



GÖTEBORGS
UNIVERSITET

DEPARTMENT OF POLITICAL SCIENCE

COOPERATOR OR DEFECTOR?

A qualitative study of a superpower's policy efforts on collective environmental issues.

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Master's Thesis:	30 credits
Programme:	Master's Programme in International Administration and Global Governance
Date:	June 30, 2022
Supervisor:	Marcia Grimes
Words:	19 808

Abstract

The thesis studies whether and how China, as an emerging superpower, cooperates on collective environmental issues through complying with international agreements, taking the management of chemical fertilizer and pesticide (agrochemicals) as a case. Through theories neorealism, neoliberalism and neoliberal institutionalism, to gain different theoretical expectations how states like China act to international agreements and collective environmental issues. Moreover, the discussion of realist approach and functionalism of compliance with international agreements identify the links between international actions and local compliance and implementation of international agreements. Neorealism and realist approach would expect that China will not comply with international agreements about collective environmental issues and implement those on the local level. Neoliberalism (and neoliberal institutionalism) and functionalism would expect that China sees environmental protection as equal to economic growth, and China is more likely to cooperate with international agreements through international institutions by complying with and implementing international agreements. The analytical framework unfolds from five criteria to analyze and evaluate China's policy efforts of managing fertilizers and pesticides at the national and provincial levels. The paper uses the qualitative approach, including content analysis of policy documents and video statements, and one informant interview, to collect qualitative data. On this basis, this study finds that China has taken a slow pace to comply with and implement the international sustainability agreements. In addition, China has shown an increasing willingness and actions to reduce the use of agrochemicals, but there are still many issues that need improvement.

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1. Introduction

In recent years, sustainable development has shown increasing importance, not only in the United Nations (UN) Sustainable Development Goals but also in different global environmental conferences, such as the UN Climate Change Conference. The reason behind this is that widespread collective environmental problems, such as global warming, biodiversity loss, deforestation, etc., require more states' cooperation and contribution to them. As an emerging superpower, China's response and contribution to collective environmental issues has become even more important to the world. Thus, it is interesting to know whether China is willing to cooperate on collective environmental issues, and how they will implement that cooperation. This raises the question: Is there evidence that an emerging superpower cooperates on collective environmental issues?

1.1 Research aims and questions

The aim of this study is to gain a more comprehensive understanding of whether and how China is cooperating on collective environmental issues. The focus is placed on China's agriculture policies, particularly regarding agrochemicals. "Agrochemicals" is a general term for a range of chemical products used in agriculture, which are usually divided into two main categories, namely pesticides and fertilizers (Hough, 2014), as detailed points in the ecosystem. Since agricultural policies have direct or indirect impacts on environmental outcomes (Yu & Wu, 2018, p.1), it is critical to examine agrochemicals from both policy and implementation perspective to understand the process of whether China's action is in line with international agreements. The study is mainly descriptive, evaluation-oriented, and have an explanatory ambition of whether and how China cooperates on collective environmental issues by testing of different theoretical expectations. The analytical framework lays out the points along which to evaluate the national vision and policy efforts. Thus, the overarching question, "Is there evidence that an emerging superpower cooperates on collective environmental issues?" will be answered through the following sub-questions.

- Do China's policies in agriculture keep pace with the general global move toward sustainable agriculture?
- Is there evidence of implementation all the way down to the local level?

1.2 Outlines

The entire paper is structured as follows. Following this introduction, the literature review describes China's compliance with international agreements, especially international environmental agreements (IEAs), explains the importance of sound management of agrochemicals, and presents global and national actions on agrochemical management,

respectively. Since agrochemical management as one of collective environmental problems without sufficient studies, this paper takes it as a case to explore China's compliance with IEA. Moreover, this study researched agrochemicals on voluntary international agreements. These two aspects can be seen as small contributions.

The theory section builds on international relations theory, neorealism, neoliberalism, and neoliberal institutionalism, as well as compliance theory, to gain different theoretical expectations about how a country like China might behave towards collective environmental issues through its compliance with international agreements. Neorealism would expect that China did not see cooperation on international environmental issues as important and that it treats compliance with international agreements as unnecessary. Neoliberal institutionalism would believe that international institutions can make states easier to achieve international cooperation and that China will commit to working on collective environmental problems by cooperating with other states to advance shared interests. Moreover, two approaches to compliance – realist approach and functionalism – further explain why China complies with international agreements in local implementation. The realistic view would see China, a developing superpower, will have little interest in and willingness to comply with international agreements at the local and national levels. Functionalism would suggest that China is willing to join in ratifying and complying with certain international agreements with other countries to solve collective issues. Rational functionalism argues that China will comply with and implement international agreements in domestic areas in a reasonable and responsible manner, which also promotes China's national reputation as an emerging superpower.

The analytical framework elaborates the evaluation criteria that serve the subsequent analysis. Research design, methodology, and case selection will be presented, followed by an assessment of validity and reliability, and the limitations of this study. The analysis part analyzes the national vision (policy will) from the temporal dimension and analyzes the policy efforts from the ban of hazardous agrochemicals, positive incentives, subsidies, and information, and finally discusses the misgovernance in China.

The paper ends with the conclusion, showing empirical analysis that China has shown a gradually strong willingness to adhere to the international agreements regarding sustainable agricultural development, particularly in the agrochemical aspect, which corresponds with the theoretical expectations of neoliberal institutionalism and functionalism respectively. Furthermore, agrochemical management and the use of green agricultural inputs will become a tendency in China's subsequent agricultural development. However, some problems can be improved.

2. Literature Review

To answer the research questions, this section reviews previous research on states compliance with international agreements, especially on international environmental agreements (IEAs), to further understand China's compliance and implementation of IEA. In order to comprehensively understand how international agreements are implemented at the Chinese local level after having been ratified and complied by the Chinese government, the paper further explores China's governance on the environment. Moreover, taking agrochemicals (fertilizers and pesticides) as a case through reviewing the previous studies on why agrochemicals are important to agriculture and ecosystems, and what policy interventions have taken by global and national governance to manage it, which set the basis for later analysis of whether and how China works on international environmental issues regarding agrochemicals management. Research gaps are reflected in the fact that agrochemicals have not been adequately studied as a chain of collective environmental issues; the voluntary international agreements, the "Fertilizer Code" and the "Pesticide Code", have not been sufficiently study compared to the UN SDGs.

2.1 International Agreements

The growing role of formal international agreements in the organization of relations among sovereign states is a central theme in much recent international relations scholarship (Simmons, 1998, p.1). States have shifted from the traditional assumption of national governments' desire to preserve their sovereignty to "states agreeing voluntarily to give up a portion of their most basic aspect of sovereignty to authoritative international institutions" (ibid.). Raustiala (2005) defines, "International agreements are, at root, an exchange of promises among states." (p.585). There are more states entering into international agreements on a continuous basis (ibid., p.580). Several scholars have found that international agreements vary widely in many ways, in both the substantive duties agreements impose, and the form of agreement --- both in terms of legal bindingness and the range of structural mechanisms for monitoring and addressing noncompliance (Simmons, 1998, p.1; Raustiala, 2005, p.581). As Simmons (1998) points out, the number of international agreements has exploded in the last forty years with the growth of regulations that regulate economic, social, environmental, and human rights behavior (p.1).

2.1.1 International environmental agreements (IEAs)

Environmental protection is widely acknowledged as a global issue (Zhao, 2005, p. 58). Many environmental degradation issues are transboundary in nature and therefore require an international solution (Kütting, 2013, p.2). As states are the most important regulatory actors

in the international community, international environmental agreements between states are seen as the primary form of international environmental cooperation (ibid.). Furthermore, developing countries are becoming important contributors to global environmental issues because the most adverse effects of climate change are most likely to manifest in developing countries, and global greenhouse gas emissions are unlikely to be curbed without their involvement (Zhao, 2005, p.58).

The ability of international institutions to construct successful IEAs to engage developing countries is thus critical to maintaining the global environment (Haas et al., 1993). The resulting development of large-scale, organized international environmental cooperation can usually be traced back to the 1972 United Nations Conference on the Human Environment in Stockholm, followed by more comprehensive initiatives and agreements including the Brandt Commission Report (1980) with the Brundtland Commission Report (1987), and the 1992 Earth Summit, the United Nations Conference on Environment and Development held in Rio de Janeiro (Kütting, 2013). At the Earth Summit, the concept of sustainable development was further reviewed, and further, the principles regarding national responsibilities and international cooperation on environmental protection were emphasized (Lahiry, 2010; Taqwadin, 2013, p.3). The concept of “common but differentiated responsibilities,” which was introduced in this declaration, underlines that “developed countries have the primary efforts to protect the global environment, although it is a common concern of both developed and developing countries” (Kiss & Shelton, 2007; Taqwadin, 2013, p.3). Thus, each state needs to take responsibilities on the international environmental cooperation.

Jacobson and Weiss (1990) explore national implementation and compliance with international environmental accords. They describe several factors which affect national compliance, including “the characteristics of the agreement”, “the characteristics of the state (its government structures and economic condition)”, “the behavior of other states who are parties to the agreement”, “the technical and economic characteristics of the problem that is the subject of the agreement”, and “the importance of individual leaders”, etc. Since each state is different in their developing conditions with different political leaders or parties, there will be certain gaps for international agreements implementation and compliance. For instance, Smardon (2008) compared the local implementation of Agenda 21 between North America (the United States and Canada), Europe and India of local Agenda 21 sustainability planning and implementation status through abundant literature and web search and found that European communities have a large support network with about 6,000 sustainability plans have been produced, whereas North American with roughly 100 and Indian communities have a much

smaller one (ibid.). Hence, developing countries' compliance with international agreements about 'advanced development' is likely to be slower than developed countries based on their development demands, such as in the economy.

As Zhao (2005) states, there has been very little research on a deeper understanding of how developing countries comply with IEA's so far (p.58). Due to China's rapid economic growth and increasingly strong power, China must play a significant role in resolving global environmental issues (ibid.). Therefore, China, as a representative among developing countries, will be the case in this paper, to understand Chinese compliance with IEAs.

2.2 Chinese Compliance on IEAs

The historical roots of China's environmental protection have not developed in a linear way. On the forest side, Robbins and Harrell (2014) describe the historical roots of China's deforestation crisis, showing that China had experienced centuries of deforestation during the Qing and Republican era, but policies in the Maoist Period (from 1949 to 1978) neglected to address the forestry crisis (ibid., p.382; Mol & Carter, 2006, p.15). From 1978 to 1998, despite some attention to afforestation, environmental policies changed little from those of the Maoist era (ibid., p.383). Although environmental concerns were recognized and environmental protection became an objective of state policy, Chinese leaders repeatedly emphasized that environmental policy should not impede economic expansion (ibid.). The situation changed until the devastating floods happened in 1998, with a general trend to focus on environmental conservation and restoration, including a succession of environmental protection legislation and promoting "sustainable development" as a national slogan, China's environmental record is clearly mixed since some conflicting problems hindered to protect forestry industry: improving rural livelihoods, protecting and enhancing ecosystem services, and growing the forestry sector's economy (Robbins & Harrell, 2014). Khan and Chang (2018) state similarly that the roots of environmental damage can be traced back thousands of years, and China's economic expansion accelerated the destruction of the country and its resources, for instance, air and water pollution have increased because of China's rapid economic expansion. However, the most significant causes of these problems were rapid industrialization and weak environmental monitoring (ibid.).

Bryan et al. (2018) investigated China's response to the sustainable development of its national land system¹, with finding that are similar to those of Robbins and Harrell (2014), showing that China experienced a series of natural disasters in the late 1990s that were widely considered to

¹ being published in the leading scientific journal Nature

be caused by unsustainable land management, including the Yellow River cut-off in 1997, the Yangtze River floods in 1998, and the Beijing dust storms in 2000 (p.197). This series of events triggered an acceleration of investment in sustainable development in China, with the launch of many ecological projects (Bryan et al., 2018). The environmental goals of these projects include mitigating soil erosion, sedimentation, combating desertification in the arid north, reducing the impact of sand and dust storms on the capital city of Beijing and nearby areas, protecting natural woodlands, and increasing the productivity of arable land (as shown in Figure 1).

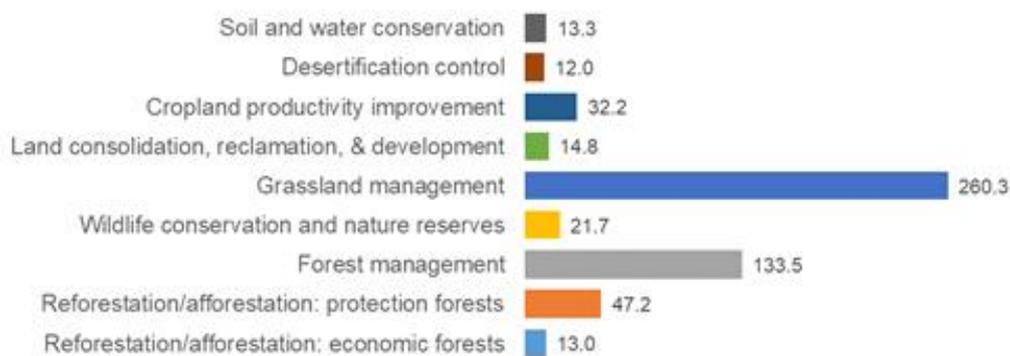


Figure.1 Area covered by major sustainable development projects in China (10,000 km²) (Beijing Normal University, 2018)

Thus, it is acknowledged that China's sustainable development transition began at least in 1998. As shown in Figure 1, the sustainable development programs with the most attention have been given to grassland and forest management, but less attention has been given to soil and water conservation.

Over the past two decades, environmental and emissions regulations have changed dramatically - from weak to strong. Environmental issues in China have recently become political targets, meanwhile, regulatory measures to address environmental issues have been strengthened due to the efforts of the Chinese government (Khan and Chang, 2018, pp.2-3). As Mol and Carter (2006) state, China is rapidly improving its environmental governance system in the face of unprecedented levels of economic and industrial growth, and it has taken a conventional command and control approach to environmental management, which fits well with its centrally planned economy (p.149).

There have been many international agreements ratified by China since 1971, which was a watershed year as China joined the United Nation and participated in the multilateral treaty system (Chan, 2005, pp.64-70). Since its founding in 1949, China has acceded to only six treaties, but the treaties signed between 1971 and 1979 largely reflect China's increased participation in the system (ibid.). The Chinese government's major involvement in

environmental protection began in the late 1970s, roughly coinciding with the onset of economic reforms (Mol and Carter, 2006, p.151). Pollution control began in the early 1970s, particularly following the 1972 UN Conference on the Human Environment in Stockholm (ibid., p.152). The core concepts of environmental preservation in China were established in 1984 (Mol and Carter, 2006, p.152).

As Ma and Ortolano (2000) point out that several environmental activities in China are based on IEAs, such as *the Basel Convention on Control of Transboundary Movements of Hazardous Wastes* in 1991, *the Montreal Protocol on Substances that Deplete the Ozone Layer* (hereinafter referred to as "the Montreal Protocol") in 1991, *the Convention on Biodiversity* in 1992, and *the Convention on Combating Desertification* in 1994 (p.18). Among these, the Montreal Protocol has involved an unusually large number of developing countries, making it the most successful IEA to date (Zhao, 2005, p.58).

Zhao and Ortolano (2003) find three factors motivated the Chinese government to ratify and comply with the Montreal Protocol, namely: "the Multilateral Fund created by amendments to the Montreal Protocol", "the nation's desire to appear as a responsible and cooperative actor in solving global environmental problems", and "the interest of China's principal implementing agency in expanding its responsibilities and authorities". Moreover, the factors influencing the government's ability to implement this Protocol include administrative capacity, involvement of local governments, and regulations and enforcement (ibid., pp.718-721). Corresponding with three factors in Jacobson and Weiss (1990)'s study on several factors affecting national compliance, which are individual leaders, "the characteristics of the state and its government structures and processes" and "the economic characteristics of the problem".

In addition, fulfilling international responsibilities in good faith has been not just one of China's main foreign policies, but also a fundamental concept of Chinese law, since the establishment of the People's Republic of China in 1949 (Xue & Jin, 2009, p.300). However, there are no provisions in the Chinese Constitution or Basic Law regulating the legal status of foreign treaties and their place in the domestic legal system (ibid). International treaties do not automatically become part of national law, even after ratification, accession, or approval, and so do not automatically have domestic legal impact (ibid.). As Chan (2005) describes, one of China's key challenges today is integrating its international commitments with domestic law, particularly in the areas of human rights, trade, environmental protection, and arms control (p.75).

Most studies, taking China as a case, explore its compliance with international agreements regarding human rights (such as Woodman, 2005; Guo, 2009; Wilde, 2013), investment (such

as Qingjiang, 2003; Cai, 2008; Gallagher & Shan, 2009; Sauvant & Nolan, 2015), etc. Furthermore, many studies on China's compliance with IEA have mostly focused on collective environmental issues including climate change, for example, on the Paris agreement (Van Asselt, 2016; Zhang et al., 2020; Khan et al. 2021), on the Montreal Protocol (Zhao & Ortolano, 2003. Zhao, 2005); resources, with relevant studies on forest areas (Robbins et al., 2014) and on water (Zeitoun et al., 2017); and pollution, mainly on air pollution (Van Rooij & Lo, 2010; Zhang et al., 2019; Nguyen et al., 2021).

Brown et al. (2010) aim to find the priority among various environmental challenges in China by undertaking a content analysis for 1,564 government documents from 1999 to 2008. The research focuses on four topics: pollutant types, high-polluting industrial sectors, environmental policy agreements, and international environmental treaty implementation. They found from 1998 to 2008, the control of soil pollution, light pollution, and persistent organic pollutants (POPs) attracted relatively little attention in the Chinese environmental policy arena, with a small increase in the number of documents on soil pollution from 2007 to 2008 (ibid., p.229). It reflects that the attention to agrochemicals management at the Chinese levels has yet to be strengthened. The promulgation of the two zero-growth actions of fertilizers and pesticides, announced by the Chinese government in 2015, makes the management and control of agrochemicals a new focus of the Chinese government in recent years.

However, agrochemicals have not been used as an empirical case in previous studies to assess whether China is cooperating on collective environmental issues. Thus, there are insufficient studies on whether and how China cooperates on international environmental agreements from the perspective of agrochemicals management, which makes this paper intend to contribute to this topic.

2.2.1 China's governance on environment

To clearly understand how the international agreements after ratification are implemented at the local level, it is essential to understand Chinese governance systems on the environment. The national regulatory framework is applied vertically through a four-tier management system, which includes national, provincial, municipal, and county levels (Mol & Carter, 2006).

First, the National People's Congress (NPC), the State Council, and the Chinese Communist Party (CCP or the Party) are the main actors in China's policy-making processes (Ma & Ortolano, 2000, p.13). The NPC is the highest legislative body in the country, the State Council is the most powerful administrative body, and the CCP has a significant influence on both (ibid.). The central government (refers to "NPC and the State Council") designs and leads the project, sets high-level goals, and assigns responsibilities to relevant *ministries, commissions,*

and administrations (Bryan et al., 2018, pp.196-197). These departments design project scope and priorities and coordinate implementation by guiding and supervising responsibilities to provincial/local government (*ibid.*, p.195).

Second, since China's environmental regulations are broad and frequently intentionally ambiguous, the State Council, national agencies, and local governments can add specifics that affect implementation (Ma & Ortolano, 2000, p.15). The provincial government and its departments refine and adapt project plans according to regional/local conditions, develop and implement projects, manage funds, and monitor interventions (Bryan et al., 2018). For instance, the provincial People's Government released its own "measures" defining fee calculation procedures to be utilized throughout the province shortly after the State Council issued the policy documents (Ma & Ortolano, 2000, p.15); and propose and write policies (e.g., regulations and development plans) based on lessons learned from pilot projects, issues identified through bottom-up feedback, and recommendations from research institutions (Jinrawet et al., 2021, pp.6-7).

Third, national environmental law's day-to-day implementation occurs at the local level. Local governments adapt the interventions to their specific context under the supervision of the provincial governments, and communicate them to implementers (e.g., farmers and pesticide retailers) through a variety of methods, including but not limited to compensation, regulatory frameworks, training, and advocacy (Ma & Ortolano, 2000, p.15; Bryan et al., 2018, p.196). Provincial/local governments and their departments at all levels need to raise awareness and enthusiasm among end-implementers to motivate and organize them to implement projects announced by the central government (*ibid.*). The most important implementers, farmers, usually participate in conservation programs and receive direct compensation from local governments (Jinrawet et al., 2021).

Last, research institutions and public opinion institutions, independent of the governance chain, play essential roles in the whole process. Research institutions will support the central government in designing programs by detecting potential problems, assessing the efficiency of programs, providing early warning systems, identifying agricultural and ecological problems, and proposing solutions (Bryan et al., 2018, p.196; Jinrawet et al., 2021, pp.6-7). Public opinion institutions can provide feedback to the government, inform progress, and report on local community attitudes and reactions to the project (*ibid.*).

Self-evaluation, inspections at local, provincial, and national levels, and verification against accepted standards are common practices to monitor and assure the quality of sustainability activities (Bryan et al., 2018, p.196). However, it is difficult to know how monitoring and

evaluation are conducted in China as there are not fully reliable and transparent indicators to show the results of the implementation of these programs.

As every country in the world can have governance problems, China's governance also faces challenges such as corruption. Wu and Christensen (2021) found that corruption among village and township cadres is a major problem in the management of rural poverty in China. In addition, Robbins and Harrell (2014), and Khan and Chang (2018) find that Chinese authorities tend to prioritize economic issues over environmental issues, and similarly, as described by Liang² (2016), governors' performance is assessed based on the economic growth rate they can increase. In addition, as mentioned above, the Chinese government is responsible for everything, so they may have strong ties with businesses because they make important contributions to the country's economic growth.

These phenomena happening in misgovernance will bring challenges when implementing local compliance. Robbins and Harrell (2014) found that the challenges existed to the forestry industry is a top-down manner to implement reforestation and forest conservation often ignores the applicability of specific programs and specific species in different places, and leaves little room for flexibility regarding local choices, which means many reforestation efforts were unsuccessful and much of the program's funding wasted. Furthermore, Khan and Chang (2018) propose that China neither has accurate records of CO₂ emissions nor regularly publishes official emission reports. It is possible that China prohibits the publication of certain elements of environmental studies due to national security and sensitivity concerns (ibid.). As a result, environmental researchers and research institutions have taken on the task of quantifying CO₂ emissions using logical assumptions and data previously collected from various sources (ibid.). As Khan and Chang (2018) suggest, despite the government's stated goals, real reforms and effective implementation of environmental policies require a re-examination of the linkages between the state, civil society, government, and markets, as well as China's bureaucratic power structure (p.3).

2.3 International agreements and agrochemicals

Natural ecosystems provide the basic functions that support agricultural production, and the processes of agricultural practices affect ecosystems (Jinrawet et al., 2021, p.3). Agrochemical traces can be discovered in the soil, water, and air, as well as accidentally in crops and animals (Hough, 2014, p.13). These effects eventually become chemical pollution, eutrophication, and other collective environmental problems. In the marine environment, for instance,

² Vice President and Researcher of Liaoning Academy of Social Sciences

agrochemicals that float into the ocean can cause algae blooms, which are very damaging. In this regard, the negative impacts of overuse and misuse of chemical fertilizers and pesticides affect not only China but also the global commons.

As described by Jintrawet et al. (2021), policy initiatives can benefit ecosystems (p.3), and Bryan et al. (2018) note that agroecological interventions make a significant contribution to sustainable development goals, so this section highlights the importance of sound management of fertilizers and pesticides, describes the actions that other countries manage agrochemicals, and elaborates on principles related to agrochemicals from a global perspective.

2.3.1 Agriculture and agrochemicals

Agriculture is the backbone of human life, the foundation of every state's economy and a key goal for world sustainability (Yu & Wu, 2018, p.1). The fundamental challenge for the agricultural sector is to feed the world's growing population with fewer resources (e.g., water, farmland, and biodiversity) while reducing the environmental impact and conserving natural resources for the future (Omilola & Robele, 2017, p.8; Nhemachena et al., 2018, p.2; Streimikis & Baležentis, 2020, p.1702). Shifting to a more sustainable approach to agriculture is the only way to solve this dilemma (Nhemachena et al., 2018, p.2). Agricultural sustainability includes environmental, social and economic factors, with the goal of not only enhancing existing agroecosystems but also meeting the needs of future generations (Jintrawet et al., 2021, p.3). In this regard, the overuse of agrochemicals has become an environmental concern in agricultural production worldwide and should be addressed as a priority to achieve sustainable development by 2030.

Unlike other developed countries, China is a special case with controversial discussions about feeding 22% of the world's population with 9% of the planet's arable land, despite the constraints such as the highly uneven distribution of water resources (Jintrawet et al., 2021). The role of pesticides and fertilizers contribute to such a great achievement, as both are important to sustain and stimulate agricultural production (Wu et al., 2019, p.2). However, to boost the intensive production of agricultural raw materials, the use of agrochemicals in China has shown an increasing trend since 1985 (National Bureau of Statistics of China, 2020) and China respectively accounts for 25 percent and 42 percent of the total world consumption of fertilizers and pesticides, respectively (FAOSTAT, 2019). In this sense, China is described as the largest producer and consumer of agrochemicals in the world (Wu et al., 2019, p.2). The intensity of agrochemical use in China is four and five times higher than the world average, however, the efficiency of agrochemical use is low. According to China's first national census

of pollution sources, fertilizers and pesticides on farms cause a greater source of water pollution than industrial discharges (ibid.).

2.3.2 International Agreements

Hough (2014)'s study about trading and use of agrochemicals explores the problems associated with agrochemicals as follows: human poisoning, environmental pollution, agrochemical residues in food, and international trade in agrochemicals. Furthermore, Hough (2014) puts forward the FAO's Pesticide Code of Conduct when advocating the use of Integrated Pest Management, and *the Rotterdam Convention*, *the Stockholm Convention* and *the Basel Convention* when discussing the politics of Persistent Organic Pollutants (POPs), indicating the fact that "regulation of pesticides became part of the global agenda, promoting agroecology, coordinated by UNEP and the WHO" (p.37).

In this section, the different international agreements designed by the UN, both legally binding and voluntary, will be discussed. It starts with the legally binding agreements, the Basel, Rotterdam, and Stockholm Conventions, and focuses on the non-legally binding agreements, the UN SDGs, and the International Code of Conduct for the Sustainable Use and Management of Fertilizers, as well as the International Code of Conduct on Pesticide Management. Due to the popularity of the three legally binding conventions and the UN SDGs, two rarely known codes will be the principles highlighted here. Moreover, the UN SDGs can be seen as an umbrella beyond the two international codes, as the 2030 Agenda covers economic, social, and environmental aspects of sustainability.

A) The Basel, Rotterdam, and Stockholm Convention

International environmental conventions have emerged as the most effective means of addressing global environmental issues and the most active convention mechanisms globally (Liu et al., 2021, p.132). China has signed or acceded to more than 50 international environmental treaties and protocols so far (Li. et al., 2016). Among them, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention), the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Substances and Pesticides in International Trade (Rotterdam Convention) and the Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention), which essentially cover the core elements of chemicals and waste management, all contribute to achieving SDG 12 ("ensure sustainable consumption and production patterns") (UN, 2015).

According to the United Nations Institute for Training and Research (UNITAR), "the Basel, Rotterdam and Stockholm conventions are multilateral environmental agreements that share

the common objective of protecting human health and the environment from hazardous chemicals and wastes” (UNITAR, n.d.). However, these conventions have varied aims, control targets, and regimes for the same environmental issue (Liu et al., 2021, p.137).

As a major country in the production, use and trade of chemicals, China has always attached great importance to the negotiation and implementation of global convention. *The Rotterdam Convention* and *Stockholm Convention* entered into force in China in 2005 and 2004, respectively (“Global Convention Introduction”, 2016).

B) Sustainable Development Goals

The 2030 Agenda for Sustainable Development consists of 17 Sustainable Development Goals (SDGs) and associated 169 targets, started on 1 January 2016 (UN, 2015). Among the 17 SDGs, SDG 12 and its Target 12.4 are most related to the sound management of chemical fertilizers and pesticides. Moreover, SDG 12 can synergistically affect the agricultural sector because it is concerned with better chemical management in terms of increasing production and making better use of natural resources (Griggs et al., 2017, p.21; Plastun et al., 2021, p.65). Further, reducing and managing chemical usage will also directly alleviate the soil degradation which contributes to the SDG 15 (Life on land) and help to balance the biodiversity in the aquatic system which relates to SDGs 3 (target 3.9) and 6 (target 6.3) (air and water pollution) and SDG 13 (greenhouse gas emissions) (Zhao et al., 2021, p.1042; United Nations, 2015, p.16). Jin (2020) describes sustainable development in general terms as a concept and goal with global consensus, but the development disparities among countries are so wide in economy, politics, and culture terms that the concept is inevitably abstract, general and covers a wide range of fields to form a consensus (p.81). Thus, to see the international agreements on the management of chemical fertilizers and pesticides, the next section will focus on the Fertilizer and Pesticide Code.

C) The Fertilizer Code & The Pesticide Code

Implementing the 2030 Agenda provides an opportunity for many different actors to work together at all levels to reduce the negative environmental and health effects of pesticides and fertilizers (the United Nations Environment Assembly, 2021, p.13). The two international codes describe more specifically the global harmonized standards designed by the Food and Agriculture Organization of the United Nations (FAO) and the United Nations World Health Organization (WHO) for pesticide management and for the sustainable use and management of fertilizers.

The main objective of the International Code of Conduct on Pesticide Management (*referred to as the “Pesticide Code”*) is to “maximize the benefits of pesticides and to effectively control

pests in public health and agriculture while protecting human and animal health and the environment from their harmful effects” (FAO & WHO, 2014). In the Pesticide Code, FAO and WHO (2014) elaborate that due to the risks of pesticides, governments should be responsible for their management, including testing, regulation, use, distribution and trade, labeling, packaging, storage and disposal, and monitoring. According to a survey from WHO and FAO (2018), this guideline is widely accepted in most countries (p.31).

The International Code of Conduct for the Sustainable Use and Management of Fertilizers (*referred to as the “Fertilizer Code”*) emphasizes the appropriate usage and management of fertilizers to avoid overuse, underuse, and inappropriate use, and aims to address global aspects to promote the implementation of the SDGs (FAO, 2019). Furthermore, the Fertilizer Code provides a locally adaptable framework and voluntary set of practices that can be used by governments and the fertilizer industry, supporting academic and research institutions, civil society, and end-users to contribute to sustainable agriculture and food security by following or adhering to the guidelines and recommendations provided (ibid.).

The Pesticide Code and the Fertilizer Code include different steps and sound management processes, thus, both can be used as an assessment tool to see if China is meeting these requirements or standards, not only in the national documents, but also from the practical experiences of experts and farmers, to identify what has been fulfilled and qualified, and what lacks change or needs to be promoted.

2.4 Policy intervention on agrochemical management

2.4.1 China’s Policy intervention on agrochemical management

The two Action Plans for the zero growth of chemical fertilizers and pesticides use by 2020 has been issued by the Ministry of Agriculture on 17 March 2015 (MOA, 2015; Jin & Zhou, 2018; Ji et al., 2020). Both are the most specific documents written regarding agrochemical use. Previous literature built their analysis of “the progress in zero growth in chemical fertilizer and pesticide use” from four aspects: policy formulation, local practice, technical support and achievements, especially Jin and Zhou (2018) take four provinces (Shandong, Liaoning, Zhejiang and Sichuan) as examples to see the local implementation (pp.53-55). Studies on provincial governments are crucial because provincial governments can be seen as a bridge between the central government and local governments (Wu et al., 2020, p.2). Moreover, some studies (Wu et al., 2019; Ji, et al., 2020) used the logarithmic mean Divisia index (LMDI) method to quantitatively analyze the scale effect, intensity effect and structural effect of fertilizer use change in China, finding that Shandong province and Hebei Province are the most

important agricultural provinces in China. Further, Heilongjiang province is an important commodity grain base in China, and its black soil with the highest organic matter content contributes the strongest output capacity (Huiqin, Z. & Wenhui, L., 2020, p.39).

Further, Wu et al. (2020)'s fieldwork that was conducted in Yunnan Province, found economic incentives that include subsidies and free organic fertilizer have been widely utilized (p.13). Moreover, they explored through interviews with farmers that economic incentives motivate farmers to grow crops in a more sustainable way (ibid.). Since organic fertilizers are much more expensive than conventional fertilizers, they suggest a need to provide higher subsidies to increase the desire of farmers across the country to use organic fertilizers (ibid.). Similarly, from Yi et al.'s (2021) study on the Organic-Substitute-Chemical-Fertilizer (OSCF) for Fruits, Vegetables, and Tea policy, they found cost-benefit is one of the key reasons why vegetable farmers select organic fertilizer instead of chemical fertilizer.

Therefore, there are some studies that investigated the implementation process and results of the two zero-growth action plans for chemical fertilizers and pesticides use or mainly focus on fertilizer in China, but these studies haven't analyzed the change in national vision or regulations on agrochemicals management. Furthermore, previous studies build their analysis on policy formulation, local practice, technical support, and subsidies or economic incentives, but they haven't analyzed the laws' change with national vision and information.

2.4.2 Other countries policy on agrochemicals

This section reviews some Asian developing countries policy interventions on agrochemical management in order to understand the policy efforts of the countries that share similar agricultural situations with China on regulating and controlling chemical fertilizers and pesticides.

Adhikari (2017)'s study on the use and misuse of agrochemicals in Nepal, found that Nepal faces irreversible health risks and environmental hazards due to misuse, overuse, and inappropriate use of agrochemicals. Lack of knowledge of proper storage, handling, application, and disposal methods; inadequate occupational safety measures; low public awareness of pesticide residues in food and their hazards to human health and the environment; and lack of strict measures to restrict the import and use of extremely hazardous pesticides have contributed to the negative situation (Adhikari, 2017).

Pandey et al. (2020) mainly discuss highly toxic agrochemicals used in India. The contributing factors of the situation that many farmers in South Asian countries (including India) were using banned and toxic pesticides in their farms include "Literacy, Knowledge & Information"; "Training & Extension Services"; "Safety Equipment and Health care" (p.1540;

Schreinemachers et al., 2015). Pandey et al. (2020) concluded that farmers have a limited understanding of pesticide type and characteristics. Even though various socioeconomic factors contribute to this issue, education and extension play a significant effect. Thus, Pandey et al. (2020) recommend improved education and literacy among Indian farmers as the foremost need, then integration science and technology in traditional agriculture. Moreover, they recommend redefining existing government laws for agrochemical dealers and manufacturers to regulate pesticide applications, including dosage and best application periods, and strengthening information exchange about the pesticide issues between farmers by use of print and electronic media to enhance public environmental awareness. India, as an agriculture-dominated Asian country, feeding the second largest population in the world, its situation and development path will be a good reference to China's agrochemicals management.

Nelles and Visetnoi (2016) discuss theoretical, policy and practical issues concerning the problem of 'agrochemical dependency' in Thailand by examining relevant national policy documents and 15 interviews of managers or senior officers in the department of agricultural extension (DOAE) and choosing one province (Nan) to illustrate the diversity and rural uniqueness of national problems. Based on the interview data, perceived contributing factors concerning agrochemical dependency/abuse include but it is not limited to "corruption in government and private cooperatives", "Education/knowledge and ability to examine issues", "Moral and ethical awareness/farmers' self-discipline", "law enforcement and adequately strict regulations", "sufficient substitutes and alternatives to meet farmers' needs", "Non-cash payment incentives (loans, payback later schemes, etc.)", etc. (these factors have been mentioned by Bangkok officials and Nan officials simultaneously) (p.232). Correspondingly, DOAE officials' recommendations for change/improvement in programs, policies and research activities include but are not limited to "Increase learning and knowledge in preventive pest/disease management" "Need learning center in every village"; "More intensive and serious law enforcement"; "More price incentives (for higher value organic or healthier products)"; "More collaboration across Departments to better enforce laws and regulations", etc. (ibid.).

Thus, these studies explore several aspects that countries need to improve in national agrochemical management, from education, strict measures to restrict use of hazardous agrochemicals, update existing laws, and more price incentives, which sets the foundation for the Section Four Analytical Framework.

2.5 Research Gap

The contribution that this thesis attempts to make to existing scholarship can be seen in two ways. First, agrochemicals are a key aspect of agriculture, and can lead to collective environmental problems. There are studies focused on investigating China's compliance with IEA and collective environmental problems, as stated in section 2.2, but these studies are mostly focused on the problems of climate change, air pollution, water, and forest resources. In this regard, this paper takes agrochemical management, one of the specific collective environmental problems, as a case to explore China's compliance with IEA related to agrochemicals can be seen as a contribution to the research gap. Moreover, there are research studied on agrochemical reduction and control in China's domestic area that are mentioned in section 2.4.1, and in other Asian countries that are described in section 2.4.2. However, there is a lack of sufficient research trying to find linkages between international action and regional implementation of agrochemicals management in China. In addition, studying the management of agrochemicals provides insight into China's willingness to cooperate as a superpower on global environmental issues — whether it is willing to cooperate on and comply with global environmental problems. Thus, in the case of agrochemicals and by looking at China's policy compliance and implementation, this study can contribute to the existing research through providing insight into the country's thinking.

Second, this study aims to clarify the connections between agrochemicals and sustainable agriculture. In the international system, the Basel, Rotterdam, and Stockholm Convention are legally binding agreements that require states to comply with, whereas the voluntary international agreements, except for the UN SDGs, the "Fertilizer Code" and the "Pesticide Code", published by the UN FAO and WHO, have not been studied sufficiently by academic studies. The author only found the Pesticide Code has been put forward in Hough (2014)'s study. In this paper, the author mainly used these two codes to compare Articles in the voluntary international agreements with Chinese implementation, reflecting whether China's compliance with this collective environmental issue (agrochemical management) is strong or weak. Hence, this study here regarding researching agrochemicals on voluntary international agreements can be seen as a contribution.

3. Theory

This section presents established International Relations (IR) theories, neorealism, neoliberalism, and neoliberal institutionalism. Based on the respective arguments of neorealism, neoliberalism and neoliberal institutionalism, there comes respective theoretical expectations on how states like China act to international agreements and collective environmental issues. This section further discusses states compliance with international agreements, to identify links between international actions and regional compliance and implementation of international agreements.

3.1 Neorealism, Neoliberalism and Neoliberal Institutionalism

Neorealism emerges with a focus on the structure and relative power capabilities of the international system (Waltz, 2004, p.3). Neorealists point out that the structure or architecture of the international system compels states to pursue power (Mearsheimer, 2021, pp.51-52). Due to the main concern of realism in IR being state insecurity, it portrays the international system as a sphere driven by "self-help" (Walt, 2010). In this regard, states must ensure their own security because no other institution or actor can be relied upon to do so (ibid.).

As Paterson describes, neorealism assumes, first, that the world consists mainly of sovereign states, which can be unitary actors (Imber & Vogler, 1996, pp.62-63). Second, these states exist in an anarchic condition; that is, no government has power over them (ibid.). Third, because of this anarchy, these states must always be on guard against their neighbors, as they are always in potential danger of being invaded (ibid). Fourth, the result of this situation is that states behave in a way that maximizes their power relative to other states (ibid). Thus, the neorealist explanation of how international political outcomes are produced is that they are produced by the distribution of power capabilities in the system (ibid.).

According to these assumptions of neorealism, it can be said that China, as a sovereign state, especially as a strong power, needs to always protect itself to avoid invasion from other states, and to promote its national power in an anarchic international system, which may decrease the cooperating possibilities among China and other countries. Neorealism sees economic development as more of a priority than environmental conservation and expects that states will not take actions on cooperating with collective environmental issues. Therefore, in terms of collective environmental issues and from this theoretical perspective, China would not see cooperating with other states through ratifying, complying, and implementing international environmental agreements as necessary and worthwhile.

The basic concern of neoliberalism is how cooperation among states and other actors, such as international institutions, can be achieved in the international system (Sterling-folker, 2021, p.89). Furthermore, in a neoliberal analysis, interdependence lays the foundation for the development of common interests that can only be obtained when states cooperate successfully with each other (ibid., p.92). Due to modern technological and industrial advances, states are increasingly interdependent across various global issue-areas, such as the global economy and environmental resource depletion (Griffiths et al., 2014, p.172; ibid.). As Baldwin (1993) points out, both neoliberals and neorealists believe that national security and economic welfare are crucial, but their priorities differ. Neorealists are more interested in international security and war; neoliberals emphasize international political economy (IPE) and environmental issues (Jervis, 1999).

Historically, environmental issues have never been a prominent subject in the field of international relations, which in fact has typically focused on the study of power, security, and interstate conflict (Taqwadin, 2013). However, from the 1970s onwards, awareness of the growing number of transboundary ecological challenges began to emerge, from ozone-layer depletion (that led to the 1987 Montreal Protocol), and the projected climate change associated with the enhanced 'greenhouse effect' with a global scope (Vogler, 1996; Eckersley, 2006; Taqwadin, 2013). In this regard, environmental issues cannot be neglected anymore since the continuing dominance of realist thought has been a hindrance to investigating more on this topic (Vogler, 1996, pp.1-7). Then a unique subfield of IR - neoliberal institutionalism - later arose, focusing on international environmental cooperation (Eckersley, 2006; Taqwadin, 2013). According to Vogler (1996) "the response of academic IR to the international environmental politics of the late 1980s and early 1990s was essentially liberal-institutionalist" (p.7). International cooperation was singled out by the Brundtland Report, the Hague Declaration of 1989, by national financing agencies, and by those involved in the UNCED process as a key determinant of sustainable development (ibid.).

Taqwadin (2013) and Keohane (2018) define neoliberal institutionalism. Since neoliberalism is a variant of liberal IR theory that focuses on the role of institutions play in international collective actions, it is often called Neoliberal institutionalism (Taqwadin, 2013, p.5). Changes in global political institutionalization have had a profound impact on government behavior (Keohane, 2018, p.2). Patterns of cooperation and dispute, in particular, can only be understood in the context of the institutions that assist in defining the meaning and relevance of government action (ibid.). This perspective on international relations is referred to as "neoliberal institutionalism" (ibid.).

Neoliberal institutionalism believes that international institutions are effective and indeed necessary in managing environmentally degrading behavior. In contrast, neorealism, the protagonist in the international cooperation debate, is less convinced of the efficacy of institutions per se but places great emphasis on the underlying power structures, particularly the requirement for hegemonic leadership (Vogler, 1996, p.8).

Therefore, neoliberalism sees the importance of environmental protection as equal to economic development and highlights the collective environmental issues that need to be solved by international cooperation. Further, neoliberal institutionalism believes states are more likely to achieve international cooperation through international institutions, since the interdependence among states increases under globalization and funds the development of common interests. Moreover, institutions can assist in defining government actions when facing corporations and conflicts. International agreements are important and necessary to each state. In terms of collective environmental issues, China realizes the necessity of environmental protection as being equivalent to economic growth and the importance of cooperating on collective problems. Moreover, China is more likely to cooperate with international movements such as sustainable development through international institutions such as the UN by complying with and implementing international agreements.

3.2 Compliance with International Agreements

Formal international agreements are increasingly important in the international relations field (Simmons, 1998, p.1). States have moved away from the conventional presumption that national governments want to protect their sovereignty and are now willingly accepting the transfer to international institutions a piece of their most fundamental element of sovereignty (ibid.).

Simmons (1998) brings up the concept of compliance from Oran Young (1979)'s groundbreaking study on compliance with international public authority: "Compliance can be said to occur when the actual behavior of a given subject conforms to prescribed behavior, and non-compliance or violation occurs when actual behavior departs significantly from prescribed behavior." (p.3). To define compliance with an international environmental agreement, Zhao (2005), citing Weiss and Jacobson (1998) definitions, stated that "Compliance refers to whether countries adhere to the provisions of a treaty and to the implementing measures that they have adopted" (p.59).

In this section, the theory of compliance aims to connect international action to regional implementation of international agreements. Simmons (1998) provides four broad approaches

- realist theory, rational functionalism, domestic regime-based explanations, and normative approaches - to the question of why governments comply with international agreements that can be costly in the short term. Among these, domestic regime-based explanations reflect those democracies are more likely to comply with international legal obligations (Simmons, 1998, p.11), and the focus of normative approaches to the problem of compliance shows the force of ideas, beliefs, and appropriate behavior standards as important influences on governments' desire to comply with international agreements (ibid., p.17). Hence, this paper will choose realist theory and rational functionalism to further come up with theoretical expectations about regional implementation of international agreements since both will be more suitable to analyze China's case.

For realists, power, not law, has historically been the primary determinant of the path of interstate relations (Simmons, 1998, p.5). Most realists are highly skeptical of treaties or formal agreements that have a considerable impact on state action (Boyle, 1980; Bork, 1989/90). Realists see international agreements as lacking binding force, especially since governments typically retain the right to selectively interpret and apply the terms of international agreements (Morgenthau, 1985). Moreover, strong states and the pursuit of important interests are considered as extremely unlikely to be subject to legally mandated or prior agreement restrictions (Simmons, 1998, p.5).

Therefore, realists do not believe in the necessity of treaties or formal agreements since states can selectively comply with the agreements. In particular, powerful states are less likely to be restricted by international agreements. As Falkner (2005) describes, hegemony can be both the basis and a source of veto power for environmental leadership (p.591). For instance, the United States has been both a leader and a veto player on global environmental issues for the past 30 years, and in recent years has shifted more decisively to the latter (ibid.). Hence, the realist theory would believe that China, as an emerging superpower, will show low interest and willingness to comply and implement international agreements at the domestic and local level. Both realism and rational-functionalism are interest-driven theories in which incentives play a significant role (Simmons, 1998, p.6). From the functionalist perspective, international agreements are created because states desire to address common problems that are impossible for them to solve in any other way, such as unilaterally or by political means alone (Bilder, 1989, p.492). Rational functionalism likes to see a specific agreement, or perhaps the entire international legal system, as a social good from which states might profit collectively, but no one wants to contribute excessively or be perpetually disadvantaged (ibid.). One of the goals

of international accords is to improve information about other countries' actions by establishing procedures that increase transparency and increase the reputational costs of noncompliance (Keohane, 1984; Milgrom et al., 1990; Mitchell, 1994). This is similar to the assumption of neoliberalism that collective interests can be gained through greater use of human rationality, and that increased interaction and information exchange among self-interested individuals and actors is important (Sterling-folker, 2021, p.90; Russett, 2021, p.69). According to some scholars, reputational explanations of compliance are especially crucial for new and developing countries seeking to establish a reputation as "rule of law" countries (Shihata, 1965). Simmons (1998) states that greater transparency and opportunities for reciprocity can enhance compliance in the context of repeated gaming in a small group, for instance, among the large countries in the WTO (p.6).

Hence, functionalism proposes that a state like China ratify and comply with certain international agreements in order to solve the problem of having to deal with other countries together. Rational functionalism argues that countries may profit from international agreements, but no one wants to contribute excessively or be permanently disadvantaged in this collective cooperation. In terms of China, it will comply with and implement international agreements in the domestic and local areas in a responsible and reasonable manner. China will be more transparent and open to information exchange with other states during international cooperation, which can promote its national reputation as an emerging superpower by cooperating on collective environmental issues.

4. Analytical Framework

This paper intends to provide a comprehensive analysis of the policies and regulations on fertilizers and pesticides in China through a new analytical framework based on previous studies. Zhao and Ortolano (2003)'s study uses the Montreal Protocol to analyze the Chinese government's role in implementing multilateral environmental agreements and found the desire of the country to be a responsible and cooperative player in resolving global environmental issues as one important motivating factor for China to comply with the Protocol. According to this, and China's one-party dominated political system, political will (national vision) can be an evaluative criterion. Moreover, based on other studies analyzing agrochemical management (discussed in section 2.4.2), focusing on the criteria of information and education (such as literacy, knowledge, and public awareness), stringent restrictions on the use of toxic agrochemicals, updates to current legislation, and increased financial incentives, which become the reference to formulate the evaluative criteria in this study to assess China's policy efforts on agrochemical control and reduction.

The first research question is "Do China's policies in agriculture keep pace with the general global move toward sustainable agriculture?". "Keep pace with" refers to whether China makes progress at the same speed to comply with international agreements regarding sustainable development. Furthermore, "global move" refers to international agreements, either legally binding or voluntary. Agenda 21 was adopted as a representative international agreement of the global sustainable development milestone in the 1990s. China's ratification and compliance with Agenda 21 can be an example to further answer the first research question by using the evaluative criterion of political will (national vision) in section 6.1.

Five evaluation criteria are used to assess and analyze whether national and provincial fertilizer and pesticide management were policy-compliant and well-implemented, namely: political will; policy efforts of ban highly toxic fertilizers and pesticides; positive incentives; subsidies; and information.

Table. 1 Evaluative Criteria

Evaluative Criteria		Strong	Weak
Political Will (National Vision)	Compare China's actions in implementing Agenda 21 and the Montreal Protocol; Whether sustainable agriculture appears in China's national vision	China has taken less time to comply with and implement Agenda 21 than the Montreal Protocol; Sustainable agriculture has reflected on the national vision	It is taking China longer to comply with and implement Agenda 21 than the Montreal Protocol; Sustainable agriculture has not been stressed and integrated into the national vision

Policy efforts	Ban	Law changes	Laws updated and followed the shift in national vision; Language in the laws	Laws are constantly updated to reflect the national vision; Language in the law is strongly normative	Laws have not followed and changed with the national vision; Language in the law is soft and vague
		Type prohibition	Types prohibitions are updated over time and whether they are complied with international agreements or not	Updated over time at the national level; complied with international agreements	Types of prohibitions have not been updated and are not complied with international agreements.
		Usage restriction	Pesticides: At the central or provincial level, harmful agrochemicals have clear usage restrictions or not	Usage restrictions were clearly stated in the numbers	Lack of clear standard on usage restrictions either at the national or provincial level
			Fertilizer application standards are enacted and implemented the same or different in different regions	Standards are the same across Chinese regions	Standards are developed and implemented at different paces in different regions; Lack of standards to control
	Positive Incentives (“Turning waste into treasure”)		Policy documents guided to use organic fertilizers	Policy documents regarding utilization of straw and manure as organic fertilizers are concrete and popular	Government did not guide the public to utilize and recycle organic agricultural inputs
	Subsidy	For farmers	Whether the subsidy level has been changed by time or not	Subsidy level has enhanced and promoted by time	No subsidy, or subsidy level has not been changed
		For corporations	Whether governments provide subsidies to guide green production	Governments provide various subsidies to guide green production	Governments did not provide subsidies
	Information (Education)		Whether educational information is easily accessible and understandable	Educational information is easy for farmers to access and learn	Government did not provide channels to educate; or farmers feel hard to get resources

- Political Will (National Vision)

In this context, political will can be understood as ideas and actions of key political leaders to achieve their goals. More specifically, the analysis of China's political will and national vision will begin with the concept of "sustainable development" at the international level and its historical roots of development, and then move to the national level.

To assess whether China has shown strong or weak political will to comply with the international agreements regarding global sustainable agriculture, the timeline of China's actions in complying and implementing international agreements (for instance, Agenda 21 compared to the Montreal Protocol) and whether sustainable agriculture appears in national development vision will be used as assessment tools. If China has taken less time to comply with and implement Agenda 21 than the Montreal Protocol, and its national development vision

has stressed and integrated sustainable agriculture, then it can be said that China has a strong political will and national vision to keep pace with the global action. If China is taking a longer time to comply with and implement Agenda 21 than the Montreal Protocol, and its development vision has not stressed sustainable agriculture, it would be referred to as a weak political will. If its actions fall in between, it can be said as a moderate but not powerful political will.

Besides national vision, policy effort in this paper refers to what policies are issued, whether these policies go far enough, and whether these policies are implemented well. This paper will analyze the policy efforts on the management of fertilizers and pesticides through bans, positive incentives, subsidies, and information to evaluate whether these efforts are weak or strong in China.

- Ban

In terms of the ban on harmful chemicals, it is mainly manifested at the policy and regulatory levels. The ban on hazardous chemicals can be divided into three aspects. First, whether China's laws banning hazardous agrochemicals change with the national vision and political will. Regulations on banning hazardous chemicals will be good and effective if it is constantly updated following the national vision and if the language in the law is strong normative ban.

Second, banning certain types of hazardous agrochemical inputs. A good ban for dangerous types should be kept pace with the change of national vision and international agreements regarding agrochemical inputs. Third, limiting the usage of harmful agrochemicals. Good regulations on banned quantity limits should clearly state the limits in numbers, and application standards are enacted and implemented the same in different regions, which makes end-users and monitors crystal clear about the exact amount they can or cannot use. If government policies or regulations either on central or provincial level are not regulated in this area, this can be seen as a weak ban regulation.

- Positive Incentives

I analyze positive incentives from a perspective of "turning waste into treasure". In the Chinese context, turning waste (livestock and poultry manure, and crops straw) into treasure (organic fertilizer) can be seen as a new positive incentive. Here, I will evaluate this incentive policy effort by looking at the time it takes on promoting organic agricultural inputs. If this policy effort is promoted and concretely implemented on the ground, I consider it strong, and if the government does not act on the ground, I believe it remains weak.

- Subsidies

Subsidies are elaborated from two subjects: farmers and corporations. In this context, positive incentives are "economic, legal or institutional measures designed to encourage beneficial

activities, such as incentives for organic farming, agricultural land reservation, etc." (Convention On Biological Diversity, n.d.). Subsidies are government incentives in the form of cash, grants, or tax breaks to individuals or businesses to improve the availability of certain goods and services (Corporate Finance Institute, n.d.). In the case of production subsidies, production, consumption increases but prices remain unchanged, however, the disadvantage of this incentive is that it may promote overproduction (ibid.).

Subsidies will be assessed based on whether the subsidy level for farmers has been changed by time and whether governments provide subsidies for corporations to guide green production. Because each provincial government has different levels of subsidies, it is difficult to know the exact amount of funding. Hence, I think that if the data show farmers received gradually increased subsidies from the past to present, and businesses received various subsidies from governments to guide them produce environmentally friendly, then it can be seen as a stronger subsidy in China. If the government is not acting to provide subsidies or changing the subsidy levels to farmers and enterprises, then I think it is weaker in this regard.

- Information

The last evaluation criterion is related to information, such as government efforts to educate farmers and other implementers of fertilizers and pesticides in different ways, and to raise awareness of ecosystem conservation among relevant stakeholders. International agreements, namely the Pesticide Code and the Fertilizer Code, are used as references to compare with actions at the national level.

Information will be assessed through educational means, whether the delivery and access to educational information is easy to access and understand. If the information is convenient and easy for farmers to obtain and understand, it can be considered as strong education, otherwise, it can be considered as weak education.

In addition to these points above, there are also some discussions about misgovernance, in line with the discussion in section 2.2.1 that governance plays a key role in the overall policy communication and implementation process. Issues regarding Chinese governance are relevant to these policy efforts, but they are much more difficult to study in the same systematic way. Still, it is important to point out some evidence of that.

Furthermore, to answer the second research question, "Is there evidence of implementation all the way down to the local level?", I chose Heilongjiang, a strong agricultural province, to narrow the scope and see if this province also shows strong changes and intentions to reduce chemical fertilizer and pesticide. If the transformation and management at the provincial level

are consistent with the national level, then this paper argues the commitment down to the local level is equally strong. UNEP (2022) describes national and regional legislations, policies, and cooperative platforms as critical to effective pesticide and fertilizer use and management (p.14).

5. Research Design & Methods

5.1 Design

As stated by Abutabenjeh and Jaradat (2018), "A research design is a blueprint to guide the research process by laying out how a study will move from the research purpose or questions to the outcomes." In this light, the research design shows the way to obtain empirical data about the study that serves to answer the research questions.

Intending to gain a comprehensive understanding of the overarching research question "Is there evidence that an emerging superpower cooperates on collective environmental issues?", the thesis uses the qualitative approach through content analysis that combines policy documents and online interviews to collect qualitative data (e.g., published text and video statements).

Understanding and analyzing the policy documents is the basic method for this study, interpreting global and national documents on chemical fertilizers and pesticides. Looking at sources other than documents from the government helped me to better understand what I found in the policy, aiming to gain a more comprehensive understanding of whether China is cooperating on collective environmental issues, rather than limiting myself to believing the answers in government documents.

Through content analysis, this paper analyzes not only international agreements, but also national policies, initiatives, and documents regarding agricultural chemical fertilizers and pesticides. International agreements, as discussed in section 2.3.2, I put the emphasis on the Fertilizer Code and the Pesticide Code that were published by the United Nations Organizations. Chinese policies related to the reduction and control of the use of chemical fertilizer and pesticide are mentioned in a series of national development plans, such as from 11th (2005-2010) to 14th (2021-2025) Five-Year Plan and several central No.1 Document³, but these plans are vague to some extent. Instead, the paper mainly investigates four laws (Agriculture Law, Agricultural Products Quality and Safety Law, Soil Pollution Prevention, and Control Law and Solid Waste Pollution Prevention and Control Law), and four administrative regulations regarding pesticides, as well as action plans such as the "Organic-Substitute-Chemical-Fertilizer (OSCF)" and the Agricultural Sustainable Development Program (2015-2030). All policy documents can be easily accessed on the website of the Ministry of Agricultural and Rural Affairs of the People's Republic of China (*hereafter referred to as "MOA"*) (<http://www.moa.gov.cn/gk/>). The list of policy documents shows in Appendix 1.

³ the Central No.1 Document is the first policy statement regarding agriculture and the country's policy priorities will be announced every year (Wu, Wang & Miao, 2019, p.1)

Except for the policies, it is important to gain insight into practice. Ideally, interviews with knowledgeable experts and NGO staff who have worked or are working in the field of agricultural chemical fertilizer and pesticide would strengthen the analysis. However, multiple factors made interviews difficult to achieve in a short time, such as scientific institutions and associations not accepting invitations from overseas and by a private person, and their information disclosure rules. Thus, I chose to obtain information from videos of experts and farmers on the Internet, as social platforms provide a platform by which citizens may convey some level of criticism. We Media has become popular in China in recent years, providing a popular way for ordinary people to express their thoughts on policies, social phenomena, and situations. Through online interviews and statements by experts and farmers, I can gain a deeper perspective on the implementation and progress of agrochemicals management in China. The transcripts of five videos and one informant interview are stored on an external hardware, inaccessible for unauthorized people. The strengths and limitations of these data sources are discussed below.

5.2 Case Selection

5.2.1 Why Agriculture chemical fertilizers and pesticides?

The aim of the thesis is to understand whether a superpower is willing to honor international cooperation commitments. As discussed in section 2.3.1, the use of chemical inputs in agriculture can have impacts on ecosystems and human health, thus causing global environmental problems.

China is not only an emerging superpower but also a country with a long history of agriculture, and its consumption of chemical fertilizers and pesticides is among the highest in the world. Chemical fertilizer and pesticide use is a good case to understand China's willingness to cooperate on collective environmental issues as a superpower by examining the management of fertilizers and pesticides, whether it is pursuing more economic power and growth or another effort that means less economic growth and trying to work toward cooperation on international environmental issues.

This is an illustrative case where this policy area shows conflicts between economic growth and environmental protection, capturing collective action problems. Moreover, given that some studies have already examined collective action issues such as greenhouse gas emissions, fertilizers and pesticides remain an area of less global concern. Therefore, in the case of agrochemicals, we can understand what this country is thinking by looking at its actions in this policy area.

5.2.2 Why Heilongjiang Province?

As Wu et al. (2020) assert, "provincial governments are responsible for making local agricultural policies, while the central government provides more general principles for agricultural development, as China is a very large country with different provinces having different resource and climatic conditions" (p.2). The province analyzed in this study is Heilongjiang Province. Heilongjiang province has ranked first in total grain production in China for nine consecutive years, with the highest area and production of the three major varieties of corn, rice, and soybeans (Heilongjiang Provincial Party Committee Agricultural Office, Department of Agriculture and Rural Affairs, 2021). Its black soil area accounts for 45.7% of the total black soil area in China (Yang, 2021). In this regard, its remarkable agricultural production capacity is valued by the government.

Therefore, a reduction in the use of fertilizers and pesticides in this particularly important agricultural region would demonstrate the strong willingness of the Chinese government to reduce fertilizers and pesticides, proving that they are working in step with global sustainable development to address collective environmental issues.

5.3 Content analysis

According to Marshall et al. (2022), content analysis is the foundation for a wide range of data collection and analysis methodologies (p.192). While content analysis can be applied quantitatively and qualitatively, it is currently seen more broadly as a method for describing and analyzing the textual production of a society or a social group (Marshall, 2016, p.314). This study echoes this finding in that the author was able to identify the most important parts of the material by reading different policy statements and watching and noting narratives from online videos. Thus, the overall method will be qualitative content analysis (QCA), which will be utilized for both document analysis and online video analysis.

To obtain empirical data, international agreements can be divided into two types according to the United Nations Environment Assembly (2021): legally binding agreements and voluntary agreements (p.13). The UN SDG 12.4 provides a starting point against which to assess the national level policy documents. However, it is too vague and general to use this target to analyze the national-level process. More specifically, I use the two voluntary international agreements, the "Pesticide Code" and the "Fertilizer Code" (stated in section 2.3.2), as standards or references when I find it difficult to analyze based only on national policies. Meanwhile, international level agreements on agrochemical inputs are available on the SDG 12 and UN websites.

At the national level, the national documents from MOA can be classified as law, administrative regulations, policy, etc., whereas the bulletin is shown in a separate category on the official website ("Public Government Information", 2022). I surveyed these policy documents under the section "to public" on the website of MOA, to find the most related policy documents regarding the chemical fertilizers and pesticides. (See Appendix 1 for a list of global and national documents on fertilizers and pesticides).

5.4 Online video

The utilization of existing interviews and talks as data rather than interviews conducted by academics for research is becoming more widespread. 'Home-made' domestic video, broadcast media (Chouliaraki, 2006), automated CCTV recordings (Goodwin, 1994), and YouTube videos (Adami, 2010) are just a few examples of research 're-purposing' films for study (Jewitt, 2012).

As stated in 5.1, discussing and criticizing Chinese policies and government actions is sensitive and uneasy for scholars and NGOs, and reaching an increasing number of potential respondents would take more time and effort, the researcher considered using online videos to gain professional and local perspectives on Chinese policy implementation. Many Chinese use social media platforms, such as Weibo (China's Twitter), to describe their current situations and express their opinions.

The videos I chose are highly relevant to my research and were published within the last two years, ensuring that they are timeless. Most of the videos are from Professor Wen Tiejun, an expert on Chinese agriculture, familiar with Chinese agriculture development and policy, and former dean of two famous Chinese universities⁴ (ThinkInChina, n.d.). The expert's video format is like an interview where he sits in front of the camera and shares his assessment of specific agriculture policies, issues, and situations in China based on his research experiences and knowledge. From all these aspects, I think it is a convenient and effective way to obtain the data and materials needed for this research. Prof. Wen's videos are available on Toutiao⁵ (from both domestic and international internet) and YouTube (only from international internet). The videos I used as data and their sources are listed in Appendix 2. Since the expert, Prof. Wen, provided an extensive overview of China's agricultural development progress and

⁴ Dean of the School of Agronomics & Rural Development and Executive Director of the Institute of Advanced Studies for Sustainability at Renmin University of China and the Executive Dean, Institute of Rural Reconstruction of China, Southwestern University of China, with his professions in "social-economic sustainable development and rural issues, especially in policy studies and macro-economic".

⁵ 头条, "headlines", a Chinese news and information content platform

policies, it is more feasible to understand the implementation of policies at the local (grassroots) level.

In recent years, expressing real opinions and ideas through social media has been the most common and popular way in China, which can be called "We Media," where the public, enhanced by digital technology, provides and shares their own facts and opinions (Luo, 2009), or reflects their thoughts on government actions and policies. For example, millions of Chinese posted their real-life situations during the Shanghai Lockdown on Weibo and wanted to make the government and the media pay attention to their problems.

5.5 Semi-structure informant interview

The analyses also build on one informant interview with a researcher with expertise in Chinese agricultural fertilizers and pesticides to obtain expert inputs in this area. Informant interviews can help to identify a potential problem and explore a topic before digging for the details by selecting people who have been central (experts) in relation to the event I want to study. (The interview guide is shown in Appendix 4).

In preparing for the informant interviews, I reached out to a total of 14 people (listed in Appendix 3), and unfortunately, I only conducted one on 5 April 2022. Since the scientific research institution that the only interviewee works for does not accept overseas interview invitations, she asked me to consider this online meeting as a chat between friends rather than a formal research interview. Considering that this paper will not be published or used for other purposes and that I have committed to the anonymity of the interview, the data from this interview will be retained because I believe that what we discussed was more specific than what was obtained in the videos, bringing a new perspective to the analysis.

Similarly, this situation arose when I contacted NGOs working on agrochemicals in China. The deputy secretary of one organization declined my interview invitation because of the association's information disclosure management system and the fact that my interview invitation came from overseas and private.

In addition, I think China is a society where doing things depends on *guanxi* (i.e., connections), as the only successful interview was because the person who introduced me was a workmate of the interviewee. Therefore, I can understand that the organizations or individuals I tried to contact did not respond to my interview requests because they did not have direct connections with me. They did not want to violate the privacy and disclosure rules of their work organizations, and they wanted to avoid the distraction of talking about sensitive topics involving Chinese policy and government.

5.6 Reliability

The main problem with online videos is reliability, as everything can be published online, regardless of whether it is right or wrong, which brings about skepticism or controversy. Due to the regime in China, criticizing Chinese policies in public can sometimes come with a cost. For this reason, when one does so, it is almost based on the need to automatically bear the costs of making critical statements. Particularly, the fact that Professor Wen is an expert in the field and that he is willing to take certain risks to express and criticize China's policies and status quo adds to the credibility of what he said.

In addition, people dare to be more honest on media platforms because the Internet and social media platforms have become highly dominant and pervasive in China, especially Weibo and video platforms. Due to the regulation of speech in print and other media, Weibo and video platforms have become the most important and convenient platforms for speech in China today, or at least it has become a gathering place for the most important sources of information on breaking news. People can express their opinions through posts with text, photos, or videos that others can forward and comment on. If it is a common topic of discussion and concern, then it will become a hot topic and will likely be noticed by the "higher" government and the media. Thus, it may be safer for people to express very public criticism than to speak in an interview because silencing public critics comes at the cost of the regime.

5.7 Limitations

Since the policy documents, videos, and one interview were conducted in Chinese, it is possible that some of the nuances in the material were difficult to show during translation because English is not my native language. Another possibility is that the quotations do not correspond exactly to the way the videos and discourse are expressed in English.

The reason I did not analyze the policy for monitoring and enforcement is that it is hard to analyze and evaluate it without available statistics. I understand that another source of data might be statistics on environmental performance because social science research does use these environmental indicators to see what governments do well and what they do not do well, but these statistics are non-public in China. Thus, national and provincial statistics could show how well policies are working, but they are hard to come by.

6. Analysis

The overarching question, "Is there evidence that an emerging superpower cooperates on collective environmental issues?" will be answered by starting with a general vision of international agreements of sustainable development and China's corresponding development, then moving on to specific policy efforts by the Chinese government on chemical fertilizers and pesticides to evaluate whether these efforts show weak or strong positions. This will be followed by a description of misgovernance issues.

6.1 Political Will and National Vision

Internationally, the idea of sustainable development was first introduced by the Brundtland Commission in the Brundtland Report (also entitled "*Our common future*") in 1987 (Jarvie, 2016; Du Pisani, 2006). Through Agenda 21, as the UN's non-binding action plan on sustainable development, the Millennium Development Goals (MDGs) and finally landing on the global commitment to the Sustainable Development Goals (SDGs) under the UN's Agenda 2030, recently designed at the Sustainable Development Summit in 2015 (Bryan et al., 2018, p.93; Adams, 2019).

China joined Agenda 21 in 1994, which also clearly implies China has adopted sustainable development as the goal that the country needs to achieve in the 21st century. However, China is known for its rapid economic development in the 2000s, joining the World Trade Organization (WTO) to boost China's economic growth since 2001.

Faced with this situation, the Chinese leader at that time, Jintao Hu, put forward a "scientific outlook on development" in 2003, which was promoted based on the sustainable development in Agenda 21 and MDGs, and proposed to abandon the pure pursuit of GDP (an overly radical development goal) and to pursue inclusive and sustainable development (Wen, V2⁶, 2021). As Prof. Wen further explains the historical roots of ecological civilization,

"Ecological civilization, at the beginning, was only shown as the 'scientific outlook on development', then transformed to green GDP and green growth in 2006, and later it was proposed as the development concept in 2007. However, this series of adjustments has not really been implemented in the first decade of development in the 21st century because it is hard to balance rapid development and environmental protection for a developing country. It really evolved into action in 2012, when a new leadership group came out and formally proposed the development strategy of ecological civilization."

In this regard, from Prof. Wen's critique, China's political will for ecological civilization and sustainable development has undergone a long process of transformation. In 1994, China joined

⁶ V2 means video two, hereafter is the same.

the global advocacy of sustainable development, but still needed to develop its economy; in 2003, the Chinese leader initiated the concept of not blindly pursuing GDP growth at the expense of the environment, but little effort was made to balance this situation until 2012; after 2012, the promotion of ecological civilization became a development strategy.

Taking China's commitment to the Montreal Protocol as a comparison, China issued its national program for *the Phaseout of Ozone Depleting Substances under the Montreal Protocol* (hereafter referred to as the "China National Program") in 1993 and revised in 1998, which describes China's plans and measures to complete its commitments under the Protocol (Zhao, 2005, p. 60). Specifically, the United Nations adopted the Montreal Protocol in 1987, which mandated developed countries to stop using freon in 1996 and restricted developing countries' use of freon in 2006. By July 2007, China had achieved its goal of phasing out freon (United Nations Industrial Development Organization (UNIDO), 2019; 联合国工业发展组织, 2019). In this regard, China officially ratified the Montreal Protocol in 1991 (UNIDO, 2019), complied and implemented it as a national program since 1993, which can be recognized as a quick response to complying with this international sustainable agreement. Comparing China's action to this agreement, it seems China took two decades after joining Agenda 21 in 1994 to make significant action is quite slow. Therefore, comparing China's compliance with the Montreal Agreement and with Agenda 21, China's implementation of Agenda 21 is lagging. China's willingness to comply with the Montreal Protocol reflects its intention to cooperate with this specific global environmental issue. However, its slow compliance with Agenda 21 shows the struggle of China as a developing country between economic growth and environmental protection.

After 2012, the Chinese leader changed from Jintao Hu to Jinping Xi. Since Xi changed the electoral system, he remains the Chinese leader from 2012 to the present, which means that his national development strategy will continue in the following years. For instance, Xi introduced the concept of "clear waters and green mountains are as good as mountains of gold and silver" in 2005 and combined it with ecological civilization in 2017, aiming to uphold the harmonious coexistence between humans and nature (Xinhuanet, 2017). From this, I believe Xi is a leader who emphasizes environmental protection and sustainable development, which guides China's following development path.

However, to answer the first research question "Do China's policies in agriculture keep pace with the general global move toward sustainable agriculture?". There is a quiet lag between its implementation with Agenda 21 and the Montreal Protocol as far as the timeline issue is

concerned. China has not really kept a “fast” pace with the international sustainability agreements, but rather has taken on the role of a later comer.

With the expansion of the 14th Five-Year Plan (2021–2025), "Building the Agricultural Modernization of Socialism with Chinese Characteristics in All Respects" is put forward by the State Council in 2021 (the State Council, 2021). As Prof. Wen analyzes, three factors should be taken into consideration to achieve this agricultural modernization (V4, 2021).

"The first is ecology, which means this modernization cannot be ecologically destructive. It cannot be the kind that relies on, for example, the continued use of chemicals on a large scale. That's not modern agriculture; that's destructive agriculture. ..."

This paper answers the research questions with a focus on fertilizer and pesticide use in agriculture. Since ecological civilization became a national strategy in 2012, the government's attention to agrochemicals has increased. Interviewee 1 shares a scientific research project on aquatic system pollution that she was involved in 2008 and found that chemical fertilizer and pesticide use on land is also one factor in water pollution.

Furthermore, the concept and urgency of ecological civilization are gradually gaining popularity with the passage of time and economic development, and both the governments and the public recognize the importance of chemical fertilizer and pesticide reduction and control in agriculture. Moreover, the effect of policies to control and reduce agrochemicals needs time to test whether they are effective or meaningless, as interviewee 1 believes

“Perhaps the government's concern about fertilizers and pesticides can be traced back to earlier times, but I was impressed by this aspect because I participated in the 2008 water pollution control project. This gradual process is probably more than a decade. The government may also be little by little to see, little by little to come, ...”

Therefore, ecologically sustainable development and rational use of agrochemicals have attracted increasing attention and focus from the government and have eventually risen from small concepts to national strategies, appearing more and more in national development concepts and documents. I believe from the past to the present, although China is about 20 years behind in acting with respect to cooperation toward international sustainable development, China's political will and vision for ecological civilization and sustainable management of agricultural inputs have become stronger and firmer since 2012.

6.2 Policy efforts

The political will and national vision reflect a gradually strong will for ecological civilization and sustainable development. In this section, policy efforts for sound management and control of agrochemicals are discussed. First, bans of hazardous chemicals are analyzed as follows: whether regulations of bans changed with the national vision, whether bans of types are updated

with time and aligned with international agreements, and whether harmful agrochemicals have clear usage restrictions. Second, positive incentives, discussing whether organic agricultural inputs are promoted in a timely manner. Third, analyzing the extent to which farmers and corporations are subsidized. Last is the information section, describing how education is promoted from top to bottom.

6.2.1 Bans

A) Law changes

In this section, the Agriculture Law, the Agricultural Products Quality and Safety Law, and the Soil Pollution Prevention and Control Law were chosen to analyze whether national regulations banning harmful chemical fertilizers and pesticides have changed with the national visions and whether they indicate strict regulatory rules.

Regarding the Chinese government's ban on harmful chemicals, China has three mandates that emphasize the illegality of using highly toxic agrochemical inputs. The production, sale, and use of agricultural inputs banned by the state are prohibited, as described in Article 25 of *the Agriculture Law*, Article 25 of *the Agricultural Products Quality and Safety Law*, and Article 30 of *the Soil Pollution Prevention and Control Law*. Further, the sale of products containing pesticides or other chemical substances prohibited by the state is not allowed, as described in Article 25 of *the Agriculture Law* and Article 33 of *the Agricultural Products Quality and Safety Law*.

Taking *the Agriculture Law* is analyzed as an example here because it has been published for the longest time compared to other laws. It was promulgated in 1993 and revised on 28 December 2012, as well as amended twice in 2009 and 2012 (State Administration for Market Regulation, 2012). While comparing the 1993 and 2012 Articles on fertilizers and pesticides, they are still categorized under "Agricultural Production", while the latest amendment strengthens the detailed classification of subjects.

From Article 34 in 1993, which states "People's governments at all levels and agricultural production and management organizations shall establish a sound system for the safe use of pesticides, ...", to Article 25 in 2012, which separately stipulates the obligations that the government and agricultural production and organizations should fulfill, people's governments at all levels "should establish a sound system for the safe use of agricultural production", and farmers and agricultural production and management organizations "shall not use pesticides that the state has explicitly ordered out and prohibit the use of pesticides"

The Agricultural Products Quality and Safety Law is a law enacted to ensure the quality and safety of agricultural products, safeguard public health, and promote agriculture and rural

economic development. The law was passed and came into force in 2006, and was later amended on 26 October 2018, and further revised on 1 September 2021. Compared with the old version, it focuses more on the quality of agricultural products and environmental protection. It also promotes the supervision of the whole process, including the production environment of agricultural products and inputs (such as fertilizers and pesticides) (Yiyang.gov.cn, 2018).

The Soil Pollution Prevention and Control Law recently entered into force in 2019 (Ministry of Ecology and Environment, 2018). Several articles also regulate agricultural inputs, such as prohibiting the production, sale, and use of agricultural inputs explicitly prohibited by the state (Article 30), and the state encourages and supports agricultural producers to take measures to reduce the use of chemical fertilizers and pesticides to protect soil (Article 29).

Thus, the revision and amendment of existing laws and the publication of new laws on agricultural inputs indicate a growing demand and willingness for sound management of fertilizers, pesticides, and other inputs. While these laws continue to be revised gradually and comprehensively and change with the vision of the country, some words such as "encourage", and "support" still seem to leave room for violations with impunity in this area of regulation.

At the provincial level, Heilongjiang Province issued *Regulations on the Protection and Utilization of Black Soil* in March 2022, which corresponds with *the Soil Pollution Prevention and Control Law* and combines its provincial specialty of black soil. The regulation not only stipulates that pesticide users should use pesticides in strict accordance with the provisions of the pesticide label or instructions, but also prohibits the production, sale, and use of pesticides, feed, and other agricultural inputs containing toxic and harmful substances more than the standard (Article 27). It is prohibited to use toxic and hazardous waste as fertilizer for land (Article 30).

As these articles in the three national laws and one provincial regulation refer to "prohibiting the use of agricultural inputs banned by the state" and "using pesticides in strict accordance with their labels or instructions," I will discuss the ban on harmful agrochemicals in terms of B) type prohibition and C) usage restriction as follows.

Thus, this section finds a revision and adjustment of state regulations banning harmful fertilizers and pesticides in response to changes in the national vision, but the wording of some laws that ban harmful agricultural chemicals reflects a softer approach.

B) Type prohibition

As the regulations state that "agriculture inputs banned by the state are prohibited," among the highly toxic agricultural inputs, mainly pesticides, are banned by the Chinese authorities by type.

The management of highly toxic and hazardous pesticides is receiving increasing attention in China, and the timely publication of banned or restricted pesticides is an important pesticide management measure (MOA, 2021). *The list of prohibited and restricted pesticides* began in 1997 and is regularly revised by the ministries (Agriculture Technology, 2022). It was updated from 23 banned pesticides and 19 partially banned pesticides in 2010 (MOA, 2010) to 48 prohibited and restricted pesticides and 20 partially banned pesticides in 2019, which must not be used mainly for controlling health pests, producing vegetables, fruits, tea, mushrooms, Chinese herbs, and aquatic plant pests and diseases (Department of Pesticide Management - MOA, 2019). As interviewee 1 explores,

"There are indeed some changes in the country's policies on the management of pesticides, and the classification of pesticides is changing. Highly toxic pesticides can't be bought."

In addition, China has shown its action in step with the Stockholm Convention, the world's legally binding instrument. Announcement No. 23 in 2009 of the Ministry of Environmental Protection shows that the "Stockholm Convention" stipulates that the production, circulation, use, import, and export of four types of substances, such as persistent organic pollutant ("POP") DDT, should be eliminated. According to the Convention, China implements the National Implementation Plan of the Stockholm Convention and relevant national management policies and has stopped the production, distribution, use, import, and export of four types of POP including DDT since May 2009 (Agriculture Technology, 2022).

Thus, with development, more and more types of pesticides are banned, which can be seen as progress made by the government. Reducing the use of highly toxic pesticides from the source and expanding the scale of implementation. Complying with the global convention and incorporating them into the national plan shows China's commitment to keep pace with global sustainable action.

C) Usage restriction

This part is mainly about the prohibition of quantitative restrictions, respectively, in terms of pesticides and fertilizers, and whether the provincial governments set specific standards to regulate this area according to the different development of each Chinese province.

Pesticides

China has issued and regularly revised *the Pesticide Management Regulations* since 1997, with the most recent revision in 2017 (The State Council, 2017). Regarding the maximum usage of pesticides that can be used, Article 34⁷ states

"Pesticide users should strictly comply with the labeling regulations of pesticides, including the scope of use, methods of use, ...; pesticide users shall not use prohibited pesticides.; ...; highly toxic pesticides shall not be used for controlling health pests, ..."

From this legal Article, I found that there is no general standard or document to specify the maximum amounts of pesticides that can be used by the end-users, and the user can only know the usage restrictions of pesticides according to the label on pesticide packaging.

In addition, the authorities updated *the Measures for the Administration of Pesticide Labels and Manuals* on 1 August 2017 and abolished the old version published on 8 December 2007.

Article 8 specifies what information needs to be elaborated on pesticide labels, including

“(1) the name, dosage form, active ingredient, and content of the pesticide; (2) the pesticide registration certificate number, product quality standard number, and pesticide production license number; (3) the pesticide category and its color marking band, product performance, toxicity, and its identification; ...”

In the *Pesticide Registration Management Measures* (published in 2017 and further specified in 2022), Article 9 states that the list and limit of pesticide additives shall be announced and adjusted in a timely manner according to their toxicity and hazard level.

These three specific regulations on pesticide and management, ranging from general management (since 1997), registration (since 2017), labeling and manuals (since 2017), and prohibited and restricted lists (in 2020), show good signs of China's increasing emphasis on sound pesticide management. However, laws in China do not clearly state the usage restrictions of pesticides in a document but only show separate limits on pesticide packaging or labels, which makes it difficult for end-users to find and review standards in a uniform manner.

As UNEP (2022) reflects, pesticides have both immediate and long-term health consequences. Every year, an estimated 385 million incidents of non-fatal inadvertent pesticide poisoning occur, with roughly 11,000 deaths (p.3). And at the global level, they want to scale up the development of international pesticide evaluations (ibid., p.22). As they also identify to evaluate the environmental and health risks of pesticides requires considerable resources, these resources are scarce, particularly, in low- and middle-income countries (ibid.).

⁷ In the Fifth Section "Pesticide Use".

Therefore, due to the high death rates and harm caused by using pesticides incorrectly, the regulations are necessary as guidelines for users to use fertilizers and pesticides correctly and efficiently.

Fertilizers

As shown above, many regulations exist for the regulated use of pesticides, however, regulations for fertilizers are still missing. The Fertilizer Code, announced by the UN FAO in 2019, intends to provide guidelines and recommendations on fertilizer use for governments, industry, farmers, traders, and civil society at large to ensure that fertilizer use is sustainable, effective, and has minimal negative environmental effects (FAO, 2019, p.VI, VIII). It explicitly declares in Article 6.3.2 to “set and regulate evidence-based safety standards, limits, and guidelines on harmful contents of fertilizer products, ...” (ibid., p.28).

Reasonable amounts of fertilizer can be used as nutrients for plants, and they are less harmful than pesticides, thus, action to control fertilizer use is not as urgent or comprehensive as it is for pesticides. A UNEP report summarized the status of pesticide and fertilizer use globally: “National pesticide legislation and policies exist in most countries in the world, while fertilizer legislation is less well developed, particularly in low- and middle-income countries.” (UNEP, 2022, p.14). Thus, fertilizer legislation and local support for its sound implementation are still lacking, not only in China but also from the global perspective.

Article 26 of *the Soil Pollution Prevention and Control Law*, which was implemented in January 2019, stipulates that the Ministry of Agriculture, Forestry and Grassland Department should improve relevant standards and measures to strengthen the guidance on the use of pesticides and chemical fertilizers on farmland and the control of the total amount used through the development of detailed standards (Ministry of Ecology and Environment, 2018). However, from my research, I have not seen specific fertilizer standards at the national level.

Because the situation varies from province to province in China, it is also worth noting whether provincial governments have established maximum limits on fertilizer or pesticide use in a timely manner. If provincial governments have not set precise standards, this may reflect weak and outdated efforts to prohibit excessive use of pesticides and fertilizers.

Heilongjiang Province has not yet set a "specific standard" to regulate the usage restrictions of pesticides or chemical fertilizers. The Hubei Provincial Department of Agriculture and Rural Affairs issued "Guidance on Further Improving Fertilizer Reduction and Efficiency" in June 2021 ("Hubei Arable Land Quality and Fertilizer Workstation", 2021). It apparently notes that different agricultural raw materials (rice, corn, wheat, and canola) have different requirements

for fertilizer application methods. Under each point, it describes the specific details of how to apply fertilizer in different periods and amounts, indicating that the provincial government is guiding users on scientific and appropriate fertilizer application. Comparing Hubei province with Heilongjiang Province, it is found that the control of fertilizer application standards is still in an unbalanced state across Chinese provinces, which should be regulated and monitored by the highest level of the Ministry of Agriculture.

In addition, Hou et al. (2017) elaborated that fertilizer efficiency varies widely among crops, with each crop requiring different amounts of fertilizer and planting on different land (p.363). Based on this, I argue that it is indeed more difficult to set a precise and uniform standard for fertilizer use at the national level, but provincial governments can still set a precise maximum limit for fertilizer and pesticide use for each province precisely. Due to the differences among crops, setting precise standards would help avoid excessive use of fertilizers and pesticides in an efficient way. This deserves attention and research afterward.

In conclusion, in terms of the national ban on the use of highly toxic chemicals, policy efforts in banning the use of hazardous pesticides and fertilizers have been gradually strengthened regarding regulations and standards, which aligns with the national vision of ecological civilization. However, policy efforts in setting tangible standards or regulations for fertilizers and pesticides' usage restrictions still need to be improved, as the quantity limits of highly toxic pesticides are currently only shown on their labels and packaging rather than clearly listed in a document, and the central and provincial governments are still negligent in regulating the maximum usage restrictions of fertilizers. For now, China's ban on pesticides is mainly based on their type, which can be seen as an effective way to control their sources. Finally, the Chinese government currently places more emphasis on banning pesticides through various regulations and administrative documents. It would be a good start if the government could start making efforts to control high-risk fertilizers.

6.2.2 Positive incentive

This section will discuss “turning waste into treasure” as a representation of positive incentives in the Chinese context. This incentive is increasingly promulgated and highlighted in national policy documents and incorporated into provincial implementation actions, demonstrating the increasing use of this positive incentive.

China produces more than four billion tons of livestock manure per year (Yi et al., 2021, p.2). Livestock manure, as a great organic fertilizer, has several merits over chemical fertilizers, such as enhancing soil fertility, improving soil conditions and microbial communities, and

eventually effectively promoting crop growth (ibid.). Originally, livestock and poultry manure would be thrown away, while straw⁸ from mature crops would be burned by farmers, resulting in wasted resources and pollution.

Several policy documents in China call for the recycling use of manure and straw. In the 12th Five-Year Plan, the Chinese government has continuously advocated for enhancing the recycling of livestock manure and straw as organic chemical fertilizers since 2015. This has been repeatedly emphasized in various policy documents, such as the 14th Five-Year Plan, the two Zero Growth Actions, and the Agricultural Sustainable Development Program (2015–2030), etc. In the "Action to Achieve Zero Growth of Chemical Fertilizer Use by 2020", it is stated that the reduction in chemical fertilizer use can be achieved by returning nutrients from livestock and poultry manure and returning nutrients from crop straw (MOA, 2015). Moreover, the MOA released the "Action Plan for Organic-Substitute-Chemical-Fertilizer (OSCF) for Fruits, Vegetables, and Tea" in 2017. The main purpose is to "reduce the use of chemical fertilizer, enhance the resource exploitation of livestock manure, and achieve agricultural green development." (Yi et al., 2021, p.2). Replacing some chemical fertilizers with organic fertilizers in vegetable cultivation can increase yields while improving the quality of the soil and products.

Returning livestock and poultry manure nutrients, returning crop straw nutrients, discovering the nutrients in these materials, and converting them into organic and green manure instead of chemical fertilizers can reduce non-source pollution. I believe that finding the hidden values of these materials is a good way to use the waste and turn it into treasure. As interviewee 1 illustrates, livestock manure is a relatively nutrient-rich material and, if used properly, a way to reduce environmental pollution - a two-for-one approach. Interviewee 1 believes that "This can also be considered a national policy change in recent years to collect more healthy raw materials for organic fertilizers."

Heilongjiang province implements *the Regulations on the Protection and Utilization of Black Land* from March 2022 (Sohu.com, 2022). It declares "scientific and rational application of chemical fertilizers and increased application of organic fertilizers." (Article 25) and "promote the use of straw fertilizer technology, encourage and support the development, production and application of organic fertilizer with straw and livestock manure as the main raw material" (Article 26). Corresponding to Article 29 in *the Soil Pollution Prevention and Control Law*,

⁸ Here, straw is a general term for the stem and leaf (ears) portion of mature crops. It is usually the remaining part of wheat, rice, corn, potatoes, rape, cotton, sugarcane, and other crops after harvesting the seeds.

“The State encourages and supports agricultural producers to take measures, such as ‘using organic fertilizers, high-efficiency fertilizers that meet standards’ and ‘comprehensive use of straw’”. At this point, national and provincial-level regulations are nearly identical to these key points emphasizing the utilization of straw and manure as organic fertilizer.

Thus, government policy actions have guided the recycling of livestock and poultry manure and straw transferring from being a waste and pollution generator in the past to being an organic agriculture input nowadays. This reflects the policy efforts to promote organic agricultural inputs. Since the policy concretization and popularization, I believe that policy incentives at both national and provincial levels have gradually shown strong intentions to increase the utilization rate of organic fertilizer.

6.2.3 Subsidy

This section focuses on subsidies to farmers and corporations, respectively.

A) For farmers

Agricultural subsidies are one of the factors that influence farmers' farmland conservation behavior (Li & Chen, 2017). A survey conducted by the international NGO (China Dialogue) in 2012 showed farmers' preferences for chemical pesticides over biopesticides due to economic factors (Yang, 2012). Compared to chemical pesticides, biopesticides have fewer side effects on crops but are not as effective as chemical pesticides (ibid.). Moreover, the price of biological ones is high. For instance, 500 ml of biological pesticides may cost hundreds of RMB, while chemical pesticides may cost 10 RMB (ibid.). Thus, farmers are reluctant to invest in this area, so the promotion of biological pesticides faces obstacles (ibid.).

According to interviewee 1, who conducted an empirical survey of farmland in rural Beijing in March 2022, she found that organic fertilizers are subsidized. For example, the government distributes free organic fertilizers in agricultural stores, and these fertilizers are distributed according to the area of farmers' farmland. In addition, biopesticides are expensive because they contain biological formulations. Then, some provincial governments decide to subsidize 70 percent of the purchase of biological pesticides, and others may offer free biopesticides, which can be seen as a strong promotion. Furthermore, interviewee 1 states

“Giving farmers this subsidy is equivalent to giving farmers cash subsidies, which is the most direct way. Based on that, the way farmers buy the fertilizer and pesticides is through a card. They can use the card to redeem fertilizer and pesticides in the agricultural store.”

The same cases in 2012 and 2022 have different results. I can see that government subsidies for the use of organic inputs are gradually increasing, which confirms that the government is guiding farmers to choose organic inputs over chemical ones. These new efforts to subsidize

organic fertilizers and biopesticides may have a positive effect on guiding farmers to use green inputs.

B) For corporations

Among the existing policies, *the Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming*, and *the Opinions of the General Office of the State Council on Accelerating the Resource Utilization of Livestock and Poultry Farming Waste* contain subsidies for organic fertilizer production and use, such as the use of agricultural electricity tariffs, value-added tax concessions, highway greenways, and subsidies for use in the production process (Jin, Zhang & Wu, 2016, p. 49). For example, Article 29 of *the Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming* provides that "those engaged in the use of livestock breeding waste for organic fertilizer products production and operation and other comprehensive utilization of livestock and poultry waste activities, enjoy the relevant tax preferential policies stipulated by the state." In addition, the corporate income tax policy issued by the Heilongjiang Provincial Taxation Bureau (2022) indicates that "corporate income tax is levied at a reduced rate of 15 percent on third-party enterprises engaged in pollution prevention and control," suggesting that providing tax incentives for pollution prevention and control can be a means of promoting green development.

The General Office of Heilongjiang Provincial People's Government issued the *Implementation Opinions on Strengthening Agricultural Non-Source Pollution Prevention and Control* in July 2018, which mentions in Part V that strengthening policy support for tax incentives, financial credits, land, electricity, etc., encouraging and attracting social capital investment, cultivating and growing new business entities, and leading enterprises in the prevention of agricultural non-source pollution (Heilongjiang Province People's Government, 2018).

In summary, the Chinese government and the Heilongjiang provincial government are encouraging and guiding the individuals and business groups to improve the production and supply of green fertilizers and pesticides through cash, subsidies, and tax breaks, which I propose is a gradually visible sign to promote organic agriculture inputs. This will be a positive way and sign that China is actively responding to agricultural input control and promoting ecological civilization.

6.2.4 Information

Article 8 of the Fertilizer Code states the importance of "information, extension and outreach" with one principle recommend that governments should "encourage and support collaboration and coordination to provide educational programs," and the other describes that the fertilizer industry should "develop, promote and distribute understandable information (in

local/applicable languages) on fertilizer best management practices to fertilizer retailers, salespeople, farmers and end-users; provide understandable information (in local/applicable languages) to fertilizer users" (UN FAO, 2019, p.21). In addition, Article 3.7 of the Pesticide Code emphasizes the importance of having educational materials and the need to make them easily understood by farmers and retailers, as well as other pesticide users (FAO and WHO, 2014, p.9). Both international agreements reflect that the delivery of information can be achieved primarily through education. In this section, therefore, policy efforts in information will be analyzed around education.

NGO China Dialogue pointed out that one of the reasons farmers prefer to use chemical pesticides instead of biological pesticides is because of the low price and strong killing effect on insects (described in section 6.2.3). However, most farmers would ignore the fact that not killing all insects or pests is good for the plants and ecosystems. As Prof. Wen and Farmer said, respectively,

"When there is a lot of use of pesticides, have you ever thought that pesticides will almost kill all the natural enemies?" (Prof. Wen)

"When we use pesticides, the pests are killed, but the beneficial insects are also killed. So, do these birds eating pests for a living still exist? This means that the ecosystem chain is broken." (Farmer)

Hence, to convey this value and enhance users' self-awareness and sense of responsibility to protect the soil and environment, the government and other stakeholders should make joint efforts to educate the 'traditional' ideas.

Media education can be reflected in articles posted on WeChat Official Accounts, such as "Wei Yu Nong Yao" (meaning small talks about pesticides, "微语农药"), and video platforms like Bilibili, Toutiao, and YouTube, which provide lots of information about how to scientifically use pesticides and the harms of pesticides, shared by technicians or farmers.

In 2021, the MOA in Heilongjiang Province held training lectures on science and technology to help farmers, recorded TV programs such as "Face to Face with Agriculture and Farmers" and "Technology Helps Spring Farming" on the agricultural channel of the provincial TV station, and organized online live broadcasts of popular science, which are broadcast on social platforms (such as Kuaishou and Jiguang) (MOA, 2021). Furthermore, the Provincial Plant Protection Station uses the official account of Heilongjiang Plant Protection Kuaishou to conduct weekly broadcasts live. The province's plant protection technicians and production and operation entities held 38 Heilongjiang Plant Protection Technology Network Lectures and six

Heilongjiang Plant Protection Technology Network Training Classes, with a total of 125,000 people trained (ibid.).

This can be seen as an interesting and popular way to promote awareness in China, as the government has also transformed mobile phones into "new farming tools". The Provincial Department of Agriculture and Rural Affairs innovatively launched mobile applications (such as "Handheld Plant Protection") that integrate public service functions such as monitoring and investigation, pest and disease forecasting, plant protection work management, work communication and online consultation, plant protection classroom, and data query. The number of registered users reached 22,000. Used 3.398 million times, experts answered 2,975 plant protection technical questions online (MOA, 2021).

In this sense, multiple efforts to support and guide the right direction will drive fertilizer and pesticide reductions across the board. The proper use of agricultural inputs is being communicated and educated through various channels provided by the government and other stakeholders, and people can easily and conveniently access and learn about them by using their cell phones and the Internet. Thus, I believe that China is becoming more comprehensive in its approach to education. However, in some cases, farmers can be very subjective in deciding whether to change their thoughts and opinions on reducing agrochemicals, which can be further analyzed through future research.

6.3 Governance and misgovernance: how economic interests inhibit change

During the research process on how China cooperates on collective environmental issues, there are some governance issues that may affect the policy implementation process and inhibit changes. These problems discussed below are explorative, as it is difficult to analyze these points in a systematic way, but the misgovernance problems presented as follows can be seen as a reference for further studies on the Chinese governance system.

According to the news report explored in Southern Weekly in 2010, China began to subsidize different chains of fertilizer companies in 1998, from production to transportation to taxation, etc., prioritizing and subsidizing the supply and transportation of fertilizer and their raw materials, and implementing tax incentives for the production, operation, and domestic shortage of fertilizer varieties. However, China's nitrogen fertilizer production has been in surplus since 1997 and the national subsidy policy has not yet been adjusted (Southern Weekly, 2010). This indicates that the subsidy policy for small-scale fertilizer companies has not been adjusted in time, highlighting the lagging nature. Despite the fact that nitrogen fertilizer saturation may bring serious agricultural non-source pollution to China, the government

continues to ignore the situation (ibid.). As analyzed by experts working in the investigation team, one of the reasons is capital interests, since at that time, most of the top 100 selected within the fertilizer industry are national and local coal and chemical enterprises, which were powerful and large taxpayers (ibid.). From this point of view, it shows that the government's financial compensation will be exploited by interest-oriented people in the 2010s. I speculated that maybe civil servants can benefit from it, which may even become corrupt.

Prof. Wen shared his story with an expert from the United Nations⁹:

“An expert from the United Nations, who works in biological control in China, complained to me, ‘We've had success in over 30 countries, but only in China we haven't.’ He was working on biological control, mainly means not to use highly toxic inputs, but there was no way he could do that in the Chinese context because those people in China were engaged in pest monitoring and reporting while they were selling pesticides. So that means that we (China) then took the grassroots agricultural administrative system and changed it into a trading system. Those people had to sell pesticides, so of course, they said that the local pests were developing very badly to make everyone come and buy pesticides, and so biological control was eliminated. Further, the combination of these pesticide sellers and producers resulted in the world's most highly toxic pesticides being produced in China. This is also GDP, so we (China) simply for the sake of GDP growth expand the scale of production of these highly toxic pesticides, which objectively cause environmental pollution. Most people are largely suffering from it and do not know.”

Furthermore, Prof. Wen's described there are scientific innovations and technologies that exist, and there are environmentally friendly and efficient impacts, but it is hard to scale up on a large scale.

“I once contacted the president of the provincial Academy of Agricultural Sciences, who has researched and developed microbial fermentation beds for a large number of farms that can be completely odorless and tasteless, with no environmental pollution and very good benefits, but this technology is just as impossible to be promoted.”

From his expression, I think that harmless technology is not being promoted, probably because reducing the use of other technologies would infringe on the interests of people associated with the government.

These two examples show that the central and provincial governments are not monitoring and enforcing enough at the grassroots and local levels. When politics is tied to profit, some officials at the grassroots level use their position and power for profit. China does not have a third-party regulator independent of the government system, such as Hong Kong's Independent Commission Against Corruption, to oversee the work and implementation of the government. In addition, the past Chinese government was singularly obsessed with rapid economic growth

⁹ in Video 1

at the expense of environmental protection and sustainable development. On the one hand, because regional GDP growth was used as one of the criteria for official promotion, on the other hand, some top government officials also lack the awareness of sustainable development. Therefore, the actual problems within the governance system present in a variety of ways, corruption, and backward and interdependent governance systems can be concluded as the main problems within the Chinese misgovernance, which inhibit policy efforts.

7. Conclusion

The Chinese government shows a gradually strong intention to comply with the international agreements regarding sustainable agricultural development, especially in the agrochemical aspect. Although China struggled with balancing economic growth and environmental conservation in the past 20 years, agrochemical control and utilization of green agricultural inputs will be a tendency in China's following agricultural development. The timing of it suggests that China's policies have not kept pace with the pace of global sustainable development because China's action is late by a decade. When China signed these international agreements, such as Agenda 21, maybe because they were at a specific stage of economic development, and since economic growth was the priority at that time, it took a slow pace to implement the international agreements regarding sustainable development. China's economy and other sectors are much stronger now than it was 20 years ago, which drives China to comply with these international agreements. Neorealism and realist approach would expect that China will not comply with international agreements regarding collective environmental issues and implement that on the local level, but China shows the opposite case, like neoliberalism (and neoliberal institutionalism) and functionalism would expect that China treats environmental conservation and economic development equally and is willing to cooperate on collective environmental issues by complying with IEAs since China has shown obvious signs and actions in terms of national vision and regional implementation in recent five years.

China's policy efforts on agrochemical control and reduction show in a variety of ways that have significant policy implications. First, the ban on the use of hazardous agrochemicals has been gradually strengthened regarding regulations and standards. However, in terms of pesticides, governments should clearly list the quantity limits of highly toxic pesticides in one document instead of only show on their labels or packaging, which helps to monitor the implementation. In terms of fertilizers, Chinese governments need to start to make efforts to control high-risk fertilizers, and the central government should monitor provincial governments to set fertilizer application standards according to the province's situation. Second, the positive incentives for the utilization and recycling of straw and manure reflect the considerable policy effort in environmental protection. Hence, the central and provincial governments should continue to provide as much support to guide end-implementers to use organic fertilizers and biological pesticides as possible. Furthermore, stronger subsidies for farmers and corporations, respectively, make them produce, supply, and use more green inputs. Last, governments provide more comprehensive education to farmers through technician guidance and online

lectures, to increase end-implementers' knowledge about the proper use of appropriate inputs. To summarize, China has shown a growing willingness to reduce the use of chemical fertilizers and pesticides, but there are still problems that need to be improved. Additionally, the misgovernance problem that existed within the Chinese governance system needed set up a third-party regulator that was independent of the government to monitor China's different levels of government. These misgovernance problems are difficult for me to assess, which should receive continued attention by both researchers academically and authorities empirically.

The reduction of chemical fertilizers and pesticides is a collective environmental problem that requires more nations to solve, contributing to the research gap that previous studies focused on the collective environmental issues and China from climate change, global warming, air pollution, and water resources.

Moreover, the Fertilizer Code and Pesticide Code are mainly used in sections 6.2.1 and 6.2.4, aiming to see whether Chinese implementation corresponds with parts of the Articles. Since both codes are voluntary international agreements instead of legally compulsory ones, if China's compliance with the voluntary ones, which demonstrates China's compliance is strong on this collective environmental issue (agrochemical management). This study, which investigates agrochemical research on voluntary international agreements, can be viewed as a contribution.

In addition, to gain an understanding of how China, as a global power, balances environmental protection and economic growth from top to bottom, which can be generalized to deal with collective action problems. Future research can use top-down and bottom-up theories except compliance theory to further analyze the Chinese internal governance system and to see how "top" policies are implemented at the "bottom" level.

8. Appendix

Appendix 1. Global and national documents regarding chemical fertilizers and pesticides

Category		Effective Time/Date	Document
Global	Legally binding international agreements	adopted in 1989; entered into force in 1992	The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
		adopted in 1998; entered into force on 24 February 2004	The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
		adopted in 2001; entered into force on 17 May 2004	The Stockholm Convention on Persistent Organic Pollutants (POPs)
	Voluntary (non-legally binding) international agreements	approved in June 2013; entered into force in May 2014	the International Code of Conduct on Pesticide Management
		adopted in September 2015; entered into force on 1 January 2016	The Sustainable Development Agenda
		initiated in December 2017; endorsed in June 2019	the International Code of Conduct for the Sustainable Use and Management of Fertilizers
National	Ministry of Agriculture and Rural Affairs Bulletin	17 February 2015	The “Action to Achieve Zero Growth of Chemical Fertilizer Use by 2020”
			The “Action to Achieve Zero Growth of Pesticide Use by 2020”
		8 February 2017	the “Action Plan for Organic-Substitute-Chemical-Fertilizer (OSCF) for Fruits, Vegetables and Tea”
		29 November 2019	List of Prohibited and Restricted Pesticides
	Policy	28 May 2015	The Agricultural Sustainable Development Program (2015-2030)
		Adopted on 3 March 2021; Entered into force on 3 September 2021	National food safety standard— Maximum residue limits for pesticides in food (GB 2763-2021)

	Administrative regulations	Adopted on 8 May 1997, further revised and announced on 5 April 2017	The Pesticide Management Regulations
		1 August 2017	Measures for the Administration of Pesticide Labels and Manuals
		announced on 27 August 2020; entered into force on 1 October 2020;	Management Methods for Recycling Pesticide Packaging
		Announced on 21 June 2017; mandated on 7 January 2022	Pesticide registration management measures
	Law	Published on 2 July 1993; Second mandated on 28 December 2012	Agriculture Law of the People's Republic of China
		Adopted on 29 April 2006; entered into force on 1 November 2006; further revised on 26 October 2018	Agricultural Products Quality and Safety Law of the People's Republic of China
		Adopted on 31 August 2018; entered into force on 1 January 2019	Soil Pollution Prevention and Control Law of the People's Republic of China
		10 May 2020	Solid Waste Pollution Prevention and Control Law of the People's Republic of China

Appendix 2. Video statements and lectures used in the analysis

Data	Title	Platform	Date	
Video (in Chinese)	1	“Foreign ‘slow life’, domestic ‘modernization’, Wen Tiejun: Chinese people do not take life for money”	Toutiao	2020-10-29
		“国外“慢生活”，国内“现代化”，温铁军：中国人不要拿生命换钱”	YouTube	2021-07-20
	2	The economy runs fast and ecology "takes the blame", is it dirty growth? Wen Tiejun: ignoring the ecological environment is to harm ourselves	Toutiao	2021-03-09
		经济迅跑生态“背锅”，是肮脏增长？温铁军：忽视生态环境就是伤害自身	YouTube	2021-07-22
	3	Domestic "high pollution", foreign cursed, why China still accepts the transfer of Western industries?	Toutiao	2021-03-14
		国内“高污染”，国外遭骂名，中国为什么还要接受西方产业转移？	YouTube	2021-07-22
	4	Agricultural modernization cannot copy the US model! Urban people find it difficult to be rural, farmers find it hard to enter urban cities, where is the problem?	Toutiao	2021-03-16
		农业现代化不是照搬美国模式！市民难下乡，农民难进城，问题出在哪？	YouTube	2021-07-22
	5	Are pesticides and fertilizers the point of no return for modern agriculture? Who is the biggest victim?	Toutiao	2021-10-15
	农药化肥是现代农业不归路？谁才是最大受害者？			

Appendix 3. List of people I reached out in the process of preparing informant interviews

	Title, organization	Status
1	IKEA Sweden	Responded
2	IKEA China	
	Chinese Local NGO (I volunteered there before)	
	Chinese Local NGO (working in pesticide packaging recycling)	
3	expert in agrochemicals – working in scientific agency (research institute)	Had conversation but noting was officially recorded; conducted on 5 April 2022
4	International NGO	No response
5	Association working in agrochemicals	No, low possibility to interview
7	Expert in Yunnan agriculture	No Response
9	Institute working in agrochemicals	
10	NGO in Yunnan Province	
11	NGO in Shanghai	

Appendix 4. Interview Guide in English and Chinese

Thematic guide	Dynamic guide (questions)	Follow up Questions
Introductory questions	Please tell me a bit about your professional background.	
	How long did you work in this organization / area?	
	What is your area of expertise?	
	What is the role of the organization you are working with in the agrochemicals policy implementation?	Could you give an example of such?
Knowledge of global agreements/ Conventions regarding agrochemicals	Do you have any knowledge about the global agreements regarding the agrochemicals?	What is it? Anything related can be discussed...
Knowledge of China's policy or initiative regarding agrochemicals	What national policy or initiative do you know that is related to agrochemicals?	What do you think of these policies or initiatives?
	Do you think China's policy has changed because it wants to align with global agreements/ Conventions (the SDGs)?	
Thoughts on China's agriculture agrochemicals	Based on your expertise/experiences, you know about the pollution brought by misusing or overusing agrochemicals, what does it look like in China?	What did it look like in the past and in recent years respectively? Do you see any change? If so, is there any specific turning point of the change? Can you give examples for these changes?
	Which chemicals pose the largest risk to the environment, and can you compare those with other less harmful chemicals?	
Thoughts on China's agrochemicals policy implementation	Do you know the process of governing chemical fertilizers and pesticides in China? (From top to down)	Especially how these policies were enforced by the end-users, such as farmers?
	Do you think outsider pressure, such as Covid-19, brought more barriers for different stakeholders to sustain agrochemicals management and control?	Why?
Ending Questions	What is your recommendation to achieve the sound management of agrochemicals?	Why?
	Is there anything besides what we have discussed that you think are relevant, or that you want to highlight, related to the agrochemicals management in China?	Is there anything more you would like to add?

主题	问题	跟进问题
介绍性问题	请告诉我一些关于您的专业背景	
	你在这个组织/领域工作了多久？	
	你的专业领域是什么？	
	您所在的组织在化肥农药政策实施中的作用是什么？	你能举一个例子吗？
了解有关农用化学品的全球协议/公约	您是否了解有关农用化学品的全球协议？	它是什么？任何相关的都可以讨论...
了解中国有关农用化学品的政策或倡议	您知道哪些与农用化学品相关的国家政策或倡议？	您能谈谈这些政策或举措？
	您是否认为中国的政策因它希望与全球协议/公约（例如联合国可持续发展目标）保持一致而发生了什么变化？	
对中国农业中化肥农药的思考	根据您的专业知识或经验，您了解在中国，误用或过度使用农药化肥带来的污染和危害是什么样的吗？	过去和最近几年分别是怎样的？你看到有什么变化吗？如果有变化，变化有没有具体的转折点？你能举例说明这些变化吗？
	哪些化学品对环境构成最大风险，您能将这些风险大的化学品与其他危害较小的化学品进行比较说明一下吗？	
关于中国农药化肥政策实施的理解	你知道中国化肥农药治理的流程吗？（从政策颁布到落地实施）	尤其是农民等最终用户如何执行这些政策？
	您认为新冠疫情等外部压力是否为不同利益相关者维持农用化学品管理和控制带来了更多障碍？	为什么？
结束问题	您对实现农药化肥的健全管理有何建议？	为什么？
	除了我们所讨论的内容之外，您认为与中国的农用化学品管理相关或您想强调的还有什么？	您还有什么要补充的吗？

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