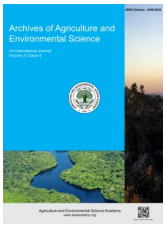
Archives of Agriculture and Environmental Science 5(2): 223-230 (2020)
https://doi.org/10.26832/24566632.2020.0502021

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes



REVIEW ARTICLE

Organic farming in Nepal: A viable option for food security and agricultural sustainability

Sovit Parajuli[1*], Jiban Shrestha[2] and Sabita Ghimire[3]

[1]Agriculture and Forestry University, Rampur, Chitwan, NEPAL
[2]Nepal Agricultural Research Council, Agriculture Botany Division, Khumaltar, Lalitpur, NEPAL
[3]College of Natural Resource Management, Puranchaur, Kaski, NEPAL
[*]Corresponding author's E-mail: parajulisovit52@gmail.com

ARTICLE HISTORY

Received: 09 May 2020
Revised received: 24 May 2020
Accepted: 12 June 2020

Keywords

Agriculture
Conventional farming
Food security
Organic farming

ABSTRACT

Increasing use of agrochemicals, higher production cost and deterioration of ecosystem health have advocated the need to change the traditional and external input using agriculture towards safe and sustainable organic production. The article reviewed on general overview of organic agriculture in Nepal. The article aims to put light on the current scenario of the dawdling-paced organic agriculture and the options to revive the pesticide dominated conventional agriculture. Promotion of organic agriculture was first appeared as a priority in the10th Five Year Plan of the Government of Nepal. Now it has been embedded in the national agricultural policy. Organic agriculture provides benefits in terms of environmental protection, conservation of nonrenewable resources, improved food quality, improve health status and the reorientation of agriculture towards areas of market demand. Various institutions, individuals and farmers are engaging in organic farming. Nepal is exporting organic products to international markets. The adoption of organic agriculture increases agricultural production and improves soil health and consumer health and seems a better option in countries like ours where fortunately integrated crop-livestock system is still prevalent. It is found to be viable option for better livelihood in the context of Nepal. Because the haphazard pesticide use has marred the conventional agriculture, all these contexts gesture this system to be scrutinize thoroughly and supplanted by organic farming system as a viable option towards food security and agricultural sustainability.

Citation of this article: Parajuli, S., Shrestha, J. and Ghimire, S. (2020). Organic farming in Nepal: A viable option for food security and agricultural sustainability. *Archives of Agriculture and Environmental Science*, 5(2): 223-230, https://dx.doi.org/10.26832/24566632.2020.0502021

INTRODUCTION

Organic agriculture 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 Nepalese government is aware of the problems of agricultural chemicals, and in some areas is promoting integrated pest control in order to reduce the use of pesticides (PMRD, 2008). The organic agriculture has proven to be effective in increasing and stabilizing yields, particularly in marginal lands. This means it is a system that empowers farmers to restore and uphold food security (Maxwell and Frankenberger, 1992; Menezes, 2002). Organic agriculture also helps to increase resistance to pests and diseases, which is crucial to building food security (Patel, 2009). Recent analysis suggests that organic farming offers a way to reduce the use of synthetic pesticides for the management of animal pests and pathogens without increasing their levels of infestation.

The five-word sentence "Nepal is an agricultural Country" has become hackneyed these days. The problem of brain-drain and muscle-drain escalating in tandem, leaving Drudgery as a quotient is obviously not a good sign for transcending the existing

agriculture system of Nepal. With Nepal's unemployment rate hovering at 40%, its compulsion of a number of people to choose foreign destination temporarily or permanently. The 2015 earthquake affected the social economic, political and environmental atmosphere. Of the total, 24% population lives under poverty (Sen, 1981; CBS, 2018).The nation with 29 million population has sent its 10% of the population between 20-40 years of age who are compelled to do 3D work (Dirty, Dangerous, Difficult) (DoFE, 2014). The data has revealed a total of 1400 migration/day which is really a matter of pity and shame. As the country's agricultural GDP shares 26.98 percent while the remittance share 52.4 percent (MoF, 2019), the percentage share contribution of emigrants via remittance is almost double the share from agriculture. (Adhikari, 2018) mentioned that Nepal is predominantly an Agrarian country. However, the scenario of haphazard pesticide use is reducing the quality of soil and products. About 3035 trade (commercial products) of pesticides under 170 common names are registered in Nepal (PQPMC, 2019). The existing population involved in agriculture is sufficient to feed such a small country if interventions on the parameters affecting agriculture are made. It includes production of quality inputs such as quality seeds and seedlings, effective pest management practices, mechanization and ICT based agriculture alike. While targeting the sustainable Development goal, the Zero Hunger Challenge, are we really prepared for achieving the target? The answer is, "a big No". Government of Nepal has banned 21 pesticides in the country (PQPMC, 2019). However the use of such proscribed pesticides is being used throughout the Terai region especially near to the border. The use of pesticides has created four-fold problems through trophic levels; the health problem, the environmental problem, yield loss due to non-target pesticide application and burden to farmers (Koirala *et al.*, 2009). Pesticides use has a harmful effect on the environment (Ibitayo, 2006). The existence of non-target organisms in the nature is also in challenge due to the use of pesticides (Aatreya *et al.*, 2011). The major challenge that has encumbered the sustainability in agriculture production system and self-sufficiency is irrational and haphazard use of agrochemicals, the pesticides and thus, leaving organic agriculture as a only way to food and nutritional security.

Organic agriculture's gaining popularity worldwide and about 162 countries with its 1.8 million farmers are involved in organic farming on 37 million hectares of agricultural land worldwide (FIBL/IFOMA, 2013). According to the International alliance of sustainable agriculture (1990), organic farming is defined as "a system of agriculture that encourages healthy soils and crops through such practices as nutrient recycling of organic matter (such as compost and crop residue), crop rotations, proper tillage and the avoidance of synthetic fertilizers and pesticides" (Reijntjes *et al.*, 1992). The global market for organic food has now reached 62.9 billion US dollars which was more than in 2010 (by 4 billion) (FiBL, 2013). The indiscriminate use of agrochemicals has led to air, water and soil pollution including health hazards and economic loss despite increasing agriculture productivity (Bhandari, 2006; Pokharel and Pant, 2008). It has resulted in the emission of green-house gases and climate change too (Khanal, 2009). Organic agriculture defines the doctrine of it as health, ecology, fairness and care. It is explicit that whether the practices of achieving organic agriculture vary accordingly with regions to some extent, the minimum standard set for agriculture to be organic is same. These days, some of the evidences suggest that farmers are interested in organic farming after the awareness on adversity of pesticide usage and its impacts.

About 9,789 ha (0.23% of total agricultural land) of land in Nepal is managed under organic farming by 1470 organic growers (IFOAM, 2012) whereas the certified organic land in 2017 was 9,361 ha (0.2% of total cultivated land) (Willer *et al.*, 2019). Several studies suggest the scope of organic agriculture in the context of countries like ours where the risk adaptation and mitigation by pesticide use cannot be compensated in short course of time. Some initiatives too have been addressed on behalf of organic farming taken by various governmental and non-governmental institutions (NGOs) and Private agencies such as RONAST, DOA, NARC, IAAS, SSMP, LIBERD, CEAPRED, ECOCENTER, Tea and Coffee Development Board, Kathmandu Metropolis, Nepal Perma-culture Group, AEC, HOPTA, etc. (Shrestha and Pant, 2006). However, the level of technology generation and dissemination on organic farming is not significant in Nepal. Even today, the extension services provided by government agencies are very limited and are confined to awareness and training programs only. This shows the humongous scope and importance of organic agriculture to address national as well as global food and nutritional security (Table 1).

Organic farming as a boon

Organic farming uses carbon-based fertilizers and biological pest control and does not use synthetic fertilizers. It reduces the cost of agricultural production and also improves the soil health. The organic farming system has the potential to improve soil fertility by retaining crop residues and reducing soil erosion (Reganold *et al.*, 1987; Siegrist *et al.*, 1998). The organic farming system has the potential of reducing the use of irrigation water and sequencing CO_2 (Niggli *et al.*, 2009). The organic farming system has the potential to reduce the emission of greenhouse gases by agronomic practices as the nitrogen application rates in organic farming systems are 62-70% lower than those compared to conventional agriculture due to recycling of organic crop residue and use of manure (Kramer *et al.*, 2006). The organic matter has a stabilizing effect on the soil structure, improves moisture retention capacity and protects soil against erosion (Reicosky *et al.*, 1995). The haphazard use of chemical fertilizers and pesticides has resulted deleterious effects on the human health causing immune-suppression, skin cancer, hormone disruption, reproductive abnormalities, birth defects and liver and kidney problems. Organic agriculture improves the health of people. Since consumption of organic food products is the best remedy to prevent the numerous health hazards caused by conventionally produced foods, the global market has experienced exceptionally high growth in organic foods in the United States,

Europe, and in other countries, yet market shares remain quite small (Piyasiri and Ariyawardana, 2002; Torjusen *et al*., 2004).

Organic farming and soil health

Organic farming has the potential to improve soil fertility and help building both nutrient and carbon stocks (IFOAM, 2008). The organic matter improves the soil quality and crop yield by increasing the carbon content and other plant nutrients in the soil (Stanhill, 1990). When it comes to building, maintenance, and replenishes the soil health, organic farming is far superior to conventional agriculture (RI, 2011). A sound and systematic organic practice is always a prudent way of enhancing a better agriculture system with minimum loss to ecology. Once the practice of organic agriculture is flourished, healthy soil system is developed and according to the views from representatives of different organizations, healthy soil will support healthy plants and in turn, healthy humans and animals (Soil Association, 2002) (IFOAM, 2005). The major advantage to small farmers shifting to organic production are enhancement of soil fertility; the closeness to traditional and existing system; reversal of soil erosion and the low cost of self-reliance existing technology (IFAD, 2003). The organic agriculture can help maintain fertility of the fragile land, contributing to maintain agriculture productivity by avoiding the loss of biodiversity. Adhikari (2012) and Deshar (2013) mentioned that heavy use of chemical fertilizers, mainly in suitable and remunerative farming pockets of Nepal, has resulted farm land degradation (Kanshakar, *et al*., 2002). Also, major soil indicators (OM, N, P, K and pH) were found to be influence heavily in Nepalese soil by the use of organic manures (Regmi *et al*., 2006). Several examples are found to be supportive and evident on the preference of organic farming over conventional one. The biomass of Mung bean after two pickings of pods when incorporated in rice field increases the rice grain yield by 20% (Khanal *et al*., 2006). The incorporation of Asuro leaf in the rice field increases rice yield by 45% (Subedi, 1992). Increase in biodiversity of soil micro-organisms has been evident in Mung bean biomass incorporated field that are important in maintaining soil health (Devkota *et al*., 2006). Also, there has been found more abundance of mycorrhizal population in the roots of crops grown in organic manure -rich soil (Eason *et al*., 1999). All these evidences support the need and flourish of organic agriculture in Nepalese agriculture indeed.

Organic farming and food security

When all people at all times have access to sufficient, safe and nutritious food to maintain a healthy and active life, food security prevails (FAO/UNDP, 2003). Until the early 1980s, country used to be exporter and managed to be self-sufficient however, over the past decades, country has been experiencing food shortage and depend on export mainly from India and China. Several studies conducted by Gaire *et al.* (2015), Chapagain (2014), Chapagain and Gentle (2015) and Adhikari and Hobley (2011) highlighted the challenges Nepal's facing in accomplishing food and nutrition security. With a global hunger index (GHI) of 19.8, it's depicting a melancholic situation of hunger in different regions of the country (IFPRI, 2009). Of the total population, almost 50% of the population is undernourished, 41% children under the age of five are stunted, and 29% are underweighted. According to World Food Program (WFP, 2019), 4.6 million Nepalese are suffering from food insecurity (Yaro, 2004). In Nepal, the import and formulation of pesticides was about 50 thousand kg in 1997/1998, which was increased to 350 thousands kg in 2011/2012 which six fold increment is showing dependency of agriculture production on pesticides (Kafle *et al*., 2015). Among cereals, vegetables, cash crops and fruits, the pesticide use was dominant in vegetables (1.60 kg a.i./ha) (PPD, 2015). Further, studies reveal that more than 90% of the pesticides are used in vegetable production (Atreya and Sitaula, 2010). This scenario if persisted for some years is sure to create a serious threat on Nepalese agriculture system affecting food and nutritional security. The only way to get rid of such crises suits for organic farming. Organic farming emanates safe, healthy, nutritious, and mineral-rich tasty food (Worthington, 2001) . Several evidences have shown that organic plant-based food usually contains higher antioxidants, minerals, vitamins, and other beneficial substances (Woese *et al*., 1997; IFOAM, 2008; Worthington, 2001). The scientific communities agree that regarding the pesticide residues, food additives, irradiation etc., such food poses their form and amount in very negligible amount with no considerable health risks (Low *et al*., 2004; Magkos *et al*., 2006; Winter and Davis, 2006). Also, while describing from health perspective, such certified organic foods possesses 3-4 times lower risk than conventional food regarding pesticide residues. These scenarios depict the scope of organic agriculture from human and animal health perspective (Winter and Davis, 2006). The organic food and their products have an improvement in taste and nutrient content (Parrott and Marsden, 2002). People preference to organic food has also been reported in the western terai of Nepal because of its good taste (Aryal and Dahal, 2010). Thus, unleashing the pesticide dependent agriculture and embracing organic agriculture is the relevant way to secure national food security and agricultural sustainability.

Organic farming and pest control

Insect pest and diseases are challenging threats responsible for descending the production and thus, various components or forms of organic agriculture can be used for their control without negative impact to the environment. Green manuring, biofertilizers, biopesticides, bio-fungicides, botanical pesticides and trap crops can be the best option for pest control (Aryal, 2006). Crude water extracts of green neem leaves (*Azadirachta indica*), Chinaberry (*Melia azadirach*), Malabar nut (*Justicia adhatoda*) and Indian privet (*Vitex negundo*) (each 200 g of leaves per liter of water) can be effective for controlling cabbage butterfly, soya bean hairy caterpillar and tobacco caterpillar (Neupane, 1999). A review on eco-friendly management of Diamondback moth (*Plutella xylostella*) of cabbage in Nepal also addressed botanical, cultural, irrigation measures at their best control DBM (Parajuli and Paudel, 2019) which also supports organic agriculture (Table 2).

Voyage of Nepalese agriculture: From traditional to organic

Nepalese farmers have been practicing traditional agriculture since time immemorial with always emphasizing the use of local resources and free of chemical fertilizers. Each house with at least a few pair of goats and chickens, a pair of bullocks, few buffaloes and cows and so on used to be evident. Promotion of organic agriculture first appeared as a priority in the10th Five Year Plan of the Government of Nepal (NPC, 2003). It is now embedded in the national agricultural policy. The shift of traditional agriculture and often broke down of the agroecological linkage started in "the green revolution agriculture" or "the industrial agriculture" where innovation of DDT (1950s), miracle wheat by Norman E. Borlaug (1970) and many achievements in agriculture were made. More or less, these were responsible to disturb the agroecosystem as they were emphasized on productivity and profitability. Later, the book "Silent Spring" made people realize of the impacts of industrial agriculture. The book put light on "the use of chemical pesticides, limitations of technological advancement and the responsibility of science" (Lear, 2002). With time, several incidents of pest problems, pesticide impacts and so on started encumbering agriculture production causing ecological disturbances. Altieri and Nicholls (2005) grouped these negative ecological disturbances into two categories as; i) disease of the ecotype (physical environment), and ii) disease of the biocoenosis (biotic community). At present, it is being realized that neither ancient agriculture, nor the traditional agriculture could best fit to feed the world crammed with billions of population and on contrary, the present day conventional/ commercial agriculture heavily dependent on agrochemicals can't be the proper option from ecological point of view leading to the emergence of "sustainable agriculture". However, due to its vagueness, clearness and measurability, the term 'sustainable' it is not free of controversy (Petersen and Snapp, 2015). As the sustainability paradigm couldn't depict what techniques, for example, can be used to get 'end product' of sustainability, concept of 'the best' agriculture system emerged. Organic agriculture is one of the approaches of sustainable agriculture. Organic agriculture has become a field of trial where farmers/ producers, with long-term suffering associated with risk and cost, constantly try, fail, learn and retry (Tittonell, 2014). It is pointed out that "chemical paradigm is about controlling nature, the organic paradigm is about respecting nature" (Rodale, 2010)

Organic farming and Nepal's experience

Organic agriculture was first appeared as one of the priority sectors in Nepalese agriculture since the 10th Five Years Plan. But nowadays various institutions, individuals and farmers are emergently engaging in this field. The paradigm shift from traditional to the conventional agriculture system depicts the scenario of zero or minimum pesticide use at past; that is, until the 1950s Nepalese farming system was largely organic. Chemical pesticide was introduced for the first time in 1950s (Dahal, 1995) for the control of malaria. DDT made its first impact in 1956 followed by organochlorines, organophosphates, carbamates and synthetic pyrethroids (Delaplane, 1996; Atreya, 2008). In 1997/98, about 51 million rupees (NRs) was spent in pesticide import and formulation. The expenditure rose to more than 374 million (NRs) in 2011/12 (Dhital *et al*., 2015). In Nepal, the organic agriculture movement was first observed when it was at infancy stage in the US policy level. The philosophy of organic agriculture was accepted by the US National Research Council and put forward as "Alternative Agriculture" in 1989. American research scholar Ms. Judith came to Nepal (Bhaktapur) in 1987 and started "organic agriculture" and on the same year, founded an NGO, Appropriate Agricultural Alternatives (AAA), devoted for research advocacy and marketing of organic agriculture. As she was the pioneer of organic agriculture, local people often referred her as "mother of Nepal's organic farming" (Bisht, 2011). Organic agriculture was put into light of promotion in the 10th five-year plan (2002-2007) of the Government of Nepal (NPC, 2003). In 2008, the National Coordination Committee for Organic Agriculture Production and Processing System (NCCOAPPS) was formulated and National Organic Standards have been developed. The National Adaptation Plan of Action to climate change (NAPA) has mentioned organic agriculture as an important agricultural strategy to adapt to the changing climate (MOE, 2010). Bhusal (2005) mentioned that many of the farmers are aware of the negative impacts of conventional agrochemicals-based intensive farming system at the same time. Also, some of them are practicing organic agriculture in different agroecological regions of the country independently (Adhikari, 2005).

Table 1. List of some organic farms of Nepal.

S.N.	Name of the farm	Location
1	Himalayan Organic Farm	Kathmandu
2	Ashapuri Organic Farm	Kathmandu
3	Prasiddhi Organic Coffee Estate P.Ltd.	Madanpur
4	Green Valley Organic Farm	Kathmandu
5	Herb Nepal	Bhaktapur
6	Patale Gaun Organic Farm	Kashikhanda
7	Organic Farm House	Kapan
8	Organic Farm House	Pokhara
9	Fresh Farms	Kathmandu
10	Everything Organic Nursery	Patlekhet

Table 2. Some research findings related to pest controls under organic farming.

S.N.	Insect pest	Research findings	References
1	Potato tuber moth	Chopped and shade dried *Chenopodium botrytis. Mentha arvensis*, *Artemisia vulgaris* and *Eucalyptus* sp. Leaves with stem.	(Pradhan, 1988)
2	Cabbage butterfly, Diamondback moth and Cabbage aphid on cole crops	Water extract of neem seeds, tobacco stem and leaves, and chinaberry seeds and leaves.	(Joshi, 1994)
3	Flea beetle on Cole crops (Radish, turnip and broad leaf mustard)	Aqueous solution of pyrethrum @ 3 g/L water	(Dawadi *et al.*, 1993)
4	Aphids on vegetable crops	Aqueous extract solutions of *J. adhatoda*, *Melia azedarach*, seed pomace of *Brassica campestris* (1:4 ratio)	(Vaidhya, 1993)
5	*Brevicoryne sp.*,*Hellula sp.*, *Plutella sp.*, *Trichoplusia sp* for cabbage	Cloves of garlic (50 g/L+) resulted yield gain	(Baidoo and Mochiah, 2016)
6	*Brevicoryne sp.*, *Plutella sp.* for pest control of cabbage	Cloves of garlic (30 g/L+) resulted yield gain	(Fening *et al.*, 2013)
7	*Sitobion avenae* for pest control of wheat	Neem cake @ 100 g/L+ resulted pest reduction	(Aziz *et al.*, 2013)
8	*Sitophilus oryzae* of stored wheat	Neem oil (10 ml/kg) resulted weight loss reduction	(Kemabonta and Falodu, 2013)
9	*Helicoverpa armigera* of chickpea	Fresh leaves of Neem (50g/) resulted pest reduction	(Kumar *et al.*, 2015)
10	*Sesamia calamistis* of Sorghum	Seed kemels of Neem(5 g/plant) resulted yield gain	(Okrikata *et al.*, 2016)

Conventional agriculture versus organic agriculture

Various evidences suggest that there are many basis that seem logical and scientific to replace conventional agriculture by organic agriculture. With respect to direct energy consumption (fuel and oil) and indirect energy consumption (synthetic fertilizers and pesticides), organic agriculture generally performs better than conventional agriculture (Scialababa and Hattam, 2002). It has been documented from many studies that plants take up pesticide from soil (Fantke, 2013) and use of pesticides is unrestricted in conventional agriculture. The other results of indiscriminate use of pesticides in conventional agriculture are loss of ecosystem resilience, biodiversity loss, pest resurgence and resistance, bioaccumulation and bio magnifications of the pesticides, and food contaminations (Raven *et al.*, 2008). Organic agriculture can reduce farmers' dependence on energy and the efficiency of energy per unit of production can be increased (Ho and Ching, 2008). According to a study conducted in 18 European countries, organic farming has resulted increase in soil organic matter, improvement in soil biology and lower nitrate leaching and pesticide contamination (Stolez *et al.*, 2000). The net economic return per hectare was often equal to or higher than conventional agriculture (Pimentel and Burgess, 2014). In case of the arid and semi-arid conditions and with low external inputs, organic agriculture generally improves over time (Pretty, 2002; Blaise, 2006). When grown under stress condition marked by drought, heat, excess rain or cold, organic production supersedes conventional agriculture. In contrast, the performance of crops is high in conventional farm under favorable growing conditions (Shearer *et al.*, 1981). Certified organic coffee (90 metric tons) is produced in about 210 ha of land and some 59 ha of land is under conversion (Shrestha, 2011). Adhikari (2008) found that the benefit-cost ratio of organic carrot was relatively higher compared to the conventional one. In the same way, organic coffee production was viable financially under different conditions in Gulmi district (Paudel *et al.*, 2010). Also, they mentioned that Nepalese organic coffee fetches a 10-33% premium in international markets.

Problems and challenges of organic agriculture

Emphasis on organic agriculture at policy and program level looks inadequate for its development and promotion. There is a virtual lack of government support to organic growers and marketers. It is necessary that marketability of any organic products, and that too at a premium price over the traditional and modern products has to be assured before starting the cultivation of organic crops. Mass production of organic products and the business volume for market sale are still invisible. Research work on processing and certification are weak and, in many cases, are missing. Organic farming has its own shortcomings in Nepal. Poor technical skills and capacity in managing complex farm land problem, insufficient organic technology to support production, lack of research on processing and certification, poor investment capacity, small and fragmented land holding, and less risk bearing capacity among others are the key constraints at the producers' level. Poor consumers' awareness about organic products, quality and availability, lack of trust regarding the authenticity of the products, higher prices of organic products, impoverished market infrastructure are the constraints at marketers' level.

Conclusion

Organic farming facilitates a healthy agricultural atmosphere by balancing a better soil health, providing a pace of gradual increase in production over time, maintaining a minimal or zero pesticide residue on agricultural produces and thus ensuring national as well as global food and nutritional security. Several botanical pesticides, green manures, biopesticides, bio-fungicides, and even kitchen and field wastes can be better bases to embrace organic agricultural system. Thus, in agrarian countries like ours, where integrated crop-livestock farming system is still in practice, organic agriculture or biodynamic agriculture is best among the better options. A shift from conventional to organic or biodynamic agriculture, government must need to formulate a rigid plan. A crystal clear, holistic and coordinated approach is necessary in the policy level to facilitate the organic agriculture to the portal of food security. The government should have a concrete set of strategies such as clearly defined objectives, plausible national organic standards, easy certification mechanisms, banned in pesticides import, reliable market and premium price of organic products, define critical zones and hotspots that need organic system as intervention and so on. Adoption of these strategies can lead to a pathway of food and nutritional security and sustainable agriculture rather than woolgathering a better agriculture embracing conventional farming system. It is time for Nepal to adapt to proper organic farming

ACKNOWLEDGEMENT

The authors are grateful and want to emanate cascade of thanks and acknowledge to all friends who supported and providing information for this article.

Conflict of interest

The authors declare there is no conflict of interests regarding the publication of this paper.

REFERENCES

Aatreya, K., Johnsen, F. and Sitaula, B. (2011). Health and environmental costs of pesticide use in vegetable farming in Nepal. *Environment Development and Sustainability*, 14(4): 477-493.

Adhikari, C. (2005). Proceedings of National Workshop on Organic Agriculture and Food Security (December 13-15). Babarmaahal, Kathandu, Nepal: Nepal Permaculture Group.

Adhikari, J. (2012). Farmers in lurch. Kathmandu: The Kathmandu Post.

Adhikari, J. and Hobley, M. (2011). Everyone is leaving-who will sow our fields? The effects of migration from Khotang district to the Gulf and Malaysia.

Adhikari, P. (2018). An overview of pesticide management in Nepal. *Journal of Agriculture and Environment* , 18, 95-105.

Adhikari, R. (2008). Comparative economics of organic and inorganic carrot production and marketing in Chitwan District of Nepal. Proceedings of International Workshop on Opportunities and Challanges of Organic Production and Marketing in South Asia. Babarmahal, Kathmandu: Nepal Permaculture Group.

Altieri, M. and Nicholls, C. (2005). Agroecology and the search for truly sustainable agriculture. Mexico: United Nations Environment Program.

Aryal, K. and Dahal, K. (2010). Report on the status of organic agriculture in Terai, Nepal. Babarmahal, Kathmandu: Nepal Permaculture Group.

Aryal, S. (2006). Concepts, Status, Prospects and Opportunities of Organic Farming in Nepal. Proceedings of a First National Workshop on Organic Farming , (pp. 27-34). Kirtipur, Kathmandu.

Atreya, K. (2008). Proabilistic assessment of acute health symptoms related to pesticide use under intensified Nepalese Agriculture. *International Journal of Environment Health Research*, 18(3), 187-208.

Atreya, K. and Sitaula, B. (2010). Mancozeb: Growing Risk for Agriculture Commodities, 6(8).

Aziz, M., Ahmad, M. and Nasir, M. (2013). Efficacy of different neem (*Azadirachta indica*) products in comparision with Imidacloprid against English grain aphid (*Sitobion avenae*) on Wheat. International *Journal of Agriculture and Biology*, 15(2): 279-284.

Baidoo, P. and Mochiah, M. (2016). Comparing the effectiveness of garlic (*Allium sativum* L.) and hot pepper (*Capsicum frutescens* L.) in the management of the major pests of cabbage *Brassica oleracea* (L.). *Sustainable Agriculture Research*, 5(2): 83.

Bhandari, D. (2006). Community level organic vegetable production program: an experience of Kathmandu district. Proceedings of a First National Workshop on Organic Farming in Nepal. Kathmandu: Directorate of Agriculture Extension, Department of Agriculture, Government of Nepal.

Bhusal, P. (2005). Problems, Challenges and Opportunities for Sustainable Agriculture and Its Organisational Development In Sharma, G; P B Thapa(Ed). Proceedings of National Workshop on Organic Agriculture and Food Security (December 13-15). Kathmandu, Nepal: Nepal Permaculture Group.

Bisht, K. (2011). An Organic Revolution. ECS Nepal magazine (April 2011). ECS Media Pvt. Ltd., Lalitpur, pp 46-54.

Blaise, D. (2006). Yield, Boll Distribution and Fibre Quality of Hybrid Cotton as Influenced by Organic and Modern Methods of Cultivation. *Journal of Agronomy and Crop Science*,192(4): 248-256.

CBS, C. (2018). The Global Food Security Strategy Nepal Country Plan. Government of Nepal.

Chapagain, B. and Gentle, P. (2015). Withdrawing from agrarian livelihoods: Environmental migration in Nepal. *Journal of Mountain Science*, 12(1): 1-13.

Dahal. (1995). A study on pesticide pollution in Nepal. Kathmandu, Nepal: National Planning Comission, Government of Nepal, in collaboration with International Union for Conservation of Nature (IUCN).

Dawadi, V., Gautam, S. and Thapa, M. (1993). Test of the Efficacy of Some Local Measures Against Pest and Diseases in Vegetable Crops at PAC. Pakhribas Agriculture Centre, Dhankuta.

Delaplane, K.S. Pesticide usage in the United States: history, benefits, risks, and trends. North Carolina Cooperative Extension; 1996.

Deshar, B. (2013). An overview of agricultural degradation in Nepal and its impact on economy and environment. Global *Journal of Economic and Social Development*, 3(1): 1-20.

Devkota, K., Yadav, D., Chaudhary, N., Dangol, D. and Basnet, K. (2006). Influence of spring season crop residueon productivity of rice-wheat cropping system. *Journal of the Institute of Agriculture and Animal Science*, 27: 53-58.

Dhital, S., Rupakheti, D., Tripathee, L. and Sigdel, S. (2015). A review on Status of Pesticides Use in Nepal. *Research Journal of Agriculture and Forestry Sciences*, 26-29.

DoFE, (2014).Labour Migration For Employment Status, Report 2014-15, Kathmandu, Nepal.

Eason, W., Scullion, J. and Scott, E. (1999). Soil parameters and plant responses associated with arbuscular mycorrhizas from contrasting grassland management regimes. *Agriculture, Ecosystems and Environment*, 73(3): 245-255.

Fantke, P.W. (2013). Dynamics of pesticide uptake into plants from system functioning to parsimonious modeling. *Environmental Modelling and Software*, 40: 316-324.

FAO/UNDP. (2003). Agricultural policy and strategy for poverty alleviation and food security. Rome: FAO.

Fening , K., Amoabeng, B., Adama, I., Mochiah, M., Braimah, H., Owusu-Akyaw, M.

and Ekyem, S.O. (2013). Sustainable management of two key pests of cabbage, *Brassica oleracea var. capitata* L. (Brassicaceae), using home made extracts from garlic and hot pepper. *Organic Agriculture*, 3(3-4): 163-173

FiBL. (2013). New Impulses for continued growth. The Research Institute of Organic Agriculture (FiBL) and The International Federation of Organic Agriculture Movements (IFOAM).

FIBL/IFOMA. (2013). The world of Organic Agriculture 2013' Frick and Bonn.

Gaire, K., Beilin, R. and Miller, F. (2015). Withdrawing, resisting, maintaining and adapting: food security and vulnerability in Jumla, Nepal. *Regional Environmental Change*, 15(8), 1667-1678.

Ho, M.-W. and Ching, L. (2008). Mitigatiing Climate Change Through Organic Agriculture and Localized Food Systems. The Institute of Science in Society. London: ISIS Report 31/1/08.

Ibitayo, O. (2006). Egyptian farmers' attitide and behaviour regarding agricultural pesticides: implications for pest risk communication. *Risk Analysis*, 26(4): 989 -995.

IFAD. (2003). The adoption of organic agriiculture among small farmers in latin america and the Carribean-thematic evaluation. International Fund for Agricultural Development(IFAD).

IFOAM. (2005). Retrieved from http://www.ifoam.org/about_ifoam/principles/index.html

IFOAM. (2008). Criticisms and frequent misconceptions about organic agriculture: the counter-arguments.

IFOAM. (2008). Criticisms and frequent misconceptions about organic agriculture. the counter-arguments.

IFOAM. (2012). International Federation of Organic Agriculture Movement.

IFPRI, (2009). Global hunger index. The challenge of Hunger, the focus on financial crisis and gender Inequality. Washington DC: IFPRI.

Joshi, S. (1994). Nepalma Tarkari Balika Mukhya Kiraharu. Khumaltar, Lalitpur: Vegetable Seed Production Project.

Kafle, B., Pokhrel, B., Shrestha, S., Raut, R. and Dahal, B. (2015). Determination of Pesticide Residue in Water and Soil Samples from Ansikhola Watershed, Kavre, Nepal. *International Journal of Geology, Earth And Environmental Sciences*, 119-127.

Kanshakar, V., khanal, N., and Ghimire, M. (2002). Use of Insecticides in Nepal. Kathmandu: Proc. in developing Countries.

Kemabonta, K. and Falodu, B. (2013). Bioefficacy of three plant products as post-kharvest grain protectants against *Stophilus oryzae* Linnaeus (Coleoptera: curculionidae) on stored wheat (Triticum aestivum). *International Journal of Science and Nature*, 4(2): 259-264

Khanal, G.S. (2016). Patterns of pesticide use and associated factors among the commercial farmers of chitwan, Nepal. *Environmental Health Insights*, 10(S1): 1-7.

Khanal, N., Khanal, N., Gurung, G., Thapa, S., Gupta, K. and Sherpa, L. (2006). Mungbean(Vigna radiata) in cereal fallows: Experience of farmers' participatory research and development activities in foothills and Terai of Nepal. Proceedings of 4th International Food Legumes Research Conference (pp. 357-368). New Delhi: Indian Society of Genetics and Plant Breeding.

Khanal, R. (2009). Climate Change and Organic Agriculture. Journal of Agriculture and Environment, 10:116-127.

Koirala, P.K. (2007). Pesticide residues as environmental contaminants in foods in Nepal. *Journal of Agriculture and Environment*, 8: 311-318.

Koirala, P., Dhakal, S., and Tamrakar, A. (2009). Pesticide Application And Food Saety Issue In Nepal. The Journal of Agriculture and Environment, 111-114.

Kramer, S., Reganold, J., Glover, J., Bohannan, B. J. and Mooney , H. (2006). Reduced nitrate leaching and enhanced denitrifier activity and efficiency in organically fertilized soils. Proceedings of the National Academy of Sciences, 103(12): 4522-4527.

Kumar, M., Kumar, S., Prasad, C. and Kumar, P. (2015). Management of gram pod borer, *Helicoverpa armigera* (Hubner) in chickpea with botanical and chemical insecticide. *Journal of Experimental Zoology, India*, 18(2): 741-746

Lear, L. (2002). Silent Spring: the classic that launced the environmental mvement. New York, USA: Houghton Mifflin Company.

Low, F., Lin, H., Gerrard, J., Cressey, P. and Shaw, I. (2004). Ranking the risk of pesticide dietry intake. *Pest Management Science*, 60: 842-848.

Magkos, F., Arvanti, F., and Zampelas, A. (2006). Organic Food: Bying More Safety or Just Peace of Mind? A Critical Review of the Literature. Critical Reviews In Food Science and Nutrition, 46, 23-56.

Maxwell, S. and Frankenberger, T. (1992). Household food security: Concepts, indicators and measurements. New York: UNICEF and IFAD.

Menezes, F. (2001). Food Soverreignty: A vital requirement for food security in the context of globalization. *Development*, 44(4): 29-33.

MoAD. (2014). Kathmandu: Ministry of Agriculture Development.

MOE. (2010). National Adaptation Program of Action to Climate Change. Ministry of Environment, Government of Nepal.

MoF, (2019). Economic survey. Kathmndu, Nepal.

Neupane, F. (1999). Field Evaluation of Botanicals for Insect pest Management of Cruciferous

Niggli, U., Fliebbach, A., Hepperly, P. and Scialabba, N. (2009). Okologie and Landbau, 141: 32-33.

NPC. (2003). The Tenth Plan, Nepal. Singhadurbar, Kathmandu, Nepal: National Planning Commission, Government of Nepal.

Okrikata, E., Mai Bukar, S. and Ali , B. (2016). Economic viability of chilli pepper and neem seed kernel powdered formulations vis-a-vis Sevin dust (85%) in the management of Lepidopterous stemborers on sorghum in North Eastern Nigeria. *Journal of Biology, Agriculture and Health*, 21(6): 99.

Parajuli, S. and Paudel, S. (2019). Eco-friendly Management of Diamondback moth (Plutella xylostella L.) of Cabbage (Brassica oleracea var.capitata) in Nepal. *International Journal of Applied Sciences and Biotechnology*, 7(3): 304-308.

Parrott, N. and Marsden, T. (2002). The real green revolution. Greenpeace Environmental Trust London.

Patel, R. (2009). Food sovereignty: What does food sovereignty look like? . The Journal of Peasamt Studies, 36(3): 663-706.

Paudel, K., Sugimoto, Y., Yamamoto, N., Nishiwaki, A. and Kano, H. (2010). Capital budgeting analysis of organic coffee production in Gulmi District of Nepal. *International Research Journal of Finance and Economics*, 43: 139-148.

Petersen, B., and Snapp, S. (2015). What is sustainable intensification? Views from exports. 46: 1-10. Land Use Policy.

Pimentel, D. and Burgess, M. (2014). Environmental and economic costs of the application of pesticides primarily in the United States. In Integrated pest management (pp. 47-71). Springer, Dordrecht.

Piyasiri, A. and Ariyawardana, A. (2002). Market potentials and willingness to pay for selected organic vegetables in Kandy. Sri *Lankan Journal of Agricultural Economics*, 4: 107-119.

PMRD, (2018). List of registered pesticides in Nepal. Department of Agriculture, Hariharbhawan, Lalaitur.

Pokharel, D., and Pant, K. (2008). Policy concerns in organic farming promotion in Nepal. Proceedings of International Workshop on Opportunities and Challenges of Organic Production and Marketting in South Asia. Kathmandu, Nepal: Nepal Permaculture Group.

PPD. (2014). Survey on National Pesticide Consumption Statistics in Nepal. Harihar bhawan, Lalitpur: Plant Protection Directorate.

PPD. (2015). Annual Progress Report. Hariharbhawa: Plant Protection Directorate.

PQPMC. (2019). List of registered pesticides and pesticide consumption statistics. Plant Quarantine and Pesticide Management Centre.

Pradhan, R. (1988). Indegeneous weeds as protectants against Potato Tuber Moth infestant under farmers' storage condition. Proeeding National Conference on Science and Technology. Kathmandu, Nepal: RONAST.

Pretty, J. (2002). Lessons from certified and non-certified organic projects in developing countries. *Organic Agriculture, Environment and Food Security*, 139 -162.

Raven, P., Berg, L. and Hassenzahl, D. (2008). Environment. John Wiley and Sons Inc.

Reganold, J., Elliott, L. and Unger, Y. (1987). Long-term effects of organic and conventional farming on soil erosion. *Nature*, 330(6146): 6146.

Regmi, B., Paudel, C., Rajbhandari, N., and Hada, N. (2006). Combating desertification process in hills of the Himalayan Region in Nepal through sustainable soil management practices. *Journal of Arid Land Studies*, 15(4): 227-230.

Reicosky, D., Kemper, W., Langdale, G., Douglas, C. and Rasmussen, P. (1995). Soil organic matter changes resulting from tillage and biomass production. *Journal of Soil and Water Conservation*, 50(3): 253-261.

Reijntjes, C., Haverkort, B. and Waters-Bayer, A. (1992). Farming for the future, an introduction to low-external input and sustainable agriculture. London: Macmillan Press Limited.

RI. (2011). The farming system trials celebrating 30 years. USA: Rodale Institute.

Rodale, M. (2010). Organic Manifesto: How organic farming can heal our planet, feed the world and keep us safe. New York USA: Rodale Inc.

Scialababa, N.-H. and Hattam, C. (2002). Organic agriculture, environment and food security. Rome: FAO.

Sen, A. (1981). Poverty and famines: An essay on entitlement and deprivation. Oxford: Clarendon Press.

Shearer, G., Daniel, H., Wanner, D., Kuepper, G., Sweeney, S. and Lockeretz, W. (1981). Crop production costs and returns on Midwestern organic farms. 1997 and 1998's *American Journal of Agricultural Economics*, 63(2): 264-269.

Shrestha, P. (2011). Organic Coffee in Nepal: a situation analysis. Proceedings of the National Policy Dialogue Workshop (March 21, 2011), (pp. 25-28). Kathmandu, Nepal.

Shrestha, P.L. and Pant, K. (2006). Agriculture Extension in Promoting Organic Farming in Nepal. Proceedings of a First National Workshop on Organic Farming. Kirtipur, Kathmandu.

Siegrist, S., Schaub, D., Pfiffner, L. and Mader, P. (1998). Does organic agriculture reduce soil erodibility? The results of a long-term field study on losses in Switzerland. *Agriculture, Ecosystem and Environment*, 69(3): 253-264.

Soil Association. (2002). Organic farming, food quality and human health; a review of the evidence. 87.

Stanhill, G. (1990). The comparative productivity of organic agriculture. 30(1-2): 1-26.

Stolez, M., Piorr, A., Harring, A. and Dabbert, S. (2000). The environmental impacts of organic farming in Europe. Organic Farming in Europe: Economics and Policy, 6: 143.

Subedi, K. (1992). Search for indigeneous green manuring speciesin order to sustain soil fertility (In Nepal) Prabidhi Sangalo. Nepal: Lumle Agricultural Research Centre.

Tittonell, P. (2014). Ecological intensification of agriculture-sustainable by nature. Current Opinion In Environmental Sustainability, 8: 53-61.

Torjusen, H., Sangstad, L., O'Doherty Jensen, K. and Kjaernes, U. (2004). European consumers' conceptions of organic food: A review of available research. Oslo, Norway: SIFO (National Institute for Consumer Research).

Vaidhya, K. (1993). Agriculture Pest Manageent using animal and plant Products. TU, Kathmandu, Nepal: GTZ/GATE Project.

WFP. (2019). WFP Nepal country brief. World Food Program.

Willer, Helga and Julia, L. (2019). The World of Organic Agriculture. research institute of organic agriculture (FiBL), Frick and IFOMA-Organics International. Statistics and Emerging Trends 2019.

Winter, C. and Davis, S. (2006). Organic Foods. *Journal of Food Science*, 71: R117-R124.

Woese, K., Lange, D., Boess, C. and Bogl, K. (1997). A comparison of organically and conventionally grown foods: results of a review of the relevant literature. *Journal of Science, Food and Agriculture*, 74:281-293.

Worthington, V. (2001). Nutritional Quality of organic versus conventional fruits, vegetables and grains. *Journal of Alternative and Complementary Medicine*, 7(2): 161-173.

Yaro, J. (2004). Theorizing food insecurity: Building a livelohood vulnerability framework for researching food insecurity. Norweigean *Journal of Geography*, 58(1): 23-37.