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Contextual Compliance: Situational and Subjective Cost-Benefit Decisions about Pesticides by Chinese Farmers

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This article analyzes how cost-benefit calculation influences compliance with pesticide regulation by Chinese farmers. Building on a study including 150 farmers and experts, it studies how operational costs and benefits and deterrence affect compliance. Moreover, it studies what variation in cost-benefit perceptions there are with different types of rules, farms, and villages. It finds that, in this context, cost-benefit calculation matters for compliance; with operational costs and benefits being more clearly related to compliant behavior than deterrence. It highlights that perceptions about costs and benefits are situational and vary along the type of legal rule and the type of regulated actor. It also shows that such perceptions are individually subjective, as even with similar rules and similar types of actors, perceptions vary. The paper concludes by stating expectations on how the situational and subjective nature of cost-benefit calculation can inform regulators seeking to enhance compliance.

INTRODUCTION

Chinese regulation continues to suffer from an enforcement gap. Many of the country's regulatory laws are weakly enforced. China's administrative agencies tasked to enforce regulatory laws have been experiencing difficulties detecting violations of regulatory law including labor (Cooney 2007), food safety (Liu 2011), environmental law (Van Rooij and Lo 2010), and intellectual property rights (Dimitrov 2009; Mertha 2005b). Moreover, they have been lacking sufficient legal authority to issue strong sanctions, and even within their authority, they often issue sanctions far below the maximum allowed (i.e., SEPA 2007). Consequently violations of regulatory law are quite common.

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There has been much scholarly attention to this problem. Scholars have, for instance, studied how regulatory law is enforced in China and what variation there has been in terms of enforcement styles (i.e., Lo, Fryxell, and Van Rooij 2014; Lo and Fryxell 2003). Among others, their work indicates that the picture of weak enforcement in China is more complicated than it is sometimes depicted, as there is much variation both in time and space, with some locations in China recently seeing more formalistic and coercive forms of enforcement than others. Scholars have also looked at the organization of regulatory law enforcement, aiming to understand better what has influenced the prevalence of weak enforcement (Cooney 2007; Lo and Tang 2006; Mertha 2005a). This strand of literature indicates that regulatory enforcement is weak because administrative regulators lack independence and capacity, and operate in an environment with limited vertical coordination, with limited authority, with close state-enterprise relations, and in an environment lacking sufficient civil society and media oversight (Van Rooij 2012).

Much less is known about how regulated actors in China respond to regulation and its (weak) enforcement. As such we have little insight into what the current enforcement practices mean for individuals and businesses subject to regulation. We know very little about how regulated firms make decisions about whether to obey or break regulatory rules in China and what role enforcement plays in such decisions. For instance, a key finding from a unique study on tax compliance by Chinese lawyers is that, even when state enforcement is weak to nonexistent, these lawyers still perceived a high risk of breaking the law, because such risk came from other sources, including clients and their own firms. In other words, weak enforcement in China does not necessarily mean that there is no deterrence effect (Van Rooij 2015). For improved compliance behavior in China a better understanding of such issues is necessary. Moreover, a better understanding of such behavior in China has broader implications for policy and theory alike, as noncompliance with regulation is not solely a Chinese problem.

Responding to such issues, this article makes an exploratory study of how a particular subset of Chinese actors, vegetable farmers in Hunan province, make decisions about compliance with a particular set of legal rules: pesticide rules. It studies two main questions. First, how do perceptions about both the costs and benefits of legal and illegal pesticide usage shape their compliance behavior? Second, what is the variation in how these farmers perceive such costs and benefits? Building on the rich rational choice literature on compliance (i.e., Simpson and Rorie 2011; Thornton, Gunningham, and Kagan 2005; Winter and May 2001; Paternoster and Simpson 1993, 1996), it approaches cost-and-benefit decision making by studying both the perceived operational costs and benefits of using pesticides in a compliant or violating manner, as well as the perceived risks of being caught and punished for violations (subjective deterrence). The study explores these perceptions in a qualitative and inductive way, seeking to understand how the farmers

understand both operational costs and benefits and deterrence. The article will draw out broader conclusions inferred from the data and their relation to the existing literature that may help improve the study of compliance decision making in China and beyond.

SETTING THE SCENE: BACKGROUND OF THE STUDY

This article explores farmers' compliance behavior with pesticide regulation. In response to the severe health and environmental risks originating from pesticide usage, the Chinese government has published a large body of legal rules and regulations at both national and local levels. Within these rules, three main aspects stand out: (1) rules that restrict usage of certain harmful pesticide types; (2) rules that regulate the manner of disposal of pesticide containers; and (3) rules that set a time interval between the use of pesticides and marketing of crops.[1] Some recent Chinese studies have analyzed which pesticides farmers use and thus indirectly studied compliance with pesticide regulation (as no study directly looks at compliance itself). These studies found that the types of pesticides used are influenced by factors like age, level of education, training, and market channels (Zhou & Jin 2009; Huang et al., 2003). However, existing studies have not yet considered how farmers make cost-benefit decisions in relation to what can explain compliance with pesticide rules. Also, compliance with time-interval and waste-disposal rules has not received much scholarly attention to date. The current study will first seek to understand how cost-benefit analysis shapes compliance with pesticide rules in China. Second, it will seek to understand variation in such cost-benefit analysis. It will study variation at three levels and study variation between three different sets of regulatory rules (pesticide-types restrictions, pesticide-disposal rules, and time-interval rules). Moreover, as detailed below, it will look at variation both in terms of the type of farm as well as the type of village.

The study is based on data obtained through a year-long field study in Hunan province in Central China. Hunan province is a traditional agricultural province ranked seventh nationally in terms of acreage cultivated for vegetable production (Hunan Province Statistics Bureau 2012). During the fieldwork, 119 farmers and thirty-one experts and other informants were interviewed (these individuals will be referred to as *cases* throughout the article). To capture the variation within the population of Hunan vegetable farmers, a particular sampling strategy was developed. Cases were first of all sampled to include different types of farms. The different types of farms were selected to capture different scales of farming, which may have vital differences for the costs-and-benefits perceptions and compliance behavior. The first type was individual farmers who usually plant small-scale vegetable fields as a family unit and transport and sell vegetable by themselves. The second was small-scale cooperative or associative farmers who are organized

and associated by agricultural cooperatives or associations. They also often plant small-scale vegetable fields in villages. The cooperatives or associations provide means of agricultural production (such as vegetable seedlings, pesticides, and fertilizers) as well as the transportation and sale of their vegetables. The third group was medium or large cooperative farmers (hereafter referred to simply as *large cooperative farmers*). These are farmers who establish agricultural cooperatives, tend medium-scale or large-scale fields in the villages, as well as hire several local farmers for vegetable planting. They are often highly educated farmers, capable of productive and operational activities such as large-scale planting, livestock farming, and processing of agricultural products. These farmers are encouraged or even financially supported by the local government. For an overview of the sample of farmers interviewed, see Table 1.

Our second way to capture variation of farming practices was to select different types of villages with individual farming. At first, three counties (counties N, C, and D) in Hunan province were selected on the basis of levels of economic development and crop yields, with one high-income county producing for provincial markets (N), one middle-income county producing for local county markets (D), and one poor county producing for cross-provincial markets (C). Within these three counties, seven villages were selected: three in N County (villages 1, 2, and 3); three in D County (villages 4, 5, and 6); and one in C County (village 7). Table 2 further describes the seven villages, and shows that the selected villages allow for comparison

Table 1. Overview of Farmer Interview Sample

Scale of Farming	No. (%)	Age	No. (%)	Education	No. (%)
Individual	70 (59%)	≦40	19 (16%)	Primary school or less	51 (43%)
Small cooperative	42 (35%)	40–60	75 (63%)	Middle school	49 (41%)
Large cooperative	7 (6%)	≧60	25 (21%)	High school or more	19 (16%)

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

Table 2. Characteristics of Individual Farming Villages

Village	1	2	3	4	5	6	7
Crops	Multiple	Multiple	Multiple	Multiple	Multiple	Green onion	Radish
Crop yields	High	High	High	Low	Low	Low	Low
Distance from cities	Near	Near	Near	Far	Far	Far	Far
Economic development	High	High	High	Low	Low	Low	Low
Number of interviews	6	16	9	14	11	9	12

between villages with high and low economic development, near or far distance from cities, and between different crops, as well as differences between singular and multiple types of crops.

In each village, a sample size was determined relative to the village population, and adult villagers engaged in individual farming were then selected to be interviewed on the basis of 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. Additional interviews were conducted with relevant experts, regulators, and market participants including local agricultural bureau officers, village committee members, pesticide storeowners, and others.

APPROACH AND OPERATIONALIZATION

In order to understand compliance with pesticide regulation, we focused on the cost-benefit decision making in relation to compliance.[2] At its most simple, cost-benefit analysis of compliance considers the expected costs of violation (Vc), the expected benefits of violation (Vb), the expected costs of compliance (Cc), and the expected benefits of compliance (Cb). From this literature it follows that once the sum of benefits minus costs of compliance (Cb – Cc) is higher than those of violation (Vb – Vc), compliance is expected to result (Ehrlich 1972; Becker 1968).

In this study, we follow three approaches as part of this original cost-benefit approach. First, while many cost-benefit studies of compliance continue to focus on the *eventual* costs of violating the law by studying deterrence (i.e., Parker and Nielsen 2009b; Gunningham, Thornton, and Kagan 2005), some scholars also analyze the immediate operational costs and benefits of both violation *and* compliance as they occur within everyday business practices (Nielsen and Parker 2012; Simpson and Rorie 2011; Winter and May 2001; Paternoster and Simpson 1993, 1996). In the case of pesticide compliance, deterrence costs arise from the risk of getting caught and punished for violations, while operational costs and benefits relate to the costs of pesticides and their usage, as well as the effect they have on agricultural yield and income. Second, studies of compliance increasingly take a subjective approach to costs and benefits, including how regulated actors perceive certainty, celerity, and severity of sanctions (Nagin 2013; Thornton, Gunningham, and Kagan 2005; Decker, Wright, and Logie 1993; Paternoster et al. 1983), as well as how they view other types of costs and benefits (Simpson and Rorie 2011; Winter and May 2001; Paternoster and Simpson 1993, 1996). The subjective approach allows for an inductive understanding of how the studied actors see these costs and benefits, which is in the end what shapes their compliance decision making. Third, scholars emphasize the situational nature of cost-benefit decision making, including the type of offense (Simpson and Rorie 2011; Paternoster and Simpson 1993) and the

type of regulated actors involved (Jacobs 2010; Pogarsky 2002; Paternoster and Simpson 1993). To understand this we have focused our analysis both on variation in the scale of farming as well as the location-related conditions of types of crops, yield, economic development, and distance to regulators.

In light of all this, the present study analyzes the effects of two types of cost-benefit analysis on compliance: (1) operational costs and benefits; and (2) the expected costs related to deterrence. Second, the present study seeks to understand inductively how the sampled farmers understand such costs and benefits. Third, it seeks to understand what variation there is (in terms of compliance) among different types of rules and different types of farms, as well as in different types of villages.

COMPLIANCE

Measuring compliance is, of course, complicated, and any method suffers from either low levels of representativeness (as happens in small-n participatory observation studies), low levels of external validity (as happens in experimental and vignette studies), low levels of reliability because of the sensitivity of asking about illegal behavior (as happens in larger-size studies relying on self-reported behavior), or because of bias in recorded governmental data on violations (Parker and Nielsen 2009a; Elffers, Weigel, and Hessing 1987). We have opted to study compliance through semistructured interviews with regulated actors. We were influenced by Winter and May's study of Danish farmers' compliance behavior (2001). Similarly, we studied compliance by asking farmers highly factual and thus not-too-sensitive questions about their farming practices. Contrary to Winter and May, however, we did not rely on a survey, but rather on semistructured interviews with farmers and regulatory experts.

We have tailored our questions to the particular types of compliance we were interested in. First, to measure compliance with the types of pesticides farmers are allowed to use, respondents were shown a chart that contained a large selection of common legal and illegal pesticides, and were asked to indicate which pesticides they normally use. Second, to measure disposal compliance, farmers were asked to explain how they usually disposed of pesticides. Third, and finally, to measure compliance with the time-interval rules, farmers were asked how many days occurred between applying pesticides and harvesting the crops.

Answers were coded for each category of behavior separately. Codes signaling compliance were used for respondents who indicated that they do not use illegal pesticides; who indicated disposal of pesticide containers by means of recycling or burying them in ground far away from water sources and residential areas, or other legal ways; or who indicated that they harvest vegetables at least a week after applying pesticides. Codes signaling noncompliance were used for respondents who indicated that they use illegal pesticides; that they dispose of pesticides not by means of recycling or burying in

ground far away from water sources and residential areas, or other legal ways; or that they generally harvest vegetables within less than a week after applying pesticides (see Appendix).

OPERATIONAL COSTS AND BENEFITS

The next part of the interviews addressed the operational costs and benefits of compliance and violation. Here we were interested in the compliance benefits (Cb) and compliance costs (Cc), as well as the violation benefits (Vb) (Paternoster and Simpson 1993). This, we expect, adds an important understanding to compliance. After all, the deterrence literature predominantly addresses a specific part of the expected violation costs (Vc). It covers the eventual costs, if the (expected) risk of being punished materializes, but not the immediate costs that some types of violations incur (cf. Ehrlich 1972). We have followed what we call *a subjective approach* to study these costs and benefits, thus looking not at what the actual costs and benefits are, but inductively studying how they are perceived by the regulated actors (cf. Simpson and Rorie 2011; Paternoster and Simpson 1993).

Inspired by the extant literature, we developed a way to study and understand better perceptions about costs and benefits in the setting of a qualitative, semistructured interview. We did so only for two of the three types of compliance studied here: (1) types of pesticides; and (2) time interval between pesticide usage. Through our pilot study, we learned that there are no operational benefits to legal disposal and no operational costs to illegal disposal, and thus the calculation is likely to be predominantly negative. We started this part of the interviews by asking respondents first to ponder whether there was an alternative to the behavior they had just reported, discussing this until they came up with either a compliant alternative, if they had reported noncompliant behavior, or a noncompliant alternative, if they had indicated compliant behavior. Then we asked respondents to compare which behavior was cheaper (his/her own or the alternative), and which behavior was more cost effective (for types of pesticides), or brought more earnings (for the time interval between pesticide usage and marketization). In this way both the costs of compliance and violation, as well as the benefits of compliance and violation, other than those measured through the deterrence questions (explained below), could be analyzed. Answers to these questions were coded separately for the two behaviors studied here. Answers were coded *positive* when the respondent indicated that $(Cb - Cc) > (Vb - Vc)$, and *negative* when indicating $(Cb - Cc) < (Vb - Vc)$.[3]

DETERRENCE

After discussing compliance and its operational costs and benefits with respondents, we focused on deterrence. We followed the general deterrence

tradition by studying how respondents perceive the expected risks of being caught and punished for violating the law (i.e., Van Wingerde 2012; Parker and Nielsen 2009b; Thornton, Gunningham, and Kagan 2005; Kuperan 1998; Braithwaite and Makkai 1991; Casey and Scholz 1991; Reiss 1984; Scholz 1984). The study further looks at the elements that deterrence theorizing considers most relevant to achieve compliance, namely, sanction certainty and severity[4] (Simpson and Rorie 2011; Thornton, Gunningham, and Kagan 2005; Paternoster and Simpson 1993). But contrary to addressing modeled or actual certainty or severity of sanctions, we address inductively how these elements are perceived by regulated actors. In doing so we build on the work of Thornton, Gunningham, and Kagan (2005). We also draw on methodological insights from criminology (Decker, Wright, and Logie 1993; Williams and Hawkins 1986; Grasmick and Green 1980).

First, we recognize that there is a difference between other-referential questions, which ask what respondents would think in other situations (as used by Thornton et al. 2005), and self-referential questions, which ask what the respondents themselves think about the risk of getting caught and punished (Williams and Hawkins 1986). Due to the sensitivity of the questions about deterrence, we opted for a middle road. We did not ask what respondents thought would happen to themselves (cf. Grasmick and Green 1980) or what would happen in fictional cases different from their own (cf. Thornton et al. 2005), but rather we asked them what they considered would happen to someone like themselves. Second, we recognize that severity of punishment is relative, and the same punishment can be experienced with different levels of impact by different respondents (Williams and Hawkins 1986). Thus, instead of asking respondents the exact severity of the punishment/sanction (cf. Thornton et al. 2005), we asked what the effects of punishment would be and what the most serious consequences would be (cf. Grasmick and Green 1980).

We operationalized this in our interviews by asking our respondents a series of related questions. Respondents were asked to assume that someone similar to them engaged in one of the three types of illegal behavior studied here. First, they were asked whether such behavior can be discovered. Second, if they answered affirmatively, they were asked how high the possibility of such discovery was. Third, they were asked what the effects would be if they were disciplined, and what the most serious consequences would be. This set of questions was asked after the compliance questions (explained above) to ensure that respondents' compliance answers were not influenced by the deterrence answers. Answers to these questions were coded, for each of the three types of illegal behaviors separately. Answers were coded *high* when the respondent in any way indicated a high detection probability or a sanction impact; answers were coded *low* when the respondent in any way indicated no detection probability, or a low detection probability, or a low or no sanction impact.[5]

DEALING WITH INTERVIEW BIAS

While it is impossible to overcome interview bias fully through these self-referential questions, we sought to decrease it in several ways. First, our method of using qualitative interviews allowed sufficient time for conducting personalized and open-ended, yet factual, interviews during which some trust could be established. Second, the interviews were conducted through a guided dialogue structure in which the respondents were guided naturally from their general farm practices to their usage of pesticides without sending any normative messages about legal and illegal, or right and wrong. Third, the selected types of violation are not highly sensitive and are deemed to be quite common. A large portion of farmers talked openly about noncompliance (13 percent [$n = 16$] for pesticide types, 58 percent [$n = 69$] for disposal, and 59 percent [$n = 70$] for time interval), indicating a comfort level that would help ameliorate bias. Fourth and finally, interviewees with relevant expertise, regulators, and market participants were used to validate interview responses and general trends we were finding in the interviews with farmers.

FINDINGS

This section presents the data as well as our findings. It first addresses how operational costs and benefits, as well as deterrence, relate to compliance. From here we move to discussing variation between legal rules, farm types, and villages in terms of perceived deterrence. Finally, we address variation in operational costs and benefits.

COST-BENEFIT PERCEPTIONS AND REPORTED COMPLIANCE

The data in this study indicate that cost-benefit calculation matters for compliance. Table 3 combines and summarizes compliance and deterrence data.

The data indicate that farmers who perceived a high level of deterrence, both in terms of probability of detection and impact of sanction, reported compliance with the law. However, of those that reported a low perception of deterrence, a large proportion still reported compliant behavior. They did so especially for using legal pesticides (56 percent [$n = 20$] for perceived low probability of detection, and 52 percent [$n = 17$] for perceived low impact of sanction), but also for disposal (39 percent [$n = 44$] of both perceived low probability of detection and low impact of sanction), and time interval (34 percent [$n = 36$] and 29 percent [$n = 28$], respectively). This indicates that (perceived) deterrence cannot fully explain compliance and that other variables may be at play.

Among these other variables are the operational costs and benefits. Table 4 gives insight into the relation between compliance and perceived operational costs and benefits.

Table 3. The Association between Vegetable Farmers' Perceived Risk and their Compliance Behaviors

Compliance Behaviors			Perceived Detection Probability		Perceived Sanction Impact	
			High	*Low*	*High*	*Low*
Use of types of pesticides	*Compliant*	No. (%)	83 (100%)	20 (56%)	86 (100%)	17 (52%)
	Noncompliant	No. (%)	0 (0%)	16 (44%)	0 (0%)	16 (49%)
Total			83	36	86	33
Disposal	*Compliant*	No. (%)	6 (100%)	44 (39%)	6 (100%)	44 (39%)
	Noncompliant	No. (%)	0 (0%)	69 (61%)	0 (0%)	69 (61%)
Total			6	113	6	113
Time interval	*Compliant*	No. (%)	13 (100%)	36 (34%)	21 (100%)	28 (29%)
	Noncompliant	No. (%)	0 (0%)	70 (66%)	0 (0%)	70 (71%)
Total			13	106	21	98

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

Table 4. The Association between Vegetable Farmers' Perceived Operational Cost-Benefit Calculation of Compliance and Pesticide Compliance Behaviors

Compliance Behaviors			Operational Cost-Benefit Perception of Compliance	
			Positive	*Negative*
Use of types of pesticides	*Compliant*	No. (%)	97 (100%)	6 (27%)
	Noncompliant	No. (%)	0 (0%)	16 (73%)
Total			97	22
Time interval	*Compliant*	No. (%)	49 (100%)	0 (0%)
	Noncompliant	No. (%)	0 (0%)	70 (100%)
Total			49	70

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

As with deterrence, our data indicate that all farmers who report a positive cost-benefit ratio also report compliance with the legal norms addressed in our study. In contrast with deterrence, however, our data indicate that a substantially larger number of farmers who report a negative cost-benefit ratio also report noncompliance with the law. The exception is the legal usage of pesticides, for which 27 percent (n = 6) of those who report a negative cost-benefit calculation still report compliance.[6]

In sum, perceived costs and benefits appear clear and strong drivers for compliance. In our study, a positive perception of costs and benefits better explains compliant behavior than perceptions of high probability of detection and severe impact of sanction. Further, in our study, a negative

perception of costs and benefits better explains noncompliance than perceptions of low detection probability and low sanction impact.

This is an important lesson for regulation in China, and likely for regulatory scholarship more broadly. Our data indicate that operational costs and benefits are likely a key aspect of compliance decision making. Deterrence cannot, and should not, be seen in isolation from operational costs and benefits, as happens in many studies, because its role in compliance is relative to such costs and benefits.

SITUATIONAL AND SUBJECTIVE DETERRENCE

Now that we have uncovered that both operational costs and benefits and deterrence matter for compliance, let us look at our second main research question concerning the variation of perceptions about both aspects of cost-benefit decision making regarding compliance, starting with deterrence. We will first look at the variation that exists between the three legal rules studied, then at variation between the types of farms, and finally at variation amongst villages.

When we compare deterrence perceptions in relation to the three legal rules studied here, we find a great deal of variation. As Table 2 has already shown, farmers perceive a much higher probability (70 percent [$n = 83$]) of being discovered for using illegal pesticides than for illegal disposal of containers (5 percent [$n = 6$]), or for illegally short time intervals between applying pesticides and harvesting crops (11 percent [$n = 13$]). One explanation for this difference is that, in conducting their inspections, enforcement authorities have prioritized illegal pesticides over disposal or time-interval violations. Recently pesticide enforcement agencies at the national and local levels have published a large number of rules and regulations on prohibition of highly toxic pesticides. The prohibition of using highly toxic pesticides has gradually become one of the key focuses of pesticide enforcement.[7] Such prioritization appears, in part, to result from a lack of capacity of administrative agents to focus on all violations. As one agricultural officer explains: "It is impossible to enforce the disposal. Vegetable farmers dispose [of] pesticide containers everywhere and frequently. It is impossible to do the inspection" (N2.10.04. 2012).

The lack of capacity of state regulators can, in theory, be alleviated by third-party regulators (Van Rooij 2012; World Bank 2000). In this study, we indeed see that third parties may have an impact on the perceived probability of detection. These include vegetable vendors, customers, and the cooperatives or associations. Our data indicate that these third parties are perceived as more likely to detect illegal pesticide use than to detect violations of time interval and that they are not perceived as being able to detect disposal violations at all (see Table 4). Deterrence perceptions of farmers in our sample appear to be relative to the perceived capacity and priorities regarding detection of administrative regulators and third parties (cf. Nagin 2013).

When we analyze the different types of farms, we find considerable variation in deterrence perceptions. The results show that large cooperative farmers appear to have perceptions of very strong probability of detection, even for disposal and time-interval violations (86 percent [n = 6], and 100 percent [n = 7], respectively). Individual farmers and small cooperative farmers have completely different perceptions of detection probability than large cooperative farmers, but differences in perceptions among these two groups are considerable as well. It is particularly striking that individual farmers have a perception of much lower detection probability for the use of illegal types of pesticides, with 44 percent (n = 31) reporting a low probability. One explanation for this difference may again be law enforcement prioritization and capacity. Enforcement authorities appear to prioritize cooperative and associative farms. As one law enforcer of the local agricultural bureau in N county explained, at some length:

> In our county, there are thousands of vegetable farmers who mainly live on vegetable production and almost every family in rural areas plants 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 thirteen vegetable cooperatives in our county and all of them plant large-scale vegetable fields. It is much easier to do an inspection. We often test the pesticide residue and some of the bigger cooperatives are required to purchase instruments and to test pesticide residues every time before the vegetables are sold on the market. (N1.12.28.2011)

Enforcement priority however cannot fully explain why the scale of farming matters for the perception of detection probability with regard to disposal, which is not a focus of inspectors. It is plausible that a generally high perception of risk among larger-scale farmers stems from them having more interaction with inspectors.

Finally, when we look at variation among the villages studied here, we find variation between the villages. Table 5 sketches the variety in perception between individual farmers in the same villages, taking use of types of pesticides as an example.[8] We compare individual farming practices in the seven villages (1–7) in which they exist in our sample.

Our data indicate that, overall, between these villages, detection probabilities vary considerably. Of the seven villages compared here, two show a low probability (villages 4 and 6), two a medium probability (villages 5 and 7) and three relatively higher probabilities (villages 1, 2, and 3). Clearly we see that nearer distance to the city enhances probability perceptions, with villages 1, 2, and 3 all being nearer to the city. This happens to coincide with a higher level of economic development, which logically in itself seems to result from being closer to the city rather than a clear cause for higher deterrence probabilities. The near distance to the city however does not seem to affect deterrence perceptions through more regular governmental inspections.

Table 5. Individual Vegetable Farmers' Perceptual Detection Probability for Pesticide Behaviors by Different Villages in Terms of Use of Types

Perceived detection probability*			Villages						
			1	*2*	*3*	*4*	*5*	*6*	*7*
High	State	No. (%)	0 (0%)	7 (44%)	2 (22%)	1 (9%)	0 (0%)	0 (0%)	0 (0%)
	Vegetable vendors	No. (%)	4 (67%)	3 (19%)	3 (33%)	1 (9%)	1 (11%)	1 (8%)	0 (0%)
	Customers	No. (%)	0 (0%)	1 (6%)	2 (22%)	1 (9%)	3 (33%)	3 (25%)	3 (43%)
	Mixed	No. (%)	1 (17%)	2 (13%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Low		No. (%)	1 (17%)	3 (19%)	2 (22%)	8 (73%)	5 (56%)	8 (67%)	4 (57%)

Note: Percentages do not always add to 100 because of rounding.
*This column indicates the actors whom the respondents considered to be most likely to detect noncompliance.

Instead the data further show that detection probabilities depend on vendors and customers. Only in village 2 do we see that 44 percent (n =7) of respondents perceive the state to play a role in high chances of detection. In all other villages, percentages are much lower, ranging from 22 percent ($n = 2$) (village 3) to 0 percent (villages 1, 5, 6, and 7). We see that high probability of detection thus depends on other sources, such as vegetable vendors[9] and customers.[10] And again, we see variation between villages in the perceptions about which of these sources matters most. For instance, farmers in village 1 consider high detection chiefly as a matter of vegetable vendors, and in village 5, they consider it mostly as a matter of customers. This shows that there is geographical variation not just in the state of enforcement, but also in other forms of regulatory oversight through market actors. More generally, it appears that forms of market oversight in these cases are more influential in shaping deterrence perceptions when there is a close proximity to city markets.

When we analyze the data in Table 5 for variation within villages, it is striking to see how even in singular villages, there are divergent ideas about the chances of getting caught for violations. Within both villages 5 and 7, for instance, villagers are nearly evenly split between those reporting high and low probabilities, while in all other villages minority opinions on detection probability range from 17 percent ($n = 1$) to 33 percent ($n = 4$). This variation in perception of probability of detection within single villages shows that deterrence is not just situational, depending on the type of enforcement or type of violations, but that it is also subjective, since similar farmers have different perceptions about what in reality must be similar risks. After all, the homogeneity of the individual farmers in each village is quite high. They are quite similar in geographic factors (e.g., geographic conditions, local economic development, local culture), farm size, types of vegetable planting, and vegetable selling method. They also deal with similar inspectors, vendors, and

customers. Thus we can conclude that deterrence perceptions in relation to the perceived probability of detection are both situational and subjective, and vary for different violations, different types of violators, and the subjective opinions of similar violators.

These findings confirm earlier literature on the subjective nature of deterrence (Thornton, Gunningham, and Kagan 2005; Decker, Wright, and Logie 1993; Paternoster et al. 1983; Grasmick and Bryjak 1980) and literature that considers that compliance hinges on the deterrability of offenders (Jacobs 2010; Pogarsky 2002; Paternoster and Simpson 1993) and offenses (Simpson and Rorie 2011; Paternoster and Simpson 1993).

SITUATIONAL AND SUBJECTIVE COST-BENEFIT ANALYSIS

Our data indicate that, along with deterrence, operational cost-benefit analysis is situational and subjective. First, our data highlight a clear difference between perceived operational costs and benefits among different legal rules: here between rules on the use of types of pesticides and time interval. As Table 3 shows, farmers generally report an overwhelmingly (92 percent [n = 97]) positive perception of operational costs and benefits for using compliant types of pesticides, while being split between positive (41 percent (n = 49]) and negative (59 percent [n = 70]) on the operational costs and benefits for time-interval compliance.

The way farmers reasoned about the operational costs and benefits of these two kinds of violations was different. When discussing the costs and benefits of use of legal and illegal pesticides, farmers looked predominantly at how they perceived the effectiveness of the pesticides (for positive attitudes) or both the effectiveness and the cost (for negative attitudes). Consider for instance the two quotes below:

> I think the prices are almost similar, but what I use is more effective as some insects and diseases have already produced resistance to those prohibited pesticides. Vegetable farmers have given up continuously using them. (village 1, NO.5.04.22.2012)

> It will be less costly and more effective if I apply those alternative ones [referring to illegal pesticides]. (village 1, NO.4.04.21.2012)

The considerations for time interval were more complex and included fears of over-ripeness and their effects on the appearance and marketability of the vegetables, the time controls limiting influence on effective disease and pest control, sudden changes in the market requiring flexibility in harvest times, and timing in response to picking ripe crops to leave sufficient fertilizer for unripe produce. What this shows is that the two legal norms have completely different meanings and implications in terms of costs and benefits.

Also similar to deterrence, costs and benefits vary depending on the type of farm scale. Our data indicate considerable differences in perceived costs and

benefits among the individual, small cooperative, and large cooperative farmers. For large cooperative farmers, the operational costs and benefits of compliance are always positive. For most small cooperative farmers (93 percent [$n = 39$]) and a clear majority of individual farmers (73 percent [$n = 51$]), they are positive for using legal pesticides but not for the legal time interval, where the majority of individual farmers (54 percent [$n = 38$]) and large cooperative farmers (76 percent [$n = 32$]) report a negative perception of costs and benefits of compliance. The minority of individual vegetable farmers who reported a negative cost-benefit perception for using legal pesticides were predominantly older farmers from three villages in D county. They typically plant small vegetable plots and have grown accustomed to applying old and illegal pesticides for years. As one farmer there explained clearly:

> Carbofuran (a type of illegal pesticide used for vegetable plants) is cheap. It costs five RMB per package. It is more effective. However, lots of those old effective pesticides are eliminated. I do not trust those new environmentally friendly pesticides. They cost more. Of course, we plant vegetables for pursuing better effectiveness. The old highly-toxic ones are always effective in killing insects, but those new brands always fail to kill them. (village 4, NO.5.07.21.2012)

In their answers to questions about the costs and benefits of legal pesticides compared with illegal ones, these farmers further stressed that they prefer the illegal ones because their effects are quick and therefore clearly visible, as opposed to legal ones that work slowly and subtly.

To understand the variation in perceptions between large cooperative farmers and small cooperative and individual farmers, several variables appear to be relevant. First is the type of vegetables they plant. Many of the small cooperative farmers with negative cost-benefit perceptions on compliance with time intervals grow tomatoes and eggplants. These vegetables require frequent harvesting to prevent the costs of rotten produce, especially during summer when the frequency of pesticide spraying increases and time intervals thus become costly. Second, large cooperative farmers receive government subsidies and are therefore a little cushioned from the market and need not respond as rapidly to market price changes. Third, for large cooperative farmers, a good reputation arising out of compliance, even with time interval, is seen as beneficial, especially in order to continue receiving government subsidies. As one of the interviewed experts explained:

> Basically, those cooperatives who plant large-sized fields deal with time interval better, because it is much more convenient for them to plant in a standardized way. But 90 percent of them sell vegetables at a loss as on the one hand, the payments for workers are very high, on the other hand, the vegetable prices are unstable and go up and down. Most of them are motivated by the government subsidies. For example, large standardized vegetable bases can obtain subsidies of three to four hundred thousand RMB each year. They can even get more subsidies elsewhere. I heard that someone who plants 400 acres of vegetable fields got a subsidy of 1.6 million RMB. Meanwhile, it means that the

> cooperatives should regulate the vegetable fields very well and obey the rules. In order to get innovation funds from the local technology bureau, they need to plant pollution-free vegetables. (expert in N county, 04.01.2012)

Let us now look at variation between and within villages with individual-scale farming practices (villages 1–7). As with deterrence, we find that, overall, perceptions about the calculated costs and benefits vary between villages. In villages 1, 2, 3, 6, and 7, we find high percentages of positive perceptions about compliance cost-benefit ratios for usage of pesticides (higher than 60 percent); in village 5, there is only a small majority of positive perceptions, while in village 4, there is a minority of positive perceptions. Here, none of the village characteristics selected gives a clear indication of why these differences exist. For time-interval cost-benefit perceptions, we see that only villages 6 and especially 7 have a majority of positive perceptions about the operational cost-benefit ratio of compliance (75 percent [n = 9] and 100 percent [n = 7], respectively). These villages stand out because they only plant one type of crop instead of multiple types. It is, however, not entirely clear whether and how this can logically explain differences in perceptions on time-interval cost-benefits in these two villages, as compared to the other five. In sum, for cost-benefit perception variation between the villages, we do not yet have a clear indication of why differences exist. This shows that village-level variations in cost-benefit calculations likely depend on other more fine-grained variables related to each village. As a matter of speculation, we can think here of the type of support village leadership provides in acquiring pesticides or educational support and content difference between villages related to the costs and benefits of pesticides. More detailed study is however necessary to unearth such village-level situational differences.

When we look at variation (Table 6) within the villages, we again find that there is unexpected variation among farmers engaged in similar scales of farming. We thus perceive variation among individual farmers located in the same village. More precisely, there is variation even though the farm scale, as well as geographical conditions and economic development, are highly similar. There even exists variation among farmers who plant exactly the

Table 6. Vegetable Farmers' Perceived Operational Cost-Benefit Calculation of Compliance by Different Villages

Villages			**1**	**2**	**3**	**4**	**5**	**6**	**7**
Use of types of pesticides	Positive	No. (%)	4 (67%)	14 (88%)	8 (89%)	5 (46%)	5 (56%)	10 (83%)	5 (71%)
	Negative	No. (%)	2 (33%)	2 (13%)	1 (11%)	6 (55%)	4 (44%)	2 (17%)	2 (29%)
Time interval	Positive	No. (%)	1 (17%)	5 (32%)	2 (22%)	6 (55%)	2 (22%)	9 (75%)	7 (100%)
	Negative	No. (%)	5 (83%)	11 (69%)	7 (78%)	5 (46%)	7 (78%)	3 (25%)	0 (0%)

Note: Percentages do not always add to 100 because of rounding.

same crop types in exactly the same geographical conditions. For instance, our data indicate variation in the cost-benefit perception (with some having a positive and others having a negative calculation of operational costs and benefits), among individual farmers in village 7 where all farmers plant radish. In villages 6 and 2, we observed similar variation in terms of perceptions of costs and benefits for time-interval compliance, even though individual farmers there also plant the same crops (village 6 plants green onions, and village 2 plants pod peppers).

All of this shows again, just like deterrence, that operational costs and benefits are both situational and subjective. For the cases studied, the costs and benefits of compliance compared with violation first of all depend on the type of violation and type of regulated actor involved, confirming earlier literature in the field (Simpson and Rorie 2011). Second, even for similar violations and regulated actors, subjective differences exist. Such differences likely depend on personal experience, personality, long-term versus short-term outlook, and the level of knowledge and information (Van Rooij 2006; Huisman 2001, 148).

CONCLUSION

A better understanding of how regulated actors weigh the costs and benefits of compliance and violation may well help to improve implementation of law in China and elsewhere. The current study highlights the importance of understanding implementation problems beyond just the style and organization of enforcement, which are the dominant foci in current compliance studies that consider China and other contexts.

To improve compliance in China, it is key to understand how regulated actors perceive such enforcement but also how they perceive the operational costs and benefits of compliance and violation. In this study we found that operational costs and benefits were a key and clear driver of compliance, yet such costs and benefits have been largely overlooked in the existing literature on China's regulatory challenges. The broader lesson from this study is that whereas deterrence shapes the eventual costs of violation, working through a distant perceived threat, the operational costs and benefits operate at a daily level of economic decision making and concern both immediate as well as eventual costs and benefits, many of which are related to intimate knowledge of the regulated actor involved (cf. Ehrlich 1972). Deterrence appears necessary, therefore, only when the operational costs and benefits of compliance are negative.

Moreover, we find that even within this fairly confined study of farmers' pesticide compliance, much variation exists, both in deterrence as well as in perception of operational costs and benefits. We conclude compliance cost-benefit calculation here and likely elsewhere is highly situational and subjective, depending on at least the type of legal norm, the type of regulated actors, the location and economic conditions at play, the availability of third-party enforcement actors, and the particular and varied subjective views, experiences, and conditions of each individual actor.

Table 7. Cost-Benefit and Deterrence Interactions (after Thornton et al. 2005)

COST-BENEFIT	*Positive*	Deterrence effective but not necessary (a)	Deterrence weak but not necessary (b)
	Negative	Deterrence effective and necessary (c)	Deterrence ineffective but necessary (d)
		High	*Low*
		DETERRENCE	

All of this has important implications for law enforcement policy in this particular context of study and most likely beyond it. A combined view of operational costs and benefits and deterrence can help to allocate enforcement capacity more strategically. It may help to target those situations in which considerable enforcement activity is necessary because the operational costs and benefits of compliance are negative, and it may help to prevent redundant enforcement in less critical situations. To illustrate this, Table 7 highlights when deterrence is likely necessary and effective (cell (c)) and when it is less so (cells (a), (b), and (d)). This insight is similar to what Thornton, Gunningham, and Kagan (2005) found when mapping the interactions between the *duty to comply* and *fear of the consequences of noncompliance* of regulated actors.

Second, practically, we see that within the law enforcement context studied, prioritization of scarce detection resources does not necessarily target actors with a negative operational cost-benefit analysis. In our study, larger firms were selected for inspection over smaller firms and individual farmers. However, here large firms' cost-benefit perceptions were found to be always positive, which implied that to them deterrence was redundant and the scarce inspection resources were wasted. It is likely that our study is illustrative of a broader trend in contemporary enforcement practice to target larger firms, mostly because they present the biggest risk (cf. Sparrow 2008; Baldwin, Hutter, and Rothstein 2000). However, we hypothesize that larger firms are not necessarily the ones most likely to have a negative cost-benefit calculation, especially because their larger scale operations can more easily reduce the costs of compliance. In simpler terms the implication is clear: enforcement prioritization should move from a dominant risk-based prioritization to one that is also need-based, targeting those firms that are most likely to have a negative cost-benefit perception of compliance.

Third, the situational view of cost-benefit analysis can help such a need-based enforcement strategy. In our study, cost-benefit perceptions depended on the legal norm and on the type of regulated actor, as well as the context in which the actor is situated. An understanding of how costs and benefits relate to the different types of norms and regulated actors involved can help guide enforcement prioritization. While it may not be possible to know exactly how each actor perceived costs and benefits, the insight that there are major differences of costs and benefits depending on the type of norm and the type of regulatee can help regulators in estimating where negative perceptions are

more likely and thus where more enforcement is necessary. For academics, the situational nature of cost-benefit analysis requires more in-depth study into the variables that can explain variation. Here we have taken a first step. We hope that scholars will take up some of the questions and challenges that we have highlighted throughout the article. A promising avenue of research could, for example, be an in-depth comparative study of compliance variation between villages by studying the village history of pesticide promotion, education, and usage, and how the villagers interact with their own leaders and outside experts, regulators, and vendors.

Fourth and finally, further improvement of compliance can possibly be achieved by addressing the subjective nature of cost-benefit perceptions. As our study illustrates, regulatees subject to similar legal rules and facing similar contextual conditions in terms of, for instance, local markets and types of farming and produce, may hold very different perceptions of the cost-benefit of compliance. In instances where such regulatees are wrong to presume that the operational costs and benefits of violation outweigh compliance, an educational and cooperative enforcement strategy may likely yield positive results (Braithwaite 2011). Here, for instance, peer-to-peer learning could be added to more traditional deterrence, especially if it involves peer learning from similar regulated actors who have developed a positive cost-benefit calculation.

All of this, of course, necessitates that regulators quit assuming that costs and benefits are objective and stable, but rather that they develop the tools to understand the contextual nature of compliance and thus the situational and subjective nature of cost-benefit decision making in compliance.

NOTES

1. Rules regulating the three norms include No. 199 of Announcement of Ministry of Agriculture of the People's Republic of China; Article 7, Chapter 4 of Provisions for Safe Use of Pesticides; Article 26, 27, Chapter 5 of Regulations on Pesticide Administration; Article 18, Chapter 3, Article 25, Chapter 4 of Law of the People's Republic of China on Quality and Safety of Agricultural Products.
2. Of course the study of compliance has yielded many other approaches, including those emphasizing the capacity to obey the law (Gray and Silbey 2011; May 2004; Coleman 1987; Kagan and Scholz 1984), opportunity to break the law (Benson, Madensen, and Eck 2009; Clarke 1995), the influence of social norms (Keizer, Lindenberg, and Steg 2008; Cialdini and Goldstein 2004; Heimer 1999; Cialdini and Trost 1998) and personal morality (Kuperan and Sutinen 1999; Tyler and Darley 1999; Paternoster and Simpson 1996), the amount of procedural justice (Tyler 1990), and the perceived general duty to obey the law (Vandenbergh 2003; Scholz and Pinney 1995; Tyler 1990). Also, some scholars have sought to look at the influence of social and personal norms on amoral calculation in compliance (Nagin and Pogarsky 2001, 2003; Grasmick, Bursik, and Kinsey 1991; Grasmick and Bursik 1990; Grasmick and Green 1980).
3. We understand that the binary (positive/negative) coding of our data comes with its own methodological shortfalls. For (the small number of) cases that did not neatly fit the *positive* or *negative* categories, we have coded them according to their closest fit. See further Appendix.

4. In doing so, the study does not look at celerity, the speed with which punishment is meted out, which is also an important variable and perhaps one for future study (see Nagin 2013; Nagin and Pogarsky 2001; Zimring and Hawkins 1973).
5. We understand that the binary (high/low) coding of our data comes with its own methodological shortfalls. For (the small number of) cases that did not neatly fit the *high* or *low* categories, we have coded them according to their closest fit. See further Appendix.
6. While the space provided does not allow us to address exhaustively the variables that may explain this finding, our larger study indicates that variables such as capacity, legal knowledge, social norms, personal morality, and procedural justice are at play (cf. Yan 2014).
7. For example, No. 194, No. 199, No. 274, No. 322 and No. 632 of the Announcement of the Ministry of Agriculture of the People's Republic of China.
8. Please note, our data from villages N.R., C.X., and C.M. unfortunately do not allow for the fine-grained analysis presented in Table 4.
9. Here vegetable vendors are individual businessmen who buy vegetables wholesale from farmers and then sell vegetables to customers retail, or wholesale in the local area, or in other cities.
10. Here customers are schools or supermarkets in the local area, or individual residents who buy and consume vegetables.
11. Note that only two pesticide behaviors are compared, since it is presumed that there is no interaction between operational cost-benefit calculation and disposal of pesticide containers. As by the pilot study, the vegetable farmers indicated that there is no direct and obvious cost-benefit calculation concerning disposal.
12. Note that for middle cases, such as those where the respondent indicates behavior A (compliant) is more expensive but more effective/profitable than behavior B (violating), it is coded as positive, and vice versa. The coding method here is based on how vegetable farmers themselves weigh both aspects.
13. (Cb – Cc) > (Vb – Vc) indicates that benefits of compliance minus costs of compliance are greater than benefits of violation minus costs of violation.

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APPENDIX: MEASURING COMPLIANCE AND AMORAL CALCULATION VARIABLES

Items		Brief Introduction of Interview Questions	Scoring Arrangement	
Compliance behaviors			**Negative**	**Positive**
Use of types of pesticides		Which pesticide(s) do you usually use on what vegetables and for what pests or diseases?	In any way indicates that he/she has applied or will apply any type of illegal pesticide.	Does not indicate in any way that he/she has applied or will apply any type of illegal pesticide.
Disposal of pesticide containers		How many pesticide containers do you have after each pesticide application? Do you take them home? If not, how do you dispose of them?	In any way indicates that he/she generally disposes of pesticide containers by throwing away on farm or in village, or other illegal ways.	In any way indicates that he/she generally disposes by means of recycling or burying in ground far away from water sources and residential areas, or other legal ways.
Time interval		What is your general time interval between last pesticide application and vegetable pick-up?	In any way indicates that he/she generally harvests vegetable within seven days after pesticide spraying.	In any way indicates that he/she generally harvests vegetable at least seven days after pesticide spraying.
Independent variables Amoral calculation			**Low**	**High**
Deterrence (Becker 1968; Winter and May 2001; Thornton et al., 2005)	Detection probability	Assume that someone similar to you does the specific violation behaviors in terms of use of types/disposal/ time interval. Is it possible he/she will be found out? How high is the possibility? By whom?	In any way indicates low or no possibility of being discovered by the inspection bureau/other sources.	In any way indicates high or certain possibility of being discovered by the inspection bureau/other sources.
	Sanction impact	What negative and most serious effects would happen if punished?	In any way indicates no or low impact of punishment.	In any way indicates an impact of punishment.
			Negative	**Positive**
Operational cost-benefit calculation of compliance (Kagan and Scholz 1984; Winter and May 2001)		How does your compliance behavior compare to an alternative option (a noncompliant option if their own behavior is compliant, and a compliant option if their own behavior is noncompliant),[11] in terms of price and effectiveness (for use of types of pesticides), and cost and earnings (for a time interval)?	In any way indicates any of the two specific compliance behaviors are more costly and less effective/profitable than violation behavior/(Cb – Cc) < (Vb – Vc)	In any way indicates any of the two specific compliance behaviors are less costly and more effective/profitable than violation behavior[12]/(Cb – Cc) > (Vb – Vc)[13]