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Prospect of organic agriculture in achieving food security in the least developed countries

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Introduction

The global food production is sufficient to feed its entire population. The world food supply constituted energy supply of 2884 kilocalorie (kcal)/capita/day (FAO, 2019), which is above the minimum threshold of 2100 kcal/capita/day. Despite this global achievement, 821 million people, globally, are estimated to be suffering from hunger and 654.1 million people are severely food insecure. The vast majority of these undernourished people is residing in developing countries comprising more than 23% of the population in Least Developed Countries (LDCs) (FAO et al., 2019). Most of these populations are smallholding farmers, for whom green revolution is out of reach mainly due to their limited financial, physical, and human capital (Halberg et al., 2006). Moreover, green revolution, is often criticized for negative ecological, social and economic effects caused by high use of chemical inputs (Kings and Ilbery, 2012), thus, raising a concern for its sustainability.

New technologies that build on the efficient use of local resources readily available in rural areas of LDCs will be crucial for them to be food secure. Organic Agriculture (OA) is one among such technologies. However, there is scepticism regarding the possibility of its lower yield compared to the external input intensive agriculture (conventional agriculture - CA hereafter) thereby possibly having negative consequences on the global food supply. Despite such scepticism, there are several evidences showing the overall positive impact of OA on global food supply (Badgley et al., 2007). The above-mentioned study grossly divided the countries into developed and developing countries disregarding the severity of the problem in LDCs. Furthermore, LDCs are heavily underrepresented in the prominent meta-analyses comparing the yield between the OA and CA (Badgley et al., 2007; Seufert et al., 2012; Te Pas and Rees, 2014; Meemken and Qaim, 2018). The OA being the technology that relies on local resources, the assessment of its overall impact on food supply in LDCs is crucial in promoting the technology thereby tackling the overarching problem of undernourishment in the region. Therefore, this paper explores a contribution that OA could make in food supply in LDCs, the region dominated by predominantly subsistence farmers, in comparison to developed countries taking reference of Northern America (NA), mainly the United States of America (US) and Canada.

Methodology

Data source: Data on three indicators of energy such as calorie, protein and fat supply (for 1963, 1973, 1983, 1993, 2003 and 2013) as well as production and supply of different categories of food (for 2013) on regional basis were compiled from the FAOSTAT (FAO, 2019). Categorizations of food crops and the region into LDCs are based on Food and Agriculture Organization of United Nations (FAO) categorization. NA is one of the most advance regions in agricultural production practice and a pioneer in agriculture technology development. NA is also the region which has the largest global share in retail sales of OA and is the fastest growing OA food sector in the world (Lernoud and Willer, 2019).

Data analysis: Yield ratios, a ratio of organic to conventional yield, were compiled through several literatures that focus on comparative yield between CA and OA. A total of 902 cases were compiled from mainly from peer-reviewed articles (available on request). This includes 258 cases from LDCs and 644 from NA. The yield ratio observed for LDC i.e., 1.05 for all plant foods is low compared to 1.79 in Africa (Pretty et al., 2006) and 1.8 in developing countries (Badgley et al., 2007). The tendency of comparing the yield of OA with subsistence farming in LDCs could be an important reason for the higher yield ratio in

LDCs. Thus, a lack of scrutiny in selecting the cases for the study is important reason in this overestimation. Following Seufert et al. (2012), the cases in this study were selected carefully. The yield ratio observed for NA is 0.84 for all plant foods. The yield ratio is highly contextual and shows the possibilities of OA attaining or even exceeding the yield of CA. Food production, and food supply and the energy supply are estimated based on the methods and assumptions adopted by Badgley et al. (2007).

Concepts: OA represents the practices that utilize local natural nutrient-cycling process in order to sustain and regenerate the soil quality, thus exclude the use of synthetic chemicals. Examples of such practices could be manures, compost, biological pest control, SRI and etc. CA, on the other hand, is generally regarded as a capital intensive, large-scale agriculture often with monoculture of crops and extensive use of external chemical inputs. It also includes intensive animal husbandry. CA is admired for its contribution on the recent increases in food production, but at the same time concern for its sustainability has been raised due to its adverse impact on environment, society and economy (Kings and Ilbery, 2012).

Results and Discussion

Food crops production and supply situation in LDCs and NA between 1963 and 2013: Food production in LDCs is significantly low compared to NA. The difference is ever increasing in the recent decades despite LDCs achieving relatively higher production growth rate (3.09%) compared to NA (1.76%). Domestic supply of food crops in LDCs throughout the period after 1963 is greater than domestic production. This shows a persistent dependency of LDCs on the imports. A large proportion of the food crops produced in NA (48.5%) is consumed for animal feed and relatively less (13.2%) for the food supply. This indicates that NA is producing food crops not only for domestic food supply, but also for export and feed. A growth in feed use is high in LDCs, specifically at the later decades (8.68% after 1993).

Nutrient supply situation in LDCs and NA between 1963 and 2013: Nutrients supply is consistently higher in NA compared to LDCs. Moreover, nutrient supply is higher than the standard requirement throughout the period in NA. For instance, calorie, protien and fat supply is greater than the minimum threshold of 2100 kcal/capita/day, 50 gm/capita/day and 70 gm/capita/day, respectively (Ritchie et al., 2018). This could be the contributing factor to the overarching problem of malnutrition i.e., obesity in NA. US has the highest obesity among the developed countires, hence, regarded as the important health issue (Finucane et al., 2011). Food waste is another important issue to be considered in NA, which can contribute to curb the need of food supply and easing the pressure in natural resources involved in its production. It is estimated that over 800 kcal/person/day is wasted by the US consumers (Conrad et al., 2018).

In contrast, the average calorie supply in LDCs has reached the standard requirement only in 2013. Consideration of food wastage in the region might result in the short supply of calorie. Supply of protein and fat is still far behind the standard requirement in LDCs. The comparatively higher growth rate of food supply was not translated into a higher growth rate of nutrient supply. The growth rate is merely 0.37, 0.42 and 0.92% for calorie, protein and fat, respectively against 2.64% growth rate of food supply. The high population growth rate in LDCs during these periods is responsible for the low growth rate. Hence, undernutrition is widespread in LDCs.

Share of nutrient supply by different crop categories: Cereal is the single largest source of calorie and protein in LDCs. However, in case of NA, cereals along with vegetable oils, sugar & sweeteners, meat+offal, and milk have an important share in total calorie supply. Similarly, meat+offal, cereals and milk are the important source of protein in NA. In LDCs, second important source of calorie is starchy roots and vegetable oils with the share of 9.5% and 6.8% respectively. Pulses, meat+offal and milk are other sources of protein besides cereals (51.8%) contributing 11.9%, 9.6% and 5.9% share in total protein supply in LDCs. However, vegetable oil is the largest source of fat supply in both NA as well as in LDCs. Other important sources of fat in NA are meat+offal (17.8%) and milk (13.4%), whereas in LDCs cereals, meat+offal, oil crops and milk contribute 15.1%, 13.5%, 9.8% and 8.3% respectively. This shows the high dependence on cereals for all nutrient categories in LDCs. However, in case of NA sources are diversified. Several food items such as sugar & sweeteners, vegetable oils, meat+offal and milk are playing equally important role in nutrient supply. This indicates higher dietary diversity, which is quite crucial in supplying a wide variety of nutrients, in NA.

Food supply estimates from OA: There will be 7% increase in food supply through OA in LDCs. In contrast, 14.4% decline can be expected in NA. It is due to the lower yield ratios in NA. Despite this, OA can sustain the current human population in terms of daily nutrient supply in LDCs as well as in NA. The current food supply in LDCs and NA contributes 2348 and 3664 kcal/capita/day respectively. A calorie supply in LDCs is slightly higher than the standard requirement, whereas in NA the calorie supply substantially exceeds the standard requirement. Improvement in calorie supply from pulses and fruits can be observed in LDCs. The current protein supply in LDCs is 61.3 gm/capita/day, which is just above standard minimum requirement. However, OA is estimated to supply 67.6 gm/capita/day of protein in LDCs. Protein supply through OA in NA would decrease, but still remain above the standard requirement. Fat supply in LDCs is below the standard requirement. OA could contribute in achieving fat supply of 46.5 gm/capita/day, which will still be below the standard requirement. In case of NA, however, fat supply could decrease, but still remain higher than the standard requirement. Hence, all these estimates for calorie, protein and fat suggest that OA has the potential to support the population in both the regions as also claimed by Badgley et al. (2007). Similarly, Muller et al. (2017) reports that OA could be a viable option to feed the world even with less land than CA if combined with reductions of food wastage, and food-competing feed from arable land, and subsequent reduction in production and consumption of animal products.

Organic agriculture and LDCs: Agriculture in LDCs is low-yielding and largely subsistent with the indiscriminate use of external input raising the issue of land and water resource degradation, and food safety. Converting such low-yielding, extensive, and subsistent systems into OA is the most efficient option benefitting poor and small farmers the most (Halberg et al., 2006; Meemken and Qaim, 2018). The extensive use of local resources in OA will have a positive multiplier effect on the local economy. This helps small farmers in LDCs with lack of capital by reducing the dependency on expensive imported inputs thereby reducing the vulnerability to external price shocks as experienced in 2008 (Halberg et al, 2006; UNCTAD, 2011). Similarly, it creates employment to landless people in rural areas, which are relatively cheap labor. Consequently, the production costs of OA will be lower. OA can result in the highest profitability in dry, water-scarce, least developed regions and under uncertainty condition like climate change (Te Pas and Rees, 2014). OA, thereby, improves livelihoods without destroying the natural resources, viability of rural economics or incomes, food self-sufficiency and food security in LDCs.

Challenges: Despite such prospects of OA benefitting the small-scale resource poor farmers in LDCs, there are challenges as well. Such challenges need to be addressed in order to achieve the goal of sustainable agriculture production in LDCs through OA. OA requires the higher knowledge to sustain the anticipated yield. This is more critical in LDCs where smallholder farmers tend to have low level of education and limited access to required training (Meemken and Qaim, 2018). This also greatly demands more research on crop and livestock breeding for OA and their efficient management practices ensuring a sustainable use of natural resources in LDC (Jouzi et al., 2017). Meeting the soil nutrients need upon conversion to OA is another important challenge. This demands for production of adequately high proportion of legumes, which will supply the necessary nutrients through biological nitrogen fixation (Seufert and Ramankutty, 2017). The management of crop rotation and organic matters is crucial in balancing soil nutrients and maintaining the soil fertility in OA system (Jouzi et al., 2017). A large proportion of small farmers in LDCs are not able to receive the premium in absence of certification (Meemken and Qaim, 2018). The access of small scale farmers to certification, and thereby organic market, can be facilitated through the approaches such as group certification via internet control systems or participatory guarantee systems and based on trust, social networks and knowledge exchange. Similarly, management of additional labor required for OA is also an important challenge. This challenge could be tackled by providing the incentives to improve financial competitiveness of OA, which otherwise is taxed by subsidizing CA (UNCTAD, 2011; Eyhorn et al., 2019).

Conclusions and Outlook

This paper is the pursuit to analyze the prospects of OA in achieving food security in LDCs. LDCs can achieve the standard nutrient requirement through OA and help in dealing with the problem of persistent undernourishment in LDCs. However, OA itself being a technology, due effort is needed for its dissemination and adoption by small-holder farmers currently undertaking inefficient traditional agriculture. Similarly, emphasis should also be put on the development of inputs necessary for OA and their sustainable use. Supporting and enhancing OA can directly contribute in many of the 17 Sustainable Development Goals (SDGs). Fostering the demand of OA; incentivizing practices such as OA that contributes to SDGs; and raising legal requirements and industry norms through the coherent policies to make OA more competitive will ease the challenges leading to sustainable agriculture driven by OA (Eyhorn et al., 2019).

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