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Does Small-Scale Organic Farming Contribute to the Local Environment—A Case Study in Suburban Shanghai, China

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Abstract: Small-scale organic farming is developing rapidly in China, especially in suburbs of megacities, and enriches the connotation of urban agriculture. Much attention has been paid to the socio-economic aspects of small-scale organic farming and takes for granted that it contributes to the local environment and the sustainable agriculture while little has been explored regarding its actual environmental contributions and associated influencing factors, especially in those rapid developing suburb areas. Based on the case study of three small-scale organic farms in the suburbs of Shanghai, we examined uncertificated organic farming practices, focusing on the farm diversity, fertilization and pest control without chemical inputs, and the restoration of biosystems. Potential of environmental contributions were evaluated from the production perspective of input reductions. It was found that such uncertificated small-scale organic farming does contribute to the local water environment, helping improve soil quality, and gradual recovery of farm biodiversity. However, all the environmental benefits are fragile and highly dependent on the profit availability and professional knowledge of the farm as well as the availability of policy supports.

Keywords: small-scale organic farming; environmental contribution; professional knowledge; profitability; Shanghai



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1. Introduction

The vast changes in China caused by rapid urbanisation and industrialisation have led to the collapse of traditional farming and the overwhelming of modern agriculture, characterised by heavy mechanisation and chemicalisation [1–6]. Consequently, environmental problems caused by agriculture have been identified, such as soil contamination and degradation and non-point source pollution and emerged and threatened the food safety and public health, especially in highly populated megacities [7–13]. This is also a reason why recently small-scale organic farming has been growing rapidly in suburbs of Chinese megacities, not only satisfying the changing social demands for green and healthy food, but also reducing the negative environmental impacts of agriculture. [14].

Generally, ecological agriculture (including organic farming) have been advocated as one of the solutions of sustainable agriculture [15]. It has challenged conventional agriculture to transform production by avoiding the use of chemical inputs or by totally banning chemicals according to organic principles [9,16–19]. In China, ecological farming has been developing rapidly. For example, the certified organic agriculture land has reached as much as 3.02 million ha in 2017 [20]. However, these certified organic productions are mainly export oriented and remain expensive in domestic markets [5,10,21]. Moreover, the public mistrust in the certified produce due to food safety scandals [6,22] remains high. Consequently, many small-scale farms were established following organic farming rules but choosing to not get organic certification [23], as organic certification is losing its reputation among urban customers [24,25] while too expensive to be afforded. Most of

these farms also claimed themselves to be community supported agriculture, which initiate in Japan and expanded to United States and many European countries.

Research on these small-scale organic farms farming in China currently focuses on its socio-economic issues, such as its development in different areas [21], driving factors and marketing [26], economic performances and challenges [27,28]. However, little has been explored regarding the extent and degree of environmental contribution of these farms, which is widely taken for granted. For example, Horlings and Marsden [29] and Scott et al. [5] stated Chinese ecological agriculture should be promoted by the media for the sake of both the environment and farmer livelihood, as urban consumers may not be aware of them due to the delivery schemes. This issue is especially important in China, as small-scale organic farming is shaped by its socio-economic background, such as rural collective ownership and urban–rural dual structure, and it might be varied under certain conditions. Therefore, whether and how its development would contribute to sustainable agriculture remains unclear in China [5,29]. In addition, the New Urban Agenda was launched in 2016 to enhance the local sustainability of cities and communities [30]. According to this, the management of global urban spatial development will be supported, e.g., facilitating trade links across the urban–rural continuum and ensuring that small-scale farmers and fishers are linked to the various scales of value chains and markets. Regarding sustainable agriculture, decision makers are, therefore, recommended to aim at achieving a balance between the maintenance of the natural environment and the provision of healthy food, economic viability and social welfare. It's a major challenge and therefore, our research question is whether and how the development of small-scale organic farms contribute to environmental sustainability, especially in the areas with complicate and rapidly changing socio-economic circumstance, such as the suburb of Shanghai.

2. The Operational Environment of the Ecological Farming System in China

A spatial cropping system (inter-planting) with rotation is typical in Chinese ecological agriculture [19,25,31]. The purpose of temporal crop rotation is to balance soil fertility, e.g., by using green manure sequentially with cereals and other crops or by rice–wheat rotation. Crop diversification is provided, along with this traditional system, to enhance pollination and to avoid plant-specific diseases and pests by increasing the abundance of pests' natural enemies [16,32–35]. However, in their review on the relationship between urban agriculture and biodiversity, Clucas et al. [36] claimed that more confirmed, empirical research is needed along different geographical locations and on a greater diversity of species and taxa.

The canal networks and irrigation ponds in the subtropical lowland and deltas are traditional elements of the farming landscape [19,37]. The quality of natural water resources is affected by the implementation of water protection measures, which has been improved in Shanghai, with the proportion of water quality better than Grade III (included) in the main water system monitored section comprising over 74% in 2020 (2020 Shanghai Ecological and Environmental Bulletin). The modern technologies of wastewater treatment and soil purification have been widely used and expanded to rural areas [4,6,13,38]. For example, the coverage of rural wastewater treatment in Shanghai reached 75% in 2019 (Xinhua Press, Beijing, 2019). Numerous regulations have been issued and implemented to decrease pollutions and emissions. Shanghai City issued restrictions in 2004 for livestock husbandry, and the Chinese government issued national regulations in 2014 to prevent pollution from large-scale livestock and poultry breeding [7].

Regarding soil properties, ecological farming practices such as manure application, organic fertilisers, minimal use or non-use of chemicals and crop diversity with rotation are seen as enhancing soil biota and increasing soil organic matter [7,18,33,39–41]. The prevention of soil erosion is a key practice to decrease nutrient losses from farming land into waterbodies. The terracing on the gentle slopes and afforestation on the steep slopes are traditional practices to manage soil erosion [19,42–45]. The lowland grasslands and vegetated field margins along the canals decrease nutrient leaching attached to soil parti-

cles [46–48]. Additionally, stratified vegetation such as hedgerows and clumps of bushes or trees, if available, enhance the diversity of the agricultural landscape structure [49–51].

We present a case study of three small-scale uncertified organic farms to evaluate their environmental contributions. Qualitative analysis based on in-depth interviews were adopted rather than quantitative analysis due to the scarce availability of official data from farms and government bureaus. We interviewed three farmers or their representatives practicing ecological production in suburban Shanghai between November and December 2019. The in-depth interviews were recorded and supplemented by farm walking with the farms' representatives to contribute to our understanding of their environmental management practices. Each interview took around three hours, with discussions about environmental management, such as the crop diversity, rotation, fertilisation, livestock husbandry practices, weed control, pests and plant diseases and the management of the natural or semi-natural habitats within the farm area. These themes cover the main aspects of environmental sustainability regarding the practice of agriculture [33,52,53]. Additionally, we used the previous interviews, recorded between August 2014 and July 2016 on these case farms, if the discussions included any unpublished issues about environmental practices. The previous interviews were part of the research into the spatial and cultural connectedness between the ecological producers and consumers published by Liu et al. [23] and Ding et al. [14].

In this study, we aim to increase the knowledge of what kinds of challenges the ecological farms, specifically uncertified organic farms that do not use any chemicals in their production, confront in Shanghai area with their environmental contributions. The paper's specific research question is how the environmental practices are managed to increase the quality of the farming environment and what are the factors influencing their environmental contributions.

3. The Study Area

The megacity Shanghai, with over 24 million people, is expanding rapidly: The urbanisation rate between 1990 and 2014 increased from 60.8% to 86.4%. The pressure on land resources is high. The total land area of Shanghai is 6340 sq.km, of which 29.7% was arable in 2014. Shanghai's suburban landscape with villages is typically dominated by small-scale agricultural farms that are usually not included in the official statistics, as they are uncertified. According to the official introduction of Shanghai agriculture, only 9 certified organic producers and 22 products existed in 2018 [54].

One of the three case farms that agreed to interviews for this study is located on Chongming Island about 70 km east of Shanghai's city centre, whereas the two other farms are located in Qingpu District about 60 km west of the city centre. These locations, both Chongming and Qingpu, have been under strict environmental protection regulations (for wetland and biodiversity conservation and drinking water source protection, respectively) [14,55]. The origin of Chongming Island (1267 sq.km) is principally based on the accumulation of alluvial soil particles brought by the Yangtze River. The island's topography is a low-lying plain; therefore, the ground water table is near the soil's top surface, and the networks of channels and ditches control the terrain's water balance. Qingpu District can be separated into the highly urbanised east and the rural west, and both case farms are located in the west, which is of low terrain with tens of lakes, and the soil has mainly originated in the organic mud that has settled down in the lake or the riverbed. The vast network of channels has been dug over the centuries to transport the residents and their goods. Historically it was the core part of the world-famous water town of South Yangtze River [37].

4. Results: Environmental Contributions of the Case Farms

4.1. Mengtian Farm

The Mengtian ecological farm on Chongming Island was established in 2009. It is a family farm with 3.3 ha (50 *mu* (Chinese unit of area, 15 *mu* equals one ha)) of farmland,

the majority of which (about 46 *mu*) is rented for their villager group. The farm is mainly managed by Chen and his parents: Chen is in charge of promotion and sales while his parents deal with all the field farming work along with the 5–7 hired local farmers. The produce is marketed with the stable memberships via online platforms.

Compared with other farms, there are the following significant differences in their farming practices.

(1) The plantation variety and the regular arrangement of rotations. They grow a total of more than 30 varieties of food crops, including seasonal vegetables and fruits (e.g., pea, bean, okra, white lentil, asparagus, carrot, pepper, sweet and eddo potato, strawberry), rice and wheat. Crop rotation is managed annually based on the farmers' experiences, e.g., potato planting is followed by the aboveground crops, vegetable plantation is regularly rotated with rice plantation. Crop rotation is precisely arranged in order to adjust pest control and to enhance the utilisation of soil nutrients, which is becoming increasingly important as chemical pesticides are given up in organic farming.

(2) No chemical fertilisers or pesticides. Mengtian Farm adopted organic farming in 2009 and has since tried its best to look for effective and affordable substitutes. At the beginning of its transition, it managed to purchase biogas slurry from a pig farm nearby, and it turned out to be a win–win situation: the pig farm saved costs for wastewater treatment, the farm had stable and effective organic fertilisers and the regional environmental pressure was reduced.

Biogas slurry was delivered by trucks, about 6 tonne each, and usually 10–20 trucks one time. We paid about 300–500 RMB (Chinese unit of currency, RMB (renminbi)) for 20 trucks (of biogas slurry). “We used over 1000 tonnes every year” (Chen's father, interviewed in March 2015).

However, pig raising was gradually forbidden at Chongming by the year 2018 and the farm had to find another substitute. Finally, they bought pigeon dung from a local farm and fermented it with water to generate biogas slurry, even though the costs increased by almost ten times and it was more difficult to use:

“I put pigeon dung into a cement pond, mixed it with water to get fermented. Then I pump it into land. It is not as good as the biogas slurry, as there are more impurities and the pump is frequently blocked by pigeon feathers” (Chen's father, interviewed in November 2019).

As the pigeon dung was much more expensive, Mengtian Farm could not wholly depend on it as before. Thereafter, it planted broad beans intensively as green manure crops. Normally, it is required that 9 kg seeds is planted per *mu* land, while the farm plants as much as 22–25 kg/*mu*. These crops would then be ploughed into the mud and fermented into fertilisers for the field.

Pest control without chemical pesticides is a major challenge for the farm. As the biological pesticides are not stable and the old farmers have difficulty using them properly, they have tried and experienced all kinds of available means, such as manual picking, pouring hot water onto the land, spraying pepper water and equipping moth-killing lamps (Figure 1a). However, it turned out that none of these is effective enough and they depend greatly on picking by hand, suffering considerable loss all the time.



Figure 1. Pictures taken in November–December 2019 in Mengtian on Chongming Island, Miuer and Cen-gu Farms in Qingpu District in Shanghai: (a) light appeal equipment for flying pests in Mengtian; (b) the field view of Mengtian Farm, and behind the field, the stratified vegetation with bushes and trees; (c) the tiny field plots of Miuer Farm; (d) the clogs tree fence along the farm road; (e) the overview of Cen-gu Farm, where trees are growing along the lake; (f) part of the environmental treatment project of Cen-gu, a sedimentation pond.

(3) Integrated model of plantation and poultry raising. Mengtian Farm also raises a total of 200 chickens, 150 ducks and 15 sheep, which not only enriches the farm output (meat and eggs) but also makes nutrient recycling in the farm possible. For example, the residue or unsold vegetables could be used to feed ducks and goats, chicken and ducks help with pest control and the manure of animals could be recycled as fertilisers for plantation.

After ten years of organic farming practices, the environment of the farmland was significantly improved even though their contribution to a broader area is difficult to evaluate (e.g., the contribution to local water environment). According to our site investigation, soil hardening, common at the nearby modern farming fields, has been averted to soft and dark soil with many associated earthworms. Birds and even pheasants are returning for foods, as well as other wild animals such as weasels.

4.2. Miuer Eco Farm

Miuer Eco Farm in Qingpu District started their organic farming practices in 2015. It is very tiny, with a scale of 11 *mu* (0.73 ha), and all the lands are rented from the Cenbu Village as the owner, and Kang is a newcomer from urban areas. She hires 3 long-term local

farmers (all over 60 years old) with 5–10 seasonal employees. All their products, mainly vegetables, are not certified and marketed via online memberships.

Different from the other farms, Kang, who graduated as a master of ecology and worked as farm manager of two organic farms, has a deep understanding of organic farming. She also has farming skills. Therefore, even though Miuer Farm also depended on hiring old local farmers for farming, she arranges everything in detail and gives clear instructions to ensure everything is in accordance with her understanding of organic farming. For example, the farm managed to cultivate over 80 varieties of vegetables annually with such a small piece of farmland, e.g., cabbage, pea, radish, carrot, bean, okra, white lentil, asparagus, sweet and eddo potato, purple yam, spinach, broccoli, cauliflower and rice (Figure 1c). In addition, Kang offers training courses in organic farming, which is also an important income source for the farm.

Crop rotation is treated as a must and strictly implemented in Miuer Farm. Kang has divided the farmland into small units, weighed seeds, labelled them and told local farmers to do the plantation. Equipped with ecological knowledge, she was very clear about the plants and pests and has tried her best to control pests via rotation. By offering significant variety, she also satisfies the online members, which are gradually increasing in number.

No chemical fertilisers in organic farming also presents a big challenge for Miuer Farm. According to Kang, there should be a balance of organic matter between the input to and output from the land, which means about 2 tonnes of organic fertilisers per mu is required for one rotation of vegetables, and the total demand for organic fertilisers might reach as high as 40–60 tonnes annually if there are two to three rotations. At first, she reused and fermented mushroom sticks from a nearby farm, but it was neither enough nor stable. Therefore, she purchases commercial organic fertilisers available in the market. The overall quality of commercial organic fertiliser is low and the cost is high, but is acceptable with governmental subsidies. Kang has the knowledge to choose an appropriate one, and she has managed to mix and re-ferment them with straw and animal manure, which also helps release the environmental pressure locally, such as the risk of straw burning and air pollution. Green manure crops are grown every winter as well. Kang chooses *milk vetch* as it not only generates beautiful landscape but also provides a breeding ground with nitrogen-fixing effect. With the heavy input of organic fertilisers, the soil quality of the farm is improving significantly.

“The soil is very loosened. At first the soil was agglomerated, as hard as stone. Now it is loose. These are earthworm manure—the more, the more loose the soil is. It also contains lots of natural antibiotics that inhibits germs” (Kang, interviewed in December 2019).

For pest control, Kang also explores the solutions best for the farm. With her knowledge, Kang adopts different methods for different kinds of pests. For example, equipment such as moth-killing lamps and bug nests are used to control moths using phototaxis. Pest predators are introduced by growing fennels, which turned out to be quite effective to control the *larvae*. Lots of white fungi are sprinkled to parasitise pest and control the insect density. When the pest has spread out of control, biological pesticides permitted in organic farming should be applied. In addition, Kang tries to set up pest–predator chains in the farm by introducing predators and increasing farm diversity. None of these ways is effective enough by itself, and manual picking remains as the last solution. However, with the advantage of the professional knowledge, Kang managed to reduce the labour requirement on the farm.

Kang also spent great efforts on rebuilding the ecosystem of the farm, which makes Miuer Farm unique among those small-scale organic farms. The first step was to integrate vegetable plantation with animal raising, same as what has been done at Mengtian Farm. However, due to local governmental restrictions, raising of pigs, chickens, ducks or goats is forbidden in the farm. Finally, Kang decided to raise rabbits instead, which eat the vegetable residues, produce meat and provide urine and manure for fermentation. Secondly, Kang planted hedges for the farm with a local clogs tree (Figure 1d), with special emphasis on

providing habitat and shelters for beneficial insects during ploughing, such as lady bugs and mantis. She called it an ecological corridor of the farm. Thirdly, Kang spent great efforts to restore the habitat for species in the farm and enrich farm diversity. For example, she left the ditches covered with water plants and made it suitable for frogs and dragonflies to live. Fennels are grown in the farm to attract and raise a local beautiful butterfly, and bees are raised to increase pollination and inhibit pests.

“(There are many) Pest predators in the farm. For example, I grow fennels in the farm to attract Jin-shan-feng-die (a beautiful butterfly). This year many larvae appeared . . . but all were eaten by their predators. I used to pick up some pupas of cabbage butterfly, and almost all of them had been parasitized by parasitic wasps.” (Kang, interviewed in December 2019).

The Miuer farm is located along the channel, which is connected to Lake Xiaofengyang nearby which is part of the Drinking Water Source Protection Zones of Shanghai. Therefore, the environmental contribution by replacing modern agriculture with small-scale organic agriculture is more valuable. Miuer Farm has earned a high reputation due to its remarkable practices among other small-scale organic farmers, consumers as well as local government.

4.3. Cen-Gu Eco Farm

Cen-gu Eco Farm is also located in Qingpu District in suburban Shanghai. The farm was established in 2009 based on a local NGO, which is defined as:

“The farm is run as a company. (By doing this) we actually want to advocate a social enterprise model. So we registered a company to operate. . . . We are not only doing organic farming, but also try to experiment and advance wetland agriculture . . . I have a feeling that there should be enough profit to push the changing of farming practices of farmers, both small-scale and large-scale” (Shen, Leader of the Cen-gu Farm, interviewed in July 2016).

Cen-gu Farm cultivates around 30 varieties of seasonal vegetables, e.g., cabbage, carrot, sweet potato, eddo, okra, asparagus and rice, in its total area of 9.1 ha (136 mu) (Figure 1e). The hired local farmers are in charge of cultivation, plantation and harvest as well as packing and delivery, and Shen is mainly in the charge of marketing.

Cen-gu Farm’s production depends on commercial organic fertilisers and consumes as high as 50 tonnes annually plus 5 tonnes of rape seed cake and 2–3 tonnes of animal manure. Usually, they were mixed up and refermented in order to improve the fertility of commercial organic fertilisers. Pest control is a big problem for the farm. Methods such as installation of moth-killing lamps in the field, the utilisation of sticky fly paper and spraying pepper water seems to have limited effects. One of the main reasons is that old local farmers cultivate with rather scarce organic farming knowledge, while leaders of the farm do not have sufficient time to give detailed instructions. Therefore, they could not identify proper methods for specific pests and the best timing for intervention. They have to depend greatly on manual picking, but the farm could not afford the labour cost—there are only 5–7 farmers dealing with cultivation, harvest and packaging, less than one-third of the estimated labour input required. As a result, many vegetables are left to be eaten by the insects, and the vegetable residues are not well recycled.

As Cen-gu Farm was established by an NGO targeting to protect the wetlands and drinking water source, and it is the only small-scale organic farm that has ever justified its environmental contribution [14]. Several ponds were dug in the farm for the experiment (Figure 1f), and the result was exciting.

“We practice organic farming, so we don’t have pollutions from the chemical fertilisers and pesticides. However, we still have nitrogen and phosphorus discharge from animal raising, organic composting, etc. We have done some experiments to test the contribution to water quality. In summer, water quality in the Lake Xiaofengyang is about Grade V, while the water discharge of the farm is

about Grade III or IV . . . In winter, the water quality is about the same, mainly Grade IV." (Shen, Leader of the Cen-gu Farm, interviewed in July 2016).

Several cows and geese are raised on the farm, though basically for tourism purposes as the farm randomly holds nature education and other activities for families.

With the support of the NGO, Cen-gu Farm pays less attention to profits and more on exploring ways of sustainable organic farming. Because of its relatively large scale and subsequent output, Shen has tried hard to expand sales and has established cooperation with kindergartens, primary schools, companies as well as e-commerce platforms (Yi-Mi-Shi-Ji). It also provides the possibility of leaving lands uncultivated for one-third of a year, which helps improve fertility and biodiversity.

5. Discussion

5.1. Adopted Environmental Practices—Plant Protection Is Most Challenging

The environmental practices of the three case farms, which we saw when we visited the Shanghai area in late autumn 2019, are based on the traditional Chinese ecological farming style. This is based mainly on the diversified spatial cropping system with rotation [9,19,31]. These case farms do not utilise any chemicals, but their organic production is uncertified. It is prevalent among small-scale organic farms globally, due not only to the high costs of certification but also the failing reputation of organic certification [56]. Instead, all the farms claim that onsite visits and monitoring are welcome all the time, and they believe that stable memberships rely more on their understanding and involvement with the farm, and public trust in the shorter food chains is one of the reliable factors for food safety [12,28].

The crop diversity varied among the case farms: Miuer Farm in Qingpu has a diversity of around 80 varieties/0.73 ha; Mengtian Farm on Chongming has around 30 varieties/3.3 ha, and Cen-gu in Qingpu has around 30 varieties/9.1 ha. It is to be noted that the number of varieties was only stated by the farmer. However, the differences in the number of varieties were visible during our farm walking tour of the late autumn season. There were also some differences in the rotation system: Mengtian practiced potato and aboveground crop rotation, whereas Miuer followed detailed rice-vegetable rotation plans, because the soil is in good health for Solanaceae plants (potato, tomato, pepper) after rice. The Miuer farmer also recommended sowing the vetch after rice as a green manure to fix nitrogen and to attract butterflies. Cen-gu Farm's rotation was stated to be practiced according to the experiences of farm workers, but no example was given.

Livestock husbandry is practiced to a lesser extent due to regional and national restrictions [7]. However, it is important for the nutrient recycling in the farm as vegetable residues are consumed, meat and eggs are provided for sale and urine and manure are generated for fermented slurry. Farm animals also attract visitors, especially families with children. Green manure crops are planted in all three farms; however, the commercial organic fertilisers are the main nutrient sources for the crops in the Miuer and Cen-gu Farms in Qingpu.

Even though methods for plant protection are similar in the three farms, such as installation of moth-killing lamps, the effects are different. With adequate knowledge, Miuer Farm managed to maintain a healthy farm biosystem in a tiny area and clearly knew which methods should be applied to control specific pests. Therefore, even though the manual weeding and picking off moths and snails is required, the labour input is not as much as for other two farms. Farmers of Mengtian and Cen-gu Farms are retired local farmers and mainly cultivate according to their experience. The young leaders have no background of farming and could not be as instructive as Kang. Overall, the gap in knowledge and skills led to varied productivity and costs as well as contribution to the environment.

Another environmentally friendly practice of the case farms is the management of their vegetated margins. It is widely known that these buffer strips prevent soil erosion and nutrient leaching into waterbodies [43,46–48,51]. The clumps of bushes and trees also

create habitats for wild fauna and flora that offer habitats for the vegetable pests' natural enemies and diversify the farming landscape [31,35].

5.2. Consumer–Producer Trust and Shrinking Profitability

The major challenge regarding the environmental contributions in these small-scale organic farms is from themselves—whether they could survive in the market [14,28], as most of them remain in the unstable stage of pioneering. Because of their high cost and high price, their produce has no advantages in the local market and depends much on online memberships, most of which are based on atypical trust relations. One of the farms used to have over 100 members as it was broadcasted on a local TV program, while this decreased to 50–60 as people could rarely distinguish organic foods from ordinary foods.

“We don't know why they left. It's possible that they feel no direct improvement (of their health) after trying our vegetables, and hesitate to pay a high price. But how could organic vegetables be that effective? We earn little money actually. (in organic farming) the more you invest, the more you have to lose.” (That's why we do most of the work in the farm by ourselves) (Chen's father, Mengtian Farm, interviewed in December 2019).

Mengtian has gained a reputation from foreign newspapers and Shanghai TV stations (Washington Post 1 November 2010; China Daily 15 June 2015; Global Times 12 October 2015), but it remains vulnerable [28]. The economic situation limits the possibility to maximise production and multiply the environmental benefits by enlarging farm scale. For example, Chen's parents firmly gave up the chance of taking another 50 mu of farmland nearby, as the larger, the more risky, which can sometimes develop into a vicious cycle: high production cost leads to high price of the product; high price leads to unstable membership; unstable membership increases the overall production cost; and the farm has to charge more to overcome the cost. Such a phenomenon is more obvious with larger farms like Cen-gu. Shen always spends most of his efforts looking for customers, and there are changes among consumer members all the time. The increasing economic pressure not only presents challenges for sufficient farm management but also harms the capacity of hiring enough farming labour. Relatively, Miuer Farm with a much smaller area faces less economic pressures. Convinced by Kang's expertise in organic farming and farm ecology, members of the farm are increasing steadily. However, the major challenge for Kang is that she is incapable of enlarging the investment in organic farming. Therefore, the environmental contribution within Miuer Farm is limited.

It is remarkable that in this vague situation, these small-scale organic farms without certification manage to create trust in their safe food via online membership, which solves the challenges of long distance between producers and consumers. However, mechanisms to enhance such mutual trust should be further developed to overcome the knowledge gap of consumers regarding organic farming and the disadvantages of word-of-mouth promotion.

5.3. The Lack of Professional Knowledge and Policy Support

In order to study the environmental contributions of the case peri-urban farms, it is also necessary to observe how motivated and skilled the farmers are in managing their farming. The in-depth interviews proved some trends: the Mengtian farmers (Chen's parents) on Chongming Island are experienced with traditional farming knowledge, and they learn organic farming from other farms as well as consulting one of their relatives, who is an agricultural expert, while there have been no governmental instructions or training for them. Cen-gu Farm is faced with similar problems. Even though plans are made according to the knowledge of the NGO-based enterprise, cultivation remains dependent on the local farmers' understanding of farming. For example, they follow organic farming rules, but only a few methods were used against pest infestations, and farmers have little knowledge about different pest species. In addition, without efficient management from the leaders, farmers have little motivation of learning as it is different from what they have experienced.

In Muier farm, with the background of ecology, Kang is quite special among those small-scale organic farmers. Kang puts the ideas of wetland protection, habitat restoration and ecological corridor, among others, widely into practice by advising the hired workers, which significantly contributes to the farm biosystem. Furthermore, detailed crop rotation is made possible to improve both the productivity and overall biodiversity of the farm.

“We plant five vegetables in such a small plot every time . . . the management is very complicate . . . it places big challenge for the manager. Now I am in charge of this myself. You have to evaluate and decide what to plant every day, and list clearly the requirement of plantation (for the farmers). Or they will plant it with over high density, or lack of density. Every time I weight carefully the seeds with balance, tell farmers how and where to plant, and make sure the density is properly maintained.” (Kang, Miuer Farm, interviewed in December 2019).

Therefore, we claim that the availability of extension services to provide professional training is the most challenging factor for influencing ecological and uncertified organic food producers in managing their farms in an environmentally friendly manner. In order to cultivate organically, farmers must have adequate knowledge about soil health, the species of plants and their pests and the ecosystem of the farm, which serves as the base of cultivation, management and intervention. However, organic farming is always treated as going back to the traditional way, and the lack of proper knowledge is universal:

“It is people who do not know how to practice. Agricultural universities do not necessarily offer teachings on how to cultivate. Few people really understand the cultivation and keep up with (new knowledge)” (Kang, Miuer Farm, interviewed in December 2019).

None of three farms have ever gained technical service or training offered by governments. According to our survey, there are no such training programs or extension services available:

“Generally, there are some agriculture trainings organised by the township government, mainly for conventional farming, not for us. No organic training provided and we have to explore by themselves. Many organic farmers actually know little and gain no good experience to share, with poor performance. We have been the better one than others, both in the quality and varieties” (Chen’s father, Mengtian Farm, interviewed in December 2019).

Considering the different practices in the three case farms, there is a strong need for providing training and technology services in organic farming to the small-scale organic farms. Due to the externality of ecological and environmental contribution of organic farming, especially in the protected Drinking Water Sources Zone, it is the responsibility of agricultural and environmental institutions and local governments to provide these public services. Currently, the only available support is the subsidy for purchasing a limited share of commercial organic fertilisers, which is far from being sufficient.

6. Conclusions and Further Research

This study defines preliminary trends as one of the first case studies about the environmental practices of small-scale ecological farms in suburban Shanghai. We interviewed and observed how three uncertified ecological, organic farms cultivate their crops against weeds, pests and plant diseases, and how they managed the waterbodies and environment around their farms. The variations between the case farms were with their crop diversity and rotation but, principally, with the farming skills of how to manage pest infestations and plant diseases. The main factor influencing the ecological farms’ profitability and, therefore, the farmers’ ability to enhance a healthy farming environment is based on their professional skills. Training and policy support for the chemical-free food production are absent. We agree with other studies of Schumilas [9], Smith & Siciliano [38] and Ding et al. [14], which addressed their concerns about the state level of which the subsidy system favours large-scale commercial and certified organic farming. Moreover, we highlight that extension services for sustaining healthy soil properties are especially necessary for productive,

environmentally friendly farming and should be provided for all Chinese ecological and organic farms.

We would recommend further research focusing more on not only the farming practices of Chinese ecological production but also on the certified organic and conventional farms. This information would be necessary to assess and monitor the probable differences in the environmental contributions between different farming systems. The baselines, e.g., the soil qualities of the different systems, should be measured regarding soil fertility, organic matter, soil biota and especially the harmful substances that are defined as risks for healthy food production. Moreover, it is of utmost importance to manage the farming environment as a holistic ecosystem along with profitability. It is our responsibility to share knowledge about safe food systems and, furthermore, to enhance the public trust in food production.

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