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A Perspective on Organic Agriculture in China - Opportunities and Challenges

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Keywords: production systems, organic agriculture, China

1 Overview of Chinese Organic Agriculture

With the rapid development of international production and trade in organic food, organic agriculture is also boosting in China. The milestone of Chinese organic agriculture was set in 1990 with the first export of a certified organic product (tea) from Lin'an county of Zhejiang Province, China, which marked the launch of organic production in China. By the end of 2005, there had been about 4.384 million ha organic land, including 1.694 million ha organic, 0.61 million ha conversion as well as 2.08 million ha collection area, about half of which is certified area. About 4.93 million tons organic products and nearly 1600 projects had been certified with 300~400 varieties. According to the above data, now China ranks the 3rd largest country of organic production in the world.

In China, organic development mostly is export oriented, the export products include beans, rice, tea, mushroom, vegetable, processed oil and herbs, etc. According to the certifying body COFCC of Ministry of Agriculture (MOA), the value of exported organic products increased from 0.3 million USD in 1995 to 0.35 billion USD at the end of the year 2004. Chinese domestic organic market started from 2000. Presently, most of the products sold in domestic markets are certified by COFCC and OFDC in some largest cities such as Beijing, Shanghai, Guangzhou, Nanjing and Shenzhen, etc. The price of the organic products is often up to 3 times the price of conventional products. Average organic food consumption accounts for 0.08% of the conventional food (LI 2006).

2. Opportunities for Chinese organic agriculture development

2.1 Background and basis for the OA development in China

All forms of sustainable agriculture in China are based on 4000 years of traditional practices such as crop rotation, compost application with matter recycling as well as some traditional ecological models, like "mulberry base combined with fish pond", which enable maintenance of soil fertility and good environment ecosystem through thousands of years of cultivation without modern inputs.

The so-called Green Revolution based on high inputs of fertilizer, the application of hybrid technologies and improved irrigation was widely extended to China only in 1980s, which indeed greatly improved the food security and affected Chinese agricultural. Almost all of the farmers still keep the traditional agricultural style; in fact most of the farmers have no money to input in the fields, they have to keep the original agriculture practice such as crop rotation, diversified plantation, manure application and legume crop integration, etc. for soil fertility maintenance and pest & disease control. This provides good basis to developing organic agriculture in these areas.

The improper application of chemical inputs in food production resulted in a series of problems, such as resource exhaustion, destruction of the eco-environment and food safety, etc. As a result, Chinese Ecological Agriculture (CEA) was promoted by the Chinese government from the late 1980´s to early 1990s. Supported with modern science and technology, CEA was thus not only an evolution of traditional, biological and organically based agricultural production systems, but also a new alternative to decades of conventional agricultural practices (YE 2002).

2.2 Diversified agro-ecological conditions and way of development

The natural conditions are also favorable to developing organic agriculture in China. For example, Liaoning, Heilongjiang and Jilin located in northeast China occupy 15% of cultivated land are with loamy fertile soil, abundant rainfall and cold weather. In these regions the grain production in check plot (no fertilizer) is more than 6000kg/ha for maize, 4500kg/ha for rice and 1500 kg/ha for soybean. Diseases seldom happen in these regions due to cold weather.

The southeast area of China, such as Zhejiang, Fujian, Jiangxi, Guangxi, is abundant in natural resource. Organic farming can be developed in an easy way, with organic tea, mushroom, wild collection products such as bamboo shoot and tea oil being the dominant products. The low-income and marginal areas are located in western regions, such as Guangxi, Guizhou, and Yunnan, which comprise the major areas of Yungui Plateau. Middle mountain area includes Jiangxi, Sichuan, Hunan Province and Northwest region includes Xinjiang, Shanxi, Gansu and Inner Mongolia area. Crop production is diversified in these regions and low input in agricultural production makes the products naturally organic. This situation can be improved with the development of organic agriculture. At present, organic farming is just emerging in this region and promoted by the government as a strategy to benefit the social, economic and environment development in the future.
The east coastal area, such as Hebei, Jiangsu, Shandong and Zhejiang provinces, is relatively developed. The farmers here are well educated and easy to accept new ideas. Although they are used to apply chemicals these years, they can implement new technologies to produce organic products, such as vegetables and fruit with high additive value.

2.3. Surplus labor in China rural area

Organic operation is labor intensive, so organic agriculture can improve the employment especially for woman compared with the conventional production system. From the survey data of 2003, the employment rate with organic farming can be 25%~40% higher than conventional production and 20~60% higher for woman. This would be constrains for some developed countries with high labour cost. But for China, with 210 million surplus labours in rural area and relative labour cost for 10-30 Yuan/ day, organic agriculture would be an attractive business. Organic operation can also improve the incomes of the farmers. Normally the premium price of the organic products will be 20%~200% higher than the conventional ones. Research on “Comparison Benefits between Organic and Conventional Production” shows that organic farming increases woman’s income at about 25%~40% (GREENPEACE 2003). In Wanzai, Jiangxi Province, the average net income per capita is around 1000RMB in conventional agriculture before 1998, and now was increased to about 2200RMB after they converted to organic agriculture. This provides a good choice for rural development.

3. Constraints for the development of Chinese organic agriculture

3.1 Lack of substantial and practical techniques

Chinese organic production was promoted by the global trade; the increasing market makes the products to be certified in a short time, so the enterprises turn to the favorable area mentioned in part 2.2, Although the organizer of the organic production set up a set of quality control system to guarantee the conformity of the organic regulations, but the substantial technologies for pest and disease control, soil fertile maintenance were transferred to the farmers and were not well implemented. The essence technology of the traditional agriculture and new techniques was not well summarized, developed and implement, the farmers can not find practical techniques once they meet some problems which will cause crop failure.

3.2 Lack of persistence of organic production organizer

For a long term, not all the organic production organizers - enterprises will do the organic farming continuously, especially for the companies who want to get benefit in a short time. The enterprise should pay for 20,000~40,000 CNY for organic certification every year and spend much time and energy for the internal managements, the cost is too much for the enterprise to develop organic products. Most of the enterprises do not regard the organic certification as the tools or way to improve the production quality of the enterprise, they just want to get the certificate, so some of them will stop the organic certification after one or two years, especially when the foreign market is not good.

3.3 Organization mode of organic production was not assured

Currently, organic food production in China are organized in three styles, 1) own lands with hired labour as western countries;2) rent the lands from the farmers, with farmers only earning their salaries; 3) "Company + Farmers" pattern. For farmer organizations, most of them are small grower groups, so it is hard for the companies to control. Most of the farmers do not know the essence of organic production. They only know that no chemical substance is allowed in organic production, the economic aspects attract them to cooperate with the enterprises.

3.4 How much price premium can the farmer obtain?

Generally, Chinese farmers are "too poor, too weak and too isolated to embark on conversion to organic agriculture". As far as price premiums and their trends are concerned, Green Food (A grade) no longer earns Chinese farmers any significant price premium, but do provide a competitive advantage in the domestic market. In contrast, organic price premiums remain high for some products, while for others the premiums decrease as global competition escalates (IFAD 2005). In fact how much benefit the farmers can get is not known, but it will be better than the conventional production.

3.5 Lack of policy support

Less support from government and enterprises is another constraint for the farmers to develop the organic farming. At the early stage of organic farming, crop yield will decrease greatly due to no inputs. The farmers will suffer during the conversion period, because no products will be traded and the farmers will get no benefits at this time. Chinese government is facing great tension in food security. It is forecasted that 550 million tones grain would be needed in 2010 which is 15% percent higher than real production. They are trying their best to ensure food production by encouraging the chemical input and controlling the grain planting area. This would be the vital constraint for the development of organic agriculture. There is just one way they can put great effort in organic agriculture if we prove scientifically that organic agriculture will not reduce grain production. So, research on scientific operation technology, reasonable management measures and standards and the demonstration of successful business model are necessary in next phase.

4 Some Strategies

The secret of everlasting prosperousness of traditional Chinese Agriculture relies on Chinese farmers' hardworking, frugality and intelligence. The farmers are good at spatial aspect, using dejection from human beings and animals, plus all sorts of trash, to improve soil fertility, and recycling useful substances to increase resource use efficiency. In order to achieve better organic agriculture in China, people should inherit and absorb the experience of traditional agriculture, combine the plantation with breeding and make use of crop straws, pasture and bean cake to transfer them into edible animal proteins, meanwhile provide a great deal of organic fertilizer, which will reduce fertilization and alleviate pollution. This approach can keep substances such as nutrient, energy and water in a closed cycling process and maintain soil fertility.

At present, major parts of Chinese organic agriculture production bases are located in remote areas with superior environmental conditions. The maintenance of soil fertility has to count on spontaneous rotation cropping, legume plantation and green manure plants. Prevention and cure of diseases and pests mainly rely on balance between natural enemy and application of biological pesticide, while this kind of system has very slow nutrient conversion rate, poor stability and low yield. People have very limited knowledge of the process of keeping yield which mainly base on the potential of natural system itself, particularly the processes of the material cycling and energy conversion. Consequently, people don't think deeper about natural potential of systems.

Thus, it is necessary to carry out research from technology point of view and make some modifications about traditional organic agriculture, to allow integration of each factor within the whole agricultural ecological economy domain, then building up systematic agricultural production, focusing on the self-replenishment of soil fertility. It is necessary to make appropriate use of multiple cultivation systems such as rotation cropping and inter-cropping to improve energy utilization efficiency, fertility, and use efficiency of water and nutrition, and to manage various diseases and pests by integrating physical and biological methods and natural compound.

There are huge gap between organic agriculture and traditional agriculture in terms of cost and production management, etc. As regards to changes of economic structure system and the energy transformation process, so far, no investigation has been performed in China. Therefore, enormous effort should be put into the following five major areas, including hydrology, soil, atmosphere, and plant and soil microbiology, to study the abiotic and biotic constituents within these systems. Based on multi-disciplinary theory and method, the mechanism of structure and functional changes will be deciphered behind the application of water resources, soil, fertilizer and gas. Analysis of ecological status will depend on the quantitative inspection system's structural change, as well as the observation of changing pattern which is influenced by the different manner of production based on historical data. At the same time, we should strengthen the comprehensive evaluation of production, cost and social benefits of organic agriculture by selecting circumstances such as energy transformation, cycling of nutrients and the ecological environment to evaluate the economic profit of organic agriculture, on the other hand, choosing the ratio of commercialization, the degree of opening and the product quality to evaluate the social benefits.

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Was kann der biologische Landbau zur nachhaltigen Entwicklung im Süden beitragen? – Langfristige Systemvergleiche in den Tropen

What can organic agriculture contribute to sustainable development? – Long-term farming system comparisons in the tropics

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Keywords: long-term experiments, production systems, internationality, crop farming, soil fertility

Schlagwörter: Langzeitversuche, Betriebssysteme, Internationalität, Pflanzenbau, Bodenfruchtbarkeit

Abstract:
The demand of producer organisations, development agencies, national authorities, and international donors for secured data regarding the agronomic, ecological and economic performance of organic agriculture in low-income countries of the tropics is high. Yet, no systematic comparisons between organic and conventional farming systems have been conducted which allow long-term statements in these areas. The Research Institute of Organic Farming (FiBL), together with its partners, wants to establish long-term farming system comparisons in various agro-ecological and agro-economic contexts to study the various parameters which are essential for sustainable development. At present, three sites are being established: (a) in a sub-humid area in Kenya where farming is subsistence-oriented; (b) in a semi-arid area in India where cotton is produced for the export market; and (c) in a humid area in Bolivia where perennial fruits are produced for the local and the export market. This network of system comparisons in the tropics will support the development of organic farming and sustainable agriculture on a technical, economic and political level.

Hintergrund:

In Europa und in Nordamerika ist viel Forschung zum biologischen Landbau und seinen Auswirkungen betrieben worden. Die Vorteile des Systems hinsichtlich der Erhaltung der Ökosysteme und in Bezug auf die betriebswirtschaftliche Leistung sind in vielen Studien belegt (PIMENTEL et al. 2005, OFFERMANN & NIEBERG 2000, STOLZE et al. 2000). Ein wichtiger Beitrag dazu hat der DOK-Versuch (DOK = dynamisch, organisch, konventionell) in Therwil (Schweiz) geleistet (MÄDER et al. 2002), welcher seit 28 Jahren durchgeführt wird. Inzwischen wird der Biolandbau auch von Nichtregierungsorganisationen (NGOs) in tropischen Ländern propagiert, und Bauerngruppen übernehmen biologische Anbaumethoden, um ihre Produktivität zu erhöhen und die Ernährungssicherung zu verbessern. Bis jetzt gibt es aber keine systematischen Studien darüber, wie effizient diese Methoden in den Tropen im Vergleich zu konventionellen Ansätzen sind, um ökonomische, soziale und ökologische Ziele zu erreichen (PARROTT & KALIBWANI 2006). Ob und wie der biologische Landbau zur nachhaltigen Entwicklung in tropischen Ländern mit niedrigem Einkommen beitragen kann, ist sowohl für Produzentenorganisationen,

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Forschungsinstitute, Entwicklungsorganisationen, nationale Behörden und internationale Geldgeber von Interesse.
Das Forschungsinstitut für biologischen Landbau (FiBL) hat sich zum Ziel gesetzt, zusammen mit seinen Partnern in einem Netzwerk von langfristigen Systemvergleichen den Beitrag des biologischen Landbaus zur Ernährungssicherung, zur Armutsbekämpfung und zur Erhaltung tropischer Ökosysteme zu untersuchen.

Fragestellungen:
In den langfristigen Systemvergleichen des FiBLs wird der biologische mit dem konventionellen Anbau verglichen. Folgende Fragen werden angegangen:

- Wie beeinflusst der biologische Landbau den Ertrag und die Ertragssicherheit, insbesondere in Jahren mit extremen Klimabedingungen wie Trockenheit oder Überschwemmungen? Welche Auswirkungen hat er auf die Qualität und Lagerfähigkeit der Produkte?
- Wie beeinflusst der biologische Landbau die Stabilität der Agrarökosysteme sowie die Verfügbarkeit und Qualität der natürlichen Ressourcen, insbesondere die Bodenfruchtbarkeit, die Energie-Ressourcen, die Biodiversität und nützliche Organismen?
- Schaffen biologische Produkte einen wirtschaftlichen Mehrwert, welcher ein höheres Einkommen generiert?
- Wie wirkt sich der biologische Landbau auf den Lebensstandard der Bauern und Bäuerinnen aus?
- Wie effizient ist das System des biologischen Landbaus bezüglich des Nährstoff- und Energieeinsatzes, sowie bezüglich des Kapital- und Arbeitsaufwandes?

Methoden:
Zentral bei den FiBL-Systemvergleichen in Afrika, Asien und Lateinamerika sind exakte Feldversuche, welche die Fruchtfolgen und die Anbaumethoden der aktuellen lokalen Praxis wiedergeben (siehe auch weiter unten). Diese Versuche sind dazu geeignet, agronomische und ökologische Fragestellungen über längere Zeit zu bearbeiten und Veränderungsprozesse zu untersuchen. Auch einfache Wirtschaftlichkeitsanalysen (Deckungsbeiträge) können gerechnet werden. In einem zweiten Schritt werden die gleichen Parameter auch in on-farm Versuchen unter Praxisbedingungen verglichen, allerdings mit einem kürzeren Zeithorizont. Hierbei wird auf jedem am Versuch beteiligten Betrieb eine Wiederholung mit allen Verfahren geführt. Um das Bild zu vervollständigen, werden sozioökonomische Aspekte wie Einkommensbildung und Lebensstandard nach dem Beispiel von EYHORN et al. (2005) auf Betriebsebene verglichen. In Regionen, wo viele Biobetriebe vorhanden sind, werden zufällig ausgewählte Stichproben untersucht. Wo der biologische Landbau nur wenig verbreitet ist, werden biologische und konventionelle Betriebe unter vergleichbaren Bedingungen paarweise verglichen. Hier werden auch Fallstudien durchgeführt, welche den Umstellungsprozess und seine Auswirkungen auf die ökologische, ökonomische und soziale Situation über einen längeren Zeitraum beschreiben (LEE & FOWLER 2002). Die Datengrundlage, welche aus den Feldversuchen und on-farm Versuchen und Erhebungen gewonnen wird, steht nachher für die Entwicklung des Bio-Sektors in den jeweiligen Regionen, insbesondere für die landwirtschaftliche Bildung und Beratung, für die Marktentwicklung und für die Politikberatung zur Verfügung (Abb. 1).

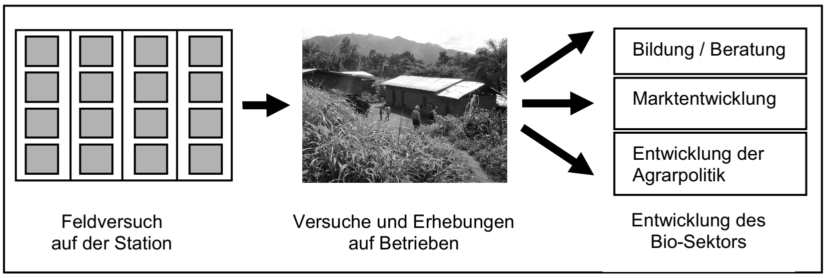

Abb. 1. Entwicklung der FiBL-Systemvergleiche in tropischen Ländern über die nächsten 10 bis 20 Jahre: Vom Feldversuch auf der Station über Betriebserhebungen zur Entwicklung des Bio-Sektors.

Standorte:
Das FiBL und seine Partner bauen in drei Ländern Standorte für die langfristigen Systemvergleiche auf:
In Kenia wird ein vorwiegend auf Subsistenzwirtschaft ausgerichteter Anbau von Mais, Phaseolus-Bohnen und Gemüse unter sub-humiden Bedingungen untersucht. Die Verfahren - konventionell und biologisch, auf je zwei Intensitätsstufen - werden im März 2007 zum ersten Mal appliziert. Lokale Partner sind das Institute of Insect Physiology and Ecology (ICIPE), das Tropical Soil Biology and Fertility Institute (TSBF-CIAT), das Kenyan Agricultural Research Institute (KARI) und die School of Environmental Studies and Human Sciences of Kenyatta University (KU).
In Indien wird in einem semi-ariden Gebiet ein Systemvergleich im Anbau eines Exportprodukts – der Baumwolle – angelegt. Soja und Weizen, zwei weitere wichtige Agrarprodukte der Region, werden in die Untersuchungen mit einbezogen. Der Versuch besteht aus einem biologischen, einem bio-dynamischen, einem konventionellen und einem GVO Verfahren. Der Versuchsbeginn ist für die Baumwollsaison 2007 geplant. Der lokale Hauptpartner ist eine Baumwoll-Handelsfirma (bioRe India). Forschungspartner werden zurzeit evaluiert.
Ein dritter Standort im humiden Teil Boliviens wird zurzeit ausgewählt. Hier soll der Anbau von mehrjährigen Produkten wie Kakao, Kaffee und tropischen Früchten in Agroforestry-Systemen untersucht werden, welche sowohl auf dem lokalen Markt wie auch auf dem Exportmarkt gehandelt werden. Die Partnerauswahl ist im Gang.

Strategische Ziele:
Das FiBL baut das langfristige Systemvergleichsnetz auf, weil:

- die Diskussion um den Biolandbau in südlichen Ländern eine sachliche Basis braucht;
- so die Regierungen und Geldgeber in den südlichen Ländern in ihrer Strategiefindung und Aktionsplanentwicklung unterstützt werden können;
- dadurch die Herausforderungen für den Biolandbau in südlichen Ländern erkannt und gezielt bearbeitet werden können;
- die Entwicklung des Biolandbaus in einer Region durch entsprechende Ergebnisse entscheidend unterstützt werden kann, wie die Erfahrungen der 1970er und 80er Jahre mit dem DOK-Versuch in der Schweiz gezeigt haben.

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Analysis of Soil Nutrients and Organic Matter in organic and conventional Marine Shrimp ponds at Guaraíra Lagoon, Rio Grande do Norte State, Brazil

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Keywords: marine shrimp farm, nutrient management

Abstract:
This study compares the soil nutrients from an intensive and semi-intensive and an organic marine shrimp farm located in Guaraíra Lagoon, Rio Grande do Norte State, Brazil. The organic system showed significant lower levels of organic matter and phosphorus when compared to the two conventional systems. The results indicate that the conventional systems release large amount of nutrients into the environment and the organic system is a sink of nutrients from the Guaraira Lagoon ecosystem.

Introduction and Objectives:

Shrimp marine farming is a growing industry in Brazil. Most of the farms are located in Rio Grande do Norte State, which produces 40.6% of the total national production. Guaraíra Lagoon is located at Rio Grande do Norte State and is surrounded by a large number of conventional marine shrimp farms. More recently a former local conventional farm was converted into an organic marine shrimp farm. The local conventional marine shrimp farms use compound feed in order to enhance shrimp growth while in the local organic farm only the natural food is used. Several authors (AVNIMELECH & RITVO 2003, AVNIMELECH & LACHER 1979) state that there is an association between the input of feed in aquaculture ponds and the accumulation of organic matter, phosphorus, and nitrogen in the soil of the pond bottom.
This study aims to compare soil characteristics from intensive, semi-intensive, and organic marine shrimp ponds located at Guaraira Lagoon.

Methods:

Area description:

The farms studied were situated at Guaraira Lagoon. The lagoon is located in the South of the eastern coast of Rio Grande do Norte State and has a volume of $2.4*10^6$ m^3 and covers approximately 325 km^2 (IDEMA 2005).

Tab. 1: General characterization of the marine shrimp ponds studied at Guaraíra Lagoon.

	Intensive farm	**Semi-intensive farm**	**Organic farm**
Cultured species	*Litopenaeus vannamei*	*L. vannamei*	*L. vannamei Crassostrea gigas*
Number of cycles/yr	1	1	3.5
Use of aerators	Yes	Yes	No
Use of nursery ponds	No	No	Yes
Stocking density/m^2 in the grow-out ponds	65 PL10	30 PL10	2.6 shrimps*
Final weight (g)	9.8	9.2	9.9
Yield per pond (kg/ha/yr)	2 510	2'060	650

Source: direct interview.
* Stocking density from the grow-out ponds. In the organic system, the post-larvae are stocked in nursery ponds prior to the transfer to the grow-out ponds with an average weight of 2.2 g.

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Soil analysis:
Samples of soil were collected from inside the organic, semi-intensive and intensive grow-out ponds during one rearing cycle at the intensive and semi-intensive pond and two consecutive rearing cycles in the organic pond. The samples were analysed for phosphorus, nitrogen, and organic matter according to the EMBRAPA (1997). The data was analysed in a two way ANOVA with repeated measures on one factor. Duncan´s multiple range test was used to compare the averages.

Results and Discussion:
Fig. 1 shows that the soil from the intensive farm has significantly higher average values of organic matter (87.8 g/kg). During the first rearing cycle the organic farm system had a higher organic matter content (73.1 g/kg) compared to the semi-intensive system (66.6 g/kg).
The organic system can be comparable to the extensive system, as it does not use artificial feed and large amount of fertilizer to improve the yields. The organic system is a sink of organic matter in the Guaraira Lagoon ecosystem and it uses organic matter from the environment to raise the shrimps. According to BOYD (1992), influent water poses a major source of sediment in extensive systems.

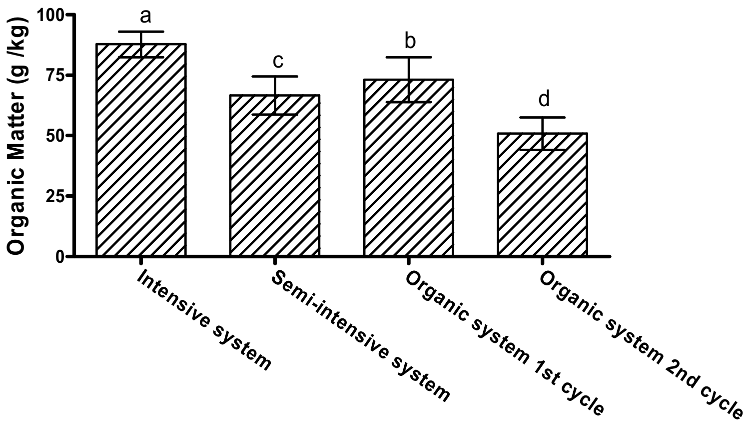

Fig. 1: Content of organic matter (g/kg) in the soil of the intensive, semi-intensive and organic marine shrimp pond. Average ±1 SD. Different letters above the columns indicate significant differences at *p<0.05* according to Duncan´s test.

Fig. 2 shows significantly higher concentrations of phosphorus in the soil from the intensive system (282.7 mg/kg) followed by the semi-intensive system (103.9 mg/kg). The organic system showed the lowest concentrations with 33.7 (mg/kg) during the wet season and 25.5 (mg/kg) during the dry season. Fig. 3 shows a significant difference in nitrogen concentration in the soil from the intensive system (400 mg/kg) compared to the semi-intensive system (280 mg/kg) and the organic system in the first (240 mg/kg) and second (230 mg/kg) rearing cycle.

Tab.2. Estimated values for organic matter inputs and outputs from an intensive, semi-intensive and organic marine shrimp farm located at Guaraíra Lagoon.

	Intensive pond	Semi-intensive pond	Organic pond 1st cycle-rainy season	Organic pond 2nd cycle-dry season
Organic matter in the feed input (kg/ha)	5 400	3 632	-	-
Organic matter in the fertilization and other organic inputs (kg/ha)	30	19	4.8	1.9
Estimate total organic matter input (kg/ha)	5 430	3 651	4.8	1.9
Organic matter content in the harvest (kg/ha)	500	441	37.2	42.2
Estimated ratio organic matter input/organic matter output	10.8	8.3	0.12	0.04

Source: direct sampling and records from the studied farms.

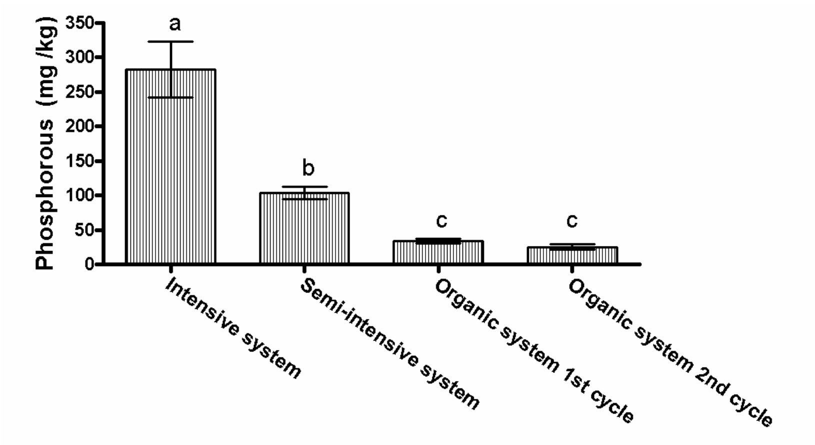

Fig. 2: Phosphorus content (mg/kg) in the soil of the intensive, semi-intensive and organic marine shrimp pond. Average ±1 SD. Different letters above the columns indicate significant differences at *p<0.05* according to Duncan´s test.

MARTIN et al (1998) showed that up to 38% of the total nitrogen input accumulates in the sediments of a shrimp pond. About 63% of the added phosphorus was reported to accumulate in the sediment of a semi-intensive shrimp farm (PAEZ-OSUNA et al. 1997).

Fig. 2: Content of phosphorus (mg/kg) in the soil of the intensive, semi-intensive and organic marine shrimp pond. Average ±1 SD. Different letters above the columns indicates significant differences at *p<0.05* according to Duncan´s test.

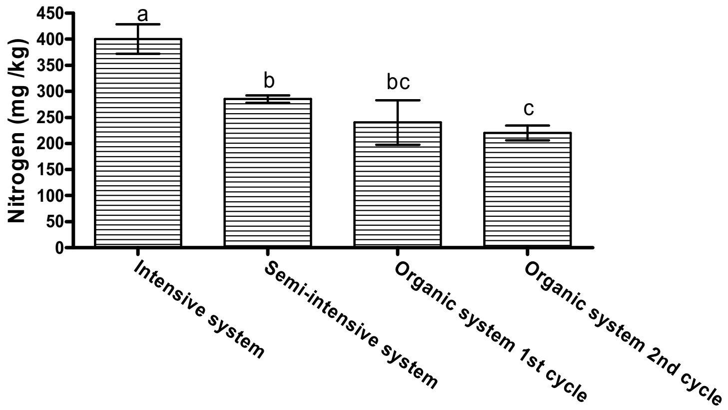

Fig. 3: Nitrogen content (mg/kg) in the soil of the intensive, semi-intensive and organic marine shrimp pond. Average ±1 SD. Different letters above the columns indicate significant differences at $p<0.05$ according to Duncan´s test.

Conclusions:

The results of this study report lower concentrations of nutrients (N and P) and organic matter in the organic system. The environment is the main source of organic matter in the soil of the organic pond while in the conventional systems the feed is the main source of the organic matter content. The organic farming system is environmentally friendly but studies are required to evaluate the sustainability of the spread of the organic marine shrimp farms at Guaraira Lagoon.

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Impact of Organic Farming on Yield and Quality of BASMATI Rice and Soil Properties

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Keywords: organic farming, bio fertilizer, organic amendments, grain quality, Basmati rice, soil microbial activity

Abstract:

The management of soil organic matter is critical to maintain a productive organic farming system. No one source of nutrient usually suffices to maintain productivity and quality control in organic system. In addition, the inputs to supplement nutrient availability are often not uniform presenting additional challenges in meeting the nutrient requirement of crops in organic systems. With this concept, a field experiment was conducted at the research farm of Indian Agricultural Research Institute, New Delhi, India during 2003-06 in rice-wheat-green gram cropping system. In this experiment, different treatments comprising organic amendments such as Blue Green Algae (BGA) 15kg/ha, Azolla *1.0 tonne/ha, Vermicompost and Farm Yard Manure (FYM) 5.0 tonne/ha each applied alone or in combination were tested in organic crop production. These treatments were compared with absolute control ($N_0P_0K_0$) and recommended dose of chemical fertilizer ($N_{80}P_{40}K_{40}$). In wheat crop* Azotobacter *replaced* Azolla, *but other treatments remained same. For rice, a scented variety 'Pusa Basmati 1' and for wheat and green gram HYVs were taken. Biomass of green gram was incorporated in soil after picking of pods and wheat was sown using zero tillage practice. The observations on grain yield, contents of Fe, Zn, Mn and Cu in rice grains, insect pest incidence, soil nutrients and microbial activity were taken.*

Results revealed a significant enhancement in grain yield of rice over absolute control due to the application of different organic amendments applied alone or in combinations. Rice grain yield increased by 114 to 116.8% over absolute control when all the 4 organic amendments were applied altogether. The rice grain yield (4.0 t ha^{-1}) obtained under combined application of four organic amendments was at par with the yield recorded under recommended dose of chemical fertilizer application. An interesting observation recorded was that there was no serious attack of any insect pest or disease in organically grown crop. Soil microbial population (Actinomycetes, Bacteria, Fungi and BGA) enhanced due to the application of organic amendments in comparison to absolute control as well as recommended fertilizer application that in turn resulted in a notable enhancement in soil dehydrogenase and phosphatase enzyme activity. Soil organic carbon and available phosphorus contents were also found to be significantly increased due to organic farming practice over control as well as chemical fertilizer application.

Rice grain analysis for nutrients viz. Fe, Zn, Mn and Cu showed a significant increase in Fe and Mn content in the treatments having 2 or more organic amendments over control. Zn and Cu content also increased but the increment was significant with combined application of 3 or 4 organic amendments.

The study revealed that addition of four organic amendments viz. BGA, Azolla, *FYM and Vermicompost could give the optimum yield (4.05 t/ha) of organic Basmati rice and improve grain and soil quality.*

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Introduction:
Organic farming production system aims at promoting and enhancing agro-ecosystem health, biodiversity, biological cycles and soil biological activities. In organic farming we constantly work to build the healthy soil that translates into healthy plants. Crop plants remove varying amounts of different nutrients from soil and to compensate the loss from the soil, organic amendments rich in nutrients must be added (SINGH & MANDAL 2000). In organic farming we feed the soil micro and macro-organisms, which deliver a smorgasbord of minerals, vitamins and other nutrients to the crop at a metered pace.
The rice - wheat production system of South Asia, occupying 11 million ha area in India, is among the most productive cropping systems in the world. However, this system has shown signs of fatigue and evidences suggest that natural resources may be reducing productivity in this system. Problem of such resource degradation may be solved to some extent if organic farming is taken up in selected areas having this system. Basmati (scented) rice is best suited for this due to its lower nutritional requirement. To adopt organic farming of Basmati rice and wheat, areas need to be demarcated and reasonable price guarantee may be necessary (PRASAD 2005). India's export of Basmati rice may be further boosted if it is grown organically. Through organic farming, incidences of occurrence of disease and insects may be reduced; soil and grain quality improved (STOCKDALE 2001) and fragrance (aroma) in Basmati rice may be upgraded. With such background an experiment was conducted to find out the feasibility of organic farming in rice –wheat-green gram cropping system and examine the impact of this on the yield and quality of grain and soil properties.

Methods:
A field experiment was conducted at the research farm of Indian Agricultural Research Institute, New Delhi, India during 2003-06 in rice-wheat-green gram cropping system. In this experiment different treatments comprising organic amendments such as Blue Green Algae (BGA) 15kg/ha, *Azolla* 1.0 tonne/ha, Vermicompost and Farm Yard Manure (FYM) 5.0 tonne/ha each applied alone or in combination were tested in organic crop production. These treatments were compared with absolute control ($N_0P_0K_0$) and recommended dose of fertilizer ($N_{80}P_{40}K_{40}$). The treatments (16) were laid out in Randomized Block Design and replicated thrice with a plot size of 24 m^2 each. In wheat crop *Azotobacter* replaced *Azolla*, but other treatments remained same. For rice, scented variety 'Pusa Basmati 1' and for wheat and green gram HYVs were taken. Biomass of green gram was incorporated in soil after picking of pods and wheat was sown using zero tillage practice. The observations on plant growth, grain yield, concentrations of Fe, Zn, Mn and Cu content in rice grains, insect pest incidence, soil nutrients and soil microbial activity including soil enzymes were taken as per standard procedures.

Results and Discussion:
Grain and straw yield of rice and wheat increased significantly over absolute control due to the application of different organic amendments applied alone or in combination (Tab. 1). Mean data on rice grain yield of 3 seasons (2003-2006) revealed that organic amendments applied alone showed an increase of 14.3 to 44% over control. Positive effects of use of green manuring (MANDAL et al. 1992), BGA and *Azolla* (SINGH & BISOYI 1989, SINGH & MANDAL 2000) and incorporation of crop residues (SINGH & MANDAL 2000) have been reported. Combined application of two and three organic amendments increased the grain yield in rice in the range of 65 to 102% and 100 to 112% respectively, compared to absolute control. Application of all the four organic amendments together had the maximum cumulative effect and increased the rice

grain yield by 114 to 116.8% over absolute control. The rice grain yield (4.05 t/ha) obtained under combined application of four organic amendments was at par with the yield recorded under recommended dose of chemical fertilizer application (4.38 t/ha). Similar trend was recorded in grain yield of wheat but yield of wheat was lower as compared to its optimum yield level. Interestingly, there was no serious incidence of any insect pest or disease in organically grown rice and wheat crop. Soil microbial population *viz.* Actinomycetes, Bacteria, Fungi and BGA increased due to the application of organic amendments which further influenced the soil dehydrogenase and phosphatase enzyme activities.

Tab. 1: Effect of different organic treatments on rice grain yield, content of Iron (Fe), Zinc (Zn), Copper (Cu) and Manganese (Mn) in rice grain and microbial activity in soil at mid crop stage of rice (mean of 3 years). 1*=Actinomycetes; 2*= Bacteria; 3*=Fungi; 4*= BGA; 5*=Dehydrogenase enzyme activity (µgTPE.g^{-1} soil.$24h^{-1}$).
Rate of application/ha: *Azolla* 1.0 t; BGA 15 kg; FYM 5.0 t; Vermicompost 5.0 t.

No	**Treatments**	**Rice grain yield (t/ha)**	**Content in rice grain (ppm)**				**Soil microbial population (x10^3CFU/gm of soil) and enzymatic activity***				
			Fe	Zn	Cu	Mn	1*	2*	3*	4*	5*
1	*Azolla* (A)	2.54	35.1	32	12	34	332	369	31	59	131
2	BGA (B)	2.46	34.8	31	12	33	341	356	63	74	124
3	FYM (F)	2.24	35.2	32	12	34	261	322	51	61	110
4	Vermicompost (V)	2.66	35.3	32	13	35	276	365	43	48	108
5	A+B	3.25	37.2	34	12	35	287	380	32	23	121
6	A+F	3.42	36.2	33	13	36	279	364	33	42	134
7	A+V	3.85	36.9	33	14	34	195	321	32	35	113
8	B+F	3.26	36.1	33	13	35	267	386	34	55	113
9	B+V	3.50	37.1	34	14	36	243	364	37	68	127
10	F+V	3.58	37.4	34	13	35	267	368	34	57	112
11	A+B+F	3.66	38.9	35	15	37	256	376	41	78	120
12	A+F+V	3.70	37.6	35	16	39	380	402	65	98	124
13	B+F+V	3.82	38.3	35	16	38	376	378	75	86	132
14	A+B+F+V	4.05	39.8	36	17	40	301	334	61	87	125
15	$N_{80}P_{40}K_{40}$	4.38	33.1	32	13	36	164	332	69	23	101
16	$N_0 P_0K_0$	1.84	32.4	31	12	32	160	312	29	12	101
	CD (at 5%)	0.48	3.4	3	4	4					

Microbial population of Actinomycetes, Bacteria, Fungi and BGA in a composite soil sample before starting of experimentation in 2003 was $74x10^3$, $203\ x10^3$, $14\ x10^3$ and $3\ x10^3$ CFU/gm of soil respectively. Rice grain analysis for Iron and Manganese content showed a significant increase in the treatments having 2 or more organic amendments over control (Tab. 1).

Conclusion:

Use of different organic amendments *viz.* Blue Green Algae, *Azolla*, Vermicompost and Farm Yard Manure in a cumulative manner can meet the nutrient requirement of organic scented rice in rice- wheat-green gram cropping system. Organic farming enhanced soil organic carbon, available phosphorus content and microbial population / enzymatic activity of soil thus making it sustainable for organic crop production. Increase in Fe and Mn content in rice grain further indicated that their use not only maintain the soil productivity but also improve the grain quality.

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Organic and alike farming in Latin America: state and relevance for small-scale livestock keepers

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Keywords: development of organic agriculture, internationality, regional economics, animal husbandry and breeding, Latin America

Abstract:
While the organic movement is growing, its contribution to small-scale livestock farming in Latin America is contentious. Secondary literature and available statistics were used for this study. Farms and area under certified organic agriculture are rising, but small-scale livestock farming is little represented. The latter is yet to be found in non-certified organic-like farms, offering locally adapted paths to securing livelihoods.

Introduction and Objectives:
The forms and approaches of organic agriculture are quite heterogeneous and a clear-cut definition of what "organic" includes is lacking. Even though there is an umbrella organisation for organic agriculture in the world, IFOAM, its leadership is questioned. It seems to follow a "Western-oriented" concept because of historic roots and development of the organisation. Harmonisation processes are established and the international discourse is more and more oriented towards regional realities all over the world, in particular including developing countries in the tropics and subtropics. However, a dominance of Western concepts is still being perceived by stakeholders from developing countries. The organisation's actions are basically directed by the aim to improve the contribution of developing countries to world markets, thus emphasising certification and subsequent export of produces. On the one hand this may increase the options of farmers, and here especially poor households, to raise their income. On the other hand export-based production bears the threat of dependence on world markets and does not contribute to securing local markets and livelihoods by supplying food, non-food products and services. In this paper, Latin America will be taken as a case to compile different approaches of organic and alike livestock farming and to assess their relevance to smallholdings with livestock.

Methods:
A secondary literature search, including grey literature, was performed. Web-searches were carried out to detect different practical examples which were not (yet) published in scientific journals. Categories of approaches were established, and their importance exemplarily outlined for two countries, namely Brazil and Bolivia.

Results and Discussion:
The documented contribution of Latin America to worldwide organic farming is relatively high as it makes up 20% of the worldwide certified land and shows highest continent contribution in terms of farms (YUSSEFI 2006). The estimated share of pastures to worldwide organic land use is about half of the certified area. The authors however mentioned that databases are incomplete. At best formally certified areas can be quantified. The registered land area under organic management increased 11-fold from 2000 to 2006 (Tab 1). Unlike the numbers of members and associates of IFOAM, which decreased by 23% from 1994/95 to 2006.

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Average country data under organic management give a clue to types of systems involved. Argentina e.g. includes extensive rangelands with large-scale livestock farming. In a small country like Uruguay, already few farms can make up a high share of organic land area. Both countries account for more than half of the organic land in Latin America. As they are known to also sell produces like cereals and mate tea, the remainder of pastures will be found in Brazil (see below) and Chile besides its organic fruit production. Yet, the bulk of farms, mainly smallholdings, is to be found in countries with average farm sizes smaller than 100 ha, such as Mexico, Peru, Brazil and Bolivia. Most of those countries supply international markets with their organic crop production. Almost nothing is known however on livestock practices in mixed farms certified for selected crops.

Tab. 1: IFOAM member organisations, certified organic land area, and number of certified farms in Latin American countries.

	-- Members (n) --			----- 1,000 ha -----			- % of land -		Farms (n)	ha/farm
	'94/95	2006	Diff.	2000	2006	Diff.	2000	2006	2006	2006
Argentina	12	11	-1	380.0	2,800.0	x 7	0.22	**1.58**	1,824	1,535
Belize	0	0	0	.	1.8	.	.	**1.19**	.	.
Bolivia	4	3	-1	8.0	364.1	x 46	0.02	0.99	**6,500**	**56**
Brazil	9	5	-4	100.0	887.6	x 9	0.20	0.34	**14,003**	**63**
Chile	5	2	-3	2.7	639.2	x 237	0.02	**4.19**	1,000	639
Colombia	5	4	-1	.	33.0	.	.	0.07	4,500	**7**
Costa Rica	1	3	2	9.0	13.9	x 2	0.31	0.49	3,987	**3**
Cuba	2	0	-2	.	10.4	.	.	0.16	5,222	**2**
Dominican Rep.	0	1	1	.	72.4	.	.	**1.96**	819	88
Ecuador	3	2	-1	.	27.4	.	.	0.34	2,427	**11**
El Salvador	1	0	-1	4.9	9.1	x 2	0.31	0.53	37	246
Guatemala	2	4	2	7.0	14.7	x 2	0.16	0.33	2,830	**5**
Guyana	0	0	0	.	0.1	.	.	0.01	28	**4**
Honduras	0	0	0	.	1.8	.	.	0.06	3,000	**1**
Jamaica	0	0	0	.	1.3	.	.	0.26	12	111
Mexico	9	10	1	50.1	295.0	x 6	0.05	0.27	**120,000**	**2**
Nicaragua	1	1	0	.	59.0	.	0.02	0.83	.	.
Panama	0	0	0	.	5.2	.	.	0.24	7	749
Paraguay	2	2	0	.	91.4	.	.	0.37	2,827	**32**
Peru	10	5	-5	.	260.0	.	0.04	0.85	**23,400**	**11**
Trinidad & Tobago	1	1	0	.	0.1	.	.	0.06	.	.
Uruguay	0	0	0	1.3	759.0	x 584	0.01	**5.10**	500	1,518
Venezuela	4	1	-3	.	16.0	.	.	0.07	4	4,000

Note: IFOAM members include both members and associates. Country data for land area (ha) and share of total agricultural land (%) are from 1997 instead of 2000: Bolivia, Costa Rica, El Salvador, and Mexico.
Sources: IFOAM 2006, YUSSEFI 2006, WILLER & YUSSEFI 2000, IFOAM undated.

Large organic producers in Mexico were found to increasingly benefit from established certification systems while hampering the marketing chances of smallholdings (GÓMEZ TOVAR et al. 2005). This can partly be explained by the fact that certification primarily acknowledges current products rather than whole farming systems, long-term planning and underlying producer concepts (GONZÁLEZ & NIGH 2005).

Non-formalised organic farming:
Besides the formalised organic farms, other types of farm organisation co-exist that similarly deserve consideration in organic and alike land use. The expected range is broad from only using different terms for the same facts to clear discrepancy in the underlying approaches. Thus, it is hardly possible to actually estimate the magnitude of what can be considered “organic” livestock farming.

Two major groups of organic and like-minded agriculture are commonly distinguished, namely certified and non-certified organic farming (PARROTT et al. 2006, CACERES 2005, IFAD 2003, SCIALABBA & HATTAM 2002). Very few scientific articles deal with livestock systems under organic or alike management in Latin America. A database search (Scopus) on the various organic and alike approaches plus livestock plus Latin America did not yield a single scientific article, whereas simultaneously produced web hits were almost 13900 for traditional, 8600 for low-external input, 6200 on certified organic, 3200 on wild harvested, 1700 on agro-ecological, and only 200 on non-certified organic approaches.

The following types of organic and alike livestock farming are suggested, mainly based on books and project reports.

i) Certified organic farm: certified by IFOAM accredited or non-accredited certification body. The certification is either related to a farmers' association such as the biodynamic group and therewith emphasising a process-based view, or simply meant for trade without identification with a farmers' association and thus generally following a product-based approach.
ii) Non-certified organic farm: not officially certified as organic, but similarly run farm,
iii) Agro-ecological farm: based on agroecology, sometimes in opposition to certified organic, if in accordance then more or less covered by the certified or non-certified organic type,
iv) Traditional farm: farms that are managed organic-like, but principally not with an attempt to be an organic farm,
v) Wild collection: hunting (game) or gathering (honey) in an environment declared as almost undisturbed,
vi) Low-external input agriculture: emphasis on a large degree of self-sufficiency in farm inputs therewith promoting internal recycling,
vii) Green production: a pasture-based feeding system where the pasture management may but does not necessarily follow an organic approach,
viii) Locally branded production: pursuing a territory concept in order to promote a speciality following production procedures strictly adapted to local conditions.

A clear distinction between the types is not always possible due to partial or complete overlaps as well as inconsistent uses of the terms.

Types of organic and alike livestock farming in Brazil:
Organic livestock farming in Brazil is very heterogeneous like its large area with different social, economic and ecological frame conditions. The consumer demand for organic products is assumed to be higher in urban than rural areas and increasing towards the south of the country. Popular fairs exist with a small range of organic or alike animal products. Formal certification is less relevant where those fairs offer direct producer-consumer contact. While on the one hand few farms are engaged in the international organic poultry and honey trade, on the other hand there are organic-like managed farms with no direct connection to world markets. The latter are partly being assisted by NGO's and national research centres, inspired by organic principles and partly aiming at improving livestock farming in drought-prone semi-arid regions of the North-East. Recently, a locally branded goat production scheme has been suggested (HOLANDA JÚNIOR 2005). Green production might in some cases meet organic principles whereas in general its similarity with organic farming is rejected. The formally registered organic livestock enterprises are again prevailing in the south, where for instance a number of organic dairy associations exist. Governmental support increased recently, however again favouring export production, as demonstrated during BIOFACH fair 2005 at Nuremberg, Germany.

Organic versus traditional livestock farming in Bolivia:
Frame conditions are similarly heterogeneous in Bolivia. The connectedness to world markets is however, till now, restricted to crop production, and governmental

engagement seems to be comparatively insignificant or inexistent. Traditional mountainous farming is expected to widely correspond to organic principles, if not even going beyond the minimum standards in some aspects. Fibre of camelids is already occasionally traded as a product of quasi-organic origin, whereas lack of assured market chains is still hampering its broader dissemination. Integration of organic approaches with traditional farming could offer promising ways to cope with difficult environments under climatic and socio-economic stress.

Conclusions:

Certified organic livestock keeping is widely restricted to extensive large-scale ranching and small to medium scale dairy cow farming, mainly in southern parts of Latin America. Bee keeping enterprises are an exception to this. Those systems at least partly benefit from premium prices by serving specialised markets. However, in tropical and subtropical regions, another major function of organic livestock farming could be to better adapt to adverse bio-physical conditions. Whether certified organic farming really meets the declared claims remains unproven in the target region und thus, it's often assumed ecological, economic and social superiority over uncertified production systems could not be proven so far. Reflection on core aspects of organic farming, across the various approaches, could help to better appreciate the role of livestock and to refine management practices of farm systems having evolved in congruence with local resources and conditions.

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Concepts and actors in organic livestock husbandry in Bolivia

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Keywords: organic livestock husbandry, production systems, development of organic agriculture, animal husbandry and breeding, Bolivia

Abstract:
Traditional smallholder livestock production is expected to correspond widely with principles of organic livestock farming. Though, the real magnitude of livestock under organic and alike management is unknown. From stakeholder analysis and structured interviews with key persons in Bolivia it is deduced that similarities are widely given, whereas it is questioned whether a formal individual certification approach for livestock products will match the farmer interests and consumer demands.

Introduction and Objectives:
During the last decades, organic agriculture has developed rapidly all over the world. Organic farming is practised in approximately 100 countries and the area under organic management is continuously growing. In Bolivia, the land under organic production grew from 31,025 certified ha in 2000 to 364,100 in 2002. In the same period, the number of organic farms increased from 5240 to 6500, which means a share of 1.04 per cent of total agricultural area (WILLER & YUSSEFI 2004). According to GÄRTNER (2005), organic certified livestock production in Bolivia nearly does not exist, though organic Bolivian crop products enter international markets. The main obstacle faced by peasants in order to become certified organic farmers is economic rather than linked to the production process itself (CÁCERES 2005). However, traditional ways of life and management techniques of Bolivian smallholders seem to correspond largely with the concepts of organic farming (RIST 2001). The main objective of this study was to identify similarities and dissimilarities of traditional livestock production systems in the highlands of Bolivia to legislations of IFOAM (International Federation of Organic Agriculture Movements), and to identify magnitude, state and prospects of Bolivian organic and alike livestock production.

Methods:
To compare traditional livestock production systems in the Bolivian Andes with concepts of organic livestock production according to IFOAM standards (2002), semi-structured interviews (ATTESLANDER 2000) were conducted with five technicians of AGRUCO (Centro de Excelencia Universitario en Agroecología y Revalorización de los Saberes Locales, Universidad Mayor de San Simón, Cochabamba, Bolivia) active in the communities Tapacari and Sipe Sipe, in the Department of Cochabamba. To facilitate comparison a categorization of different aspects concerning animal management, origin of animal sources, mutilations, veterinary medicine, breeds and breeding, animal nutrition and transport and slaughter was established.
Two structured interviews via e-mail for international stakeholders and 14 personal structured interviews with national actors were accomplished to obtain information about demand structure, possible prospects and extension activities of the certified and non-certified organic livestock sector in Bolivia.

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In the stakeholder analysis (GRIMBLE 1998), different stakeholders like producers, traders, shopkeepers consumers, certifiers, foundations, non-governmental organizations and the Bolivian government involved with organic or alike husbandry were identified. Subsequently, visualization with concept map software was realised to highlight interconnections as well as the absence of connections between the actors. Three case studies, not shown here, further complemented the study (KNEER 2006).

Results and Discussion:

Similarities and dissimilarities of concepts

Assessments about animal management showed conformance in the aspects of maintenance of herd structure, animal husbandry in cages and land tenure organization (Tab 1). The aspect of access to sufficient forage and water was valued as mostly analogue given the seasonal fluctuations between the dry and rainy season that determine water and forage availability.

Tab. 1: Overview on conformance of traditional livestock husbandry systems in the communities of Tapacari and Sipe Sipe with rules and legislations of IFOAM.

	Conformance	+/- Conformance	No conformance
I Animal management:			
Appropriate stocking density		X	
Access to sufficient water / forage		X	
Access to shelter		X	
Maintenance of herd structure	X		
Keeping of animals in cages	X		
Protection for wild and feral animals		X	
Land tenure organization	X		
II Animal sources/origin:	X		
III Mutilations:		X	
IV Veterinary medicine:			
Preventive disease measures			X
Veterinary techniques		X	
Synthetic substances	X		
Vaccinations		X	
V Breeding goals:	X		
VI Animal nutrition:			
Forage composition		X	
Nutritional needs		X	
Origin of forage	X		
Feeding of by-products	X		
Fodder subjection to chemicals		X	
Growth promoters, stimulants	X		
Use of supplements	X		
Use of fodder preservatives	X		
VII Transport and slaughter:			
Transport distances and types	X		
Handling during transport		X	
Synthetic tranquilizers, stimulants	X		
Watering, feeding during transport	X		
Identification during transport	X		
Use of anaesthetics		X	

Shelter was partly accessible for animals as the technicians mentioned installations of fences and housing facilities for small stock as well as natural protection areas in Sipe Sipe. Farmers purchased animals mainly within the communities. They rather favoured adapted livestock purchasable in traditional markets than breeds from commercial farms that show low performance in harsh environments. Multipurpose traits and adapted breeds are the main criteria for the farms' being analogue to the guideline. In these communities above 4,000 m.a.s.l., mainly camelids, sheep and some cattle represent the animal husbandry. The generally difficult production circumstances exclude the use of high performance non-adapted breeds. Therefore, conformity with the guidelines was confirmed.

The aspect of mutilations in Tapacari and Sipe Sipe was also valued as mostly compatible with international rules. Certainly, the farmers undertake mutilations like castrations and dehorning, allowed in the frame of the guidelines.

In Tapacari and Sipe Sipe disease measures are rather curative than preventive, displaying non-conformity to the legislation. The kinds of veterinary techniques and vaccinations applied differ largely according to the farmers' purchasing power, access to markets and services (VAN'T HOOFT 2004) and are assessed as more or less conform to the rules. The forage can be valued as organic because, according to the technicians, no fertilizers are used to improve the pasture sites. Additionally fodder is basically derived from the particular holding. The non-use of synthetic substances and growth promoters also complies with the requirements of the legislation. Feeding was assessed as more or less conform according to nutritional needs and an equilibrated forage composition because of deficiencies during dry season.

Assessments of the technicians concerning aspects of transport and slaughter turned out as more or less conform, besides the non-use of anaesthetics, the collective transport of animals of different species and further difficulties justified by the deficient infrastructure and absence of transport possibilities.

Magnitude, state, demand structure, possible prospects and extension activities in the organic livestock sector in Bolivia

All of the 16 stakeholders valued the demand structure for organic livestock products as very low as well as the possible prospects and potentials for organic livestock husbandry in Bolivia. The responses for national and international markets were divided into high potential (0; 0 respectively), medium potential (0; 7), low potential (14; 5) and no statement (2; 4). Whether producers, which already certified their plant production had any access to extension referring to organic animal husbandry with possible prospects for certification was further investigated. The certifiers responded with yes (1), no (10) and no statement (5). According to the stakeholders, chances for organic products in general are located in the export and niche markets. A crucial point mentioned by several stakeholders was the problem of the required transparency and traceability in organic food markets, followed by substantial arguments for the class of consumers: higher prices for organic products versus cheap conventional products, and the lack of awareness about organic and alike livestock husbandry in Bolivia.

In Fig. 1, connections between different stakeholders active in organic and organic alike livestock husbandry are visualized. The graph structure is starting with a centred casket, from which the reader can follow different paths for different stakeholders. All the identified stakeholders involved are marked with white caskets. The dark-grey caskets outline background information for the different stakeholder, whereas the light-grey caskets describe interrelations between the respective actors. Further, information on product prices of the several production systems is added.

Certified organic livestock farming in Bolivia is currently inexistent although there are "model farms" with potential for certification. Compared with numerous farmers, which certified their crop production for export markets, the organic-like livestock sector in Bolivia is dragging behind. Until today, there is a lack of an institutional framework stabilizing organic and traditional producers in Bolivia.

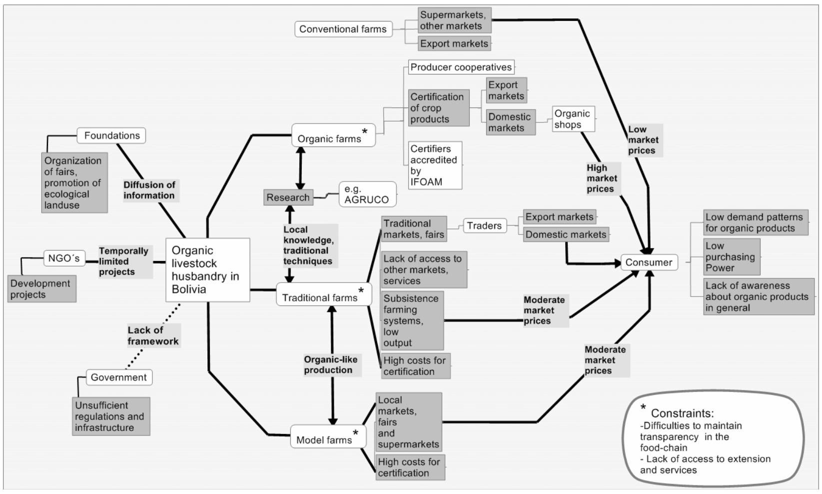

Fig. 1: Stakeholders and their interrelations with organic livestock husbandry in Bolivia.

Traditional systems show numerous intersections with guidelines of IFOAM. However, there are yet some differences between the underlying conceptual frameworks of traditional systems and formal certification processes. Whether adapting the rules to specific needs will be a beneficial path especially for traditional farmers constitutes an important aspect for future discussions about certification.

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Effect of plant biomass and their incorporation depth on organic wheat production in Kenya

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Keywords: green manures, crop farming, soil fertility, plant nutrition

Abstract:
Intensive agricultural technologies introduced in Africa some six decades ago paved the way for extensive land clearing and destruction of organic materials, development of high yielding crop varieties under monoculture and replacement of landraces. Simultaneously, pesticides and antibiotics for use in agricultural pest and disease control were being developed and soon the face of agriculture was transformed by what was termed the Green Revolution. However, the apparent success accruing from such heavy investment was short-lived since the system would easily succumb to soil erosion, reduced soil organic matter, environmental pollution and pest and disease outbreaks. The inevitable result is the inability of land to sustain food productivity and worsening poverty. In response to these dangers, organic agriculture is considered a viable approach which meets the critical need for food security, food safety, as well as human and environmental health. The use of naturally occurring and locally available farm inputs such are plant materials, animal manures and mineral nutrient rich rock ores such as rock phosphates as plant nutrient sources are instrumental in refurbishing soil fertility in a sustainable and economical way. In this experiment, green manures derived from Tithonia diversifolia*,* Dolichos lablab *and* Tephrosia vogelli *were evaluated for their effect on the performance of organically grown wheat. These materials were incorporated at different soil depths namely; 0 cm (mulch), 15 cm and 30 cm deep. Rock phosphate was used as a source of phosphorus and wheat was planted 2 weeks after incorporation. Significant yield increase (15% higher than the untreated control) was observed in the* Tithonia *treatment. This was attributed to the high nutrient concentrations and the quick release of these nutrients in the tissues of* Tithonia*. Shallow applications of the plant materials also gave better responses than deep application. Apparently, shallow applications are appropriate for shallow rotted crops like wheat. It was concluded that locally available plant material of high nutrient concentrations which decompose easily to release its nutrients can complement other soil management packages for organic crops in Kenya.*

Introduction:

Practices such as burning or removal of crop residues from crop fields leads to a decline in soil organic matter which in turn reduces the lands ability to hold water, cations, and to support soil micro-flora and a sustainable crop yield. There was loss of traditional knowledge on use of ethno-botany for disease and pest control and an increase in pests, diseases and weeds incidences coupled with a rise in environmental pollution and an increase in pesticide related human diseases. The intensive agricultural systems based on high external inputs are not sustainable and threatens food security in Kenya, particularly at smallholder level.

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The weaknesses of the Green Revolution are pronounced in tropical environments like Kenya where the warm climate favours the rapid decomposition and loss of soil organic matter. In traditional agriculture, arable land could be left fallow for some years to allow soil to acquire self-rejuvenation, but increased population pressure leads to shorter fallow periods, which are not sufficient to restore the soil nutrient pools and soil organic matter levels sufficient to support economic crop yields. In Kenya, 80% of the farmers are classified as small-scale who cannot afford high input investments.

There is therefore a need to examine crop production systems that could promote sustainable crop production in Kenya. The organic system favours the use of renewable resources and emphasizes the use of techniques that integrate natural processes such as nutrient cycling, biological nitrogen fixation and soil regeneration.

This research provides a case study of how organic farming can sustain the yields of stable food crops in Kenya. The trial was designed with a purpose of identifying appropriate cropping systems for long-term restoration of natural soil productivity. Green manures derived from high-nutrient legumes (*Dolichos lablab* and *Tephrosia vogelii*) and a non-legume (*Tithonia diversifolia*) species were either used as mulch or incorporated into the soil at various depths to understand the most appropriate biomass management strategy that will lead to quick release of nutrients. The effects of these organic farming strategies on yield of wheat are reported.

Methods:

The experiment was carried out at Egerton University, Nakuru district in Rift Valley province of Kenya for a period of five months beginning April to September, 2005. It involved the application of green manures from three species, namely: *Tithonia* (*Tithonia diversifolia), Lablab* (*Dolichos lablab*) and *Tephrosia* (*Tephrosia vogelli*). The material was applied at a uniform rate of 2 tons/ha except for the control plot which did not receive such materials. The plant material from each species was applied using three different methods, namely: mulch, incorporation into the soil at 15 cm and at 30 cm depth. This gave rise to ten treatments including the control. The experiment was laid out in a randomized complete block design (RCBD) with 4 replication on 40 plots. The plot size measured 3 m x 2.5 m. Two weeks after application of the plant material, rock phosphate at a rate of 290 kg/ha (46 kg P_{2O5}/ha) was broadcasted uniformly in all the 40 plots. Fifteen planting furrows that are 20 cm apart were then made in each plot to a depth of about 3 cm. Wheat seeds were then sown uniformly along the rows.

Data taken included the plant height at 100% flowering, spike length at grain filling stage and grain yield at harvesting. All data was analyzed statistically using analysis of variance (ANOVA). Differences between treatments were analyzed by Duncans Multiple Range test.

Results:

Effect of organic green manures on wheat

The different plant materials incorporated into the soil had little effect on the total height and spike length of the wheat crop, but significant ($P<0.05$) differences were observed in grain yield. *Tithonia* was more superior in influencing the grain yield followed by Tephrosia, Dolichos and the control in that order (Tab 1, Fig. 1). The *Tithonia* treatment gave an average wheat grain yield of 3905 kg/ha (15% higher than the control).

Tab. 1: Effect of organic plant materials on yield and yield components of wheat.

Biomass	***Average plant height at maturity (cm)***	***Average Spike length at maturity (cm)***	***Average wheat yield (Kg/ha)***
Dolichos lablab	88.9ns	8.4ns	3680ns
Tithonia diversifolia	87.5ns	8.3ns	3905*
Tephrosia vogelii	85.7ns	8.5ns	3822ns
Control (no application)	87.5ns	8.3ns	3297ns
Mean			

* significantly different at $P<0.05$, ns = not significantly different at $P<0.05$.

Effect of incorporation depth

The mulching treatment showed significantly ($P<0.05$) higher figures in all the parameters measured. Organic matter incorporation at 15 cm depth also increased yields significantly (Tab. 2, Fig. 2).

Tab. 2: Effect of biomass management on yield and yield components of wheat.

Incorporation depth (cm)	**Average plant height at maturity (cm)**	**Average Spike length at maturity (cm)**	**Average wheat yield (kg/ha)**
Incorporated at 15 cm	85.16ns	8.36ns	3809*
Incorporated at 30 cm	86.59ns	8.35ns	3772ns
Surface mulch	90.31*	8.48*	3806*
Control (no application)	87.41ns	8.31ns	3297ns
Mean			

* significantly different at $P<0.05$, ns = not significantly different at $P<0.05$.

Discussion:

Plant residues as organic fertilizers

Different plant materials that are potential fertilizer sources to crops have different nutrient concentrations and have variable rates of decomposition and release of plant nutrients. In this experiment, *Tithonia diversifolia* increased grain yield significantly when compared to other biomass used in the experiment. However, all types of biomass were better than the control. The observation could be attributed to the higher nutrient concentrations and quick release in *Tithonia* already reported in other studies. In another experiment conducted in Maseno district of Western Kenya, *Tithonia* produced a total dry matter biomass of 11.8 t/ha during the six month growth period. The nutrient concentrations in the leaves were 30g/kg nitrogen (N), 1.8 g/kg phosphorus (P), 46 g/kg potassium (K), 19.1 g/kg calcium (Ca) and 3.7 g/kg magnesium (Mg). The shrub therefore had high concentrations of N, K and Ca but low in P and Mg (RUTUNGA et al. 1999). In the same experiment, *Tephrosia* accumulated 9.5 t/ha. Nutrient concentration in the leaves of Tephrosia leaves after the six month period were 30.5 g/kg N, 1.2 g/kg P, 15.7 g/kg K, 13.0 g/kg Ca and 4.7 g/kg Mg. The above ground biomass for the two shrubs accumulated higher amounts of N, K, Ca and Mg than the natural fallow and maize (RUTUNGA et al. 1999). Though *Tithonia* is a non-legume its ability to accumulate N is as high as that of Tephrosia, a N fixing legume. Additionally, it accumulates more P, K and Ca than *Tephrosia*.

The positive effects of *Tithonia* could also be attributed the fact that the nutrients contained in its tissues are easily decomposed and resealed as plant nutrients in forms that are easily available to plants (PALM 1997). This is because it has a lower concentration of leaf lignin and polyphenol contents (less than 15 and 4%, respectively), so that it decays relatively easily (ICRAF 1997).

Several experiments have been conducted to compare the performance of *Tithonia* biomass with chemical fertilizers. Experimental evidence suggests that addition of N and P through the application of *Tithonia* biomass may increase yields more than the use of equivalent quantities of mineral N and P (JAMA et al. 2000). This has been attributed to the presence of micronutrients such as K, Ca, and Mg and also because of an improvement to soil physical characteristics. One of the pioneer experiments with *Tithonia* in Kenya compared *Tithonia* biomass with Triple Superphosphate (TSP) applied at equal rates of P (ICRAF 1997). Available P was generally comparable following either applications, indicating that Tithonia releases a considerable fraction of its total P as plant-available P. But unlike TSP, *Tithonia* increased soil microbial activity and was more effective in reducing the sorption (fixation) of P by iron and aluminium oxides in the soil. The organic anions released during decomposition compete with P ions for sorption sites therefore making it more available for plant uptake (ICRAF 1997).

Mode of application of organic materials

In all the variables observed, the surface application of plant material (i.e. mulching) was more superior in influencing wheat performance as compared to incorporation at various soil depths. This was followed closely by the shallow incorporation at 15 cm in the case of grain yields. This could be attributed to wheat root morphology of wheat. Wheat are known to have mainly two types of roots; the 3-5 seminal roots which go as deep as 1 m into the soil, and several lateral roots which go up to 15 cm deep. The lateral roots are concentrated within the top 6 - 13 cm of the top soil (KINYUA et al. 2002). The main function of these roots is to absorb nutrients and water. This implied that soil moisture and plant nutrients should be available at these shallow depths in orders to maximize plant growth. The application of organic material as mulch or at 15 cm depth is therefore likely to be the most appropriate depth of application for such a shallow rooted crop as wheat especially in warm environments. Deeper applications like 30 cm are likely to make most of the nutrients to be inaccessible to the plant roots.

Conclusions:

Plant materials with high nutrient concentrations together with can support organically managed wheat crops in Kenya. This is likely to be economically viable for small scale farmers who cannot afford chemical fertilizers due to capital constraints. It may contribute to sustainable soil management in organic wheat production systems. The present research agrees with the findings of other scientists that *Tithonia diversifolia* can provide most of the primary nutrients to crops, particularly nitrogen and potassium. With an addition of phosphorus fertilizer from external sources, *Thithonia* can be as good as a chemical fertilizer and yields that are equivalent to those under chemical fertilizer management can be obtained. The depth of incorporation of plant materials is dependant on, among other factors the root morphology of the crop species, since shallow incorporations are appropriate for shallow rooted crops and vice versa. Future trials should study the effect of incorporation depth on different crop species which have different rooting depths.

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Recognizing and realizing the potential of organic agriculture in Kenya

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Keywords: development of organic agriculture, non-governmental organizations, declining agricultural productivity, shifts in consumer preferences

Abstract:
Formal organic agriculture in Kenya dates back to the early eighties when the first pioneer organic training institutions were established. During the same period, a few horticultural companies started growing organic vegetables for export. Initial efforts to promote organic agriculture in Kenya were made by rural development non-governmental organizations (NGOs), faith based organizations and community based organizations (CBOs). They seek to help rural farmers in addressing the issue of declining agricultural productivity (especially the degradation of soils and natural resource base), high poverty incidences, food insecurity and low incomes which prevented farmers from assessing high costs inputs. Currently Kenya has five major players in organic agriculture namely Kitale-based Manor House Agricultural Center, Baraka College in Molo, the Sustainable Agriculture Community Development Program in Thika, the Kenya Institute of Organic Farming (KIOF), a training center on the outskirts Kenya's capital Nairobi, and the Association for Better Land Husbandry (ABLH), headquartered in Nairobi. The organic sector is relatively small; however, it is growing very fast, led mainly by NGOs and private sector (companies growing organic produce for export). Exports of organic products have been taking place for the last two decades, mainly with vegetables and fruits produced on large scale farms. Over the years exports have developed beyond vegetables and fruits to include other products such as essential oils, dried herbs and spices as well as products for the cosmetic and pharmaceutical industries which are more often produced by smallholders. Currently, there are five international certifiers operating in Kenya, namely: the Soil Association (SA), EcoCert International; IMO (Institute for Market Ecology); USDA's (United States Department of Agriculture) National Organic Programme (NOP) and Bio Suisse.

Introduction and Objectives:
In the pre-colonial period agricultural production was mainly in traditional form and involved use of non-purchased inputs. It mainly entailed soil-building practices, non-use of synthetic inputs and use of non-chemical material like ash, cow dung etc. to control pest and diseases. On the arrival of the white settlers land occupation was high especially in the high productivity highland areas, and larger farms developed with an emphasis on high external input agriculture. As a result, many of these inputs were made available to the surrounding smallholder producers. With the exit of the white settlers and the transfer of land to the locals in the early sixties agricultural productivity continued showing an upward trend. However, as was in the rest of the continent was short-lived, as the cost of the external inputs continued to be unsustainable for the smallholders and the natural fertility declined rapidly probably due to toxicity problems of chemical fertilizers. Coupled with declining food security was poverty that resulted from low agricultural productivity, consequently calling for alternative sustainable production systems. Organic agriculture includes all agricultural systems that promote the environmentally, socially and economically sound

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production of food and fibres with a greater emphasis on soil fertility (UNCTAD 2006). This study aimed at identifying the status and institutional infrastructure available in support of organic farming in Kenya.

Initial efforts to promote organic agriculture in Kenya were made by rural development non-governmental organizations (NGOs), faith based organizations and community based organizations (CBOs).

Current status of organic farming in Kenya:

Kenya has a two decades history of institutional development for promoting organic and sustainable agriculture. Six major players in the field are the Kitale based Manor House Agricultural Center, Baraka College in Molo, the Sustainable Agriculture Community Development Program in Thika, the Kenya Institute of Organic Farming (KIOF), a training center on the outskirts Kenya's capital Nairobi, The Sustainable Agriculture Centre for Research, Extension and Development in Africa (SACRED-Africa) and the Association for Better Land Husbandry (ABLH), headquartered in Nairobi. All of these organizations have attracted major support from American and European donors, without whose long-term investment much less progress would have been made. Side-by-side with these national groups its dozens of local organizations, scattered across the country, practicing and teaching environmentally sound farming techniques but not specifically organic farming. Many of these groups employ diploma holders from Manor House, Baraka or KIOF.

The organic sector is relatively small; however, it is growing very fast, mainly led by NGOs and private sector (companies growing organic produce for export). Over 182,000 hectares of land are under organic management, which accounts for 0.69% of the total agricultural area in Kenya. About 30,000 farms have changed over to organic cultivation methods so far (IFOAM & FiBL 2006). However, in Kenya as is in other developing countries statistics about organic farming are usually sporadic and thus becomes difficult to quantify the exact acreage under organic farming. Currently other public stakeholders like the Universities are taking up the initiative and integrating them in their curricula. For example, Egerton University situated in the Rift valley province has taken up the lead in this sustainable agricultural production, culminating into the establishment of an organic demonstration unit. This is being strengthened by the growing number research initiatives and establishment of an institute of organic farming in Egerton University. Exports of organic products have been taking place for the last two decades, mainly with vegetables and fruits produced on large scale farms. Over the years exports have developed beyond vegetables and fruits to include other products such as essential oils, dried herbs and spices as well as products for the cosmetic and pharmaceutical industries which are more often produced by smallholders (UNCTAD 2006).

Most smallholders are organized into groups and some of these are registered. For example Mount Kenya Organic Farming (MOOF) is an independent registered non-profit making NGO in Kenya which seeks to promote the acceptance and implementation of sustainable low external input farming systems. MOOF has already developed a local network of Self-Help smallholder groups which it services with training and advice on certified organic farming technologies in accordance with IFOAM smallholder group certification guide (MURAGE 2006). The farmers' network is under the umbrella organization initiated by MOOF known as the Kenya Organic Oil Farmers Organization KOOF, for the organic certification and business management purposes. Three years ago, some small-scale farmers formed a national representative organization, the Kenya Organic Farmers Association (KOFA). Larger companies and commercial farms, who are already in the export market, have organized themselves into Kenya Organic Producers Association (KOPA) (UNCTAD 2006). In 2005, organic agriculture stakeholders in Kenya, comprising KOPA and KOFA, formed the umbrella network Kenya Organic Agriculture Network (KOAN) to support the successful growth of the sector.

Challenges to organic agriculture in Kenya:
The development of Organic Agriculture in Kenya still faces a lot of bottlenecks stemming from agricultural policies, production and marketing. A close look at each of these challenges in a SWOT provides a good insight of the scenario (Tab.1).

Tab. 1: SWOT analysis of Organic Agriculture in Kenya.

Strength	Weakness	Opportunity	Threat
Agricultural Policy			
Focuses on the growth objective of mass production	Overlooks equity issues., largely neglects the small farmer in prioritizing agricultural research and setting research & development agenda	>85% of Kenyan farmers are small scale and presence of NGOs promoting organic farming	Policies focus on the development and commercialization of cash crops destined for export
Marketing and Certification			
Locally adapted guidelines and standards are almost in place now	Importers wish to buy organically certified produce	Apart from export market the local market for organic produce is picking up	High cost of certification coupled with too much paper work which local farmers are not familiar with

a. Agricultural policy
The Kenya government has not yet recognized the role of organic agriculture and thus no efforts have been made to promote the sector through its agricultural policies (MOA 2005). The government seems to embrace the Genetically Modified Organisms- GMO has the answer to the perennial food problems and poverty suffered by rural farming communities. This is evidenced by the big expensive (GMO) research complex in Nairobi, commissioned by the president recently and the onset of GMO maize trials. This has come about due to the number of strategies being used to butt the technology down African throats? Kenyans included. These include the mastermind siege on agricultural research centers (KARI), and Universities in Kenya. The mentioned development in political activities sets a grim picture towards Kenyan agricultural policy on organic agriculture. Consequently there are not many organic success stories so far reported in Kenya to convince the government to think and act into this direction. Subsequently since organic agriculture in Kenya is small and led by civil society organizations who work with poor and marginalized smallholder farmers its adoption may be constraint by lack of technological support, extension services and big funding associated with the government.

b. Marketing and certification
The main drawback in marketing of organic products is that importers wish to buy organically certified produce. Organic certification process is very expensive for smallholder farmers. The organic certification is tedious with a lot of paper work and farmer training which require financial support. For example the MOOF Borage seeds project organic certification was funded by USAID at US$ 15,000 for five groups (MURAGE 2006). Though organized in groups there is a missing link between producers, traders and consumers of organic produce in Kenya which is usually a

hindrance to marketing. Most of the times producers complain of lack of markets and abandon organic production and on the other hand supermarket chains complain of lack of supply (Personal communication due discussion with one player).

Conclusion and policy implication:

I Education, research, dissemination

a) Enhance and support research in organic farming through its research institutions e.g. Kenya Agricultural Research Institution (KARI). Furthermore there is need to partner with other private Organic research based institutions to enhance research and dissemination of organic knowledge.
b) Develop and expand organic curricula at all levels of education system. Development of curricula and research demo-farm as well as local adapted research at University

II Policy, regulations and law

a) The government needs to come up with clear policies on organic farming through its ministries and extension agents.
b) Kenya needs to legislate organic laws in favor of organic agriculture- thereby enabling Kenya to be included in the 3rd country list according to the requirements of EU regulation 2092/91.
c) Finally in line with strategic plan for revitalizing agriculture (2005), there is a need to encourage and support value addition of organic produce at point of production to enhance incomes and motivate production.

III Market development

a) Develop and enhance local markets for organic products through sensitization of consumers and advertisements- additionally have supermarket chains and tourism sector hotels offering organic foods for Kenyans.
b) The many NGOs currently involved in organic farming should develop further to built linkages between producers, traders and consumers. Additionally they should be in inspection and certification in order to develop local market regulatory practices.

Acknowledgments:

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Human Capacity Development for Income Generation and Organic Market Linkages in Uganda

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Keywords: organic, market linkages, community development, natural resource management

Abstract:
Rapid economic growth in Uganda has resulted from the strong emphasis on the market liberalization policies tied to export promotion. Commercialization of smallholder farmers' products has been at the heart of the country's development program since the year 2000. This study describes how the organic farming sector links farmers to markets through community empowerment, resource development and market linkage intervention strategies using a qualitative analysis of the institutional support provided by the organic sector. The private sector assures technical commodity related support, organic export linkage, and higher incomes while the civil service society emphasizes facilitation to a wide range of market linkages and builds capacities along aspects of the market chain. They both contribute to the empowerment of the communities to make decisions on various aspects of their farm lives. Further studies to assess the impact of the respective farmer market interventions on the livelihoods of the rural population are required.

Introduction:
Organic Agriculture (OA) is one of the fastest growing segments of the food sector worldwide (SCIALABBA & HATTAM 2002). The International Trade Centre (ITC) estimated organic sale figures between 2000 and 2001 at 25% (ITC, 2002). Organic markets form 1% - 2% of the total food market share, hence qualifying this segment as a niche market. Despite the nature of the organic market as a niche market, these sale figures have the potential to increase. Sub-saharan Africa has 46,211 ha of organically managed land of which Uganda has the highest share in Africa. In Uganda, smallholder farmers form about 75% of the farmer population. Climatic, economic and social capital are strong motivating factors in stimulating production, however, the quality of natural resources such as soil fertility continue to decline. The predominant farm management practice is traditional agriculture[4], however, land managed using organic methods form 1.4% of the total agricultural area. Smallholder farmers often have low levels of literacy, minimal access to information on production practices and potential markets. Their holdings are rural based and characterised by severe poverty. Market liberalization policies of the early 1980's have resulted in rapid economic growth in Uganda. However, the reduction in the prices of Uganda's primary exports and oversupply in turn led to commodity prices falling to a 40 year low. High transaction costs of output trading caused predominantly by fuel costs (in turn caused by taxation of petroleum products), information asymmetry between farmers and

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[4]Traditional farming as characterised by FAO, (2002) are farming management practices that have evolved through centuries to create agricultural systems adapted to local environmental, cultural and economic conditions

traders due to remoteness in the farmer locations; and poor product quality continue to mar the market chain (NKONYA 2002). Strategies for sustainable farmer market linkages include policy intervention, attention to the natural resource management and the investment in the market chain (KAARIA & ASHBY 2001). Studies on the market chain interventions include KINDNESS & GORDON 2001 and in Uganda specific case studies include NKONYA 2002 and SANGINGA et al. 2004. This study in a broader sense compares the methodologies employed to invest in the farmer-to-market linkages applied by the NGO's committed to organic agriculture, and the formal private organic sector.

Methods:

Key informant interviews with the marketing personnel and field visits were made to farmers for the NGO and the private sector. Annual reports from the NGO's were reviewed. Literature was more inaccessible for the private organic sector. Using an interview guide, factors such as capacity building, institutional and infrastructural development within the community empowerment, natural resource development and commodity linkage strategies was assessed. The format used for the different thematic characterisations in the content analysis was adapted from SCHUFFENHAUER (2004). Sample selection was conducted at four hierarchical levels along the NGO's and the formal private organic sector institutional stratifications. NGO and private agricultural organisations that facilitate organic farmer to market linkages and have a large scale of operation and outreach were selected. The sampling frame for agro-based NGO's and private sector were obtained from the NGO board of Uganda and the National Organic Movement of Uganda (NOGAMU) respectively. Three NGO's and private organisations were purposively selected at the first three levels and randomly at the last level.

Results:

Different NGO's use different methods and models to engage farmers. The NGO 'Kulika' provides class room training to individual farmers where they graduate as Trainer of Trainers (TOT's). These graduates use their farms as model farms to teach neighbouring farmers as a technology outreach program. The NGO 'SG 2000' uses the One Stop Centre (OSC) model, to legally register associations, build institutional capacities and viable enterprises. A multi purpose structure is jointly constructed with the farmers, to facilitate the groups to aggregate demands for services and it reduces on the transaction costs of the farmers. The NGO 'Africa 2000 Network' uses the resource to consumption model to engage farmers. Pilot sites are selected, strategic partnerships are built and a collective community Strength-Weakness-Opportunities-Threats (SWOT) analysis is conducted. Farmer groups assess the market demand characteristics to match them with the biophysical and socio-economic potential in a market visit. Agro-enterprise options are then designed and implemented, through business support services and market institutions and promoting gender equity.

Tab. 1: Evaluation of the capacity development aspect of service provision by sector.

Capacity development		
NGO sector		
Community empowerment	Resource development	Link to the commodity chain
Gender Production technologies Participatory methods Training of trainers Cross cutting issues Groups strengthening	Sustainable agricultural practices Demonstrations Participatory technology development	Markets Market information Credit for market linkages Post harvest handling Agro-processing Provide production finance/credit
Private sector		
On-farm trials	Organic approaches Integrated soil management	Marketing

Private sector organizations build capacities in organic production methods to improve skills and to reduce price risks due to lower quality than stipulated by the contractual agreements. The private sector organisation ‘BoWeevil’ finances crop and inputs through the production wing of the tripartite agreement, the Lango Organic Farming Promotion (LOFP). The Internal Control System (ICS) is set up in accordance with European standards. Inspectors pay annual random visits to ensure compliance with organic requirements. Farmer participation is ensured through contractual production to guarantee adherence to the organic principles, and high quality production for the export market.

Tab. 2: Evaluation of the institutional development aspects of the service provision by sector.

Institutional development		
NGO sector		
Community empowerment	Resource Development	Link to the commodity chain
Formation of farmers into groups one or more committees Legalization of farmer groups Second order associations Establish partnerships Establish linkages Integrate the disadvantaged	Engage in partnerships Input delivery	Initiate market linkages Micro finance linkages Institutional linkages (input & output) Collective marketing Facilitate production to market transactions Market development & intelligence Financial assistance for crop storage
Private Sector		
Large farmer groups Have no, or one committee One woman in each committee	Internal control system Contracts Certified production Use organic inputs	Purchase produce Sell to export market Contract out growers Financial access Group certification Cash on the spot payment Absorption of transaction costs

All NGO linkages operate through farmer groups to reap the economies of scale in service delivery and communication (Tab. 2). Africa 2000 Network and SG 2000 also work with larger groups called second order associations (SOA’s). The SOA’s are registered with the sub-county or district. The formalization of group structures facilitates group recognition to demand services. The private sector deals with out growers rather than with groups. The ‘groups’ (comprising 200 farmers) are organized according to their aerial zones. While the BoWeevil and AMFRI Farms farmers have a committee, the Masaka Organic Producers (MOP) farmers do not have a committee. Less emphasis is paid on group strengthening/dynamics. The demand for services in the private organic sector is confined to the organic production requirements of the product. However, formalized contractual arrangements in the private organic sector enable the inputs to be supplied by the buyer on credit and removed from the sales proceeds, and compliance with the set and agreed standards, hence improved product quantity and quality. The NGO sector associates it's farmers with varying levels of linkages to the local, national and export markets, while the formal private sector predominantly serves the certified organic export market.

Discussion:

The NGO sector is dynamic in its strategies to engage farmers for community empowerment, however is challenged in the scale of operation, scale out strategies, low adoption and adaptation rates. The largely profit oriented private sector, attempts to utilize cost effective strategies hence hampering community empowerment through human capacity development aspect. It does however, contribute to market linkage infrastructure development, facilitate the organisation of the farmers under the ICS and absorb the transaction costs along the market chain. However, this contribution, because of the limited human capital development I insufficient to empower farmers to establish their own market linkages. This sector also improves farmers' livelihoods through increased incomes, while the NGO sector provides linkages to the private sector but may not quickly impact on farmer incomes due to market chain dynamics.

Recommendations:

The private organic and the NGO sectors face challenges that compliment one another. Lack of adherence to market demands due to low production and poor quality still challenges the NGO sector, while the former easily absorbs these challenges with the use of the ICS and contracting large numbers of farmers. It however lacks in the human capacity development to empower communities. It is therefore inevitable that continued collaboration between these two sectors could draw lessons strengthening farmer empowerment within the market chain.

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Adaptation to climate change and the role of agrobiodiversity

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Keywords: biodiversity, crop farming, climate change, genetic engineering, agricultural policy

Abstract:
The world's biological diversity is eroding. This concerns in particular the entire agricultural diversity of genes, species and their agrarian ecosystems, the resource base for food. With species becoming extinct, mankind is jeopardised. With climate change becoming reality, genetic resources are getting a new value as they are of vital importance for adaptation. This calls for a revision of present conservation approaches. Emphasis has to be placed on in-situ conservation in order to allow a maximum of species conserved and to enable species adaptation to environmental change.

Climate change - a menace to food security

The implications of climate change for agriculture have opened a new window in the discussion of agrobiodiversity. Five climate change-related factors can be identified: the rise of temperature, changes in precipitation patterns, the rise of sea levels, increased incidence of extreme weather events and the increase of greenhouse gases in the atmosphere, of which carbon dioxide is the most prominent.

The rise in temperature - commonly known as global warming - is probably the most obvious phenomenon of climate change. Since 1861 the global mean annual temperature has increased by 0.6℃ as atmospheric carbon dioxide concentrations have risen by 32%. Emission scenarios suggest that we will have 550 ppm within the next 40 -100 years, almost double the pre-industrial concentrations. This rise will be accompanied by a further increase in temperature. Depending on the geographical region, scientific estimates propose an additional mean annual temperature rise of 1 - 5.8℃. It is expected that the increases will be highest in tropical and subtropical regions. There, the increasing temperature will reduce farming system's diversity, lower agricultural yields and change land use patterns. Indirect temperature effects may not be less important. The evaporation of soils is increased, decomposition of organic matter accelerated, the incidence of pests and diseases aggravated.

Changes in precipitation patterns pose another problem of increasing importance. In the last century, subtropical regions were confronted most likely with around 3% less precipitation and more frequent droughts. Contrary to this, the northern hemisphere likely experienced 5 -10% higher rainfall. At the same time, increasing seasonal and regional rainfall irregularity has been observed and scientific research suggests that this trend will become more pronounced.

Among the various greenhouse gases it is not only carbon dioxide that matters. Chlorofluorocarbons, for instance, have severely reduced the atmosphere's protective ozone layer. High levels of UV radiation may nurture pests and diseases and reduce crop yields. For example, fungus infection rates in wheat increased by 9-20% when experimental UV radiation was increased by 8-16% above "normal".

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Adaptation of agriculture is needed

Dramatic implications are expected for global agriculture and food supply, but with enormous regional differences. Ironically, the poorest are most at risk. It is predicted that by 2080 the 40 poorest countries, located predominantly in tropical Africa and Latin America, may lose 10-20% of their basic grain growing capacity due to drought. It is also argued that many rain-fed crops in the tropical belt of Africa and Latin America are already near their maximum temperature tolerance, and their yield may fall sharply with a further rise. By contrast and for temperate regions, yield increases are expected due to higher temperatures, increased carbon dioxide levels and partly higher rainfall; a country like China could experience a rise in production by 25%.

As a consequence, not only mitigation of climate change is required but also adaptation to changes that have become irreversible. This concerns agriculture in particular and agrobiodiversity is of key importance in this. Adaptation describes a plant's, animal's or ecosystem's capacity to adjust to changes such as heat, drought, or salinity – an adjustment enabling them to overcome constraints, take advantage of new opportunities and cope with the consequences of changing environments. The adaptation capacity of agricultural ecosystems relies fundamentally on genetic diversity. Plants with no economic value so far - may it be a drought resistant millet variety or a heat tolerant race of goats - may become important, and serve as genetic material for new breeds that can tolerate better environmental stress. The continuous loss of such species is a serious matter of concern.

Adaptation to drought: neglected millets save the poor from starvation

"Sankappa is a small farmer owning three hectares of dry land in Vittalpura village of Bellary district in Northern Karnataka, India. This village is situated in the semi-arid Deccan Plateau and receives annual rainfall of 500 mm in two to three months a year, which allows one crop during July to October. Sankappa like his forefathers and other farmers of the village is growing foxtail millet. (…) The amount of rainfall during the last four years continuously dropped during the last four years in this part of the country. It was below 300 mm in 2003. 'All other crops failed due to extreme drought, and my family and livestock were saved from starvation by the harvest from foxtail millet,' says Sankappa. The (…) varieties grown and conserved by the villagers have excellent drought resistance."

"Eight minor millet crops grown in different regions of Africa, Asia and Eurasia are finger millet (*Eleusine coracana)*, proso millet (*Panicum miliaceum*), little millet (*Panicum sumatrense*), barnyard millet (*Echinochloa crusgalli* and *E. colona*), kodo millet (*Paspalum scrobiculatum*), teff (*Eragrostis tef*) and fonio (*Digitaria iburua*). Little millet and kodo millet were domesticated in India."

"The long history of minor millet cultivation and its spread to different regions of the world that are notable for extremely harsh farming conditions generated considerable genetic variability in these crops. (…) Global neglect of the minor millets and increasing emphasis on few elite food crop species are precariously narrowing the food security basket. The most disadvantaged by this food production policy are the poorest of the poor (…) The shrinking number of food crops in the regional and global food basket is restricting the opportunity of farmers in difficult regions to use their land resources, environment and traditional knowledge."

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Agrobiodiversity – how much shall be conserved?

As conservation is costly, the question arises: how much agrobiodiversity do we need? Scientists propose mathematic models by which priorities shall be set and the optimal degree of conservation shall be calculated. But, can we base public conservation strategies on mathematical modelling, or must we conserve all we have because the future needs for human survival are unknown?

It is often argued that conserving all – irrespective of any valuation – is unrealistic. But as a basic principle it can be formulated that a maximum of genetic resources has to be conserved at the lowest possible public cost. If this holds true, a conservation concept is required that goes far beyond the predominant approach of *ex-situ* conservation. Storage of seeds in refrigerated banks or botanical gardens is essential. But this method exceeds the capacity of public funding, is of limited scope and of limited security.

Such a more comprehensive approach relies primarily on *in-situ* concepts, managed by farmers and farming communities doing conservation and breeding on their farms and in their villages. Farmers have done so over thousands of years, have been ignored or neglected by the formal seed sector during the past 40 years and, since recently, are slowly being rehabilitated. On-farm conservation is not necessarily less costly, but the costs are mainly borne by farmers whereas the benefits are private and public.

Latest concepts of *in-situ* conservation follow the idea that conservation and use of genetic resources are closely linked. True to the slogan "use it or lose it", plant species or animal breeds should be used whenever possible, should contribute to securing rural livelihoods and to rural culture. As long as farmers themselves find it in their own best interest to grow genetically diverse crops, both farmers and society as a whole will benefit at no extra cost to anyone.

As a consequence, economic or social benefits have to be found for seemingly useless crops or farming systems and value has to be discovered in them. Some examples of adding economic value are: wild plants may be used for medicinal purposes, wheat landraces grown under organic agriculture may get a higher price, farming communities as a whole may profit from agro tourism if they maintain their diversity, etc. However, it will not be possible to find a market for everything that should be protected. Therefore, a remainder will have to be protected without "using" it - a service that has to be paid for by the public.

Species adaptation – but how?

Another argument that calls for a revised understanding of agrobiodiversity conservation is adaptation to climate change of single crops and animals, a process of selection and breeding. What matters within this process, is not so much the drought-resistant minor millet landrace, well stored in isolation and deep-frozen in a gene bank, but rather, exposure to the environment, on farmers' fields and considering the wide agro-ecological variations of sites. Resistance of plants to environmental stress (e.g. drought tolerance) is mostly a multi-genetic characteristic best developed by *in-situ* exposure to it. In contrast, it is difficult to achieve such traits through genetic engineering.

The social dimension is no less important. Adaptive capacity building has to address the poor and should enhance their human and social capital.

The focus on women addresses the fact that in rural societies everywhere women have always been the seed keepers, the preservers of genetic resources.
Such a strategy as outlined above addresses regional and local agro-ecological variations. It offers site-specific solutions contrasting with those of the corporate sector that follows the law of economy of scales and aims to distribute a standardised variety or a whole cropping system technology as widely as possible.

Urgent action is required
There is little awareness among the various international development initiatives of the close relationship between climate change and food security and the role agrobiodiversity has to play. This concerns without distinction the programmes to fulfil the Millennium Development Goals (MDGs), the National Adaptation Plans for Action (NAPAs) by the United Nations Framework Convention on Climate Change and others. Adaptation to climate change in agriculture - if discussed at all - deals mainly with improved water management (in view of more frequent drought and flooding events). Agrobiodiversity - although being a fundamental resource for adaptation - is almost forgotten.

Instead, it must become imperative to manage agrobiodiversity in a sustainable way and to use it systematically to cope with the coming environmental challenges. The following aspects deserve consideration:

- Stronger coordination is needed between main global programmes such as the United Nations Framework Convention on Climate Change, the Convention of Biodiversity and the International Treaty on Plant Genetic Resources for Food and Agriculture.
- Agrobiodiversity conservation is to be made a basic component of adaptation strategies to climate change.
- Programmes that manage agricultural genetic resources require re-orientation in their strategies. Formal institutional systems based on gene banks (*ex-situ* conservation) must be broadened to an integrated management system that includes the farmer based (in-situ) conservation.
- *In-situ* conservation of agricultural biodiversity must be made an integral part of agricultural development and be supplemented by *ex-situ* conservation.

Only the public sector can take the lead in implementing such a comprehensive approach, in which the private sector has an important supportive role. National and intergovernmental laws and regulations will have to provide the necessary legal frame, and civil society organisations as well as the corporate sector are more than ever in demand to fill this frame with development reality on the ground. Genetic resources must remain largely a public domain with well-balanced benefit-sharing concepts among the various stakeholders that use and conserve agro-genetic resources. Climate change-induced environmental stress may in fact go beyond the reach of adaptation. But the *in-situ* approach offers a great chance to shape a future worth living.

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