FARMING IN TOMPKINS COUNTY, NEW YORL STATE, USA - ARE THERE RELEVANT IDEAS FOR FARMING IN XIANGYANG CITY, HUBEI PROVINCE, CHINA

A Thesis

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by

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ABSTRACT

In order to be ready to face the food security caused by the population growth in 2050, the United States and China as the two largest food production countries should both make progress together and contribute to the development of mankind. At the same time of increase food production, most of the world pays more attention to the protection of ecological environment and sustainable development of agriculture. This article introduces the agricultural system of Tompkins County, NY, USA from four factors: natural features, land management, marketing, and national policies. The discussion includes the similarities, and differences between Tompkins County and Xiangyang City, Hubei Province, China on how they build their agricultural system, to see what information can be brought. By learning the agricultural systems of these two regions, people who want to engage in agriculture and farm operation will have a basic understanding of the agricultural industry.

BIOGRAPHICAL SKETCH

Siying Huang was born in Xiangyang, Hubei, China on July 15th, 1998. She completed her bachelor's degree of Food Science at Iowa State University (ISU), Ames, Iowa. During the time learning about food industry and human nutrition at ISU, she shaped her interests in agriculture and life science, specially focused on food security, food nutrition and sustainable agriculture. Subsequently, she enrolled the program of Master of Professional Studies degree in Soil and Crop Science at Cornell University under the guidance of Dr. Peter Hobbs in Ithaca, New York. At Cornell, she focused on systematic learning and understanding of soil, crop, and pest management and how to develop sustainable ecological agriculture within these management practices. The experience helped her find the direction of her future career pathway in develop sustainable agriculture.

ACKOWLEDGEMENT

I am very grateful for this experience at Cornell University, all the people I met during this program are very nice and gave me emotional support. I would like to express special thanks to my advisor Dr. Peter Hobbs. He was very patient to help me complete my capstone project and guide me through my MPS program. He pushed me forward and gave me professional advice on how to improve my skills.

I give thanks to Monika Roth; she offered great help in the completion of this project. I interviewed her about the management and marketing of agriculture in Tompkins County. She took me to visit the local dairy farms, CSA farms and farm markets. In the process of completion, it also gave me a lot of help in writing and gave me great confidence.

I give thanks to Dr. Tim Setter and Dr. Jonathan Russell-Anelli. They showed me their professional skills and cared about my progress. Tara Reed took my project forward and helped me a lot when I first came to Cornell. I also want to thank all my friends and family who supports me all the time.

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INTRODUCTION

Project Objectives

The first objective of this capstone paper is to understand the structure of agriculture in Tompkins County in New York State by researching and describing the types of farm operations, crops and livestock grown, marketing, input use, credit availability, land ownership, extension advisory system, farmer problems encountered, and other factors that must be taken into consideration for farmers in this county. The second objective is to discuss the relevance of farm operations in Tompkins County for Chinese agriculture. The third objective relates to my career goal to operate a farm and engage in sustainable agriculture when I return to China. By learning about agriculture in Tompkins County, I will be better prepared to operate a farm in the future.

Background – impetus for learning about agriculture system

In the future, people will face the problem of food security, with rapid population growth, food production will need to increase by at least 70% to feed 9.1 billion people in the world by 2050 (Bishopp & Lynch, 2015). Increasing agricultural output while maintaining sustainable environmental protections will be a major goal for agricultural development. China and the United States are two prominent agricultural countries; they are innovators in new crop varieties, agricultural technology, agricultural products, markets, and consumer issues. There are many similarities and differences in the

structure of the food and agriculture sectors in these two countries in terms of agricultural systems, policies, nature of society, technological developments, and the complexity of product networks (Veeck et al., 2020). Sustainable agriculture is the direction of transformation and development that all countries around the world pay attention to. In the face of non-renewable resources on the earth and the increasingly severe ecological damage caused by human activities, how to increase food production under the condition of ensuring food security and green ecology has become the world's major goal, and this is what these two agricultural powers need to work on together.

First, we need to understand agriculture, and the factors that affect plant growth. Natural climatic factors, including temperature, rainfall, and sunshine duration, all contribute to crop yield. Climate affects crop growth by impacting plant phenology, physiology, and water requirements, which directly determine yield (Wang et al., 2016). Climate also affects water availability, but allocation of irrigation water, water price, water-saving technology, irrigation methods and other adaptation measures are important water management issues. Increased demand for water caused by climate change will exacerbate the water crisis in many parts of the world facing water shortages due to economic and population growth (Wang et al., 2016). Increased agricultural irrigation has caused a drop in water tables in many areas, so environmental sustainability is an inevitable factor in future agricultural development. For different provinces and states in these two countries, each has specific climate issues to be addressed.

Soil is another important factor for plant growth. Soil provides nutrients, water, air,

and space for plant growth. Different soil characteristics such as soil type and soil properties determine what crop are suitable to grow. Soil compaction affects the growth of plant roots and permeability resulting in negative growth and yield. Soil health and fertility also have a significant impact on crop yields. Doran has said: “Soil health is the ability of soils to function as vital living systems within ecosystems and land use, maintain plant and animal productivity, improve water and air quality, and promote animal and plant health” (Doran & Zeiss, 2020). However, soil degradation due to intensive human activities is negatively affecting soil health in many countries. Other human activities affecting soil quality include overgrazing, soil erosion, soil salinization and desertification. Adopting sustainable soil management practices by farmers will be needed to overcome these issues now and in the future.

It is necessary to develop a management plan based on the needs or characteristics of crops. Each crop has its own suitable growing environment and planting requirements. Farm managers need to make detailed management plans based on the above conditions. Even if the same crop is planted in the same area, different management methods will bring different yields. Marketing research by farmers is also necessary before a product is put into production since supply and demand will indicate if a product can be sold. Some agricultural products, especially vegetables and fruits, also have a short shelf life and storage and advance sale channels becomes important.

Agricultural development in both China and the United States is closely related to national characteristics and government policies. China's agricultural sector has undergone changes since the founding of the People's Republic of China, including

institutional transformation, policy restructuring, technological progress and more. China's land ownership and farm size and form are very different from that of the United States due to national policies. In the face of increasing supply and demand and environmental pressure, how can we adjust the present agricultural government policies to better ensure food security in future?

METHODOLOGY

Data and information for this paper was obtained by interviews, farm investigations, literature, and personal understanding. In the first stage before writing, my advisor Peter Hobbs helped me to I decide the main concept of this paper. We came up with list of topics to address and developed an outline for this paper.

In the selection of regions, I chose to learn about US agriculture in Tompkins County (TC), New York, and focus my discussion on the differences between the agriculture system in TC and China in Xiangyang City (XY), Hubei Province. Cornell University is located in TC, where there are professional and comprehensive farms to study, and Cornell University located in TC is a leader in agriculture education provided many resources. XY is my birthplace and the place where I grew up for many years. I have a good understanding of the local climate, and it is also the location where I hope to develop my agriculture career after returning to China.

In developing this TC content of the paper, I interviewed Monika Roth, who is a retired extension agriculture educator at Cornell Cooperative Extension of Tompkins

County in Ithaca. Monika gave me a more comprehensive understanding of the agricultural system of TC and took me to visit different types of farms and marketing strategies in TC. At the same time, I read reports about TC, which helped me to understand the agriculture of TC in a more detailed way. The paper is based on information about TC agriculture based on a literature review and analysis of published government data obtained from libraries, published documents, and information provided by Monika, and my own understanding.

The first part of the paper is an introduction to TC's geographical location, ecological environment, natural resources, agricultural system, markets, and policy. The discussion in the second part of this paper is based on comparing Tompkins County agriculture with my understanding of XY agriculture

RESULTS

Description of Agriculture in Tompkins County, New York

Size & Location

New York State is in the northeast of the United States. TC is in south-central New York State, the latitude and longitude of TC is 42.4576° N, 76.5488° W. In Figure 1 below shows where TC located in New York, and where New York is located within the United States. TC covers 467 square miles, contains 16 municipalities, and had a population of 105,740 in 2020 (Geographic and Demographic, 2001). The county's population is concentrated in the town of Ithaca. Ithaca is a college town that houses

Cornell University and Ithaca College. Farmland accounts for 30% of the county's land area.

Figure 1. Maps of Tompkins County's location within the U.S. state of New York (top) and New York's location within the U.S. (bottom). Source.

Topography and geology

The geology of TC dates back to the Ordovician period, and the collision of

primordial continents which created mountainous regions, with remnants that make up the modern Appalachian Mountains. TC lies in the Allegheny Plateau section of the Appalachian Region with land sloping down to the Cayuga Lake valley. The topographic variation between northern and southern TC is largely due to glacier movement and stream sedimentation (Schoen, 2016). The lower terrain of the northern part of the county is a vestige of glacial advance and forms a relatively flat plain at an elevation of 300 to 450 meters while the southern part is dominated by rough Devonian lithography and the steep hills ranging from 120 to 640 meters (Flinn et al., 2005). The average elevation of Tompkins County is 424 meters with a maximum of 640 meters. The glacier-receding terrain left narrow deep canyons, plateaus, and hills in between; agriculture was concentrated in the valley and plateau areas.

Water sources

TC is located at the southern end of Cayuga Lake, one of the Finger Lakes. 80 % of the water in TC flows into Cayuga Lake. TC is situated around the southern portion of Cayuga Lake and surrounded by hills to the east, west and south side. Water resources are relatively abundant in the county, with abundant ponds, streams, and the lake. Many farms have on-site water sources such as a pond or well. Ground water is another major water source. Rainwater is stored in aquifers which are then tapped by well drilling. Wells provide potable water for livestock and supply people's homes, whereas ponds are used for irrigating vegetable and fruit crops. Annual rainfall (average 38 inches) contributes significantly to replenishing the county's overall water supply.

Precipitation

According to precipitation data from the Northeast Regional Climate Center at Cornell University, TC gets about 38 inches of rain on average every year which is sufficient for most needs for the county. Table 1 shows the sum of monthly precipitation in 2021, and the average for the past ten years (1991-2020). Winter precipitation in TC is mainly dominated by snow. Figure 2 illustrates that rainfall begins to increase from the springtime when temperatures rise. The most rainfall is concentrated in the summer, from July to October.

Tompkins County receives enough rainfall throughout the year to allow field crops to grow without irrigation. Therefore, field crops such as corn, soybean and hay are not irrigated in Tompkins County. Timely rain is more critical for growing vegetables especially at planting time. Most vegetable farmers can irrigate crops when needed. Berry crops may also need irrigation in Tompkins County, whereas tree fruits may not need as much given deeper roots. Large orchards in New York State generally irrigate tree crops, but not in Tompkins County due to the smaller size of orchards.

Table 1. Monthly precipitation in inches for 2021 and the average of past 20 years at Ithaca.

Data source: Northeast Regional Climate Center at Cornell University.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Monthly, 2021	1.84	2.43	1.19	3.88	4.05	4.42	6.32	6.24	5.23	7.35	2.69	2.26	47.9
Average (1991-2020)	2.23	1.98	2.78	3.40	3.20	3.98	3.90	3.77	3.83	3.70	2.94	2.57	38.3

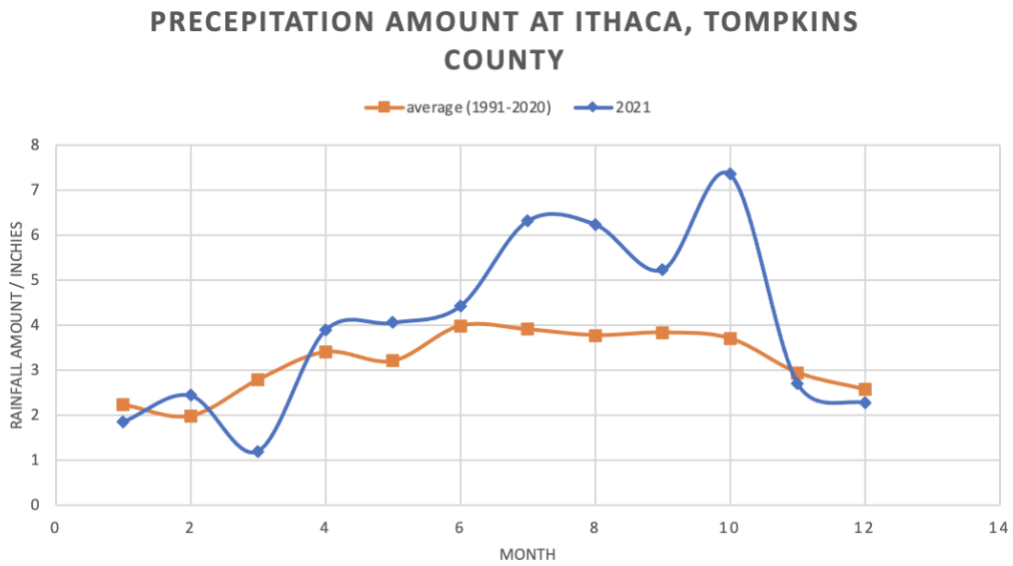

Figure 2. Monthly precipitation summary for 2021 and average of past 20 years at Ithaca. Data source: Northeast Regional Climate Center at Cornell University).

Temperature

TC is in a Warm-Summer Humid Continental Climate zone, also known as a Semi-Cold Climate, that covers the central and northeastern portions of North America, Europe, and Asia. Climate in TC is characterized by brief, warm summers, and long, cold snowy winters, with cool temperatures between seasons. The main reasons for TC's unique temperature are latitude, longitude and topography (lakes and hills). The downtown area has an elevation around 122 meters and most of the farming areas have an elevation around 366 meters. There are subtle differences in temperature at different elevations in the county. For every 100 meters increase in elevation, the temperature drops 1.26 degrees Fahrenheit. The terrain and altitude contribute to temperature variation in the county.

Cayuga Lake also impacts the surrounding climate, bringing benefits for agriculture. It has the greatest impact in areas near the shore and in the downtown area of Ithaca, where temperatures can be up to 10 degrees warmer than those in the surrounding hills.

Freezing temperatures start in early fall until late spring. Table 2 shows the monthly average temperature in Ithaca in 2021. The first column shows the average monthly temperature in 2021 and the second column shows the difference between the average monthly temperature in 2021 and the average monthly temperature in the past decade. The monthly mean temperature from 1991 to 2020 can be found in the third column. Ithaca's monthly average temperature is above freezing in March, however warmer

temperatures are required for most plants to grow. Temperature determines when to start planting and the growth cycle of the plant. The frost-free growing season generally runs from May 10 to October 5th in Tompkins County. To extend the growing season, many vegetable farmers use greenhouse and hoop house growing structures to grow fresh greens all season long.

Table 2. Monthly temperature for 2021 and average for past 20 years at Ithaca. Unit C °. Data source: Northeast Regional Climate Center at Cornell University.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean,2021	-3.5	-5.6	2.0	7.1	12.4	19.6	20.1	21.5	16.8	13.2	2.9	1.3
Departure from normal	1.6	-1.2	2.4	0.6	- 0.7	1.5	-0.4	1.83	1.2	3.7	-0.7	2.9
Normal (1991-2020)	-5.1	-4.4	-0.4	6.5	13.1	18.1	20.5	19.7	15.7	9.4	3.7	-1.6

Impact of climate change on the growing season

There is a warming trend that can be seen in Table 2 above, which shows that the average monthly temperature for eight months in 2021 was higher than the average for the past two decades. The growing season has become longer as a result of warming temperatures. For example, farmers commonly only harvest hay crops 3 times a year,

now it is common to cut hay four times a year. Farmers also reported that they are using longer season varieties of corn to take advantage of this situation.

Growing degree days differ every year. Growing degree-days is a calculation method used to estimate the growth and development of plants during the growing season. Maximum, minimum temperature of the day and the base temperature for plant growth is required for this calculation.

Even if the air temperature starts warming up in late March, the soil temperature is still too cold for many crops to grow. Soil temperature is a critical factor; most crops require a minimum soil temperature of 10 C °. During late April to mid-May, the soil starts to warm up sufficiently for planting most crops. However, a late spring frost is common so some vegetables such as tomatoes and other warm season crops are best planted after the middle to the end of May. Late spring frosts can also be damaging to orchard crops if blossoms are damaged, resulting in lower yields, or in some cases resulting in no fruit for that season.

Soil formation

The formation of Tompkins County soil is the result of glacial retreat. The darker brown areas in Map 2 below are farmland with prime agriculture soil mainly located in the northern part of the county on the green areas. There are about 40,000 acres of prime soil. The northern part the County has soil that contains limestone deposited during glacial retreat (pH greater than 6.5), as well as, a relatively gentle terrain and fertile soil suitable for agricultural production. The southern part of the county is dominated by

rugged hills and an undulating landscape with an elevation of more than 1,000 feet that is more suitable for growing grass or hay crops. Drainage is another important soil factor for agriculture. Farmers can use the USDA Soil Survey to locate the soil information on their farms.

Prime soils have the best combination of physical and chemical characteristics for agricultural production and with minimal inputs of fertilizer and lime can produce good yields. Prime soils are characterized by having a neutral pH, high nutrient supply capacity, good structure/texture, well drained (or when artificially drained), flat to gently sloping, and significant depth before reaching bedrock. Figure 3 and Figure 4 in the next two pages depict general soil associations. In the northern green areas are soil series for prime soil, they are Lima – Honeoye, Hudson – Cayuga, Hudson – Rhinebeck, Palmyra, Conesus – Lansing, Howard – Valois. These soils have good drainage and high in organic matter with a neutral pH which contribute to their suitability for productive agriculture in this area.

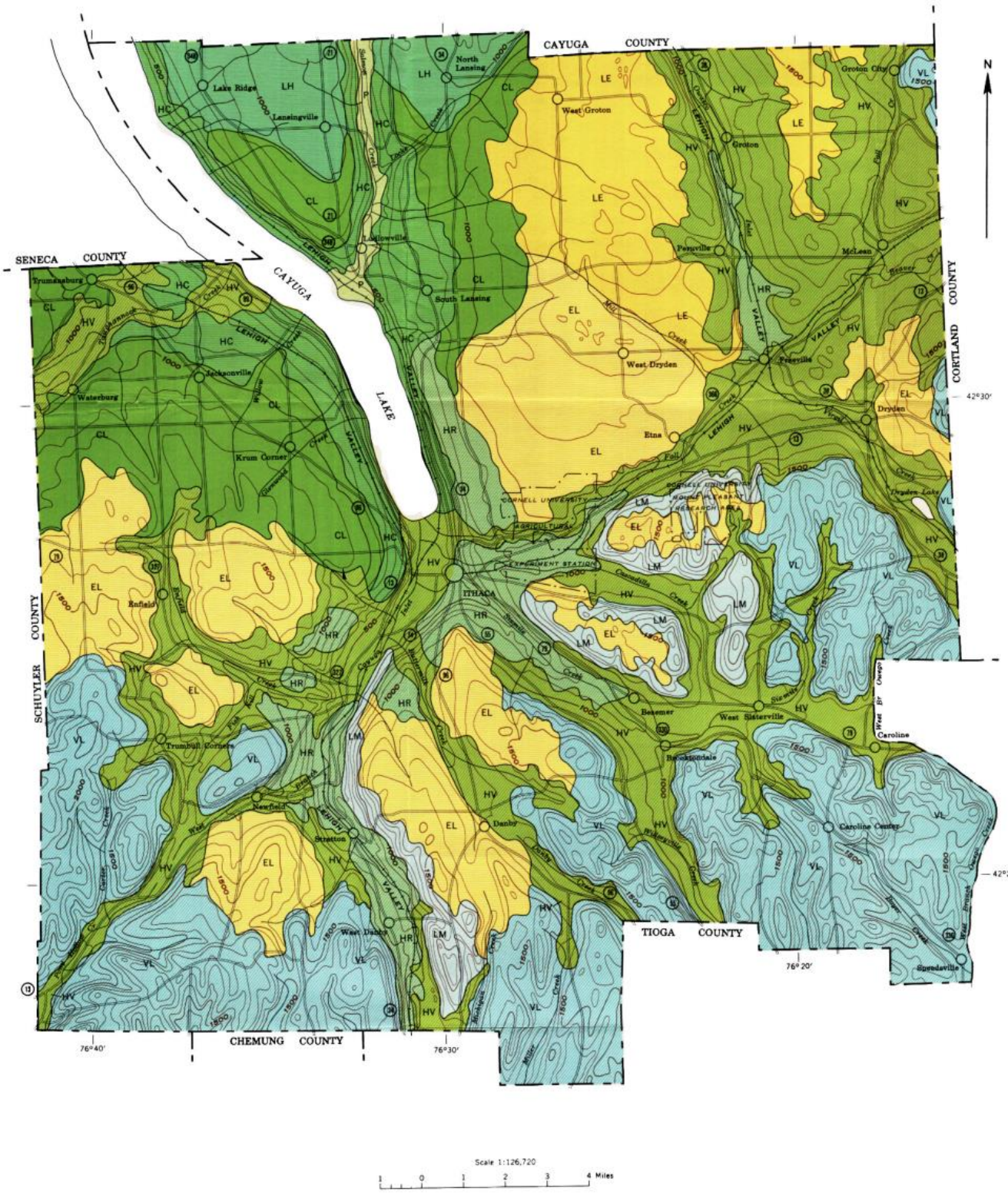

Figure 3. Map of general soil distribution of Tompkins County. Source: Soil Survey of Tompkins County, New York (1965).

Figure 4. Continued Legend of Figure 3. Soil Association of General Soil Map of Tompkins County. Source: Soil Survey of Tompkins County, New York (1965).

Farming in Tompkins County

Tompkins County has a diversity of farming enterprises in terms of both type and size. There are large commercial dairy and crop farms, as well as mid-sized and small farms of all types. According to Monika Roth, retired Agriculture Extension Educator, the diversity of agriculture is a major strength of agriculture in the county. Large farms provide jobs and keep most of the farmland in production, smaller farms raise food that is primarily sold locally to consumers thus providing a measure of food security for the county.

Livestock Production

Dairy Farming

According to TC Ag & Farmland Protection Plan, dairy farming is a very valuable agriculture industry sector in Tompkins County. Dairy farmers operate the most acreage of land and they produce the highest value of market products. The entire dairy industry has created many jobs in Tompkins County, with an average worker to cow ratio of 1:45 and an estimated 200 full-time jobs.

Dairy farming has dominated Tompkins County agriculture since the 1950's when cow numbers started increasing as milking operations became more modernized. Over time, dairy farm numbers have declined but the farm operations in terms of land farmed, and cow numbers are much larger. Today there are only 40 full time dairy farms in the county shipping milk from their farms.

Dairy farms range in size from 50 cows to 3000 in a herd. Holsteins, or Holstein

crosses, are the most common breeds. Based on New York National Agricultural Statistics Service 2010, the annual milk production of TC reached 197.5 million pounds, 19,800 pounds per cow. As herds have become larger, animal waste has become an environmental concern for dairy farms. Manure is a good resource and can be used as crop fertilizer as long as the application process meets the requirements of the federal government. In addition to milk cows, there are significant numbers of young cows and dairy males that are sold for beef. In addition to producing milk, most dairy farms raise all the crops needed to feed their herds and will buy the minerals and protein needed to make a complete nutrient feed.

Milk is generally sold to a dairy cooperative; dairy farms have a contract with the cooperative and a hauler comes to pick up milk on a daily basis depending on the size of the farm. The milk market has always been strong but does fluctuate resulting in unstable returns. In recent years, the demand for milk at home and abroad continues to grow, and the milk price has been stable. Therefore, dairy farms are generally financially stable and able meet their farm expansion plans, though the competition for agricultural land is very intense among large dairies and may limit their ability to expand.

Because of strict facility and licensing requirements for dairy processing, most of Tompkins County's dairy farms send whole milk to processing plants and distribution centers. Cornell University has its own dairy farm, “Cornell Dairy” and processes its own product, then sells it on campus and to a local store. A few small dairy farms in the region do their own milk processing and sell products directly to the public or via small

stores. There is a challenge for a small dairy farm to sell their products to stores because most large stores already have a contract with a dairy supplier. Only one farm in Tompkins County is currently making cheese on a very small scale.

Since 1990, several dairy farms in the county transitioned to organic production because of the price premium. To become a certified organic dairy is a 3-year process to convert both the herd and the cropland to all organic production methods. At the peak, TC had 7 organic dairies, but several have retired, so now there are 4 lefts, including one very large organic dairy with 3 farms and 1500 milk cows.

Dairy Farm Visit - Walnut Ridge Dairy, Lansing, NY

Walnut Ridge dairy is one of TC's three largest dairy farms, with 1,720 dairy cows and 700 young stock. They also raise breeding cattle for better genetics and for sale.

About 1500 cows are milked three times a day. A view of the rotatory parlor is showed in Illustration 1 on page 21. Cows spend about 310 days a year producing milk, with a dry period of more than 50 days. The average cow can produce 95 pounds of milk a day. The computer on a rotary parlor detects the activeness of cows which can determine whether the cows are healthy or not.

Cows stay in the barn all year round. In the winter, there will be more calories added in the cow's diet, and the temperature in the barn is warm and comfortable. In summer, the ventilation inside the barn is increased and a sprinkler system is used to cool the temperature down. If no measures are taken to prevent heat in summer, the milk production will drop by about 20 pounds. Cattle waste is stored in the lagoons to

make manure which will reduce the need for commercial fertilizer input.

In addition to milk production, the farm has 2,300 acres of agricultural land which includes: 1,400 acres for corn, 200 acres for pasture, and the rest for alfalfa and grass mix. Most of the crops are used to feed cattle; the farm also makes silage. Because TC is suffering from a drought this summer; all the corn plants will have to be made into silage, and they will have to purchase corn meal to feed cows. Normally they raise some corn to maturity and harvest corn kernels from ears to make corn meal.

The farm used to use bST (Bovine somatotropin, a growth hormone naturally produced in cattle) to increase the production of milk. Now they use BMR (Brown midrib) corn silage. BMR is a specialized corn that is more digestible and the whole plant can be consumed. Even though it is harder to grow, it can increase the milk production. Cattles are fed a TMR (Total Mix Ration) diet where all the meals are mixed by a machine that calculates the nutrients needed in the mix.

Walnut Ridge Dairy is member of Cayuga Marketing LLC where most of their milk is sold. Cayuga Marketing is comprised of 29-member owners who own and manage the dairy farm business. Farms ship milk to the Cayuga Milk Ingredients plant in Auburn, NY where the milk is further processed into many protein components to make baby formula or other milk products that are easy to store and export. Surplus goes to warehouse storage as a dried product and is sold based on market demand.

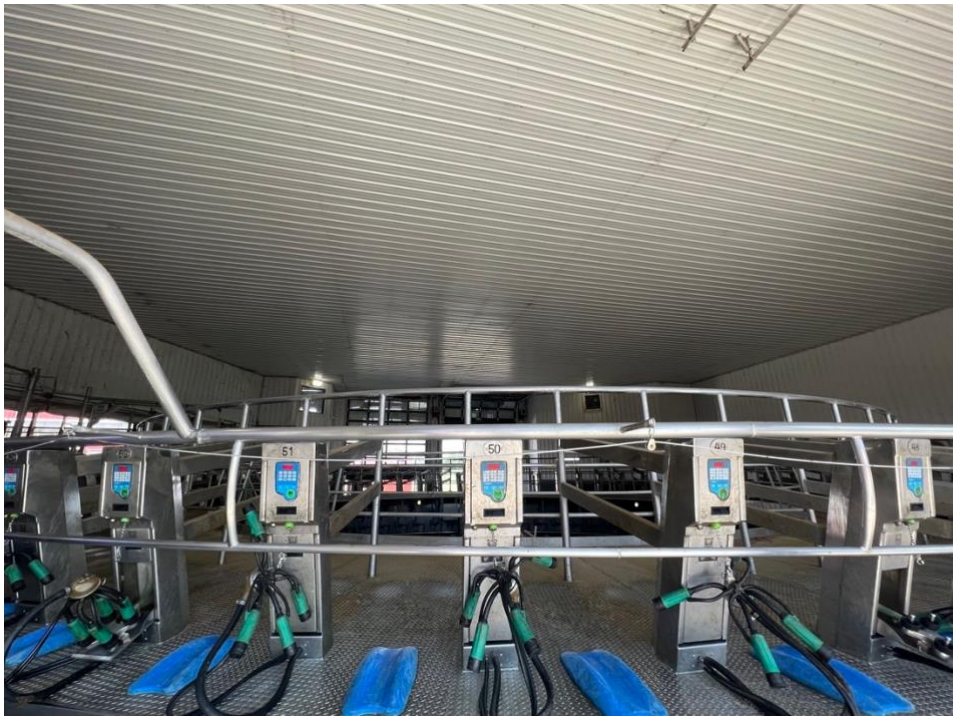

Illustration 1. Rotatory parlor in Walnut Bridge Dairy, Lansing NY.

Livestock (other than dairy)

In addition to dairy, there are many small part-time livestock farms with beef, sheep, pigs, and poultry. Table 3 on page 22 & 23 shows the types of livestock enterprises operating in TC, their market value, and the number of farms. According to the market value data, the value of dairy sales is far higher than that of other types of livestock sold. Beef production is the next most common livestock on farms, but herd sizes are small, and most are raised on pasture instead of in feedlots common in the western USA. Sheep are the next most numerous animal species, mostly raised for meat (lamb) and wool. There are only a few pig producers in the county selling at a commercial scale, and chickens are generally small home-based enterprises. Some vegetable farms may raise pigs or chickens so they can feed surplus vegetables and

obtain manure for fertilizing crops. Only a few people raise goats for milk.

All of these livestock, except dairy, are raised and sold within the region direct to consumers or, in the case of both dairy and beef breeds which may be sold at a Livestock Auction. Local meat such as beef, pork and chickens tend to be sold direct from the farm or at the farmer's market. "Meat Suite" is a website for information about where to buy local meats in New York State. Farmers can create a profile on the site and the public can contact them directly to make a purchasing arrangement.

Only 2% of meat purchased locally is from area farms. The limitation on meat production is the lack of easy access to meat processing facilities. Scheduling an appointment for slaughtering animals and cutting meat may require an appointment be made a year in advance. Larger meat producers avoid this problem by selling animals at an auction or directly contract with large processors.

Table 3. Animal farms type & market values in Tompkins County, 2012. Data source: USDA Census of Agriculture.

Enterprise Type	Market Value ($1000)	Number of farms
Poultry and eggs	$60	71
Cattle and calves	$5,334	123
Milk from cows	$37,831	55
Hogs and pigs	$211	18
Sheep, goats, wool, mohair, and milk	$430	56

(Table 3 continued)

Horses, ponies, mules, burros, and donkeys	$713	16
Other animals and animal product	$122	35

Crops Produced & Marketing in Tompkins County

Field Crops

Crop production in TC is dominated by agronomic crops used to feed animals. As dairy herds expand, the need to grow feed crops has increased resulting in the large acreage and market value attributed to corn, soybeans, hay, and small grains (see Table 4 below for the breakdown). Some crop farmers that do not have animals may sell corn and soybeans to dairy farmers or on the open market, or on contract to grain companies.

Table 4. Major crops in acres in Tompkins County. Data source: Census of Agriculture, 2017

Major Crops	Acres
Forage (hay/ haylage), all	29,931
Corn for silage or green chop	7,478
Corn for grain	4,821
Soybeans and beans	3,077
Wheat for grain, all	1,673

Pasture acreage is made up of a variety of grasses that animals graze. Farmers usually fence their grassland into sections with animals grazing in one section and once finished they are rotated into another section allowing the grass to regrow. Sheep and beef are mostly raised on pasture, but some additional corn and corn silage and hay (alfalfa) is fed to dairy and beef cows.

Table 5. Crop Farm types & market values in Tompkins County, 2012. Data source: USDA, Census of Agriculture

Enterprise Type	Market Value ($1000)	Number of farms
Grains, soybeans, hay	$8,310	110
Vegetables, potatoes	$5,396	66
Tree Fruits and berries	$555	39
Nursery, greenhouse	$4,242	54
Cut Christmas trees and short rotation woody crops	$237	15
Other crops	$3950	172

Vegetable, Fruit production & Sales Channels

The production of fruits and vegetables is primarily associated with smaller farms that sell directly to local consumers. Fruit and vegetable farms range from a few acres to 200 acres. Only a few farms are large enough to sell to wholesale accounts.

Vegetable farms in the area are very diversified growing more than 30 different

vegetable crops throughout the year, from leafy greens to root crops that are harvested and can be stored in winter. Because most of the vegetable farms in the area sell at farm stands, farmers markets, or via Community Supported Agriculture schemes (CSA), they must offer a wide variety of produce to attract customers for season long sales and purchasing. Many of the vegetable farmers in the area raise their crops organically based on customer demand. As mentioned before, for optimal growth, vegetables raised on area farms must be irrigated at some times during the growing season, and in particular in years of drought. A longer growing season, because of hoop house technology, has however, allowed vegetable farmers to enjoy a longer season of sales.

Apples are the main fruit type grown, but cherry, plum, peach, pear, and apricot trees are also grown. Fruit production is sometimes unreliable because of freezing spring temperatures during blossom time which may eliminate the entire season's crop. This is especially true for peaches, apricots and cherries. This lack of consistent fruit supply is a major reason why fruit is a small agricultural sector in TC. Most of the fruit produced is sold at the farmer markets or some is sold to local retail stores. More of the apple crop is being used for hard cider (alcohol) production and growers are planting some cider apple types. This has resulted in a flourishing cider industry with 3 cideries near the county's borders.

There are only a few berry farms with strawberries, raspberries and blueberries. These are very perishable crops and timely harvest is important; as a result, some farms choose to sell these crops by Pick-Your-Own – allowing the customer to come harvest.

Marketing

Marketing is mainly about finding sales channels. Farming for commercial purposes means that products need to be sold. Before producing a product, it is important to find an appropriately sized market where a producer can sell what he or she raises. Vegetables and fruit are sold direct to consumers using several methods. Direct marketing is strong in Ithaca and Tompkins County because of the long-standing Ithaca Farmers Market (1973) where only producers from within 30 miles of Ithaca can sell their products raised on their farms.

There are several market channels used for direct marketing: 1) sell at your own farms from a farm stand or fruit farms often offer the opportunity for customers to Pick Your Own crops reducing labor costs and making it more economical for the customer; 2) sell at farmer's market; 3) sell via CSA; 4) sell to local stores such as Green Star and P&C Fresh; 5) sell to restaurants (this is the least profitable market channel for farmers because of the unpredictability of sales); 6) sell to a distributor (who buys products from multiple farmers and has multiple customers who buy from them); an example is Headwater Foods in Rochester who buy vegetables from local farmers and has customers throughout NY.

CSA stands for Community Supported Agriculture. CSA is a kind of "agreement and commitment" between the farmer and consumer. Subscribers pay a fee to the farmer before the production season starts, and the farmer commits to planting the food. Subscribers will receive a weekly box of produce or other farm goods. This includes seasonal fruits and vegetables but may also include breads, eggs, milk, meat, honey, or

other products from local farms. Some CSAs also offer opportunities for customers to pick products that are in surplus or time consuming for the farmer to pick.

The remaining crops shown in Table 5 are not for human consumption. Ornamental nursery and greenhouse crops are mostly sold locally for property landscaping. This is a viable economic sector of TC agriculture but is not the focus of this paper.

Price

The main factors causing the price fluctuation of agricultural products are the relationship between supply and demand, but also production and distribution cost. USA is the largest exporter of agriculture products where the price can be influenced by international supply or surpluses. In addition, there are some differences in the price of the same food in different local markets. The price of vegetables is set locally with the price in the store; some of the product costs more in the store, some costs less due to its processing and other marketing factors.

Farm and Farmers' Market Visits in Tompkins County

Full Plate Farm CSA, Trumansburg, NY

One of the farms I visited is the largest CSA farm in the area called "Full Plate Farm". The day I visited there were some customers who came to pick up their vegetables. The concept of a CSA Farm is quite new to me and may hold some potential in China. When you become a member or a CSA, you are committing to a weekly share of vegetables and fruits for the season. With a CSA farm, you can select fresh fruits and

vegetables picked on that day at a pick-up location held at a specific time every week. You can also choose home delivery service.

The first picture (Illustration 2) below shows the rules for how the CSA share pick up works when you visit “Full Plate Farm”. First, you check in after you arrive at the shop and then check the vegetable selection of the day. As shown in Illustration 3, some varieties of vegetables can be selected at will, while some types of vegetables and fruits are limited in quantity. You can then choose your food according to your own needs. Illustration 4 shows washer for vegetables. CSA Farms usually produce fresher vegetables since the products are harvested daily and there is a saving on shipping and processing time; this extends the shelf life compared to products from supermarkets. To ensure a fresh and varied supply of vegetables every week, a CSA Farm needs to plan the types of vegetables and when to plant. On the day of my visit, u-pick pea pods were available for customers to pick by themselves (You-pick), which not only saved labor costs for the farmer, but also provided entertainment for customers.

Illustration 2. "Full Plate Farm" rules.

Illustration 3. "Full Plate Farm" (Veggies for Today on June 15, 2022).

Illustration 4. Washer for veggies at "Full Plate Farm".

Nook and Cranny CSA Farm, Caroline, NY

Nook & Cranny Farm is a small CSA vegetable farm that has been operating since 2008. During this visit I toured the intensive vegetable production used by Bob Tuori, owner of this farm. After learning about Nook & Cranny's intensive farming practices, we were also given insight into the intensive level of farm business organization and management to operate this profitable small farm. The farm provides abundant and high-quality fruit to the community from April to December each year. The farm grows hundreds of varieties of more than forty types of vegetables. They sell vegetables at four different farmers' markets on Tuesdays, Wednesdays, Thursdays, and Saturdays, and provide vegetable supplies to CSA members on Sunday afternoons, to ensure the

supply of vegetables.

This CSA farm has an intensive level of organization of farm management. Bob has been working on this land for about 20 years and he is very familiar with the performance of every piece of soil in this farm, such as soil type, drainage, fertility and so he knows very well what vegetables are suitable for planting in each soil bed, like, the east side of his farm is sandy soil which is drier and more suitable to grow root crop like garlic, onions and potatoes. Sometimes there is only one day gap between harvesting the last crop and planting the next one, the timing is carefully planned. He creates maps of what has been grown in each seed bed and plans the sequence of planting to maximize his space. The maps help him track what was grown year after year to keep track of rotation.

Nook & Cranny does not rely much on machinery, the farm had about seven full time workers and a couple of local part-time workers; the working season started in April and ended in November, about 6-8 months later. Most work is done by hand: hand cultivation, hand seeding, hand harvesting and crop washing. He uses equipment for tillage and irrigation, including a rotary plow, BSC tractor and dripline irrigation system. For irrigation, they use the water from a well. The farm also collects the rainwater from the roof, about 600 gallons each rain. Rainwater has separate pumps for each line, and the water can be delivered to where it is needed.

This farm is organic, but not certified. The farmer uses row cover and rotation to avoid the spread of insects and diseases, and by having an effective rotation plan, the spread of diseases and insects is reduced. The farm is a good example of how to create

a small sustainable ecosystem. He raises several pigs each year who eat all the vegetables that were not sold in the market or consumed by people. Surplus vegetables feed the pigs, in return, pigs produce manures to make compost to bring nutrients to the fields.

Farmers' Market Visit –Trumansburg Farmers Market

Monika took me to visit a smaller Farmers' Market in Tompkins County called "Trumansburg Farmers Market" that opens from 4–7pm on Wednesdays (closed during winter season). Illustration 5 below shows how this farmer's market looks. Here you can buy some products from nearby farms, including fruits and vegetables, cheese, bakery, handicrafts, flower bouquets and ready to eat food from food trucks. Not only does it provide a place for nearby farms to display and sell their products, but it also provides an opportunity for residents to get in touch and connect with farmers. One of the problems with this farmers' market is that people use it as a place to socialize rather than spend money to buy food, so the farmers complain they do not make enough profit from it.

Illustration 5. Trumansburg Farmers' Market in Tompkins County.

Farm Management

Management is an important factor which farmers can adjust to influence the yield. In sustainable agriculture, improved management is an important way forward. We cannot change the uncontrollable natural factors and national policy easily, therefore, management practices become the key to achieving sustainable agriculture.

Pest management

In Tompkins County, the deer population is a threat to forest regeneration, but also inflicts significant damage to agricultural and horticultural crops. The main maintenance solution is the use of fencing though it is costly and so is rarely used other

than by a few vegetable farmers.

Pests, other than weeds, in field crops are somewhat limited may be controlled by treatments at planting. Vegetables and fruits have more pest pressure and require that farmers monitor crops and spray as needed, organic or chemical sprays may be used depending on the farm management practices.

Farmers of all kinds are increasingly plagued by new pests that threaten crops such as the Spotted Lantern Fly, Leek Moth, and many others that are spreading and limiting crop production. Farmers must pay attention to emerging pests and learn about ways to control them to avoid crop loss.

Weed management

The existence of weeds is a competitive relationship with crops in the field. The growth of weeds will rob the growth resources of crops like water, sunlight, nutrients and space, hence lead to the reduction of crop yield. (Curran & Lingenfelter, 2001). The most traditional methods of controlling weeds are physical methods such as mowing, cultivating and hand-removal. Mowing reduces weeds' ability to compete, depletes carbohydrate reserves in their roots, and prevents them from producing seeds. Mowing will be required several times a year in order to weaken the weed population. Cultivating done with a tractor mounted cultivator is common on many farms including organic farms. Hand removal of weeds is done by gardeners, but it is not suitable for large farms.

Herbicides are one of the most convenient and economical chemical weed control

methods available. However, herbicide use is not allowed on organic farms, and herbicide residue is a concern for many consumers. The use of herbicides is specific to the type of crop and weeds present.

Some recent research is focusing on biological control of weeds. This works by introducing insects, mites, nematodes, or pathogens to slow weed growth Finally, grazing by herbivores can be used to reduce specific weed problems such as using goats or sheep to reduce woody weeds in fields.

Nutrient management

Field crops grown in TC are fertilized using a mix of sources. Nutrients are generally applied based on the what the soil needs as shown in a soil test report and also based on what the crop needs. For some farms, only commercial fertilizers are applied, but some also apply manures if available. Many incorporate cover crops in their rotations as another source of organic matter.

Many vegetables farms in TC raise crops organically. These farmers use manures and cover crops as major sources of nutrients for soil and crop. Vegetable farmers buy manure from animal farms (it can be quite expensive), while dairy farms use manure from their herds to fertilize fields.

Tillage

Tillage is the process to prepare the seedbed for planting. It can help break up the soil layers if the there is a compaction problem. Tillage can be divided into primary and

secondary tillage. Primary tillage is the time between the harvest of the previous crop and the planting of the next, and it involves deeper soil depth tillage and results in a relatively rough soil surface. Secondary tillage is used to prepare a smoother, finer seed bed for the crop. Commonly used primary tillage equipment are moldboard or rotary plows and disks.

Many crop and dairy farms have adopted conservation tillage practices to reduce loss of soil structure and improve moisture retention in TC. Conservation tillage methods can be divided into no-tillage, with no mechanical use and maximum cover crop left on soil; rotational-tillage, instead of tilling the soil every year, tilling the soil every other or every few years; strip-tillage, where only the area where the seeds are planted are tilled, leaving the soil in between the rows untilled before planting.

According to Census of Agriculture 2017, there are 10% farms that operated no till and 11% of farms used reduced till in TC. Less or no tillage can leave crop residue on the soil surface as a mulch that reduces the rate of soil erosion and preventing the loss of water in the soil from the surface but can also help with weed control. The crop residues that are left protect microorganisms and animals like earthworms, enhance soil biological activity, and increase organic matter content. Conservation tillage also reduces the use of machinery which reduces fuel use and soil compaction. Conservation tillage is the leading form of managing arable land in the United States. It not only protects the soil, but also brings sustainability to the environment.

Crop Rotation

Crop rotation is a common field operation system in which different crops are planted in rotation on the same piece of land over time (more than one year). Crop rotation management can be based on the different requirements of different crops for soil nutrients, adding crops to the rotation that are beneficial for the next round of planting. Crop rotation brings benefits to soil such as increase soil fertility, increase nutrients availability, increase yield, increase biodiversity, and protect crops from disease, weeds and pest problems under a long-term practice. All the farms in Tompkins County practice crop rotation. A common crop rotation in TC is corn with soybean or alfalfa. Legumes (soybeans and alfalfa) have bacterial or rhizobia associations on root nodules that can fix nitrogen. The Figure 5 on next page shows the nitrogen fixation process: rhizobia fix the nitrogen gas (N_2) from the atmosphere turning it into a readily usable nitrogen source for plant uptake, and the plant produces carbohydrates in exchange for the bacteria.

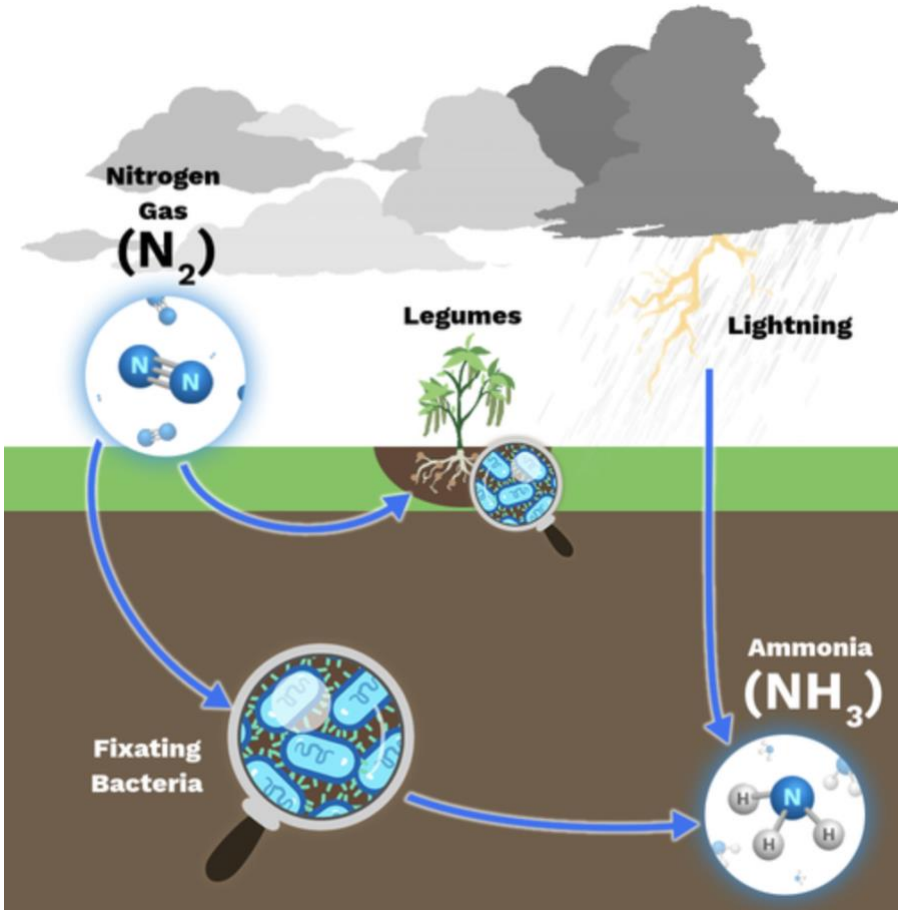

Figure 5. Nitrogen fixation process. Source.

Crop rotation requires you to understand the management mechanism of each crop so that you can plan your crop rotation better. In TC, there is only one or two crop seasons a year. There are already several fixed crop rotation patterns that occur over several years. The rotation for vegetables is more complex. Things you need to consider are nutrient needs, soil pH, soil type, and growth habitat of the vegetable. Another major reason to rotate vegetable crops is for pest, disease and weed control.

Cover Crop

Cover crops are being more commonly adopted by farmers in TC and are generally

planted in the Fall after the main crop harvest. The cover crops help protect the soil and improve soil structure and health. Winters in Tompkins County are too cold to grow any food crops. Cover crop is planted after crop harvest and depending on the species chosen either survive the cold of winter or are killed but in both cases the cover crop and roots are left behind to protect the soil. Cover crops can also be incorporated into rotational cropping systems to protect the soil while also serving as pasture. Common cover crops include grasses (e.g., rye, barley, oat, ryegrass, sudangrass, millet, and sorghum); legumes (e.g., peas, beans, alfalfa, hairy vetch, and clover); and other broad-leaved plants (such as buckwheat, radish, canola, mustard, marigolds, and kale) (Guo, 2021).

Organic Farming

Over 16,000 acres of Tompkins County farmland out of 50,000 acres of cropland are organically managed though they may not be certified by a certifying agency. In TC, most vegetables are grown organically, and these farms are following organic standards in their management practices, in the non-essential use of chemicals. Not all farms that follow organic or low chemical practices chose to become certified because of the cost or because they have a direct relationship with their customer and can explain their production methods. There are many small livestock farms that rely on pasture for grazing animals and therefore do not use chemicals.

Organic farming prohibits the use of artificial chemical pesticides, artificial chemical fertilizer, genetically modified organisms, animal and plant growth regulators

and other non-natural materials for their agricultural products, production, and processing. Organic and conventional farms have different management approaches in pest management; organic farms pay attention to the development of ecological diversity, cut off the transmission routes of viruses, or use biological defense means to attack pests with predatory insects like ladybugs, or parasitoids like wasps. The nitrogen sources of organic farms mainly come from crop residue, grass/clover leys, catch crops and cover crops, manures, and composts (Berry et al., 2002).

In field weed management, organic farms are prohibited from using herbicides. Biocontrol is a natural solution used in organic farming, in addition to traditional crop rotations, cover crops, mechanical weeding, and other management practices. Allelopathy, for example, is a biological method in which one organism produces one or more biochemical components and releases them into the environment to affect the growth, survival, and reproduction of other neighboring organisms. It plays a role in the cross-planting of a variety of plants. Other biocontrol methods include the use of competitive plants to suppress weed growth and using animal predation to control weeds in areas without crops.

All agricultural products must be certified before it can be labeled “organic” on the packaging. Certification of organic products in United States must comply with all USDA organic regulations and be supervised by a USDA NOP (National Organic Program) authorized certification agent. There are four different organic food labels, which also represent different standards of organic food production. The market for organic food in the United States is a subjective trend, with consumers seeing it as a

healthier and more environmentally friendly option. However, organic food costs more than conventional food; this purchase tendency is tied to affordability of customers (Prentice, Chen & Wang, 2019).

Machinery

Most of the arable land in the United States is flat and vast, making it ideal for mechanization, field agriculture relies heavily on machinery. The modernization of US agriculture began as early as the 1860's through a series of mechanical innovations addressing land management, sowing, fertilization, irrigation, weeding, harvesting and so on which not only saved labor costs, but also improved efficiency. Machinery can be farmer owned or rented/leased from a machinery agency or other farm. Now the mechanical agriculture development in the United States has come of age and is moving to the agricultural Internet Technology Revolution. The focus is on combining artificial intelligence, data analytics and connected sensors to improve productivity, better detecting and inferring subtle changes in the field.

Harvest

Most of the crop farms use machinery to harvest. Corn plants are harvested by chopping the whole plant and then place the harvest into silage bags, bunkers, or horizontal silos. Silage will undergo a fermentation process and last for a winter. Soybeans are always harvested for their beans. Alfalfa and grass hay can be harvested 3 – 4 times a season and made as hay/silage for feeding cows.

Almost all vegetables and fruits are hand harvested in Tompkins County, except for potatoes. Only 4 vegetables farms hire Hispanic workers for harvesting during the season and they share these workers between farms. Hispanic workers can be found on almost all dairy farms in the county where they are primarily involved with milking, manure handling, and animal care.

Agriculture Agencies & Policy

A country's policies on land largely determine the pattern of agricultural development. Agricultural land in the United States can be purchased privately, and once purchased, the land can be inherited by their children, and can be owned forever. According to the USDA's National Bureau of Agricultural Statistics (NASS) Northeast Land Values report, the average value per acre of New York farm property ranges from $3,160 to $3,270, but this can vary greatly depending on the demand for land and prices paid for farmland either for farming or development. About 30 % of farmland is rented, and more than half of crop land is rented (Bigelow et al., 2016). The average farm size of New York state is 197 acres which is only half of the national average farm size (DiNapoli & Bleiwas et al., 2010).

Land ownership in TC

Agricultural land in the United States is privately owned, and landowners have the right to use the land in perpetuity; also, they can use the land at will. Half of the land that farmers work in Tompkins County is owned by farmers and the other half is

rented/leased from nearby landowners who may be retired farmers or who are not farming themselves. There is pressure occurring on farmland in TC that is caused by solar developers who want to use the farmland for solar panels. Normally land may rent for $30 to $100 an acre, but these firms are willing to pay landowners a rental price of $1000 to $1500 per acre which farmers cannot afford to pay or rent for farming. The price of farmland has also increased due to competition for land between farmers, especially dairy farmers who need lots of land to produce the crops needed to feed their growing herds and to spread manure. Land that was once $3,000 per acre may now be as much as $10,000 per acre. This makes it hard for new farmers starting out to find affordable land and, as a result, they end up buying cheaper less productive land which makes it harder for them to build a successful farm operation.

USDA & FDA

There are two main Federal Agencies that regulate agriculture in the United States, USDA (United States Department of Agriculture) and FDA (Food and Drug Administration). USDA develops and enforces laws and regulations related to agriculture, forestry, food, and rural economic development. FDA is a federal agency within the Department of Health and Human Services that oversees food safety, tobacco products, dietary supplements, prescription and over-the-counter drugs, vaccines, biopharmaceuticals, blood transfusions, medical devices, electromagnetic radiation, and more. USDA regulates meat, poultry, egg products, raw fruit, and vegetables, whereas FDA regulates most of the food supply including dairy products,

whole eggs, seafood, packaged foods, bottled water and food production. In addition to the regulation of raw food materials themselves, USDA focuses on the social, economic development and environment of the entire countryside, promoting rural commercialization and food production. FDA controls the whole process of food production, ingredients, and all chemicals. Together, these two federal agencies provide food security for people.

Other Agencies

FSA (Farm Service Agency) is an agency of USDA that provides information on agricultural programs that support farmers, ranchers, and agricultural partners. The primary responsibility is to provide credit and loan programs and administer conservation, commodity, disaster, and farm marketing programs. FSA provides farm loans, disaster loans and payments, price support and other subsidies to support all farm workers (Farm Service Agency Programs, 2016).

NRCS (Natural Resources Conservation Service) works on anything related to the protection of soil and water and provides funding to farmers through grant programs aimed at soil conservation and water protection.

Policy

The Farm Bill is the main legislation that governs all farm programs and policies administered by USDA Congressional Research Service. Farm Bill includes legislation that authorizes mandatory and discretionary spending for food and farm-related

assistance. Programs of the federal agencies are reviewed every 5 years when the US Congress negotiates a “Farm Bill”. The Farm Bill sets out the policies of the federal government in twelve titles. Farm bill provides discretionary funding for farm programs, rural development, food policy and conservation measures. Moreover, it also provides farmers with risk insurance in the face of natural disasters and promotes the development of agriculture and rural areas.

New York State Policies

New York farm policies are consistent with federal policies but do not duplicate federal programs such as price supports or loans. The State offers some grant programs administered through county Soil and Water Districts for environmental stewardship and water quality protection. Many farmers participate in these programs.

The State also has a goal to protect farmland through agriculture districts and farmland preservation grants. Agriculture districts are identified at the county level as areas where agriculture is the major activity. The Ag district program offer farmers and landowners that rent to farmers an incentive to keep land in farming through lower property taxes (agricultural assessment). Another important aspect of the Ag district program is the limitation of local laws that might restrict farming.

Farm Lending

Most farmers have operating loans that provide funds from year to year to buy supplies such as seed and fertilizer or other input supplies. Most commonly they

obtain a loan from the FSA – Farm Service Agency. Another commonly used agricultural lender is the Farm Credit Bank, which also provides accounting services to farmers. Some farmers obtain loans from commercial banks just like any other business.

Small farmers tend to operate without credit but as a farm grows, however, credit is almost always used to finance the operation from year to year due to the fluctuations in cash flow. There are at least 2 loan programs for beginning farmers that offer low interest rates, but a beginning farmer still must have the ability to repay the loan.

Crop Insurance

Crop yields depend on the climate each year, therefore some farms may purchase crop insurance or enroll in federal disaster programs to help with the risk caused by climate. Late spring frosts can kill tree fruit blossoms resulting in total loss of yield. Late frost can also mean that vegetable growers must replant frost sensitive crops like tomatoes or peppers. Excess rainfall can delay planting or harvest resulting in crop losses. The United States has a very detailed and comprehensive crop insurance program. For more information, please refer to the Crop Insurance Handbook published by USDA every year. This handbook covers every type of agricultural insurance available as well as, the responsibilities of farmers and insurance companies, the insurance quotas corresponding to various risks, the calculation of various units, price fluctuations, and the policy differentiation of different categories of crop, etc.

DISCUSSION

The second objective of this paper is to discuss the relevance of farm operations in Tompkins County (TC) for Chinese agriculture. The discussion will focus on the sustainable management of agriculture compared to large scale field crop agriculture. When comparing the similarities and differences between TC and Xiangyang City (XY), a first step is to gain a basic appreciation for each place. They are two completely different regions; therefore, many aspects are not comparable in the broad sense and the narrow sense. The third purpose of this article is to present the differences in agricultural systems in these two regions and gain a broad understanding of what is needed before you commit to having a farm.

Natural Features

Innate natural features determine the type, variety, distribution, quality, and yield of crops. All the natural features of an area impact agricultural production practices followed in this region. Environmental features should not be overlooked when studying agricultural systems in a new region. It is these natural features that determine the characteristics of the TC agricultural system. When comparing agriculture of TC and XY, it is important to understand how farmers in these two places make use of the unique local environmental conditions to develop their farm operations.

Size & location of XY

XY is a prefecture-level city administered by Hubei Province (Figure 6) and located in the middle of China with convenient transportation. The Han River (one of the tributaries of the Yangtze River) passes through the middle of the province. XY has jurisdiction 9 county-level administrative regions, including 3 districts, 3 county-level cities, and 3 counties. It covers an area of 7,616 square miles, and the urban area reaches 1,418 square miles. At the end of 2021, XY had a permanent population of 5.27 million. XY is about 16 times the size of TC. According to the population data, at the end of 2021, TC had 105,200 population, and XY is about 50 times the population of TC. And TC is only 426 square miles in area. This serves to illustrate a significant difference between XY and TC – population, size/area, and municipal government, therefore, they are not comparable in size and scope.

Figure 6. Map of Xiangyang City's location within Hubei Province and the location of Hubei Province within China. Source.

Topography

Topography explains why farming in TC is concentrated in valleys and on plateaus. Soil is more likely to be deposited in the valleys between the plateaus, where a thicker organic soil layer can be formed. Soil erosion carried by stream flow and rainfall is more likely to occur on slopes without the protection of vegetation, where the parent material of soil is more easily flooded away. And the plants in flat areas get more of the sun evenly. Flat land is also more suitable for the operation of machines, and convenient for large-scale agriculture. The agricultural areas of TC and XY are concentrated in the flat areas. But in addition to the flat land in XY there are also many small farms in the mountains that still rely on small equipment and hand farming. XY and TC both have hilly areas. TC is a county with an average elevation of about 424 meters while XY is on average 119 meters. XY has more plain areas (larger land areas), which contribute to a deep soil layer and flat soil surface to grow field crops. Ideally, XY has more flat land suitable for mechanized large-scale agriculture. However, China's large-scale agriculture started more recently than in the US, and agriculture in China is now transitioning to larger mechanized farming.

In summary, topography and soil conditions influence what type of agriculture is suitable for each area. For larger scale agriculture, level ground is more suitable for machinery to operate.

Climate

Climate influences temperature, rainfall, daylength, and growing season. These

natural features also limit the range of crops that can be grown, and farm management plans are based on climate and growing season. Both XY and TC are regions with four distinct seasons and the rainfall is mainly concentrated in the warm seasons, although snowfall is significant in TC in the winter months and adds to the precipitation. The average annual precipitation of XY is 34.6 inches which is very similar to TC (38.6 inches). XY is located at 32°N and belongs to the transition zone of subtropical monsoon continental climate, whereas TC is at 42°N. XY is situated at a lower latitude than TC, contributing to stronger solar radiation, warmer winters, fewer frost days and a longer growing season. In XY, average annual temperature is 15.1~16.9°C, and the average temperature during winter is above 0°C. The annual average frost-free period is 241 days. The annual temperature in TC is close to 8°C throughout the year while winter in TC is often below freezing, especially at night, and not suitable for crop growth. A warmer winter in XY provides a longer growing season, where vegetables and food crops can be grown year-round, and there are generally tow crops harvested a year. In the XY winter, mainly winter wheat and canola are grown, but vegetables can be grown with mulched film and in greenhouses, although some vegetables with better cold resistance can still be grown in the field in Winter.

In TC, cover crops, pasture and a small amount of winter wheat are left on the land during winter. Some vegetables are grown in winter in greenhouses and hoop houses that can moderate temperatures and even be heated. Cover crops planted in the fall are left in the fields in the winter to protect the soil, reduce soil loss when the snow melts, and provide temperature protection for the survival of soil microorganisms, which are

important for soil health. XY has sufficient light, abundant heat, and adequate rainfall, which all contribute to provide superior climatic conditions for agricultural production (Li & Lu, 2018).

In the summer of 2022, both places faced drought problems due to low rainfall and higher than normal temperature. This reduced harvests and crop yields in both places, especially for TC since crop irrigation is not used on field crops in TC. XY has reservoirs and lakes that are used to supply irrigation. The main field crop impacted by drought is corn. Corn is very susceptible to drought damage because insufficient water for cell elongation delays vegetative growth and causes yield loss. Corn in TC is generally grown for silage and grain; however, most was chopped for silage in 2022 as the grain yield was small. In XY, large fields are irrigated to reduce the risk of total crop failure. From this heat wave in 2022, we can also see the impact of global warming. Climate change will bring early springs and late falls, a longer growing season, and planting dates will need to be modified based on the temperature. A longer growing season benefits crop production by extending the period of photosynthesis and plants have more time to absorb carbon dioxide and slow the rise of carbon dioxide in the atmosphere. On the other hand, climate change may also affect precipitation and the frequency and severity of extreme weather events. The sustainable development of agriculture in the future will depend on climate mitigation strategies jointly adopted by the efforts of all mankind.

When choosing a location for farm, you need to know if the crops you want to grow are suitable for the environment. Either choose the environment and area according to

the crops you want to grow or choose the right crops according to the conditions you have. For example, some fruits are more acceptable in climates with large day and night temperature fluctuations that helps to accumulate sugar content, while other fruits are grown in warmer subtropical climates. Before starting a farm, this is something to think about ahead of time.

Soil

Most of the soil in Hubei Province including XY comes from alluvial and wind-blown loess material; some was also formed by weathering of rocks such as carbonate rocks and clastic rocks including shale, limestone, and Politic siltstone. The soil in TC was deposited from glacial retreat with agriculture farmland concentrated in areas of glacial tilth with high lime content that are well-drained and have a neutral pH . Soil color in XY is yellowish brown and called yellow-cinnamon soils (Li et al., 2013), as shown in Illustration 6 below. Yellow-cinnamon soil is deep, clay-loam texture, compacted soil that is suitable for agriculture. The clay in the soil allows it to retain water and fertilizer, making it suitable for growing aquatic crops, like rice and lotus root which are grown in XY.

Illustration 6. A leveled agriculture field in XY.

TC pays more attention to soil health and sustainable soil development. Farms in TC employ professional soil experts to regularly test the health of the soil. Cornell University provides a soil laboratory test called Comprehensive Assessment of Soil Health (CASH), which is designed for farmers, gardeners, agricultural service providers, landscape managers and researchers who want to test a soils property. A CASH assessment will be generated after the soil test, and it provides physical, chemical and biological information of soil: soil surface hardness, subsurface hardness, soil aggregates, available water capacity, pH, and organic matter, nutrient content and some biological properties. These indicators will give farmers information on how to manage and maintain their soil health. Compared with modern agriculture, organic

agriculture is more beneficial to soil health, providing more organic matter, carbon storage, better water retention capacity, richer soil biology and healthier soil (Xue et al., 2019). In XY, soil reports issued by each testing institution have differences in detail; the analysis is based on overall the soil chemical situation, including the indexes of nitrogen, phosphorus and potassium content, pH value, organic matter, moisture, salt, minerals, and heavy metals. Physical and biological properties are not measured at this time.

XY pays less attention to soil health, which is related to land ownership. Land in China does not belong to individuals, only to the state and the collective; farmers can only sign 30-year contracts with the state and renew them or sublet them from others, but it is difficult to determine how long you can own the land. Therefore, for farmers who only have short-term land use rights, they will not choose to spend time and money on land improvement. From the economic perspective, they choose to extract the maximum benefits from the land relying on inputs rather than soil building.

The soils of TC and XY are suitable for agricultural development. From the observation of the soil surface, the soil organic matter layer of TC is thicker, and TC also attaches importance to soil management to enhance agricultural production. Soil is the foundation of agriculture and having a healthy soil that contains microbes and nutrients, plus good physical structure will sustain higher crop yield and ensure food security. Everyone needs to realize the importance of soil.

Agriculture Products

The climate of XY is suitable for planting crops all year round, and it covers a larger area and spans a wider range of latitude and longitude, and as a result, the agricultural product variation in XY is more diverse than in TC. It is difficult to collect all the data in XY, because the province covers a larger area and has a large population base. Basically, all the plant species and animal species that can survive in the subtropical monsoon continental climate are included in XY. The main field crops are wheat, rice, and corn; and oilseed crops are peanut, canola, and sesame. There are more than 150 varieties of vegetables grown in XY, among them, there are more than 60 kinds of vegetables such as radish, cabbage, kale, lotus root and green onion, which are planted on a large area (Zhang et al., 2022).

According to the Statistical Yearbook of 2020 for XY, the main fruits are apple, orange, pomelo, pears, grape, kiwi, peach, dates, persimmon, and some other fruit types. Another important agriculture industry in XY is tea. XY has its own tea brand named "High Aroma Tea". The soil in the tea area is mainly composed of stone muck, subtype yellow brown soil, which has good permeability important for growth and development of tea. Furthermore, low spring rainfall in mountainous areas where tea is grown helps with fragrance even though low precipitation reduces yields. There is also wood production for use in building. The main forest products are raw lacquer, oilseed, rapeseed, turpentine, walnut, chestnut, and spices. The main livestock raised are poultry, pigs, sheep, cattle, and silkworms and the related products are eggs, milk, wool, and cocoons. XY is landlocked, but is also rich in freshwater aquaculture including fish, shrimp, crabs, and others (e.g., bullfrogs).

The main crop in TC is fodder needed to feed livestock, especially dairy cows, but some field crops are grown for human consumption. Corn, soybeans, alfalfa, and grasses are grown to feed livestock. Based on the Agricultural Census, 2017, food crops grown in TC are cereals, dried beans, vegetables, melons, potatoes, fruits, tree nuts, berries, floriculture, Christmas trees, and hay; some of the food crops like vegetables are grown in greenhouses and hoop houses. The animal industry includes poultry including eggs and meat, cattle, calves, milk from cows, hogs, pigs, sheep, goats, and wool.

In general, both places have a rich range of agricultural products and are similar in basic crop and animal products. The warmer climate and paddy fields in XY make it suitable for growing rice. Dairy farming is the highest value among the farming industry in TC. Abundant natural rainfall, cool climate and a great tradition of dairy farming makes a great place to produce dairy.

Summary

In terms of natural conditions, TC is located at a higher latitude than XY, so the temperature of TC in winter is lower than XY. Most regions in XY have two crops grown a year, while TC has only one, and no crops are planted in winter unless in protected and heated structures like greenhouses and hoop houses. XY has mainly yellow-brown soil. In terms of soil, the soil of TC is more fertile and more suitable for agriculture, which is related to the rich content of organic matter and limestone in the soil profiles of TC. There is greater emphasis on sustainable agricultural operation and

management of TC farms that helps better maintain the soil health. The main agriculture in TC is dairy, which brings the largest economic benefits. The crops planted are mainly for feeding animals. Both places combine local advantages to develop diverse agriculture.

Production Practices

Agriculture in the future will require it to be sustainable and ecologically friendly. There are several management practices that help farmers achieve these two goals. Production practices are the most important methods humans can control while there are factors beyond their control like the natural environment itself especially the climate.

Tillage

No-till (or reduced tillage) provides permanent soil cover with crop residues and crop rotation or diversification. Farmers benefit most from this system if they leave the previous crop residue on the soil surface and do not burn it. Recent research data has shown that no-till or reduced tillage results in increased soil organic matter by leaving crop residue on the soil surface from the previous crop or a cover crop planted after harvest of the food crop. Furthermore, crop residue reduces soil erosion and decrease soil compaction caused by machines.

In Tompkins County, a total of 10% of farms are implementing no-till, 11% of farms have reduced tillage, and 12% are using cover crops. Although 23% of farms are still using conventional tillage, many are realizing the benefits of no till, leaving the

residues in the field and growing cover crops, especially for economic and soil health reasons (Census of Agriculture, 2017).

Traditional farming methods in China use conventional tillage, moldboard plows and rotary hoes, crop residues are used as animal feed and household fuel (He et al., 2010). In XY, the surface soil is harder, most farmers still till the land for seed preparation. There are also some farmers who have adopted the management ideas of no-till and reduced-till which help them achieve good yields. Chinese agriculture is entering a transformation state, accepting new management ideas, and starting sustainable agriculture development.

Crop Rotation

Crop rotation is a management tool for growing different crops in the same field over several years. Examples of common crop rotations in TC include corn the first year, followed by soybeans in the second, and then winter wheat or alfalfa in the third year. Crop rotation is an important component of integrated pest/disease and weed management. It helps to prevent the buildup of these three problems by helping to break the pest/disease/weed cycles and also improve the biological health of a soil. In TC, the most used crop rotation practice is corn/soybean/alfalfa. Legume crops such as soybeans and alfalfa can also provide nitrogen to the soil through rhizobial bacteria associations with the roots of these legume crops; the bacteria fix atmospheric nitrogen in root nodules and in exchange for this nitrogen the plant supplies carbohydrates to the bacteria. The symbiotic rhizobia get nutrients from the crops in exchange for this

nitrogen (Guo, 2021).

Many farmers in XY do not choose soybean in the rotation, which is largely influenced by the international market. Soybean yield is low in XY, and the price of imported soybeans is low with good quality, which further depresses the local soybean market price. Farmers who choose to grow soybeans have less income than those who grow corn. China's non-GMO varieties of soybeans have lower yields, are less resistant to pests and diseases, and are more complex to manage in the field; it costs a lot more to grow than import, therefore, nitrogen-fixing crops such as soybean are not part of the mainstream XY crop rotation. In recent years, the Chinese government has stepped up subsidies for growing soybeans, which has encouraged some farmers to start, but much more is needed.

Organic Farming

Organic practices are implemented by a small number of farms in XY. According to a report of Xiangyang Radio and Television Station interviewing organic farmers in 2020, I learned about XY organic market. 1) “Donggongzhaizi” Rice Planting Cooperative of Nanzhang County, XY is growing organic rice. The yield of organic rice per acre is 60% lower than that of traditional rice. However, organic rice can be sold at RMB 41 per pound, which is much higher than traditional rice. The price range of traditional rice is also wide according to the variety, and the price of ordinary rice is generally less than 10 RMB per pound. The co-op's director shared their approach to physical pest control, using solar armyworm panels, which add solar panels and lights

to the traditional yellow and blue panels. In addition to attracting pests by spectrum during the day, it can attract pests by light at night, which is more efficient. 2) At Shangshanyuan Organic Farm in Nanzhang County, more than 30 greenhouses grow over 10,000 kilograms of tomatoes, eggplants, peppers, and cucumbers organically, which are shipped to all parts of the country every week.

These farmers pay more attention to environmental protection and the concept of sustainable agriculture. Organic farming is a model of ecological coexistence, without the use of any chemical products, using the diversity of organisms to achieve a state of harmony. Raising geese, chickens and other poultry in orchards control some fruit tree pests, but also produce manure as organic fertilizer to provide nutrients for trees. In addition, aquatic products such as fish, shrimp and crabs can be cultivated in rice paddy fields. They eat the insects and grass in paddy fields, purify the water quality, and achieve ecological balance and economic benefits.

Organic food certification requires that the production base or land in the recent three years has not received pesticides, fertilizers and other prohibited substances; also, that seeds are used without genetic engineering modification. Organic food certification bodies also verify through certification, that food production, processing, storage, transportation and point of sale and other links are in line with the standards of organic food. Applicants apply to the authentication center and pay the fee; detailed information of application processes can be found on Baidu encyclopedia. The validity period of China's national organic product certification is one year. To maintain the certification, a third party needs to inspect and audit every year.

Many vegetables growing in TC are grown according to organic standards, but some farms are not certified due to the cost of certification. Without certification, products cannot be labeled as organic, and cannot be sold to commercial outlets and stores. Many organic products are sold from the farm to the consumer, and customers are invited to visit farms to learn about production practices.

Education Level of Farmers

In terms of management practice, TC pays more attention to ecological protection and the development of sustainable agriculture. The Agriculture and Life Science College of Cornell University is a top agricultural college. As a result, farms in TC have easy access to current knowledge and technology in agriculture. The research office of the College of Agriculture of Cornell University also cooperates with farms in TC and the extension service is active in all NYS counties. TC is geographically located in this academic atmosphere and the farmers are much better educated on farming practices than those in XY. According to research done by Xiong in 2011, the average age in XY of the main labor members of a family is between 30 and 65 years old among the 323 rural households sampled, among which the 40-year-olds account for the largest proportion 58%, and 54% of the samples that only have a middle school education level (Xiong, 2011). Although XY also has universities and Faculty of Agricultural Sciences, the education level of the average agricultural worker is far below TC.

Summary

The concept of sustainable agriculture has been implemented more comprehensively and for a longer time in TC. Farmers realized that sustainable agriculture land management was a mutually beneficial process for both production and the environment. XY is now undergoing a transformation in agriculture. Traditional agricultural management in the past was based on the pressure of food security for the large population and most of farmers working in the field did not have the opportunity to receive higher education on sustainable agriculture. Farmers did feed a lot of people with their farming practices over time, but farming management practices need to be improved, and there are local attempts at organic farming and sustainable farming management. There are many planting methods that are different from traditional agriculture and will be popularized in XY. Now that XY is making changes, it needs time and process.

Marketing

The Market is informed by a variety of environmental political decision-making factors. Although there are similarities in the macro ways of market operation and sales, each region has its own peculiarity. Analyzing and learning the success pattern of other regions, and making innovation, is a way of social progress.

Marketing Methods

XY has a very complete industrial chain of agricultural production, processing, and

sales. There are several large-scale agricultural processing bureaus in Xiangyang, such as “Xiangyang Zhengda” and “Wanbao Grain and Oil”. For example, Wanbao Grain and Oil engages in acquisition, storage, processing, sales, and logistics, and therefore is a completely integrated system of agricultural companies. There are many grain and food processing companies in Xiangyang that buy grain from farms and then process and package food to create their own brands and sell it. In addition to grocery stores near residential areas, supermarkets can buy fresh fruits and vegetables, and farmers' markets are opened every day. An overview of a Chinese Farmers Market is shown in Illustration 7 below. Vegetables, fruits, and meat are often unpackaged at farmers' markets. Some aquatic products and chicken, duck and poultry products can be bought fresh and alive in the farmers’ market and the seller can process the products based on the needs of customers. Not all the sellers in Farmers Market sell the food they grow; there are also many sellers who buy vegetables from small farmers to sell in the market. In residential areas, it's common to see farmers bringing carts full of fruits, vegetables, and other agriculture products. You can buy local fruits and other regional fruits, such as some tropical fruits that are not locally produced.

Illustration 7. A Farmers' Market in China. Source.

Recent years, the price of fruit has increased greatly in XY. Many small fruit shops with exquisite packaging have appeared near urban residential buildings. The whole fruit can be placed in the store for customers to select, and then can be packaged and sliced according to customers' needs. But the fruits sold in these stores tend to sell at a higher price since many are imported or produced in a more suitable climatic region. Picking your own fruit is also a method that some orchards used to attract tourists in some cities.

Digital marketing is also increasing in popularity, for example, online shopping apps like "Hema" and "Meituan" provide fast door-to-door delivery services and the stores are offline operation, like the function of an app called "Instacart" in TC. Instacart is an APP that you can use to purchase food from stores and have it delivered to your

door within several hours. Nowadays, selling goods online in XY is also becoming common. Some farmers use live broadcasting to increase the exposure of their products to customers that saves many unsaleable agricultural products on “Douyin” (Chinese TikTok). Douyin is the most downloaded mobile application in China. The use of short video platforms such as Douyin to increase product exposure and increase sales is widely used in China, you can find almost all products on Douyin, and the price is very favorable. The platform is pervasive and has high transparency for this business company, thus, the competitiveness in the industry brings price advantages for the customer. Agriculture products entered the market of e-commerce platforms such as Douyin relatively late in China. Many farmers are older and have no experience with online sales, thus they are slower to accept new things than the younger generation. In the early stages of the COVID epidemic, offline trading was used, and the sales of many agricultural products had difficulties to market, especially the fresh vegetables and fruits with a short shelf life. On the contrary, vegetables and fruits were in great demand in cities. At this time, some bloggers with experience in sales helped farmers to sell through short videos and live broadcasts on Douyin.

XY and the whole country's grain sales use hard currency, so there is no need to worry about the sales channels. China has a huge population base, and its consumption is also large. XY has many local individuals and enterprises that purchase grain. Moreover, the minimum price policy for grain purchase provides a guarantee for farmers.

The marketing methods used in TC have been introduced in the earlier part-1

section. Except for the short video strategy, marketing channels used in XY are also used in TC. Meanwhile, TC has a sales mode that XY does not have at the moment, which is the CSA farm. A description of the CSA farm can be found in the prior section of this paper. To establish a CSA farm, it is important to recruit customers and establish trust that you will provide them with a weekly supply of produce. Customers must pay for the product in advance. Farmers need good land management, space planning, and time management skills for success. During the lockdown period in China, a similar approach was taken to provide fresh food for residents to choose and have delivered to them at customers' homes. I don't know if this has resulted in a demand for continuing this model after lockdown. Whether the model of CSA can be developed in China is a question that needs to be verified by the market. The competitiveness and implementation of CSA farms are difficult to realize due to the different social conditions.

CSA farms are not present in XY but have existed in China. Based on the experience of "Sunshine Farm", a CSA organic vegetable farm established in 2012, the difficulties of operating a CSA farm in XY are analyzed by Cao in 2016. CSA is still a new concept in China in most regions and needs improvement and innovation. The problems encountered in the operation of Sunshine Farm are as follows: 1) The concept of sharing benefits and risks between farms and members is not reflected. Members see the CSA model simply as a way to buy fresh, organic food for a healthy and high quality of life. There is no close relationship between the farmer and the members, and the members rarely visit the farm. When farms overproduce, the surplus is not shared with

consumers, and when they encounter risks, the losses are borne only by the farms; 2) The CSA market has not reached a viable scale, in order to ensure that the fruits and vegetables picked on the day of harvest reach customers, the distribution cost is too high and there are not enough customers; 3) There is a shortage of talent in CSA farms. CSA needs educated people or people who want to work on sustainable and innovative agricultural (Cao, 2016). At present, most agricultural workers in China are people with low income and low education. XY is a third-tier city in China where I have observed several large supermarkets, but there is no evidence of demand for organic vegetables in the store. There is no effort to authenticate and distinguish locally produced organic food in retail stores from non-organic sourced food. There are many farmers who use organic practices but do not use fertilizers, pesticides, herbicides, but they don't have this marketing mindset to differentiate their products as being organic. At the same time, the way residents buy vegetables is convenient enough. At present, there are sufficient food purchasing options and little market demand for CSA to be applied in XY

Summary

Both XY and TC have comprehensive and complete marketing systems, have similar agricultural market sales, such as wholesale market, supermarket, farm market, to customer, door-to-door delivery, etc. The specific business form of XY will have its own national characteristics. Unlike TC, XY has more individual farmers set up stalls for sale, and more targeted sales shops, such as those that only sell fruits, vegetables, grains, and aquatic products. Different from TC, XY has a short video way of selling

agricultural products, use mobile phone APPs with the largest number of users to increase the traffic, which helps solve the problem of unsalable agricultural products. This makes market prices transparent, expands customers, but increases competition. If local industries with local characteristics want to expand their market to other states, they can use the method of posting video to social media like Tik Tok to increase the exposure. The main marketing difference in TC is the CSA farm. For XY, CSA is a new business model that needs foundation and development. XY, as a third-tier city in China, it is unlikely that CSA will show up here before the practice is successful in other Chinese cities first.

Policy

Agricultural policy represents the development direction and support provided by a country in agriculture. If you want to develop agriculture in your own country, copy the successful cases of other countries may not always work, instead, you need to learn policies and find the best development strategy for your country. In the USA, federal farm policies are embedded in the Farm Bill which is legislation that has evolved over time and is renewed every 5 years. It covers both production and food assistance programs. States may have some additional policies that support agriculture, but the regulation can only enhance the federal policy and must not conflict. At the local level, there are no policies that impact farming other than land use control.

In China, the Central No. 1 Document, the first document issued by the Central government every year, has been released for 19 consecutive years from 2004 to 2022,

with a focus on agriculture, rural areas, and farmers. At the beginning of the year, the document lays out specific plans for rural reform and agricultural development in the coming year. Agriculture has been the focus of China's development in recent years.

Land Ownership

Land in China is not privately owned; all land ownership is with the state. Agriculture land was allocated to farmers in 1998 when the land contract period was 30 years. The next overall realignment of land resources will be in 2028. The authority of land is also clearly defined, and agricultural land can only be used for agricultural development. If the purpose of land is to be changed, an application for registration of land alteration can be filed with the land administrative departments of the Government at or above the county level in the place where the land is located. Land ownership has largely changed the mainstream consciousness about soil management in XY. Farms in TC are privately owned, and freely held. Managing soil health requires extra effort, time, and money, and the duration of improving soil conditions may be long. A farmer who leases land for a few years from someone else has no guarantee that the lease will be renewed, therefore investing money in soil improvement is less profitable and meaningless, which seems to be the case in China.

Government Agencies

Before 2018, the Ministry of Agriculture of the China Food and Drug

Administration was one of the departments directly under The State Council in charge of crop farming, animal husbandry, aquaculture, agricultural reclamation, township enterprises and feed industry. Since 2018, the Ministry of Agriculture has been abolished and the Ministry of Natural Resources, the Ministry of Ecology and Environment, and the Ministry of Agriculture and Rural Affairs have been established. The Food and Drug Administration in China is responsible for overseeing food, health products, cosmetics, and drugs. In the United States, food safety is regulated by the USDA and the FDA. Both China and the United States have sound supervision systems for agricultural food safety. Although there are differences in the details of implementation, both maintain the domestic food safety system. It can also meet consistent standards on food exports.

Government Support

The natural risks and disasters of agriculture include meteorological, ecological, geological, and biological. With global warming, extreme weather brings various natural disasters one after another. The risk management system in United States is more complete, composed of three major Programs: Federal Crop Insurance, Farm Commodity Programs and Agricultural Disaster Assistance. Together, these three systems are called the Federal Farm Safety Net by the American agricultural community. China also has agricultural insurance and natural disaster insurance, but the whole system is not as complete as the United States. It is difficult to supervise the actual implementation because there are too many small farms, and it is difficult to calculate.

Besides, the application period is not as long as the United States

China has a price protection mechanism for farmers' production. In order to reduce the impact of the international market on China's grain prices and ensure the interests of the Chinese people and the stability of the grain market, China has formulated the minimum grain purchase price policy, which allows the purchase of grain at the minimum grain purchase price even when the market price is lower than the minimum grain purchase price. This pricing is macro-adjusted by the state according to the influence of market supply and demand. On the one hand, it ensures the basic income of farmers, and on the other hand, it prevents food prices from rising too high in the international market, which may affect food security and inflation in China (when the cost of raw materials rises, the state provides economic subsidies to farmers).

China's policy in recent years has been to encourage the development of agriculture. According to the agricultural policy issued in 2022, financial services for rural revitalization will be strengthened. Government will give greater support to local but legal financial institutions that operate in counties, and whose funds are mainly used for rural revitalization by providing small loans and discounts to farmers and implement a more favorable reserve requirement policy. The Government will support various financial institutions in exploring medium and long-term credit models for agricultural and rural infrastructure.

XY is implementing the dryland reclamation project, which changes the abandoned dryland into a paddy field that can grow aquatic crops by pushing and irrigating the soil to increase the yield. To transform low-yielding dry land into

irrigable high-yield and high-quality paddy fields, the main construction requirements include land leveling, irrigation and drainage pipelining, and field road construction in rural areas. It's all funded by the government to build beautiful villages and attract the urban population to the countryside, which is now a development direction in China.

Problems

XY: Before the urbanization construction period, most of the population in XY lived in the rural area, and the farmland area allocated to each person was very small (<0.2 acres). Without large-scale farmland, at the end of the year, even though farmers work very hard to grow crops, their incomes are severely limited. In the time of construction and development of cities, farmland lost a lot of people who worked in the fields, because they could earn more money in cities. XY has been faced with the problems of loss of rural population, abandoned farmland and aging of farm population in the past 30 years.

Now the center of the country's economic development has shifted to the agriculture, it is easier for non-rural residents who want to work in agriculture to rent large-scale of land. Much of the countryside's abandoned land has been consolidated by local cooperatives and leased to others, integrated land areas are usually larger and more suitable for large-scale mechanical agriculture.

TC: One of the current pressures on land in TC is coming from solar energy companies who wants to place solar panels on open agricultural land, which could provide energy to the area. But at the same time, TC will lose good agricultural land.

The development of solar energy as a renewable energy source is good in nature, but it is also a different kind of loss if the land suitable for farming is taken away. TC faces a limited amount pressure from development, however, given low farm profitability, if there is demanded to buy farmland, many farmers are willing to sell their land.

Summary

The income of Chinese farmers is low. With the development of urbanization, rural land and farmer population loss became a serious problem. This was also accompanied by the burden of degradation of the ecological environment brought about by the rapid urbanization and lack of farmland development and management. In recent years, the Government has encouraged support for agriculture, but many of the provisions favorable to agriculture are only on paper, and the real implementation depends on the actual situation. In terms of retaining the farming population, China encourages farmers to stay in the countryside, but it does not solve the problem of low agricultural incomes. The rural population without agricultural knowledge can only be trapped in the countryside when responding to the call of the country. China still lacks more young, trained people willing to work in the countryside, because developing small-scale artisanal farming is not the first choice for them. The Government needs to provide more incentives and train young people with agricultural education to entice them to farm in the rural areas and be successful economically.

The development of agriculture in TC has been relatively mature. The United States has developed the consciousness of sustainable agriculture and green ecology much

earlier than China. In terms of policies, TC has not issued too many provisions to promote the progress of agriculture, because all aspects have been developed. Both the United States and China need innovation in scientific research technology and agricultural development thinking. However, now we are facing the problem of the loss of the agricultural population and the aging of farmers. The country should develop policies that encourage farmers and agricultural workers to farm the land.

How to start a farm

I interviewed Monika Roth, Agricultural Extension Educator, about some of the things you need to consider before starting a new farm in Tompkins County. The first thing you need is motivation. Having a relevant educational background or working experience in agriculture will be helpful in the beginning. Successful farmers are not just passionate but have the skills and experience to support the success of a business. You also need money to get started and maybe even start by renting land. Vegetable farms cost the lowest to start, since one acre is enough to get started. Vegetable farms do not have high requirements for equipment, they can be farmed by hand and when sales and customers increase, they can start to expand agricultural production. Poultry is a good place to start an animal enterprise. Dairy Farming needs a large initial capital investment of at least $500,000 to start. Loans are also an option for many start-up entrepreneurs, but require property collateral, such as land and other assets. Agricultural loans will not be easy to get, depending on your experience in agriculture, whether you have a solid business plan, and whether you have mortgageable property. So, in TC, a

lot of new farmers start with a small farm if they don't have a family farm or enough assets. The Farm Service Agency and Farm Credit are two farm support agencies to help with the loans. Farm service agency provide $35,000 for newer farmers and Farm Credit has a program that provides up to $50,000 as agricultural assistance in the form of a loan and business advice. Loans from a family member is another option. Agricultural equipment will also be a big expense, and a second-hand tractor can cost $ 10,000 dollars. A combine for harvesting corn may cost $100,000, and there will be additional equipment and startup capital needed if large-scale field crop planting is to be started. If labor is needed for farm expansion, it is necessary to follow labor regulations. Farms in Tompkins tend to not employ labor or employ as few laborers as possible because of cost and regulations that must be followed; they often keep labor within their own family members which limits expansion. At some CSA farms, the members may work on the farm to get a reduction in price. Cornell Cooperative Extension agriculture educators help both new and existing farms get answers for business and production questions. Extension offers classes and guidance to help the farmers with their business plan and problems with agriculture.

Things to consider before starting a farm.

1. Know about the natural resources of the farm, get the data about the topography of the farm, the altitude, the climatic characteristics of this region, the characteristics of the soil.
2. Visit nearby farms and talk to farmers and learn about the kinds of crops they grow,

how they manage them. Learn about field operations and marketing.

3. Visit local government, making connections and finding out what local policies they offer to support a new farm.
4. Find out how to obtain agriculture loans.
5. To learn more about China's agricultural policy, visit nearby agricultural universities and see if there are professors and experts who can help with agricultural knowledge.
6. Identify where to buy seed, fertilizer, livestock and other inputs and sale channels used by farmers.
7. Make a detailed plan and map, including the planting schedule of each crop and the type of crop rotation each year, choose the farm equipment you need.
8. Develop a system for describing what practices are undertaken, timings, input use, varieties planted, pest and weed control, harvesting etc. In other words, collect data each year on how the farm is managed, including the costs and returns.

(The paper is based on my understanding, there might be information that I do not know and not included in here, so please contact me if you have any question.)

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