the agricultural advantages of raised fields in securing the livelihoods of their families and the system's technical virtues in preserving sustainable natural resources has led to a progressive abandon of the technology in Caritamaya and similar rural communities. Eventually, this will threaten the natural landscape, the livelihoods of the poor majority, the long-term cultural history and the sustainability of traditional agriculture in the region.

KEYWORDS Lake Titicaca basin, Caritamaya, raised fields, technology, abandon, institutions, social organisation

# BATCH 9: 2014–2016



## 134. Impact of Biodiversity on Household Dietary Diversity and Children Nutrition Cross-sectional study in Rabinal, Baja Verapaz, Guatemala

AUTHOR **Diana Verónica Luna González**

SUPERVISORS Marten Sørensen | Stephen Onakuse

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**B**ackground: Undernutrition is widespread in developing countries, such as e.g. Guatemala, especially in rural areas populated by indigenous people. This condition traps people in poverty and it is caused, in some cases, by inadequate and insufficient intake of macronutrients, vitamins and minerals. Consequently, agricultural interventions aiming to increase the variety and quantity of produced foods are promoted to improve nutrition, such as e.g. home-gardens (HG). Hypothesis: Therefore, the thesis was interested in assess if 'biodiversity, as a pool of vitamins and minerals, positively affects the dietary diversity scores (DDS) and consequently child nutrition'. In addition, the effect of other variables in nutrition (i.e. education and age of child caregiver, gender of household head, membership to Association Qachuu Aloom (QA), ethnicity, socio-economic status (SES), distance to market, and morbidity) was assessed. Methodology: The thesis was carried out from March to July of 2016 in six villages in the highlands of Rabinal, Baja Verapaz, Guatemala. The nutritional status of 163 children less than 5 years old were assessed (i.e. height and weight) and their mothers were interviewed to gather information about their dietary patterns and food production practices. HGs and Milpas were visited to record the crop species cultivated for food production and to take botanical samples. Secondly, DDS, nutritional functional diversity scores, crop species richness, SES, and nutritional status of the children were calculated. Then, analysis of correlation between variables (i.e. Pearson and Spearman), regressions (i.e. linear and non-parametric) and comparison of groups (i.e. Mann-Whitney, Kruskalwallis and t-test) were carried out. Normality of variables and residuals were always checked. R, Microsoft Office Excel and SPSS were used for the statics tests. Results: Results indicated that biodiversity was positively affected by membership to QA and ethnicity, and negatively affected by distance to market. Gender of household head and SES did not affect biodiversity. Beside, DDS was positively influenced by animal ownership for food production, education of main child caregiver and biodiversity, but it was negatively influenced by distance to market. In addition, SES and ethnicity did not influence DDS. Furthermore, child nutrition was positively impacted by education of main

caregiver and SES, whilst it was negatively impacted by ethnicity, morbidity and age of main caregiver. DDS nor biodiversity impacted nutrition as it was expected. Conclusion: In conclusion, interventions that increment biodiversity have the potential to improve nutrition, since they increase DDS. However, these interventions should be accompanied with nutritional education, sanitation improvements, and women's empowerment to ensure success.

KEYWORDS     undernutrition, indigenous people, dietary diversity scores,  
home gardens, micronutrients

## 135. Wouldn't it be sweet? Governance and smallholder participation in the honey value chain of Kinshasa, DRC

AUTHOR **Barbara Forbes**

SUPERVISORS Thi Minh Thai | Stephen Onakuse

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Supporting smallholder inclusion in value chains is embraced as a way of reducing poverty through engagement with existing market structures. Literature on governance structures (Gereffi, Humphrey, & Sturgeon, 2005) and the livelihoods framework (Ellis, 2000) is used to understand participatory mechanisms in the honey value chain in the province of Kinshasa, Democratic Republic of the Congo (DRC). Special consideration is given to its position as a local value chain producing for the domestic market, as well as the oft-under researched position of horizontal governance structures. The research finds that the interaction of multiple governance structures is heavily influenced by asymmetrical power relations: namely, the sole non-governmental organization (NGO) operating in the local area acts as a lead firm and has authority on determining who is a honey producer. This effect is illustrated by actors with more social and, to a lesser extent, natural capital being more likely to participate in the chain. This research concludes that for development projects to effectively engage smallholders in value chain participation, they must consider the power and position of all actors – including the organization implementing the activities.

KEYWORDS governance, honey, value chain, small-holders, participation, power relations

## 136. Spreading the Word: How Communicating Innovation Add Value for Primary Producers: A Case from Bio-diversity-friendly Rice and Fish Value Chains

AUTHOR **Katharina Sofie Zwiulich**

SUPERVISORS Thi Minh Thai | Stephen Onakuse

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Value Chain (VC) upgrading in low- and middle-income countries includes various strategies to benefit VC stakeholders on different levels. While the impact of governance (Gereffi & Lee, 2016; Humphrey & Schmitz, 2000), partnerships (McDermott, 2007; Riisgaard, 2009; Trienekens, 2011) and collective efficiency (Gereffi & Lee, 2016) has been highlighted, communication has been merely understood as sub-concept of these constructs. However, in other streams of research communication has been found to be a key relational competency increasing performance and forming value-enhancing chain stakeholder relationships (Cousins and Menguc, 2006; Paulraj, Lado, & Chen, 2008; Schultz & Evans, 2002). This study investigates communication of innovation practices in bio-diversity-friendly rice and fish VCs in Lang Sen, Vietnam. In particular, it is concerned with how communication adds value for primary producers. A qualitative Multi-Grounded Theory approach (Goldkuhl & Cronholm, 2010) is used to explore a construct that is not yet well defined in the given context. Various direct and indirect effects of VC communication on value addition have been identified through four types of functional bilateral communication types (receiving, mutual exchanging, hierarchical exchanging, utilizing) and two communication patterns (receiving exchanging and receiving exchanging utilizing). Value addition through communication highly depends on producers' social capital. Further, the contribution to objectives on each stakeholder side is crucial for successful communication of innovation practices.

KEYWORDS community, innovation, added value, primary producers, bio-diversity

## 137. Social Capital in relation to third-party voluntary certification: Assessing social capital for certified Cocoa producing communities in Ghana

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SUPERVISORS Aske Skovmand Bosselmann | Andreas de Neergaard |  
Stephen Onakuse

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This paper aims to deliver a comparable baseline of social capital data for different voluntary third party certification schemes in order to facilitate impact comparison studies in the future. Design/methodology/approach: The study is mainly based on a household survey of 225 small-scale cocoa farmers from the Ashanti and the Western region in Ghana. The study sample included four different groups of farmers: UTZ, Rainforest Alliance, and Fairtrade certified groups and one uncertified control group. The quantitative analysis compared peoples' level of social capital on a network, a bonding, and a bridging level. This data was triangulated with qualitative methods like PRA and group discussions. Findings: The findings for all three levels of social capital: network, bonding, bridging show significant differences between the certified groups and the uncertified control group. Certification showed a statistically significant correlation to a higher level of social capital. The causality behind this observation however could not be clarified within the scope of this research. The UTZ group showed a slightly lower level of network social capital but it was not statistically significant and this trend was not sustained for the bonding and the bridging level. While single indicators showed statistically significant differences for the certified group the overall level of available social capital is homogenous for the three group. The only significant finding is the clearly lower level of social capital of uncertified farmers, proofing the hypothesis that certified farmers have higher levels of available social capital. However, the hypothesis that Fairtrade certified farmers have more social capital available then UTZ and Rainforest Alliance certified farmers had to be rejected. Research limitations/implications: The research presents a limited level of detail on social capital based on the chosen set of indicators. The suggested type of research holds much potential for future voluntary third party impact assessment, but needs follow up. Originality/value: The research adapted and suggested a quantitative approach to social capital analysis and linked it to voluntary third party certification impact assessment. The author has no knowledge of a similar study in the context of cocoa certification. The findings have the potential to serve as social capital baseline for future research and the methodology facilitates comparable data collection.

KEYWORDS social capital, cocoa farmers, voluntary third party certification (VTPC), Ghana, baseline study

## 138. Choice of intercropping systems in immature rubber plantation in northeast Thailand: beyond price analysis

AUTHOR **Deo-Gratias Hougni**

SUPERVISORS Isabelle Michel-Dounias | Eric Penot | Benedicte Chambon-Poveda

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All over the world, adaptation to global changes has triggered a tremendous research effort focusing on farming systems at the local level. This study strives to evaluate how much intercropping alleviates economic vulnerability of smallholders during the immature period of rubber plantations in Northeast Thailand. Rubber intercropping was also used as a case study to understand farmer decision-making process and drivers in a real-world context. An assessment of economic performance of main rubber cropping systems found in Buriram province has been carried out alongside an analysis of farmers' choice. Forty (40) farmers were interviewed from May to August 2016 to capture diversity of rubber cropping systems and gather economic data on farm systems and on household's livelihood activities. In addition, 26 farmers representing all rubber cropping systems were further interviewed individually in order to understand choices made over cropping system selection and fertilization management. Farmer's objectives, alternative cropping systems and main reasons guiding their choice were sought as well as their constraints, satisfaction level, information source, and deliberation process when facing multiple-choices. Two focus-group discussions were held to broaden the spectrum of drivers, and rank them. Results suggested that rubber intercropping has rapidly expanded in Buriram, originating from South Thailand. Two main associated crops were found: cassava in upland and lowland, and rice in lowland. Other rubber intercropping systems including rubber-banana, rubber-vegetables and rubber-marigold were marginal because of important entry-barriers, namely knowledge in pest management, irrigation, commercial relationships and financial capital. On average, over 3-year period, rubber-cassava and rubber-rice intercropping systems generated annual gross margins estimated at 11,340 and 4,235 THB/ha/year in respective. Rubber-cassava, which is more market-oriented, can lower by 59% rubber plantation expenses over the immature period. However, contribution of rubber intercropping systems to household annual net income is about 10%, regardless of landholding, reliance on farm income or wealth status. Decision to intercrop largely depends on farmer's perception of interspecific ecological interactions. Choice of the associated crop mainly depends on

site topography, soil physical characteristics, market opportunity and commodity prices. Processes of decision-making were identified as social pressure and deliberate choice. The latter is mediated by the knowledge-belief system, which is fed through observation, experimentation and persuasion. A framework has been suggested to describe farmer tactical decision-making process.

**KEYWORDS** Northeast Thailand, farmer decision-making, rubber, intercropping, livelihood, global changes

## 139. Migrations and Land Management in the Ecuadorian Andes. How do farmers adapt their practices to reduced labour and increased income?

AUTHOR **Judith Bouniol**

SUPERVISORS Add Kessler | Claire Marsden | Mark Caulfield (Ekorural)

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The influences of human migrations on land management practices in the Ecuadorian Andes remain poorly understood. The objective of this study is to investigate how farm households adapt their land management practices to the consequences of migrations, in an indigenous community of the Cotopaxi province. A survey was conducted to create a household typology based on their labour availability and additional income entailed by migrations. Two workshops were organised to determine the labour and investment requirements of the land management practices. The relationships between migration patterns and land management practices, documented during semi-structure interviews with 43 households were analysed with Pearson correlations and ANOVA tests. Qualitative insights were brought by a simulation of practices adaptation in case of migration changes, based on choices of cards. The results show that the households adapt their strategy of income “generating production between labour” and investment” requiring productions (milk and potato) according to their labour availability and additional income from migration. Migrations are shown to lead to capitalisation of the farming system when they favour low “labour and high “investment requiring productions, like potato. The adoption of conservation practices is partly correlated to labour availability, suggesting that there might be a threshold of labour availability under which the adoption of conservation measures is not feasible. However, additional income is not significantly related to conservation practices, signifying that it is not a determinant factor for investment in soil conservation. The research concludes that households of Carrillo adapt their land management to consequences of migration in a different manner for production and conservation practices. Hence, it calls for considering migrations as a determinant factor when making a diagnosis of intervention areas. Corresponding population targeting and incentive strategies should take into account the specific influences of labour and additional income in land management.

KEYWORDS migrations, land management, indigenous community, agricultural production, Soil conservation, Andes, Ecuador

## 140. Characterization and subcellular localization of candidate Banana (*Musa accuminata* cv Berangan) salt responsive gene *Chorismate Mutase* and expression in transgenic *Arabidopsis*

AUTHOR **Mahfuza Pervin**

SUPERVISORS Andreas de Neergaard | Carmelo Rapisarda | La Malfa Stefano |  
Hans Jørgen Lyngs Jørgensen | Jennifer Ann Harikrishna

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Banana crop is listed among the 10 most important food crops in the world. Banana plants are sensitive to different abiotic stresses among which salinity stress is most limiting factor for banana production. The molecular basis of salinity stress in banana is poorly investigated. In this report, we have studied salt responsive candidate gene *Chorismate Mutase (MaCM)* previously isolated from banana cultivar *Musa accuminata* (cv. Berangan). The gene *MaCM* is involved in aromatic amino acid biosynthesis and seems to be involved in salt stress tolerance. In this present study, the gene *MaCM* was subsequently characterised through different bio-informatic analysis tools. In details, we investigated similarity with other genome sequences through performing BLAST analysis and evolutionary relationship through establishing phylogenetic tree using available online tool named NCBI, Banana Genome Hub and TAIR. The phylogenetic tree showed that *Chorismate Mutase (CM)* is a small gene family which has close evolutionary relationship with *Musa accuminata* subsp. *Malaccensis* and two *Arabidopsis* CM (Genebank accession no. AT1G69370.1 and AT1G10870.1). The gene structure analysis revealed that exon, intron and upstream and downstream (5' and 3') regions. We cloned a full length (969-bp long) of *MaCM* into plant expression vector pCAMBIA1304. The obtained construct pCAMBIA1304*MaCM* was then used for subcellular localization in transient expression assays using Green Florescent Protein (GFP) fusion platform (*MaCM*: GFP) and confirmed its nuclear localization in transformed onion epidermal cells. Further, we performed sensitivity tests associated with abiotic stress responses using wild type *Arabidopsis* seeds (Columbia ecotype 0) tested by Polyethelene Glycol (PEG) 8000 concentrations ranging from 10%-25% and NaCl ranging from 50mM-250mM. From our experimental results, we demonstrated that 20% PEG 8000 and 200mM NaCl concentrations was the effective concentrations to test the salinity stress responses. Preliminary functional screening was done using putatively floral dip transformed T<sub>1</sub> *Arabidopsis* seeds harbouring *MaCM* and Hygromycin B as a

selection marker. Total 247 putative transgenic *Arabidopsis* Hygromycin resistant plants were survived which will use for further analysis. However, the present study has provided a base for further investigation of functional roles of the salt responsive gene *MaCM* and expression in *Arabidopsis* plants.

**KEYWORDS**     *Musa accuminata* (cv. Berangan), salt stress, Chorismate mutase gene, *Arabidopsis thaliana*

# 141. What ground cover? An exploratory study of the role of herbaceous ground cover in coffee agroforestry plantations of Turrialba, Costa Rica

AUTHOR **Sara Capelli**

SUPERVISORS Andreas de Neergaard | Claire Marsden | Karel Van den Meersche |  
Bruno Rapidel | Clémentine Allinne | Philippe Tixier

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Ground cover vegetation is a real opportunity for coffee agroforestry systems. Benefits in terms of nutrient cycling, pests and diseases control, and erosion control could help to increase the sustainability of coffee production. In Costa Rica, intensive monoculture dominates the landscape and coffee prices have been low and unstable for a long time. Agroforestry plantations – which follow the principles of agro-ecology – are a valid response towards environmental and economic sustainability. Yet the focus is often on shade trees, whereas the potential of multi-layered vegetation is not fully explored. More knowledge on the role of herbaceous cover in Costa Rican coffee agroforestry systems is needed. Here, we investigated the current distribution of ground cover vegetation and its management in agroforestry coffee plantations of Turrialba, Costa Rica. Semi-structured interviews with 18 farmers enabled an in-depth knowledge on farm characteristics, field and ground cover management, together with the farmer's view on the limits and benefits of herbaceous cover. Field design and ground cover morphology were also characterized. Generalized Linear Models were used to study the correlation between ground cover morphology with environmental and management related variables; performances – in terms of production and pests & diseases incidence – across ground cover management and morphologies were analysed with pairwise MANOVA. The results were combined with the information provided by the farmers. This research revealed that there is room for improvement in the management of ground vegetation, at least for the organic and sustainable coffee farmers of the area of study. Indeed, the farmers' interest for less labour-intensive management of ground cover vegetation clearly emerged. At the same time, a diverse herbaceous cover was found across all farms, providing good material for implementing new strategies. However, some constraints remain. Altitude (range 476-1028m) influences positively plant species richness. Shade, mostly from the coffee plant, was one of the main factor affecting ground vegetation, together with ground cover management. A negative relationship emerged between herbaceous cover % and chemical management, while it is frequency, rather than type of management, which is significant in the case of manual or

mechanical options. Species composition is an important factor to be considered for the sustainability of ground cover management. Grasses (Poaceae) are the most present, but numerous plant species found across the different farms are good candidates as cover crops (*Bidens spp.*, *Spananthe paniculata*, *Laportea aestuans*, *Geophila macropoda*). Further research is needed to investigate the feasibility of improved strategies for ground vegetation management in coffee agroforestry plantations in Turrialba.

**KEYWORDS** ground cover vegetation, herbaceous cover, sustainable management, coffee agroforestry, Turrialba, Costa Rica

## 142. Land use and climate change effects on surface water runoff, Wadi Zabid, Yemen

AUTHOR **Fares Al Hasan**

SUPERVISORS Henk Ritzima | Dider Pillot | Wahib Al-Qubati

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Identification and assessment of the effects of land use and climate on surface water runoff is very important for the most of coastal plains in Yemen where spate water and groundwater are the main water resources for agricultural productions. Since the starting of political situation in 2011, the situation in Yemen has become unstable and dangerous to do field's works. With this situation, it was necessary to explore the feasibility of using remote sensing data combined with the SCS Runoff Curve Number method to detect the effects of these two factors on surface water runoff in Wadi Zabid, Yemen. It is expected from implementing this study to improve spate water managements and to set early flood alert in such unstable areas. Land use maps was obtained from the Landsat-NDVI time series data after improving it by applying the Harmonic Analysis of Time Series method (HANTS), while rainfall maps was obtained from the TRMM mission rainfall data after calibrating it by the available rain gauges data depending on the elevation factor. The effects of land use and climate on surface water runoff were obtained from combining these remote sensing data with the SCS Runoff Curve Number method. The comparison between 1998/1999 and 2014/2015 in terms of land use revealed on change in land cover occurred at the plain part of Wadi Zabid particularly in the middle stream area where most of the agricultural lands there became barren lands. The rainfall rate and distribution were in 2014/2015 better than in 1998/1999, where the total rainfall amount was higher by about 32%. In terms of surface water runoff, the total surface water runoff amount was higher in 2014/2015 by about 107% than it was in 1998/1999. As most of runoff change happened in the mountainous part where there was unnoticeable change in land cover type while the change in rainfall rate was more pronounced in this part. Therefore, the effect of rainfall was the main reason behind the change in surface water runoff at Wadi Zabid. Despite of this huge increase in runoff amount, it did not prevent the severe deterioration that had occurred to vegetation cover in middle and downstream areas. The mismanagement of surface water runoff and the diesel crises that happened during and after the political situation of 2011 probably were the main causes for these sharp changes in vegetation cover in this part of Wadi Zabid. Besides that the average NDVI differences map indicated to serious problem in surface water run-off allocation between upstream users and other water users, which

probably has emerged during and after the political situation of 2011. Finally, when field data collection becomes difficult or even impossible because of geopolitical reasons, remote sensing data combined with SCS-CN method can provide us with valuable tool to assess the status and the performance of spate irrigation schemes in such situations.

**KEYWORDS** surface water runoff, GIS, NDVI, land cover, climate change

## 143. AFOP Program, a National Training System. Conditions and effects of the agricultural insertion of young Cameroonian at Bafoussam

AUTHOR **Gretel Rivera Blanco**

SUPERVISORS José María Díaz-Puente | Betty Wampfler | Frédéric Lhoste

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The support program for the renovation and development of vocational training in agriculture, livestock and fishing (AFOP, French acronym) is an insertion-training system financed by the C2C funds, started in 2008 in Cameroon. It aims to train and support young people, without qualification, to move into agriculture. This thesis has the objective to analyse the conditions and consequences of the insertion of these young farmers, trained and accompanied by AFOP in the formation centre of Bafoussam. In addition, to provide an outside view of the entire apparatus set up to feed a plea, in connection with the institutionalization of the program in 2019. The study is based on three levels of analysis: the effects of the training and insertion of (1) the trainees and their farms, (2) their families and their territory (3). Agriculture developed by the trainees is creating wealth, jobs and social stability. It seems to approach to what is envisaged by the Cameroonian government, an agriculture of “second generation”. Many effects of the device have been identified in various fields (social, economic, technical and environmental). The trainees therefore settle gently into the territory by creating an internal AFOP network and promoting exchanges (technical, services ...) with their entourage (family and neighborhood) for example. Considered as new standards in their territories, the trainees provide their expertise and contribute to enlarge the area of impact of the training provided by AFOP program.

KEYWORDS training, insertion, effects, influences, young, territory, family, sustainable, progressiveness, sizing

# **BATCH 10: 2015–2017**



## 144. Resilience Assessment of Social-Ecological Systems in MENA Region: An application of Tri-Capital Framework in Jordan, Tunisia and Morocco

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SUPERVISORS José Luis Yague Blanco | Stephen Onakuse

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**D**rylands of MENA regions have diverse agricultural production systems that are embedded under more global social-ecological systems (SESs). In order to meet population needs, food production and intensification schemes in this area engender social and environmental costs because of the vulnerability of these systems, which orients current research to promoting sustainable intensification. Considering the complexity, vulnerability and diversity of systems, by this work, we propose, at a first level, a typology of social-ecological systems' resilience profiles in MENA region, using an explanatory set of variables defining rural livelihoods and agricultural systems on one hand, as well as resilience determinants; buffer capacity, self-organization and capacity for learning, on the other hand. Consequently, we proceed to measure and scale precariousness (Pr) indicator, which represents the distance to collapse point, for the different social-ecological systems resulting from the typology using the Tri-capital Framework method, which consists of developing and scoring composite indicators. By tri-capital, we relate to economic capital (EC), social capital (SC) and natural capital (NC). For data analysis; factor analysis, typology and indicators scoring, we used SPSS (Statistical Package for the Social Sciences). The study covers three countries: Jordan, Tunisia and Morocco; where data were collected by ICARDA in 2014 within Consortium Research Program on Livestock (CRP1.1). The results highlighted the diversity of and differences, or similarities, between production systems in the same country and between countries. The Pr indicator values start from zero to 5.3; while householders with Pr between zero and 3.50 are considered weakly resilient. Therefore, if the Pr indicator range between 3.50 and 4.20, householders, are considered as moderately resilient and if the score is between 4.20 and 5.28, they are strongly resilient. The result shows that a moderate resilience are engendered by balanced contributions of natural, economic and social capital, which highlights the importance of a holistic approach in promoting sustainable intensification and making rural development policies.

KEYWORDS sustainable intensification; social-ecological systems, resilience, precariousness; Tri-capital framework

# 145. Impact of host plant species and whitefly genotype on feeding behaviour of *Bemisia tabaci* – An electrical penetration graph study

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SUPERVISORS Didier Pilot | Carmelo Rapisarda | James P. Legg

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The cassava-colonizing genotypes of whiteflies belonging to the *Bemisia tabaci* species complex are economically important pests of cassava. Their damages is primarily caused through vectoring of viruses, which are responsible for cassava mosaic disease (CMD) and cassava brown streak disease (CBSD), both of them being the most important challenge in cassava production in Africa. Several other components of the *Bemisia tabaci* species complex are colonizing crops grown close to cassava, most notably sweet potato, but the feeding interactions between cassava and all different *B. tabaci* genotypes are unknown. A powerful method to study the feeding behaviour of the sap-sucking insects, including *Bemisia* spp., is the electrical penetration graph (EPG), which creates the electric circuit through the insect and the plant and measures the fluctuations in voltage in real time while insect is feeding, producing the graph that describes the feeding behaviour in detail. In this study, we utilized this tool to explore the feeding behaviour of cassava-colonizing whiteflies on cassava, sweet potato, and cotton; and sweet potato-colonizing whiteflies on cassava and sweet potato. Results (1) provide first ever-feeding characterization of cassava-colonizing *B. tabaci* on different host, and (2) show that cassava whiteflies are not restricted to feeding solely on cassava. The practical implications on whitefly control strategies, and host preference mechanisms are discussed. In addition, (3) feeding of sweet potato whiteflies is heavily restricted on cassava. These results lay the foundations for future studies aimed at understanding the mechanisms behind and opening the possibility for discovery of new whitefly resistance factors, which may be helpful also for implementing sustainable strategies to reduce the impact of cassava virus diseases by applying cultural control based on newly selected resistant varieties. Finally, the first EPG laboratory in Africa has been established for this research, allowing the feeding studies of all sap-sucking insects.

KEYWORDS cassava, EPG, whitefly, sweet potato, *Bemisia tabaci*, feeding behaviour

## 146. An analysis of high Andean production systems. A case study from the southern occidental communities of Chugchilán's parish

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SUPERVISORS Sébastien Bainville | Darío Cepeda

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The following analysis is in response to a request from different stakeholders: SIPAE, MCCH and CESA. Understanding the production systems, which are in use in the southern occidental communities of Chugchilán's parish, a rural parish in the middle of Ecuadorian Andes, it is fundamental to comprehend the area dynamics. This work is the result of the combination of different processes, the landscape analysis, and assessment of the historical context and the technical economic analysis of the farms. The study area lays on two sides of the Quilotoa volcano. It is a very heterogeneous region and it has different ecosystems, which have the systems chosen by the farmers and the types of challenges they have been facing. Moreover, the region's hacienda past has also played a role in land distribution amongst farmers and it has given rise to a variety of cropping and livestock systems. Since 2014, a factory, which process chocho, the Andean lupin, has been installed in the area and started to purchase the locally produced chocho. Therefore, the price rose significantly, and the production on a parish level has been intensified. However, local producers still struggle to get an income above the survival rate (1050 USD/year), even if they work every single day of the year. A new land distribution and an extension of the irrigation system could be the solutions to an otherwise unavoidable rural exodus.

KEYWORDS Ecuador, Andes, lupin, production systems analysis, smallholders, family farming, SIPAE

## 147. Farmer's motivations to participate in the “sellos manos campesinas”: a commercial innovation for family farming in Chile

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SUPERVISORS Pablo Vidueira | Aurelle de Romémont | Claus Köbrich

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Smallholder farmers are in an unfavourable position in the global markets, since a group of them does not fulfil with the required standards such as to produce great quantities of homogeneous products. Therefore, nowadays the emergency of new markets more focused on consumers, reduce those barriers or constraints since those market appreciate more the intangible assets that are abundant in the family farming. These valuable characteristics come from the traditional farming methods that are in harmony with the environment, and in producing foods that rescue the identity of the peasants. In this context, it is important the innovation in the marketing of family farming's products, aiming the strategic positioning of them in the markets, with tools that value and guarantee these attributes to the consumers. In this context, in 2015, Chile through the Agricultural development institute (INDAP) committed to star up a certification system denominated “Sellos Manos Campesinas” (SMC), in order to rescue the value of the family faming's products. The first phase of the pilot programme was developed as an operational strategy, but without considering the key factors that motivate farmers to take part in this innovation. Through the empirical analysis of farmers' perspectives, the present study explores the motivations that participants (15 farmers) had to engage into this certification process. Concepts such as innovation adoption and subsistence trajectory provide the reference framework to understand the reasons for their participation in the SMC. Results suggest economic and social motivations, which emerge from the construction of a specific trajectory and from an institutional influence. As a contribution of this study, it was evidenced that SMC match with the trajectories related with commercial innovation and with strategies of short circuits. In conclusion, it is important to explore the motivation from farmers to participate in an innovation due to the rise of tools that allows promoting a targeted adoption in the coming participants.

KEYWORDS motivations, participation, Sello de Manos Campesinas, family farming, family subsistence trajectory, innovation, INDAP, Chile

# 148. Medicinal plants from the roof of the world: Understanding the interface between vernacular value and economic development in the Pamir Mountains of Tajikistan

AUTHOR **Edith Welker**

SUPERVISORS Maten Sørensen | Carole Lambert

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**M**edicinal plants are relied upon by billions of people, primarily the world's poor, as part of diversified health care strategies. This is threatened by the global trend of precipitous and permanent loss of knowledge of plants and their uses, which places medicinal plants at the centre of the crisis of diminishing bio-cultural diversity worldwide. Medicinal plants also represent important livelihood opportunities, valorised in local and global value chains. All these elements play out at once in the remote Pamir Mountains of Tajikistan, where medicinal plant resources sit at a development crossroads. In an effort to identify a pathway forward that honours the practical, bio-cultural, and economic value of medicinal plants, this research seeks to understand how medicinal plants are valued in the Pamirs, what relationships exist between actors, and what development perspectives are presented by this valuation and interaction, particularly pertaining to value chain development. This research employed social, participatory, and ethnobotanical methods collecting qualitative and quantitative data. Aspects of plant use, valuation, and institutional influence were extracted from structured household interviews and focus groups across three villages, semi-structured interviews with consumers across four outlet locations, and exhaustive semi-structured interviews with commercial and institutional actors. Plant inventories were generated from interview data, and validated by literature review. Forty-nine plants were found to be in use across all actors interviewed. These hold value for users that include in order of importance: medical use, trust, access, cultural, and economic value. Diverse commercial actors were identified, fitting three categories based on their business model and social investment. A complex institutional environment emerged comprised of formal, informal, as well as hybrid institutions. Value chain development in the Pamirs Mountains of Tajikistan demands consciousness among practitioners of the intricate valuation of medicinal plants, and the importance of supporting social ties between actors. Novel contributions of this work include the articulation and quantification of embedded value, and the notion of hybrid institutions.

KEYWORDS medicinal plants, value concept, value chains, bio-cultural diversity, rural development

## 149. Water balance study on urban watersheds with the use of a Sustainable urban Drainage system-SuDs-(application of a case study)

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SUPERVISORS Stephen Onakuse | Leonor Rodriguez Sinobas

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**D**uring the last century, a large proportion of populations has migrated from rural to urban areas. This movement has produced vast urbanization areas affecting the water management. Water in urban areas can be found in tap water, sewage and precipitation. Urban areas are characterised by a large extension of impermeable surfaces, which affect the natural hydrologic cycle and the water infiltration into the soil. Additionally, the rainwater in contact with the urban surfaces can result in water pollution that could be harmful to both environment and human activities. Its management is complicated and requires different approaches depending on the area. This work discusses the management of the surface water runoff considering a volumetric water balance, which includes a Sustainable urban Drainage system (SuD). It addresses this issue by calculating the greenhouse gasses (GHG emissions) and the energy consumption fitting them in different climate change scenarios. The methodology takes into consideration the volume of water reaching the permeable areas, as well as the impermeable surfaces. The conveyance of the water runoff is carried out through the SuD system. The volume of runoff that exceeds the capacity of the SuD system is led to the existing drainage system. The aforementioned volumes are used as parameters of the introduced water balance in order to define the total volume of infiltrated water and the possible mitigation of the urban runoff.

KEYWORDS urban storm water management, urban water balance, SuD systems, Climate change, urban hydrology

## 150. Analysis of agrarian practices around the Kalalao tropical forest, Sainte-Marie, Madagascar

AUTHOR **Caroline Balloux**

SUPERVISORS Olivier Philippon

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The internship mission for GRET is part of the project “protecting the last forests and endemic endangered species of the island of Sainte Marie”. It focuses on the Kalalao forest and agricultural practices in its periphery. This preliminary study is inspired by the method of an agrarian diagnosis whose results will have to be translated to guide the elaboration of recommendations for an agro-ecological transition of the farmers affected by the creation of a protected area around Kalalao and to whom to prioritize support. The study shows that the farmers most affected by the creation of the PA, are the inhabitants of Maromandia and Ambohitra. These must be accompanied by giving them access to a lowland and creating new sources of income. Market gardening support and the development of poultry farming is recommended. The entire study area is prone to significant soil degradation due to fallowing of the tanety system, which is being shortened due to population growth. To mitigate this degradation, the accompaniment / sensitization of the inhabitants to the use of agroforestry technique with local nitrogen-fixing trees is recommended. In addition, separating the culture of grevillea tree used for charcoal the cultivation of rain fed rice is recommended.

KEYWORDS Sainte-Marie, Madagascar; agrarian diagnosis, vanilla, cloves, smallholder-farming systems, GRET, agroécologie, Kalalao, tavy

# 151. Young Rural Women Participation in Trainings, Employment and Business Opportunities through the Case Study of the OYE Project in Nampula Province

AUTHOR **Silvia María Amador Velásquez**

SUPERVISORS Stephen Onakuse | José Luis Yague | Roy van der Drift | Gancilei Soca

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The creation of employment opportunities for the youth are a top priority in development agendas, as a rapidly growing young population can be a driver for economic growth. Still, mismatches between market demands and youth skills have prone development programs to investing on basic life skills and business trainings. However, despite these efforts, unequal power relationships have fostered young women's exclusion from development initiatives. In this regard, this research provides insights on the factors that influence young women participation in training, employment and business opportunities provided by vocational and entrepreneurial programs as short-term interventions. Exploring gender differentiated roles, motivations and skills; identifying set of characteristics and requirements demanded by employers; and contrasting it to the youth profile supply. This is a non-experimental study using a gender comparative approach and mixed methods for data collection. Research results have evidenced that deeply rooted socio-cultural beliefs about gender roles are hindering young women participation in development opportunities; since these influence gender differences in time use and location of activities, access to productive inputs and services, as well as the skills and confidence needed to access employment opportunities or to start their own business. Concluding that programmatic approaches in development initiatives are more likely to operate from an operational aware approach to gender, however, only a gender transformative approach can contribute to young women's empowerment and well-being.

KEYWORDS gender; youth; vocational training; employment; entrepreneurship

## 152. Egg production and Value chain analysis in Iran – Case study; Mazandaran Province

AUTHOR **Sara Dastoum**

SUPERVISORS Henning Otte Hansen | Betty Wampfler | Ali Jabbari

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Value chain approach has been used in agriculture and rural development to identify the limitation and problematic of agricultural products marketing. This study aims to examine the views of various actors in egg production value chain in Iran and review the constraints and opportunities in this chain to provide possible intervention(s). This research has conducted in Mazandaran province as a case study and has used both desk study and field study to collect data from different actors of the chain through key information interviews, questionnaires and focus group. Instability in prices, presence of the intermediaries and brokers, inadequacy of governmental support, low bargaining power and access to information are among the main constrains of this chain. Therefore, increasing the competitiveness by value adding approach, limiting the power of the brokers and expanding permanent export polices are some of the possible interventions.

KEYWORDS value chain, egg production, egg industry, poultry industry, eggs, Iran, Mazandaran

## 153. Understanding Agrobiodiversity in Urban Market: A Comparative Study of Crop Species and Varietal Diversity in Traditional Wet Market and Supermarket in Cau Giay District, Hanoi, Vietnam

AUTHOR **Laxmi Lama**

SUPERVISORS Minh Thai | Didier Pillot | Stef de HA | Jessica E. Raneri

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Importance of agrobiodiversity in the market is recognized for its contribution on dietary diversity in both rural and urban space and ultimately to the on-farm diversity. Agrobiodiversity assessments have typically focused on rural spaces and little is known about its composition and presence in urban outlets. With an aim for comprehensive understanding of agrobiodiversity situation in urban market in the context of rapid food system transformation in Vietnam, we conducted agrobiodiversity assessment comparing species and varietal diversity of vegetables, fruits, condiments, (pseudo) cereals, legumes and roots and tubers in traditional wet markets and supermarkets in Cau Giay, an urban district of Hanoi. Seventy-one vendors in four wet market and four supermarkets were surveyed with semi structured questionnaire. Descriptive statistics were used for comparison of crop species richness and crop varietal diversity. The species and varieties were further examined to identify the neglected and underutilized species (NUS) and subsequently applied basic value chain assessment for two NUS species: “foxtail millet” and “weedy amaranth”. Fifty-four respondents consisting value chain actors and consumers were interviewed using semi structured questionnaire. High number of species and varietal diversity as well as wide number of NUS species were found in both wet market and supermarket but distinguished contrast was found for the unique species. Unique species to wet market consisted of species and varieties of local food habit where as exotic species imported from distant location (international) were unique to supermarket. This was due to the supermarket’s capability to direct sourcing. The unique species to each type of market suggested the important complementary role of both the market in bringing the dietary diversity and agrobiodiversity. Vendors’ independence on decision making over the choice of species and varieties and the sources in wet market was found to be attributing to the presence of wild/uncultivated species unlike in supermarket. In the present trend of increasing supermarkets, the study suggests on need of special attention to support the existence of wet market for the local

agrobiodiversity. The main finding of NUS value chain assessment is the observed economic value of the NUS species by the producers for income and the nutritional value of the NUS species from traditional knowledge by the consumers were the main driving force for the presence of NUS crops in the urban market. Farmers were found to be ignoring the other value of the NUS species (drought resistant, low investment etc.). Consumption is limited among nutrition conscious and vegetarian consumers. The study suggests the need for intervention at consumer level by expanding the demand for NUS species to wider consumer to keep the on-farm diversity and providing dietary diversity with traditional species to the urban consumers. Overall, the study points out the importance of agrobiodiversity assessment in markets in different space and temporal course that can allow tracking of food system transformation at agrobiodiversity level.

**KEYWORDS** agrobiodiversity, urban market, neglected and underutilized species (NUS)

## 154. Automated oestrus detectors allows a new insight into Ram effect in Lacaune dairy Ewes

AUTHOR **Ngozi Mercy Umezurike**

SUPERVISORS Luisa Biondi | Francois Bocquier | Nathalie Debus

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The ram effect “a natural method” for out-of-season breeding of dairy ewes was experimented to estimate its efficiency in synchronization. Four trials were conducted during consecutive years (T13), (T14), (T15) and (T16) in an organic farm of the Roquefort area in France. More than 200 ewes per year were involved in the trials giving a total of 955 individuals aged 1 to 7 years. The trials were all carried out between April and May. The aim of this study was to determine ewes’ ovarian status through validation of progesterone test by the oestrus detector (Alpha-D), investigate ewe response to the ram effect and the effective synchronization of oestrus. Rams introduced to the ewes were equipped with Alpha-D and aproned during the first 15 days from (D0 to D14) to stimulate anoestrus ewes. From D15 onward, males also detected oestrus in both cyclic and induced ewes. Mounts recordings provided precise kinetics of oestrus occurrence. Our results show that the proportion of non-cyclic ewes varied greatly with progesterone test giving 71%, 72%, 41% and 41% (respectively for T13, T1, T15 and T16) against Alpha estimations 88%, 87% and 82% respectively for all trials (except T16, when Alpha-D was not available). The proportion of induced ewes after ram effect was in an increasing sequence of 43%, 53% and 80% respectively through T13 to T15. There was also more Peak 2 (D24-D26) oestrus occurrence 26%, 38%, 36%, 24% respectively for T13, T14, T15 and T16 than Peak 1 (D18D20). Success of induction by rams were also analysed individually confirming the positive effect of age, body condition score, and to a lesser extent negative effect of milk yield and interval from lambing. The results show that ram effect is an efficient method of inducing oestrus in anoestrus ewes. Validated sexual status by oestrus detection allowed predicting ewes’ response to male effect. However, a constant and unpredictable year effect remained, thus limiting the practical use of this method. More work is needed to predict the year effect or to explore other animal factors; the male libido would be an interesting insight.

KEYWORDS dairy Ewe, ram effect, Alpha detector, automatic oestrus detection, organic farms

## 155. Public Food Procurement as an incentive to integrate family farming sector within a sustainable supply chain management. Case study: Economic Community Farmers Organization (OECOM) region of Potosí – Bolivia

AUTHOR **Stéfanie De Buck**

SUPERVISORS Stephen Onakuse | Jose Luis Yague

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Over the last decades, efforts have been made by Government of Latin American countries to jointly reduce poverty and food insecurity. Between 1990 and 2014, the region, decreased by 60% the proportion of undernourished person on the continent. However, challenges remain. Over 33 million of the rural population is still living in extreme poverty and deprivation of its basic needs, such as affording a nutritional diet. Public Food Procurement (PFP) oriented towards family farming associated with National School Feeding Program (NSFP) are interesting initiatives, to improve local food systems. PFP pursues a wide range of development objectives that embrace the triple bottom line's concept, which simultaneously considers the pillars of sustainability to achieve economy, social and environmental benefits. Data was collected on a participative assessment from three Community Farmer Organizations (OECOM) of approximately 30 members each, located in different rural municipalities of the Altiplano region of Potosí Bolivia. All are suppliers of the NSFP. Through a system approach, based on an inclusive value chain methodology, this paper will discuss how PFP could generate a constant and steady income to family farming sector and act as an incentive to integrate themselves within a sustainable supply chain management.

KEYWORDS family farming; sustainable supply chain management, public food procurement, food system

## 156. Decreased Labour Supply in the Ayeyarwady Delta, Myanmar: Transformation of Farming Systems in Bogale and Mawlamyinegyun Townships

AUTHOR **Yi-Jen LU**

SUPERVISORS Didier Pillot | Céline Allaverdian

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The aim of the study is to examine the transformation of farming systems in response to the decreased labour supply. In view of labour scarcity, the diversity of farming systems and the strategies of agricultural production reflect the difference in the value attributed to agriculture by the farmers. Hence, the study analysed the current farming systems, agricultural production strategies, as well as the situation of labour shortage and its relevant impacts. Looking into relationships between agriculture, landscape and socio-economy in the lowest land expanse of Myanmar, the Ayeyarwady Delta. The study explore the agro-ecological areas, agrarian history, cropping and livestock systems as well as farming systems. The study covered two townships and essentially included four villages by working with two NGOs, GRET and WHH. To evaluate the copping and livestock systems, analysis of economic performance was used. Furthermore labour requirements, income structure, estimated income and average amounts of loans were utilised to build a typology. The type of farmers, farm size, workforce, cultivation practices and off-farm activities were revealed as differentiating factors of farms. Based upon the empirical findings, a set of simple scenarios is drawn to amplify the plausible consequences of continuous labour shortage. As a result, four agro-ecological areas, an agrarian history of approximate 200 years, eight cropping systems with a focus on rice and cash crops, eight livestock production systems, and four farmer types followed by one to four sub-types were identified. The diversity of farming systems implied the different strategies to mobilise labour and to mechanise the farms within the demography of agricultural holdings.

KEYWORDS farming systems, labour, scarcity, income structure, off-farm activities

## 157. Local action groups as project oriented organizations: an approach from organizational competences

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SUPERVISORS Stephen Onakuse | Ignacio de los Ríos | Ángel Riomoros

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The increasingly complex and dynamic world, requires to meet the more demanding expectations of the stakeholders through a better management of projects, programmes and portfolios, challenging the implementation of the process-oriented assessment models. The Local Action Groups (LAG) are dynamic organizations undertaking rural development in the EU, which have become vehicles for an effective endogenous development. Competency based methods have served to improve management for decades filling up the gaps with a more holistic approach to management. By using the Organizational Competence Baseline (OCB), this study provides comparison points to help rural project-oriented organizations to expand their assessment spectrum. This is a non-experimental study in which, GALSINMA, the LAG in the northern mountain zone of Madrid is analysed using an Organizational Competence approach and mixed methods for data collection. The International Project Management Association (IPMA), describe five groups of organisational competences used in this study, concluding that the structure of the LAG itself strengthens the organization in Government, Alignment and Management. Given the inclusion of the stakeholders in decision making, the alignment with the local and regional rural policies and strategies for development and the constant supervision of the projects implemented. However, the lack of appropriate communication strategies, incentives for participation of certain sectors, and bureaucratization, are challenges to be tackled for a better performance within the organization in the groups of Performance and People's Competences.

KEYWORDS **local action groups, organizational competences, management, local administration**

## 158. Participatory Development of Agro-Climate Advisories in Cambodia

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SUPERVISORS Andreas de Neergaard | Didier Pillot | Elisabeth Simelton

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**A**gro-climate information services (ACIS) have the potential to facilitate adaptation among farmers, if they are actionable. An actionable ACIS provides useful and timely information is accessible and understandable. This study assessed the potential for ACIS in the context of multi-ethnic smallholder farming communities in Ratanakiri, Cambodia. PRAs, FGDs and interviews were combined to analyse the current situation, then different design options were developed and tested participatory. The cropping systems in Ratanakiri are highly dependent on seasonal rainfall patterns. The Perception of seasonal climate conditions vary among the population and are related to the experience of specific impacts. Currently, most farmers do not use climate information systematically in their decision processes. Barriers are the access, availability and the capacity to understand climate information. The ability to carry out desired actions is constrained by access to labour, land, technology and financial capital. Future climate change is likely to have adverse impacts on smallholder agricultural production in the area. The results suggests that end-users have different capacities to access, understand and act on climate information. Socio-economic factors like gender, age and wealth influence these capacities. The design of agro-climate advisories requires a conscious balancing of trade-offs. Future research is needed to identify synergies that could arise from integrating ACIS with a wider system of extension services.

KEYWORDS participatory, development agro-climate, multi-ethnic, smallholder farming

## 159. Budget transparency and innovation in traditional water infrastructure projects

AUTHOR **Moritz Hofstetter**

SUPERVISORS Alex Bolding | Marie-Jeanne Valony | Barbara van Koppen

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Despite the promises and the efforts of the South African government to provide water services to rural communities, many of these communities are still not receiving them. The government is facing the challenge of high cost for new infrastructures and that inadequate operation and maintenance leads to a breakdown of existing infrastructure. New approaches and solutions have to be developed for service provision for rural communities. This action research project has been conducted within the “Operationalising multiple use water services in South Africa” project of the African development Bank and documented in the form of an extended case method. It examines first a new approach to increase the community involvement in the planning and implementation of infrastructure by communicating the available budget of the project to the community from the start. Budget transparency on government level has been identified to reduce corruption, improve community participation and to strengthen accountability relationships between municipalities and communities. Similar effects were observed in this project. Budget transparency has shown to have positive effects on the community’s sense of ownership and the willingness to participate in planning process. Only further fieldwork will show if the hypothesis that budget transparency increases the willingness of villagers to contribute to the infrastructure investment can be verified. The second point of focus is on the mechanisms that hinder and foster innovation within traditional development project structures. Locally adapted participatory processes have been identified as a key factor to create sustainable infrastructure investments. Findings show that the willingness of actors to innovate and to apply paradigms like community participation ends where they perceive them as contradictory to their personal interests. This also thesis makes recommendations to improve the functioning of traditional project structures and proposes new models to improve the service provision to rural South Africa.

KEYWORDS budget transparency, participation, service delivery

## 160. Harmonisation of legislation system in Middle Zambezi riparian countries for environmental sustainability of Zambezi River Basin

AUTHOR **Anna Kryvonos**

SUPERVISORS Marie-Jeanne Valony | Alex Bolding

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The absence of detailed and coherent institutional framework all together with efficient conflict settlement and guidelines for cooperative management including the member states of the river basins have become the major hindrance for achievement effective management of transboundary water resources. This thesis examines the harmonization of legal instruments within the Middle Zambezi River Basin countries to ensure the environmental sustainability of the whole Zambezi River Basin. The three countries of the Middle basin have own established legislation system. However, the fact of sharing waters of international watercourse implies certain level of cooperation and common goals towards the use of water resources. Extensive results and analysis of this policy research challenges with cooperation and conflict of interests that rooted to the ancient historical background and political prerequisites.

KEYWORDS Transboundary River, Zambezi river basin, legislation, laws, policies, harmonization

## 161. The case study of value chain design and development in Eastern Cape, South Africa

AUTHOR **Bermet, Koshoeva**

SUPERVISORS Christian Baranger | Guillaume Baud | Laurence Mioche

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South African farmers lack access to the main important resources, such as land, infrastructure, equipment, but most importantly lack access to information and knowledge. This thesis examines case study of a cooperatives group Agripark, established and supported by the University of Fort-Hare in Alice, situated in Eastern Cape Province of South Africa. Cooperatives have been provided by UFH with necessary facility and equipment for successful farming activities. However, coops have little income from their products and lack access to the market. Extensive results analysis of this case study shows that challenges with market access are rooted from the inability to access information, and use the knowledge for the benefit of the farms, to be self-sufficient and sustainable.

KEYWORDS value chain, cooperative, value added, market access, South Africa

## 162. Water to the cities – a critical look at rural-urban water transfers and their socio-environmental impacts. The case of the project El Realito in San Luis Potosí, Mexico

AUTHOR **João Pedro Borsoi Rohloff**

SUPERVISORS Rutgerd Boelens | Didi Stoltenborg | Marie Jeanne Valony

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In many large cities around the world, rural-urban water transfer projects are increasingly used in order to attend the ever-bigger urban water demand. However, in this process often little attention is given to the important social and environmental injustices related to these projects. This study was based in the city of San Luis Potosí in México consisting of 1.2 million inhabitants, a city for more than 90% dependent on groundwater resources. Problems with both quantity and quality of the groundwater resources have urged the city to find other sources of drinking water, resulting in the rural-urban water transfer project “El Realito”. The concept of hydro-social territory was employed to study changes in the biophysical surroundings, water distribution and governance, legislation and socio-political changes. Interviews, field observations and document/literature review were used during a 3 months fieldwork as the main data collection methods. In the El Realito case, we show how the Mexican government uses modernization and sustainable aquifer management as arguments for urban development, yet at the same time marginalizing rural communities’ water access. The results show that the project ended up benefiting the city’s industrial and economically powerful actors that can pay for such a water service, whilst poor rural actors’ water needs are ignored and their livelihoods threatened. After two years of water transfer from the El Realito, the city’s growth and industry-based development model is guaranteed with the extra water brought by the water transfer. However, the project has neither addressed the problems of aquifer overexploitation nor the inequalities and lack of water access inside the city and even less the urgent problem of lack of water services in the affected rural communities.

KEYWORDS rural-urban water transfer, social and environmental injustices, El Realito

## 163. Survival of fruit and multipurpose tree seedlings planted to restore degraded land in smallholder agroforestry systems in Saesi Tsaeda Emba, Tigray, Ethiopia

AUTHOR **Vilde Maria Lavoll**

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Land degradation has been a severe problem in the northern Ethiopian highlands and many studies have demonstrated that agroforestry can serve as a successful tool in restoring degraded lands. Tree planting has hence been included in many land restoration projects, but the survival of seedlings has been low. The objective of this study is therefore, to understand the factors affecting survival of tree seedlings planted to restore degraded land on small-scale farms in Saesi Tsaeda Emba woreda in Tigray, Ethiopia. The species *Mangifera indica*, *Coffea arabica*, *Rhamnus priniosides*, *Psidium guajava*, *Casimiroa edulis*, *Faidherbia albida*, *Acacia seyal*, *Persea americana* and *Moringa oleifera* were planted on 59 farms in three watersheds in an on-farm field trial, called planned comparison. Before planting the seedlings, participating farmers agreed upon certain irrigation and mulching treatments. Data on survival, growth, agro-ecological conditions, stress factors and seedling care were collected 12 months after planting and analysed using a logistic regression model. Focus groups and semi-structured interviews were used to triangulate the findings and to collect data on socioeconomic factors. Agro-ecological conditions were found to affect the survival of tree seedlings, but their resilience varied between species. Shade was the only agro-ecological condition that had a significant positive effect regardless of species. The practices fertilization and shelter had a significant positive effect on seedling survival, while fencing was found to be less important. Weak seedlings were an important mortality reason for *Faidherbia albida*. Treatments with the most water and most frequent irrigation had the highest survival rate, but it was also shown that the presence of mulch increases the probability of survival when the quantity and frequency of irrigation were reduced. Both the seedling care and survival differed significantly between socioeconomic groups. Farmers with limited labour capacity showed a significantly lower use of seedling care practices, but not a lower seedling survival, than the other farmers. The trees of old farmers were found to have a significantly higher survival than the other trees while the trees of young farmers had a significantly lower survival rate than the other trees. The study showed that the survival of tree seedlings is a result of complex interactions between species, agro-ecological conditions and seedling care and studies with larger samples sizes are needed to identify single determinants of success or failure.

KEYWORDS land degradation, coffee Arabica, agro-ecological conditions, smallholder agroforestry systems

