

# Food Security through Organic Agriculture: A Global and National Perspective

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## Abstract

Organic farming practices have been spreading gradually in both developed and developing nations as a system following agro-ecological principles, depending on locally available resources, healthy produce or certified-export oriented production. This has raised a question of whether organic farming would be able to feed the world population, especially when food insecurity is expected to intensify further in the future. While there is skepticism that excluding the use of fertilizer and pesticides will be a threat to total food production, there are also numerous studies which has shown that farmers have in fact improved the level of food security after being introduced to organic farming methods. Thus, this paper assesses achievements made by organic agriculture for attaining food security and provides direction for organic agriculture development in Nepal. This paper is based on various scientific papers, proceedings, books and websites of different organizations working for organic agriculture and food security. Studies have shown that in areas with intensive high-input agriculture, conversion to organic farming reduced crop yield. But those with low input agricultural system, yields have been predicted to increase when agro-ecological principles are used. Also as it is claimed that though global food production is sufficient to feed the present global population, incidence of food insecurity largely looms in the society. Therefore, it is clear that food security depends not only on yield determining factors such as seeds, soil structure and overall geographic condition but also on socio-economic factors such as availability of technologies, human capacities, policies, prices, trade and infrastructural context. The analysis of research findings show that organic agriculture can be one of the option for achieving food security with primary focus on agro-ecological and socio-economic factors. Finally the paper concludes by emphasizing on how food security can be enhanced through agro-biodiversity, strong political will, public-private partnership, research and development based activities for better accomplishment.

**Key words:** Food insecurity; food availability, accessibility, utilization and stability; extension service.

## 1. Introduction

Food insecurity remains a growing concern and is expected to further intensify in future as well. Food and Agriculture Organization of the United Nations (FAO, 2010) estimates that there are 925 million people undernourished, 98 percent of whom are in developing countries. This figure is still far from the Millennium Development Goal (MDG) 1 of halving the number of undernourished people in developing countries from 20 percent in 1990-92 to 10 percent in 2015. Even though the world undernourished has declined (from 20 percent in 1990-92 to 16 percent in 2010), population increase has put a setback in reducing number of hungry in developing countries with the figure instead rising from 27 million in 1990-92 to 906 million in 2010. Countries like Afghanistan, China, Bangladesh, DPR Korea, India, Indonesia, Kazakhstan, Pakistan, Tajikistan and Uzbekistan, all suffer from various forms of hunger and South Asia remains one of the seriously affected regions (Mukherjee, 2008). Hunger constitutes deprivation that affects throughout the life in the form of higher mortality, increased risk of disease and lower productivity. Nepal - one of the poorest countries in South Asia - is no exception when it comes to facing problems related to food security. It has 54 percent of its population living on less than US\$1.25 per day (UNICEF, 2010). According to World Food Programme (WFP, n.d.), three and a half million people are considered moderately to severely food insecure and 41% of the population are estimated to be undernourished. It has recognized the ongoing political instability coupled with natural disasters such as droughts and floods with high food price inflation to increase vulnerability to food insecurity in the country. Thus, it is clear that food insecurity in Nepal can be claimed to have caused because of climatic, socio-economic and political issues.

Nepal has always been vulnerable to climate as it has frequently been affected by severe drought, natural disaster, fluctuations in food production and poor access to energy sources. The challenge imposed by climate change has further exacerbated the risk of hunger. Crop reduction is expected to be deepened in Nepal by increasing drought, erratic monsoon, a rising snow line, crop disease, pests, and severe weather conditions if no considerable interference is made (WFP, 2009). Climate change has been causing distress in many parts of the world. For instance China, whose grain production used to surpass demand between 2000 and 2003, faced decline in production for four years due to chain of natural disasters and reduction of land availability (Mukherjee, 2008). The promising approach of Green Revolution to boost the agricultural productivity also seems doubtful in terms of its sustainability. As pointed out by the International Conference on Organic Agriculture and Food Security, there has been declining grain productivity irrespective of increasing use of chemical agricultural inputs. In addition rising cost of agricultural inputs; increase in nutrition related diseases; and environmental and social cost such as deaths from pesticide poisoning, farmers' suicide due to debts and loss of jobs in rural areas brought upon by industrialized food systems (Scialabba, 2007) has put forth a serious issue of how viable these inputs are in terms of both productivity and social justifiability. All these issues are more or less concerned with food security of a given society.

Ensuring food security for present and future generations by making sure that the food supply is stable and affordable in the face of these difficulties is of specific concern for the nation. Therefore, a resilient agricultural practice should be adopted which has the potential to revive even in the face of unpredictable climate, assure sustainability to feed the population in generations to come and is likely to be economically and socially just as well. Therefore this paper intends to discuss how organic agriculture can contribute to food security on a global, regional, national and household basis, providing an alternative for a sustainable food system for present and future generations. This paper has assessed food security on the basis of four dimensions as identified by World Food Summit: physical availability of food, economic and physical access to food, food utilization and finally stability of previous three dimensions over time. In addition to this how a proper extension service plays a huge part in upholding of such practice cannot be underestimated. Thus, the paper also discusses important extension services that can be provided by the government, I/NGOs, CBOs, private organizations and other stakeholders in information dissemination and logistic services for successful implementation.

## 2. Methodology

This is a review work done by analyzing papers including journal articles, proceedings, scientific papers, books and websites of different organizations working for organic agriculture and food security. The related papers have been reviewed to get the overall view of food security dimension. Information on how organic agriculture can contribute to all four dimensions of food security has been assessed from general to more specific context. How organic agriculture can help overcome problem of food insufficiency in the face of weather extremes has been evaluated. Finally the various extension services that can be provided for successful implementation has been identified through related literatures.

### 3. Results and discussion

#### 3.1 Organic agriculture and environment health

Organic agriculture practices have been spreading gradually in both developed and developing nations as a system following agro-ecological principles, depending on locally available resources, healthy produce or certified-export oriented production. It is practiced in more than 120 countries, covering about 92 million hectare (ha) land. The organic market value was estimated at about US\$40 billion in 2006 and was further expected to reach US\$70 billion by 2012. Since the early 1990s organic market has been growing globally by 20% per year (Chen, n.d.).

Organic agriculture is considered to be the most sustainable food production system that has huge potential for mitigation and adaptation to climate (Niggli, 2007; Muller, 2009; Wietheger, 2010). The main reason for less emission from this system is due to its avoidance of energy intensive inputs such as synthetic fertilizers. It rather uses leguminous crops, crop residues and cover crops to supply nitrogen and improve soil fertility. Besides improvement in soil fertility helps in higher and stable soil organic matter. Usually under organic practice carbon dioxide sequestration into the soil is high which means less is being emitted into the atmosphere. The high rate of carbon retained in soil also has higher capacity to resist challenges to climate change. The soil's capacity to retain more water in organic practice makes it more useful during droughts or areas with erratic climate conditions followed by higher temperature and uncertain rainfall. Organic agriculture can complement well the agro forestry production system by increasing its productivity and at the same time reducing emission of GHGs. Due to huge diversity, soil fertility and most importantly relying on traditional skills and farmer's knowledge, organic practice is well equipped for adapting to the changing climate (Niggli, 2007). The vulnerability of soils to erosion, which is also one of the sources of GHG emission, is also considerably reduced due to high level of organic matter and increase of carbon stocks. Mandatory crop rotations, preference for seeds and breeds with better resistance to pest, diseases and climatic stress, lower fluctuation in yields and diversification help reduce production risks in cases of a single crop failure, environmental adversity or socio-economic shocks (Scialabba, 2007).

Organic farming has the capability to bring out environmental advantages. For instance, SEKEM Initiative, which started its first farm on biodynamic systems on 24 ha in the desert of Egypt 30 years ago, now has almost 20,000 ha with another 20,000 ha in transition. Going organic has helped utilize rice straw which farmers usually burn, to make microbial compost, thus replacing mineral fertilizers. This has reduced emission of carbon dioxide, nitrous oxide and methane gases; thereby increasing air quality. The economic liberalization policy and increased exports to the international market led farmers to rely on biological fertilizers instead of chemical fertilizer. A research showed organic agriculture significantly lowered nitrate leaching rates per ha lessening the pollution in drinking water. The use of pesticide chemicals reduced from 30,000 tons annually in the early 1990s to around 3,000 tons in 2007. With better food quality, and increasing awareness and health consciousness; consumers' willingness to pay increased. The farmers too showed satisfaction due to significant reduction in health problems (Brandt, 2007).

#### 3.2 Organic agriculture and food security

When it comes to providing enough food for the world population, productivity based on organic agriculture is usually questioned. The skeptics of organic production often argue that it is necessary to increase land area to bring production equal to conventional farming and also lack of availability of enough organically acceptable fertilizer makes it difficult for producing better yields (Trewavas, 2002; Meisner, 2007); imposing a doubt whether organic production will be able to feed the world population. On the contrary, organic practice undeniably leading to food shortage is hard to generalize as studies have shown that in some cases organic production if practiced in an effective way can get yield equal or higher than that of conventional. A study done on organic agriculture and the global food supply showed that organic production method has the capacity to sustain current or even larger human population without increasing the agricultural land base, emphasizing the importance of leguminous cover crops for effective results (Badgley et al., 2006).

A more comprehensive detail on results from numerous studies has been compiled by Leu (2011) in a scientific study that validate organic system to be the low cost, high yield, both environmentally and economically profitable endeavor. In the paper, it has been claimed that even after introducing conventional agriculture, food production per person in Africa decreased by 10 percent compared to 1960s level; and the United National Conference on Trade and Development (UNCTAD) and the United Nations Environment Programme (UNEP) found that organic agriculture can boost yields in Africa with crop yield increasing as much as 116 per cent for all African projects. In Madhya Pradesh, India, farmers had to face declining returns, toxicity and severe pest problem despite of increase in pesticide use, due to which many abandoned cotton production altogether. Then what started as an experimental plot for organic cotton farming, after seven years more than one thousand farmers were cultivating more than 15,000 acres with cotton yields increasing upto 20% more than on neighboring conventional farms. Faced with similar problems, in Peru too organic cotton yielded 10-20% higher than the national average in the arid coastal plain (Parrott & Marsden, 2002). A similar

result in China also showed improvement in food security in terms of nutrition and quantity, optimization of the agricultural structure and ensuring profit for both farmers and the company involved for organic vegetable production, processing and trading (Brandt, 2007).

While contemplating about capability of organic productivity to feed the ever growing population, we should look into how it can contribute to global, regional, national and household food security along with other benefits through four dimensions of availability, access, stability and utilization.

### **3.3 Organic agriculture and dimensions of food security**

Food security, as defined by Food and Agriculture Organization of the United Nations is the physical and economic access to sufficient, safe and nutritious food which meets the individual's dietary needs and food preferences for an active and healthy life (FAO, 2006). This means that food security not only implies enough food production but also accessibility and not only quantity consumed but the quality as well, for one to remain active and healthy. The four dimensions: availability, accessibility, utilization and stability are the most widely accepted definition of food security and hence this paper tries to analyze the suitability of organic farming to all these dimensions.

#### **3.3.1 Food availability**

Food availability is '*the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid)*'. Thus, this entails that there must be adequate quantity and suitable quality of food available. In case of organic farming, it is claimed that during the conversion phase, i.e. the first two to three years, yield reductions were usually low or sometimes indifferent if a low-input system has been converted. After the conversion period, organic yields have a potential to be more productive than conventional system. However, yield reduction is higher if the land had been run on a high-input level and after conversion too, the productivity is generally lower than the conventional yields (Zundel & Kilcher, 2007). Nepal's usage of chemical fertilizer per hectare compared to other countries is very low (Joshi G. R., 2010; Vaidya, Shrestha, & Wallander, 2008) which according to above claim could provide better result (in low-input system) when organic principles are followed. Also in places such as Kathmandu valley and some districts in Tarai, where regular chemical fertilizers are applied, have started to experience deteriorating soil quality (Vaidya et al., 2008). Soil quality is directly related to soil health which largely determines productivity, and environment health (Kinyangi, 2007) which can be brought out by organic practice. On the other hand there are places in Nepal where resource poor and subsistence farmers have been practicing farming in a traditional way which can be claimed as organic by default and thus converting to organic would not be that complex (Pokhrel & Pant, 2009). This can be of particular interest to certify as an organic for export-orientation. Besides these there might be other indicators which decide the productivity under organic practice such as availability of water and required nitrogen fixing materials for a complete soil fertility management system, labor cost, assurance of receiving premium price, market accessibility, long-term contracts and capacity building for farmers to benefit from the conversion. Clearly in Nepal lot needs to be done to fulfill the void in all of these facets.

#### **3.3.2 Food accessibility**

Food accessibility is an '*access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet*'. Access to food depends on affordability of production inputs, livelihood factors such as income, and accessibility to food even by those far from market area. Productivity does not assure accessibility. However organic farming through household farm yields, nutritional benefits, cost-effectiveness, environmental sustainability, water and energy efficiency, biodiversity, labor availability, resilience, farmers' capacity and social stability ensures accessibility to an extent possible. The probability of higher income and reduced debt, most likely due to exclusion of acquiring expensive fertilizers, poses financial benefits as well (Sligh & Christman, 2007). Nepal government has always emphasized on chemical fertilizer to boost agricultural productivity. An unbalanced (excessive) use of fertilizer is rampant though and it has known to contribute in increasing soil acidity and deteriorating soil physical condition and underground water quality (Shrestha, 2010). Since all of these fertilizers are imported, the major advantage of going organic would be to be dependent on locally available resource inputs combined with local knowledge, thus building the farmers' resilience. The fact that over 80 percent of the population is involved in agriculture for livelihood (Rahija, Shrestha, & Stads, 2011) makes it suitable for organic farming as it is known to demand more labor than conventional farming due to non-use of pesticides, chemical fertilizers or drugs that has instant reaction on plant growth. A higher return on organic produce also enables food security through higher purchasing power for which there needs to be a strong market mechanism which should ensure better price and accessibility as well. Besides these, the enhanced environmental services and energy efficiency in times of crisis makes organic farming a reliable option.

### 3.3.3 Food utilization

Food utilization is the '*utilization of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met*'. Chemical induced farming results in professional hazard, environment problems, yield loss due to pests resurrection and food residues which has grave repercussion on farmers' and consumers' well-being. Even so there is lack of regular pesticide monitoring at the field level in Nepal, which resulted in harming export of tea, honey and other food commodities in the recent years (Koirala, Dhakal, & Tamrakar, 2009). Though there is no comprehensive report of health hazards due to chemical exposure or consuming contaminated food, some studies have emphasized on this issue through haphazard use of chemical pesticides, food residue and probable health issues due to such exposure or contact (Palikhe, 2002; Shah & Devkota, 2009). Organic system contributes in proper food utilization by protecting from exposure to pesticides; providing safe, residue free, high quality nutritious food. The cropping diversity in organic farming along with rotation crops of minor economic value but that has high micronutrient and protein content such as legumes (Scialabba, 2007) enhances household diets and hence improves health status. The higher activity of plant defense mechanisms and longer shelf life reduces losses during transport and storage (Brandt, 2007). Thus, it greatly contributes to human health and that of local environment.

### 3.3.4 Food stability

Food stability is '*both the availability and access dimensions of food security*'. It largely depends on natural resources and environmental services; climate change and economic factors like trade policies. Climate change is now widely recognized as the major challenge facing the world today and agriculture forms as one of the major contributors of climate change. It accounted for 10-12% of total global anthropogenic GHG emissions (Smith et al., 2007). On the other hand, agriculture certainly is extremely vulnerable to climate variability and change as it is highly dependent upon weather and climatic conditions to produce food and fiber required to sustain human life. Climate change is likely to have varying effect in the production rate of different regions. For instance it is expected to favor temperate regions but hamper tropical ones (FAO, 2008). Though higher yields in temperate regions might offset lower yields in tropical to maintain the global food productivity, it might not ensure food security at local level, especially in developing countries where poor subsistence farmers might not have access to sufficient amount of food from other parts of the world where production might be increasing. The effects of climate change are already evident through reducing yields though, particularly in developing countries due to rising temperature and decreasing water availability (Niggli, 2007) which calls for a resilient agricultural system to cope with changing climate. Agriculture sector should both be able to adapt to changes and provide a foundation for mitigating GHG emissions as well as increase productivity to meet global needs. An organic agriculture principle is inclined more towards this goal which is deemed to work with nature rather than against it. It is the most sustainable form of production system that is resilient, can adapt and mitigate climate change (Jordan, 2009). Its greenhouse gas (GHG) emission rate is much lower and carbon sequestration in the soil is much higher. It builds resilience mainly due to efficient use of water, flexibility to withstand extreme weather events and minimize possibility of complete crop failure. Thus, due to resilience, soil stability, water-use efficiency, diversity, mitigation and adaptation features have made organic practice to provide food stability for local community.

In Nepal too food security is very much affected by natural adversities. The drought situation in the year 2005 and 2006 decreased food production (Regmi, 2007) and so did during the time of 2008/09 global food crisis - in addition to soaring food prices by 20-40 percent, Nepal was also hit by winter drought severely affecting the household production. Likewise flooding events are also reported in Tarai to be on rise and more vicious than before. This in addition to frequent crop loss due to disease and insect infestation has been causing agricultural losses (WFP, 2009). Thus, for climatic stress-stricken country like Nepal organic agriculture provides groundwork for increasing the resilience in agro-ecosystems to intensifying weather extremes such as drought, irregular rainfall, floods and rising temperature. Also being net importer of food (Joshi, Maharjan, & Piya, 2010), a self-reliant agriculture system which authenticates sustainability must be adopted for continuity in food supply. Through techniques such as crop rotation and mixed cropping manages biodiversity, diversifies and optimizes farm productivity, reduces the need for procuring inputs and stimulates market-orientation among farmers for higher income. It contributes in soil stability and resilience of food supply through agro-ecological approach, which is an important factor in food supply stability. Organic system invests in natural and human capital improving livelihood, providing fair return on labor and offering affordable technology for boosting productivity (Scialabba, Organic Agriculture and Food Security, 2007). Nevertheless, the proper extension services to bring out these numerous benefits should not be under-emphasized.

## 3.4 Promotion of organic agriculture in Nepal

When it comes to food security, a much broader aspect rather than just an agricultural system should be scrutinized. Food security is also influenced by factors such as soil nature, geographic condition, technologies, human capacities, policies, prices,

trade and infrastructural context. The variability of these factors are found diverse from one place to another which is why even though today's global agricultural production is sufficient to feed the current world population, the ability to supply is unequal in different communities (Scialabba, 2007). Therefore, besides the agriculture system followed, we should also look into various factors which highly affect the overall development of organic sector. When it comes to organic farming in context of Nepal, it is still in its initial phase. Much can be done to improve and uplift this sector. There are numerous ways to support organic farming, some of which are pointed below:

- i. Creating awareness and information dissemination through advertisements, distributing leaflets/brochures, setting up websites, organizing campaigns, trade fairs, food festivals and other events are necessary. Producers and consumers both need to be aware of its social, economic, environment and health benefits to form a balance on the production and consumption side.
- ii. Organic management is a knowledge-based approach that requires understanding of agro-ecological processes. Lack of experience, training and inadequate extension services might hamper in achieving acceptable yield. Insufficient technical advice might lead to poor management and thus inconsistent quality (ibid.). Farmers thus should be provided with knowledge of biological principles and ecosystem processes through proper training.
- iii. The organic farming productivity compared to conventional strongly depends on soil, climatic conditions and choice of crops. Therefore, it is important that long-term investments be made on capacity building and research and development of location-specific management system which includes production, distribution and marketing aspects.
- iv. An effective way to go about it would be to develop farming system comparison trials which will form as a basis for other farmers to make decision on conversion. Not only them, but it provides basis for researchers, project implementers, donor agencies and policy makers to come up with vigorous decision based on productivity, efficiency and ecosystem services data and to identify and overcome challenges therein (Zundel & Kilcher, 2007).
- v. The most complex issue of increasing soil organic matter, soil microbial activity, managing timely mineralization and nutrient availability can be very demanding especially in areas with limited biomass production due to climatic limitation which is why research should also focus on soil fertility management. One way of doing this could be being involved in participatory research by which locally adapted technologies will be developed (ibid.).
- vi. As for the starters, in order to cover the production cost with lower yields, especially during primary years of conversion; financial support through subsidies and credit facilities should be made available.
- vii. Again for reducing certification costs, local certification bodies and participatory guarantee systems should be assured (ibid.). It should be such as to encourage large scale conversion by farmers in a given area.
- viii. A strong alliance between public and private sector or any other stakeholders at production and marketing level is also important. For instance an association between manufacturers and a retail company in an Indian state of Madhya Pradesh brought increment in income of farmers in organic cotton production by 10 to 20 percent. In addition to that, intercropping of legumes added to their family food baskets as well (Sligh & Christman, 2007).
- ix. The potential of organic agriculture to contribute to food security greatly depends on political will. Such as in Tigray Region of Northern Ethiopia, the increase in grain and straw yields was higher in fields where compost was used than those with chemical fertilizer or no input were applied. Since 1998, the Bureau of Agriculture and Rural Development of Tigray Region adopted compost production as part of its extension package, as a result of which chemical fertilizer use decreased from 13,700 to 8,200 tons between 1998 and 2005, while total grain yield for the region almost doubled from 714,000 to 1.3 million tons. With this success, production and use of compost has been promoted in other regions as well, through various projects of the Ministry of Agriculture.

Another national promotion of organic gardens and farms; Pro-Huerta in Argentina was established in 1990. The model garden claimed to fulfill 70 percent of family's fresh vegetable demand. In 2003, the number increased to about 550,000 gardens. The main reason for this success is due to institutional structure of National Institute of Agricultural Technology (INTA) through their territorial presence with effective operational strategies of promotion, training, provision of strategic inputs and technical assistance. Various approaches were implemented such as entitlement to seeds only upon participation in training courses or access to dual purpose chicks for protein supply only after responsibility and creditworthiness in garden management was confirmed. The high technical corps and promoters' commitment along with close coordination with various actors of civil society - grassroots organizations, religious, municipal and school bodies; proved to be its strength for successful implementation (Zundel & Kilcher, 2007).

Another widely known example of Cuba, which shifted to organic agriculture for food security substituting the country's dwindling imported supplies of agrochemicals, petroleum and food to 10-50% of previous levels, demonstrates how a firm political commitment contributed to its success. It started with urban organic production at the beginning of country's food crisis which helped contribute to food security within a short period. This prompted government to continue its support

through incentives for diversification, higher prices for production, land accessibility and decentralizing and downsizing massive state co-operative farms to encourage farmer ownership. This resulted in tripling agricultural wage, mass migration to rural areas and doubling of major crop production towards the end of 1990s, with some crops even surpassing yields of the 1980s. The ability of Cuba to overcome food crisis maintaining basic and equitable food ration for every citizen by going organic shows the role of strong government policy for improved results (Brandt, 2007).

Unfortunately in case of Nepal, there are no clear policies and national standards for organic sector and support in agricultural sector are mainly focused on chemical-backed production system, especially in the form of subsidized chemical inputs or to other aspects that encourages the use of it (Pokhrel & Pant, 2009). Provided the benefit of organic farming and the opportunity it can provide through export orientation, the government should create national standards to provide directions for all those involved in organic farming and finally build a market mechanism which gives fair return and authentic products.

- x. The exchange of knowledge among resource-poor farmers producing organic products and other stakeholders is very necessary as it can help accelerate innovation and skills. For instance, organic input production like compost requires availability of biomass, usage of available resources and knowledge of composting techniques. Therefore, in order to practice in a large scale production, community-based projects can help produce compost together on particular site so that farmers learn how to produce high-quality compost. Such projects can also include producing seeds for cover crops, disease-resistant seeds and planting materials with the support of researchers (Zundel & Kilcher, 2007).
- xi. Documenting local achievements and challenges as well and sharing of this information through publication, academics, seminars, conferences, training and other platforms will help in rapid development of organic sector in the country. The role of higher education and research in this regard should be highly prioritized for the promotion of organic agriculture in the country. The Institute of Agriculture and Animal Science (IAAS) in Rampur, Chitwan, which is the pioneer agriculture academic institute in Nepal conducts about 5-10 M.Sc. thesis research in organic crop management under the financial support of Sustainable Soil Management Programme (SSMP), Helvetas and the National Agricultural Research and Development Fund (NARDF), Nepal. Thus, this provides an insight on how collaboration between such institutions has helped develop research and generate information, which will only help to further identify deep-rooted problems.

#### 4. Conclusion

Nepal is an agro-based economy and despite of more than half of its population being engaged in agriculture, food insecurity still prevails in the country. Obstruction in food productivity due to climatic hazards that Nepal has been accustomed to has been further deterred by the rapid climate change. Additionally, the chemical usage has its share of damage done to soil productivity, environment and human health. Hence, a more sustainable form of agriculture should be established. Organic agriculture can be acknowledged as an appropriate practice so far that can overcome the issues of climate change and provide social and economic validity. Being a knowledge-intensive farming system, it calls for a range of extension services for better yields. Government plays a huge role in changing attitudes and decision making through information dissemination and its favorable policies. Plenty of facts are available which proves how beneficial organic farming can be to a society. The government should thus play an active role to bring all the stakeholders together to work towards shared goal.

#### References

- Badgley, C., Moghtader, J., Quintero, E., Zakem, E., Chappell, M. J., Aviles-Vazquez, K., et al. (2006). Organic agriculture and the global food supply. *Renewable Agriculture and Food Systems*, 22(2), 86-108.
- Brandt, K. (2007). *Organic agriculture and food utilization*. United Kingdom: Newcastle University.
- Chen, S.-S. (n.d.). *Development of the International Market for Organic Vegetables*. Retrieved 11 5, 2011, from <http://coa.cpc.org.tw/edu/class/doc/98/09808/04%E5%9C%8%E9%9A%9B%E6%9C%89%E6%A9%9F%E8%94%AC%E8%8F%9C%E5%B8%82%E5%A0%B4%E7%99%BC%E5%B1%95.pdf>
- FAO. (2006). *Food Security*. Food and Agriculture Organization of the United Nations.
- FAO. (2008). *Climate change and food security: A framework document*. Rome: Food and Agriculture Organization of the United Nations.
- Food and Agriculture Organization of the United Nations (FAO). (2010). *Global hunger declining, but still unacceptably high*. Retrieved August 9, 2011, from <http://www.fao.org/docrep/012/al390e/al390e00.pdf>
- IFOAM. (2002). *Organic agriculture and food security*. International Federation of Organic Agriculture Movements.
- IFOAM. (2009). *High sequestration low emission food secure farming*. International Federation of Organic Agriculture

Movements.

- ITC. (2007). *Organic farming and climate change*. International Trade Centre.
- Joshi, G. R. (2010). Factors influencing the adoption of fertilizer technology among rice farmers in the Terai region of Nepal. *SAARC J. Agri.*, 8(1), 21-32.
- Joshi, N. P., Maharjan, K. L., & Piya, L. (2010). Poverty and Food Insecurity in Nepal: A Review. *Journal of International Development and Cooperation*, 16(2), 1-19.
- Kinyangi, J. (2007). *Soil health and soil quality: A review*. Retrieved 11 7, 2011, from <http://www.worldagroinfo.org/files/Soil%20Health%20Review.pdf>
- Koirala, P., Dhakal, S., & Tamrakar, A. S. (2009). Pesticide application and food safety issue in Nepal. *The Journal of Agriculture and Environment*, 10, 111-114.
- Leu, A. (2011). *Scientific studies that validate high yield environmentally sustainable organic systems*. Organic Federation of Australia.
- Meisner, C. (2007). *Why organic food can't feed the world*. Retrieved 10 29, 2011, from Cosmos online: <http://www.cosmosmagazine.com/features/online/1601/why-organic-food-cant-feed-world>
- Mukherjee, A. (2008). *Food Insecurity: a Growing Threat in Asia*. Beijing: UNESCAP-Asian and Pacific Centre for Agricultural Engineering and Machinery.
- Palikhe, B. (2002). Challenges and options of pesticide use: In the context of Nepal. 130-141.
- Parrott, N., & Marsden, T. (2002). *The real green revolution: Organic and agroecological farming in the South*. United Kingdom: Greenpeace Environmental Trust.
- Pokhrel, D. M., & Pant, K. P. (2009). Perspectives of Organic Agriculture and Policy Concerns in Nepal. *The Journal of Agriculture and Environment*, 10, 89-99.
- Rahija, M., Shrestha, H. K., & Stads, G.-J. (2011). *Nepal - Recent developments in public agricultural research*. Agricultural Science & Technology Indicators (ASTI).
- Regmi, H. R. (2007). Effect of unusual weather on cereal crops production and household food security. *The Journal of Agriculture and Environment*, 20-29.
- Scialabba, N. E.-H. (2007). *International Conference on Organic Agriculture and Food Security*. Food and Agriculture Organization of the United Nations.
- Scialabba, N. E.-H. (2007). *Organic Agriculture and Food Security*. Italy: Food and Agriculture Organization of the United Nations.
- Shah, B. P., & Devkota, B. (2009). Obsolete pesticides: Their environmental and human health hazards. *The Journal of Agriculture and Environment*, 10, 51-56.
- Shrestha, R. K. (2010). Fertilizer Policy Development in Nepal. *The Journal of Agriculture and Environment*, 11, 126-137.
- Sligh, M., & Christman, C. (2007). *Organic agriculture and access to food*. Rural Advancement Foundation International.
- Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., et al. (2007). *Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, USA: Cambridge University Press.
- Trewavas, A. (2002). Malthus foiled again and again. *Nature*, 418, 668-670.
- UNICEF. (2010). *2011 South Asia Data Pocketbook*. Kathmandu, Nepal: United Nations Children's Fund Regional Office for South Asia.
- Vaidya, G. S., Shrestha, K., & Wallander, H. (2008). Effect of plant residues on Am Fungi. *Scientific World*, 6(6), 85-88.
- WFP. (2009). *The Future of Food: Creating sustainable communities through climate adaptation*. Retrieved 10 12, 2011, from [http://reliefweb.int/sites/reliefweb.int/files/resources/F1AA71E084C1D47B852576BD00634D1A-Full\\_Report.pdf](http://reliefweb.int/sites/reliefweb.int/files/resources/F1AA71E084C1D47B852576BD00634D1A-Full_Report.pdf)
- WFP. (n.d.). *Nepal*. Retrieved August 16, 2011, from World Food Programme: <http://www.wfp.org/countries/Nepal/Overview>
- Zundel, C., & Kilcher, L. (2007). *Organic agriculture and food availability*. Switzerland: Research Institute for Organic Agriculture (FiBL).