Sustainable Transformation of Agri-food Systems in South Asia: Opportunities and Challenges

GANGA DUTTA ACHARYA, PhD

Abstract

There is growing recognition that agroecological principles and practices have great potential to sustain our food system by conserving and promoting biodiversity, slowing further warming of the globe, offsetting climate change impacts, and enhancing resilience, without compromising agricultural productivity. Hence, it is argued that agroecological solutions are the viable pathway to transform conventional agricultural and food systems towards sustainability.

Based on the reviews and analysis of the latest relevant literature and discourses, we argue in this article that conventional agricultural development and institutional practices are deeply entrenched by reductionist, positivist tradition and techno-methodological conceptions that poorly accommodate the complex epistemological issues of agroecology, hence are the fundamental barrier for effective promotion of these approaches. For better transformation outcomes requires innovations in agricultural and food system research and development governance- both in the public and private domains, embracing participatory, holistic, and transdisciplinary constructivist approaches.

Keywords: *Agroecology, Greenhouse Gas, Climate Change, Industrial Agriculture, Food Systems.*

1. Background

1.1 Introduction

Agri-food system is conceptualized as the combination of all elements and activities (such as people, environment, institutions, infrastructures, and inputs) related to the production, processing, distribution, preparation, and consumption of food, and the associated outcomes such as nutrition and health, socio-economic status, and environmental conditions (Caron et al., 2018; HLPE, 2014). Agri-food systems are thus the nexus of human welfare, environmental health, and climate change. Poverty, social inequalities, food insecurity, hunger and malnutrition, degradation of

natural resources, loss of biodiversity, and climate change are in fact, connected with the ways we produce, distribute, and consume food (El Bilali, Callenius, Strassner, & Probst, 2019). Therefore, agri-food systems are at the center of socio-economic and environmental challenges of the world.

Agri-food system accounts on an average one quarter of the total anthropogenic greenhouse gas (GHG) emissions which is the main contributor to the global climate change. The production and use of synthetic fertilizer is one of the main features of global agriculture that constitutes the most significant sources of GHG emissions. It is estimated that production of Nitrogen-based fertilizers alone, which are the key pillar of conventional industrial agriculture, is accountable for over 20 percent of GHG emissions connected to agricultural and food system (Dale, 2020), that has triggered global warming and fundamental changes in in the pattern of precipitation and temperature. Climate change-induced natural disasters such as drought, floods, storms, and cyclones cause more than 200 billion USD aggregate economic loss in agriculture and related sectors annually (Arora, 2019). The yield loss in field crops is mainly attributable to the variation in temperature, water stresses and the pests and diseases outbreaks. Livestock yield is adversely affected due to diseases/ pest outbreaks, potential changes in prices of the feed grains due to declining production and decreasing pasture and rangeland productivity caused by the weather variability.

Even though humans could eat more than 2500 plant species, only three major crops: wheat, rice, and maize, are grown extensively constituting the sources of more than 50% of the calories consumed globally (Miguel A. Altieri & Nicholls, 2020). Pushed mainly by the dominant corporate food system and free-trade agreements, food is increasingly commodified, subsuming into the market economy, thereby forcing people to move away from traditional largely a localized, and highly diverse consumption practice to an industrial commodity system of universal mass consumption. This has resulted into a drastic shift in our everyday food habits moving away from having a context-specific, diverse and nutrients-rich diets to homogenous, highly processed, micronutrients-poor, and calorie-dense limited food items (Popkin, Adair, & Ng, 2012).

The ongoing pandemic of the novel corona virus (COVID-19) has further raised serious concerns about the sustainability of current agri-food system configuration across the globe. COVID-19 has profound implications not only on healthcare systems and economy but also on all dimensions of the food system-production, processing, and supplies. The virus containing measures that majority of the countries have adopted such as physical distancing, lockdowns, and restrictions on, transport, physical movements, and the market closures affected food production, processing, marketing, and consumption (Rasul, 2021a). The outbreak itself is connected to the current unsustainable food system that degraded the natural environment at an unprecedented scale (GAFF, 2022).

On the heels of the harsh impacts of the climate emergency as well as the ongoing global pandemic, and widespread poverty and undernourishment problems, a sustainable, vibrant, and resilient food systems capable of meeting the food and nutrition security needs of ever-increasing population has become one of the most important agendas of global development. Along with this, there is growing recognition that agroecological principles and practices have great potential to sustain our food system by conserving and promoting biodiversity, slowing further warming

of the globe, offsetting climate change impacts, and enhancing resilience, without compromising agricultural productivity. Hence, it is argued that agroecological solutions are the viable pathway to transform conventional agricultural and food systems towards sustainability.

1.2 Agroecology and Transformation of Agri-food Systems

In recent years, agroecological approaches are increasingly recognized in the scientific and political discourses, as credible pathways to transform the conventional agri-food systems towards sustainability and resilience (Miguel A Altieri, 2018; Caron et al., 2018; Dale, 2020; Davis, Lipper, & Winters, 2022; Eakin et al., 2017; Fernandez, Goodall, Olson, & Méndez, 2013; S. R. Gliessman, 2014; HLPE, 2019b; Sanderson Bellamy & Ioris, 2017; Weber et al., 2020; Wezel et al., 2020). However, agroecology itself is a dynamic and contested concept and represents diverse perceptions regarding its meaning and the ways in which it can contribute to the sustainability of the agri-food system. As multiple definitions and concepts of agroecology exist, different institutions adopt definitions that reflect their own concerns and priorities. Researchers however generally recognize agroecology as a science, a set of practices and a social movement, applicable to every component of the agri-food-system, i.e., from food production through to consumption and all that comes in between (Miguel A Altieri, 2018; Anderson & Kenan, 2017; FAO, n.d.; Fernandez et al., 2013; S. R. Gliessman, 2014; Wezel et al., 2020)

Agroecology as a science examines and informs functioning of agroecosystems including ecological, biophysical, economic, socio-cultural, and political designs, mechanisms, functions, and relationships of the agri-food system (Akram-Lodhi, 2021). From its roots as a branch of agricultural science, agroecology traditionally focused on ecological processes of food production at a farm unit and hence tended to provide technological support to food production only. However, in later years agroecological analysis includes socio-cultural, economic, and political aspects of food production and consumption, i.e., an ecology of entire food system (Francis et al., 2003; Sanderson Bellamy & Ioris, 2017). With this, the scientific approach of agroecology has essentially become a transdisciplinary and inclusive, focusing on the integrative study of the complex systems of food production, processing, distribution, and consumption.

As a set of agricultural practices, agroecology offers a systemic and holistic ways to improve agri-food system by minimizing the use of synthetic external inputs and high energy, particularly through harnessing natural processes of beneficial interactions among the components of agroecosystems (Akram-Lodhi, 2021; Wezel et al., 2020). Such practices include nutrient recycling, building soil organic matter, enhancing agrobiodiversity and resources, focusing on crop/animal diversity, rotations, and polyculture for enhancing beneficial interaction, promoting native seeds/breeds, and adopting integrated approaches of nutrient management and pest control. Agroecological practices also emphasize on revitalizing small-scale family farms, application of low energy inputs, promotion of indigenous knowledge, institutionalizing collaborative research with the local people/communities, community empowerment, collective actions, and local markets. In short, agroecology as a practice introduces alternative modes of food production, processing, distribution, and consumption particularly by minimizing the use of external inputs and high energy and aims at bringing about broader changes in entire food system towards sustainability with better socio-economic, nutritional, and environmental outcomes (Rosset & Altieri, 2017).

Finally, agroecology as a social movement emerged as a farmer-led, grassroots countermovement against the modern dominant corporate agri-food systems, emphasizing small-scale family farms and localized production and consumption along with the principles of sustainability and farmers' autonomy in food production (Sanderson Bellamy & Ioris, 2017). Agroecological approaches aim at giving voices to those who have traditionally been marginalized and excluded, thereby increasing their access to and control over productive resources and foods they produce.

1.3 Agroecological Principles with Respect to Agri-food System Transformation

Agroecology is a transdisciplinary field that encompasses ecological, socio-cultural, technological, economic, and political dimensions of entire food system. Agroecological approaches as science, practices or movement follow common principles that govern the agri-food systems making them environmentally sound, socio-culturally acceptable, localized, and traditional knowledge-based, economically viable, and politically empowering and justiciable. There is a general agreement globally that the pursuit of social equity and justice, human welfare (food security/ healthy diet and employment) and environmental integrity are three basic features of all agroecological approaches (Eakin et al., 2017).

To make the agroecological approaches distinct and concrete, various scholars and agencies have devised number of principles that guide practices and provide measurable criteria for assessment. The Food and Agriculture Organization of the United Nations (FAO), through a multi-stakeholder's consultative process, first developed and described 10 interlinked and interdependent principles as the salient 'elements' of agroecology that are crucial guideline for the agri-food system transformation towards sustainability (Box 1).

Box 1

The 10 salient elements (principles) of agroecology

1. *Diversity:* promoting and prospering diversities of species, ecological functions, and knowledge, activities, and livelihoods options of various stakeholders of the agri-food systems.
2. *Co-creation and sharing of knowledge, practices, science, and innovation:* fostering participatory processes of knowledge generation, and sharing, through multi-stakeholder engagements including farming communities for mutual learning between science and society. Agroecology aims at blending traditional and indigenous knowledge, producers' and traders' practical knowledge, and global scientific knowledge.
3. *Synergy:* enhancing integration and complementarity among different components of agroecosystems and promoting positive ecological interaction for creating synergies.
4. *Efficiency:* promoting agricultural systems with the necessary biological, socio-economic and institutional diversity and alignment in time and space to support greater efficiency.

5. *Recycling:* using local renewal resources and supporting biological processes that drive the recycling of nutrients, biomass, and water within production systems, thereby increasing resource use efficiency and minimizing waste and pollution.
6. *Resilience:* diversified agroecological systems are naturally resistant to extreme weather events and diseases/pest outbreaks. Similarly, agroecological approaches enhance socio-economic resilience through reducing dependence on external inputs and diversifying and integrating the various components of farm enterprising.
7. *Human and social values:* emphasize human dignity, equity, inclusion, and justice. It aims to empower people to become their own agents of change.
8. *Culture and food traditions:* supports healthy, diversified and culturally appropriate diets based on local tradition and identity, while maintaining the health of ecosystems.
9. *Responsible governance:* strengthening policy and institutional mechanisms to recognize, support, and improve smallholder and peasant producers, ensuring equitable access to land and natural resources.
10. *Circular and solidarity economy:* ensuring proximity and confidence among producers and consumers through a circular and solidarity economy that prioritizes local markets and supports local economic development by creating virtuous cycles.

Adapted from FAO (2018), Wezel et al. (2020)

In an attempt to bringing many different perspectives on agroecological principles together, a report of the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security (HLPE) synthesized a wide range of different publications on the theme and consolidated a list of 13 principles of agroecology HLPE (2019a). These 13 principles are listed in Box 2 below.

Box 2: The 13 consolidated principles of agroecology

• recycling,	• inputs reduction,	• soil health,	• animal health,
• biodiversity,	• synergy,	• economic diversification	• co-creation of knowledge
• social values and diets,	• fairness,	• connectivity	• participation.
• land and natural resources governance,			*Source: HLPE (2019b)*

Apparently, the 13 principles consolidated by HLPE also correspond with one or more of the 10 elements of FAO, except for the 'resilience' and 'efficiency', which are here considered as expected outcomes of the system performance from the application of the agroecological principles rather than being principle itself (Wezel et al., 2020). Even though, the principles of agroecology are seemingly generic in nature, they are

not the standard recipes, or dogmatic approaches, rather they are general guidelines and allow to generate diversities of locally adapted practices applicable to contextual circumstances. Therefore, there are number of different farming practices that can broadly be considered as ecological, such as biodynamic, community-based, eco-agriculture, ecological, environmentally sensitive, extensive, farm-fresh, free-range, low-input, organic, permaculture, sustainable, and wise-use etc. (Pretty, 2006).

2. Agroecological Transformation of Agri-Food Systems: Potential and Challenges

2.1 The Framework for the Agroecological Transformation of Agri-food systems

S. Gliessman (2016) conceptualizes a five-level framework of agroecological transitions of the conventional agri-food systems for sustainable outcomes, which is also taken up by the High-Level Panel of Experts on Food Security and Nutrition (HELP) commissioned by the UN Committee on World Food Security (HLPE, 2019b). We use this framework (Table 1) to analyze the current status, prospect, and challenges of the agroecological transformation of agri-food systems in South Asia.

Table 1: Framework for Agroecological Transition of Agri-food systems

Change process	Transitional goals	Corresponding agroecological principles	Applied to
Transformational	**Level 5:** **A new global agri-food system** - localized, inclusive, equitable and justiciable	participation, social values and diets, fairness, land and natural resource governance and connectivity. ⇑ Co-creation and sharing of knowledge, practices, and innovations ⇓	Agri-food System
	Level 4 **Closing gaps between producers and consumers** through development of alternative food networks (localized food markets, short food chain, participatory guarantee systems)		
	Level 3 **Redesign agroecosystems** (promoting diversities, and integration)		
Incremental	**Level 2** **Employ sustainable alternatives** to the conventional practices (inputs, and technologies)	nutrient recycling, enhancing soil health/ animal health, inputs reductions, promoting diversities, economic diversification, and synergy.	Agroecosystem
	Level 1 **Increasing resource-use efficiency** within the existing conventional inputs/practices		

The food system transformation framework devised by Gliessman is seemingly a linear and deterministic, however, in practice the transformation process is not straight forward, rather it involves non-linear, contextual, and messy process. Therefore, the transitional changes as specified in various levels of the framework should not be understood as unfolding successively and neatly, rather the changes may start at any point and the interventions and improvements may occur simultaneously at different levels (Anderson, Bruil, Chappell, Kiss, & Pimbert, 2021). Thus, this framework offers flexibility of analysis depending upon the contextual situations.

The Level 1 and 2 of the transition pathways, tend to be incremental and is primarily limited to the production domains, while the level 3, 4 and 5 involve transformational process and cover the entire food system including production, processing, marketing, and consumption.

2.2 The South Asian Agri-food Systems: current status, transformation potential, challenges, and ways forward

Current Status

South Asia (Afghanistan, Bhutan, Bangladesh, India, Maldives, Nepal, and Sri Lanka) is the region of impressive socio-cultural, environmental, and agricultural diversities. The region has a broad range of topographic variation from high mountains, hills, valleys, to lowlands, river basins, coastal plains and most importantly the Indo-Gangetic area which is the world's largest alluvial plain of fertile soils deposited by the river flood waters. As with the topographic diversities the region has wide variation in climatic conditions from humid tropics in the lowlands to cool temperate climate in the highlands.

The region holds less than 3.5% of the world's land area but provides home to a quarter of the global population, and hence is the most densely populated region of the world (Enamul Haque, Mukhopadhyay, Nepal, & Shammin, 2022; FAO, IFAD, UNICEF, WFP, & WHO, 2021; Xue et al., 2021). Moreover, it is one of the poorest regions bearing one-third of the world's poor, with about 70% of them living in rural areas and depending primarily on agriculture (Rasul, 2021b; Rasul et al., 2021).

With just 5% of the global agricultural land, South Asian farmers feed nearly a quarter of the world's population (Rasul, 2021a). Around 65% of the population in South Asia lives in rural area and depend upon agriculture and allied sectors for their livelihoods (Bhandari & Meah, 2021). Moreover, agriculture continues to drive a significant share of the economy in South Asian countries even though contribution of the sector to the national GDP is declining over the years. In 2020, the contribution of the agricultural sector to GDP was the highest in Afghanistan, (26.82%) among 8 South Asian countries, followed by Nepal (24.3%), Pakistan (22%), India (16%), Bhutan (15.8%), Bangladesh (12.7%), Sri Lanka (7.4%), and Maldives (5.2%) (Aryal, Rahut, Thapa, & Simtowe, 2021). The region has predominance of small size farm holdings (less than 2 ha).

South Asia accounts for about 30% (170 million) of the global landholdings (570 million), and 85% of them are small size family farms with less than 2 ha, which supply 75% of the food in the region (Bhandari & Meah, 2021; Herrero et al., 2017). Women already constitute 60% workforce of the farming in South Asia, there is increasing trend of outmigration of the working age males from villages towards city centers and abroad leading to growing evidence of the feminization of agriculture in the region (Meah & Puskur, 2021). However, women farmers across the South Asia have been constrained by severe challenges in

accessing productive resources, training, and other extension support services due to deep-seated gender-based inequalities pervasive in the region.

For the last six decades, agricultural policies and programs in South Asia, as elsewhere have greatly been influenced by green revolution (GR) strategies for productivity growth that promoted rapid intensification of farming through excessive use of irrigation, synthetic fertilizers, agrochemicals, and high yielding varieties. There has been enormous constellation of policies, and institutions dedicated to promoting and maintaining economic and policy environment for massive extension of green-revolution technologies for more than six decades, now. Research, studies, and development with respect to this mainstream approach have been generously financed by many of the corporate institutions such as the World Bank and are producing and disseminating highly accessible policy and practice documents worldwide, and thus the knowledge domains of agri-food system have overwhelmingly dominated by green revolution narratives.

The GR strategies have been successful in dramatic increase of yield of major staples particularly wheat, maize, rice, and potatoes. During the period of 1960-2000, developing countries across the globe including South Asia, achieved an impressive growth in the yields of major field crops- wheat 208%, rice- 109%, maize-157%, and potatoes-78% (Pingali, 2012). Consequently, overall, food production has been doubled in most of the South Asian countries in last five decades, and hence are now food surplus in the narrow sense that food availability in the region exceeds the current demand (Meah & Puskur, 2021; Pradhan, Warchold, Schönlau, & Kropp, 2021). However, pervasive poverty and systemic inequality, structured mainly by class, caste, ethnicity, and gender as well as the globalization have resulted into an unequal access to this abundance forcing almost 50% of the regional population deprived of basic food security today. In 2020, nearly 850 million people in the region (almost 158 million more than that of the previous year) have been reported moderately or severely food insecure; and more than 30% of the children below 5 years of age have been stunted due to malnutrition (FAO et al., 2021; WHO, 2020). Even though stunting rates have declined significantly over the years in South Asia, the region still bears more than one third of the global burden (Gillespie et al., 2019).

To sum up, the agri-food system in the South Asia has been facing intertwin challenges of climate change threats along with long-standing development obstacles such as widespread chronic poverty, socio-economic inequalities, limited productive resources, population growth, resources degradation, and poor infrastructure.

Transformation Potential: challenges and ways forward

South Asia is overwhelmingly dominated by smallholder farmers as more than 85% of the South Asian farm households operate in less than 2 ha of agricultural land (Bhandari & Meah, 2021; Herrero et al., 2017), which are basically the family farms. It is noteworthy that the green revolution technologies were unsuitable for the millions of smallholder farmers operating in the complex and risk-prone agroclimatic conditions and hence, are practicing the locally adapted indigenous farm practices which are by default ecological in nature. The family farms in general have better environmental and ecological impact, as they favor genetic, species and land use diversity in the given agricultural landscape and are managed with fewer resources (González, León, & López-Estébanez, 2022).

Moreover, though in small scale and scattered, agroecological approaches have

been consciously promoted by civil society organizations, farmers' cooperatives, and associations, and some of the external development partners in many parts of the South Asian region even in the era of massive swing of green revolution. However, there is dearth of substantial documented cases of the adoption of agroecological practices in this region with adequate depth and details.

This paucity is understandable as alternative discourses to green revolution strategies such as agroecology generally confined to the academic circles with limited popular reach and impact. It is only in the recent years that the limitations of the green revolution model of development have surfaced to common parlance with the greater attention of policy makers and other stakeholders along with increasing calls for the sustainable development.

It is noteworthy that the smallholder farmers in the hinterlands generally have limited access to modern extension support services, inputs, and technologies and hence they operate without using costly external inputs. They use the natural processes of nutrient recycling, mixed farming, green manuring, composting, and other indigenous means to maintain the farm productivity. This type of compulsive practices, though are the bliss for sustainability, are not the conscious interventions for the deliberate transformation. For example, when the rural areas are linked with the urban centers, the commercial prospects of farm products push the smallholder farmers 'to produce more' by using high yielding varieties/breeds, and external inputs as like in conventional industrial mode of farming, fueling the unsustainable use of land, water, and resources. In commercial production pockets of peri-urban areas rampant use of synthetic fertilizers, pesticides, and irrigation water can be seen in South Asia as else elsewhere. It is noteworthy that without conscious interventions, the poor and ignorant farmers may avoid using costly external inputs but are not able to reduce other means of environmental degradation such as soil erosion, pollution, and overuse of water.

Hence, there is urgent need to institutionalize deliberate efforts to protect and prosper the unspoiled farmlands of the smallholder farmers in the hinterlands, hills, and rainfed areas of the South Asia for the sustainability transformation. Agroecological approaches variously called as 'alternative', 'sustainable', 'natural', 'low-input', 'low-external-input', 'regenerative', 'holistic', 'organic', 'biointensive', 'biological' etc. (Thompson & Scoones, 2009, p. 392), have been practiced in many parts of the region. All of them, representing thousands of farms and farming environments, are niche innovations that share a vision of 'farming with nature' and promote biodiversity, protect soil from erosion, conserve water, use minimum tillage, and integrate crop and livestock enterprises on the farm units. In later years, government agencies of the region- India, Sri Lanka, Bangladesh, Pakistan, and Nepal have also emphasized to promote variety of these approaches. There is huge potential of optimizing and extensively promoting many of these locally adapted agroecological farming practices for sustainable transformation of the agri-food systems in South Asia.

Level 1 and/or 2 of the Gliessman's transition framework may serve as the entry point for this process. Conscious application of the agroecological principles of nutrient recycling, enhancing soil health/animal health, inputs reductions, promoting economic and ecosystem diversities, and building synergy should be done through massive sensitization campaigns, appropriate technology development and technical support services.

Almost all of the agroecological research so far are limited to technical aspects of

agricultural science and cover the principles which are related to 'increasing efficiency' of the conventional inputs/practices (related to Level 1 goals) and developing locally adapted 'sustainable alternatives' required for achieving level 2 transitional goals. Therefore, future agroecological research needs to focus more on socio-cultural, economic, and political dimensions of the agri-food systems, adopting a holistic perspective.

Moreover, the agricultural research and development practices in South Asia as elsewhere are deeply entrenched by reductionist, positivist tradition and techno-methodological conceptions which is the fundamental challenge to agroecological transformation. The institutional practices are characterized by having a top-down, linear, paternalistic, clientelist, and demobilizing relationship among agricultural scientists, farmers, and other stakeholders. The conventional metrics of performance measurements value only the direct output i.e., the yield, without considering the environmental costs and benefits.

Contrary to this, agroecological approaches demand a distinctly different approach of research and extension, where farmers and local stakeholders take central role in defining research problems and developing solutions alongside the agricultural and social scientists and other stakeholders. They use different- holistic metrics, new framework of performance measurement. Therefore, conventional agricultural research and development institutions require massive reforms to include interdisciplinary/ transdisciplinary, participatory approaches and holistic and constructivist perspectives in their operations so as to address the complex epistemological issues of agroecology in practice. For better transformational outcomes, greater institutional capacities for articulating technical as well as socio-cultural and political dimensions of agri-food systems should be developed.

One of the basic features of agroecology is the 'community agency' that has foundation on the primary producers' resistances of the mainstream agri-food systems that are environmentally damaging and controlled and shaped by the corporate interests. However, conventional alarmist discourse of 'feeding the increasing population' is so powerfully ingrained among the policymakers and other stakeholders that the 'community agency' is often compromised with the continuous emphasis on 'productivity' limiting it into the narrow sets of technological solutions to address merely the sustainability crisis of the conventional agri-food systems. Overcoming such a threat of cooptation and insidious appropriation of agroecology by the mainstream actors is fundamental for effective transformation.

Therefore, conscious efforts on building the agency of primary producers, and their organizations and promoting grassroots collective action should be the priority of agri-food policies and programs.

3. Conclusion

This article reveals that agroecology offers plausible pathways of transformation of conventional agri-food systems towards an inclusive, sustainable, and resilient food systems. However, there are still some pertinent conceptual as well as structural issues that constrain the wider acceptability of agroecology as a means of sustainable future among the policy makers.

Participation and co-creation and sharing of knowledge are the key to agroecological approaches where farmers and local stakeholders take central role in defining research problems and developing solutions alongside the agricultural and social scientists and other stakeholders.

However, there has been a critical challenge for the conventional agricultural scientists to appreciate indigenous knowledge and expertise and bring them into the center of the innovation processes.

Thus, for better transformational outcomes, it requires novel innovations in agricultural and food system research and development governance- both in the public and private domains. Furthermore, it requires greater institutional capacities for articulating technical as well as socio-cultural and political dimensions of agri-food systems, and for transdisciplinary associations with grassroots movements that are defying at various scale hegemonic corporate ideas of agri-food systems across the world while offering sustainable alternatives.

References

Akram-Lodhi, A. H. (2021). The ties that bind? Agroecology and the agrarian question in the twenty-first century. *The Journal of Peasant Studies, 48*(4), 687-714. doi:10.1080/03066150.2021.1923010

Altieri, M. A. (2018). *Agroecology: the science of sustainable agriculture*: CRC Press.

Altieri, M. A., & Nicholls, C. I. (2020). Agroecology and the reconstruction of a post-COVID-19 agriculture. *The Journal of Peasant Studies*, 47(5), 881-898. doi:10.1080/03066150.2020.1782891

Anderson, M. D., & Kenan, W. R. (2017). Agroecology: A Transdisciplinary, Participatory and Action-Oriented Approach, by V. Ernesto Méndez, Christopher M. Bacon, Roseann Cohen, and Stephen R. Gliessman. *Agroecology and Sustainable Food Systems*, 41(9-10), 1191-1193. doi:10.1080/21683565.2017.1358962

Arora, N. K. (2019). Impact of climate change on agriculture production and its sustainable solutions. *Environmental Sustainability, 2*(2), 95-96. doi:10.1007/s42398-019-00078-w

Aryal, J. P., Rahut, D. B., Thapa, G., & Simtowe, F. (2021). Mechanisation of small-scale farms in South Asia: Empirical evidence derived from farm households survey. *Technology in Society, 65*, 101591. doi:https://doi.org/10.1016/j.techsoc.2021.101591

Bhandari, H., & Meah, N. (2021). Strengthening the multidimentionality of family farming to promote social innovations contributing to territorial development and food systems that safeguard biodiversity, environment and culture in South Asia. In R. B. Shrestha, P. Ferrand, M. E. Penunia, M. Dave, & Y. Ali (Eds.), *UNDFF 2019-2028: Regional action plan to implement the UNDFF for achieving SDGs in South Asia* (pp. 195-209): SAC, Dhaka, FAO, Rome, AFA, Philippines, ICA-AP, India.

Caron, P., Ferrero y de Loma-Osorio, G., Nabarro, D., Hainzelin, E., Guillou, M., Andersen, I., . . . Verburg, G. (2018). Food systems for sustainable development: proposals for a profound four-part transformation. *Agronomy for Sustainable Development, 38*(4), 41. doi:10.1007/s13593-018-0519-1

Dale, B. (2020). Alliances for agroecology: From climate change to food system change. *Agroecology and Sustainable Food Systems, 44*(5), 629-652.

Davis, B., Lipper, L., & Winters, P. (2022). Do not transform food systems on the backs of the rural poor. *Food Security.* doi:10.1007/s12571-021-01214-3

Eakin, H., Connors, J. P., Wharton, C., Bertmann, F., Xiong, A., & Stoltzfus, J. (2017). Identifying attributes of food system sustainability: emerging themes and consensus. *Agriculture and Human Values, 34*(3), 757-773. doi:10.1007/s10460-016-9754-8

El Bilali, H., Callenius, C., Strassner, C., & Probst, L. (2019). Food and nutrition security and sustainability transitions in food systems. *Food and Energy Security*, 8(2), e00154.

Enamul Haque, A., Mukhopadhyay, P., Nepal, M., & Shammin, M. R. (2022). South Asian stories of climate resilience *Climate Change and Community Resilience* (pp. 1-7): Springer, Singapore.

FAO. (2018). *The 10 elements of agroecology: Guiding the transition to sustainable food and agricultural systems*. Retrieved from Rome.

FAO. (n.d.). Agroecology Knowledge Hub. Retrieved 17 April 2022

FAO, IFAD, UNICEF, WFP, & WHO. (2021). *The State of Food Security and Nutrition in the World 2021: Transforming food systems for food security, improved nutrition and affordable healthy diets for all* (Vol. 2021). Rome, Italy: Food & Agriculture Organization.

Fernandez, M., Goodall, K., Olson, M., & Méndez, V. E. (2013). Agroecology and Alternative Agri-Food Movements in the United States: Toward a Sustainable Agri-Food System. *Agroecology and Sustainable Food Systems*, 37(1), 115-126. doi:10.1080/10440046.2012.735633

Francis, C., Lieblein, G., Gliessman, S., Breland, T., Creamer, N., Harwood, R., . . . Poincelot, R. (2003). Agroecology: The Ecology of Food Systems. *Journal of Sustainable Agriculture, 22*, 99-118. doi:10.1300/J064v22n03_10

GAFF (2022). Untapped Opportunities for Climate Action: An Assessment of Food Systems in Nationally Determined Contributions., from Global Alliance for the Future of Food https://futureoffood.org/wp-content/uploads/2022/03/assessment-of-food-systems-in-ndcs.pdf

Gillespie, S., Poole, N., van den Bold, M., Bhavani, R. V., Dangour, A. D., & Shetty, P. (2019). Leveraging agriculture for nutrition in South Asia: What do we know, and what have we learned? *Food Policy, 82*, 3-12. doi:https://doi.org/10.1016/j.foodpol.2018.10.012

Gliessman, S. (2016). Transforming food systems with agroecology. *Agroecology and Sustainable Food Systems, 40*(3), 187-189. doi:10.1080/21683565.2015.1130765

Gliessman, S. R. (2014). *Agroecology: the ecology of sustainable food systems*: CRC press.

Herrero, M., Thornton, P. K., Power, B., Bogard, J. R., Remans, R., Fritz, S., . . . Havlík, P. (2017). Farming and the geography of nutrient production for human use: a transdisciplinary analysis. *The Lancet Planetary Health, 1*(1), e33-e42. doi:https://doi.org/10.1016/S2542-5196(17)30007-4

HLPE. (2014). *Food losses and waste in the context of sustainable food systems*. Retrieved from Rome.

HLPE. (2019a). Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. *High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security: Rome, Italy*.

HLPE. (2019b). *Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition*. Retrieved from Rome.

Meah, N., & Puskur, R. (2021). Role of research and innovation in transforming food systems in South Asia. *Geography and You, 21* (1).

Pingali, P. L. (2012). Green Revolution: Impacts, limits, and the path ahead. *Proceedings of the National Academy of Sciences, 109*(31), 12302-12308. doi:doi:10.1073/pnas.0912953109

Popkin, B. M., Adair, L. S., & Ng, S. W. (2012). Global nutrition transition and the pandemic of obesity in developing countries. *Nutrition Reviews, 70*(1), 3-21. doi:10.1111/j.1753-4887.2011.00456.x

Pradhan, P., Warchold, A., Schönlau, V., & Kropp, J. (2021). *Status and trends of food security in South Asia*.

Pretty, J. (2006). *Agroecological approaches to agricultural development*. Retrieved from Rasul, G. (2021a). A Framework for Addressing the Twin Challenges of COVID-19 and Climate Change for Sustainable Agriculture and Food Security in South Asia. *Frontiers in Sustainable Food Systems, 5*. doi:10.3389/fsufs.2021.679037

Rasul, G. (2021b). Twin challenges of COVID-19 pandemic and climate change for agriculture and food security in South Asia. *Environmental Challenges, 2*, 100027. doi:https://doi.org/10.1016/j.envc.2021.100027

Rasul, G., Nepal, A. K., Hussain, A., Maharjan, A., Joshi, S., Lama, A., . . . Sharma, E. (2021). Socio-Economic Implications of COVID-19 Pandemic in South Asia: Emerging Risks and Growing Challenges. *Frontiers in Sociology, 6*. doi:10.3389/fsoc.2021.629693

Rosset, P. M., & Altieri, M. A. (2017). *Agroecology: science and politics*: Practical Action Publishing.

Sanderson Bellamy, A., & Ioris, A. A. R. (2017). Addressing the Knowledge Gaps in Agroecology and Identifying Guiding Principles for Transforming Conventional Agri-Food Systems. *Sustainability, 9*(3), 330.

Weber, H., Poeggel, K., Eakin, H., Fischer, D., Lang, D. J., Wehrden, H. V., & Wiek, A. (2020). What are the ingredients for food systems change towards sustainability?—Insights from the literature. *Environmental Research Letters*, 15(11), 113001. doi:10.1088/1748-9326/ab99fd

Wezel, A., Herren, B. G., Kerr, R. B., Barrios, E., Gonçalves, A. L. R., & Sinclair, F. (2020). Agroecological principles and elements and their implications for transitioning to sustainable food systems. A review. *Agronomy for Sustainable Development*, 40(6), 40. doi:10.1007/s13593-020-00646-z

WHO. (2020). *The state of food security and nutrition in the world 2020: transforming food systems for affordable healthy diets* (Vol. 2020). Rome, Italy: Food & Agriculture Organization.

Xue, J., Rasool, Z., Nazar, R., Khan, A. I., Bhatti, S. H., & Ali, S. (2021). Revisiting Natural Resources—Globalization-Environmental Quality Nexus: Fresh Insights from South Asian Countries. *Sustainability, 13*(8), 4224.

https://www.fao.org/agroecology/home/en/

(Ganga Dutta Acharya, PhD is the Senior Program Specialist (Priority Setting and Program Development), SAARC Agriculture Centre, Dhaka, Bangladesh. Email: ganga1971@yahoo.com)