Shifting from Industrial Agriculture to Diversified Agroecological Systems in China

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Reclaiming Diversity & Citizenship

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Executive Summary

China's ability to continuously increase food production has always been portrayed as one of its greatest achievements. Since 1961, when the great famine ended, China's total grain output has grown almost four-fold. However, while these productivity gains have been made through the industrialisation of agriculture, the environmental, health and socio-economic outcomes have been less impressive.

Modernisation of agriculture has forged a dependence on chemicals throughout China. Excessive and inefficient use of synthetic fertilisers is contributing to greenhouse gas (GHG) emissions, while high pesticide use is affecting the health of Chinese farm workers and rural communities. Industrialised agriculture depletes and pollutes soils and aquifers and the focus of the specialised industrial food system on uniformity and profitability in a few select crops and animals is leading to permanent loss of biodiversity. Meanwhile, the process of agro-industrialisation and its inherent mechanisation leads to the displacement of farmers and farm workers from rural communities to urban centres. The loss of power of smallholders is further aggravated by incentives from the state that favour large scale and industrialised producers.

In spite of these environmental and social challenges, this report argues that China is in a unique position globally to become a leader in the development of agroecology. Although China is becoming a world leader in green economy fields such as solar power, despite the many initiatives on the ground, the greening of its food system is given less attention. The report adapts the systems framework of the 2016 IPES-Food Report *From Uniformity to Diversity* to the Chinese context to identify the roadblocks in transitioning to a more ecological agriculture in China. It shows how building on existing policy initiatives, investment in and promotion of agroecology for multiple benefits could improve the security and sustainability of China's food system.

What's stopping China from leading the world in agroecological agriculture?

A key contribution of this research report is its examination of the eight lock-ins of industrial food systems (as put forward by the IPES-Food report) within the Chinese context. These eight lock-ins put to rest the naive notion that we can rely on the market to self-correct for sustainability. Forces deeper and more powerful than public purchasing power limit the effectiveness of attempts to simply steer farmer supply through consumer demand. The drivers of some of the lock-ins are similar in China to other countries revealed in the IPES-Food report. The influence of other lock-ins on the agrifood system, such as the concentration of power, are more specific to China and are highlighted below. The following four lock-ins demonstrate distinctive features in China, compared to the dynamics revealed in the IPES-Food report.

Lock-in 3: The expectation of cheap food

Rapid urbanisation in China has resulted in Chinese consumers becoming accustomed to the abundance of cheap food. The low price of food has made eating out and ordering food from online platforms daily routines for busy urban workers. The demand for cheap food is further enhanced by the rapidly increasing demand for animal products, particularly pork and dairy products in China. Livestock production drives the expanding monoculture of soybeans and imports of animal products.

Lock-in 4: Compartmentalised thinking

In the compartmentalised mindset, agriculture is treated merely as an activity to produce profitable food commodities rather than a resource for people's livelihoods and an inseparable part of the ecosystem. People and ecosystems involved in agriculture, as a consequence, are reduced to inputs into a linear system. The compartmentalisation in policy making also renders China's food policy lacking in systematic and inclusive strategies. Food security policies at the national level, for example, are biased towards agricultural outputs and the rural context, with limited attention on other key components of food security, such as sustainability of food access and food utilisation.

Lock-in 6: Feed the world narratives

The 'feed China' narrative, although different from the 'feed the world' narrative, has become a political mission and a catalyst for China's agroindustrialisation. For example, food policies demonstrate an orientation to promote the standardised industrial farming model in order to scale up the agricultural sector. Government agendas for farmland protection send clear messages about the central focus on quantity of food production, although food quality has gradually been incorporated into the policy. While there is no doubt that producing enough food should be a top priority, this productivity-centred narrative, which defines China's primary food policies, goes hand in hand with industrial agriculture. It justifies the continuation of the industrial agricultural system, deflects attention from its consequences, and sidelines the discussion of the latent benefits of diversified agroecological systems. It fails to answer the question of how food could be produced and better distributed to everyone, particularly marginalised groups with limited resources, in a way that enhances farmer livelihoods, public health, social well-being, equity and justice.

Lock-in 8: Concentration of power

The concentration of power in the Chinese context is reflected in the rise of agrarian capitalism and the powerful state within the agrifood sector. The involvement of both public and private capital in agriculture and beyond fosters the development of large-scale industrial agriculture, the consolidation of the seed industry and the vertical integration of small farmers in the modern food supply chain. Despite these consolidation trends, unlike the situation in other countries where corporate power predominates in the food sector, the power within China's agrifood sector is still dispersed to a great extent, reflected in the large number of producers, traders and retailers involved.

Turning opportunities into action: recommendations for moving towards diversified agroecological systems in China

Our research found many opportunities and nascent initiatives to foster diversified agroecological systems in China. These opportunities stimulate a reflection of the consequences of the industrial food system and its supportive policy system in multiple ways. However, the Chinese Government's continued promotion of the standardised industrial farming model, with the consequence of eliminating smallholders and scaling up the agricultural sector, is a significant threat to the continued growth of ecological agriculture. The following recommendations could help strengthen the growing move towards agroecological systems in China:

Reconceptualise 'modern agriculture' in the policy and educational realms

Agricultural modernisation has been a key national development priority in China for decades. The central tenets of modern agriculture has long been focused on efficiency and productivity, with limited recognition of agriculture sustainability. With the central government's promotion of 'ecological civilization' as a national strategy since 2007, it is now urgent to integrate agroecology in the narratives and interpretations of modern agriculture.

Rediscover the value of agroecology in achieving developmental goals

The values of agroecological practices include but are not limited to reducing poverty in remote areas, reducing pollution, enhancing the 'ecological civilization' goal, contributing to social stability by addressing food safety issues, creating jobs and so on. Ecological agriculture should not be confined to a means of safe food production for a niche market.

Build on the diverse ways in which agroecological practitioners are experimenting to overcome the crisis of trust in the food system

Ecological farms are attempting to re-build consumers' trust not only through market mechanisms such as eco-labels, but also increasingly through relational mechanisms, building personal connections with local government, rural community, local peasants, local suppliers, and consumers (partly because of low trust in labels). Given that food safety is one of the top concerns of Chinese citizens, promoting these mechanisms beyond small farms will strongly boost public awareness of agroecology practices, consolidating public support for the transition towards diversified agroecology.

Understand farmers' roles in the agroecology transition

Besides the various studies of consumers in organic food market, farmers' roles in ecological agriculture development also deserve more attention in research and policy making. Little attention has been given to values, ideological challenges, and the roles of farmers' values in agroecology transition.

Explore opportunities for farmer participatory research and plant breeding

The rich experience of farmer participatory research from both China and other countries should be leveraged with more policy support. In addition, it is important to explore opportunities for exchanges and visits, such as bringing Chinese stakeholders to attend international events (e.g., organised by Food Secure Canada, the National Farmers' Union, Canadian Organic Growers, and the Guelph Organic Conference) and bringing foreign stakeholders, not only researchers, to share experiences.

Enhance market oversight and credibility of certification systems while increasing farmer training and consumer education for ecological agriculture

It is vital to make certification a viable option for more farmers. That being said, a more fundamental problem is the deterioration of trust in the certification system. It is also important to support farmer training and consumer education for ecological agriculture so that farmers comply better with the certification requirements and consumers understand better the meaning of certification.

Support innovative ways to attract farmers and other people back to the land

The urbanisation process has drained human resources from the countryside and thus created a favourable environment for industrial agriculture. It is therefore urgent to make land more accessible for people who are interested in farming. Providing equal support to new farmers in the ecological agricultural sector will greatly enhance their competency and viability.

1

How do the outcomes of industrial agriculture and diversified agroecological systems compare in China?

1.1 Outcomes of industrial agriculture

As a vital component of the notions of progress and development in contemporary China, the industrialisation of agriculture in China can be traced back to as early as the 1950s when the nation started to adopt agricultural machinery. Medium-sized and large machines were used on the collective farmland in communes, while more flexible and smaller machines have been used in agriculture since the establishment of the Household Responsibility System (HRS) in the early 1980s. By 2015, ploughing, sowing and harvesting had been mechanised on 63% of China's farmland and the Chinese government aims to expand this to 68% in 2020 (Yan 2016). Although the share is still low compared to highly industrialised countries, the increase since the 1950s is stunning.

Alongside the growing percentage of mechanised farming is the increasing use of synthetic fertiliser. The total amount increased four-fold, from 13 million tonnes in 1980 to 55.6 million tonnes in 2010 – an average annual growth rate of 5%. On average, the amount of synthetic fertiliser applied to each hectare of farmland in China is four times the global average (Luan et al. 2013). Similar to the growth of synthetic fertiliser, the use of chemical pesticides and herbicides is also on the rise. China is the world's largest producer and exporter of pesticides, as well as the second largest consumer (Zolin et al. 2017). Its pesticide use accounts for half of the world's total consumption (Pretty and Bharucha 2015). The total amount of chemicals used increased annually by 7.4% from 1991 to 2013. The dose of chemicals used (per area of farmland) in China is 2.5 times the world average (Chen et al. 2016).

In addition, the development and commercialisation of hybrid seeds since the late 1970s has transformed the agricultural sector. The increasing marketisation and consolidation of the seed industry in recent years has reduced the number of domestic seed companies from more than 8,600 in 2010 to 5,064 in 2014 (Wu 2016). Together, these 5,064 companies produce 70% of seeds sown in China. Although the seed industry is still far more diversified than in most countries of the Global North, there are strong pressures to continue this consolidation. While almost 100% of corn, hybrid rice and canola seeds were commercialised and little space is left for traditional seed saving practices, China has become the world's second largest seed market (Ma 2017). The vegetable seed market, although much more diversified compared to the market for staple grains, is also beginning to commercialise (Xu 2017). The commercialised seed market allows the more rapid expansion of new crop varieties, but also leads to "the loss of native seed varieties adapted to local growing conditions and tastes, and the loss of traditional knowledge associated with them" (IPES-Food 2016: 27).

Livestock production in China is also not being left out of the industrialisation process. Driven by Chinese middle-class consumers' growing appetite for meat, or the so-called 'eating meat in revenge' for past scarcity (MacDonald and Iyer 2011), the production of meat in China has experienced a dramatic change from small-scale household production to capital and resource-intensive factory farming (Schneider 2015). The production of pork – the most widely consumed meat in China – is a case in point: pig rearing has long been a side project of small-scale farming; it not only converts food waste from the farm and kitchen into an important source of protein that supplements the grain-based diet, but it also produces manure for sustainable crop farming. However, the incidence of household pig farming has declined rapidly since the early 2000s (Jian 2010; Schneider 2011). Large swine farms are rapidly replacing small-scale household pig rearing, consolidating the growing power in both China's food system (Schneider 2015) and the global food market (Sharma 2014). Pigs, previously seen as a valuable, multifunctional asset of rural households, are being transformed into a commodity that feeds into China's agro-industrialisation agenda. The situation is similar in the poultry and dairy industries, although developments in each of these sectors have unique underlying dynamics. The dairy industry, for instance, experienced dramatic changes after the melamine milk scandal in 2008, with a sharp decline of consumer trust in domestic dairy producers and a strong push from the state to scale up and consolidate the sector, in the belief that industrialisation would overcome the food safety challenge (Sharma and Zhang 2014).

1.1.1 Productivity outcomes

The most obvious positive outcome of agricultural industrialisation is the significant increase in production. Studies have pointed out that despite the overall decrease in China of cultivated farmland since the early 1990s, total output has experienced a significant increase thanks to productivity gains (Huang and Zhu 2014). Figure 1 shows that since 1961, when the great famine ended, China's total grain output has grown almost four-fold. The use of synthetic fertiliser is estimated to contribute nearly 21% of the increase of yield (Fang and Meng 2013, Wang et al. 2015b). It is estimated that in 2012, almost 19% of grain output was saved from pests by using pesticides and other pest control approaches (Chen et al. 2016). It is also estimated that for every round of renewal of commercial seeds of major staple grains in Chinese agricultural sector, which has happened roughly every ten years in the past few decades, there has been a more than 10% increase in yield (Gao et al. 2013).

The increase in production driven by industrialisation is also reflected in the meat sector. Today, China produces five times the volume of pork produced in the United States or half of the world's pork (Schneider 2017). It is also the world's second largest producer of poultry meat and eggs (Horowitz et al. 2014). China's dairy production has also been greatly boosted by scaling up production, vertically integrating small dairy producers and importing foreign breeds and feed (Sharma and Zhang 2014).

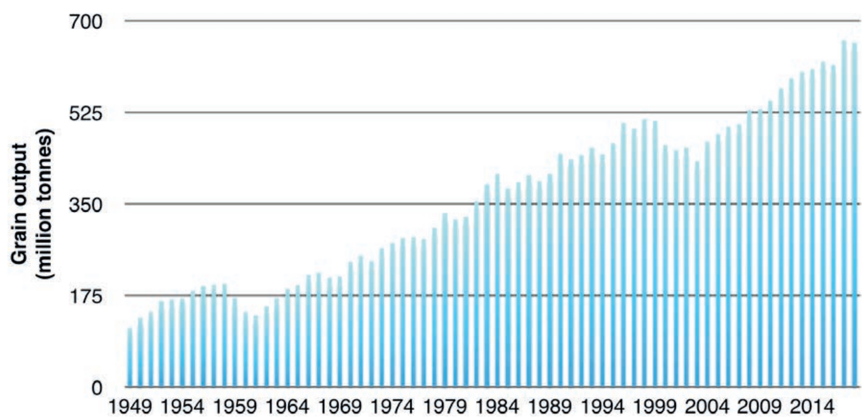


Figure 1. China's total grain output, 1949 to 2018 (in million tonnes)
Source: China National Statistical Reports

Despite the widely reported increase of total output and yield from using more synthetic fertiliser and pesticides, the contribution of chemical fertiliser inputs to yield increase has declined in recent years (Fang and Meng 2013, Wang et al. 2015b). This is because the amount of chemcial fertilisers being used by crops could not increase continuously alongside the increase of chemical fertilizers applied to the field. Meanwhile, the growth rate of grain output has lagged behind the growth rate of grain-based livestock feeds, driven by China's increasing meat consumption. The growing grain output does not really relax China's heightened food security situation.

Industrial monoculture farms in Heilongjiang (Photo credit: Xiaoping Sun)

Instead, just as is commonly experienced in many other countries, the industrialisation of China's agricultural sector has resulted in a series of negative environmental, socio-economic, nutrition and health outcomes, as discussed below. It is thus urgent to balance the food security and sustainability challenges (Lu et al. 2015a).

1.1.2 Environmental outcomes

China's great achievement of feeding more than 1.3 billion people has come at an environmental price that can hardly be ignored. The environmental consequences include land degradation and soil erosion, pollution of soil and water resources, greenhouse gas emissions from nitrogen fertiliser and livestock, and the destruction of the ecological balance (IPES-Food 2016). These consequences result from relying on various unsustainable agricultural inputs that have been widely employed in China since the late 1970s (Han 1989), including the excessive use of synthetic fertiliser and pesticides, the unsustainable intensive exploitation of soil and water resources, as well as the animal waste that pollutes the water system.

One of the major outcomes of the industrialisation of China's agricultural sector is its land use and land cover change, which is closely associated with farmland degradation. The expansion of large-scale industrial food production through land reclamation in the corn belt and soybean production base of Northeast China since the 1980s has contributed to severe soil erosion, and the decline of soil fertility and depth of the black top soil (Wang et al. 2009, Gong et al. 2013). It was estimated that the alarming rate of soil degradation in this area will destroy the 930,000 ha of cultivated black soil in 30 to 50 years (Sun 2009). Soil degradation is not limited to Northeast China, however; as one 2014 news report suggested, more than 40%

of all arable land in China was suffering from land degradation (Patton 2014). The degradation of farmland associated with intensive farming implies high economic costs for the country (Deng and Li 2015), and casts doubt on the claimed ability of industrial agriculture to sustain China's food self-sufficiency. Industrial systems of agriculture, although responsible for the degradation, fail to provide a convincing solution to the urgent need to restore these degraded lands (IPES-Food 2016).

The exploitation of natural resources in agro-industrialisation is also implicated in the depletion of groundwater resources. Alongside industry and mining, irrigation is a major contributor to the pollution and depletion of unrenewable aquifers in many regions of China, particularly the North China Plain where intensive agriculture activities take place (Feng 2016, Kong et al. 2016). Kong et al. (2016) found that the intensive irrigation on the North China Plain has led to a decline of groundwater levels at a mean rate of 0.46 ± 0.37 metres per year for the shallow aquifer and 1.14 ± 0.58 metres per year for the deep aquifer. Although a national investigation of the condition of groundwater pollution has been conducted since 2005 by the central government, the results have been kept a secret. No official report has been released. However, a separate report found that 41% of monitored groundwater sites were polluted (Li, 2013).

The degradation of farmland induced by both natural systems and human interventions might not be as strong a reason to question the whole industrial system as the scale of soil and water pollution from industrial agriculture. Scholars have found that the marginal increase of productivity contributed by nitrogen fertiliser has been declining and the use of nitrogen fertiliser has far surpassed the optimal level (Zhu and Chen 2002). A striking fact is that only 30% of synthetic fertiliser applied to fields in China has been utilised by crops, compared to more than 40% in many developed countries (Yang 2012), and the crop utilisation rate is declining (Fang and Meng 2013). This nutrient imbalance is a consequence of the excessive usage of nitrogen and phosphorous fertiliser that is common in China. The other unutilised 70% of fertiliser has evaporated into the atmosphere, infiltrated into the groundwater and flowed to the river system, causing soil acidification (Guo et al. 2010), as well as air and water pollution (Vitousek et al. 2009, Strokal et al. 2016). Nitrogen and phosphorous cycles are among the nine planetary boundaries identified by Rockstrom et al. (2009).

The excessive use of synthetic fertiliser, particularly nitrogen fertiliser, is also contributing to climate change by releasing greenhouse gases (nitrate and gaseous N compounds such as ammonia, nitrogen oxide, and nitrous oxide) to the atmosphere. The greenhouse gas emission from the production, transportation and application of nitrogen fertiliser constitutes 8% of total GHG emissions in China (Zhu and Chen 2002, Kahrl et al. 2010, Cheng and Shi 2010). This is added to the increasing emission from the livestock industry in the form of carbon dioxide, methane and nitrous oxide (Liu and Zhang 2011, Schneider 2011). According to Caro et al. (2014), China is the largest overall emitter of both pig and sheep GHG emissions, which contributed to 30% and 25% of the world's pig and sheep GHG emissions respectively.

The pollution of air, water and soil is worsened by the overuse of pesticides. The substantial increase in the use of pesticides since the early 1980s in China is leading to a dependence on pesticides in the agricultural sector, particularly in southeast and central China (Li et al. 2014, Zhang et al. 2015). Hu and Rahman (2016) argue that the modernisation trajectory of agriculture and rural China has forged a dependence on pesticides. This dependence has resulted in some widely recognised environmental problems including soil, water and atmospheric pollution, lost soil microbial diversity, ecological imbalance, food safety concerns, and potential health risks (Pimentel and Lehman 1993, Chen et al. 2016, Hu et al. 2015, Jacobsen and Hjelmsø 2014, Lu et al. 2015b, Zhang et al. 2011a,b). Yet, published studies of the environmental impacts of the current use of pesticides in China are limited, with most studies focusing on legacy pesticides such as DDT and HCH, two highly toxic and persistent pesticides heavily applied in China before they were banned in 1983 (Li et al. 2014, Zhang et al. 2011a). Pesticides use per unit of farmland in China is estimated to be twice the global average. Rising pest resistance to pesticides is stimulating further use of pesticides (Lu et al. 2015b).

Agro-industrialisation also significantly reduces agro-biodiversity (loss of traditional and wild animal breeds and crop varieties) through the introduction and commercialised mass production of a limited number of animal breeds and plant varieties. This in turn erodes the potential for sustainable food security (Long et al. 2003). Studies of traditional agricultural practices in various contexts suggest that they effectively conserve agro-biodiversity and nurture a sustainable human-nature relationship (Dorresteijn et al. 2015). For thousands of years, the locally adaptive traditional farming systems in China have successfully managed the rich genetic resources in agriculture (Liu et al. 2013). Yet, these sustainable models of agriculture have been replaced by mass production of a few select, commercially profitable breeds and crops. As a consequence, China has experienced a significant loss of genetic agro-biodiversity in the past three decades. For example, it was estimated that the varieties of wheat extensively cultivated in China have decreased from more than 10,000 in the 1950s to about 400 in the 2000s (UNDP/GEF and MFPRC 2005). The genetic loss is not only confined to crops and farmed animals. Studies have found that the reclamation of wetlands in the Northeast China Plain is contributing to the degradation of wild genetic pools (Song et al. 2014), which jeopardises crucial ecosystem services. The lack of pollinators on China's farms is also a consequence of the ecological degradation (Goulson 2012).

1.1.3 Health and nutrition outcomes

One argument in defence of the health impacts of specialised industrial food systems is the greater selection of fresh food items available year-round. Yet, as the IPES-Food report argues, "the diversity of produce delivered by international trade has mainly benefited wealthy consumers in high-income countries, while poor people in low-income countries continue to be unable to afford the diversity available on these markets (Sibhatu et al., 2015)" (IPES-Food 2016: 27). The IPES-Food report offers governments and civil society important insights from the literature into the links between specialised industrial food systems and chronic ailments increasingly associated with affluence and the mass-produced, heavily processed foods that characterise contemporary affluent societies. These include cancer, diabetes, arthritis, heart disease, high blood pressure, depression, obesity, and other conditions that are diet-related.

At the same time, the industrial food system reduces the dietary diversity required to avoid malnutrition, resulting in a growing number of people in the US and other regions reliant on heavily processed, meat-rich diets suffering simultaneously from the health impacts of both obesity and malnutrition. A diverse and balanced traditional diet provides exposure to the anti-oxidant, anti-cancer, and other beneficial properties of various nutrients and non-nutrients such as fiber, but only if people can access these foods. The following Figure in the IPES-Food Report (2016: 28) depicts how malnutrition persists in industrial systems, despite gains made in calorie production resulting from the wide adoption of agrochemical use within farming systems worldwide and due to the Green Revolution specifically.

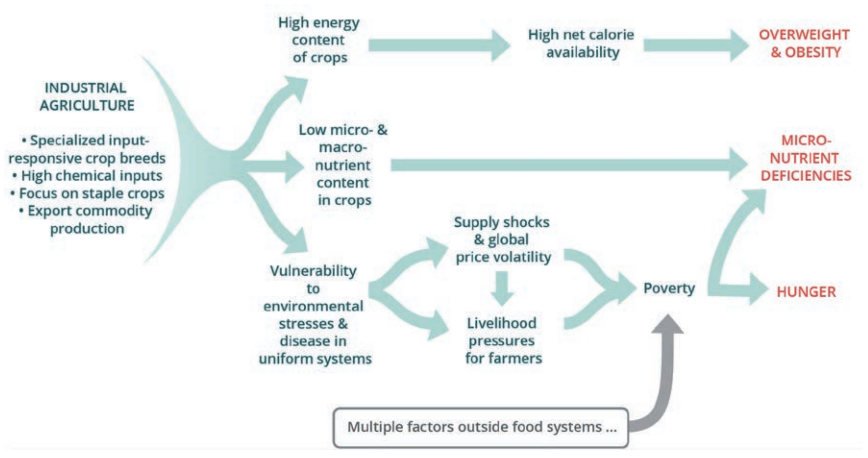


Figure 2. How malnutrition persists in industrial systems
Source: Figure 7 from IPES-Food (2016: 28)

This lack of diversity does not in any way diminish the role socio-economic conditions play in determining healthy diets. Not only are people with lower incomes likely to eat fewer fresh foods and less produce (i.e., fresh vegetables and fruits) generally than more affluent fellow citizens, but they also experience the well-documented impacts of food scarcity. These life-long health impacts affect not only quality and length of life, but also the quality of life of future generations.

Numerous studies have demonstrated the correlation between exposure to pesticides and heavy metal residues in food and health problems confronting both farmers and consumers (Li et al., 2008). On the producer side, both long-term and short-term adverse health impacts of pesticide exposure among farmers have been found in three provinces of China (Hu et al. 2015). Zhang et al. (2011b) found that 8.8% of farmers in China suffered various degrees of pesticide poisoning. Exposure to pesticides has also generated significant less visible but serious impacts on farmers' neurological, liver and kidney systems (Qiao et al., 2012).

In addition, the residues from the overuse of pesticides and veterinary drugs have food safety risks that are side effects of the intensive agriculture system. Researchers have found that soil degradation resulting from intensive farming makes heavy metals more bioavailable to crops (FORHEAD, 2014). The accumulation of heavy metals through crop production has resulted in severe health risks; for example, there is a higher incidence of cancer among residents exposed to heavy metal pollution in many parts of China (e.g. Zhao et al. 2014). 'Cancer villages', where cancer morbidity is high due to exposure to carcinogenic chemicals, are found across China, particularly in major grain-producing regions (Lu et al. 2015b). The large-scale intensive production of livestock and aquaculture also fosters the excessive use of veterinary drugs, including antibiotics. This leads to severe long-term health risks because it contributes to the genetic selection of antibiotic resistant bacteria and renders ineffective some commonly used drugs to combat diseases in both human and livestock (FORHEAD 2014).

The expansion of the agro-food industry has contributed to the dietary transition in China since the early 1980s, leading to public health problems such as the growing prevalence of overweight and obesity (Garnett and Wilkes, 2014; Hawkes, 2008). This is partly due to the introduction in China of fast food chains from the West that encourage the over consumption of energy-rich food (Astrup et al., 2008). Studies in many parts of the world suggest that the industrialisation of agriculture encourages the over density of energy and the reduction of diversity in people's food intake (IPES-Food 2016: 27-29). Yet, there have not been many studies on the nutritional consequences of the agro-industrialisation in China, other than those which show the significant improvement of food security.

1.1.4 Socio-economic outcomes

The socio-economic outcomes of agro-industrialisation are just as significant as the ecological and environmental outcomes described above. One of the commonly discussed social outcomes is the marginalisation of smallholders. The multiple but generally negative connotations of peasants in discourses in modern China, such as their economic underdevelopment, low sociopolitical status and cultural backwardness, have been used to justify and shape policy trajectories, known as *feinonghua* (非农化), that aim to reduce the number of small peasants and promote the penetration of capital in the agricultural sector (Schneider 2015). Therefore, the process of agro-industrialisation in China is accompanied by a marginalisation of smallholders, either by transforming them into urban citizens or supporting their vertical integration[1] into the industrial farming system as farm workers. The rise of dragon-head enterprises[2] (*longtou qiye*) in agriculture and contract farming backed by external capital are dispossessing peasants of their farming autonomy. Smallholders' loss of power is further enhanced by the biased state support schemes that favour large-scale and industrialised producers (Scott et al., 2014).

Despite the fact that agro-industrialisation has had environmental consequences and led to a food safety crisis, the blame is always laid on smallholders for their "low quality" (*suzhi*) and lack of modern knowledge and skills in farming; this is evidenced in Schneider's (2015) study of China's pork industry. The marginalisation of smallholders, therefore, is portrayed in developmental discourses as a necessity to modernise the agricultural sector and solve the many crises that plague the current food system and rural China. However, global experience demonstrates that the real requirement for labour input, always considered as a major advantage of industrial agriculture, is debatable (IPES-Food 2016: 24). Just as has been observed in many other countries, Chinese rural workers pushed out of agriculture can not always find decent alternative employment. Despite a recent surge in labour shortages in cities, the surplus of labour in rural areas persists as a significant socio-economic problem, due to the institutional constraints (e.g., restrictions on accessing medical care, having children attend local schools) of living in cities (see Knight et al. 2011). The prosperous informal sector in China in the past two decades also reflects the significance of the problem (Cooke 2011).

Another issue related to the industrialised agrifood system is China's increasing reliance on food imports. This has become particularly obvious since China's integration into the global market after joining the World Trade Organization (WTO) in 2001. Since 2004, China's imports of the major cereals have increased sharply alongside its further integration into the global food market. While

1 Vertical integration in the agricultural sector refers to the integration of smallholders into modern food supply chains through various organization structures of agrifood companies. In a common scenario, the company would assemble a group of smallholders to form a production base, provide inputs and instructions on farming and sell their produce to the modern food value chain. The land is usually leased to the company and smallholders are hired as farm workers.

2 "Dragon-head enterprises" is a designation only bestowed upon large-scale industrialized agrifood companies or farmers' cooperatives by the Chinese government. To get this title, the companies need to meet certain thresholds of investment, turnover, profits, market share, taxes paid, growth rates, and so on. Agricultural dragon-head enterprises are considered by the government to be one of the major approaches for agriculture modernisation and thus have received tremendous governmental support in multiple forms. See Schneider (2017).

maintaining a high self-sufficiency rate of 95% has been a state priority since it was announced at the 1996 World Food Summit, the increase in imports of staple grains (corn, rice and wheat) has outweighed exports since 2010, leading to a continuous decrease in the self-sufficiency rate (ABARES 2014). One news report indicated that China's overall self-sufficiency in staple grains, including soybean, declined to below 87% in 2014 (Li, 2014; see also Figure 3).

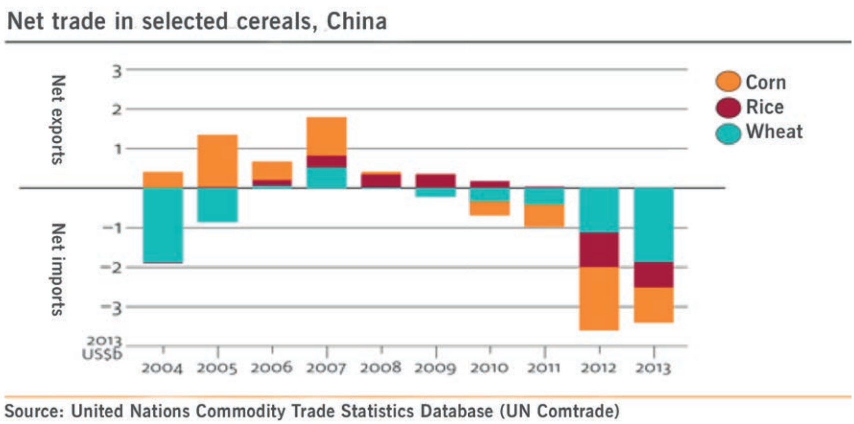


Figure 3: China's net trade in selected cereals
Source: ABARES (2014)

In 2016, only 32% of the cooking oil consumed, 44% of which was soybean oil, was produced domestically (Grain and Cooking Oil Market Newspaper 2017). The increase in food imports has put pressure on domestic food production—the increasing imports of foreign grains are not due to the shortage of domestic production, but because of the much cheaper price of foreign grain that is heavily subsidised (Alpha 2015). This is mirrored in the decline of soybean production in northeast China. Domestic soybean production has been losing its market share to cheaper imported soybeans since 2004. By 2015, 80% of China's soybean consumption was based on imports, creating heightened anxiety around food sovereignty (Jamet and Chaumet 2016).

1.2 Outcomes of diversified agroecological systems

The most widely used definition of agroecology is "the application of ecological concepts and principles to the design and management of sustainable agroecosystems". (Gliessman 1998:13) Recent development of agroecology enriches the concept to incorporate multiple dimensions such as the interactions between human natural systems (Dalgaard et al. 2003) and the ecology of the entire food system, encompassing ecological, social and economic dimensions (Francis et al. 2013). Food and Agriculture Organization of the United Nations (FAO) (2018: 2) points out that agroecology is "based on bottom-up and territorial processes, helping to deliver contextualised solutions to local problems. Agroecological innovations are based on the co-creation of knowledge, combining science with the traditional, practical and local knowledge of producers. By enhancing their autonomy and adaptive capacity, agroecology empowers producers and communities as key agents of change." Agroecological systems provide opportunities for farming communities and localised food systems to benefit from the co-production of locally valuable nutritionally important crops and commercially valuable financially important crops.

In the agroecological model, lower stocking densities combined with a mixed farm approach ensure that the faeces and urine from farm animals can be absorbed in the compost cycle of the farm or region. Using these inputs reduces the need for chemical fertilisers, increases soil organic matter and raises carbon sequestration efficiency. Diverse crops encourage diverse soil micro-biomes, and inter-cropping helps to both reduce pest issues and the need for irrigation. In addition, greater biodiversity ensures greater resilience to shocks to a single crop. Water and soil are spared contamination by agro-chemicals, and soil-building techniques leave the land in better shape than it was found.

Agroecology offers a pathway forward in an uncertain climate and resource-depleted future. Röckstrom et al. (2009) presented the nine "planetary boundaries" as a way to conceptualise the trans-national nature of our current vulnerabilities for sustaining life. Carbon dioxide and other greenhouse gases (GHGs) are not the only concern industrial agriculture raises. Nitrogen flow, biodiversity loss, phosphorous flow, freshwater consumption, chemical pollution and of course agricultural land use are planetary boundaries identified by Röckstrom et al. and implicated in our food system. The acceleration towards, and in three cases beyond, the planetary boundaries mirrors the rise of industrialised food systems.

In addition to the bio-physical value of agroecology, it also has an important socio-economic element, which is reflected in the conceptualization of planetary boundaries. In 2014, Kate Raworth added significant value to the Stockholm Resilience Center's (i.e., Röckstrom et al.) modelling to contextualise the nine planetary boundaries in an economics model called "Donut Economics". Raworth updated this mapping of social foundations onto Röckstrom's nine planetary boundaries (renamed ecological ceiling) by identifying indicators—such as access to food, water, and shelter—below which we lack the societal stability to provide the governance and economic capacity needed to address the ecological limits identified as planetary boundaries (see Figure 4).

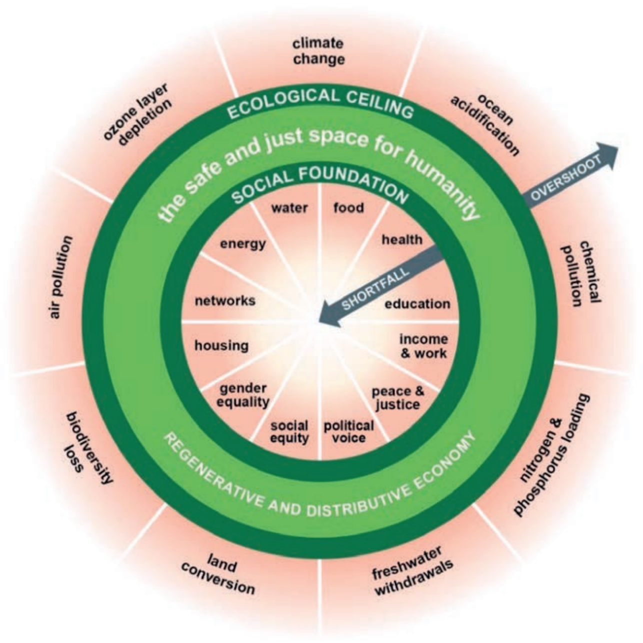


Figure 4. The doughnut of social and planetary boundaries
Source: Raworth (2017)

Diversified agroecological systems mitigate both a) the impacts of industrialised agriculture on the ecological ceilings for each of the nine criteria; and b) the negative impacts on the social foundation of industrial food systems.

The IPES-Food Report (2016) is contextualised in this view of economics, which recognises if there is to be an economy, social foundations must be intact without exceeding the ecological ceilings that ensure the continuation of life. The IPES-Food Report offers a comprehensive, data-rich, interdisciplinary critique of industrial food systems and the costs associated with the industrial model based on decades of research on the costs and benefits of industrialisation. What is of most importance in the report, however, is the detailed discussion of the value of diversified agroecological systems for meeting the modern challenges facing Chinese farmers and society more broadly.

1.2.1 Productivity outcomes

Productivity measured as commercially viable grain yield per acre misses the important "health per acre" perspective introduced by Shiva and Singh (2011), in which the nutritional value of intercropped species and the input costs are considered when determining how productive a given year was on a farm. When total outputs – and not just crop-specific outputs – are considered, diverse agroecological systems outperform industrial agriculture in terms of productivity (IPES-Food 2016: 31). The IPES-Food report provides an excellent review of the literature on productivity. It includes studies showing total output productivity positively correlated with the number of intercropped species. In particular, the studies reviewed suggest intercropped plots average 15% higher outputs over monocultures, while producing 1.7 times more harvested biomass.

With its large population, China is particularly interested in the issue of productivity. In the Chinese context, the productivity of ecological agriculture is a highly controversial issue that generates intensive debates. Previous studies have also found that scepticism surrounding the productivity of ecological agriculture is common among various stakeholders and, according to some, is one of main reasons that the Chinese Government does not fully support the development of organic agriculture (Scott et al. 2014). Despite the controversy, only a few researchers have studied the productivity of ecological agriculture in China. Jiang Gaoming, from the China Academy of Sciences, is one of them. His experimental organic farm, Hongyi Farm, was established in Shandong Province in 2006. After three years of restoring soil fertility with organic compost, he claims that the productivity of maize is 14.5% higher than in a conventionally farmed field (Jiang 2015).

1.2.2 Environment outcomes

In diverse agroecological systems, synergistic relationships are at the centre of pest management improvements, reducing reliance on and therefore exposure to a host of agrochemicals and undisclosed ingredients found in commercial formulations. The IPES-Food Report highlights the rice-duck systems found throughout Asia as an example of this synergism for pest control. Rice-fish farming is also commonly recognised as a sustainable farming system. In these systems, the ducks or fish eat weeds, weed seeds, insects and pests while their excrement fertilises the soil. This food chain reduces the need for manual weeding and chemical fertiliser. Chinese peasants have been practising rice-fish and rice-duck farming for more than 1000 years. Many studies by Chinese scholars demonstrate the various environmental benefits of the rice-fish and rice-duck farming system. For example, Lu and Xi's 2006 study shows that the rice-fish farming system significantly reduces the use of pesticides and chemical fertiliser. It increases the organic matter, total nitrogen and phosphorus in the soil by 15.6–38.5%. Compared to traditional rice farming, the rice-fish farming system also reduces the emission of methane (CH4) by nearly 30%. Similar results are found in a study by Liu et al. (2015) of the GHG emissions from a Chinese ecological farm, which shows that replacing chemical fertiliser with organic manure significantly decreases GHG emissions. A 2014 study by Zhen et al. in eastern China also demonstrates that the application of compost and bacterial fertilisers improves the microbial community structure and diversity of degraded cropland soils.

1.2.3 Health and nutrition outcomes

Diversified agroecological systems improve ecological and human health in a number of ways. Shifting away from a handful of species in the diet increases the range and quality of nutrients, ensuring that seasonality does not affect the consistent availability of key nutrients. The IPES-Food Report references several studies linking agricultural diversity and nutrient diversity in various regions, noting that mixed farming systems provide diverse nutrients for producers and consumers, and demonstrating that agrobiodiversity leads to positive human health outcomes through both dietary diversity and quality. Aside from improved nutrition through dietary diversity, studies show that health and nutrition outcomes are improved compared to industrial farming simply through reduced exposure to pesticides and other chemicals used in agriculture. There are also studies demonstrating that specific nutrient densities are improved with organic management. This is the case with omega-3 fatty acids, which are around 50% higher in organic milk and meat than in conventional equivalents (IPES-Food 2016: 39-40).

Due to the high level of anxiety over food safety in recent years, the health and nutrition of daily food consumption is becoming an increasingly important issue for Chinese citizens (Lu et al. 2015b; Si et al. 2018). We have seen a growth in popularity of organic and other certified ecologically produced food in Chinese market (Scott et al. 2018). Many studies have pointed out that health is a key factor driving Chinese consumers' purchase of organic food. A study by Si et al. (2018) in Nanjing city shows that the chemical residues in food is perceived as the major problem of food safety. More than 40% of customers buy organic and ecologically labeled food for food safety reasons. Agroecology therefore has a great potential to become more prominent in China's transitioning food system.

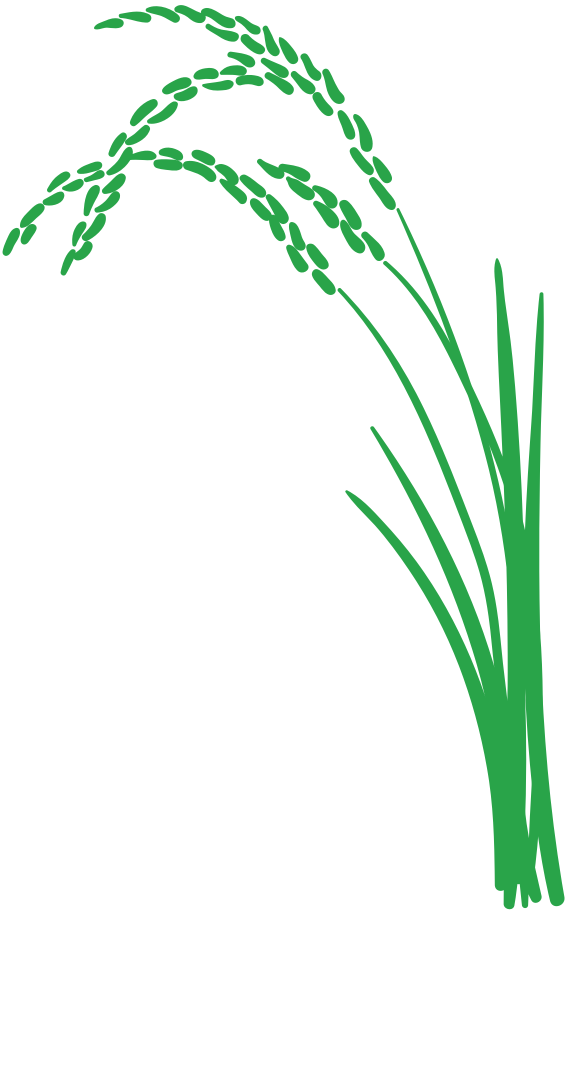
1.2.4 Socio-economic outcomes

There has been limited study of the socio-economic outcomes of diversified agroecological farming practices in China. From an economic standpoint, the crop diversification at the heart of agroecological food systems provides for year-round production and therefore income generation. The socio-economic benefits of agroecology also go well beyond the farm gate. Agroecology encourages economic diversity, which the International Institute for Environment and Development describes as crucial for livelihood resilience (Silici 2014). Diversification is a form of farmer self-insurance.

Not only does this diversity protect against losses – it also seems to be good business. The IPES-Food report concludes that despite lower yields, organic agriculture can be significantly more profitable (22–35%) than conventional agriculture, and many recent converts to organic are doing so to capture high-value markets. A study by Wang et al. (2003) points out that the direct economic benefits of the integrated rice-duck complex system is higher than conventional paddy fields. Studies also identify that diversified agroecological systems can reduce the economic risks associated with natural disasters (IPES-Food 2016: 37-38). For example, a review of the rice-fish farming system in China finds that as well as providing food and animal protein for subsistence farmers living in ecologically-fragile mountainous areas, the rice-fish farming system also reduces the economic risks that these farmers potentially face (Lu and Li 2006).

Agroecological food systems are also good for employment. The IPES-Food report references several studies that identify agroecological systems as being more labour-intensive. Organic agriculture has the potential to provide 30% more jobs per hectare than conventional farming (IPES-Food 2016). Greater employment both on farm and throughout the agroecological system (localised processing, distribution and preparation) can produce cohesive rural communities, install pride in young people engaged in skilled artisanal food production, and improve food security by re-skilling workers in traditional agroecological practices and systems-based science.

2



What is keeping industrial agriculture in place in China?

The comparison of specialised industrial agriculture and diversified agroecological systems in the Chinese and global context demonstrates the remarkable potential of the latter system to alter the various negative outcomes of the industrialised system. In recent years, agricultural sustainability and its critical role in fostering rural development have received increasing attention by the Chinese Government. Yet, specialised industrial agriculture still prevails and its dominance overshadows the potential benefits of the agroecological system. This situation demands a closer examination of the factors that are keeping industrial agriculture in place in the Chinese context. Building on the IPES-Food report, this section explores eight major factors "locking-in" industrial agriculture in China. These include factors associated with political structures, agriculture markets, and conceptual barriers. These lock-ins need to be broken if a transition towards diversified agroecological systems in China is to be achieved in the future.

Lock-in 1: Path dependency

Industrial agriculture in general demands large investments in high-cost agricultural inputs, machinery and large-scale facilities specifically designed for specialised production. Because farmers have already invested in specialised equipment for their systems, transitioning is unlikely. In China, the situation is different due to the fact that its agricultural sector is still dominated by over 200 million small farming households and more than 90% of them farm less than 10 mu (2/3 hectare) of farmland (National Bureau of Statistics 2017). A key justification of large-scale specialised food production is the rising cost of labour as temporary migration from rural areas to cities and from agriculture to other sectors gathers pace. This socio-economic transition has led to the reduction of agricultural inputs, particularly labour, that has garnered attention among agronomy researchers (Li and Tonts 2014). The reduction of inputs is reflected in Jiang et al.'s (2019) research findings that from 1990 to 2015, more than 2.5 million hectare of rice field in south China converted from double cropping to single cropping. The reduction of labour and other inputs in agriculture incentivizes consolidation of farmland and reliance upon chemicals and machineries.

Other political and market incentives tailored to industrial farming also promote the industrial mode of food production. This is exemplified by agriculture subsidy programmes that favour large-scale agrifood companies, such as the various support that 'dragonhead enterprises' receive from the Chinese government. The bias towards industrial agriculture is also reflected in the themes and results of agricultural research. The Chinese Academy of Agriculture Sciences, for example, has mostly conducted research in hybrid seed cultivation and other topics aiming to overcome obstacles to agriculture industrialisation and modernisation. Disciplines that serve the interest of chemical-based agriculture (e.g. pesticide science, agrochemistry) are also prevalent in Chinese agricultural universities while disciplines related to agroecology are still not the mainstream. This path dependency is being reinforced by the rapid expansion of supermarkets and modern food supply chains that has occurred in China since the 1990s – these often require a stable, standardised and large supply of food which is hard for diversified food production to fulfil (Hu et al. 2004). These synergies among the economic, political and institutional arrangements enhance the path dependency of industrial agriculture.

Lock-in 2: Export orientation

Food policies around the world are increasingly geared towards global food trade, leading to growing support for specialised food production and the reduction of plurality (IPES-Food 2016: 47). However, the situation in China differs given its relatively high self-sufficiency rate. Despite the growing concerns about the decline in its self-sufficiency rate, China is still one of the few large countries able to rely mostly on domestic food production to feed itself. Statistics show that more than 95% of rice, wheat and corn – China's three most consumed staple grains – are produced domestically, although the self-sufficiency rate of soybean is much lower (ABARES 2014; Cui and Shoemaker 2018). As China's food imports outweigh exports, it is difficult to say that export orientation is an important factor locking-in industrial agriculture.

Lock-in 3: The expectation of cheap food

Changing food retailing and consumption patterns have shaped the agricultural sector in various ways. On the one hand, the development of mass retailers (wholesale and supermarket chains) which rely on a stable supply of large volumes of cheap uniform food commodities is stimulating the expansion of industrial agriculture. This is because the nature of industrial agriculture (i.e. mechanised, standardised, large-scale, mono-cropping) enables it to supply food of uniform quality at low cost, albeit with high environmental and social costs that are not fully reflected in the price. The cheap but profitable processed food, with a limited number of staple grains as major ingredients, that is widely distributed and marketed by modern food retail chains is reconfiguring consumption patterns and fueling the growing demand for the limited varieties of grains commonly produced by industrial agriculture (IPES-Food 2016: 49). At the same time, the demand for cheap food is further enhanced by the rapidly increasing demand for animal products in China, particularly pork and dairy products. Although the greater awareness of healthy eating in recent years is cutting down meat consumption in some households, the growing popularity of animal products in general has not been altered. China's meat consumption grew sevenfold since the early 1980s (Rossi 2018) and the trend is to continue (Garnett and Wilkes 2014). This in turn facilitates the scaling up of industrial meat production because small livestock production could not meet the rapidly increasing demand. This demand is also driving the expanding monoculture of soybeans in countries that produce for exporting to China and imports of animal products (Bloomberg News 2017).

Chinese consumers have become accustomed to the abundance of cheap food. The low price of food has made eating out and ordering food from online platforms daily routines for busy urban workers. In recent years, the revenue of China's restaurant industry has been experiencing double digit growth (Daxue Consulting 2016). In 2016, the gross merchandise volume of China's online food delivery market reached 166.2 billion yuan (US$24.18 billion), which was almost eight times the size in 2011 (Tao 2017). While industrial food might be cheap, its price does not incorporate the many externalities generated during its production, processing, distribution and retailing. As a result, consumers rarely recognise these externalities. Instead, the growing trend of eating out and using food delivery services in Chinese cities further disconnects consumers from the food system, physically, economically and cognitively (IPES-Food 2016: 50). Consumers' daily food experience – which should be rich and meaningful – has been reduced and simplified to simple nutrition intake. For many of the farmers already caught up in the industrial food system, there is little choice other than to further specialise their production, in order to continuously supply large volumes of cheap food commodities with uniform quality to the food industry.

Lock-in 4: Compartmentalised thinking

The compartmentalised thinking in the global context is reflected in the siloed structures of the agricultural research and education system, the knowledge and technology transmissions to farmers, as well as policy-making structures (IPES-Food 2016: 51-52). It prioritises productivity growth over other increasingly urgent concerns of agriculture. It also ignores the complex dynamics of natural environment and human society interactions that underpin the current food system. It goes hand-in-hand with the marketisation of the agricultural sector, during which capitalist logic triumphs over social and ecological rationales. In the compartmentalised mindset, agriculture is treated merely as an activity to produce profitable food commodities rather than an integral part of people's livelihoods and an inseparable part of the ecosystem. The people and ecosystems involved in agriculture, as a consequence, have lost their subjectivities and are reduced to inputs into a linear system.

The role of compartmentalised thinking in the expansion of industrial agriculture in the global context can be traced back to the early 20th century, and was later solidified in the so-called ‘Green Revolution’ in the post-war period. While it is widely recognised that the Green Revolution might not be that green or socially just and inclusive, China’s agricultural research, policy and industry structures are largely modelled on the Green Revolution mindset. That is, prioritising the breeding and dissemination of a limited varieties of input-responsive staple crops, stressing the roles of technological innovation and adopting the value-chain approach (IPES-Food 2016: 51). The Green Revolution thinking in China is deeply rooted in its historical food security challenges, particularly the Great Famine from 1959 to 1961. Producing enough food has been the goal of the earthshaking era of Reform and Opening up since 1978. The capability to continuously increase food production has always been portrayed as one of the Chinese Government’s greatest achievements and thus legitimises its authority.

China’s agricultural research and education systems, also driven by the general goal of productivity, have been major contributors to the country’s food productivity growth (Huang et al. 2004). To tackle the national food security concerns, the research focus since the 1950s has mainly been on the productivity of staple grains, with an increasing emphasis on livestock and other types of food. Agricultural research was largely financed and conducted by the public sector, including universities and other institutes. Research expenditure by the private sector was as little as 1.7% of the nation’s total agriculture research budget in 1999 (Huang et al. 2004). However, researchers have observed a rapid growth in investment in private food and agricultural R&D in China in recent years, particularly by state-owned agri-businesses such as the China National Agricultural Development Corporation (CNADC) and China National Cereals, Oils and Foodstuffs Corporation (COFCO). Other privately listed companies also contribute to the privatisation of agricultural research (Pardey et al. 2016). This implies an increased emphasis on market-oriented food commodities that can secure significant returns. In both the public-led and private-led periods of agricultural R&D in China, traditional and minor crop varieties, livestock breeds and farming technologies are marginalised and ignored.

The compartmentalisation in policy making also renders China’s food policy lacking in systematic and inclusive strategies. Food security policies, for example, are highly biased towards agricultural outputs and the rural context, with limited attention to other key components of food security such as the sustainability of production, food accessibility and food utilisation (Scott et al. 2014, Regnier-Davies 2015). Although greater policy efforts have been made in recent years to control food processing, retailing and consumption due to heightened food safety concerns, there is still a significant lack of food-system thinking in the policy-making process overall (Si and Scott 2016a, but see Zhong et al., 2019). Concerns in policies for agricultural productivity are often isolated from other priorities and support industrial agriculture’s goal of increasing productivity. Moreover, the development of ecological agriculture is a systematic undertaking – having only one or two support policies is utterly inadequate. The policy-making structure, reinforced by the compartmentalised agricultural research and education system, constitutes one of the major lock-in factors for industrial agriculture.

Lock-in 5: Short-term thinking

While critiques of short-term thinking in policy making generally blame electoral cycles that favour short-term policy solutions, the short-term thinking in the Chinese context is reflected in local governments' need for better performance and investors' interest in acquiring quick investment returns. China's single-party political system ensures a certain level of policy consistency at the central government level. Yet, since the 1980s the central government has also been emphasising provincial governments' responsibilities for the "rice bag" and municipal governments' responsibilities for the "vegetable basket" (Box 1; Liu et al. 2004; Zhong et al. 2019). This results in strong motivation by local governments to secure short-term grain and vegetable supply in their jurisdictions. Agricultural output therefore has been a key indicator in the performance evaluation of local government officials. It overshadows other increasingly urgent food issues and facilitates short-term thinking in local government policies. That being said, local governments in China has been gradually incorporating more diverse objectives into local food security policies, opening up space for a change from short-term thinking to long-term food strategies (Zhong et al. 2019).

A local wet market in downtown Nanjing, China (Photo credit: Zhenzhong Si)

The short-term thinking is perhaps most obvious in food production. While transitioning to ecological farming is a gradual process that demands time to build up soil fertility and the farm ecosystem, it also means high costs for farmers, especially smallholders who are the majority of farmers in China. This calls for more support from the government, yet instead most support goes to large-scale (by Chinese standards) industrial agrifood companies (Scott et al. 2014). Dragon-head enterprises have enjoyed government support ranging from financial services and tax reduction to marketing support and land access (China State Council 2012). The majority of Chinese smallholders are left disadvantaged in this competition. Diversified agroecology approaches to farming that do not generate immediate benefits are marginalised in this broad picture.

Lock-in 6: 'Feed China' narratives

China has never made any commitment to feed the world. Instead, its determination to feed its own people ever since the establishment of the People's Republic of China in 1949 has led to a series of food policies in the past few decades which are to a great extent domestically oriented. This 'feed China' sentiment was reinforced by the widely debated question 'who will feed China?', and which owes much to the flawed report written by Lester Brown, President of the World Watch Institute in 1994 (Brown 1994). The concern of food sufficiency for China was further enhanced by the global cereal price spike in 1995-96 and it was as recently as 1995 that China shifted from being a net cereal exporter (between 1992 and 1994) to a net importer (Pinstrup-Anderson et al. 1997). The report not only raised the alarm among many ordinary Americans about China's impending Malthusian tragedy, but also stirred up the debate on how China would meet its growing food requirement (Boland 2000). Various reports on the productivity potential were published by Chinese researchers in reply to Brown's report (e.g. Cai & Zhou 1999, Liang 1996, Wang 1997). Brown's analysis, despite its errors in his data and analysis, enjoyed authority at global food security meetings, such as the 1996 World Food Summit (Boland 2000). In this milestone gathering, the Chinese government made a commitment to strive to maintain food self-sufficiency. The 'feed China' narrative, although different from the 'feed-the-world' narrative, has become a political mission and a catalyst for China's agro-industrialisation.

Adding to the emphasis on food self-sufficiency was the establishment of "farmland protection" as a basic national policy in the 1998 Land Management Law, and the launch of the 1.8 billion mu (1,200 million hectare) Farmland Protection Program in 2006. This emphasis on farmland protection sent clear messages about its central focus on the quantity of food production. While there is no doubt that producing enough food should be the top priority, this productivity-centred narrative, which directs China's basic food policies, goes hand in hand with industrial agriculture. It justifies the continuation of the industrial agricultural system, deflects attention away from its consequences, and sidelines the discussion of the latent benefits of diversified agroecology systems. It fails to answer the question of how food could be produced and better distributed to everyone, particularly marginalised groups with limited resources, in a way that enhances farmers' livelihoods, public health, social well-being, equity and justice.

Lock-in 7: Measures of success

The evaluation of different agriculture systems is always based on productivist indicators such as total yields of specific crops and simplistic cost-benefit analyses, which fail to account for ecological, social, cultural variables and the complexity of the system (Flores and Sarandon 2004). These evaluation approaches, most of which involve academic studies underpinned by neoliberal economics, are also obvious in Chinese policies measuring agricultural success (Box 1).

The indicators measuring sustainable agriculture demonstration areas issued by the Ministry of Agriculture in 2017 convey more environmental concerns as they include reporting items such as the recycling rate of agricultural waste and the amount of chemical fertiliser and pesticides used (Ministry of Agriculture 2017). Yet, most of the mandatory reporting items still emphasise the scale of standardised production bases and total output, leaving limited discursive and policy space for diversified agroecology systems. The metrics used by the Chinese Government indicate an unquestioning embracement of the standardised uniform agriculture system and an under valuation of the potential benefits of alternative systems. They overlook the dynamic need for sustainability, in that the agricultural sector has to recover from shocks and sustain production under stress conditions. Diversified agroecological systems can perform well on these fronts (IPES-Food 2016: 56). Concerns for the working conditions of farm labourers are also absent from the system. The benefits of agroecological systems, as explained in previous section, should be better incorporated into assessment systems and in agriculture and development policies.

Box 1. China's rice bag and vegetable basket scheme

One of the overarching evaluation schemes is that of the 'rice bag and vegetable basket' scheme, proposed in the 1980s and emphasised in regulations many times over the decades. It specifies the provincial government's responsibility for the production and supply of staple food such as rice, wheat and corn, and the municipal government's responsibility for the production and supply of vegetables, meat and agricultural by-products (Zhong et al. 2019). In 2017, the State Council issued a regulation to clarify the evaluation approach of the vegetable basket responsibility (China State Council 2017). The major indicators stressed in the regulation are the productivity and safety of vegetables and meat, the spatial distribution of retailers, price volatility and control, construction of storage facilities and an information-sharing platform, as well as citizens' satisfaction. While food access and food safety indicators are clearly incorporated, environmental, social equity and justice indicators are either simplistic or absent from the assessment system.

Lock-in 8: Concentration of power

Rural sociology studies suggest that the concentration of power among transnational agribusiness constitutes the 'third food regime' – the corporate food regime – which promotes the expansion of the industrial agriculture model at the expense of the environment and smallholders' livelihoods (McMichael, 2005). Experiences in many countries reveal various ways in which the concentration of power can affect the agricultural sector, such as framing problems and solutions to meet their own ends, lobbying policy makers, leveraging influence to secure favourable research focuses and findings, running campaigns to discredit crop science, and co-opting the alternatives (IPES-Food 2016: 58).

Unlike the highly concentrated power in the Western food system (Clapp and Fuchs 2009, Howard 2016), the power dynamics in China's food system are relatively dispersed. The agricultural sector is still dominated by 200 million smallholders (Ju et al. 2016). The high level of self-sufficiency in the major crops also suggests limited engagement with the global food system, although the situation has been changing rapidly with the increase in soybean imports. As aforementioned, China still produces 95% of the amount of major staple grains it consumes. The concentration of power in the domestic seed industry is also limited compared with the highly concentrated global seed industry. Multinational corporations control less than one-fifth of China's grain seed market (Elgion and Zuo 2014). The limitation of corporate power is also mirrored in the food retailing sector, which comprises millions of small traders in traditional wet markets in cities (Si et al. 2019).

However, the decentralised agriculture and food retailing sector does not mean that the concentration of power is not at work in the evolution of China's food system. To a large extent China seems to be operating its own food system, which interacts with the corporate food regime in a distinctive way—a way that allows China to engage with and shape the power dynamics in the global political economy of food (Belesky and Lawrence 2018). While China has been widely recognised as a destination for transnational capital, in recent years China's own multinational agrifood and chemical companies have been expanding globally through investment and acquisitions (Clapp 2016, Sauvant and Nolan 2015). Yet, while China's interactions with global players are significantly reconfiguring the architecture of the contemporary global food regime, the impacts on its domestic agriculture system are limited (Belesky and Lawrence 2018). The barrier to an agroecological transition is mainly created by domestic corporate forces and the state.

In the Chinese context, the central source of power as an obstacle to change involves both corporate power backed by private capital, and the power of the state in the form of state capitalism, as demonstrated in the IPES-Food report. As a matter of fact, the capitalisation of agriculture in China is playing a critical role in its agriculture transition. Schneider (2017: 3) points out that China itself is "a site of agribusiness development in its own right". The development of domestic agribusiness, particularly the so-called state-supported dragon-head enterprises, defines the agrifood system and rural political transformations in China (Zhang and Donaldson 2008, Day and Schneider 2017).

The power of agribusinesses, or corporate power, is creating barriers for the agroecological transition in ways that the IPES-Food report has already identified on a global level. For instance, although it is not very common in the Chinese context for agrifood companies to lobby policy makers, their attempts to influence policies were identified through reporting the benefits of adopting genetic-modified varieties to departments within the Ministry of Agriculture and Rural Affairs, holding press conferences about agricultural biotechnology, and funding relevant conferences (see Deng et al. 2017). Agribusiness and other private capital have also been co-opting the organic sector through the establishment of large-scale organic farms, the development of e-commerce for organic food and setting up organic food stores that could out-compete small organic farms (Karoline and Chen 2019).

Besides these channels of influence, the dominant state capitalism in China opens up another distinctive set of channels for the concentration of power to influence the food system. State capitalism spearheaded by state-owned enterprises is leading to the concentration of the seed industry in China, although the level of concentration is still not very high. The seed industry has been experiencing a growing trend of capitalisation in recent years, driven by both domestic and international forces (Zhang and Donaldson 2008). It was reported that the number of registered seed businesses fell from 8,700 in 2010 to 4,316 by the end of 2016 (Shao 2017). Large state-owned companies and companies with hybrid ownership, such as Longping High Tech, Beidahuang and Shandong Denghai, maintain stronger presence in China's grain seed industry than foreign companies (Gaudreau 2019). High-yielding varieties of hybrid seeds promoted by these companies have resulted in the loss of agrobiodiversity, a critical asset for transitioning towards an agroecological system. Facing the dissemination of commercial hybrid seeds, traditional crop varieties and their on-farm conservation are disappearing in China (Schmidt and Wei 2006; Fu et al. 2010). The reliance of these hybrid seeds on chemical pesticides and fertilisers has also resulted in severe ecosystem degradation on Chinese farms.

The power of the state in influencing the food system and hindering the ecological transition is also reflected in various food policies. As the policy direction favours industrial agriculture, despite the recent emphasis on sustainability, this makes transitioning a difficult task. Sustainability concerns, currently reflected in buzzwords in policy documents, such as 'ecological civilisation'[3], 'circular economy' and 'low-carbon economy', need to be taken more seriously and to become more than 'flavour of the

3 Ecological civilization emphasizes the harmonious relations between human and nature in developmental activities. The term is a hybrid of environmentalism, eco-ethics and postmodernism values. It offers an alternative developmental path to modernization accompanying industrial civilization. It was embraced by the Chinese central government in 2007 to denote its determination to solve the environmental problems resulting from its rapid economic growth. See Wang et al. (2014) and Pan (2016).

month' in many pro-industrial agriculture policies. The current policy direction mirrors the problematic pursuing of the American model of agriculture (e.g., standardized, large-scale and industrial), which is related to the long-standing 'learning from the West' mindset in China's policy realm. While 'agricultural modernisation' has been the top priority of many agricultural policy documents, the interpretation of modern agriculture is critical for shaping the future of China's agricultural sector.

As the concentration of corporate power in the food system is still nascent in China, it is challenging to examine how this will affect China's agricultural sector in the long run. Meanwhile, the influential role of the state makes it more effective to mobilise the transition by engaging with policy makers. Therefore, the policy recommendations made in the IPES-Food report, and in Chapter 4 of this report, are particularly relevant to the agroecological transition in China.

Other challenges to the transition to agroecological systems in China

The various lock-in factors examined above create a strong foundation for the continuation of industrial agriculture in China. In recent years, China's agriculture policies have been gradually incorporating more sustainability concerns. Yet, the transition towards agroecological systems is also being held back by the inherent problems within ecological agriculture. The first obstacle is the unequal access to government support. Our recent visits to ecological farms in China found that not all ecological farmers benefit from government support (both financial and material). Some farmers who have personal connections with local government agencies enjoy preferential access to policy benefits. In addition, local government officials may take a portion of the payments or other resources that were intended to be allocated to farmers.

What is more challenging is the adaptation to chemical agriculture among Chinese farmers. Despite the fact that Chinese farmers are well known for their rich traditional knowledge and technologies of ecological farming, after decades of agrochemical promotion, most Chinese farmers have become used to chemical-intensive farming practices. Knowledge of traditional ecological farming has been lost to a great extent. Meanwhile, the marketisation of agriculture has led to a preference for high-efficiency, high-yield and less labour-intensive agriculture among farmers. The trajectory towards industrial agriculture therefore is hard to reorient.

Studies on ecological agriculture in China reveal other hidden problems that jeopardise the transition towards agroecological systems. According to one survey, about 80% of bio-pesticides in the Chinese market are adulterated due to intentionally added synthetic chemical contents. A market inspection conducted by the Ministry of Agriculture in 2015 found that 96.2% of the bio-pesticides sampled were disqualified (Wang 2016). Many of the bio-pesticides tested were found to be mislabeled, with no indication of the active bio-contents they claimed. This troubled bio-pesticide

Workers sorting vegetables on an organic CSA farm in Nanjing (Photo credit: Zhenzhong Si)

market renders Chinese ecological farmers afraid of purchasing fake bio-pesticides. The shortage of effective technical support networks and the challenge of organizing small farmers together are also factors that hinder the adoption of agroecology.

The economic viability of ecological agriculture in China is another major factor in holding back the ecological transition. According to our interviews in China, although organic and ecological food enjoys quite a high price premium, many ecological farmers are still losing money or hardly making ends meet even several years after conversion. This is probably due to the enormous challenge of marketing in an environment where consumer trust is significantly damaged, combined with the increasing costs, particularly labour cost, of production. The distrust of consumers is further strengthened by instances of fake organic produce revealed by the media.

3

Emerging opportunities for a transition to diversified agroecological systems in China

China is in a unique position globally to become a leader in sustainable food systems technology. This is because of the size of its food economy, its rich agroecology tradition and the strong will and capacity of the state in mobilizing resources. Diversified agroecological systems contribute to domestic food security and healthy outcomes as illustrated earlier in this report. China can export not only desirable products but the skills, plant materials, and livestock as a result of investing in the development of sustainable food systems. Various state policy objectives such as ecological civilization, food security and food safety would be met through the widespread uptake of diverse agroecological systems. China's capacity to direct public research and state-owned agribusiness investments could place Chinese companies and Chinese scientists in a position of international leadership in the development of agroecology.

China is becoming a world leader in green economy fields such as solar power. Yet, compared to the attention given to the greening of industry, transportation, and other issues in China, the greening of *agriculture and food* has received less media (and scholarly) consideration, despite considerable developments on the ground in this sector. China could repeat its solar success in agriculture and food by pursuing diverse agroecological foods systems. Building on existing policy initiatives, investment in and promotion of agroecology for multiple benefits could improve outcomes and make China a sustainability leader.

The IPES-Food report identified eight opportunities globally for shifting from uniformity to diversity. These are discussed in turn below, adapted to the Chinese context.

3.1 Policy incentives for diversification and agroecology

A key opportunity globally is that governments are creating incentives to move production towards sustainable food systems. Having recognised the adverse impacts of industrial agriculture, the Chinese Government has been taking steps to support the development of ecological agriculture. The Ministry of Agriculture established the Rural Energy and Environment Agency in 2013 to facilitate the policy enforcement and promotion of ecological agriculture across the country. The National Modern Agriculture Plan (2011-2015) (China State Council 2012) and the National Agricultural Modernization Plan (2016-2020) (China State Council 2016) called for more public investment in the restoration of the agricultural environment and promotes the multi-functionality of agriculture in urban areas. They also emphasized the importance of developing integrated livestock and crop farming. This indicated an integration of environmental concerns in modern agriculture development agendas, although the integration was still quite limited. The National Sustainable Agriculture Development Plan (2015-2030), a guiding document jointly issued by eight central government agencies, marked a new beginning for agriculture development in China (Chinese Central Government 2015). The Plan highlighted the environmental challenges facing the agricultural sector and points out five major tasks, including promoting locally adapted agriculture and circular agriculture; stabilizing the amount of farmland and improving its quality; improving the efficiency of water usage in agriculture; reducing farmland pollution; and restoring the ecological system of farms. It also proposed policy recommendations such as legislation changes, providing more subsidies to sustainable agriculture development, and enhancing the agricultural educational system in universities.

Another major policy opportunity lies in the establishment of national and provincial ecological agriculture demonstration counties and sites. By 2015, the central government had designated more than 100 national ecological agriculture demonstration counties. Provincial governments have also established more than 500 provincial ecological agriculture demonstration counties and more than 2,000 ecological agriculture demonstration sites. These demonstration sites and counties are receiving various subsidies and policy support from both the central and provincial government.

In addition to these national policies, the Chinese Government has issued various types of support for so-called ‘three certifications and one symbol’ (san pin yi biao) agricultural products—’three certifications’ refer to hazard-free, green and organic food certifications and ‘one symbol’ refers to the geographical indication of a product. Many food companies get their certification costs covered by the government. In Puji county, Sichuan Province, a series of policies support the development of agroecology. For example, specialists help small farmers opening e-stores to link to markets, but only after their production has reached standards set by the government. Despite the many supports, the majority of small farmers are excluded from the organic

Vegetable greenhouse on Green Cow CSA farm in Beijing (Photo credit: Zhenzhong Si)

certification scheme not only because of its high costs but also because of consumers' distrust of organic certification (Wang et al. 2015; Scott et al. 2018). Our interviews with organic farmers found that the annual certification cost for a 13 hectare farm in Shanghai could be as high as 100,000 CNY (about 14,500 USD). This exclusion contributes to the emergence and proliferation of alternative quality insurance schemes such as community supported agriculture (CSA) commonly adopted by small ecological farmers. The force of agroecology development is thus divided into different camps, making it more difficult to exercise its transformative potential.

In a few cases, the government also supports the development of alternative food initiatives that promote diversified agroecological systems. The Little Donkey Farm—located in Haidian district in Beijing is the most prominent CSA farm in China. The farm accessed land and financial resources with the support of the local government. Its sister farm—the Big Buffalo Farm—in Changzhou, Jiangsu Province also received support from the local government. Many other ecological farms have also received various forms of government support, although in most cases this support is not explicitly for ecological farms. It is also worth mentioning that in its "Regulations on the Construction of Ecological and Civilised City" issued in 2009, Guiyang city in southwest China became the first local government to set the development of CSA farms as one of its priorities. In 2017, the Ministry of Commerce and the Ministry of Agriculture issued a notice about promoting the development of e-commerce of agriculture. This document mentioned that local governments should explore the potential of CSAs in connecting food production and consumption (Ministry of Commerce and Ministry of Agriculture 2017).

3.2 Building joined-up 'food policies'

It is not very common for non-state actors to participate in joined-up policy making in China in support of agroecological systems, although it has been demonstrated as an effective approach to construct compelling food policies in many other countries. Efforts of joint-up policy making commonly found in many other countries such as food policy councils, food committees and multi-stakeholder campaigns do not exist in China. International food organizations such as FAO and IFOAM are also playing very limited role in food policy making. That being said, in recent years, there is indeed policy space opening up for food issues and public opinions did shape the top-down policy making process in specific cases such as the extremely hot public debates over the dissemination of genetically modified (GM) food in China's food system. From 2011 to 2015, GM food has been one of the top concerns of the general public. Chinese citizens were enthusiastic over the discussion of the safety of consuming GM food (Huang and Peng 2015). Many of the debates took place on the Internet, particularly Weibo (twittter-like website for posting micro blogs). While both research results and rumors prevailed in this process, some intellectuals managed to feed into the discussion critical information beyond the safety of GM food such as the socioeconomic consequences of its production and consumption (Jiang 2015). In response to the serious public concern, the central government amended the Food Safety Law to include the requirement of GM food labeling in April 2015. The foundation of public participation in policy making has already been laid through the GM debates and the rapid development of grassroots initiatives such as alternative food networks in the past decade (see Scott et al. 2018). The country is at a critical stage of developing joint-up food policies through better integrating civil society organizations into the policy making process.

3.3 Integrated landscape thinking

Integrated landscape thinking contends that the management of land resources should consider the need for food, bio-energy and ecosystem services facing the limits of natural resources in an integrated and holistic manner (Milder et al. 2014). It recognizes the "linkages between the livelihood needs of local communities and key drivers of biodiversity loss" (Milder et al. 2014: 69). Therefore, it accords with the food system thinking that emphasizes a holistic approach to address multiple issues (i.e. economic development, environmental protection and ecosystem conservation, social justice and equity) from evaluating the interests of diverse stakeholders along the food value chain. The IPES-Food report highlights the positive outcomes reported by integrated landscape initiatives in Africa and Japan (IPES-Food 2016: 62).

Despite the challenges inherent in integrated landscape approaches (Reed et al. 2016) (Box 2), municipalities in many countries are engaging in efforts to address sociological and ecological realities of our current approach to food. The Chinese government has also been promoting integrated urban-rural development in recent years. The integrated urban-rural development underlines the necessity to facilitate urban-rural interactions and divert urban resources to rural areas, particularly the agricultural sector, in order to reduce the gap between urban and rural in China (Tian and Gao 2009). This provides an incentive to rethink some of the land-use policies from an integrated landscape perspective. For example, in October 2015, 100 mayors from around the world met in Milan for World Food Day, and committed to the Milan Urban Food Policy Pact (2015). This pact is the first international protocol calling on cities to develop sustainable food systems that grant healthy and accessible food to all, protect biodiversity and reduce food waste. Beijing, Chongqing, Guangzhou and Shanghai are the four Chinese cities among the 171 signatory cities. In 2017 the mayors committed to unite again to discuss their collaborative efforts, share experiences and document best practices. FAO is developing indicators that cities can use to assess their progress on these commitments.

Box 2. Integrated landscape thinking and its debates

New concepts have emerged from the praxis of food policy councils, regional leadership and other champions of sustaining food systems. A complex array of classifications and conceptualisations over the past 30 years have perhaps muddled the academic conversation around what is at the root called 'integrated landscape thinking'. Reed et al. (2016) identify three key barriers to increased efficacy for integrated landscape approaches. Too often champions of integrated landscape thinking have simply failed to acknowledge the inevitable trade-offs and promising unrealistic win-win scenarios. While such processes raise the profile of interdisciplinary approaches in words, in practice too often even ardent champions have struggled to overcome disciplinary boundaries. Finally, Reed et al. suggest the research community itself is possibly 'muddying the waters' when offering solutions to pressing scientific questions, resulting in an endless stream of dense terminology in relation to landscape approaches to developmental and ecological constraints (Reed et al. 2016).

3.4 Agroecology on the global governance agenda

Intergovernmental responsiveness to the case that has been made for fundamental food systems transformation is on the rise. While much remains to be done to achieve the kinds of global governance infrastructure required for a transition, a range of intergovernmental assessments and processes have been initiated in recent years (IPES-Food 2016: 62). Assessments like the IAASTD give governments evidence-based recommendations for moving forward and provide a road map that each region will need to follow based on their own socio-ecological realities and political will. By prioritising the indicators developed in these assessments and building principles from these reports into national policy, China can take steps in a common direction.

A demonstration of a vegetable share of the Green Finger CSA (Photo credit: Steffanie Scott)

As we highlighted earlier in the paper, removing the eight lock-ins identified by the IPES-Food report requires addressing flaws in our global trade agreements and building accountability for industries relative to these lock ins in order to change them. As climate change continues to dominate global governance discussions, there is an opportunity to raise agroecology as a good news story within global governance arenas. The Chinese government has increasingly been incorporating agroecology into its agricultural and food policies, such as the promotion of circular agriculture and ecological farming approaches (Luo 2016).

3.5 Integrated food systems science and education

In the global context, agriculture-related educational structures and programmes are witnessing an evolution to systems analysis, and agroecology is garnering support in the international scientific community (IPES-Food 2016: 63). In China, agroecology has been established as a discipline since its introduction in 1975 (Luo 2016). Ecological agricultural research and practice in the 1980s and the 1990s have also accumulated rich experience, with strong support from the central government (Ye et al. 2002). In this period, what is known as 'Chinese ecological agriculture', despite being deemed by some as a failure, was promoted to address the environmental impacts of conventional agriculture and the limited productivity of traditional agriculture (Ye et al. 2002, Shi 2002).

The research focus of agroecology in China has seen several shifts in the past three decades. Research started in the 1980s from analyses of the energy and material flows of traditional agroecological systems. In the 1990s, climate change, biodiversity and sustainable development became hot topics in agroecological studies – later joined by circular economy, low carbon economy and clean agriculture production concepts in the late 1990s. With the introduction of landscape ecology and molecular biology methods in the 2000s, agroecology research has extended to both macro and micro scales (Luo 2016). While the original agroecology studies in China are explicitly focused on the functionalities of the agroecosystem from scientific perspectives (e.g., crop science, soil science, animal science), in the new millennium agroecology research and education have gradually recognised the role and incorporated more analysis of socio-economic factors in the development of sustainable agriculture (Luo 2016). Substitution of chemical inputs by organic inputs, water-saving techniques, no-tillage methods, and pollution control in agriculture are hot topics in agroecology studies.

In addition to the existence of agroecology programmes in many of the agriculture universities which are the major players in agroecology education (see Luo 2016), academics in several Chinese universities have also been proactively advocating for the potential and rights of small farmers in sustainable agriculture development. For example, Liang Shuming Rural Reconstruction Centre, affiliated with China Renmin University, has been facilitating ecological farmers' co-operatives and organising training for youth to participate in sustainable rural development across the country. The Institute of Rural Reconstruction of China in China Southwest University was established in 2012 to advance the education of holistic and sustainable rural development knowledge and experience, including ecological agriculture modes and practices.

Emerging initiatives in integrated public food education are also found in several leading CSA farms such as the Little Donkey Farm and the Shared Harvest Farm. The CSA model has become popular in the past eight years and has been a viable model for conducting ecological agriculture on small and family farms. The Little Donkey Farm is the most well-known CSA farm in China, and has been promoting the CSA model through training workshops for farmers in CSA operation and management. It also cohosts the annual national CSA symposium to facilitate peer learning among farmers. The Shared Harvest farm, established in 2013, launched the Children of the Earth (dadi zhi zi) programme in 2014 on its production base in Shunyi district, providing food education to primary and secondary school students and their parents. Lectures on rooftop gardening are also being offered. These learning opportunities not only enable children to engage closely with agriculture and nature but also raise public awareness of sustainability. In addition, both the Little Donkey Farm and Shared Harvest and many other ecological farms in China provide internships for aspiring new farmers, often university graduates.

3.6 Peer-to-peer action research

In China and elsewhere, agroecology research has witnessed an emergence of participatory approaches, enabling the development of locally adaptive techniques and knowledge. In contrast to the one solution-fits-all goals of industrial-oriented research, the agroecology paradigm demands participatory research that generates meaningful results for specific local ecological and socio-economic conditions. To answer this call, researchers in China have conducted successful peer-to-peer action research in China, particularly in seed breeding, the promotion of ecological farming approaches, and the conservation of agricultural heritage systems.

The Center for Chinese Agricultural Policy (CCAP), the country's leading public agricultural policy research organisation, facilitated the participatory seed breeding projects. As China's publicly funded agricultural research is increasingly disconnected from local demands (in terms of its exclusive experimental conditions, disconnect from farmers and local practitioners, and disregard for local biodiversity), a group of action researchers including plant breeders, extensionists, farmers and policy researchers have started a participatory research programme in villages in five counties in Guangxi province. By working with local farmers and other stakeholders, this initiative bridged the formal plant breeding (R&D) system with farmers, and adapted innovations to local conditions, increasing maize yield and farmers' income, as well as bringing about policy changes (Song and Vernooy 2010). This opens up new possibilities for seed breeding beyond the formal plant breeding system supported by local and central governments and thus challenges the power that currently dominates the seed sector.

Researchers from the Chinese Academy of Sciences have been working on the conservation of traditional agroecology systems designated by the FAO as Globally Important Agricultural Heritage Systems (GIAHS). At present, there are 15 GIAHS sites in China. Their research aims to better understand the ecology, indigenous knowledge, tradition and culture associated with the GIAHS, and explore their potential for meeting the contemporary challenges in agriculture and rural development. The research has also formulated a more holistic approach to go beyond scientific studies of the GIAHS to study the GIAHS as a whole, with equal emphasis on their history, culture and customs (Fuller et al. 2015).

3.7 Sustainable and healthy sourcing

A range of responses to the increasing public concerns about the health impacts of the industrial food system are emerging around the world. Organic food sales are growing steadily. The market share of sustainability-compliant and Fairtrade certified food is increasing. Home-grown school feeding programmes and public procurement programmes are developing in a growing number of cities and countries. Some under-utilised crops are being recognised for their nutritional benefits (IPES-Food 2016: 64).

A poster of Beijing Organic Farmers' Market (Photo credit: Zhenzhong Si)

In China, similar opportunities for an agroecology transition are emerging. The sale of organic food has been rising steadily in recent years, with an increasing number of certified products. According to the Chinese Certification and Accreditation Administration, the government agency in charge of setting organic certification standards and accrediting certification agencies, in 2016, 1.74 billion packages of organic produce, valued at 36 billion yuan (US$5.3 billion) in total, were sold nationwide – up 16% from 2015 (Wang 2017). About 1% of China's farmland (more than 2.3 million hectare, roughly the size of the State of New Hampshire in the US) was certified organic in 2016. In addition to the growth of domestic sales of organic food, some private schools and companies start to source organic food for their canteens. The Waldorf School in Chengdu for example periodically organises organic farmers' markets to promote organic food and farming among urban residents (Wu 2013).

3.8 Short supply chains

Significant attention has been given to the impressive grassroots development of various short food supply chains around the world in recent years. Driven by food safety concerns and the lack of trust in conventional food sources, short supply chains, particularly CSA farms and ecological farmers' markets, have been proliferating in China in the past eight years (Wang et al. 2015a). In 2019, it was estimated that there were more than 1,000 CSA farms across the country, mainly located on the peripheries of cities (Shared Harvest Farm 2019). The Hong Kong-based NGO Partnership for Community Development (PCD) has been proactively working with local NGOs, farmers and other stakeholders to promote the CSA model and other short food chain initiatives in China (Si et al. 2015). They have developed training programmes to support young rural returnees to start ecological farms in their home villages. For example, they played a key role in fostering the development of China's first CSA farms, located in Anlong village. The New Rural Reconstruction Movement in China has also been facilitating the convergence of various initiatives on many fronts (Si and Scott 2016b).

Accompanying the development of CSA farms is the emergence of ecological farmers' markets in some Chinese cities. These markets, significantly different from conventional wet markets in various dimensions, offer venues for direct communication between small ecological farmers and concerned consumers who are willing to pay more for safe and healthy food. Although often facing social political constraints, these markets have garnered tremendous momentum in some cities (Si 2015, Zhang et al. 2016). The Beijing Farmers' Market was the first and most influential ecological market in China, and has managed to expand to three markets a week operating at multiple locations in Beijing. These markets not only provide an alternative venue for safe food, but also make small-scale ecological farms economically viable, thus offering a notable opportunity for the agroecology transition in China.

Direct purchase from ethnic minority groups in remote areas is also facilitated by consumer groups such as the 'nested market' project established by scholars (van der Ploeg et al. 2012) and buying clubs in major cities. One example is the organic restaurant Tusheng Liangpin in Nanning city, which sources high quality food directly from the province's ethnic minority villages (Song et al. 2015). The initiative has transformed agricultural production in the village from a maize-based system to an integrated crop-livestock system. The Hong Kong-based PCD also has projects to support the development of short food supply chains that connect ethnic minority groups with urban consumers. These initiatives provide livelihood opportunities to marginalised communities while disseminating food and agriculture knowledge to urban consumers. These short food supply chains are emerging forces in the agricultural sector that are challenged by the growing participation of public and private capital in the agrifood system.

4

Recommendations for moving towards diversified agroecological systems in China

The various opportunities identified in the previous section provide alternatives to the industrial food system and inform the current policy system in multiple ways. However, the Chinese Government's continued promotion of the standardised industrial farming model, with the orientation of reducing smallholders and scaling up the agricultural sector, is a significant threat to the continued growth of ecological agriculture. In addition, the current high price of organic food and other non-certified quality food puts it out of reach of most consumers, while the vast majority of small farmers do not have the capacity to convert to ecological farming. This is a problem we call 'the two dead-ends'.

Resolving these two dead-ends will help to foster the paradigm shift towards diversified agroecological systems. This is because rather than marginalizing smallholders, the agroecological transition demands the participation of small farmers – not only because of their dominance in the agricultural sector but also because of their rich knowledge of local conditions, which is an essential element of agroecology. Thus, capacity building among smallholders is critical. With more farmers participating in the transition and the expansion of the ecological agricultural sector, quality food will become more affordable for consumers. That being said, the transition means far more than converting more small farmers to ecological farming. This is reflected in the recommendations identified in the IPES-Food report (Box 3), which summarises many inspirational cases from around the world. Each of them merits more careful analysis for their feasibility of adaptation to the Chinese context.

Box 3. The IPES-Food report recommendations for unlocking the transition to ecological agriculture

The IPES-Food report identified seven key recommendations for actions to be taken to support the paradigm shift and remove the factors locking industrial agriculture in place.

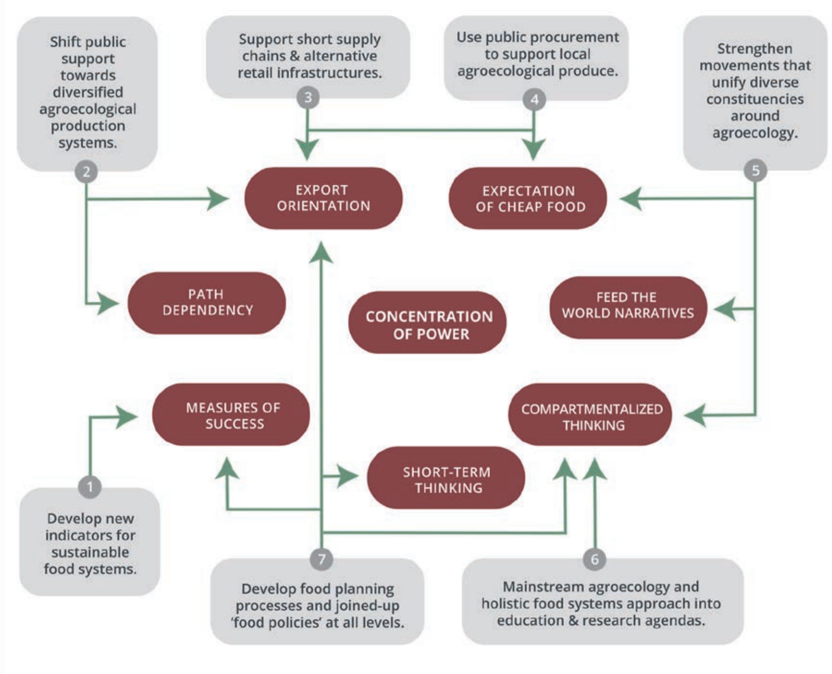


Figure 5. Turning lock-ins into entry points for change
Source: Figure 14 from IPES-Food (2016: 67)

These recommendations include the following:

1) Develop new indicators for sustainable food systems

2) Shift public support towards diversified agroecological production systems, this entails policy support to cooperatives and establish organic sector support organisations.

3) Support short supply chains and alternative retail infrastructures

4) Use public procurement to support local agroecological produce

5) Strengthen movements that unify diverse constituencies around agroecology

6) Mainstream agroecology and holistic food systems approaches into education and research agendas

7) Develop food planning processes and 'joined-up food policies' at multiple levels, this entails adopting a 'food systems' approach to planning and integrated policy.

Source: IPES-Food report (2016)

While these recommendations are relevant to China to various extents, we do not want to repeat them in detail here. Instead, we highlight a few China-specific recommendations:

1) **Reconceptualise 'modern agriculture' in the policy and educational realms.** This is a necessary step to confine the concentration of corporate power in the agrifood sector. Agricultural modernisation has been a key national development priority in China for decades. The understanding of modern agriculture has long been focused on efficiency and productivity, with limited recognition of agricultural sustainability. The emphasis on productivity ensures that power rests upon large-scale capital-intensive agribusiness (IPES-Food 2016: 58). A re-conceptualisation of 'modern agriculture' will help to break down this concentration as a lock-in factor. This will require modern agriculture to be reevaluated. With the enactment of the National Sustainable Agriculture Development Plan (2015-2030) in 2015, it is an opportune moment to integrate agroecology into the narratives and interpretations of modern agriculture. Moreover, most government interventions to promote ecological agriculture in China tend to focus on farming techniques or marketing skills, rather than considering the issues from the perspective of a social movement or community organisation. Therefore, it is vital to reconfigure agriculture policies and the content of the agricultural educational system through collaborative efforts involving multiple stakeholders. In this process, traditional agro-ecological practices should be treated as an asset.

2) **Rediscover the value of agroecology in achieving developmental goals.** The values of agroecology practices, as explained previously, include but are not limited to reducing poverty in remote areas, reducing pollution, enhancing the 'ecological civilisation' goal, contributing to social stability by addressing food safety issues, creating jobs and so on. These are all important objectives in China's development agendas. To rediscover the true value of agroecology in rural development demands an upgrade of the current status of ecological agriculture in China. Ecological agriculture should not be limited to being a means of safe food production for a niche market. It has much richer socio-economic contributions to offer (Qiao et al. 2016). It is also important to recognise the high yield potential of organic agriculture under certain conditions (see Seufert et al. 2012). In addition, the benefits of agroecological systems should be better incorporated into assessment systems and in agriculture and development policies.

3) **Build on the diverse ways in which agroecological practitioners are experimenting to overcome the crisis of trust in the food system.** Ecological farms are attempting to re-build consumers' trust not only through *market mechanisms*, such as eco-labels, but (because of low trust in labels) also increasingly through *relational mechanisms*, building personal connections with local government, the rural community, local peasants, local suppliers, and consumers (Chen 2017, personal communication). Although these approaches are expanding quickly among small

ecological farms, they are hardly recognised as feasible solutions to the food safety problem. Given that food safety is the top concern of Chinese residents, promoting these mechanisms beyond small farms will strongly boost the public awareness of agroecology practices, consolidating public support for the transition towards diversified agroecology.

4) **Understand farmers' roles in the agroecology transition.** Besides the various studies of consumers in the organic food market (e.g, Chen and Scott 2014), farmers' roles in ecological agriculture development deserve more attention in research and policy making. For example, previous studies mainly highlight technology, market-orientation and economic benefits as the key factors influencing the transformation of farmers' production. Little attention has been given to *values* or (ideological challenges) linked to this transition. Therefore, more emphasis should be given to the roles of farmers' values in agroecology transition. Understanding farmers' role in this transition also demands better resources for ecological agriculture research (Cook and Buckley 2015).

Ecological rice paddies in Guangxi (Photo credit: Zhenzhong Si)

5) **Explore opportunities for farmer participatory research and participatory plant breeding.** The rich experience of farmer participatory research from China and other countries should be leveraged with more policy support. For example, Canada has valuable experience through the Ecological Farmers' Association of Ontario, and University of Guelph Professor Sally Humphries, working with the NGO USC Canada (Unitarian Service Committee) has done great work on participatory plant

breeding in Central America. It is important to explore opportunities for exchanges and visits, such as bringing Chinese stakeholders to attend international events (e.g., those organised by Food Secure Canada, the National Farmers' Union, Canadian Organic Growers, and the Guelph Organic Conference) and bringing foreign stakeholders, not only researchers, to share experiences.

6) **Enhance market oversight and credibility of certification systems while increasing farmer training and consumer education for ecological agriculture.** It is vital to make certification a viable option for more farmers. The current certification system could be made more accessible and relevant for small ecological producers by simplifying certification procedures (Cook and Buckley 2005) and incorporating stakeholder inputs into the revision of organic standards. That being said, a more fundamental problem is the deterioration of trust in the certification system. If the credibility of the certification system is not rebuilt, making certification more accessible will make no real difference. This underlines the importance of ensuring that there is no unqualified organic or green food on the market by enhancing the current monitoring system of the organic and green food market. It is also important to support farmer training and consumer education in ecological agriculture so that farmers comply better with the certification requirements and consumers understand the certification and food system better.

Biodynamic rice farming on Time Farm in Nanjing. (Photo credit: Zhenzhong Si)

7) **Support innovative ways to attract farmers and other people back to the land.** The urbanisation process has drained human resources from the countryside and thus created a favourable environment for industrial agriculture. It is therefore urgent to make land more accessible for people who are interested in farming. Making land accessible not only to farmers, but also to people who are interested in gardening, will boost the development of ecological agriculture. Recreational gardening around major cities for example should have more support in terms of accessing land. Our research also found that most small-scale new farmers found themselves in an awkward position—their urban background makes farming a challenging career path, yet their small scale prevents them from enjoying various agriculture support designated for large farms. Providing equal support to these new farmers in the ecological agricultural sector will therefore greatly enhance their competency and viability.

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In 2016, the International Panel of Experts on Sustainable Food Systems (IPES-Food) published a report entitled From Uniformity to Diversity: a paradigm shift from industrial agriculture to diversified agroecological systems. This report provided a systematic review of existing studies of industrial and ecological systems of agriculture in the global context and offered constructive suggestions to facilitate the shift towards an agroecological system. Yet, its analysis is largely built upon general agriculture development around the world, with limited discussion on China. Meanwhile, after more than 30 years of industrial-oriented development, the agricultural sector in China is in urgent need of an ecological transition. Despite the rapid growth of the organic agricultural sector, the problem of unequal access to healthy foods persists. On the one hand, organic food is only affordable for wealthy, elite consumers; on the other hand, the vast majority of small farmers have limited capacity for conducting organic or ecological farming due to a lack of knowledge and skills and access to the market. By adapting the analytical framework of the IPES-Food report to the Chinese context, this report reviews the outcomes of industrial agriculture and agroecological systems in China, analyses key factors (lock-ins) keeping industrial agriculture in place in China, and proposes ways forward for a paradigm shift in favour of integrated agroecological systems.

The *Reclaiming Diversity and Citizenship Series* seeks to encourage debate outside mainstream policy and conceptual frameworks on the future of food, farming, land use and human well-being. The opportunities and constraints to regenerating local food systems and economies based on social and ecological diversity, justice, human rights, inclusive democracy, and active forms of citizenship are explored in this Series. Contributors to the *Reclaiming Diversity and Citizenship Series* are encouraged to reflect deeply on their ways of working and outcomes of their research, highlighting implications for policy, knowledge, organisations, and practice.

The *Reclaiming Diversity and Citizenship Series* was published by the International Institute for Environment and Development (IIED) between 2006 and 2013. The Series is now published by the Centre for Agroecology, Water and Resilience, at Coventry University.

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