

The Potential of Organic Agriculture to improve Food Security

El potencial de la agricultura orgánica para mejorar la seguridad alimentaria

¹Friederike Elisa Naegeli y Juan Carlos Torrico²

^{1,2} Institute for Technology and Resources Management in the Tropics and Subtropics. Cologne University of Applied Sciences. Cologne, Germany. E mail: fnaegeli@gmx.net

Resumen

Los alimentos producidos orgánicamente parecen no ser capaces de alimentar a la población mundial. Sin embargo, existen fuertes evidencias de que la agricultura orgánica puede contribuir a reducir el número de personas desnutridas en varias regiones. La distribución y el acceso a los alimentos suelen ser los factores principales por los que las personas están desnutridas. Además, la agricultura convencional provoca a menudo fuertes externalidades negativas. Estos pueden reducirse utilizando fertilizantes orgánicos y evitando el uso de agroquímicos. El enfoque holístico de la agricultura orgánica, como la diversificación de la producción, puede mejorar el nivel nutricional en las comunidades rurales y con esto reducir significativamente las tasas de malnutrición. Además, dado que el mercado mundial de productos orgánicos está en expansión, las posibilidades de los pequeños agricultores en los países en desarrollo a acceder a los mercados se incrementa. Esto puede tener efectos muy positivos en las economías rurales, impulsando el desarrollo rural. La conciencia cada vez mayor, de lo que la gente consume, tiene también efectos positivos en la imagen de la producción agrícola, ya que los consumidores se informan mejor sobre la estructura de producción, que conduce a una valoración creciente de la labor agrícola. Estos hechos pueden tener una influencia en disminuir la migración campo-ciudad. Por lo tanto la agricultura orgánica puede ser una opción en algunas regiones para apoyar fuertemente el desarrollo rural.

Palabras clave: Agricultura orgánica, Bolivia, Seguridad Alimentaria, sostenibilidad

Abstract

Organically produced food seems not to be able to feed the World's Population. However, there are strong evidences that organic agriculture might help to alleviate the number of people suffering from hunger in some areas. The distribution of food and the access to food are often the main factors why people are undernourished. Aside, conventional agriculture often causes strong negative externalities. These may be reduced using organic fertilizers and by avoiding the use of synthetic agrochemicals. The holistic approach of organic agriculture, meaning the diversification of the production, may additionally improve the nutritional level in rural communities and thereby reduce significantly rates of malnutrition. Further, since the global market for organic products is expanding and the possibilities for smallholder farmers in developing countries to access markets increase. This can have very positive effects on the rural economies, triggering rural development. The increasing awareness of what people consume also have positive effects on the image agricultural production, since the consumers inform themselves better about the production pattern leading to a rising valuation of the farmers work. These facts seem to have retarding influence on rural-urban migratory processes. Organic agriculture may thus be an option in some areas to support strongly rural development.

Keywords: Organic agriculture, Bolivia, Food Security, sustainability

INTRODUCTION

Around 1020 Million people are estimated to suffer from hunger (FAO, 2009). Target 1c of the Millennium Development Goal 1 addresses this issue with the objective to halve the number of people suffering from hunger by 2015 (UNDP, 2007b). However, it is already to be said that this target will most probably not be reached (UN, 2008). This fact might sound to some extent surprising, given that the global agricultural production would be sufficient to feed the world population (EL-HAGE SCIALABBA, 2007; DARWIN et al., 2005).

The problem is not just the total global production of food, but much more its distribution. The question how to face this growing problem of food insecurity becomes more and more important, especially due to the steadily increasing world population and the changing consumption pattern. Higher yields, more equitable distribution and reduced post-harvest losses shall assure future nutrition of the population.

An alternative approach to combat hunger is to change from conventional to organic agriculture. This paper will discuss in the following the potential of organic agriculture² to account for global and local food security giving the example of Bolivia.

METHODS

The study assesses the current scientific literature on the topic of organic agriculture. It attempts to illustrate the potentials of organic agriculture to develop rural areas in developing countries, facilitated by access to local and global markets, promoting a new image of rural agricultural production and generating a new willingness to pay equitable prices for the products.

²According to El-Hage Scialabba (2007) organic agriculture is referred to “[...] as a holistic production management system that avoids use of synthetic fertilizers, pesticides and genetically modified organisms, minimizes pollution of air, soil and water, and optimizes the health and productivity of interdependent communities of plants, animals and people”.

The study is based on a review of the outcomes of the FAO Conference of Organic Agriculture (3-5 May 2007, Rome, Italy), supplemented with the latest literature on the topic.

Organic Agriculture and Food Security

Today, organic agriculture is practiced in more than 120 countries accounting for 0.7% (31 million ha) of the total global. On this number the area of non-certified organic agriculture, which is often practiced by default in developing countries, must be still added (ZUNDEL & KILCHER, 2007). It has been revealed that the conversion of conventional productions to organic agriculture leads to decreasing yields in at least the first 2-3 years after conversion. But this fact strongly depends on the former amount of input level. Systems based on a high-input level will show higher reduction in yields after conversion, than those based on a low-input level (ZUNDEL & KILCHER, 2007). Nevertheless, yields comparable to former yields in conventional productions could be reached after the initial phase. In arid, semi-arid (Pakistan, India, Senegal, Ethiopia, Kenya, Lesotho, Zimbabwe) and mountain areas (Bolivia and Nepal) considerable yield increases have been shown, reconfirming the potential of organic farming for smallholder farmers (ZUNDEL & KILCHER, 2007).

Shown that organic agriculture can to some extent compete in yields with conventional yields one may question whether organic agriculture could produce enough food to feed the global population. A study done by Badgley et al. (2007) shows that the global population could be supplied with organically produced crops. The study is based on a model using average yield ratios for developing and developed countries. It has been cited frequently, even in the Conference Reports on “Organic Agriculture and Food Security, 3-5 May, FAO, Rome”. However, another study by Conner (2008) criticises vehemently in a short communication “Organic agriculture cannot feed the world” the calculations done by Badgley et al. (2007). Conner reveals that Badgley et al. (2007) overestimates the average yields of organic agriculture in developing countries leading to erroneous assumptions because of having applied wrong yield ratios to the model. As can be seen here there is no common opinion to answer the raised question above, but it seems most likely that organic agriculture alone may not be productive enough. Still, further investigation must be done to answer the question satisfactorily.

Even if it could not have been proved that organic agriculture can sustain the world's population, there is strong evidence that under special conditions organic agriculture can improve food security.

Most of the poor people who are affected by food insecurity are living in rural areas of developing countries (EL-HAGE SCIALABBA, 2007). The most vulnerable are smallholders³. They suffer from seasonal yield fluctuations, due to climate variability, pest and diseases, such as price fluctuations on the food market (MORTON, 2007; EL-HAGE SCIALABBA, 2007).

The pressure on these farmers to assure their and their family's nourishment often leads to the overuse of the soil and thereby to the degradation of the environment. This in turn has negative impacts on the yields, forcing the farmers to further expand their cultivated area (SCHERR, 1999). Farmers frequently start cultivating inappropriate areas, such as steep slopes or poor and vulnerable soils, causing additional soil erosion. It is assumed that within the last 40 years almost one third of arable land has been lost due to the intensive use of agrochemicals and over exploitation (NIGGLI et al., 2007).

To diminish the negative effects of agricultural productions, organic agriculture could be a sustainable and environmental friendly alternative. It has been reported that organic agriculture improves soil aggregate stability and increases the water-use efficiency, which in times of increasing water deficiency could be a big advantage compared to conventional agriculture. (EL-HAGE SCIALABBA, 2007).

Additionally, diversification of the production as a basic principal of organic agriculture can contribute to the improvement of food security of the farmers. A diversified production reduces the vulnerability to climate variability, spread of diseases and pests and additionally provides an improved nutritional balance base for the farmers (ZUNDEL & KILCHER, 2007). But also the positive effect on the health of farmers must be mentioned. In developing countries many farmers suffer from the usage of fertilizers and pesticides,

which can lead to serious health problems (FARIA et al., 2009; EL-HAGE SCIALABBA, 2007). Organic agriculture is less dangerous, benefiting the farmers by an enhanced well-being, which is in turn reflected in the efficiency and productivity of the farmer.

Organic agriculture is in particular being considered as a good alternative for smallholders in developing countries. This is due to the fact that it requires less capital input, but high labour input, what leads in market-orientated productions and high income countries to higher production costs (ZUNDEL & KILCHER, 2007; UNCTAD, 2002). Conventional products compared to organic products are therefore generally cheaper.

The organic products are considered as being high quality products. That is why on the markets in the EU and USA organic products achieve premium prices. For the producing farmers this is beneficiary and can lead to increased incomes. But to achieve the premium prices the products must be certified and but many smallholder farmers cannot afford the, for this purpose, upcoming initial costs. Therefore it is recommended to interact in cooperatives to reduce the costs for the farmers. Another disadvantage is that many people cannot afford to buy these products. Still, higher prices achieved on the market for certified products makes it worthwhile again for those farmers to remain in agriculture and not migrate to the cities (ZUNDEL & KILCHER, 2007).

Moreover, the application of organic on-farm produced fertilizers, decreases the dependency of smallholders from Agrochemical Concerns and thus they are less affected by price fluctuations of required agrochemicals.

Unfortunately, in many countries no or just little local markets for organic products have developed, because high prices are often the limiting factor for the people to buy organic food. Yet, there do exist good examples, where markets for organic food have developed on the local level.

In Southern Brazil a producers network EcoVida promotes the organically produced food for the local community, offering simultaneously new job opportunities and thereby creating a local markets and strong relations with their consumers. (ZUNDEL & KILCHER, 2007). Cooperatives Organic Production can be seen as an advantageous opportunity to reinforce policy makers to invest in rural areas. Thereby also conventional farmers could benefit.

³ Smallholders refer to [...] rural producers, predominantly in developing countries, who farm using mainly family labour and for whom the farm provides the principal source of income" (MORTON, 2007).

Given the example of Bolivia positive results for smallholders having converted to organic agriculture and formed cooperatives will be illustrated in the following.

Organic Agriculture in Bolivia

Bolivia has a long-standing agricultural tradition started around 2,500 B.C. after a long period of experimentation (KLEIN, 2003). In the Andean region pre-Columbian communities have already been doing agricultural research. Many different practices and technologies could be found to be very adaptive to the local conditions (DENAVAN, 2002).

With the colonization of Latin America much of the ancient knowledge got lost over time (VILLAROEEL ZENZANO, 2001).

Today, Bolivia accounts to one of the poorest countries in Latin America, occupying Human Development Index (HDI) rank 111 (UNDP, 2008).

According to the Global Hunger Index 2009 22% in the Period 2003/05 (24% 1990/92) of the Bolivian Population has been undernourished. 2008 Bolivia had 23% more undernourished than in the period 2000-2002 and 4% more than in the period 1995-1997 (Torrico, 2009). The children below five years mortality rate decreased from 12.5% (1990) to 5.7% (2007) (GREBMER et al., 2009).

34% (INE, 2009) of the Bolivian population is living in rural areas. However, the main cities in Bolivia are growing fast in the last decades (ANDERSON, 2002). Rural- urban migration in Bolivia is a serious problem. The annual urbanization rate is estimated to be 2.5% for the period 2005-2010 (CIA, 2009). Farmers in Bolivia are very susceptible to climate variability, especially to the El Niño Southern Oscillation (ENSO)⁴, being a reason for strong interannual

yield fluctuations (ORLOVE et al., 2000). Further market access for smallholder farmers in Bolivia is difficult so that income generation is often very low. These facts cause high production uncertainties for farmers making it even more unattractive to stay in the rural areas. Thus, it is not astonishing that the third main reason for the rural population just after family reasons and educational purposes to migrate to the cities is to find a job (ANDERSON, 2002).

Table 1. Rural – urban migration in Bolivia

Reason stated in survey	%
1. Job search	18.2
2. Job moved	3.9
3. Education	25.6
4. Health	2.2
5. Family reasons	50.1
Total	100.0

According to the survey 9% of the interviewed people moved within the last 5 years and from these around 34% have been rural-urban migrants. (Sources: extracted from ANDERSON, 2002)

As mentioned organic agriculture can have positive effects on yield, soil fertility, farmer's health and the nutritional level. In Bolivia organic agriculture has been ultimately increasing strongly (see Table 1).

The food crisis and the growing demand of biofuels represent a duality of options, on one hand it affects negatively to a great quantity of people in the urban areas that assign a great percentage of its income to purchase foods. On the other side, it represents the best opportunity to improve the revenues of the agricultural producers in general included the organic production (Torrico, 2008).

In 1991 the umbrella organization AOPEB (Association of Organic Producers Organization of Bolivia) has been found consisting today of 56 member organizations and more than 30.000 organic producers and those who are in transition. AOPEB aims to qualify farmers, to improve the information and communication system, to create local markets and to promote their products for the global market (AOPEB, 2009). AOPEB forms part of the IFOAM (International Federation of

⁴ The ENSO phenomenon that occurs in average every 2-7 years refers to either the inversion of the oceanic-atmospheric circulation over or rather in the southern pacific (El Niño) or the intensification of that circulation (La Niña). (SCHÖNWIESE, 1994). In the Altiplano region of Bolivia during El Niño years less precipitation has been noticed (LENTERS & COOK, 1999, GARREUAD & ACEITUNO, 2001), whereas it is predicted that in the Llanos and Amazon region of Bolivia more extreme events might occur, such as droughts and heavy rainstorms, leading to increased number of flood events (PNCC, 2007).

Organic Agricultural Movements). With the new government elected in 2006 a law (Law 3525) has been introduced that prioritizes organic agriculture and regulates organic production and certification (CABOLQUI, 2009; PIPO LERNOUD & LOY, 2008) and thereby supports the efforts done by AOPEB. It is said that at the beginning the production has been motivated by export purposes, but later positive side effects, such as increased producer's incomes were noted (RAMIREZ & VILDOZO, 2007). During the last decade the area cultivated organically in Bolivia increased in just 10 years from around 8,000 ha in 1997 (WILLER & YUSSEFI, 2001) to 1,069,560 certified hectares (including certified wild forest) and 365,052 in transition in 2007 (PIPO LERNOUD & LOY, 2008).

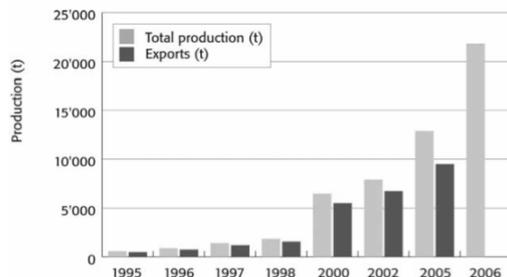


Figure 1. Development of the organic agricultural production and the exports of Bolivia. Data for exports in 2006 have not been available. (Source: extracted from Pipo Lernoud, 2008)

Given the example of Northern Potosí, one of the poorest regions in Bolivia, farmers cultivate potatoes on slopes up to 50 degrees and heights between 2.800 and 3.900 m a.s.l. (RUDDEL & BEINGOLEA, 1995). After three consecutive years with extremely small sized harvested potatoes the World Neighbors Program realized a project in that region. They encouraged the farmers realize on-farm experiments. Results have been analyzed on seminars and have shown that the yield could have been strongly increased. The farmers identified lupine as being an alternative to fix nitrogen benefiting the soil when used as green manure. Thereby the farmers could increase their yield from 1780 kg/ha to 8500 kg/ha and when combining their practices with sheep manure even up to 13000 kg/ha. This led to the fact that farmers could even reduce their field sizes (EL-HABASCIALLABBA & HATTAM, 2002).

Another example is the cacao farmer's cooperative El Ceibo, one of the fifth associates of AOPEB. In

the 1970s they found the cooperation in order to increase their competitiveness with speculators who were able to determine the prices (GEPA, 2009a).

The cooperation enables the associated farmers to increase their resilience against climate variability. In 2005 the farmers suffered from economic losses, due to droughts and uncontrolled pasture fires. With the help of the German Development Agency (DED – Deutsche Entwicklungs Dienst) and the increasing demand for Bolivian cacao (EGÜEZ CAMACHO & OLAZÁBAL SILVA, 2007) the cooperative was able to convert their production to organically produced cocoa what improved their access to international markets and their income. Fig. shows highly increasing revenues over the last year with parallel relatively small increased in expenditures.

El Ceibo nowadays is benefiting around 10.000 people, exporting their cocoa to Germany, Spain, Japan and Switzerland (QUISPE ZEBALLOS, 2005). They receive beside the premium price, fair trade prices, which enables the cooperative to develop even further, creating new jobs and being able to assure health insurances for their employees up to 200 US Dollar (GEPA, 2009a).

They did even conquered a market within the borders of Bolivia, being one of the main suppliers of chocolate for the most of the Bolivian chocolate fabricants such as Breick and Condor (La Paz), Taboada and Parat ti (Sucre) Harasic (Oruro), Sumar (Beni), and Bolivian Fruit (Cochabamba) supplying the recently grown organic supermarkets in cities (EGÜEZ CAMACHO & OLAZÁBAL SILVA, 2007). This has led to the fact that the national sales already account for 28% of their total revenue (GEPA, 2009b).

Similarly has been the development of the Federación de Caficultores Exportadores de Bolivia (FECAFEB) which has been working in the Yungas region of Bolivia (Caranavi and Nor and Sur Yungas) in the fields of technical and educative support of the farmers. They are aiming at a sustainable production, conserving the natural resources and improving the prices and conditions for export on the international market. The farmers benefited from the higher incomes. Investments could be used to improve streets and construct schools (RAMIREZ, S., 2001).

Beside these examples one should not forget about the potential of global organic markets for indigenous crops. Bolivia is producing organic Quinoa for exports. Organic markets are much

more open to “new” food crops. Since the production of the highly nutritious, gluten-free grain is organic, Quinoa was able to enter the global market. The export of Quinoa induced an enormous increase in demand and due to the premium prices higher incomes for the farmers (SLIGH & CHRISTMAN, 2007).

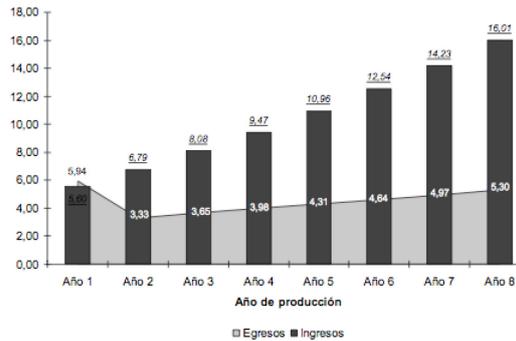


Fig. 2. Estimation of revenue and expenditure of the cacao production in the area V of Alto Beni (Source: Egúez Camacho & Olazábal Silva, 2007)

level, reducing environmental degradation, being less harmful for the farmer’s health and offering a better access to markets. Beside these facts organic agriculture in rural area may improve the living conditions by lifting the image of agricultural production. By raising the consciousness about the importance of agriculture through promoting organic products as a kind of high quality product a new value could be given to agriculture, functioning as a support to rural investment and development, counter acting to rural-urban migration.

As shown in the examples organic agriculture in Bolivia can improve yields and soil fertility and decrease negative environmental externalities. The supportive government is essential for the positive developments generated by applying organic production pattern. The creation of local market is further important to support local organic productions, in which farmers benefit more than in conventional production systems.

Cooperatives are extremely recommended in Bolivian smallholder farmer’s communities to create a legal organization, which is able to influence the prices, to share information, to make better marketing, and to have fewer burdens to access the markets. Support of development agencies has been resulted as useful to help the farmers to afford initial costs for the transformation from conventional to organic

But one factor is still of concern. Organic agriculture is a knowledge-based approach and requires training and investigations such as relatively high initial costs (ROJAS-BOURILLÓN, 2006). Still, at the same time it can provide an incentive to protect, conserve and recover traditional knowledge, due to the increasing market for indigenous and traditional crops (VILLAROEL ZENZANO, 2001). Villaroel Zenzano (2007) moreover emphasizes that organic agriculture should be under control of the social organization of the communities. This fact is especially of importance in countries like Bolivia, where common management of the resources is part of the cultural community structure.

SUMMARY OF FINDINGS AND CONCLUSION

As pointed out, there is a high potential for organic agriculture to improve food security, especially on the local and community level for smallholder farmer in developing countries by providing a diversified nutrition

agriculture and help to recover traditional knowledge needed for the production.

One possibility to further supports this kind of fair production could be the involvement of governmental institutions such as schools and hospitals as purchasers. Products could be sold for special prices and in return the institutions do marketing for the farmers, creating kind of win-win situation.

However, it could have been shown that most probably organic agriculture alone might not be sufficient to assure global food security. The increase of organic agriculture won’t increase the total global amount of food available but contribute to a more equitable distribution with regards to the essential nutrients, which in organic agriculture are produced on-farm.

Nevertheless, it must be said that till now just 1% of the total average expenditures on agricultural research is invested on research for organic production (NIGGLI et al., 2007). Thus the overall potential cannot yet be seen completely.

Since organic agriculture can have a share in improving food security especially for smallholders in developing countries and being able to reduce negative externalities on the environment, further research should be done on that issue in order to come closer to the aims of the Millennium Development Goals

REFERENCES

- Anderson, L. E., 2002. Rural-Urban Migration in Bolivia: Advantages and Disadvantages. Instituto de Investigaciones Socio-Económicas. Universidad Católica Boliviana. La Paz, Bolivia. Revised: 25/10/2009. Available: <http://www.iisec.ucb.edu.bo/papers/2001-2005/iisec-dt-2002-05.pdf>
- Badgley, C., Moghtader, J., Quintero, E., Zakern, E., Jahi Chappell, M., Avilés-Vázquez, K., Samulon, A. & Perfecto, I., 2006. Organic Agriculture and the Global Food Supply. In: *Renewable Agricultura and Food Systems*, 22:2, 86-108.
- CABOLQUI, 2009. Present Dynamics of the Quinoa Sector in Bolivia. Bolivian Chambero f Quinoa Royal and Organic Products Exporters (CABOLQUI). Revised: 24/10/2009. Available: http://www.cabolqui.org/documentos/PRESENT_DYNAMICS_OF_THE_QUINOA_SECTOR_IN_BOLIVIA_ENG.pdf
- CIA, 2009. The World Factbook – Bolivia. Central Intellegence Agency, Washington D. C.. Revised 04/10/2009. Available: <https://www.cia.gov/library/publications/the-world-factbook/index.html>
- Connor, D. J., 2008. Organic Agriculture Cannot Feed the World. In: *Field Crops Research*, 106, 187-190.
- Darwin, R., Rosen, S. & Shopuri, S., 2005. Greenhouse Gases and Food Security in Low-Income Countries. Lal, R., Uphoff, N., Stewart, B. A. & Hansen, D. O. (eds.), 2005. *Climate Change and Food Security*. CRC Press, Florida, USA. p72.
- Denevan, W. M. (2002). *Cultivated Landscapes of native mazonia and the Andes*. Oxford University Press. Oxford, UK.
- El-Hage Scialabba, N. & Hattam, C., 2002. *Organic agriculture, environment and food security*. FAO, Rome.
- Egüez Camacho, V. & Olazábal Silva, J., 2007. Organización de la Oferta de Cacao en el Area V del Alto Beni. USAID Bolivia, La Paz. Revised: 24/10/2009. Available: http://pdf.usaid.gov/pdf_docs/PNADN933.pdf
- El-Hage Scialabba, N., 2007. *Organic Agriculture and Food Security*. FAO, Rome.
- Faria, N. M., Rodrigues da Rosa, J. A. & Facchini, L. A., 2009. Poisoning by pesticidas among family fruit farmers, Bento Gonçalves, Southern Brazil. In: *Rev Saúde Pública* 2009, 43:2. Revised 03/10/2009. Available: http://www.scielo.br/pdf/rsp/v43n2/en_7200.pdf
- FAO, 2009. One Sixth of Humanity Undernourished - More Than Ever Before. FAO Media Center – 19 June 2009. Revised 03/10/2009. Available: <http://www.fao.org/news/story/en/item/20568/icode/>
- Garreaud, R. D. & Aceituno, P., 2001. Interannual Rainfall Variability over the South American Altiplano. In: *Journal of Climate*, 14. 2779-2789.
- GEPA, 2009a. GEPA Menschen/Portaits. El Ceibo. Kakao für die Rente. Bessere Chancen durch Fairen Handel für die Kakaogenossenschaft El Ceibo. Revised 04/10/2009. Available: http://www.gepa.de/p/cms/media/pdf/menschen/partner_portraits/menschen_EL_CEIBO.pdf
- GEPA, 2009b. Handelspartner Info - El Ceibo. Revised: 04/10/2009. Available:<http://www.gepa.de/p/index.php/mID/4/lan/de>
- GREBMER, K., NESTROVA, B., QUISUMBING, A., FERTZIGER, R., FRITSCHER, H., RANDAYA-LORCH, R. & YOHANNES, Y., 2009. 2009 Global Hunger Index. The Challenge of Hunger: Focus on financial crisis and gender equality. Welthunger Hilfe e.V., International Food Policy Research Institute (IFPRI) & Concern worldwide (eds.), 2009. Bonn, Washington D.C., Dublin.
- INE-Bolivia 2009. Instituto Nacional de Estadísticas Bolivia. Bolivia: Población total proyectada, por área y sexo, según departamento, 2005 y 2010. Available: <http://www.ine.gov.bo/indice/visualizador.aspx?ah=PC20411.HTM>. Revised [28/10/09]
- KLEIN, H. S., 2003. *A Concise History of Bolivia*. Cambridge University Press, Cambridge, UK.
- Morton, J. F., 2007. The impact of climate change on smallholder and subsistence agriculture. In: *PNAS*, 104:50, 19680-19685.
- Niggli, U., Earley, J. & Ogarzalek, K., 2007. *Organic Agriculture and Environmental Stability of the Food Supply*. FAO, Rome.
- Orlove, B. S., John, C., Chiang, H. & Cane, M. A., 2000. Forecasting Andean rainfall and crop yield from the influence of El Niño on Pleiades visibility. *Nature* 403. 68-71.
- Pipo Lernoud, A., 2008. *Organic Farming in Latin America*. Willey, H., Yussefi Menzler, M. & Sorensen, N. (eds.), 2008. *The World of Organic Agriculture. Statistics and Emerging Trends*. International Federation of Organic Agricultural Movements (IFOAM) & Reseach Institute of Organic Agriculture (FiBL). 166-174.
- Pipo Lernoud, A., & Loy, M., 2008. *Latin America: Country reports*. Willey, H., Yussefi Menzler, M. & Sorensen, N. (eds.), 2008. *The World of Organic Agriculture. Statistics and*

- Emerging Trends. International Federation of Organic Agricultural Movements (IFOAM) & Research Institute of Organic Agriculture (FiBL). 174-185.
- PNCC, 2007. El Cambio Climático en Bolivia. Análisis, síntesis de impactos y adaptación. Ministerio de Planificación del Desarrollo. Viceministerio de Planificación Territorial y Ambiental. Programa Nacional de Cambios Climáticos. Quality S.R.L., La Paz, Bolivia.
- Quispe Zeballos, T., 2005. El Ceibo, un ejemplo de pujanza y trabajo. Bolivia.com. Recosid 04/10/2009. Available: <http://www.bolivia.com/noticias/autonoticias/DetalleNoticia32626.asp>
- Ramirez, R. & Vildoza, L., 2007. On the Way to an Ecological Country with Food Sovereignty: A Case Study of Bolivia. Association of Organic Producers Organizations of Bolivia (AOPEB). In: Papers Submitted. International Conference on Organic Agriculture and Food Security. FAO, Rome. Revised 03/10/2009. Available: <ftp://ftp.fao.org/paia/organicag/ofs/OFS-2007-INF-rev.pdf>
- Rojas-Bourrillón, A., 2006. Limitaciones y oportunidades para el desarrollo de la producción pecuaria orgánica en Costa Rica. Análisis y Comentario. *Agronomía Costaricense* 30:2. 129-135
- Ruddel, E. D. & Beingolea, J., 1995. Towards farmer scientists. In: *ILEIA Newsletter* 11:1, 16-17.
- Scherr, S. J., 1999. Soil Degradation. A Threat to Developing-Country Food Security by 2020? Food, Agriculture and the Environment Discussion Paper 27. International Food Policy Research Institute. p.32. Schönwiese, C.-D., 1994. Ulmer Verlag, Stuttgart.
- Sligh, M. & Christman, C., 2007. Organic Agriculture and Access to Food. FAO, Rome.
- Torrico, M.I. de. 2009. Sobre la seguridad alimentaria en Bolivia. IBEPA. Available: http://www.ibeapa.org/index_files/Page777.htm. revised: Revised [14/10/09]
- TORRICO, JC. 2008. Escenarios y estrategias para combatir el alza de precios de los alimentos en Bolivia. Análisis-IBEPA Mayo 2008, vol.1, p.3-7. ISSN 1999-6233.
- UN, 2008. Millenniums-Entwicklungsziele - Bericht 2008. Revised: 03/10/2009. Available: http://www.dgyn.de/fileadmin/user_upload/PUBLIKATIONEN/Sonstiges/mdg_report_2008_german_081219_klein.pdf
- UNCTAD, 2002. Organic Agriculture and its benefits. Revised 24/10/2009. Available: <http://www.unctad.org/Templates/Page.asp?intItemID=4281&lang=1>
- UNDP, 2007a. Human Development Report 2007/2008. United Nation Development Program. Revised 03/10/2009. Available: <http://hdr.undp.org>.
- UNDP, 2007b. Millennium Development Goals. Goal 1: Eradicate extreme poverty and hunger. Revised: 03/10/2009. Available: <http://www.undp.org/mdg/goal1.shtml>
- UNDP, 2008. Human Development Report 2008. Available at: <http://hdr.undp.org/statistics/>. Revised [14/06/09]
- Wilhelm, B., 2007. FAO Konferenz Ökologische Landwirtschaft und Welternährung Mai 2007 - Zusammenfassung und Analyse der Ergebnisse