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Sustainable Agriculture in the Frame of Sustainable Development

M. Lodovica Gullino and Corrado Clini

The agro-food sector is a major component (of course, not the only one) of sustainable development and represents a highly relevant example of the main issues which this topic at large can raise. Today, the world is not food secure in terms of access to food. Moreover, most populations in the developing world are increasing rapidly. By the year 2020, there will be an additional 1.5 billion people to feed. Improvements in yields on a sustainable basis will be needed to meet the food demand of this growing population. Today, over 800 million people, equivalent to 15% of the world's population, get less than 2000 calories per day, live a life of permanent or intermittent hunger and are chronically undernourished. Most of the hungry are women and young children. About 180 millions under 5 years old are severely underweight for their age.

Lack of proteins, vitamins, minerals and other micronutrients in the diet is widespread. Over 100 million children suffer from vitamin A deficiency. They are more likely to develop infections and the severity of the infection is likely to be greater. Each year half a million go blind and some 2 millions die as a result. Iron deficiency is also common. About 400 million women of childbearing age (15-49 years old) are afflicted by anemia caused by iron deficiency and are therefore more likely to die in childbirth.

Agriculture is an essential engine of economic growth in the developing world. Local gains in productivity will not only increase food security for the poor, they will also increase farmer incomes and allow them greater opportunity to break the cycle of poverty. A new system of sustainable agriculture is needed which is ecologically sound and meets the food needs of the poor.

Agriculture faces the need to meet new challenges both in highly industrialized countries as well as in developing countries. Such challenges are represented by sustainable growth, social integration of rural communities and proper use of the advantages deriving from emerging global markets.

The Focus published on this Newsletter issue concerns the work done in China over the past years in the field of sustainable agriculture, aimed at building a solid partnership between Italy and China in this important domain.

MEPs push back new EU car-pollution limits

The European Parliament's environment committee voted to delay the introduction of new EU laws known as Euro 5 aimed at reining in pollution from new cars.
The original draft suggested enforcing the new rules for private cars as early as mid-2008; but opposition from European car manufacturers, voiced in a high-level industry advisory group called CARS 21, seems to have frustrated this schedule.
A set of compromise amendments to the Euro 5 proposal was agreed by the committee: Euro 5 standards would start to apply a year later, as of September 1st 2009. Full compliance will become compulsory only as of January 2011. Heavier vehicles of more than 2,500 kg will have from September 1st 2010 to January 1st 2012 to comply. This category includes mini-buses of seven or more people and light commercial vehicles. The amendments also comprise an upward revision of emissions limits for hydrocarbons (HC) and nitrogen oxides (NOx) produced from vehicle exhausts which can contribute to smog formation and are harmful to human health.

Parliament approves extra funds for cleaning-up oil slicks

MEPs have adopted a first-reading report in which they back granting 154 million euro to the Agency responsible for maritime safety (EMSA) in order to better respond to pollution caused by ships.
After a series of oil slicks that devastated European coasts in the past decade, the Commission decided that it was necessary to grant additional funds to the European Maritime Safety Agency in view of helping Member States to provide an effective response to pollution caused by oil from ships. Thanks to the additional resources, EMSA will also be able to develop a centralized satellite imagery service which will facilitate the surveillance of European seas so as to detect polluting incidents earlier and identify the ships responsible.
The European Parliament adopted a report on this proposal wherein it supports the Commission's plans, although specifying that the activities of the Agency should not replace coastal states' action to combat pollution, but rather be complementary, providing, for example, adequate vessels for fighting pollution. The Parliament's report also extends the scope of the regulation intervention to deal with hazardous and noxious substances that can endanger human health and marine life.

EU environment ministers push for eco-efficiency

Increased eco-efficiency, new eco-taxes and abolishing harmful subsidies are the main elements of the new generation EU environment policy advocated by the Finnish Presidency.
EU environment ministers discussed a proposal for a "new generation of environmental policy" as, unfortunately, Europe is still very far away from a model of development that is anywhere near sustainable.
Changes in production and consumption patterns are needed, according to the EU environment ministers, and these should

be brought about by using economic incentives and the incorporation of environmental costs into prices; therefore, a plan to promote eco-efficiency and integrate material and energy efficiency into all EU policies was presented.
Moreover, the Commission was asked to adopt a Green Paper on the use of market-based instruments for environmental policies and the need for new, strong incentives that drive the market towards sustainability was expressed. Such incentives are environmental fiscal reforms and systematic greening of public procurement. Eco-taxes and the impact of subsidies that are harmful for the environment should be looked at in this Green Paper.

Cleaner air in Europe: more ambitious targets but greater flexibility

The European Parliament adopted a co-decision report on the "new" directive on air quality. The Parliament calls for more ambitious targets than those set out by the Commission for cutting maximum concentration levels of pollutants, in particular PM2.5.
At the same time, the Parliament calls for more flexibility in achieving the targets, to allow Member States, areas and cities which have problems meeting the criteria more time to adjust. However, there will be safeguards to ensure that Member States take the measures needed to reduce pollution.
The directive aims at reducing maximum concentration levels of the largest particles - known as PM10 - to 33 µg/m3 on average per year starting from 2010, as compared to the Commission's proposal to keep the limit at 40µg/m3. However, for the daily limits of these same particles - where the Commission states that a figure of 50µg/m3 should not be exceeded more than 35 times per year – it was requested greater flexibility (a maximum of 55 days per year) for Member States unable to meet the standards because of special geographical

or climatic condition or significant cross-boundary condition.
Moreover, new articles were requested as regards to the measures to be taken by the Member States to reduce atmospheric pollution notably the inclusion of norms for incinerators, heavy goods vehicles (Euro VI norms), the installation of domestic heating systems and measures to be coordinated at the European level to encourage ship-owners to reduce their pollution.

The thematic strategy on Urban Environment

Around 80% of the European Union's population lives in cities, where their needs and interests are often neglected by the EU's funds, projects and strategies. The Parliament adopted a report in which it welcomes a Commission paper on the Thematic Strategy on Urban Environment (TSUE). The TSUE would boost the overall environmental performance of cities in Europe by cutting bureaucracy, improving the implementation of environmental policy and encouraging long-term environmental planning at local level.
The Parliament strongly believes that a Sustainable Urban Management Plan (SUMP) and a Sustainable Urban Transport Plan (SUTP) should be required by Community laws for all urban areas

with over 100,000 inhabitants. Clear deadlines and binding targets at local and European levels would be needed, since voluntary measures have so far proven to be ineffective.
The Parliament says SUMPs should include waste management plans, noise maps and action plans, local air pollution plans and local environmental plans. SUTPs should promote non-motorised transport modes such as cycling and walking, promote public transport and tackle growing individual car use through parking restrictions and congestion charges. The report urges a greater use of environment-friendly modes of transport and technologies such as bio-fuels and hybrid car technologies. MEPs call on the Member States, in cooperation with local authorities, to make efforts to achieve a shift in inner-city passenger kilometer of at least 5% to sustainable transport methods, such as public transportation and cycling, within the period of 2002-2012.
The goal of the thematic strategy unveiled by the Commission in September 2005 is to reduce by nearly 40% by 2020 - compared to 2000 - the number of premature deaths caused by ailments linked to air pollution.

GM crops - friend or foe for European agriculture?

There are currently over 6 billion people on the planet and in the next 25 years this number is expected to grow by another 2 billion; in a public hearing on biotechnology at the European Parliament, the discussion focused on how the European Union is going to face up to the problem and understand how to provide food for everyone while dealing with diminishing fresh water for agricultural irrigation and climate change.
Europe and European consumers remain unconvinced by GMOs. In the last survey done across the EU, a clear majority declared themselves against them. Some EU countries such as Austria, Poland and Germany have even established GMO-free zones. This resistance is based on fears that GMO crops can damage biodiversity and are a danger to human health; moreover, there is also a general mistrust of genetic engineering and the majority of consumers have a hard time seeing any clear benefits associated with genetically engineered crops.
However, GMOs could offer some opportunities such as the creation of aromatic rice and wheat, edible vaccines for asthma or allergies and breeding corn that is resistant to pests and bio fuels. In the US, where GMOs are used more widely, some of the reported advantages include better yields, and crops that are more resistant to changing weather and environmental conditions.
The risk of contamination of non-GMO crops is at the heart of the debate; till now, scientists disagree on what a “safe-distance” is; moreover, segregation and “co-existence management” could be costly and make GM crops economically unviable.
The point remarked by members of the European Parliament is that, on the one hand, we are already consuming GM-products and on the other, we have to ensure the continuity of agriculture in Europe. GMOs are only one tool in a toolbox and more research is thus vital. For this reason this useful debate in early 2007 was requested by the MEPs.

Economics and Policy of Biodiversity Loss

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According to the definition of biodiversity adopted in the Convention on Biological Diversity opened for signature at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, biodiversity is the variability among living organisms from all sources, including, *inter alia*, terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems. [art. 2][1]
The expression can be used to refer to a few distinct concepts: it may point to the number of different species that are present, for instance, within a region or a country, to the variety of ecosystem types, or to the genetic variability within a single species. Biodiversity measures are used to define how biodiversity varies through time, rising and falling cyclically (Rodhe and Muller, 2005). The current documented extinction rate of a wide range of species, however, is approaching 1,000 times the background rate and may climb to 10,000 times during the next century, if present habitat destruction trends continue (Pimentel, 1997).

2. The Measurement of Species Diversity

There are measures of biodiversity based on species richness, and measures based on species evenness within an ecological community. The number of species occurring within an area of a given size is the simplest index *(α-diversity)*. A second measure of within-area diversity, but aimed at a larger scale such as a whole region, country or even continent, is called *γ-diversity*. A third measure, *β-diversity*, indicates the rate at which the mix of species changes along a given habitat or geographic gradient. β-diversity can be defined also as the ratio of the γ–diversity of a region to the average α-diversity of local areas within the region ($\beta=\gamma/\alpha$) (Bisby, in Heywood 1995). For conservation as well as for economic purposes it can be vital to account for the uniqueness of the species. An example of index of species evenness is the Shannon-Weaver index,

$$SW = -\sum_{i=1}^{N} p_i \ln p_i ,$$

where p_i is the proportion of individuals belonging to the *i*-th species and *ln* is the natural logarithm. It captures the relative rarity of species: giving more weight to rare species, it provides a measure of the information content in the system.
Another important example is the Simpson's index,

$$D = \sum_{i=1}^{N} n_i(n_i - 1)/N(N - 1)$$

where n_i is the number of individuals in a particular species and *N* the total number of organisms of all species. It captures the dominance of species, that is, it gives the probability (in values between 0 and 1) of any two individuals drawn at random from a large community belonging to the same species. In this way, it gives more weight to the abundance of the most common species.
Finally, there are indices of taxic or phylogenetic diversity, emphasizing evolutionarily isolated species that contribute highly to the assemblage of features or options. Such indices can help making choices about what to protect where it is not possible or too costly to protect everything. They represent a bridge between measurement of diversity and value. A few important examples within the economic literature are those developed by Weitzman (1992, 1993, 1998) and Solow and Polasky (1994).

3. Biodiversity and Resilience

A different approach uses the concept of *functional*

biodiversity to focus on the functions played by different species whose conservation ensures ecosystem services that are essential to the functioning of living systems and human societies (Schindler, 1990; Kaufman *et al.*, 1998). Biodiversity preserves the resilience of ecosystems – their capacity to respond to stresses or shocks imposed by habitat conversion, predation, harvesting and pollution. Functional biodiversity, in other words, contributes to determine the resilience of natural systems (Schindler, 1990).

4. Social and Economic Factors Driving Biodiversity Loss

Humans impact on biodiversity in a number of ways. The major threat to the loss of species is not intentional human exploitation, through harvesting or hunting, of wild living resources (although in some cases of economically very valuable species it does play a critical role), but our impact on habitats.
Other important causes of biodiversity loss are agricultural practices involving the use of chemicals as fertilizers and pesticides, the removal of hedgerows, ponds, and wetlands to maximise adjacent arable land, and the diffusion of surface irrigation schemes which tend to convert micro-habitats into a uniform agricultural landscape. Other causes of biodiversity loss are air, water and soil pollution from industry, transport, and waste generating consumption activities such as tourism. Population growth, and hence population density, is a critical factor behind the increase in the level of stress imposed on natural systems. Poverty often becomes at the same time both a cause and an effect of environmental degradation, thus generating a vicious cycle. The lines of causation from poverty to environmental degradation are complex: poor people tend to rely directly on natural resources (soil for crop or livestock, woodlands for fuel and building material, rivers for water, and so on) for their survival. Fragile, marginal natural capital generally requires investment to be maintained productive (fertilizing, irrigation, tree planting, management of livestock numbers). However, poor people tend to face a higher than average uncertainty about their future, as a consequence of poor health, diet and living conditions, and hence apply high discount rates to their intertemporal choices. Finally, migrations, war and refugee flows often break down social and cultural rules of resource management, leading to further deforestation and conversion of marginal lands.

5. Policies for Biodiversity Conservation

A range of policy instruments can be used to slow down or reverse the trend of biodiversity loss: the establishment of property rights, the elimination or reduction of price distortions, trade policies attentive to the pathways of introduction of alien species, the establishment of protected areas and safe minimum standards of conservation, pollution control policies, land use policies, the management of harvesting policies.

5.1 Property rights

Although local populations of endangered species and local ecosystems are often both excludable and rival in consumption, biodiversity in general is a public good: avoiding the extinction of a species generates indivisible benefits for the collective as a whole. Whenever it is possible to generate markets over natural resources without adversely affecting important social objectives, this may then prevent over-exploitation. Assignment of property rights should be accompanied by measures aimed at providing people with the means to make long-term investments in conservation (security of land tenure, access to credit, technology).

5.2 Price reforms

For those environmental resources for which markets exists or can be created, policies that act on resource prices may be an effective tool for protection. In particular, where price distortions due to government interventions are present, price liberalization can help to eliminate them and to narrow the gap between private and social value.

5.3 Incentives

The benefits of local biodiversity conservation can be enhanced, for example, by removing subsidies that artificially inflate the benefits from depletion and forest conversion (e.g. granting of titles for land clearing, under-pricing of timber concessions etc.). Damage may occur also as an indirect, unintended result of policies aimed for example at assigning responsibility to farmers over the land: in several countries, upon receiving contracted forest land, farmers, fearful that the land use policy might change again, have immediately responded by felling all the trees.

5.4 Protected areas

Habitat protection through the establishment of

natural reserves is one of the main tools used by governments in their attempt to do something about biodiversity loss. The selection of sites for establishing reserves and of species to protect should be the result of cost-effective conservation strategies that combine ecological and economic information. Institutions should ensure that the local providers of global public goods are compensated for the benefits they offer to the national and international community, taking into account that often biodiversity hotspots are in the poorer areas, where the same isolation that has slowed down environmental damage has also acted as a barrier to economic development.

5.5 Trade

Biological invasions are the second most important cause of biodiversity loss after habitat destruction. The movement of people and goods is usually taken to be the main driver of the process. Trade prohibition based on international regulations, inspections, quarantine and public education can be used as means to reduce also the unintentional introductions that can take place through merchandise containers, ballast water of ships, tourists luggage and so on, working in a way similar to the sanitary measures used to prevent the introduction of diseases in animals traded for agricultural and other purposes (Wittenberg and Cock, 2001).

6. CONCLUSIONS

Biodiversity loss is one of the most serious forms of the ongoing environmental change, involving ecological impacts, potentially enormous costs for future generations and a serious threat to development opportunities. It is not only a matter of conservation of rare species: it has to do with the stability of essential ecological services in a broader sense. The reasons why biodiversity conservation needs to be a priority on the international policy agenda, which we have briefly sketched in this article, deserve far more space in public discussions than what they have been given to date. As far as the research agenda is concerned, there is room for valuable contributions in countless directions: from the links between biodiversity loss and other forms of local and global environmental change, to issues of measurement and valuation, to the instruments for the implementation of protection policies – to name only a few.

notes

1 The text of the Convention is available on the CBD website, www.biodiv.org. See UNEP (1992).

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Sustainable agriculture for environment protection: lessons learnt during six years of cooperation

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Introduction

Sustainable agricultural development is an important goal in economic planning and human development worldwide. Agriculture plays a significant role in protecting the environment and enhancing biodiversity when it is carried out in a sustainable manner and takes into account its genetic resources. At present, agriculture faces the need to meet new challenges both in highly industrialized countries as well as in developing ones. Such challenges are represented by sustainable growth, social integration of rural communities and proper use of the advantages deriving from emerging global markets. These challenges go along with radical changes in the relation between society and agriculture.

Agriculture in China

Nowadays the agricultural sector is declining, but still represents an important element of China's economy. Agriculture accounts for almost 15% of the GDP and above 40% of employment. Even though the urbanization process goes at high speed, 60% of the total population (1.3 billion people) keeps living in rural areas. As a developing country with 9.6 x 106 Km2 of land, China must acquire a good understanding of sustainable development, develop scientific methods for evaluating the sustainable capability of its agricultural lands, and deal with the issues of regional differences and imbalance in levels of agricultural development in order to devise strategies to achieve the goal of sustainable development across the country (OECD, 2005; Xu et al., 2006).
China is relative scarce in agricultural land and water, having only 10% of the world's arable land and its water resources per capita are around one quarter the world's average. In nearly fifty years, the annual loss rate of arable land due to desertification has more than doubled, passing from 156,000 hectares in 1950 to the current 360,000 hectares (Wang, 2004). Similar trends are observed with regard to water tables. In the North China Plain, the over pumping of water from aquifers also due to backlog irrigation techniques (e.g. flooding and furrow) sets the depletion rate of groundwater levels at 1 to 3 meters a year.
Population is increasing at fast rate, nearly 15 million people annually. The efforts in tackling the higher demand of food are undermined by the decreasing trends in grain production. The phenomenal rise in China's production from 90 million tons in 1950 to 392 millions tons in 1998 comes to a halt. During the period 1992-2003, agricultural trade has shown a large increase in cereal imports in 1995 and 1996 and an increasingly high level of oilseeds imports since 1997. These trends are also due to radical dietary changes affecting both urban and rural population. With the improvement of welfare throughout the country and the general increase of per capita income, population started consuming less carbohydrates and more protein (meat, fruits, vegetables, eggs, fish). Reflecting changes in consumer demand, the composition of primary production continues to shift from crops to livestock and fish production. In 2003, crops accounted for 50% of the total agricultural production, livestock for 32%, fishery for 14% and forestry for 4%. While cereals remain the key crops, other crops, such as vegetables and fruits, became more important and profitable. During the last decade the area of fruits and vegetable productions expanded by an average of 1.3 million hectares per year. The fast urbanization is cause of increasing social conflicts in rural areas. Agricultural incomes stopped growing in real terms after 1996 and grew slowly after 1985 onwards, while incomes in urban areas continue to rise rapidly. The widening gap between rural and urban in terms of incomes and access to most social services is

provoking a massive migration of rural workers – mainly young people- to urban areas. The migration of young farm workers to cities may halt the ongoing conversion to high value crops (i.e. vegetables, fruits, and grape) usually more labor-demanding.
China's challenge to individuate sustainable solutions to social and economic pressure put on agriculture is even greater due to the threat posed by agriculture on environment and human health. China's agriculture represents one of the most polluting production sectors. In 2003 China used 44.12 million tons of chemical fertilizers and 1.33 million tons of pesticides, reaching the top of the world consumers list. In 2003 the total consumption of fertilizers and pesticides was registered at 44.20 and 1.33 million tons respectively. Estimations calculate around 135 millions hectares of cropland highly polluted because of accumulation of heavy metals, nitrogen, phosphorus and other chemical compounds. Each year nearly 1.7 million tons of nitrogen is released into the soil from fertilization of grains and horticultural crops at average doses often beyond 150-200 kg per hectare (CCICED, 2004).
In the effort to reconcile economic and social needs and environmental protection China is undertaking countermeasures towards the promotion of sustainable agricultural practices. The attention paid to activities in the agro-environmental sector has been increasing over time due to the high social and economic priority attached by the Chinese authorities to the modernization of agriculture that must be pursued in a sustainable manner, addressing at once food security, environment protection, economic development, and good management of natural resources. While priority is given to boosting grain production and to stop the increasing reliance on grain import, particular attention is paid to keep the positive trends registered during the last 10 years in fruit and vegetable production. Indeed, the area invested in fruits and vegetables passed from 10 millions hectares in 1991 to 26 millions hectares in 2003, mainly in response to a rapid growth in domestic demand and in the export market. In a country like China where the average farm surface is around 0.65 hectares, the shifting to higher value crops remains the only solution to increase salaries. Although modernization is occurring mainly in the traditional agricultural sectors, other emerging sectors such as organic farming are drawing attention of policy makers as promising both in terms of export and sustainability. Nowadays organic farming in China represents only 0.4% of the total agricultural area, far below the European average of 3.5%. The value of trade in exports of organic products that jumped from 300,000 dollars in 1995 to 120 million dollars in 2003 is expected to further increase in the future at an annual rate of 30% (Xie et al., 2005).

The agriculture cooperation projects in China

Foreign assistance is regarded by China as a fundamental mean to channel additional funds and to accelerate agricultural modernization. A growing trend of projects linking agriculture to environmental protection and sustainable development at large has been registered during the recent years. Agriculture is not addressed anymore as a stand alone sector. Particularly in emerging countries like China that achieved acceptable levels of food production, cooperation in agriculture is not regarded anymore as a matter of food security, but as a fundamental occasion to develop sustainable models of production, ensuring protection and conservation of natural resources and improvement of quality of life in rural areas.
The agro-environmental projects implemented within the Sino-Italian Cooperation Program for Environmental Protection reflect this changing trend (Gullino *et al*., 2006). Under such umbrella, all agro-environmental projects respond to the primary goal of reducing China's reliance on a massive use of fertilizers and pesticides that is posing serious threats to global environment and causing exceptional phenomena of soil erosion and water pollution within the Chinese borders. Project objectives and instruments of implementation have to be site specific and to properly address the particular social and economic needs of the area of interventions. In large developing countries like China, with an extremely diversified agricultural sector in terms of climate, levels of infrastructure and mechanization, economic and social conditions, it is furthermore important avoiding generalized approaches.
Since the launch of the Sino-Italian Cooperation Program, significant investments have been made for the phasing out of methyl bromide, a highly toxic fumigant used in the horticultural sector for pre-plant soil disinfestation and banned by the Montreal Protocol because of its implication in the ozone layer depletion (Gullino *et al*., 2003). Pilot activities aimed at demonstrating the technical and economic feasibility of innovative and low environmental impact techniques for soil disinfestation started in 2001 in Shandong and

Hebei provinces with the final objective to individuate solutions replicable in other areas of China. The positive project outcomes eventually contributed to the definition of China's MB National Phase-out Plan under the framework of the Multilateral Fund of Montreal Protocol. While the choice of target areas went quite automatically to Hebei and Shandong provinces because of their high methyl bromide consumption and characterized by an expanding horticultural sector, the selection of target technologies took fully into account the local level of infrastructure, mechanization, availability of agricultural inputs and know-how. Solutions like soil steam pasteurization and soilless cultivation systems were ruled out in favor of cheaper alternatives, easier to apply and less energy consuming. Soil solarization, the use of grafting on resistant rootstocks and the application of less harmful chemicals at reduced dosages *via* drip irrigation, tested on tomatoes and strawberries, resulted of higher acceptance by local growers because while providing level of treatment effectiveness comparable to methyl bromide, they require lower cost of investment and small changes to fit within the traditional cultural practices.

The same approach was adopted in different regions, in order to ensure the reproducibility and long-term sustainability of transferred technologies. In Xinjiang and Inner Mongolia, for instance, Chinese western regions characterized by poor social conditions, a very low level of infrastructure and scarce capacity of farmers in managing modern cropping systems, the choice went to very basic and low cost technologies. Drip irrigation systems resulted as a win-win solution to the serious problems of desertification, soil erosion and pollution affecting the two regions. Used in substitution of the locally adopted flood irrigation and also for the distribution of fertilizers at reduced dosages, drip irrigation systems permitted to achieve significant reduction in the use of water and fertilizers (5-6 times less compared to common practices) on tomatoes, pumpkins, cabbages, grapes and corn. These were promising outcomes for regions like Xinjiang, formerly one of the poorest regions of China and now preparing to be one of the main agricultural production areas of the country. Differently from Xinjiang and Inner Mongolia, more specialized technologies and complex cropping systems were considered by the project implemented in Chongnming Island (Shanghai). The Shanghai area is the most advanced in China as for technology, know-how, foreign trade and capital turnover. The expectation in terms of technology transfer is quite high.

The project is meant to convert the traditional local agricultural systems into organic farming production. The aim is to develop environmentally friendly green food production not only to increase potential for higher incomes for local growers looking with interest to foreign markets, but also to enable the production of healthy food and the promotion of a safe environment for national eco-tourists visiting Chongming Island in the future. In particular the project aims at reducing the use of chemical fertilizers (currently far over the national safety limit of 225kg/ha) and pesticides.

In two-years field experimental trials on tomatoes, watermelons, pumpkins, horse beans and other horticultural crops, technical and economical feasibility of the use of tolerant and resistant varieties, grafting on resistant rootstocks, biodegradable mulching films in combination with the use of fertigation and environmental monitoring systems, and integrated pest management also based on the use of biological products will be evaluated. The project goes beyond the merely environmental concerns and strengthens the role of rural areas as multifunctional dynamic systems. This is an important aspect for Chongming Island, planned to be converted into the first Ecological Recreational Island of China: the present economic growth, the urbanization and the extended leisure time, also increase in China the demand for tourism and recreation activities in rural areas.

The selection of vegetables and fruits as target crops represents a constant in all the agro-environmental projects of the Sino-Italian Cooperation, due to environmental and economic reasons. Crops, like fruit and vegetables, became more profitable in China and the government relaxed most of the policy measures, which had previously forced farmers to produce cereals. However, if on the one hand changes in the domestic demand and emerging export opportunities guided the impressive increase in vegetable and fruit production and provided farmers with more margin for higher incomes, on the other hand the shifting of Chinese agricultural production from grains to horticultural crops, notoriously demanding higher amount of chemical inputs, is likely to worsen the increasing consumption trend of fertilizers and pesticides.

The lack of technical and scientific know-how, and capacity in managing innovative cropping systems

emerged as one of the major barriers towards the actual adoption of transferred technologies. The challenge is to re-orient scientific and technical capabilities towards the market and industry requirements. Again, international cooperation programs play a fundamental role in filling the educational gap.
All demonstration projects implemented within the Sino-Italian cooperation projects provide back-to-back with technology transfer a full package of training activities particularly tailored on the specific needs of local farmers and technicians, but involving also academic institutions and private companies in the attempt to establish cross-sectorial partnerships. Particular emphasis is given to the scientific collaboration with academic institutes and research centers. At the micro level, there is a need for China's higher education institutions to learn how to identify, develop, and implement research and extension programs well adjusted to the global and domestic scenario. At the macro level, there is a need for China's policymakers to consult experts in order to formulate appropriate sustainable development strategies and policy. In this perspective, strengthening capacity and efficiency of the role of universities towards government, industry and market operators is strategic for the future sustainable development of Chinese agriculture and the promotion of innovative "green" technologies. Several Sino-Italian cooperation projects are pursuing this objective. Among them, it is worth to quote a project co-financed by the European Commission in the framework of the Asia-Link Programme. The project is promoting sharing of technical, scientific, economical and ethical knowledge on organic farming within a partnership of eight European and Chinese Universities.
The involvement of the private sector is particularly sought. Each project is implemented on a participatory basis, stimulating the creation of broad partnerships involving all relevant stakeholders, from governmental agencies to NGOs, from academic institutes to private companies. The model followed is that of Type II Partnership emerged from the 2002 Johannesburg World Summit on Sustainable Development as a means to promote a full integration of public and private sectors at large in the multilateral and bilateral cooperation programs, both in technical and financial terms. However, it is still quite difficult to plan the involvement of the private sector in long-term programs and give cooperation projects also a market perspective, facilitating the introduction and commercialization of environmentally friendly innovative technologies in China. Due to the fragile Chinese regulation framework on intellectual property protection, the involvement of Italian private companies is often limited to stand-alone interventions within each single project (e.g. field visits, lectures during seminars and training, short-term internships and technology procurement). Even though is offered the possibility to piggy-back on a governmental program like the Sino-Italian Cooperation Program for Environmental Protection and create effective synergies mutually benefiting both sides, the skepticism showed by private firms about a not yet conducive Chinese regulatory system represents a great barrier against an effective technology transfer. First signals of potential cooperation fully involving Chinese and Italian private companies in the development of innovative technologies for agriculture have been shown by the project "Sustainable plant protection in respect of the environment: modern techniques for the control of plant pest and diseases of horticultural crops in China". The project, co-financed by the Italian Ministry of Production Activities and the Italian Trade Commission with the aim to stimulate partnership between SMEs and universities, is opening the possibility to develop co-patents of biocontrol products for pest and disease control. Same opportunities are emerging in Chongming Island for the development of agricultural waste composting facilities for the production of biogas and organic fertilizers.

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Organic Farming Development in People's Republic of China

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Background and development

Since the1960s, together with the dramatic increase of China's population, the expansion of grain production has been an important issue for the Government. The Green Revolution featuring high inputs of water, fertilizers and the application of hybrid technologies was widely extended in China. This brought to a great improvement in China's food security, yet it also led to a series of problems.

Food safety and polluted ecological environment have turned out to be prominent problems in China. Thus, eco-labeled farming emerged in the 1990s, particularly enhanced by the Green Food project at that time. Currently, eco-labeled farming includes three levels of production: pollution-free food, green food, and organic production. Figure 1 shows food safety in the People's Republic of China. Pollution-free agricultural products are addressing food poisoning and export barriers that often occur lately, as well as the relevant safety standards which are usually low. Green food production began with a combination of modern organic farming in developed countries and in China's context and was transformed into a concept design and a development model. Chinese features emerge from the name, standards, certification and administration procedures. The overall safety standards are higher. The development of organic food in China began with a complete introduction of the modern concept, which includes the organization and accreditation, the specific standards, organization, accreditation, the monitoring and trade of organic agriculture into China from the Western countries. As a result, China has improved its integration within international markets and has promoted its production and trade. Amongst the three categories, Organic food has the highest safety standards (WU W.L. 2004).

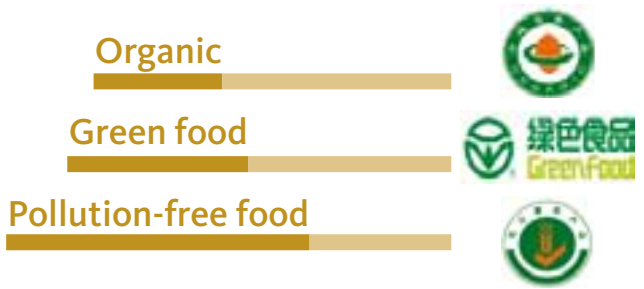

Figure 1 Food Safety System in People's Republic of China

In 1990, for the first time, organic tea from Lin'an county of Zhejiang Province was exported with the Dutch SKAL certification: this marked the launch of organic production in China. With the rapid development of international production and trade in organic food, organic agriculture is also boosting in China. Certification and management of organic food have made prominent achievements and promoted the development of organic agriculture in China. According to the incomplete statistics, by the end of 2004, about 1.15 million hm2 of organic land, 2.25 million tons of organic products, and nearly 1067 projects were certified. The exported products' value increased from 0.3 million USD in 1995 to 0.2 billion USD at the end of 2004 (IFAD, 2005). The main certified areas are located in the Northeast China as for grain and bean production; in the Middle East part of Shandong and in the Jiangsu province as for vegetable production; and in Southern China, in the provinces of Zhejiang, Jiangxi, and Yunnan as far as organic tea production is concerned. Organic products are mainly exported to Europe, the EU, US and Japan, while the domestic market is still very limited and has great potential to be developed.

China's marginal areas and their traditional agriculture

In China, low-income and marginal areas mainly refer to the western regions, such as Guangxi, Guizhou, and Yunnan which comprise the major areas of the Yungui Plateau; the Middle mountain area such as Jiangxi, Sichuan, Hunan Province; the Northwest region including Xinjiang, Shanxi, Gansu; and the Inner Mongolia area. The marginal regions present landform of high mountain ranges and complex geomorphologic features characterized by karst landscape, erosion, rock accumulation, mud flows and soft soil. Due to land degradation, desertification, and widespread soil erosion, more than half of the cultivable land has a thin layer of arable soil and is of medium to bad quality. Soil erosion is further aggravated by population pressure, improper and unsustainable agriculture practices (such as cultivation of steep slopes) on very small land plots (averaging less than 1 m^2 per household), and deforestation. The population in these provinces depends mainly on agriculture, with this sector contributing to about a fourth of the provinces' Gross Domestic Product (GDP). Rural per capita net income in 2002 also pales in comparison to the national average: as a consequence, poverty incidence (defined in terms of the official poverty threshold of CNY627 per annum) in these areas is still high. Lower yield-cereal outputs, lower crop stock per capita and lower per capita net income are the main features of poor farmers.
In the marginal and poor areas, more than 66% of the absolute and low-income poor families depend on agriculture as their main source of income; this is in contrast to higher-income farmers in other regions whose income sources are more diversified. Almost all farmers still keep the traditional agricultural style; in fact most of them have no money to input in the fields, thus having to keep original agricultural practices such as crop rotation, diversified plantation, manure application and legume crop integration etc. for soil fertility maintenance, pest and disease control. On the contrary, this provides good basis for the development of organic agriculture in these areas. However, most of these locations are far away and hard to reach and in most cases the very small land plots are difficult to manage. Furthermore, the farmers are poor and less educated and it is hard for them to accept new ideas; however, this situation can be improved with the development of organic agriculture.

Government's attention and government agencies involved in organic farming development

The Organic Food Development Centre (OFDC) under the State Environmental Protection Administration (SEPA) was established in 1994. The Centre was the first structure to be involved in the management and certification of organic food at governmental level.
In 1995, it issued the "Regulations on Administration of Organic (Natural) Foods Labeling". The "Measures on the Administration of the Certification for Organic Foods" was issued on June 19th, 2001. From 1994, SEPA set up about 20 provincial OFDC for the management of organic agriculture development at provincial level. Organic farming developed rapidly since then. At the same time, SEPA devoted more and more attention to the development and management of organic farming. The regulation on "Technical Norm on Organic Food" was issued by SEPA on December 25th, 2001 and entered into force on April 1st, 2002. In 2002, SEPA consecutively issued the "State Administration Committee for Organic Foods" in February, the "Basic Accreditation Requirements for Organic Food Certifiers" on March 8th, and the "Registration Norms for Organic Food Examiners" on March 8th so as to regulate the approval and management of organic certification bodies and staffs (WANG X.X. 2005).

In 2003, the Certification and Accreditation Administration of the People's Republic of China (CNCA) was established; it is in charge of the national certification and accreditation of different departments. From then, SEPA transferred the management authority to CNCA, which received the responsibility of organic standard development and certification management and accreditation. The national organic products standards GB/T19630.1-4 2005 have been issued and executed by CNCA since April 1st 2005 and more efforts have contributed to the management of organic certification. Now, with the development of organic agriculture in China, besides SEPA and CNCA, other government departments such as the Ministry of Agriculture (MOA), the Ministry of Commerce, the National Development and Reform Commission and local governments pay attention to the management of organic agriculture. They also issue relevant policies and give financial support to facilitate the development of organic agriculture.

National policy on organic agriculture and/or food safety management system, and food traceability system

The production of Eco-labeled products in China has a history of over 10 years, and has developed in a context of fast economic growth and gradual improvements of social and legal systems. Eco-labeled products were developed with two major objectives: one is to address the quality and safety of agricultural products; the other is to achieve ecological environmental protection within agricultural production. Since 2000, food safety and eco-labeled products are the major contents in the delegates' proposals at every session of the National People's Congress (NPC) and the Chinese People's Political Consultative Conference (CPPCC). The Law on Agricultural Food Safety has been issued by the People's Congress and become effective since the 1st of Nov. 2006. As described in part 1, China's food system can be subdivided into three categories. The government departments issued various forms of "Measures", "Suggestions", "Circulars", and "Notices" as listed in the following to guarantee the management of the system (XIA Y.F. 2003):

Organic Products:

On June 19th, 2001, the State Environmental Protection Administration issued the "Measures on the Administration of the Accreditation for Organic Food".
On March 19th, 2003, CAAC and the Ministry of Agriculture issued the "Implementation Suggestions on the Establishment of Certification and Accreditation System for Agricultural Products".
On April 2nd, 2002, the General Administration of Quality Supervision, the Inspection and Quarantine of China (AQSIQ), the State Administration of Industry and Commerce (SADIC) and the former Ministry of Foreign Trade and Economic Cooperation (MOFTEC) issued "On the issuance of the Measures of the Administration of Approval, Registration and Monitoring of Certifiers, Accreditation Training and Consultative Agencies".
On February 20th, 2003, China National Accreditation Board for Certifiers (CNAB) issued the "Basic Requirements on the Accreditation of Certifiers' Certifications to Organic Agricultural Products and Processing".
On April 1st, 2005, the national organic products standards GB/T19630.1-4 2005 were issued by CNCA and came into effect.

Green Food:

On December 28th, 1991, the State Council issued the "Circular on the Relevant Issues of the Development of 'Green Food'".
On April 15th, 1992, SADIC and the Ministry of Agriculture issued the "Notice on the Use and Protection of 'Green Food' by Law".
In January of 1993, the Ministry of Agriculture issued the "Measures on the Administration of the Labeling for Green Food", and "On the issuance of 'Measures on the Administration of the Labeling for Green Food'".

Non pollution products:

In April 2001, the Ministry of Agriculture launched the "Action Plan of Non Pollution Products".
On July 27th, 2001, AQSIQ issued the "Regulations on the Administration of Labeling for Non Pollution Agricultural Products".
On April 29th, 2002, the Ministry of Agriculture and AQSIQ jointly issued the "Measures on the Administration of Non Pollution Agricultural Products".
On July 25th, 2002, the Ministry of Agriculture issued the 137 industrial standards, such as the "Standards on Non Pollution Cucumber".
On April 17th, 2003, the Ministry of Agriculture issued and carried out the implementation of the "Procedures on Identifying Origins of Non Pollution Agricultural Products", and the "Procedures on the Accreditation of Non Pollution Agricultural Products".
On April 18th, 2003, the Ministry of Agriculture issued the "Notice on Well Managing the Accreditation Work of Non Pollution Agricultural Products".
On June 18th, 2003, the Ministry of Agriculture issued the "Plan of Promoting Quality Safety of Competitive Agricultural Products" for the period 2003 to 2007.

Starting from 2001, local governments of Shanghai, Beijing and some other cities consecutively issued local regulations and policies, including the "Provisional Measures on the Monitoring of Eatable Agricultural Product Safety of Shanghai Municipal Government" and the "Regulations on the Supervision and Administration of Food Safety of Beijing Municipal Government". As a supplement to national policies and regulations, these local policies are much practicable and make more specific provisions on market access and implementation details.

Standards and Certification Systems' Development in China

The food safety management systems described above have different standards. The basic standard for non pollution products is the *de facto* basis of all Chinese agriculture. Green Foods grade "A" standard continues as a recognized assurance of enhanced environmental and health safety, which allows reasonable application of chemical substance. Green Foods grade "AA" is in favor of organic certification and is harmonized with international standards to improve domestic and worldwide acceptance. The standards being used by local certifiers and their field application and verification are not recognized as equivalent by the EU, IFOAM, Japan and American organic regulations and are therefore not useful for export to most countries and regions.

Three relevant milestones for organic regulations were introduced recently. In 2001, SEPA issued the Organic Food Certification and Management Measures (based on the standards developed by OFDC using IFOAM's basic standards). In 2003, China National Certification and Administration (CNCA) released the Guidelines of Accreditation for Organic Products Certification Agents. In 2005, China's national organic products standards were issued and were effective on April 1st. At the same time, the Organic Product Certification Management Rule came into effect.

Local certification is conducted by domestic certifiers such as: the Organic Food Development Center (OFDC) which is the largest local certifier in China and was accredited by IFOAM in 2002; the Organic Food Certification Center (OFCC) organized by China Green Food Centre of MOA, and the Organic Tea Research and Development Center (OTRDC) of China Agricultural Academy Science. More than 20 certifiers were accredited by CNAB. Inspection and certification for export products (and for some domestic supermarkets) is conducted by international certifiers such as IMO (Switzerland), ECOCERT (France), BCS (Germany), JONA (Japan) and OCIA (United States), some of which have set up representative offices employing local inspectors. In contrast with the certification systems, consultative agencies of eco-labeled products are mostly affiliates of domestic agricultural colleges and universities, represented by the Institute of Agricultural Ecology under China Agricultural University, and the Institute of Organic Agriculture and Organic Food under Nanjing Agricultural University. Employees of the Center are scientific researchers who have made an early study on organic agriculture, with a rich knowledge on organic agriculture and organic food, thanks to experiences within foreign training courses on organic production, accreditation and consultation, and have established extensive international relations.

Farmers' perspectives on organic agriculture

a) Constraints

The major marketing and export constraints faced by organic operators are listed in the following:

_ Lack of marketing information especially in remote areas
_ Lack of distribution channels and access (high cost) to foreign markets
_ Lack of supportive policies and incentives from the government
_ Lack of infrastructures to produce quality products
_ High certification costs
_ Insufficient export facilitation; complex procedures in importing countries including lack of market information and strategies
_ Domestic consumers' lack of information and awareness about organic products

Specific problems of smallholder producers in the organic operation in China:

_ Organic producers are not organized and are not linked to markets or marketing chains.
_ Low competencies in organic production methods including composting and microbial preparations which are beneficial to soil fertility.
_ Government training and extension services in organic agriculture are very limited or nonexistent in some areas.
_ Limited knowledge of standards and national regulations.
_ Problems in implementing IQCS/alternative guarantee system including record keeping and reporting.
_ Producers fear yield declines at the start of the conversion process and lack of financing or cash to support production capital.
_ Limited sources of organic seeds (planting materials are often treated with chemicals) and organic fertilizers (non organic fertilizer manufacturers are certified).

In the long term, not all the organic production organizers/enterprises will carry on organic farming continuously, especially the companies that want to get benefits in the short term. The enterprise should pay for 20,000~40,000 CNY for organic certification

every year and spend much time and energy for internal management. The cost is too high for the enterprise to develop organic products. Most of the enterprises do not consider organic certification as a tool or a means to improve the production quality of the enterprise. They just want to get the certificate, and some of them will stop the organic certification after one or two years, especially when the foreign market is not good.

b) Benefits

In the case of the farmers' lands centralized under the companies' integrated management, the benefit is a unified management, development and application of organic agricultural technologies. Organic farming is labor intensive, therefore organic agriculture can improve employment levels especially for women, compared with conventional production systems; the following statement emerges from the data in the table "Benefits Comparison between Organic and Conventional Production" a survey statistics from a research work funded by Greenpeace in 2003. The employment rate within organic farming can reach 25~40%. Compared with conventional production, this represents 20~60% more employment for women. Organic production can also improve farmers' incomes. Normally premium prices of organic products are 20-200% higher than conventional ones. The table "Benefits Comparison between Organic and Conventional Production" shows that organic farming increases women's income of about 25~40%; organic products can be more commercialized than conventional ones. Organic farming uses no pesticides or chemical fertilizers therefore organic production ensures environmental sustainability.

Benefits Comparison between Organic and Conventional Production

Indicators	CVS1	OVS2	CVC3	OVC4	CR5	OR6	CT7	OT8
women employment increase (%)	—	60	—	50	—	30	—	20
women income increase (%)	—	40	—	35	—	30	—	25
Labor employment increase (%)	—	30	—	30	—	20	—	25
Products commercialized (%)	75	95	75	95	70	90	80	95
Export rate (%)	—	60	—	60	—	30	—	—
Chemical fertilizers (kg/ha)	375	—	330	—	300	—	225	—
Pesticides (kg/ha)	27	—	24	—	31.5	—	18	—

*CVS1, OVS2 stands for conventional and organic vegetable shallot; CVC3, OVC4 stands for conventional and organic cabbage; CR5, OR6 stands for conventional and organic rice; CT7, OT8 stands for conventional and organic Chinese gooseberry.
Source: Greenpeace 2003

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Chemistry, agriculture and environment: Novamont's way towards sustainability

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Introduction

Environment is influenced by agriculture and agriculture is dependant upon the environment
(De Soet, 1974)

Novamont is a pioneer company in the sector of starch-based biodegradable materials, constantly devoted to the production of a new generation of products derived from renewable raw materials of agricultural origin. These materials are able to provide a response to the demands of consumers, companies, and institutions for innovative products for a "truly sustainable growth". Novamont started its research activity in 1989 within the Montedison Group to realise the project "Living Chemistry for Quality of Life". The aim of the project was, and still is, to carry out and spread research in the field of biodegradable materials from renewable sources, combining agriculture and chemistry in order to develop products with a low environmental impact. Mater-Bi® is the trade name of the family of biodegradable polymers produced by Novamont. Mater-Bi® raw materials can be transformed with the same machinery commonly used for plastics, as they possess similar properties, but are totally biodegradable and compostable according to the international norms (e.g.: European Norm EN 13432, "Requirements for packaging recoverable through composting and biodegradation - Testing scheme and evaluation criteria for the final acceptance of packaging").
An important demonstration of Novamont's real effort in reducing the environmental impact was testified in 2002 at the Johannesburg World Summit for Sustainable Development, when the company was awarded the "World Summit Business Award for

Table 1. Estimation of the world plastic consumption in agricultural production (t). (Jouët, 2001).

Application	**1985**	**1991**	**1999**
Low tunnel	88.000	122.000	168.000
Mulching	270.000	370.000	650.000
Direct covers	22.500	27.000	40.000
Greenhouse and large tunnels	180.000	350.000	450.000
Silage	140.000	265.000	540.000
PP twine	100.000	140.000	204.000
Hydroponic systems	5.000	10.000	20.000
Micro-irrigation	260.000	325.000	625.000
Others (nets, plastic bags, except fertilizing bags)	80.000	130.000	150.000
Total	**1.145.500**	**1.179.000**	**2.847.000**

Sustainable Development Partnership" by UNEP (the United Nations Environmental Programme) and by the International Chambers of Commerce for the project "Living Chemistry Quality of Life".
In order to certify the real reduction of environmental impact, Novamont strategically chose to adopt the very latest testing procedures in order to test its raw materials and products, such as Life Cycle Analysis (LCA), and also certifications such as the Environmental Product Declaration (EPD).
Among the different fields of application for biodegradable materials, agriculture certainly represents an important challenge and one of the most straightforward ways to employ biodegradable polymers giving a low environmental impact answer to the problem of usage of traditional plastics. In the following pages a specific example of agricultural applications of Mater-Bi will be described: in particular Mater-Bi mulch film.

The usage of plastic materials in agriculture: state of the art

Plastic materials entered in force massively in the '60s, when their usage helped to increase the crop yields and quality, and also contributed to solve some problems of modern agriculture.
Their adoption into a broad range of agricultural applications has never stopped since their introduction. An interesting article by Jouët in 2001 gave an overview on the state of the art of plastic usage in agriculture in the last couple of decades (Table 1).
According to the data presented by Jouët, world agriculture generated the use and consumption of over 3 million tonnes of plastic in 1999, which was twice as much as in 1985.
In detail, an increase was observed in all the applications over time: low tunnel increased by 35-40 %, direct cover by about 60 %, and mulching by about 50 % since 1991. Mulching was thought to have increased by over 170 % in China, but the data are not very reliable.
Even if these numbers are quite impressive, the total consumption of plastic in agriculture represents only 2 % of the total plastic usage in Europe and 4 % in USA (Scott, 1999). Western Europe is one of the main consumers of plastic in agriculture: about 30 % of the world total consumption (Jouët, 2001). Although agricultural plastics account just for 2.5 % (848.000 t) of the total plastic consumed in Western Europe in 1999, they have a vital role to play in this sector (TN SOFRES Consulting, 1999). In warm and arid areas such as the Mediterranean countries where water is a limited resource, the plastic-based agricultural systems provide an effective solution for crop growth. Drip irrigation and mulch films, for example, can cut water consumption significantly, while increasing crop yield and quality.
One of the important applications of plastic in agriculture is represented by mulch films. (Table 2).

Table 2. Worldwide mulching area (in hectares) (Jouët, 2001).

Areas	**1999**
World	12.130.000
Africa and Middle East	80.000
America	200.000
Asia	9.760.000
Europe	450.000

Mulch films provide many advantages for crops:
_ increased crop yield and higher quality;
_ early maturing crops (important factor for crops such as muskmelons, melons, watermelons), thanks to an increase in the soil temperature compared to bare soil;
_ saving in water consumption (up to 30 % less water than in bare soil), thanks to the moisture retention in the soil under the plastic mulch;
_ enhancing insect management. Some photoselective coloured mulches can reduce the attack of some families of insects especially in the early part of the crop cycle;
_ weed control. Especially in the first part of the crop cycle, weeds can efficiently compete with crop for nutrients and water reducing the final yield and quality;
_ maintaining the soil structure and avoiding soil erosion (especially in windy areas).

Plastic materials in agriculture and environmental impact: the case study of mulch films

Plastic mulches are widely used and are of great importance for modern agriculture. However, they present some disadvantages such as their environmental impact on the agro-system and the need for a proper disposal at the end of their usage in the field.
There are many alternative approaches to examine environmental impact, but it is still difficult to find scientific articles concerning the environmental

impact of plastic materials or biodegradable plastics in agriculture (EU Project Bioplastics, 2002).
The environmental impact can be divided into global – regional – and local effects. The main parameters used in environmental impact analysis are: resource consumption, energy resources, global warming potential, acidification potential, nitrification potential, ozone creation potential, salinisation, waste management, biodiversity, soil function and quality, human and ecotoxicity, water quality (both ground and surface water), machinery, and landscape image.
Some examples of the lower impact of biodegradable materials compared to plastic at the above mentioned levels can be:
a. At the global impact level, the use of biodegradable mulches would shift the final treatment or disposal of plastic to CO_2, water, and biomass. This means the possibility to close the carbon cycle in the soil by using biodegradable materials (Fritz, 2001). This therefore reduces the transfer of carbon as CO_2 from fossil deposits (crude oil, raw material of plastics) to the atmosphere;
b. At a regional level: the capacity and possibility of treating plastic materials have a regional impact on the environment;
c. At a local level the impact could be on water quality or crop quality. In this case the use of plastic films in agriculture either in greenhouses or as soil covers has improved the crop quality. Biodegradable mulches behave as well as plastic mulch.

Plastic mulches should be removed from the field after their use and properly disposed according to the legislation. This means: collecting the used films and taking them to proper facilities where they can be recycled, or, when this is not possible, incinerated to recover energy. Plastic mulches on average have a life of one year.
After the crop has been harvested, plastic mulches are removed. This operation already represents a cost for the farmer, even in the case of a mechanical removal of the mulches. The main problem of plastic mulches is that recovered films are heavily contaminated with soil and biological waste and their mechanical recycling is difficult. Sometimes the total amount of soil and other waste attached to the plastic mulches removed from the field can reach 60 % of their initial weight (Martin, personal communication, 2005). This makes recycling extremely expensive and sometimes not feasible. The average costs for recycling conventional plastic depends on thickness of the film and can reach 80 euro/ton, in the case of mulches used for melon. This cost does not include the collection from the field and the costs for the transport to the proper facilities (EU Project Bioplastics, 2002).
When plastics are incinerated in conventional incineration plants, the power generated only corresponds to 20 – 25 % of the energy fed in (http://www.mst.dk).
Often in many countries, plastic films are not properly collected and disposed of at the end of their use. The main "illegal" ways of disposal for plastics can be classified as follows:
_ if the plastic films are thin, they can be ploughed into the soil after harvest, together with the crop residue. This creates a permanent accumulation of plastic in the soil, with a strong visual impact on the environment (the so called "white pollution");
_ illegal landfilling: the films are removed and placed in a part of the farm, where they are generally buried;
_ burning in the field: this practice is very dangerous not only for the environment, but also for human health. A variety of alkenes, alkanes, and aromatic and polycyclic aromatic hydrocarbon compounds are produced when agricultural plastic is burned after its use (Linak et al., 1998).
The European Union has shown a clear concern regarding the growing problem on how to properly manage packaging materials and packaging waste with a view to reduce their environmental impact. In 1992, the Commission came forward with a Proposal for a Council Directive on Packaging and Packaging Waste. Following a prolonged discussion in the European Parliament and the Council of Ministers, Directive 94/62/EC was adopted. According to the EU Packaging Waste Directive, the main focus should be in both reducing the usage of plastics and improving their recycling when possible, or the retrieval of energy when incinerated.

Biodegradable mulches: a low impact alternative to plastic mulches

Characteristics and advantages of biodegradable mulches

Mater-Bi mulches are biodegradable and show no toxic effect on the soil. Biodegradability is determined by measuring the actual metabolic conversion of Mater-Bi into CO_2. This property is quantitatively measured using

standard test methods, according to the substrate and the conditions where the biodegradable materials will be used. For example, the standard test method EN 14046 (also published as ISO 14855: biodegradability under controlled composting conditions) refers to compostability. A typical curve of biodegradation is reported in Figure 1. In this case two Mater-Bi polymers normally used for the production of mulches are assessed in a Sturm test at room temperature. The biodegradation of both materials is measured in terms of CO_2 evolution over time, compared to a reference material. The reference material – cellulose – is known and recognised as biodegradable.

The impact of Mater-Bi films on the quality of the soil (important indicator of environmental quality and sustainable land management) has been studied in terms of ecotoxicity on plant growth and on target organisms present in the soil using different methods, as well as analysing some other important parameters related to the soil quality.
The test methods employed were: determination of potential nitrification, rapid test by ammonium oxidation (ISO/DIS 15685) on soil samples from fields where Mater-Bi mulches were used, Flash luminescent bacteria tests (aiming at measuring the toxicity of solid and colourful samples), terrestrial plant growth test (OECD 208), Daphnia test (to check the possible toxic effect on a crustaceous species living in the soil water), earthworm toxicity tests (OECD 207).
No negative impacts on the soil quality or plants or target organisms living in the soil have been reported from these tests (EU Project Bioplastic, 2002).
Soil respiration rate was also analysed using a kit test: Solvita Test. This test measures the soil respiration rate in order to assess soil quality and fertility.
Measurements in different European trials were carried out during the cultivation period and after harvesting, using fresh soil samples. The results also in this case did not show changes in the respiration rate of soil samples from a field where Mater-Bi mulches were employed, neither during the cultivation period, nor after incorporating the biodegradable mulch in the soil.
Furthermore, the potential changes in soil microbial ecology induced by the cultivation method implementing biodegradable mulches was analysed

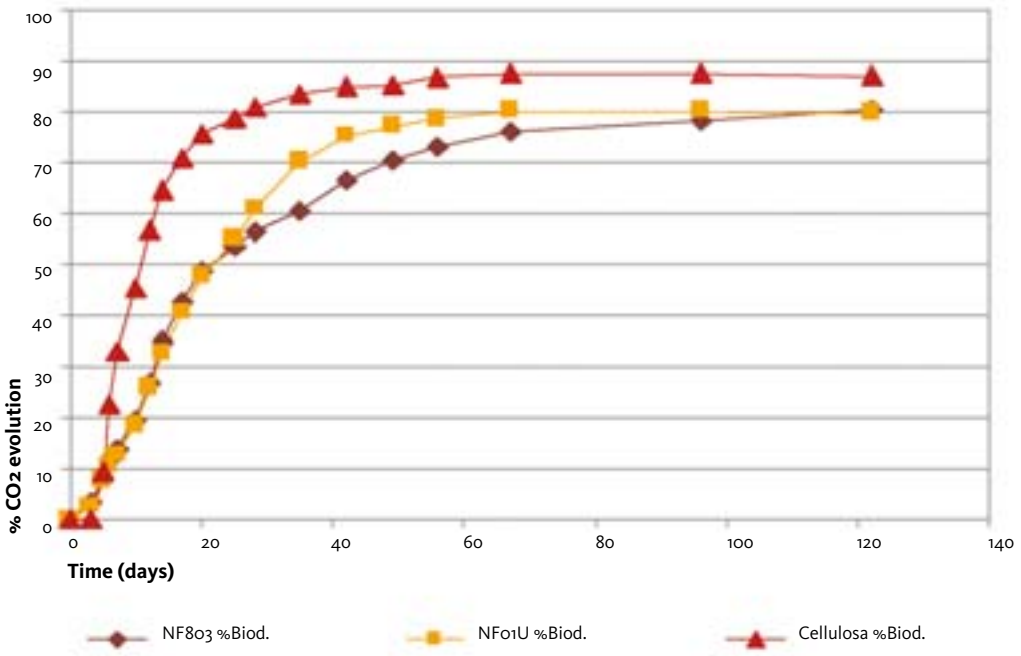

Figure 1. Biodegradation of two Mater-Bi polymers and a reference material in a Sturm test at room temperature according to ISO 14851.

by microbial community analysis. The microbial population of the soil from trials where Mater-Bi films were used was studied using molecular biology methods (PCR-DGGE method) by the Finnish Institute VTT. Microbial community analysis was performed in order to determine changes in the microbial population in relation to the cultivation method with Mater-Bi mulches compared to plastic mulches. The results of this test showed that the microbial population in different soil plots with different materials (Mater-Bi mulched and plastic mulches) was similar overall. The only changes in the bacterial population were in the course of the crop growth period (EU Bioplastics, VTT communication, 2003).
The main features of Mater-Bi mulches can be summarised as follow:
_ Mater-bi mulches do not need to be removed after harvesting, but they have to be worked into the soil with any remaining crop residues. This action places Mater-Bi mulches into the ideal environment to end their life cycle: the action of the soil micro-organisms will transform the mulch films into organic matter, CO_2, and water. The biodegradability of Mater-Bi mulches represents a clear advantage and great time and money saving for the final users.
_ possibility to be laid down mechanically using the same equipment as plastic mulches;
_ good weed control and good crop yield (in terms of production quantity and quality) comparable to black plastic mulches. In the last six years Novamont has carried out many trials around the world and on many different crops, in different climates and seasons, and collaborating with several universities and research institutes, in order to compare the agronomical results to traditional plastic mulches;
_ Mater-Bi mulches are suitable for the cultivation of most vegetables with cultivation cycles ranging from 50 days to 6 months. The lifespan of Mater-Bi mulches depends significantly on all the environmental factors at stake on the field (such as rainfall, temperature, solar irradiation, etc.) and it is therefore not only dependant on the activity of micro-organisms present in the soil. For example in autumn crop cycles Mater-Bi mulches retain their mulching power for a longer period than in the spring or summer.
_ Total costs of Mater-Bi mulches are comparable to those of plastic mulches. For the economical evaluation it is important to count also all the removal, collecting and proper disposal costs of plastic films.

Life cycle analysis (LCA) of Mater-Bi mulches

Life cycle analysis is a new method for the analysis of manufacturing processes, products, and services that favours studying systems from a global viewpoint. Novamont has realised that the only way to study production systems completely is to examine their performance, following, step by step, the route covered by the raw materials through all of the transformation and transportation processes, until they are disposed of in the ground, in the form of waste. This approach is called “from cradle to grave”.
The role of LCA is essential in identifying the manufacturing processes that have the greatest environmental impact, and in indicating the options for improvement in order to maximise the positive effects, and reduce to a minimum the negative effects on the environment.
Novamont has studied the LCA of Mater-Bi mulches compared to plastic mulches. Mater-Bi mulch was compared to plastic mulch, disposed of at the end of the crop cycle according to three possible scenarios: 1) plastic film entirely incinerated; 2) 50 % of the plastic film incinerated and 50 % taken to a landfill; 3) 90 % of plastic film recycled and 10 % taken to a landfill. The results obtained from this study are extremely interesting.
For example the use of Mater-Bi mulches induces a significant reduction in the greenhouse gas emission: 2.4 x 104 t of CO_2 if all the plastic films were to be substituted by Mater-Bi films on the 48.918 hectares of mulched salad in Italy alone. It is worth remembering that CO_2 is the most important among the greenhouse gases. The accumulation of CO_2 occurs due to the consumption of fossil biomass deposits (coal, gas, crude oil) which leads to the transfer of carbon from these deposits to the atmosphere. Therefore the possibility of shifting to the usage of renewable raw materials instead of fossil raw materials can reduce greatly the amount of carbon transferred to the atmosphere in form of CO_2.

VIU training program echo from participants

This section is written by the Chinese participants in the trainings in Italy.
We hope hereby to provide the Newsletter readers with an authentic flavour
of the training experience.

State Environmental Protection Administration of China

Environmental Management and Sustainable Development,
June and September, 2006

The training course “Environmental Management and Sustainable Development” for Chinese Director-generals jointly organized by SEPA and the Italian Ministry for Environment, Land and Sea has been successfully run for two sessions. The trainees have a high opinion of the training and all think that its contents are satisfactory, and the course design and study organization are reasonably arranged. Particularly the enthusiastic, attentive and painstaking work of the staff of Venice International University made a deep impression on the trainees.

After a short time of two weeks, the trainees can relatively systematically study and learn the Italian and EU environmental management framework and management experiences, and the effect generated by a good environmental management. In comparison with the present situation of China’s domestic environmental management, system of laws and regulations, prevention concept, national quality and especially the action of environmental awareness in environmental protection, the trainees “have expanded their view and enlightened their train of thoughts”. The training effect has exceeded the expectation of many trainees.

For the future training courses, the trainees have proposed many favourable suggestions and advices. For example, reduce repeated contents and optimize arrangement in the course set-up; for each specific environmental field, comprehensively introduce the leading technical development and present technical situation. During the discussion, many problems focused on the basic problems such as the governmental organization structure and the functions of governments at various levels for the environmental management in Italy and EU. The trainees hope that this part of content can be compiled into books and issued to them so that the discussion can be deeper and more effective. Site visit can be more representative to deepen the understanding of the courses. In addition, they hope that the content of the courses can be translated into Chinese in advance so that the trainees can easily understand them.

The trainees all think that the training itself is not the goal and the training should be a link to strengthen the two parties’ contact and conduct more substantial cooperation.

Chinese Ministry of Science and Technology

Training Workshop on Marine Protection,

June 2006

The 2006 Sino-Italian Training Workshop on Marine Protection was sponsored by the Ministry of Science and Technology of China and the Ministry for Environment, Land and Sea of Italy, and jointly organized by the Administrative Centre for China's Agenda 21 and Venice International University in Italy from June 24 to July 8, 2006.

The objectives of the workshop are to promote the Sino-Italian scientific and technical communication and cooperation in the field of marine protection and to enhance capability building of management and policy-making of marine protection. 28 Chinese participants took part in the workshop selected from the central and local government institutions, universities and research institutes.

The topic of the workshop covered the strategies, regulations and policies, the plans, managements and practices of marine protection. The courses included theory, practice and case studies (the Venice Lagoon system) on marine protection, the monitoring and control of marine pollution, the up-to-date theory and practice of the marine ecosystem, the contaminated sediment management, the port activity and integrated coastal zone management, and the ecological aspects of fisheries.

During the training, the participants also visited some sites including the central Institute for Scientific and Technological Research Applied to the Sea, ICRAM, Genova Aquarium, the Lagoon Observatory of Venice and the Port of Venice, which helped them to better understand the training course.

The workshop with abundant contents and with the combination of theory, case study and site-visit activity gave participants a profound impression. For the trainees, the workshop broadened their horizons and enhanced their thoughts, while they also studied the advanced concepts, management ways and experiences in marine protection area in Italy. It is very helpful for them to do their job better in the future.

Beijing Municipal Environmental Protection Bureau

Advanced Training Program on "Ecosystem Conservation",
July 2006

The "Ecosystem Conservation" training program is part of the cooperation activity between the Beijing Municipality, the Italian Ministry for Environment, Land and Sea and Venice International University. Twenty-one Beijing participants involved in ecology protection took part in this training program.
With the focus on "Ecosystem Conservation", the training agenda contained various lecturing sessions on finance allocation and arrangement, and conservation policy and measures. In addition, three study tours were arranged: the site visit of the Venice Lagoon, the site visit at the WWF Oasis Valle Averto and Valle Figheri and the site visit at the Gran Paradiso National Park in the Alps.
During this training, the participants could better understand the following key issues for the management and protection of ecosystems: funding for ecosystem conservation in the European Union (EU), ecosystem conservation policies and strategies at local level and EU level, Landscape Ecological Planning, Economic Evaluation of Natural Resources, Organic Farming, Role of Biotechnology for Environmental Protection.
Since all participants are engaged in jobs related to ecosystem conservation in Beijing, they could understand lectures easily and exchange experience with teachers very well. In particular, this training program provided participants with a broad vision and advanced ideas, which can contribute to their daily jobs.

VIU training program activities report

This Newsletter section reports on the training activities held in Italy and China between September and December 2006. The first part offers an overview of five trainings devoted to general issues on Environmental Management and Sustainable Development such as energy efficiency and conservation, sustainable urban development, policies for sustainable development, water and waste management (held with CASS, MOST and SEPA); the second part reports in details on three trainings that, for the first time in the Training Program, addressed specific topics, i.e. *Environmental Impact Assessment; Economics, Legislation and Enforcement of Environmental Policy; Vehicle Emission Control*. These topics were selected following the specific requirements of the Municipalities of Shanghai and Beijing.

In October, Professor Gullino and Professor Musu, respectively Director of the Advanced Training Program and President of the Thematic Environmental Networks at Venice International University, led a delegation of professors and experts invited to lecture at the opening session of the CASS trainings 2006-2007 in Beijing, and at the first module of the MOST training on *Energy Conservation and Efficiency*, that ended in Italy with a second two-weeks module.

As for the past three years of our cooperation project, the Chinese Academy of Social Sciences, thanks to the excellent management and support of the Institute of Industrial Economics of CASS, has gathered in Beijing 160 participants who will attend four thematic sessions of 40 participants each in Italy between November 2006 and March 2007.

Given the various backgrounds of the trainees involved, the first introductory session is conceived as a survey of those general issues of SD which constitute a basic knowledge necessary to successfully benefit from the thematic sessions to come. Basic principles on environmental economics, legal instruments, globalization and health were provided, together with basic principles related to energy efficiency, water, waste and sustainable urban management, i.e. those specific issues in agenda during the thematic sessions in Italy.

Policy and legal aspects concerning Energy Conservation and Efficiency focusing on global scenarios and the initiatives adopted in China were the key aspects of the MOST Training in Beijing. The specific policies adopted in the EU and in Italy for the promotion of an efficient use of energy, based on its conservation, were investigated in depth in the second module in Italy. In particular, the role of renewable energy sources as well as case studies on energy conservation and efficiency applied to residential and industrial sectors were taken into consideration.

The CASS training, slightly different from that of MOST, was devoted once more to *Energy Efficiency and Renewable Energy* (the first thematic session of the newly inaugurated training activity 2006-2007) with an overview on the different renewable sources. Solar

energy, geothermal energy, energy from waste, hydrogen and biomass were presented and explored thoroughly through case studies presented both in class and during site visits.
The second thematic section of the CASS Training 2006-2007 took place in December and explored Sustainable Urban Development and Eco-building. As last year's course, the trainings covered the policies related to sustainable architecture as well as the technologies that can be adopted in eco-building. Issues of sustainable urban planning with principles and application in Italian and Chinese case studies were given large consideration, through the presentation of tools such as sound mobility plans and Intelligent Transport System. The management of hazardous waste (such as hospital and industrial waste) was also investigated as it is an issue largely debated in the development of sustainable cities.
Although conceived as a comprehensive and broad survey of *Environmental Management and Sustainable Development*, the experience of the participants in the SEPA Training held in September (14 Deputy Director Generals of different Chinese provincial Environmental Protection Bureaus) offered the opportunity to investigate this broad topic through the analysis of some specific issues that make up Sustainable Development: Environmental Policy and Law, Industrial Ecology, Environmental Auditing, Ecological Agriculture and Urban Planning. The aim was to offer DG level participants, tools for the promotion of SD at decision-making level.
For the first time in the Advanced Training Program, the issues of Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) have been in-depth explored in the Training for the Municipality of Beijing (*Environmental Impact Assessment*, Italy, October 29th -November 12th 2006). Since the course was addressed to 17 public officers selected from the Environmental Protection Bureau of Beijing Districts with

proved experience in EIA application, the main concern was to provide them with information on what is going on in the EU and Italy as far as EIA and SEA are concerned, on how problems and obstacles are overtaken and which new technologies and tools are being used.
In particular, the Beijing Municipal Environmental Protection Bureaus are starting to introduce and apply SEA to the assessment of new plans; therefore, it was important to provide the participants with examples concerning the policies and procedures adopted in other countries and their implementation.
In order to meet the specific needs of the selected trainees, the training opened with an introduction to the EU policies on EIA and SEA and their implementation in Italy, thanks to the contribution provided by the representatives of the Italian Ministry for Environment, Land and Sea in Rome. In the following days, origins and key principles of Impact Assessment were explored as well as their application in systems, processes and approaches within EIA and SEA. Special emphasis was given to the experience of EIA and SEA at local level during the visits organised to the Environmental Impact Assessment Offices of the Veneto Region and Province. The meetings offered the occasion to exchange experiences - in terms of policies, implementation, tools and technologies - between the participants and the Italian local authorities. Many interesting case studies for local authorities were presented among which: EIA applied to an incinerator plant, to a contaminated area remediation and to the system of mobile barriers planned to protect Venice from high water. Moreover, considering that Beijing will host the next Olympics Games, the case study of Turin's Olympic Village was presented and discussed.
Public participation is a key issue for the effective implementation of EIA. A successful example of good cooperation between government and public participation was offered by ICLEI, an international association made of different national, regional and local governmental organizations that have made a commitment to sustainable development. ICLEI representatives presented some case studies on public participation in Europe and Asia, and involved the participants in the simulation of a practical case, an interesting and stimulating way for the trainees to approach a rather theoretical issue.
One of the key tasks for the Shanghai Environmental Protection Bureau is the enforcement of the legislation promoting sustainable development by taking into account also economical aspects. These needs brought to the design of a new training course that focused on environmental legislation (*Environmental Policy: Economics, Legislation and Enforcement*, Italy, November 4th -18th 2006).
Mr. Kramer, a former European Commission official with over 30 years of experience on legal issues and on the application of EU environmental law presented the organization of the European Union, focusing on the environmental policies and their implementation at national level, the approach used for their implementation and their evolution over the years. In addition, the case study on the Italian environmental policy was presented by some representatives of the Italian Ministry for Environment, Land and Sea in Rome. Considering that the training was addressed to public officers from local authorities, particular attention was devoted to the implementation of environmental regulations at local level.
Voluntary agreements were presented as an effective alternative to the command and control approach. Besides the theoretical explanation of the advantages and disadvantages of this kind of agreements, their implementation in the industrial sector was considered and discussed directly with the main actors: a meeting with the Venice Industrialist Association – Unindustria was organized and the participants visited the firm Kroll Srl that adopted this approach.

Moreover, during the visit to Ecomondo Fair in Rimini, an international exhibition addressed to all those involved in environmental issues, the delegation had the opportunity to understand the work and experiences of one of the most important international company that provides management system and product certification as well as tools and consultancy for Corporate Responsibility.
The participants also had the opportunity to explore the topic of European legislation and enforcement in agriculture, benefiting from the excellence of Agroinnova in this field.

Vehicle emission control represents a hot topic for the Municipality of Beijing, which sees an increasing number of vehicles circulating every year on its roads and rings. For this reason, the Beijing Environmental Protection Bureau asked VIU to organise a training course on vehicle emission control addressed to trainees selected from the Beijing Public Transportation Group (BPT), one of the main participating agencies in the Sino-Italian Beijing cooperation (*Vehicle Emission Control,* Italy, December 9th -22nd 2006).
The lessons and site visits arranged in Italy highlighted the main elements of the cooperation activities, giving the BTP participants the chance to see on site how the local traffic system is managed in Italy, which solutions are and have been adopted in traffic management problems, who the main actors in charge of this issue are.
For this reason, many site visits were arranged in different cities in Italy. In Rome, the BTP delegation visited ATAC, the city's mobility agency. The BTP delegates were enlightened on the organisation of public transport services in Italy and Europe, according to the related policies. The roles and responsibilities of mobility agencies were pointed, out as well as the organization, in terms of fleet and costs management of public transport societies. BTP delegates investigated the way ATAC manages traffic during big events, since Beijing will host the 2008 Olympic Games and the city will have to face this issue.
The delegation then moved to Bologna, and paid a visit to the city's local mobility agency, ATC. The visit focused more on the fleet management, investigating the costs, the technology used and the personnel management, thus offering an outstanding case study of mobility agency organization and management.
In Venice, the visit to Thetis SpA offered the possibility of learning about the so-called Intelligent Transport System (ITS), an advanced engineering and systematic integrated tool that acts on vehicle emission control. Successful examples of ITS applications in Italy and abroad were presented, in particular the way ITS could be applied in a city like Beijing. Other systems and tools for traffic management and vehicle emissions control were also offered by Maior, an engineering company that designs decision support systems for public transport agencies.
Natural gas represents another important tool for reducing vehicle emissions control, through the reduction of fuel consumption. The experience of IVECO FIAT in developing this kind of fuel was presented in the site visit to this important company in Turin. The city of Turin also offered the possibility of discussing with the local mobility agency representatives about different strategies for sustainable mobility recently developed.

Establishment of Strategy and Program on Reduction and Phase-out of Pesticidal POPs in China

On May 23rd 2001, the representatives of over 90 countries including China signed the Stockholm Convention on Persistent Organic Pollutants that triggered off the campaign against POPs.

In November 2001, the Italian Ministry for the Environment Land and Sea (IMELS) and the State Environmental Protection Administration (SEPA) signed an agreement for a cooperation project which was officially kicked off in 2002 and became the first international cooperation project within China's preparation measures for the National Implementation Plan for implementing the POPs Convention. The overall objective of this project is to formulate the Strategy and Program on Reduction and Phase-out of Pesticidal POPs in China.
The project has been implemented through the following activities: preliminary sources/inventories of pesticidal POPs, focusing on production/distribution; investigation into technology for pesticidal POPs reduction and phase-out; analysis of the gaps in terms of management and institutional capacity for implementing the Convention. The project also organized training courses for about 200 local officers and technical experts on the investigation methods for inventory establishment on in-use, stockpile and abandoned pesticidal POPs.

Transfer of Alternative Technologies to the Use of Methyl Bromide and Capacity Building in the Soil Fumigation Sector

Methyl Bromide (MB) is an ozone depleting substance banned by the Montreal Protocol, largely used in China for soil fumigation in the horticultural sector. The project, co-financed by IMELS and SEPA, has been implemented by the Center of Competence for the Innovation in the agro-environmental sector (AGROINNOVA) of the University of Torino (Italy) in collaboration with the Chinese Academy of Agricultural Sciences (CAAS) and China Agricultural University (CAU).
The most promising MB alternatives developed in Italy were selected for field demonstration trials: the use of virtual impermeable films (VIF) for the reduction of dosage rate and emission of methyl bromide; Metham-sodium applied through drip irrigation system at reduced dosages; soil solarisation combined with biocontrol agents (*Trichoderma* spp.); grafting on resistant rootstocks.
The technical feasibility and effectiveness of such techniques on tomato and strawberry production have been evaluated in two different Chinese agricultural areas (Hebei and Shandong Provinces). The project officially began in January 2001 and was completed in October 2003.
The substantial objectives of the project included: transfer of technologies that contribute to the reduction of dosages and emissions of methyl bromide; testing and adoption of alternatives to methyl bromide (chemical and non-chemical); demonstration of the technical, social and economic feasibility of the adopted alternative technologies for soil disinfestations; dissemination of the results of the application of alternative technologies; training of farmers on the application of the alternatives in the most appropriate and safe way; assessment of the social and economic implications of a total methyl bromide phase-out.
The results of the project activities demonstrated that in China, from a technical and economic point of view, MB+ Virtual Impermeable plastic Films (VIF) are an economic feasible alternative; Metham Sodium (MS) and MS+VIF have a slightly lower profit compared with MB, which needs a higher input than MB because of the drip irrigation system used, but it

is still considered to be a valid and safer alternative for high value crops by the farmers; resistant cultivars and grafting are very promising and effective feasible alternatives for tomatoes, as long as nurseries are developed in China to abate the costs of seeds and plants; solarization with bio-control agents is not a feasible alternative, but Chinese farmers believe that solarization with organic manure is a promising alternative to MB because easier to conduct, even though the yield is lower than with a MB treatment.
The project represented a pilot phase towards a broader cooperation program between Italy and China for the total phase-out of the methyl bromide consumption in China.

Italian Technical Assistance for China Biodiversity Partnership Framework (CBPF)

China is among the countries with the greatest biological diversity and one of the first countries that has ratified the Convention on Biological Diversity.
This program is a cooperation project between IMELS and SEPA.
From an institutional point of view, the project includes: formulating China's national strategy for biological diversity protection and investment planning, strengthen biodiversity governance, setting up a platform for exchanges of information, and creating a good administration environment for biological diversity protection.
At the local level, this project intends to choose the representative areas of five Provinces (Yunnan, Sichuan, Guizhou, Guangxi and Tibet) as pilot projects and conduct demonstration activities in the light of their local and specific conditions.
This project aims at applying the GEF planning methods to establish a participation-oriented development mechanism, setting up good cooperation partnerships among the central/local governments of China, the bilateral

countries, international organizations, private enterprises and NGOs.
During the International Day of Biodiversity on May 22nd 2006, a ceremony was organised for the Inception of the EU-China Biodiversity Programme (ECBP) and the China Biodiversity Partnership Framework (CBPF) which were launched at the same time. Since then, the two Programmes are working in synergy and coordination.

Survey and Evaluation of the Ecological Environment in Selected Areas of Central China

The "*10th five-year Plan for National Eco-environmental Protection*" puts forward that the basic steps for an eco-environmental protection are: "to conduct a survey on the eco-environmental status of the selected areas, to establish a nationwide database on the ecological environment conditions, to draw up a national eco-zone and an eco-protection plan, and to set up an administration information system on national eco-protection."
This project is a cooperation project between IMELS and SEPA. In June 2002, Italy and China had signed the agreement and the project was successfully concluded in 2005.
With the utilization of a technology based on Landsat TM/ETM+ image, remote sensing and geographical information systems, this project aimed at conducting special research on six typical pilot areas including the Sewage Irrigation Area in Liaoning Province, the Haihe River Basin, the Yellow River Delta, the Yangtze Three Gorges Reservoir, the Jianghan Plain and the Wuyi Mountain; moreover, the project produced a special report on these six pilot areas involving land utilization, coverage chart and eco-change detecting chart; the project verified the trend of China's eco-environment and the existing problems, promoted China's utilization of the Italian remote sensing technology, and gave a concrete contribution to the development and strategic planning of China's environmental protection. The project also aimed at conducting eco-environmental data collection and processing in typical pilot areas, as well as carrying out a classification of land utilization/land coverage, data collection on special topics such as dynamic trends, changes of water quality, vegetation and costal lines, soil erosion and riverbed formation analysis.

The Eco Development of Chongming Island

This is a cooperation project between the Italian Ministry of Environment Land and Sea (IMELS) and Shanghai Environmental Protection Bureau.
The project aims at analyzing the planning of the Chongming three islands system (Chongming, Changxing and Hengsha Island) from an environmental perspective, providing recommendations to drive the islands towards sustainable goals.
Chongming Island is the third largest Chinese island in terms of surface, situated at the estuary of the Yangtze River. Large amounts of Chinese and international financial resources are being invested to develop it into an ecological island, due to its high natural value, clean environment and socio-economic profile, and to make it a leisure area for Shanghai's metropolitan system.

The Chongming Master Plan is designed in order to contribute to the creation of a comprehensive sustainable and ecological three islands system, which shall integrate different functions, economic activities and related infrastructures.
Three main activities will be jointly carried out by Chinese and Italian experts: the analysis of the Chongming Master Plan from an environmental perspective; the analysis of environmental implications of key demonstration interventions foreseen by the Plan; the identification of potential demonstrations projects.

Strengthening Technology and Capacity of Sustainable Agriculture in China

Inner Mongolia and Xinjiang Autonomous Regions are particularly suffering an overexploitation of agricultural resources due to the overuse of chemical fertilisers and water, leading to serious problems of soil erosion and desertification. The project was co-sponsored by IMELS and SEPA in collaboration with AGROINNOVA (University of Torino).
According to the current status of the regional agricultural production and typical agricultural issues, the project aimed at improving the rural and/or regional ecological environment, and developing pollution-free agricultural products.
In October 2002, upon a discussion between Chinese and Italian officials and experts, two demonstration sites were selected for developing sustainable agriculture, one in Shihezi Municipality of Xinjiang Uygur Autonomous Region, and the other in Helin county of Hohhot Municipality, Inner Mongolia.
_ In Shihezi demonstration site, tomato and grape were selected as two target crops. Water-saving technology, degradable mulching film, organic fertilizer and integrated management system for disease and pest control were introduced and applied in this system.
_ In Helin demonstration site, an ecological agriculture demonstration system with virtuous circles was established. Corn and vegetables were selected as target crops. As in the previous site, water-saving technology, degradable mulching film, organic fertilizer and integrated management system for disease and pest control and other specific Italian technologies were introduced and applied in this system.
The advanced experimental techniques from Italy such as computer controlled irrigation and fertilization system can automatically adjust the irrigation time and water volume on the basis of the changes of crop demand and cultivation environment. The system transports moisture to crop root directly through the irrigation network in fields, reducing water waste which often occurs in traditional management. The productivity is 5 to 7 times better compared to the traditional irrigation systems. With the assistance of an irrigation system, chemical fertilizers are diluted into irrigation water and have a direct effect on the root system. Experiment results show that the efficiency of the fertilizer increases from 3 to 4 times more, and 200-300 kg of additional biomass is produced for every kilogram of fertilizer under such circumstances. The quantity and weight of weed in the fields is also reduced. Briefly, the design of the Sino-Italian Sustainable Agricultural Programme responds to the demand of the Chinese agricultural sustainable development, and favours the introduction and diffusion of Italian agricultural reduction modalities in China especially as far as water saving, chemical fertilizers and pesticides reduction are concerned.

Sustainable Agriculture in Chongming

The project "Sustainable cropping system and technologies for the production of "green" agricultural products in Shanghai Chongming Island" is one of the cooperation projects between IMELS, Shanghai Environmental Protection Bureau and AGROINNOVA (University of Torino). The aim is to develop environmentally friendly green food production not only to increase potential for higher incomes for local growers looking with interest to foreign markets, but also to enable the production of healthy food and the promotion of a safe environment for national eco-tourists visiting Chongming Island in the future. In particular, the project aims at reducing the use of chemical fertilizers (currently far over the national safety limit of 225kg/ha) and pesticides on cash crops.
The project is carrying out field experimental trials on tomatoes, watermelons, pumpkins, horse beans and other horticultural crops in order to demonstrate the technical and economical feasibility of complex organic-oriented cropping systems, integrating the use of tolerant and resistant varieties, fertigation and environmental control systems, and bio-control products. Training activities and workshops are organized with the objective of promoting a better understanding of the European regulatory framework, production, marketing and certification systems of organic farming.
The project goes beyond the merely environmental concerns and strengthens the role of rural areas as multifunctional dynamic systems. This is an important

aspect in China, since the present economic growth, the urbanization and the extended leisure time also increase the demand for tourism and recreation activities in rural areas. Considering the future development plan of Chongming Island as the first Ecological Recreational Island of China, the organic production of high value crops (vegetable and fruits) is regarded as a means to link higher incomes and market opportunities to environment protection.

Organic Farming: social, ethical, economical and technical issues

In collaboration with CAU, the Zhejiang University, the Northeast Agricultural University, the Qinghai College of Animal Husbandry and Veterinary, and three European universities (Tuscia University, Italy; Bonn University, Germany; Wageningen University, The Netherlands), AGROINNOVA is coordinating the project "Organic Farming: ethical, economical, technical and scientific aspects in a global perspective" co-financed by the European Commission within the Asia-Link Program. The project aims at implementing educational activities based on the European advanced experience, and at developing human resources in the Chinese organic farming context. Moreover, it will permit research on molecular diagnostic techniques for plant pathogens, prevention of food contamination by micotoxins, recycling of industrial organic wastes for compost production and influence climate change as regards to the diffusion of plant diseases.
The project activities promote the sharing of technical, scientific, economical and ethical knowledge on Organic Farming, based on European advanced experience in this sector. Projects activities address three main sectors: a three-month visit to the European Universities for 12 Chinese professors and assistant professors; one-year study abroad, within a three-year PhD programme for 16 PhD students (12 Chinese and 4 European students); two two-week summer schools in Europe for 48 graduate students (32 Chinese and 16 European students).
The general expected results are the development in China of the culture of organic farming as a means for sustainable development; a better knowledge of the European standards and regulatory framework with respect to the production and marketing of organic food; a network of European and Chinese academic Institutions teaching and carrying out research on Organic Farming; the upgrading of scientific and technical capacity of existing and future teaching staff from Chinese higher education Institutions; the establishment of an educational and teaching platform ensuring long distance education on Organic Farming.

Sustainable plant protection in respect of the environment: modern techniques for the control of plant pests and diseases of horticultural crops in China

AGROINNOVA and the China Agriculture University (CAU), in collaboration with Italian firms and research centers developed a project with the aim of diffusing modern techniques developed in Italy for the sustainable control of plants pests and diseases of horticultural crops. Implemented within the Framework Agreement between MAP, ICE and the Conferenza dei Rettori delle Università Italiane - CRUI (the Board of the Deans of the Italian Universities), the project focuses on the use of biological products and resistant rootstocks as well as integrated pest management. Activities take place in Beijing and Italy.
One of the purposes of this project is to improve the capacity of Chinese academic Institutions to develop new forms of cooperation by promoting the interaction between universities, the industrial sector and policy makers and in particular by creating a network between European and Chinese academic Institutions.

Education and students mobility

The establishment of joint programs that implement long-term exchanges of undergraduate and postgraduate students is considered as a high priority for all cooperation activities carried out in China. Within the cooperation agreement between the University of Torino, the Chinese Academy of Agricultural Sciences (CAAS) and the Chinese Agriculture University (CAU), as well as in the frame of the Bioasialink Project, over twenty Chinese postgraduate students and young researchers have got the opportunity of participating in training and laboratory activities on sustainable methods of plant pest and disease control during stages, Ms and PhD courses planned for the years 2006-2007 at AGROINNOVA. The student mobility is financed by the University of Torino, the Ministry of Environment, Land and Sea of Italy, the Italian Trade Commission (ICE) and the Italian Ministry of Education, University and Research (MIUR), as well as by the European Commission.

VIU Training Activities for the year 2007

VIU's Advanced Training Program enlarges its horizons and brings in a lot of new projects for the year 2007. We are glad to share them with you as our most important readers:

Environmental Training Community website

The Environmental Training Community website called ETC Program will be launched in January on www.etcprogram.org. The ETC Program website aims at strengthening the community of alumni that took part in the training courses since the beginning of the Advanced Training Program in 2003: each of you can access a private area to find and download training agendas, lecturing material, lecturers and trainees contacts, personal photobooks, etc. and to keep you updated on the training courses and share your experiences and views with your classmates.

The Municipality of Tianjin joins the Advanced Training Program.

3 training courses devoted to *Urban Sustainable Development in Coastal Areas* will be set up in China and Italy in cooperation with the Science & Technology Commission of Tianjin Municipality which, after attending VIU training courses, expressed its will to have a training tailored to its peculiar needs for the participants of its Municipality.

The University of Siena in the Advanced Training Program

Due to its outstanding know-how on Environmental Law and to the importance of this issue in themes explored in the VIU training courses, some lecturing sessions on this important topic will be organised in Siena thanks to the support of Prof. Massimiliano Montini and the University of Siena.

A distance-learning pilot project opens in March

Given the high number of applications to attend the Advanced Training Program, VIU and CASS are organizing a pilot project on distance learning with the technical support of Monserrate. Italian lecturers will be teaching in Milan while 120 trainees will be gathered in 3 classrooms in Beijing, Changsha (Hunan Province) and Xining (Qinghai Province) for a distance-learning training program on Environmental Management and Sustainable Development. A study tour in Italy will be arranged for the 15 best students in late May.

22 training sessions for 650 Chinese participants in 2007

22 training courses are being arranged by Venice International University for the year 2007. The courses will involve nearly 650 Chinese participants from CASS, MOST, SEPA, Beijing and Shanghai EPBs and Tianjin Municipality. A broad and comprehensive spectrum of issues will be covered, including Vehicle Emission Control, Environmental Friendly City, International Protocols Compliance and Electromagnetic Pollution. (www2.univiu.org/research/ten/Activities)

Environmental Management and Sustainable Development book soon to be published by Springer

Based on the experience of the Advanced Training Program, the TEN Center of Venice International University is editing the book *Environmental Management and Sustainable Development* which will be published in English and Chinese by Springer in late 2007. The book explores the main issues of Sustainable Development and gathers the best Italian experiences and case studies written by the most outstanding Italian experts in these fields.

2nd joint Workshop Tsinghua University-Venice International University

After the success of the 1st joint workshop Tsinghua University-Venice International University on *Environmental Management and Sustainable Development* held in Beijing in October 2005, a second workshop will be arranged in April in Venice. The meeting is the occasion for Tsinghua and VIU's selected lecturers to exchange on common research issues on key environmental questions of both Italy and China. Tsinghua University is a VIU member since 2005.

Tongji University students at VIU

In the frame of the agreement signed in 2005 with the support of IMELS, Tongji University students will join VIU's PhD program on *Analysis and Governance of Sustainable Development*. Students are selected among the participants of the International Master Program on Sustainable Development organized by Tongji Institute for Environment and Sustainable Development and UNEP. (www.univiu.org/tedis/isav/english/governance/index)

Prof. Ignazio Musu as the Scientific Coordinator of Asia Link project

CLIMA - Euro-Asian research and training in CLImate change MAnagement, a EU funded project within the Asia-Link Programme, is led by Prof. Musu, former Dean of VIU and now President of the TEN Center, as the project Scientific Coordinator. The project officially started in March 2006 and involves 7 institutions between Europe and Asia: Ca' Foscari University of Venice, the University of Padua (Italy), Ecole des Hautes Etudes en Sciences Sociales (France), Vrije Universiteit Amsterdam (the Netherlands), Renmin University of China, Tsinghua University (China), University of Karachi (Pakistan). The first CLIMA training sessions will take place in January 2007 in Amsterdam. (venus.unive.it/clima)