SUCCESS STORIES OF EU CHINA RESEARCH COLLABORATION

7th Framework Programme for Research and Technological Development

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COLTS: Casting of Large Ti Structure

Titanium alloys (Ti) are metals that contain titanium and other chemical elements. Large Ti components are usually manufactured by thermomechanical processing but a lot of material is wasted during the process. Castings and forgings would likely be preferred over thermomechanical processing if they could produce large quality structures. The difficulty of casting Ti components lies in the extreme reactivity of Ti alloy that limits the temperature of the molten alloy to only about 50°C above the melting point. This makes the mould filling very difficult, especially for thin and large sections. One US company is already using casting technology but, since it is in a monopoly position, its castings remain expensive for the end-users. Moreover, its products often need significant weld-repair.

Potential application for COLTS products

The COLTS project aimed to demonstrate that large, thin walled castings of Ti alloy could be produced and meet the specifications required by the end-users. Airbus and the European Space Agency (ESA) chose which demonstrator components should be realized and they indicated dimensional tolerances, quality of surface finish and the required mechanical properties.


Doorframe

No European company was ready to make the investment necessary to develop industrial scale casting of large components of Ti alloys. However, there was significant experience in this area in China and two Chinese partners had already expressed their interest in developing this technology. The Chinese members of the consortium were thus in charge of casting and electron beam welding. The European partners of COLTS brought their expertise in computer modelling of casting and welding and their experience in the assessment of microstructure and properties. The project team worked on both sophisticated gravity and centrifugal casting as well as on electron beam welding, required to repair castings and hold together components.

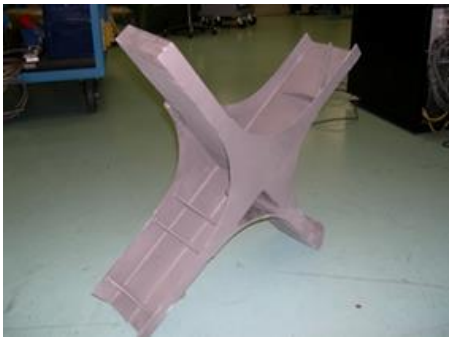
Thin-walled generic cylinders (European Space Agency Photo)

The interaction between the casting experts from China and the modellers from Europe was very productive and led to the development of optimised casting conditions. Significant advances were made and casting technologies were developed to a level far better than those available before. The project improved the strengths of wax patterns and the quality of the face-coat of the moulds. Refractories were also enhanced. All these developments contributed to improve castings and are exploitable. Welded and cast components close to the specifications for the dimensions, the surface-finishes and the mechanical properties were produced and displayed at the ESA's museum in Netherlands.

A patent was also submitted by Huazhong University of Science and Technology for a process to measure complex three-dimensional surfaces using surface structured light and light pen. The work of this university led to copyrights of the PowerMetric 3D software.

Cubic space frame

New commercial aircraft designs are moving from aluminium construction to composite structures. Developing the casting of large parts of Ti alloy is very useful in regard to this evolution. Will additional development work, European and Chinese companies could use the technology to produce aerospace components from cast Ti alloys. COLTS advances consequently aerospace industries in Europe as well as in China. The casting process could also save money in reducing the quantity of material required and the machining time. This technology could thus boost the industry.



Cross connector

The reduction in weight thanks to the utilisation of improved material properties could also allow rocket structures, space satellites and spacecraft to offer greater scientific return for space missions. Finally, in regard to environmental impact, this casting process spares raw materials in comparison with the thermomechanical one.

GlycoHIT: Glycomics by High throughput Integrated Technologies

10 million new cases of cancer are detected in the world every year. This number is expected to reach 24 million by 2035. This growing cancer burden can be explained by the aging of the population, the increase in cancer-causing behaviours like smoking and the environmental situation that lead to a deterioration of air and water quality. According to the World Health Organisation, China is amongst the countries most affected by this global rise in the disease. The country accounted for the most new cancer cases and deaths from four types of malignant tumours: liver, oesophagus, stomach and lung.

Protein glycosylation is a reaction in which a carbohydrate, glycans, is attached to proteins. During this process, sugars get linked with amino acids of proteins. Glycosylation is important for the identification of normal and diseased physiological processes. Specific sugar–protein linkage happens to patients suffering from cancer. GlycoHIT focused on the development of a technology for an analysis of blood samples using proteins with sugar linkages as biomarkers for cancer. The existing technologies for the analysis of protein glycosylation were lacking and progress was required to develop fast analysis of glycosylation proteins from clinical and biopharmaceutical blood samples.

To improve the existing technology, the project team created a new ultra-performance liquid chromatography and hydrophilic interaction chromatography (UPLC-HILIC) method. The UPLC-HILIC technique separates the components in a mixture in order to identify and quantify each one of them. This method allows analysing specific sugar–protein linkage in clinical samples. The project produced new biomarkers and enhanced lab technology. The GlycoHIT team validated the techniques with tests on samples from breast cancer patients. Further optimisation and validation of HTP technologies is expected to enhance rapid detection and diagnosis of a variety of cancers. GlycoHIT also innovated in using mammalian glycans in place of plant lectins. This enhanced the specificity and the target affinity. In addition, the project developed new biosensing technology.

Tsinghua University and Hunan University were members of the project. They linked GlycoHIT to a Chinese sister project funded under the “973” Programme and International Collaboration Programme from the Chinese Ministry of Science and Technology. This project is currently developing technologies for quantitative proteomic studies of protein post-translational modification in liver disease.

Several meetings have been organized between the GlycoHIT researchers and their Chinese counterparts. The 1st China-Europe Symposium between the projects was held in Hangzhou in 2011. In August 2012, Tsinghua University hosted another International Symposium on Bioanalysis and Biosensors. Hunan University also welcomed the second joint meeting between GlycoHIT and its sister Chinese consortium in September 2012. Most recently, the 3rd China-Europe symposium on glycoproteomics was arranged in the framework of the 8th CNHUPO meeting, in September 2013 in Chongqing.

Members of the GlycoHIT team, China-Europe Symposium, 2012

Cancer is one of the most deadly diseases worldwide. Thanks to the results of GlycoHIT, early detection and improved prognosis will be possible. The project created a promising new approach for diagnosing cancer. Early detection and treatment increased survival rates and the rates of remission. They also lower the rates of relapse and the need of invasive treatment. Fast and accurate tests are crucial to fight efficiently the disease. Besides the medical impact, the consortium deepened the links between the partners, opening the door for future collaboration and common application in diagnostic and predictive medicine.

CSFV_GODIVA and ASFRISK: preventing and combating swine fever

Swine fever is a highly contagious disease of pigs and wild boar. It usually leads to death within 15 days. The symptoms include fever, skin lesions and convulsions. The virus has disastrous consequences for the economy, animal farming and the livings of farmers. In the case of a disease outbreak, the slaughtering of all the infected animals is indeed required to contain it. The virus spread rapidly and controlling it is necessary for international trade.

CSFV_GODIVA (Improve tools and strategies for the prevention and control of classical swine fever) is a project focusing on classical swine fever. The disease is endemic in much of Asia and parts of Europe. The current available vaccine show limitations: they are not suitable for oral application and the differentiation between vaccinated and infected animals is impossible. This complicates the disease surveillance and international trade. CSFV_GODIVA undertook to find solutions to these problems. The project developed a new marker vaccine that allows this differentiation. The attenuated live marker vaccine is now in the process of registering. The project team also created a rapid response vaccine candidate. This new emergency response vaccine will prevent slaughtering of all pigs. It will also reduce treatment costs.

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CSFV_GODIVA worked on the monitoring and control of the disease and developed new tools to do so. The team conducted research on genetic and immunology tests. They created a cheap and portable colorimetric test that is more effective for field testing. They also set up more effective vaccine delivery system.

Chengdu University, the Chinese partner provided information in pig production and feral pig distribution in China. This was illustrated during field visits. They facilitated meetings with the veterinary authorities of Sichuan province and vaccine producers. During the project meetings information was exchange about CSF epidemiology, diagnosis and vaccine development.

The project provides better tools to handle swine fever, one of the most damaging diseases of domestic pigs worldwide with dramatic consequences for the farmers and for international trade. As these viruses do not stop at the borders, international collaboration is necessary to handle the issue. The projects' outcomes improve prevention, detection and control of the two diseases.

The results can have a major impact for the agriculture and the reduction of socio-economic consequences during an outbreak. They could indeed prevent the massive slaughtering required until now to contain the diseases. The outcomes of the programme will also benefit food quality and safety. These improvements will contribute to the development of the agricultural sector and of trust in international trade.

Sichuan

The city of Chengdu, in the province of Sichuan, hosts five FP7 projects.

The first one, CSFV_GODIVA (Improve tools and strategies for the prevention and control of classical swine fever), is a project focusing on classical swine fever. The disease is endemic in much of Asia and parts of Europe. The current available vaccine show limitations: they are not suitable for oral application and the differentiation between vaccinated and infected animals is impossible. This complicates the disease surveillance and international trade. CSFV_GODIVA developed a new marker vaccine. The attenuated live marker vaccine is now in the process of registering. The project team also created a rapid response vaccine candidate which will prevent slaughtering of all pigs. It will also reduce treatment costs. CSFV_GODIVA additionally developed new tools to monitor and control the disease. The team created a cheap and portable colorimetric test that is more effective for field testing. They also set up more effective vaccine delivery system.

ChinaAccess4EU aimed to raise awareness and disseminate access opportunities for European researchers and research organisations in Chinese national research and/or innovation programmes. The project's goal was to identify the Chinese programmes open to EU researchers and promote their participation. To reach its aim, ChinaAccess4EU mapped the access opportunities in China. It produced fact sheets of Chinese research funding programmes. The team spread monthly alert with the latest opportunities and biannual newsletters. Case studies of European participation in Chinese programmes were also analysed. The consortium organized project training workshops and match-making events in China as well as in Europe. Finally, a strategy paper for improving reciprocity in EU-China S&T cooperation was disseminated among stakeholders and policy makers.

The project INPAC (Integrating Post-Abortion Family Planning Services into China's existing abortion service in hospital settings) focuses on induced abortion, which implies a high risk of injury or long-term physical and psychological morbidity and a significant social and economic burden. In 2008 around 13 million induced abortions were realized in China. The INPAC project aims to include post-abortion family planning services into abortion services in hospital settings in China. It will also

assess the effectiveness of the interventions in regard of reduction of unwanted pregnancies and repeat abortions. Policy recommendations on health system organization will then be developed and disseminated. The project aims to take part in the standardization of post-abortion family planning services and decrease the costs related to abortion in China.

INPAC supervisors at the site of the First Sub-Hospital of Kunming Medical University

The project CHOICE will strengthen collaboration between China and Europe on ICT research. The ICT sector has taken more and more importance in the Chinese economy. European researchers can profit from accessing the Chinese ICT research environment. Chinese ICT research can also benefit from accessing the European research community. Horizon 2020 focused on mutual interest and common benefit in the relation with China. CHOICE is developing the EU-China partnership on ICT research and creating a bridge towards Horizon 2020.

EU-China thematic workshop on internet of things

MIDFIL (Mid-Infrared Fibre Lasers) main goal is the knowledge transfer from the Marie Curie International Incoming Fellow Dr J. Li, who is working on fibre laser science and technology and mid-infrared (mid-IR) fibre lasers, to the EU host Photonics Research Group (PRG) of Aston

University. MIDIR will also work on the knowledge transfer to 4 EU co-host Universities: Leeds Univ., Heriot-Watt Univ., Tamper Univ. and Universite de Mons. They will carry out research in novel mid-IR fibre laser science and technology. Dr J. Li will develop industry placement with two EU industrial co-hosts to look for applications and commercialisation.

Chongqing doesn't host FP7 projects but welcomes an IRSES project: LIE-DIFF-GEOM (Lie groups, differential equations and geometry). The key objective of the project is to create and develop a cooperative research network. The half of the research groups is focusing on algebra and other half works on geometry. With different backgrounds, new synergies and methodologies should be created and improve the research activities.

CACHET II: Carbon dioxide capture and hydrogen production with membranes

Pollution is reaching levels never seen and has disastrous impact on people's health and living conditions. Countries are trying their best to lower their gas emission, develop renewable energy and reach their environmental targets. The green market is consequently blooming. Since China declared war against pollution and the EU committed itself to its 2020 environmental goals, gas emission and renewable energy are high in the agenda for both of them.

CACHET II (Carbon dioxide capture and hydrogen production with membranes) looked for solutions to two major environmental issues: green energy production as well as carbon capture and storage. CACHET II worked on membrane technology, a process that captures pre-combustion carbon dioxide. Coal and gas-fired power stations emit syngas, a gas composed of hydrogen (H2), carbon monoxide (CO) and carbon dioxide (CO2). The palladium (Pd) membrane is only permeable to H2 and separates it from CO2. This hydrogen can then be used as fuel for clean energy production. The carbon dioxide is left concentrated at high pressure, which makes it easier to transport and store it.

CACHET II brought together European and Chinese partners from universities, technical institutes and industry in order to optimize the palladium membrane developed in the FP6 programme CACHET. In this FP6 programme, pure Pd membrane technology produced by the electroless plating method of Dalian Institute of Chemistry and Physics (DICP) had been successfully demonstrated. The project CACHET II succeeded in improving Pd membrane technology.

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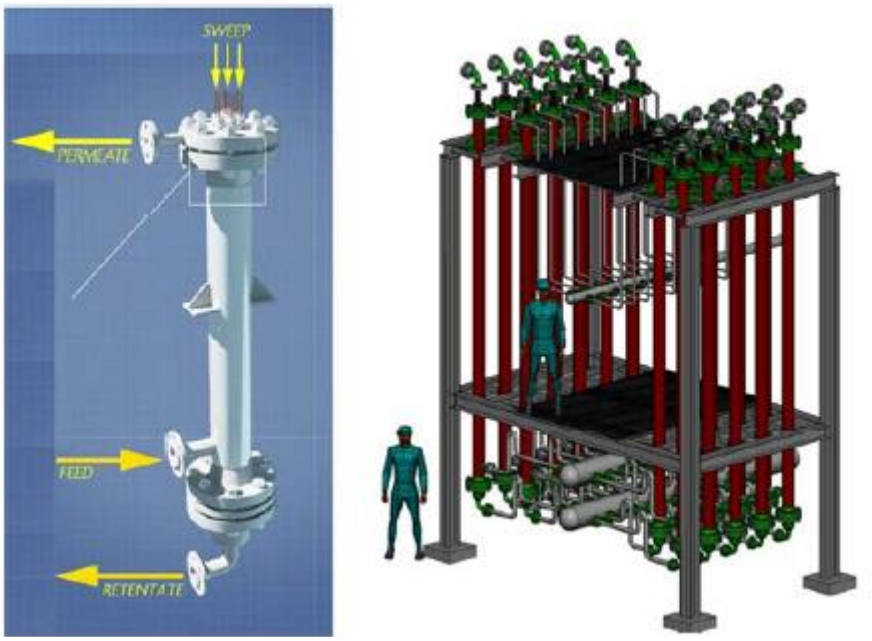
Ceramic tubing support is used and CACHET II wanted to use metal vessel in order to develop a commercially exploitable module assembly. A ceramic-to-metal mechanical sealing resistant to high temperature and pressure was thus required. The European and Chinese consortium both developed the existing seal and created a new one. Both were successfully tested for long-term use and can ensure between 120 and 150 day of stability while keeping H2 purity around 99%. Shenyang Institute of Metal Research (IMR) was in charge of the development of an innovative sealing technology.

The efficiency of the Pd membrane can be undermined by concentration polarisation effects, a phenomenon that decreases the permeability of the membrane with the time. Effective membrane separators and reactors are thus required to avoid this. The new Pd alloy membrane material prevents the saturation of the Pd-alloy surface and the decrease in H2 purity. The Pd alloy with added silver and gold proved to be the best and improved the permeability by 212%.

Pd membranes can also be undermined by sulphur compounds present in the syngas. Sulphur resistance is thus necessary to use Pd membranes into the production of energy and heating. CACHET II developed Pd-alloy material more resistant to sulphur. This new solid sorbent material avoids the cost linked to cooling and reheating of syngas and increases the energy efficiency. Thanks to this new

material, energy consumption per tonne of CO2 can be reduced by 25%. Consequently, it enhances economic benefits and competitiveness of Pd membrane in solid fuel application.

Finally, CACHET II scaled up the existing 50 cm membrane to a one meter membrane. Additional surface treatments were required to reach this objective.



The membrane module and an arrangement of 20 industrial size membrane modules

The long-term stability of the new membrane was proved by developing a scale-down version of commercial membrane module. The test measured its performance in simulated industrial conditions. The demonstration membrane lasted 1000 hours of operation under constant hydrogen permeance and with hydrogen purity higher than 95%.

In order to disseminate the findings of the project, seven papers with peer review were published. Three workshops were also organized and met a great success. The first public CACHET-II Workshop was held on 11th April 2011 at the Dalian Institute of Chemical Physics (DICP), as part of the International Conference on Clean Energy Science (ICCES).

The results of CACHET II advance greatly the existing membrane technology. This system seems a promising way to reduce gas emission and produce renewable energy. It could limit pollution and prevent its climatic and health consequences. Moreover, the growing environment concerns around the world announce opportunities for green industry. The partners of this project are well positioned to benefit from the new industry sector that is membrane technology.

PRACTICE: Prevention and restoration actions to combat desertification.

An integrated assessment

Desertification doesn't refer to the advance of deserts but to a phenomenon of persistent land degradation of dryland ecosystems caused by various factors, mainly human activities (unsustainable farming, mining, overgrazing and clear-cutting of land) and climate change. Desertification is a major global ecological and environmental challenge. Drylands represent 41% of the world's land. 70% of them are risking desertification. This phenomenon has serious implications for people, livestock and environment. Around two billion people depend on ecosystems in dry land areas. 50 million of them may be displaced within the next 10 years due to desertification.

People and authorities are trying to tackle this devastating evolution and restore the damaged lands. However, these actions and their results are largely undocumented and assessed. The project PRACTICE aimed to address this gasp in information sharing.

The team created a common international platform linking 21 sites affected by desertification for long term assessments of the actions undertaken. Data are collected and shared from sites in the Mediterranean Europe, Africa, Middle East, China, North and South America. They include a broad range of social, economic, political and cultural contexts. The platform collects and disseminates experiences and data on land restoration and sustainable management of drylands. It will support future analysis by enhancing accessibility of information and disseminating the best practices. The data are available for all stakeholders: local people living from the land, members of environment organisations, policy makers and scientists.

Degraded pastures, Qingchao's and Yuguang's farms. Changchun, Jilin Province, NE China
Improved pastures, farmers participation

PRACTICE also set up an assessment protocol, combining common indicators and site-specific indicators relevant to the specific situation. This protocol was tested and proved to be a consistent and adaptive evaluation tool. It is an integrated and participatory protocol. It integrates human and biophysical dimension: ground-bases and remote-sensing approaches, biophysical and socio-economic evaluation as well as expert and local knowledge. All categories of stakeholders are participants and evaluators to the protocol.

The participation of the Institute of Grassland Science, Northeast Normal University-NENU (Changchun, Jilin Province, NE China) incorporated a unique site in terms of socioeconomic and biophysical conditions to the PRACTICE platform. In such way, the methodology for stakeholder participation in the evaluation of restoration practices was tested and proved to be successful in a large variety of site and socioeconomic conditions, worldwide representative. The NENU team benefited from the exchanges of technologies and approaches developed in other grazing management systems in the world, and from the acquisition of the participatory protocol jointly developed in PRACTCE, that could be incorporated in the good management practices in China.

Improved pastures, farmers participation

The team promoted social learning developed education material in order to disseminate its findings and data. The results were also shared among national contact points and local communities. Experts from the United Nations Convention to Combat Desertification (UNCCD) were also involved.

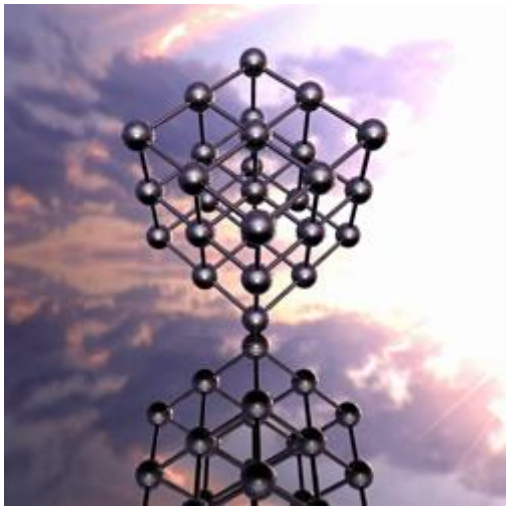
Desertification, along with climate change and the loss of biodiversity, were identified as the greatest challenges to sustainable development during the 1992 Rio Earth Summit. Thanks to PRACTICE, people dealing with this issue will access data from other parts of the world, learning from each other. This will help to take better decisions in the future. This knowledge-sharing will support the definition and implementation of efficient national action plans to combat desertification. Moreover, PRACTICE facilitates communication between the different stakeholders.

M3-2S: Multiscale modelling for multilayered surface systems

In most of the cases, engineering components fail because of surface-related issues, which include inadequate coating adhesion, cracking and impact defects. Many of the surface treatments used are multilayered surface systems (MSSs). They are made from layers of different thicknesses, going from nano (nanometre) to micro (micrometre) to macro (millimetre) scales. MSSs have been designed so far based upon experience and not models. The creation of an accurate and detailed models is required to speed up the design process and improve performance.

The project M3-2S 'Multiscale modelling for multilayered surface systems' (M3-2S) aims to fill this critical need. It developed finite element (FE) method to simulate the three different structural levels. This method is a numerical technique using subdivision of a problem domain into simpler parts, finite elements, to describe continuous physical systems.

M3-2S focused on the atomic-scale FE method (AFEM) to advance the nano-scale behaviour . Micro-scale effects were studied through the crystal plasticity FE (CPFE) method. Finally, macro-scale behaviour was described thanks to continuum mechanics FE modelling. The project realized significant progress on the three topics.



In a second time, the project team produced an advanced surface engineering system in order to create a materials property database for modelling work and for validating modelling results. The materials surface modified by the project for demonstrators included alloys, cermets and ceramics. Advanced surface characterisation techniques were also developed.The modelling technologies and software were tested and validated under various load conditions in controlled laboratory environment and then industrial conditions with a good match between predicted and experimental crack initiation.

M3-2S produced a highly accurate design tool for MSSs. These progresses will likely have positive implications for competitiveness of this sector of the economy. The results were disseminated through M3-2S website.

UrbaChina: Europe, China and the World in 2050

Urbanization is taking place in China at a fast pace and on a massive scale since 1978. While the Chinese urban population reached 572 billion of citizens in 2005, it will approach 926 billion in 2025. This increase is equivalent to building a city of Shanghai's size every year. The evolution affects almost all socio-economic aspects of China and raises sustainability issues: how will the cities manage to create jobs, develop infrastructures, provide health and education structures and lower pollution? The UrbaChina project has undertaken the task to find answers.

UrbaChina is a collaborative project managed by 11 Chinese and European research institutions. The programme focuses on 4 main themes: cities governance, economy and social policies, lifestyles, planning and environment. Interviews and fieldtrips proved that these four topics answer to Chinese urban stakeholders' expectations. Four cities, very different, were selected for the project: Shanghai, Chongqing, Kunming and Huangshan.

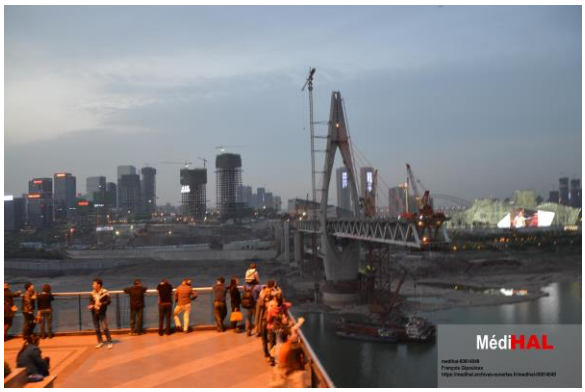
The objective of the programme was to identify the main conditions for urban sustainability and to provide answers for the current and future challenges raised by the urbanization process. In order to reach that goal, UrbaChina analysed the trends that will structure China's urbanisation for the next 40 years and defined possible future scenarios. All the information gathered by studies, workshops, surveys and field trips allowed the project team to identify the main critical uncertainties of urbanization and, on that basis, to create scenarios for the future of Chinese cities. Two of them were developed into full storylines describing possible evolutions of Chinese cities.

Kunming

Huangshan

These storylines were based on a combination of two main dimensions: the pace of economic growth and its priority in public policies as well as the pace and nature of policy reforms. The Bamboo scenario implies a rapid and unregulated growth and an accelerated pace of production and consumption. The Gingko scenario features a regulated growth and more attention paid to the social and environmental context. Surveys were conducted on the plausibility and desirability of key aspects of the two storylines. The Bamboo storyline is seen as highly plausible but less desirable than the Gingko one. However, the Gingko scenario would require major policy changes.

In developing these fictional cities' evolutions, the UrbaChina project identified challenges that the policy-makers will have to face, the possible solutions and their probable consequences. The team can afterwards propose the most efficient strategy towards urbanization and inform policy-makers and society on sustainability issues, thanks to strong dissemination strategies. The storylines aim to help decision-makers to create a strategy for a desirable future in the medium and long term. The results will be communicated to the Chinese government, the city planners and the economic actors in order to advise them in their decisions towards the current and future challenges raised by the growing urbanization.


Chongqing

Several other concrete results can already be observed. UrbaChina has enhanced the common understanding of urbanization trends in both China and Europe. Since March 2011, the project teams have visited the four selected cities. Contacts have been established with Chinese academics, officials and businessmen of these cities. Chinese stakeholders have high expectations on sustainable development policies in cities, and they are interested in learning from the past experiences of Europe. The implementation of new partnerships with local Chinese institutions has strengthened these relations. This cooperation is likely to continue after the completion of the project and contribute to the development of innovative European solutions in the Chinese context.

Moreover, the UrbaChina programme has increased its attractiveness to Chinese and international stakeholders with the launching of its own website, and the printing of brochures in both English and Chinese. The UrbaChina blog also provides the latest news on the four specific themes and information on ongoing research within the UrbaChina project. Besides the working papers, other resources are available and offer a didactic way to become familiar with the topic: audio-conferences, movies and videos on urbanization in China or in Europe. Pictures of the cities are also being gathered to illustrate the current situation and the challenges faced.


Shanghai

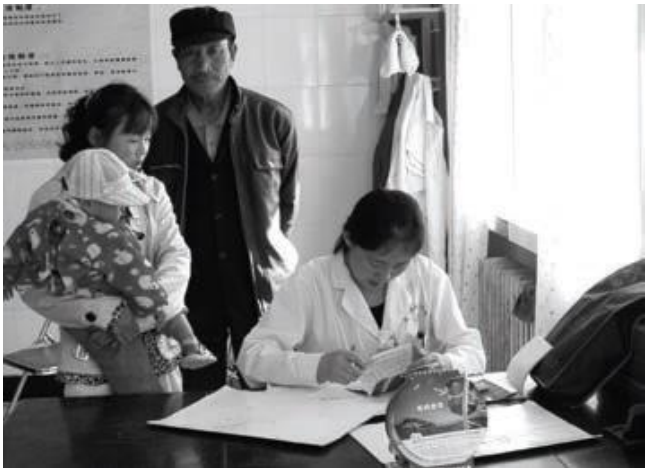
HEFPA: Health equity and financial protection in Asia

Millions of people still don't have access to effective health care interventions. The lower incomes are the most concerned group of the population as the price of health care is one of the main causes of the deficiencies in access. The lack of efficient health cover doesn't only impact people health, but also living standards as the medical expenses can drive families into poverty or worsen their situation. In addition, it decreases productivity and adversely affects the economy.

Health cover is being extended in many countries of Asia at varying speed and with different financial instruments. The project HEFPA (Health equity and financial protection in Asia) used this evolution to examine the feasibility of extended health insurance coverage and its impact on access to efficient health care and on limitation of the financial risks. Six countries were studied: Cambodia, China, Indonesia, Laos, the Philippines, Thailand and Vietnam.

First, the team carried out descriptive comparative research between the countries in order to identify the causes and consequences of limited access and affordability of health care. HEFPA came with a new method to measure catastrophic medical expenditure risk, not only based on access to health care but adding other factors such as quality or affordability. This innovative method stressed the higher risk for poorer households with fewer assets, living in poorer standard housing, less educated and using less strategies for coping with medical expenditures. Illness-induced income loss remains a major financial risk to Asian households even when comprehensive health coverage is set up. The new methodology established that medical expenditure risks are higher in China and Laos.

Secondly, the project looked for solutions to these issues through the design and implementation of health financing country-specific reforms. The Chinese Government launched in 2003 the New Cooperative Medical Scheme (NCMS) with a mainly tax-financed insurance. Between 2008 and 2012, the government subsidy per person tripled, resulting in a decrease of the out-of-pocket (OOP) expenditure share in total health expenditure. However, household medical expenditures have keep rising in absolute terms. The team confirms that the NCMS in rural China succeed in increasing access to care, but does not improve financial protection because providers increase prices and/or provide more expensive care.



In Ningxia, HEFPA conducted a quasi-experiment modifying the NCMS in some counties to increase coverage for outpatient services. The intervention led to a significant increase in the probability of receiving outpatient care at a village clinic, especially for those with poorer or middle-incomes. The experiment in Ningxia also replaced fee-for-services with capitation and pay-for-performance payment of providers. This second test showed a reduction in the probability of antibiotics being prescribed at township health centres and village clinics when not necessary. The Ningxia experiment showed that a change in the structure of the coverage can reduce OOP payments. Provider incentives can increase the appropriateness and quality of care that can be accessed.

In the latest Five Year Plan, the Chinese government identified provider payment reform as a priority. According to HEFPA findings, this is an appropriate answer but should be coupled with improved accountability of the facilities. Coverage extensions increase the utilization of health care but improvements in financial protection are much harder to achieve and depend on complex interactions between the design of insurance and provider payment.

The project reflects the high priority of health care coverage in the agenda of both the EU and Asian countries, as the 2010 World Health Report made universal coverage one of its main issues. HEFPA created a new method which improved the monitoring of health equity and financial protection. The team also provided policy suggestions to solve the problem faced by the current reforms in health covering. Ultimately, the project offered tools and advices on how to establish more accessible and affordable health care in Asia. The conclusions present an interest for the studied countries but also more broadly for international health policy.

Henan (Zhengzhou)

The Henan province welcomed four FP7 programmes, all of them still in progress.

The project Greenhouse Gas Recovery from Coal Mines and Unmineable Coalbeds and Conversion to Energy (GHG2E) enters in the energy programme. Coal mining utilisation releases methane and represents an important challenge for the fight against pollution. China's coal emissions are responsible for 670,000 deaths a year. Coal Mine Methane drainage processes allows the recovery of methane from the emissions during coal production. Primary and enhanced coalbed methane recovery can also extract methane from virgin coal seams. The main objective of GHG2E is to improve methane drainage efficiency and purity in coal mines in China and India. The project will also develop new gas drainage techniques. In addition, the team will work on methane recovery and CO2 storage. The results will be shared across the coal sector internationally.

The project "TOPS" or Technology Options for Coupled Underground Coal Gasification (UCG) and CO2 Capture and Storage (CCS) also works on energy and coal. Underground coal gasification (UCG) is an industrial process which converts coal into product gas. CO2 Capture and Storage (CCS) allows to stock CO2 and prevent it to enter our atmosphere. The main objective of the project TOPS is to develop new UCG-CCS technologies to solve the problems currently met by this process. The environmental impacts and costs of the technology options identified will then be evaluated. The project aims at minimising the need for on-site CO2 storage capacity. It will also maximise the economic benefits of UCG.

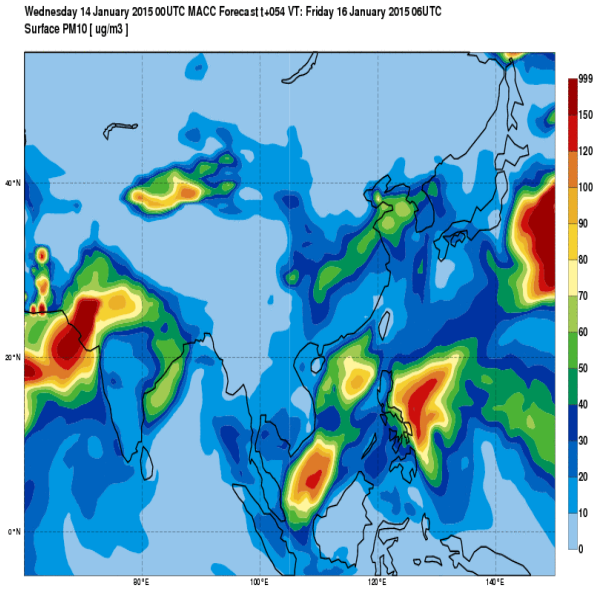
The Henan province is also hosting two Marie Curie Actions: "International Incoming Fellowships". The first one, NANOTESULPHIDE (Spark Plasma Sintering Nanostructured Thermoelectric Sulphides), concerns thermoelectric (TE) power generation. This technology could convert waste industrial heat into useful electricity and thus provide alternative energy sources. The second project, Multi-scale Modelling of Mechanical Damage to Tomatoes (MMMDT), works on the quality of fruit. It aims to investigate internal damage caused by external forces during handling and processing.

MarcoPolo and Panda (PArtnership with chiNa on space DAta)

China is currently facing a serious issue of air pollution. According to a World Bank study of 2007, 99% of China's 560 million urban residents breathe air that is considered as unsafe by European Union standards. Coal consumption creates PM2.5, "Particulate Matter" with diameter of 2.5 micrometres or less. That kind of particles causes asthma, bronchitis, acute and chronic respiratory symptoms, and premature deaths. The Chinese government declared a "war on pollution" and increased governmental efforts to limit air pollution. Monitoring air pollution is necessary to keep track of the improvements but it has proved to be a challenge. On January 2013, air quality index levels in Beijing were beyond existing measurement. Up-to-date regional air pollution information and means for emission control are becoming more and more important to fight air pollution.

Two projects have gathered Chinese and European partners to study air quality in China thanks to space observations: MarcoPolo and Panda (PArtnership with chiNa on space Data). MarcoPolo focuses on emission estimates from space and their refinement. The project used data from various satellite instruments. These emission data are then added to known information from the ground in order to create a new emission database. The new emission inventory is expected to enhance the existing air quality modelling and forecasts.

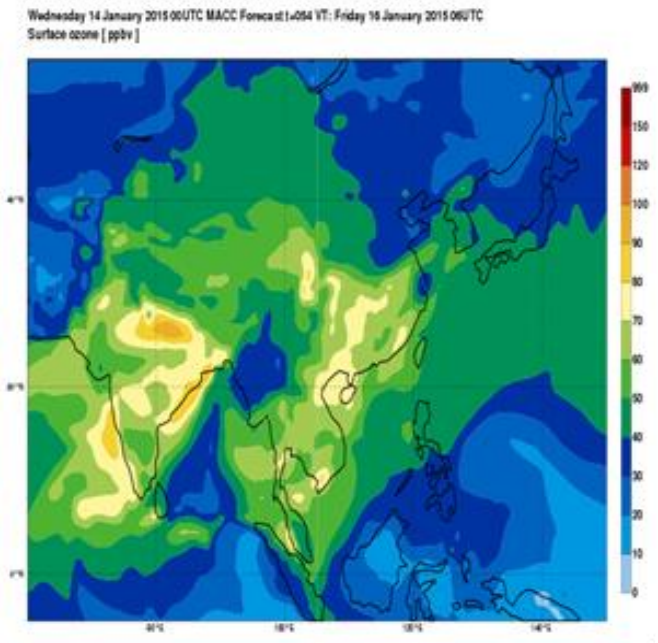
The PANDA aims to set up a team of European and Chinese scientists who will use space observations, in-situ data and advanced numerical models to monitor, analyse and forecast global and regional air quality. PANDA will create knowledge, methodologies and toolboxes to establish global and regional air quality analysis and forecasts. It will provide information to help regional and local authorities in managing air quality.



Example of PM10 forecast

These two projects have teamed up, launching a common website to promote their results. They are both ongoing but they already publish some results. The MarcoPolo team has started to collect data on air quality and to improve the algorithms to analyse them. Preparations have started to set up a MAX-DOAS instrument in the Pearl River Delta. Multi Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) measures solar stray light at different angles in order to quantify trace gases (gases including all gases except nitrogen and oxygen). MAX-DOAS has a very low residual error and detects trace gases in low concentration in both pristine and polluted environments.

Panda organized international symposium, forum tutorials and workshops, providing occasions for researchers to meet and share information. In Augustus 2015, the first Summer School will take place, where users and stakeholders will be trained to use the key products and data generated by the project. The Institute of Atmospheric Physics from the Chinese Academy of Sciences already collected the in-situ data from North China and is evaluating them with the satellite data. Nanjing University of Information Science & Technology is developing an ozone-tagging method. PANDA also proposes daily Air Quality forecasts for pM2.5 and PM10. In addition, the project published regional scale modelling and model evaluation.



Example of ozone forecast

Ultimately, both PANDA and MarcoPolo will build the knowledge and data-monitoring required to effectively tackle air pollution. They will provide advice to support the Chinese authorities in their fight against pollution.

URGENCHE: Urban Reduction of GHG Emissions in China and Europe

According to estimations, China's emission of Greenhouse Gas (GHG) is the largest in the world and represents more than the US and Canada emission put together. The Chinese emission increased by 171% since 2000. Consequently, China decided to tackle the issue. However, GHG reduction policies have a complex impact on public health, urban transport or well-being and must consequently be managed carefully.

The project Urban Reduction of GHG Emissions in China and Europe (URGENCHE) gathered experts from Europe and China working in close collaboration with cities in order to estimate the potential impact of different GHG emission policies. The team developed and applied a methodological framework for the assessment of the risks and benefits of alternative policies. They created a modelling platform and an accurate database. The results will show the consequences of two different policies until 2030 for health and well-being. The main focus will be on transport and buildings.

URGENCHE will create validated methodological framework to assess GHG emission policies for cities with a population between 50,000 and 10 million people. The differences in climate and socio-economic background will be integrated in the framework to determine which policy has the better results in regard of the specific situation of a city. For each of the cities studied, the project will create an optimised GHF reduction policy package as well as a roadmap to this optimised policy future.

The Environmental Protection Agency of Xi'an took part in the project and brought its expertise of environmental and health technologies. Peking University and Nanjing Universities were also members of the consortium.

The project put together specialists and stakeholders who created together the tools required to advice policy makers in the future and optimise their decisions.

SIOS-PP: Svalbard Integrated Arctic Earth Observing System - Preparatory Phase

Due to climate change, the Arctic is warming up rapidly with dramatic consequences for the global earth system. The Svalbard Integrated Arctic Earth Observing System (SIOS) is an international infrastructure project. It will consist in a regional observational system developing and disseminating knowledge on global environmental change. It will be located in Svalbard, a Norwegian archipelago of the Arctic Ocean very suitable for climate research. The region has a large climate gradient, alternately influenced by cold central Arctic and mild marine climate. It also allows separating internal and external factors of climate change, making research more effective on the topic. In addition, Svalbard already has substantial data coverage and infrastructures.

SIOS will provide coordinated services for the international research community. It will improve collaboration and integration between the existing research infrastructures in Svalbard. SIOS will be built upon existing national system and centres and will also establish a joint Knowledge Centre in order to coordinate and manage shared resources, data and activities. This centre will set up new services for the international research community, including coordinated open access to research facilities, data and resources sharing and knowledge management.

The Svalbard Science Centre. (Photo: Steve Coulson/UNIS).

SIOS-PP (Svalbard Integrated Arctic Earth Observing System - Preparatory Phase) helped the 51 institutions and 18 countries involved in laying the foundations for the next steps of the observing system.

The team gathered the knowledge base necessary to take decisions. Various legal options for the organisation of the SIOS project were analysed and assessed. A basic model with Norwegian national ownership and operational responsibilities was developed. Thanks to this knowledge building, SIOS-PP produced an in-depth report that advised the partners on a final legal and financial basis on which decisions and commitments can be made.

SIOS-PP then established the legal and governance structure, financial strategy, services framework and integration or cooperation strategies. The project also provided an implementation plan. It lead to an agreement on the government structure with a clear plan for the organisation of observation platform and the selection of legal framework and legal status, necessary for the implementation of the financial agreement.

Decisions on which scientific entities will be included in the SIOS legal entity were taken. In addition, the team developed internal scientific and observational integration strategies. Working group to coordinate SIOS with other arctic research networks and projects were created.

The team also evaluated the needs of the future SIOS users. They conducted investigations related to logistics planning. Contacts were made with satellite operators to integrate the satellite remote sensing sector in SIOS earth observation strategy.

SIOS-PP set the stage for the development of the regional observational system. SIOS has now finalized its preparatory phase and is starting an interim phase with implementing the SIOS centre of coordination (Knowledge Centre) in Longyearbyen, Svalbard. Nine polar research institutions/countries expressed their willingness to take part in the SIOS implementation work. One of these is the Polar Research Institute of China (PRIC). By becoming member of SIOS, the institute receives access to a much larger research infrastructure which continuously and jointly will be better integrated, developed and upgraded to state-of-the-art. Each member of SIOS will benefit from the joint services set up under the SIOS Knowledge Centre which will provide better and open access to research infrastructure, facilities and logistical services, better sharing and open access to data, state-of-the-art knowledge management and training activities, as well as active participation in an activity program aiming at better integration of the different members own and future research infrastructure.

Thanks to SIOS, costs will be saved by better coordination. Costs are indeed very high for research in the arctic as infrastructures are expensive and not used to their full capacities. SIOS will favour better and more research for less money. SIOS will also attract cooperation with industries as need to develop new remote sensing instruments and infrastructures are rising. Moreover, SIOS will strengthen cooperation in Europe and beyond.

Climate change is a pressing challenge. Decisions will be required in the coming years. To take wise decisions, reliable knowledge is a prerequisite. In regard of the environmental impact, SIOS will thus contribute to our understanding of climate change and develop observational programme and advices for national strategies.

HINAMOX: Health impact of engineered metal and metal oxide nanoparticles

Response, bioimaging and distribution at cellular and body level

Metal oxide and metal nanoparticles (NP) are used in various industrial materials and consumption products, including creams, fuel or electronic devices. However metal oxide and metal NPs may have an impact on human health. They can affect intracellular biochemical processes and cell metabolism. According to previous research, the impact of the NPs is determined by the particle size, shape, chemical composition and capping agent. These properties as well as their effects on human health must thus be studied to assess the safety of the products and to draw regulations.

The project HINAMOX (Health impact of engineered metal and metal oxide nanoparticles: Response, bioimaging and distribution at cellular and body level) adopted an interdisciplinary approach including synthetic chemistry, production technology, particle physics, biochemistry, toxicology and occupational hygiene.

The consortium systematically characterized the different NPs available in the commerce by their structural properties, their size and their catalytic activity. Their presence and behaviour inside biological fluids was also studied. The consortium designed florescent and radio-labelled NPs in order to keep track of the particles during tests in vitro (on cells studied outside their normal biological context) and in vivo (on whole, living organisms). The Chinese partner, Prof. Changyou Gao from the Zhejiang University, was involved in fate studies in vitro. Prof. Gao's group is well known in the study of materials biointeractions and brought to the consortium expertise on the behaviour of nanomaterials in cells, mainly using electron microscopies.

In a second time, the consortium analysed the uptake, distribution and release of NPs in vivo. They determined the level where the exposure becomes toxic. It was proved that the toxicity depends on the dose more than on the nature of the NPs surface. The team also carried out research on immune response in vitro. They identified the physiological effects of NPs exposure.

The team then studied the interaction of NPs with cellular and extra-cellular components. They observed the patterns of NPs depending of the exposure routes (oral, inhalation, topical or intravenous). The consortium finally analysed the risk of exposure and toxicological effects of metal and metal oxide NPs.

The HINAMOX project realized major progresses in the understanding of interaction between metal or metal oxide NPs and the human body. This basic knowledge is required to assess the potential impact of the products using NPs on human health. The results also have an economical importance as the acceptance of this material in consumption products depends on reliable information about its consequences for human health. Knowing the toxicity points will also help industries in the future development of their products. Moreover, the quantification of the dose of toxicity is crucial to develop regulations on the use of metal and metal oxide NPs. The international dimension of the consortium reflects the desire to develop in the future common safety standards with these countries.

The Chinese group interacted closely with all the partners and has been very active in the research activities and meetings.

MetaHIT: Metagenomics of the human intestinal tract

Obesity and inflammatory bowel diseases, mainly referring to ulcerative colitis and Crohn's disease, represent a growing challenge for public health. Obesity represents a major issue in developed countries and inflammatory bowel diseases have been gradually increasing over the last decades. The genetic contribution of these conditions is poorly understood. A detailed knowledge of the human genome (genetic material of an organism) is required but it is also important to study the human microbial metagenome in order to understand these diseases. Microbes are indeed present in the human body and they encode more genes than our own cells. The microbiota of the intestinal tract is the most complex and has a high impact on human health and well-being.

The project MetaHIT aimed to establish associations between the genes of the human intestinal microbiota and the health and disease. First, the project catalogued and assessed microbial genes to differentiate between diseased and healthy states in individuals. The study was carried out on 124 people and 85% of the frequent genes present in their microbiota were identified.

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The team then created the generic tools required to organize this information and study the variation of human intestinal microbiota. MetaHIT determined which genes are present in different individuals and at what frequency.

The project worked on ulcerative colitis and Crohn's disease by comparing patients in remission with healthy individuals, preferably from the same family. It was proved that some bacterial species differ in the two groups. The project showed the correlation between the presence of specific genes in the intestinal microbes and health and disease. The team then focused on obesity. Differences in bacterial species were found between the obese and the lean people.

The project developed methods to study the function of bacterial genes associated with disease aiming to understand the underlying mechanisms and host/microbe interactions.

The consortium identified three types of individuals with different composition of their gut microbial communities. These enterotypes are individual-specific with no correlation with age, gender, food, geography or genetic heredity.

MetaHIT brought together 12 European and 1 Chinese organisations. The project involved more than 60 people. The BGI-Shenzhen conducted a study focusing on diabetes and using the quantitative metagenomics. The first conference dedicated to the human microbiome was also organised in Shenzhen in March 2010. It gathered some 220 participants from 27 different countries.

The impact of the project may be observed in three fields: scientific, industrial and societal. The project developed a technique allowing for a more complete coverage of gut microbiota. In regard of the industries, the results of the project could be used by both the pharmaceutical and the nutrition sectors. Moreover, the enterotype discovery represents a major progress that may lead to a break-through in our understanding of these diseases, required to be able one day to find a solution.

-REDD+: Impacts of Reducing Emissions from Deforestation and Forest Degradation and Enhancing Carbon Stocks

Deforestation and forest degradation account for 17% of global greenhouse gas emissions, second only to the energy sector. The appellation REDD+ stands for Reducing Emissions from Deforestation and Forest Degradation. The + designates the improvement of carbon stocks with conservation and sustainable management of forests. REDD+ is a mechanism negotiated under the United Nations Framework Convention on Climate Change (UNFCCC) that allows developing countries to obtain financial compensation for reducing their emissions of greenhouse gases and removing greenhouse gases through improved forest management.

Measuring tree girth in Xishuangbanna, Yunnan, China (Ole Mertz)

I-REDD+ aims to improve the understanding of how to implement efficiently REDD+ mechanisms. The project studies various aspects of the issue such as quantification of greenhouse gases emissions, monitoring change in land use and biomass, community-based monitoring, local livelihoods or governance. I-REDD+ works on Southeast Asia and includes field sites in Laos, Vietnam, Indonesia and China. Research in China focuses on Manlin Administrative Village in Xishuagbanna Prefecture of Yunnan Province. In the past decades, the area has been through major changes: rubber replaced the shifting cultivation system, 'forest tea' were integrated in remaining forest areas and banana and commercial vegetables replaced wet rice cultivation.

Kunming Institute of Botany (KIB) has been leading all work carried out under I-REDD+ in the field sites in Yunnan Province. They moreover hosted the post doc responsible for much of the governance work. The involvement of KIB has been crucial to the project and has fostered new collaborations between the European partners and KIB.

I-REDD+ already produced significant results. The project undertook to fill the lack of methodologies and knowledge available for dealing with forest degradation. Mapping and monitoring are major issues for the implementation of REDD+ mechanisms as they are necessary to measure progress. The project developed more accurate allometric models for belowground biomass. It found that belowground biomass may be underestimated in swidden fallows.

I-REDD+ also improved the mapping of forest regrowth and densities through a combination of a landscape mosaic approach, optical data and cloud insensitive synthetic aperture radar. According

to the research conducted by I-REDD+, a combination of MODIS and high-resolution data is promising for the national level monitoring. For the regional and sub-regional level, new approaches with dense Landsat image time series are developed for monitoring forest changes in dynamic landscapes.

In addition, I-REDD+ highlighted that local community are able to monitor the above ground biomass of their forests with a level of precision similar than the one of professional foresters. Moreover, precision grows with experience. This method of monitoring would be cheaper in the long run. It would also increase participation and legitimacy of REDD+ and strengthen control rights of local communities.

The potential costs and benefits of REDD+ for local livelihoods and food security were assessed by the programme through opportunity costs analysis and participatory simulation. These simulations evaluated the impacts of hypothetical REDD+ schemes on carbon sequestration, livelihoods and food security. I-REDD+ also analysed different payment scenarios under different governance and institutional structures but no single solution were found relevant for all contexts. A paper on tree planting in Yunnan stressed the role of government programs for tree planting on former farmland even if private initiatives are also emerging.

Farmers identifying land use on satellite image, Xishuangbanna, Yunnan (Old Mertz)

Finally, a stylized system dynamics model was created to show how regime shift in land systems can be triggered. This model improves the understanding of regime shifts in land systems.

The results have been widely shared through consultations and conferences in the Southeast Asian partner countries and in international events such as the UNFCCC COP18 and COP19. I-REDD+ results are likely to be considered in policy-making at national level in Southeast Asia and at the international REDD+ negotiations.