

The Enforcement-Compliance Paradox: Lessons about Matching Regulatory Priorities to Compliance Motivations from Pesticide Regulation in China

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Abstract (145 words)

Studying amoral cost benefit analysis, legitimacy and capacity to obey the law this paper seeks to understand why Chinese farmers obey or break pesticide rules. It uses data gathered through intensive local level fieldwork including interviews with 31 pesticide experts and officials and 119 vegetable farmers in the central China. The paper uncovers an enforcement-compliance paradox: a situation where law enforcement is prioritized exactly on those rules least likely broken and the regulated actors most likely to comply. It finds two explanations. First, enforcement policy simply may not be aware which rules and regulated actors have more compliance even when there is limited deterrence. Second, technocratic risk-averse enforcement policy may be oriented at those rules and actors where violation (theoretically) results in the largest damages, not at those rules more likely broken and actors more likely to break them.

Keywords Pesticide, Enforcement, Compliance, China, Vegetable farmers

Introduction

China has to feed 22 percent of the world's population, using only seven percent of the globe's available arable land (Huang and Qiao 2002). One of the key contributors is the emergence and use of pesticides, which significantly improves agricultural production and productivity, reduces insect-borne and endemic diseases, and protects plantations, forest, harvested products, etc. (Ecobichon 1999, 2001). Pesticides of course also have negative externalities including damages to environment and the public health. The environmental externality comprises contamination of surface and ground waters, damage of fisheries, and destruction of freshwater ecosystems. The health effects consist of acute poisoning including suicide attempts, mass poisoning from contaminated food, chemical accidents in industry and occupational exposure in agriculture, and chronic effects including cancer and adverse reproductive outcome (WHO 1990).

The quantity of pesticides used per acre of land has greatly increased in China. According to China Rural Statistical Yearbook 2013 (2013), the total amount of chemical pesticides used in China increased to 1,806,000 tons in 2012; almost three times larger

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than twenty years ago. As reported by the World Resources Institute (1998), the pesticide market in the developing world including China is dominated by insecticides which tend to have higher acute toxicity than herbicides. The World Bank who conducted a research about China's compliance with food safety requirements reported that, "a 2004 DRC¹ report estimates that 500,000 Chinese suffer from pesticide poisoning every year and the death toll from pesticides may exceed 500." (Van der Meer 2006). Moreover, as one major source of agricultural pollution, pesticide pollution owing to inappropriate spraying of pesticides in rural China becomes more and more severe and harmful.

In response, Chinese government has developed a comprehensive set of pesticide regulatory laws and regulations.² These national initiatives have generally been backed up with stringent local pesticide regulatory rules and standards. Farmers continue, however to make illegal use of pesticides, resulting in severe risks. Perhaps, the most well-known case is the "poisonous cowpea" incident. In 2010, the Agricultural Inspection Centre of Wuhan City detected high residues of Isocarbophos³ in cowpeas transferred and sold by Hainan rural farmers. Soon later, more than 11 provincial cities pronounced the detection of excessive pesticide residues in Hainan cowpeas.

China thus faces a challenge in implementing its pesticide regulation, as it does in so many other fields of law. Key in such implementation is a prevalent weak level of law enforcement. Here apart from weak coordination and perhaps insufficiently strong local support for enforcement, a key problem is the absolute lack of capacity pesticide regulators have in detect violations of law. Enforcement agencies simply lack the staff to sufficiently oversee the practices that occur in China's over 1 million villages. In the face of such capacity challenges prioritization through efficient and strategized usage of scarce enforcement resources is vital (Van Rooij 2006; cf. Gunningham, Grabosky, and Sinclair 1998).

The core challenge is thus, as it is in so many other areas of law in China, how to implement the written rules in practice. This requires us to know how the existing rules are enforced as well as how farmers perceive such enforcement and how this perception shapes their behaviour (cf. Thornton, Gunningham, and Kagan 2005). In addition, it requires us to understand what other forces than enforcement shape compliance, and thus to understand in which situations enforcement may not be needed. Ideally, any legal system can only function well if there is a large amount of compliance without enforcement (cf. Tyler 1997). Enforcement when targeted wrongly on cases where there already is compliance without such enforcement may either be redundant (cf. Thornton, Gunningham, and Kagan 2005) or even counterproductive (cf. Thornton, Gunningham, and Kagan 2005). When combined, the views about the influences of enforcement and other factors on compliance (cf. Kirchler, Hoelzl, and Wahl 2008), may help us understand what reforms may be initiated to better steer enforcement prioritization to best match enforcement to other forces that may shape compliance. It is hoped that such analysis performed here on for pesticide regulation may also have relevance beyond this domain and for similar regulatory issues in China and beyond.

The data in this article were collected through in-depth qualitative interviews with 119 vegetable farmers and an additional 31 experts and informants in Hunan Province, in central China. The interviews were conducted in a semi-structured manner, consisting of open questions that covered both factual aspects of farmers' three specific types of

pesticide behaviors studied and perceptual views toward a comprehensive set of compliance variables proposed.

The remainder of this article is arranged as follows. We start by introducing the research theories applied in this article, followed by a section presenting the research methods. Then the article analyzes vegetable farmers' pesticide compliance data. And finally the paper analyses how both enforcement and other influences shape such compliance. Finally, the article concludes with potential regulatory implications for enforcing pesticide in China.

Theoretical Approach and Operationalization

This article is influenced by an idea in tax studies, that there are broadly two types of compliance that co-exist in practice (Kirchler, Hoelzl, and Wahl 2008). The first is perhaps best known, and this is enforced compliance. Under this idea people and organizations obey the law because of deterrence. Enforcement, either by the state or others, enhances the costs of violation to steer regulated actors away from breaking the law (Becker 1968) One thing thus to study is to understand how enforcement is organized and what actors it is targeting. This is not sufficient however. Enforcement, shapes regulated actors' behavior through two mechanisms, the certainty of punishment and the severity of punishment, and when combined they result in a deterrent threat. (Zimring and Hawkins 1973; Thornton, Gunningham, and Kagan 2005). Deterrence works through the perception a regulated actor has of such certainty and severity of punishment, and thus must be studied subjectively as how regulated actors perceive certainty and severity. (Teevan 1976; Klepper and Nagin 1989, 1989; Friedman 1991; Thornton, Gunningham, and Kagan 2005; Van Rooij 2014). Following from this, we operationalize deterrence as the respondents' perceived probability of violation detection and the impact⁴ that the violation would have on them (for details see Appendix A).

Enforcement and deterrence is but part of the full story of compliance. There is a host of factors that shape compliance outside of law enforcement. Kirchler and his co-authors (2008) call compliance that comes forth out of these other influences voluntary compliance. The rich literature on compliance has taught us that there are three core influences on compliance other than law enforcement. The first are the operational costs and benefits of compliance and violation other than the eventual costs of deterrence through punishment. Different from deterrence concentrating on delayed costs in case the offender is apprehended and convicted of crime, some immediate costs including those of purchased inputs and the opportunity costs are also important (Ehrlich 1972; Paternoster and Simpson 1993, 1996). Compliance is likely if the operational benefits minus costs of compliance outweigh the operational benefits minus costs of violation. We have operationalized this by asking respondents to compare the operational costs of legal usage of pesticides to illegal usage of pesticides (for details see Appendix A).

The second influence on compliance other than law enforcement is the broad category of legitimacy. This includes four aspects. The first is social legitimacy. Compliance is subject to social norms. The descriptive social norms rest on the notion that "if a lot of people are doing this, and it's probably a wise thing to do" (Cialdini 2007). As such, the regulated actor is more likely to comply if most others are perceived as doing so to (Tyran and Feld 2002; Scholz and Lubell 1998; May 2005). We have operationalized this by asking the respondents about what they believe the behavior of

other farmers like them is in relation to the selected norms of this study (for details see Appendix A).

The second aspect of legitimacy based compliance is personal legitimacy. People are more likely to obey legal rules they themselves, personally hold to be morally right (Tyler 1990; Erard and Feinstein 1994). It is an internalized obligation to follow one's personal sense of what is morally right or wrong (Kelman 1958). We have operationalized this by asking respondents about their own attitudes about the illegal behavior of others (see appendix A).

The third form of legitimacy based compliance is duty legitimacy. Regulated actors may voluntarily obey legal rules, not because others do so or because they personally agree with the rules, but out of a sense of general duty and obligation. (Tyler 1990; McGraw and Scholz 1991; Vandenberg 2003). Here we have asked respondents to state their views about the following statement people should obey the law, even if it is a bad law, even if it is not enforced, or even when the costs of obeying it are high (see appendix A).

The fourth aspect of legitimacy is procedural legitimacy. This is based on the idea of procedural justice, arguing that if procedures are fair there will be more voluntary compliance (Tyler 1997). Tyler (2003, 1990; Sunshine and Tyler 2003) examined procedural justice and defined it as the regulated actor's perceived fairness of relevant legal institutions. This article mainly adapts Tyler and his co-author's approach and understands procedural justice as the regulated actors' support for legal authorities. We specifically focus on three aspects: honesty of the enforcement officer, fairness of decision of the enforcement authority, and overall assessment of the enforcement authority (see appendix A).

The third and last influence on compliance other than law enforcement is the capacity to obey the law. Considerable literature empirically verifies that capacity is a prominent condition for achieving compliance (Winter and May 2001; May 2004; Burby and Paterson 1993; Gray and Silbey 2012). Although the regulated entity may want to comply or may feel pressure to comply, lack of capacity constitutes a barrier to compliance (Winter and May 2001). We adapt Winter and May's (2001) approach and define capacity as twofold: ability to obey the law and legal knowledge. Specifically, we operationalize ability to obey as the regulated actor's financial ability as for farmers who earn less, it is comparatively more difficult for them to obey the law at the cost of economic income. We operationalize legal knowledge as the regulated entities' knowledge about relevant rules (see appendix A).

Research Methods

This paper uses data about compliance with pesticide regulation gathered through a year-long period of local level fieldwork in Hunan province in central China. During the fieldwork we collected data on both the enforcement and other influences on compliance, as well as on the compliance behavior itself.

We selected and interviewed altogether 119 vegetable farmers. These farmers were selected by using a stratified sampling method. We concentrated on three most popular and representative types of vegetable farmers in rural China. They are respectively: individual vegetable farmers who grow small-scale vegetable fields in the family unit (N=70). They usually crop, transport and sell vegetables on their own. The second group are small cooperative farmers who also plant small-scale fields but are organized or

associated by local agricultural cooperatives or associations (N=42). Normally those cooperatives provide the farmers means of agricultural production, such as vegetable seedlings, pesticides or fertilizers. They also purchase their vegetables and then wholesale in bigger cities, while those associations only assist farmers in searching for possible purchasers in bigger cities. Finally, large cooperative farmers who rent medium or large scale of fields in villages, hire several local villagers and operate as agricultural cooperatives (N=7). They are usually encouraged or even financially supported by the local authority.

We selected these three types of farmers in three counties located in Hunan Province in China on the basis of vegetable yields and levels of economic development. County N is one of the most developed counties in Hunan province. It provides vegetables not only for the local residents but also for other cities or areas in the Province. County C has been identified as one of poverty-stricken counties nationwide for years by the state because of its low per-capital annual net income. It mainly transports vegetables to neighboring big cities or coastal areas by wholesale. County D is a moderately developed county. Vegetable farmers there mainly produce and sell vegetables satisfying the local agricultural market. Within the three counties, we selected ten villages by vegetable production yield and level of economic development, among which seven villages sold vegetables farmed by individual farmers. The remaining three villages had vegetables farmed by small cooperative farmers. Sample size of each selected village was decided by its population of vegetable farmers⁵. Specific adult villagers in each village were selected by taking care of their age distribution. Within the sampled villages, all cooperative and associative farmers were interviewed to get the largest possible sample in relation to the large number of individual farmers. We also interviewed altogether seven large cooperative farmers within the three counties by accessibility.

In order to collect complementary data for better understanding the regulatee as well as explaining compliance, we made additional interviews with 31 informants selected by a convenient sampling method. They were local agricultural officers, committee members in villages, and local pesticide sellers.

The main technique to gather the data was through semi-structured interviews. In these interviews we used a dialogue structure to engage each of the respondents to openly and freely discuss our key factors of influence on compliance (as outlined above) as well as compliance itself, while also allowing space for free discussion of other themes and for inductive learning. These questions were always kept the same to enable comparison later. Appendix A presents the readers all the specific questions that were discussed for each of the variables analyzed here. The data were coded to allow for a comparison across the interviews and to allow for systematic analysis of this rich qualitative material. All the factors listed in the table were defined in a binary way, either in the form of positive or negative, or in the form of high or low (only for financial ability and legal knowledge as it is very difficult to decide on which level of capacity that respondents have enough to obey the law, rather, we could assume that the higher the capacity, the higher their capacity to obey).

The hardest challenge in any study of compliance is how to measure compliance itself. This study uses a self-reported approach. This of course has the down-side that due to social desirability, self-concept maintenance, or risk perceptions, respondents may not be fully truthful. (Kuperan and Sutinen 1998; Winter and May 2001; Nielsen and Parker

2008; Klepper and Nagin 1989, 1989; Wenzel 2004, 2005). We have sought several ways to enhance the incidence of truthful reporting. First we sought to decrease sensitivity by not asking normatively loaded questions such as whether they comply or violate rules. Instead we asked them factual compliance questions about factual practices rather than references to law or rules. It avoids mentioning the specific norms and thus evades referring to normative or moral point of views about what is right and wrong. Second, here we focused on three pesticide norms as proxies for compliance: use of types, disposal and time interval. Unlike sensitive criminal violations, they are normal farming practices. Most farmers talked quite openly about them during the process of open-ended interviews. Third, we used the dialogue approach to interviewing to allow farmers much voice and steering and thus also to build some relation between interviewer and interviewee as essential trust to allow for discussion of more sensitive issues. Fourth, we made a general validity check by interviewing a range of stakeholders who also know many details about compliance or noncompliance but may understand them from different perspectives and thus have different viewpoints (Parker and Nielsen 2009). They are agricultural experts who work in agricultural bureaus, or village leaders, or businessmen who operate agricultural shops, or other informants like villagers and customers. The results showed that there was a strong consistency between the data collected from the respondents and these stakeholders, e.g., the results of high compliance found for the large cooperative farmers were also supported by regulators.

Let us now look in some more detail how we asked about compliance. This article focuses on compliance with three different types of pesticide norms. The first one we asked is farmers' general use of pesticide types on vegetables. It is one of the key aspects included in most recently published pesticide regulations, e.g., *Nongyao Guanli Tiaoli* (Regulations on Pesticide Administration), *Zhonghua renmin Gongheguo Nongyebu Gonggao* (Announcement of Ministry of Agriculture of the People's Republic of China), etc. According to the rules, altogether 37 types of pesticides are prohibited for application on vegetables. We asked respondents to volunteer types of pesticides they usually use by showing them a table listing all the illegal types of pesticides as well commonly used legal types to avoid untruthful answers. Respondents who indicated in any way that he or she had applied or would apply any type of illegal pesticides were as not being in compliance, and vice versa. The second norm is about disposal of pesticide containers. Based on rules of *Nongyao Guanli Tiaoli* (Regulations on Pesticide Administration) and *Zhonghua Renmin Gongheguo Nongchanpin Zhiliang Anquanfa* (Law of the People's Republic of China on Quality and Safety of Agricultural Products), containers should be disposed by means of recycling or burying in an appropriate way. For respondents who indicated doing so, they were defined as in compliance, and otherwise as non-compliant. Time interval is the third aspect also prescribed in these regulations. We asked farmers about their general interval of last pesticide application and vegetable marketing. The reports of usually harvesting vegetables for at least a week later after spraying were defined as positive ones, while the statements of within one week were coded as negative ones.

Pesticide Compliance Data

Let us first look at what compliance behaviour farmers in our sample reported. Table 1 presents farmers' compliance for each of the three norms separately.

TABLE 1 ABOUT HERE

Table 1 clearly shows that compliance behavior is quite different for the three different rules. For rules limiting the use types we see that there is widespread reported compliance (87%, n=103). As one farmer explained:

“The pesticide like Dichlorvos cannot be applied on vegetable. They are highly toxic. In your table, I mainly use Avermectin. I do not use highly toxic pesticides, as sometimes we need to harvest vegetables within two days after pesticide spraying. Thus, we only use those safe pesticides. Moreover, we ourselves eat the vegetables we plant.” (village 2, NO.2. 21.04.2012)

In contrast compliance with disposal is reported at 43% (n=51). Many farmers stated for instance that they usually throwing pesticide containers away whenever and wherever they spray. Some indicated generally disposing of containers on the farm, or in the village, or by using other inappropriate ways. Compliant farmers disposed pesticide bottles or bags appropriately and thus defined as compliant. Different types of pesticides require different time intervals. The situation that most rural villagers apply medium toxic or lowly toxic pesticide means that an interval of at least one week is required, unless farmers use biological or ecological pesticides which normally need intervals less than one week. 70 (59%) farmers reported usually marketing vegetables within two or three days after pesticide spraying and thus illegal time intervals. These farmers normally ignored legal intervals and marketing vegetables without discretion. Others (41%; n=49) farmers indicated generally waiting for one week after spraying pesticides, or applying pesticides only after marketing ripe vegetables. While such compliant behaviors were defined in a comprise way as it is hardly to achieve ideal safety intervals considering complicated types of pesticides as well as multiple kinds of vegetables.

The core question now is to understand whether the compliance differences we saw are the result of enforcement or from the other compliance variables. And also we shall analyze what this then means for enforcement priorities.

Enforced Compliance

Our data about deterrence show that some farmers have a much higher perception of deterrence than others, and moreover perceptions about deterrence also strongly vary for different offenses. If we look at Table 2, we see first, among the three types of offenders, large cooperative farmers indicated the greatest highly detection probability. They almost always indicated a highly positive possibility of being detected if violate the law. Individual and small cooperative farmers have a much lower detection possibility than large cooperative farmers. Taking individual farmers as an example, only 56% (n=39; total n=42) of individual farmers perceived a high detection probability for the use of illegal types of pesticides, and only 16% (n=11) of them perceived that the illegal time interval would be detected.

Second we see that among the three offences, a large majority of farmers reported a high detection probability for the use of illegal types (70%; n=83), and, only a few farmers perceived a high probability of being found out for illegal intervals between

pesticide application and crops marketing (11%; n=13), and hardly any so for illegal disposal of pesticide containers (5%; n=6).

TABLE 2 ABOUT HERE

As such we see that law enforcement is unevenly perceived and is skewed more strongly towards larger scale offenders, as well as towards enforcing rules on pesticide type and less so on waste disposal or time interval regulations. Such perception matches enforcement priorities. Faced with limited budgets and staff, enforcement has focused chiefly on the usage of illegal pesticides, but paid less attention on disposal and time interval. As one enforcement officer expressed:

“We mainly detect those who use illegal types of pesticides. Vegetable farmers dispose of pesticide containers everywhere. It is impossible to do inspections.” (expert in D County, 11.07.2012)

Moreover, enforcement has been directed more against larger scale farms, and hardly against individual farms. As one enforcement officer we interviewed stated:

“In our county, there are more than thousands of vegetable farmers who mainly live on vegetable production and almost every family in rural areas plant vegetables and might sell some of them on the market. They are distributed everywhere and some of them even live in remote rural areas. It is very difficult to inspect individual farmers. We mainly focus on those vegetable cooperatives. There are about 13 vegetable cooperatives in our county and all of them plant large-scale vegetable fields. It is much easier to do inspections on them.” (expert in N County, 12.28.2011)

So what has been in the effect of such skewed enforcement? Table 2 shows indication that in situations of high perceived deterrence compliance is very high (100%). It should be stated that the number of high deterrence cases for both disposal and time interval is very low (between 5% and 17%), and indicating very limited enforced compliance there overall.

This table also shows that even when there is a low detection probability and sanction impact perceptions, there is still quite some compliance. For use of pesticides we see that a small majority of the low deterrence farmers (56% of low detection perceptions and 52% of low sanction impact perceptions) still report compliance. And even for time interval and disposal, we see a large minority (between 29% and 39%) reporting compliance even when there is no perceived deterrence.

Overall we thus see that there is enforced compliance, albeit chiefly so for use types, while we also see that there are many situations where there is compliance even when there is no perceived deterrence.

Compliance Beyond Enforcement

The next step is now to understand what shapes compliance other than enforcement. This will allow us better to understand the category of farmers who report low deterrence

perceptions but still indicate to comply. Moreover, it may allow us to understand which farmers are more inclined to comply for other reasons than enforcement and thus require less enforcement action.

Operational Calculated Compliance Cost and Benefit

Let us first look at the operational costs and benefits other than deterrence. Operational costs and benefits are elements in relation to monetary expenses and earnings (Becker 1968; Paternoster and Simpson 1993). In this article, calculated costs and benefits of compliance are weighed price and effectiveness (for pesticide types), or cost and earnings (for time interval) of legal norms in comparison to the alternative violation behavior.⁶

TABLE 3 ABOUT HERE

Let us first discuss what variation we found in terms of such operational cost benefit analysis. We clearly found that the percentage of positively perceived compliance calculation for use of types (82%; n=97) is much higher than that for time interval (41%; n=22). Also we found that there was variation in the scale of farming with large cooperative farmers perceived the most positive operational cost-benefit calculation of compliance, and it was less positive for small cooperative farmers and individual farmers. Taking time interval for instance, all the large cooperative farmers believed that legal time interval guaranteed their profit (100%; n=7). However, only 46% (n=32) individual and 24% (n=10) small cooperative farmers indicated positive attitudes toward the operational compliance calculation. After checking, we find that here such variations could be explained by multiple factors like geographic condition, crop nature, age distribution, governmental support, and farmers' pesticide knowledge and other experiences. Taking crop nature as an example, among the three types of farmers, the small cooperative farmers indicated the most negative cost benefit calculation regarding the legal time interval. In their answers we found that most of the farmers plant eggplant or tomato which grows very fast during the summer when pesticides are sprayed most frequently. One farmer provided details below:

“It is definitely more profitable if we pick vegetables earlier. We have to pick eggplant every two days. Otherwise the vegetables grow old. Customers do not buy those old, bigger and wrinkled ones. So we need to spray pesticide in time.” (village 9, NO.9. 25.08.2012)

Here the vegetables they plant require frequent harvesting in case the cost owing to overripe produce increases. Such limitation and inflexibility makes farmers fail to take care of the time interval.

Further we examined how perceptions about the operational costs and benefits influence compliance. Table 3 shows that all farmers with positive perceptions about costs and benefits were in compliance. For time interval we also see that all farmers with negative perceptions are in non-compliance. For use types we see that there is a small group of farmers (n=6) who despite negative perceptions of cost and benefits still report compliance.

If we combine the findings about variation in both deterrence and operational costs and benefits perceptions and their relation to reported compliance we can see important implications. First we see that the same farmers that report high deterrence perceptions also report positive cost benefit calculations on the same types of offenses. As such large scale farmers are more likely to see a positive operation cost benefit calculation to using legal pesticides, while these farmers and offenses are also the ones that will receive most enforcement pressure and report highest deterrence. Vice versa we see that farmers who are most likely to see a negative cost benefit of compliance, also are the ones with lower deterrence and thus enforcement pressure. These findings are thus a first indication that enforcement may be targeted in a redundant manner on larger firms and on usage rules, rather than on smaller scale farmers and time interval rules where there is less positive cost benefit calculation and thus less voluntary compliance. Thus we see here with the first aspect of compliance other than enforcement, a practice of both redundant enforcement, as well as under-enforcement.

Descriptive Social Norms and Personal of Compliance

Let us now similarly look at the second and third aspects of compliance other than enforcement: the descriptive social norms and personal norms. Descriptive social norms here refer to farmers' perceptions on how most peers deal with compliance or violation behavior. Personal norms refer to their own views about compliance. Our findings both on variation of both perspectives as well as their effects on compliance are highly similar to those we saw earlier for cost-benefit analysis.

TABLE 4 ABOUT HERE

First we see that the percentage of positive descriptive social norms on legal use of pesticide types (85%; n=101) is much higher than the other two norms (38% and 38% respectively; n=45). The majority of farmers believed that, similar to themselves, most similar others applied legal pesticides, while a comparatively smaller group of compliant farmers reported that most similar others dealt with disposal or time interval differently and thus violated the relevant legal norms. For personal norms we similarly, but less clearly see a variation in Table 4 that farmers indicated the most positive percentage of moral values for use of types (87%; n=104). The percentages for the other two norms are a bit lower, with 65% (n=77) for disposal and 63% (n=75) for time interval.

Moreover, our data show that the scale of farming practices is related to the perception of descriptive social as well as personal norms. Large scale farmers all (100%, n=7) indicated that other similar farmers were in compliance with all three pesticide behaviors studied here. While less individual and small cooperative farmers did so, especially for disposal and time interval. For example, only 37% (n=26) individual and 29% (n=12) small cooperative farmers stated that most similar others deal with waste disposal legally. Generally speaking, large scale cooperative farmers also had more negative attitudes to the three violated pesticide behaviors than individual and small scale cooperative farmers.

We also see that both social norms and personal norms are related to compliance. Table 4 shows clearly that all farmers with positive views on descriptive social norms were in compliance with all three norms. And large majorities (from 89%-95%) of

farmers with negative perceptions reported non-compliance with the three norms. Table 5 shows that all farmers with negative views reported non-compliance with all norms. Farmers with positive views were mostly (99%) reported compliance with pesticide type rules, and less so but still by two thirds majority (65%) with disposal and time interval rules. As such positive views on social norms clearly relate to compliance, while negative personal norms clearly relate to non-compliance. This strengthens the idea that factors play other than enforcement can play an important role in compliance behavior. Also we see the same variation, with more positive views amongst larger scale farmers and for use types. We can again wonder then whether enforcement is not prioritized wrongly at those farmers who not only as we saw have positive views on the operational costs and benefits of compliant behavior but also deem others to be compliant as well. Moreover we can wonder whether there should not be more enforcement on those farmers with negative social norms and especially personal norms perspectives, which are so clearly linked to non-compliance. Of course here we must ask whether a different prioritization away from these rules and farmers would at some point also start to affect the social and personal norms that currently support compliance.

General Duty to Obey the Law and Procedural Justice

Let us now look at two other aspects of compliance other than enforcement: general duty to obey the law and procedural justice. Again let us first look at variation amongst our farmers in both voluntary compliance aspects.

TABLE 5 ABOUT HERE

Table 5 indicates that overall in our sample 70% (n=83) farmers indicated positive attitudes toward general duty to obey, that is, they agreed that people should obey the law despite it is a bad law, or it is not enforced, or it is costly of obeying it. Consider for instance some quotes below:

“The law is enacted by the state. As a farmer, we should obey the laws formulated by the central government. Because the state is a complete body and the formulation of the law is a deliberation process slots of professors and experts. It should be correct.” (village 2, NO.12. 05.05.2012)

“As a Party member, I should obey the policies promulgated by the central government. No matter it is constitutional law or something else.” (village 4, NO.2. 21.07.2012)

While the remaining 36 (30%) farmers reported negative attitudes toward the same statement. In contrast most (n=109, 92%) farmers had negative views on procedural justice. Consider for instance one quote below:

“It is hard to say. I think that they are not so honest. Their decisions are not fair, I think. It is hard to evaluate their work. The authorities never care about us. The officers would never come to every family. There is even no relevant

news broadcast on TV. They also never trumpet the news.” (village 3, NO.9.12.05.2012)

When we analyze for variation amongst the different types of farmers we do not find clear differences. For general duty to obey the law we find that all three types of farmers generally reported positive attitudes, albeit large scale cooperative farmers more so (86%; n=6) than small cooperative (71%; n=30) individual farmers (67%; n=47). For procedural justice we also did not find great and clear variation amongst different farmers with positive views only of 14% (n=1) of large cooperative farmers, 10% (n=4) of the small cooperative farmers and 7% (n=5) individual farmers.

The data in table 5 do not show clear relations between general duty to obey the law and procedural justice and compliance. We see that there are many cases in which negative views still yield compliance and positive views yield non-compliance. As such we do not find a clear link between both duty and procedural justice and compliant behavior, as has been suggested in existing literatures (Tyler 1990, 1997). Further study is necessary to establish whether this is just a matter of this particular case or whether Western studies simply yield different results on these variables. There is some evidence that the latter may be the case, in a comparative study of voluntary compliance in the US and China yielded that duty-type variables were the most prominent in explaining compliance in the US yet not in China (Van Rooij et al. 2015). Perhaps more importantly we see that these variables are not crucial forms of voluntary compliance and thus enforcement does not have to account for them. This is in itself good news, as it is hard for enforcement agents to know what procedural justice and duty perspective regulated farmers will have.

Capacity to Obey: financial ability and legal knowledge

The last aspect of compliance other than enforcement is the capacity to obey the law. We have looked both at financial ability and legal knowledge. Table 6 indicates variations between farmers’ reported annual family gross income.

TABLE 6 ABOUT HERE

The majority of farmers (62%; n=74) reported a low family annual income equal to or less than 40, 000 RMB. The remaining others (38%; n=45) have a higher financial ability of more than 40, 000 RMB. Overall, farmers’ reported legal knowledge is surprisingly high given their limited education level. Table 9 points that farmers have the highest percentage of knowledge on legal rules for use of types than the other two norms (90%; n=107). They have a smaller percentage of relevant legal knowledge for time interval (58%; n=69), and a smallest percentage for disposal (29%; n=35).

Just as with most earlier variables we see that the scale of farming matters also for the capacity to obey the law. The largest scale farmers had both the highest incomes as well as the highest legal knowledge. All large scale cooperative farmers reported high incomes, whole 50% (n=35) of small scale cooperative farmers and only 7% (n=3) of individual farmers did so. Similarly all large scale farmers reported the sound legal knowledge, while fewer small scale cooperative and individual farmers did so. For

instance, only 21% (n=15) individual and 31% (n=13) small scale farmers reported the sound knowledge about pesticide disposal rules.

Let us now finally look at how the ability to comply relates to reported compliance. First of all we see that the financial ability is not clearly related to compliance (Table 8). We see that there are significant amounts of farmers with high income who report low compliance, and farmers with low incomes who report compliance. Table 9 shows on the one hand that farmers with more legal knowledge are in compliance (chiefly with use types and disposal rules), and also that farmers with less legal knowledge comply less (chiefly for disposal and time interval). There are also exceptions, where a large majority (92%; n=11) of the farmers with low legal knowledge still reports compliance with use types rules, and where a large minority (46%; n=32) of farmers with high legal knowledge still report non-compliance with time-interval rules.

As such ability to obey the law has a mixed relation with compliance, especially legal knowledge has some relation to compliance, but financial ability has limited relationship. For enforcement prioritization this is a pity as financial ability is something that can be used in policy as it is easy to find out which farmers have more or less such ability. The moderate linkage between legal knowledge and compliance, as well as the fact that large scale firms have higher legal knowledge may be another indicator that compliance is not properly prioritized.

Conclusion

This paper clearly shows the importance of moving beyond a pure deterrence orientation towards implementation of law problems in China. We see that there are clearly multiple influences on compliance. In the cases studied apart from deterrence, we see that operational costs and benefits, personal norms, social norms, and less clearly legal knowledge all played a role in compliance. We also saw that for all these variables there was variation in how different actors perceived them. For all relevant compliance influences other than enforcement we found that the scale of farming mattered and that the larger the scale the more prevalent such voluntary compliance variables were. Moreover we found that the type of norm mattered and that several key voluntary compliance influences (operational cost benefits, social norms and personal norms) were more clearly present for rules regulating pesticide types than they were for disposal and time interval rules.

As a matter of principle, enforcement should be targeted especially at those types of farmers and those types of rules where voluntary compliance is less likely. The paper crucially finds that in this case enforcement was prioritized in exactly the opposite way. Larger scale farmers as well as potential violations of pesticide type rules received more enforcement, and also had a higher perceived deterrence. This case shows an enforcement-compliance paradox: a situation where enforcement is targeted exactly where it is not needed for compliance. One possible explanation for this may be that agents used a risk oriented approach to enforcement, and prioritized those firms and types of violations, which could create the largest potential damages. Whilst such risk oriented approaches make theoretical sense there is a risk of overly technocratic implementation and a too strong reliance on the heuristics underlying these approaches ((Durant 1998) (Hutter 2005)). Our paper highlights another flaw of such approaches: when voluntary compliance variables are in place the risk of such violations and damages occurring will

automatically be reduced. Under such a scenario targeting potential risks -which will not materialize because of voluntary compliance- becomes redundant. A second possible explanation for the enforcement-compliance paradox is that enforcement policymakers were simply not aware or interested in understanding other forces of influence on compliance except for deterrence itself. Most enforcement agents will not have carried out the study that we have done here and will not know about the perceptions regulated actors have about voluntary compliance conditions such as operational costs and benefits, social norms and personal morals. Their work is to understand what firms comply and which do not, but not to understand exactly why firms comply and which do so out of deterrence and which out of other reasons. Moreover, in this case a full understanding of norms and firms that require extra inspections would have meant to conduct more complex and time consuming enforcement activities at the many smaller firms, and for more labor intensive practices such as checking the exact timing between pesticide application and marketization of produce.

All of this teaches us that it is imperative that law enforcement in China, and likely elsewhere as well, must invest in getting to learn about the broader forces that constitute both compliance, seeking to understand more than just deterrence. It should carry out an assessment not just solely of what potential violations have the largest risk of damages, but also on which potential violators and violations have the lowest potential for voluntary compliance and thus the highest need for law enforcement. A move from risk towards such needs-based enforcement can help prioritize scarce enforcement resources.

Of course this is easier said than done. For each type of rule and each type of regulated actor there is likely variation in both enforced and voluntary compliance, that we can only understand through studies like the one conducted here. It is unlikely that regulators will have the research capacity to do so. Here there is a role for academic and regulatory collaboration using research data to help guide enforcement prioritization.

Another challenge concerns a key question not answered in this paper is what the linkage between the enforcement and other compliance influences is. This is crucial. As our study indicated, for some rules and regulates operational costs and benefits, legitimacy and capacity influences on compliance depend on enforcement. A change in enforcement prioritization might have the unintended effect to erode the effective functioning of these voluntary compliance conditions, and might result in more non-compliance . Logically operational costs and benefits are not susceptible to this, as they are not so much related to enforcement. However social and personal norms, and even legal knowledge might be reduced if there is less enforcement. Enforcement for instance serves both a reminder function when we hear about enforcement elsewhere we are reminded what the law is and also that we think it is correct to comply with it (Thornton, Gunningham, and Kagan 2005). Similarly a lack of enforcement might erode social norms as we see others getting away with breaking the law and we are no longer reassured that compliance is the right thing to do (Thornton, Gunningham, and Kagan 2005).

Finally, here we analyze compliance variables individually, without examining their interactions, while our data has already created some insights about the interaction between the variables as well as their joint influence on compliance. Further study on how they interact to shape compliance is still necessary.

Tables

Table 1. Vegetable Farmers' Compliance with Pesticide Norms

Pesticide behaviors	Compliance performance	No. of cases (%)
Use of types	Non-complaint	16 (13%)
	Compliant	103 (87%)
Disposal	Non-compliant	68 (57%)
	Compliant	51 (43%)
Time interval	Non-compliant	70 (59%)
	Compliant	49 (41%)

Notes: Total number of respondents = 119.

Table 2. The Association between Vegetable Farmers' Perceived Risk and Compliance

Compliance behaviors			Perceived detection probability		Perceived sanction impact	
			<i>High</i>	<i>Low</i>	<i>High</i>	<i>Low</i>
Use of types of pesticides	<i>Compliant</i>	No.(%)	83 (100%)	20 (56%)	86 (100%)	17 (52%)
	<i>Noncompliant</i>	No.(%)	0 (0%)	16 (44%)	0 (0%)	16 (49%)
Total			83	36	86	33
Disposal	<i>Compliant</i>	No.(%)	6 (100%)	44 (39%)	6 (100%)	44 (39%)
	<i>Noncompliant</i>	No.(%)	0 (0%)	69 (61%)	0 (0%)	69 (61%)
Total			6	113	6	113
Time interval	<i>Compliant</i>	No.(%)	13 (100%)	36 (34%)	21 (100%)	28 (29%)
	<i>Noncompliant</i>	No.(%)	0 (0%)	70 (66%)	0 (0%)	70 (71%)
Total			13	106	21	98

Notes: Percentages do not always add to 100 because of rounding. Total number of respondents =119.

Table 3. The Association between Farmers' Perceived Operational Calculation and Compliance

Compliance behaviors			Perceived operational cost-benefit compliance calculation	
			<i>Positive</i>	<i>Negative</i>
Use of types	<i>Compliant</i>	No.(%)	97 (100%)	6 (27%)
	<i>Noncompliant</i>	No.(%)	0 (0%)	16 (73%)
Total			97	22
Time interval	<i>Compliant</i>	No.(%)	49 (100%)	0 (0%)
	<i>Noncompliant</i>	No.(%)	0 (0%)	70 (100%)
Total			49	70

Notes: Total number of respondents =119.

Table 4. The Association between Farmers' Perceived Descriptive Social Norms/Morals and Compliance

		Pesticide behaviors					
		Use of types		Disposal		Time interval	
		<i>Compliant</i>	<i>Noncomp -liant</i>	<i>Compliant</i>	<i>Noncomp -liant</i>	<i>Compliant</i>	<i>Noncomp -liant</i>
Social Norms	<i>Positive</i>	101 (100%)	0 (0%)	45 (100%)	0 (0%)	45 (100%)	0 (0%)
	<i>Negative</i>	2 (11%)	16 (89%)	5 (7%)	69 (93%)	4 (5%)	70 (95%)
Morals	<i>Positive</i>	103 (99%)	1 (1%)	50 (65%)	27 (35%)	49 (65%)	26 (35%)
	<i>Negative</i>	0 (0%)	15 (100%)	0 (0%)	42 (100%)	0 (0%)	44 (100%)

Notes: Percentages do not always add up to 100 because of rounding. Total number of respondents =119.

Table 5. The Association between Farmers' Perceived General Duty to Obey/Procedural Justice and Compliance

		Pesticide behaviors					
		Use of types		Disposal		Time interval	
		<i>Compliant</i>	<i>Noncomp -liant</i>	<i>Compliant</i>	<i>Noncomp -liant</i>	<i>Compliant</i>	<i>Noncomp -liant</i>
General duty to obey	<i>Positive</i>	75 (90%)	8 (10%)	37 (45%)	46 (55%)	33 (40%)	50 (60%)
	<i>Negative</i>	28 (78%)	8 (22%)	13 (36%)	23 (64%)	16 (44%)	20 (56%)
Procedural justice	<i>Positive</i>	7 (70%)	3 (30%)	3 (30%)	7 (70%)	5 (50%)	5 (50%)
	<i>Negative</i>	96 (88%)	13 (12%)	47 (43%)	62 (57%)	44 (40%)	65 (60%)

Notes: Percentages do not always add up to 100 because of rounding. Total number of respondents =119.

Table 6. The Association between Annual Family Gross Income/Legal Knowledge and Compliance

		Pesticide behaviors					
		Use of types		Disposal		Time interval	
		<i>Compliant</i>	<i>Noncomp -liant</i>	<i>Compliant</i>	<i>Noncomp -liant</i>	<i>Compliant</i>	<i>Noncomp -liant</i>
Annual family gross income	<i>High</i>	39 (87%)	6 (13%)	26 (58%)	19 (42%)	21 (47%)	24 (53%)
	<i>Low</i>	64 (87%)	10 (14%)	24 (32%)	50 (68%)	28 (38%)	46 (62%)
Legal knowledge	<i>High</i>	92 (86%)	15 (14%)	28 (80%)	7 (20%)	37 (54%)	32 (46%)
	<i>Low</i>	11 (92%)	1 (8%)	22 (26%)	62 (74%)	12 (24%)	38 (76%)

Notes: Percentages do not always add up to 100 because of rounding. Total number of respondents =119.

Appendix A Measuring compliance variables

Measuring compliance variables

Compliance variables	Summary of questions	Coding method	
		<i>Positive/high</i>	<i>Negative/low</i>
Detection probability (Thornton, Gunningham, and Kagan 2005; Winter and May 2001)	Assume that someone similar to you does the specific violation behaviors in terms of pesticide types/disposal/time interval, is it possible of being found out? How high is the possibility? By whom?	In any way indicates a low or no possibility of being discovered by the inspection bureau/other sources	In any way indicates a high or certain possibility of being discovered
Sanction impact (Thornton, Gunningham, and Kagan 2005; Winter and May 2001)	What negative and most serious effects would happen if punished?	In any way indicates no or a low impact of punishment	In any way indicates an impact of punishment
Operational cost-benefit calculation of compliance (Paternoster and Simpson 1993, 1996)	How is your behavior (legal or illegal) in comparison with the alternatives (illegal or legal) in terms of price and effectiveness (for pesticide types)/cost and earnings (for a time interval)?	In any way indicates comparing with the violation behavior, any of the two specific compliance behaviors is less costly and more effective/profitable	In any way indicates comparing with the violation behavior, any of the two specific compliance behaviors is more costly and less effective/profitable
Social Legitimacy (Cialdini 2007; Cialdini, Kallgren, and Reno 1991)	Do most similar other vegetable farmers do the same as you do on (any of the three specific pesticide behaviors)?	In any way indicates that most similar others comply with the rules on any of the three specific pesticide behaviors	In any way indicates that most similar others do not comply with the rules on any of the three specific pesticide behaviors
Personal Legitimacy (Sutinen and Kuperan 1999; Suchman 1997)	What do you think of people who do (any of the three specific violation behaviors)?	In any way indicates negative attitudes toward any of the three specific pesticide violation behaviors	In any way indicates positive attitudes toward any of the three specific pesticide violation behaviors
Duty Legitimacy (Tyler 1990)	Do you agree with the following statement: people should obey the law, even if it is a bad law, even if it is not enforced, or even when the costs of obeying it are high?	In any way indicates positive views	In any way indicates negative views, or has no idea about general duty to obey, or it is hard to say, or disregard of the law
Procedural Legitimacy (Tyler 1997, 1990)	Do you agree that officers of the local agricultural bureau are honest? Do you agree that decisions of local agricultural bureau are always fair? Overall, how do you assess the work of the local agricultural bureau?	In any way indicates positive views toward all three questions asked	In any way indicates negative views toward all the three questions or any one or two of the questions, or has no idea or cannot give any judgment
Financial ability (Winter and May 2001)	What was your family gross earning last year?	In any way indicates family gross income > 40,000 RMB*	In any way indicates family gross income ≤ 40,000 RMB
Legal knowledge (Snortum,	Do you know any legal rules on pesticide types /disposal/time interval? If yes, please specify	In any way indicates relevant legal knowledge on use of types /disposal	In any way indicates irrelevant legal knowledge on use of

Berger, and Hauge 1988)	the rules. How do you know this?	/time interval	types/disposal/time interval
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* Based on the report of the Chinese Peasant Economic Status from China Rural Institute of Central China Normal University's in 2012, the average family cash income in rural China in 2011 was 38,894.38 RMB. Thus, we set 40,000 RMB as the standard line.

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Notes

¹ Here DRC refers to Development Research Centre of the State Council. In 2004, DRC, the State Council organized researchers and experts in more than 50 institutions and conducted the “China’s Food Safety Strategy” project. This project published several reports and academic papers. It especially published a book entitled *Zhonguo Shipin Anquan Celue Yanjiu* (China’s Food Safety Strategy Research) which provides ample information for policymakers.

² E.g., Regulations on Pesticide Administration, The Measures for the Implementation of Regulations on Pesticide Administration, Food Safety Law of the People’s Republic of China, Law of the People’s Republic of China of Quality and Safety of Agricultural Products, etc.

³ 水胺硫磷, a type of illegal pesticides prohibited to be sprayed on vegetable because of its high toxicity.

⁴ This article examines deterrence in a subjective manner. Accordingly, we measure sanction impact instead of sanction severity as it is more adaptive to the subjective approach.

⁵ Expect the three villages with SCA farmers. All the SCA farmers were interviewed to get the largest possible sample considering the large number of individual farmers.

⁶ We exclude disposal in the analysis as during the pilot study, none of the interviewed farmers expressed costs or benefits statements in relation to disposal.