Localising Biomass Burning and Pollution Control Policy in China

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Introduction

It's common for farmers worldwide to burn crop straws and stubble left in their fields after harvest to prepare for new crops, reduce pests, and fertilize soils [1]. However, uncontrolled biomass mass burning is a leading cause of air pollution that has been linked to 7 million deaths per year [2]. In China, annual agricultural burning released 1.036 million tons PM2.5 during 1997-2013 [3], and increased monthly PM2.5 concentrations by 10 μg/m^3 in some regions during 2010-2018 [4].

Figure 1 Agricultural biomass burning

Figure 2 The Forbidden City in smog

China first banned agricultural biomass burning in 1999 and has steadily tightened controls since 2010s, when it "declare[ed] war on pollution" [5]. However, enforcing the bans and implementing controls on biomass burning has been difficult because these practices are central to traditional livelihoods that support numerous small and vulnerable producers whose agricultural practices vary widely across China's vast territory.

Figure 3 Sanctioning biomass burning

- **What regulatory measures do Chinese local authorities use to control agricultural burning?**
- **How and why do they vary in their implementation of biomass burning policy?**

Theorizing governance variances through China studies and political geography

Our case speaks to wider debates in China studies and political geography about how to explain variability in policy outputs and outcomes. Table 1 summarises key differences in how these scholars theorise the nature of scale and other key determinants sources of local variation in policymaking and implementation. In this project, we use the case of local agricultural biomass control in China to test the explanatory power of those theories.

Table 1 Comparing Explanatory Frameworks

	China studies	Political Geog.
Governance scales	Fixed	Constructed
Hierarchical assumption	Yes	No
Departmental politics	Acknowledged	Ignored
Societal pressure	Issue dependent	Capital determined

Methods

We combined policy document analysis and 64 semi-structured interviews with regional, local, and grassroot agricultural burning regulators and village leaders in six, purposefully selected, localities from three regions in south and north China to reflect the country's diverse climate, cropping and geographical conditions.

Figure 4 Interview regions

Figure 5 Lead author in Interview

Table 2 Case selection

REGION	Chongqing (south China)		Xianyang (north China)		Yan'an (north China)	
Air quality, climate, topography	Air quality: moderate (PM2.5: 35 μg/m^3, 326 GEAQDs)		Air quality: poor (PM2.5: 48 μg/m^3, 245 GEAQDs)		Air quality: good (PM2.5: 27 μg/m^3, 325 GEAQDs)	
	Climate: subtropical (rice & maize -harvest 2 times/ year)		Climate: warm-temperate (wheat & maize -harvest 2 times/ year)		Climate: mid-temperate (maize – harvest 1 time/ year)	
	Topography: mountains & hills		Topography: basin/plains		Topography: plateau	
LOCALITY	C1	C2	X1	X2	Y1:	Y2
Air quality (PM2.5)	34 μg/m^3	39 μg/m^3	35 μg/m^3	49 μg/m^3	23 μg/m^3	26 μg/m^3
Forest coverage	47.61%	37.6%	33%	35.1%	68.29%	52.47%
Agricultural GDP	6.48%	8.15%	22.14%	12.19%	17.21%	5.42%
Agricultural population	26.64%	40.13%	55.4%	36.85%	37.72%	23.6%
Responsible authorities	Ag. Dept dominance w/ engagement of Environment. Dept	Ag. Dept dominance w/ engagement of Environment. Dept	Environment. Dept dominance	Environment. Dept	Ag. Dept dominance	Ag. Dept dominance

Findings

Although all counties formally banned any and all biomass burning, those policies were enforced in strikingly different ways.

Table 3 Diverse implementation practices of absolute bans

County	Inspection coverage and targeting strategy	Enforcement strategy	Subsidizing alternatives to burning
C1	Selective coverage of transport corridors and AQ stations, exempting pickle producers	Education-based: Advice & education, no penalties	None
C2	Selective coverage of areas where fires easily observed, with more frequent inspection of historic hotspots and AQ stations, but ignoring other areas	Symbolic: fixed quota of penalties issued, but fines paid by town govt not violators	Selective subsidies for towns near AQ stations for moving straws and weeds
X1	Universal coverage, with more frequent inspection of historic hotspots and places not easily observed by passers-by	Compliance-based: penalties proportionate to harms and additional reputational 'self-criticism' required	None
X2	Universal coverage, with more frequent inspection of historic hotspots and places not easily observed by passers-by	Deterrence-based: maximum possible penalties and additional reputational 'self-criticism' required	None
Y1	Selective coverage only of transport corridors	Education-based: no penalties	Pervasive subsidies
Y2	Selective coverage only of transport corridors	Deterrence-based and education-based combined	Selective subsidies for towns near urban areas

Explanations & Discussion

Theory suggests several potential explanations for these findings.

Explanation 1 Adapting to local environmental conditions

One explanation for this variability in the implementation of pollution control policy that it simply reflects rational adaptation by Chinese officials to the sheer variety of environmental conditions, agricultural cropping systems, terrain and forest coverage, as well as to background air pollution levels.

Thus, we would expect counties with more severe air quality problems to be stricter in their enforcement, but that was not true. For example, C1, along with C2, X1 and X2, had much higher background PM2.5 concentrations than Y1 and Y2 and even the national average level (30 μg/m^3), but while C2, X1 and X2 all adopted a universe approach of inspection, C1 only inspected selectively as Y1 and Y2 did.

Explanation 2 Responding to societal pluralist interests

Another explanation for the unevenness of pollution controls was that enforcement gaps reflected pluralist interest groups pressure from society and the relative economic importance of different industries. There is clear evidence of local special interests shaping the extent of inspection. Counties tolerated straw burning if that benefited their pillar industries. Thus, C1 accepted straw burning in mustard farmlands by not inspecting too much to protect the pickle processing industry, which provided 15% of local revenues.

This explanation was limited, however. For example, since X1 had better air quality (35μg/m^3) and a higher proportion of agricultural population (55.4%) than C2 (39μg/m^3 and 40.13%), we might expect implementation to be more lax in X1 than C2, where local air pollution was more severe and farmers less influential. But was not true: X1 used a compliance-based enforcement strategy, penalising according to violation severity, but C2 only symbolically sanctioned, with town governments rather than violators paying the actual fines.

Explanation 3 Arrangement of departmental responsibilities

Local variation in enforcement stringency might also reflect the arrangement of responsibilities between the Environment Dept. responsible for environmental quality and the Agriculture Dept. concerned with food production. For example, in X1, the Environment Dept. was responsible for enforcement, but it was the Agriculture Dept. in C2. Environmental officials in X2 wanted all pollution sources strictly suppressed, whereas Agricultural officials in C2 insisted that farm burning contributed little to pollution level and were more concerned with 'rural revitalization' and increasing farmer incomes.

However. the factor is limited in explaining some deviances. For example, while Agricultural Depts in C1 and C2 were charged with enforcement and did so permissively, balancing food production with air pollution control, C1 abandoned all penalties, while C2 continued to issue them, albeit symbolically with fines not paid by violators themselves. Why didn't C2 simply quit issuing penalties?

Explanation 4 Top-down Accountability and blame

A final explanation for the variable implementation of agricultural burning controls was that it reflected internal accountability systems and the ways in which local officials were responding to the second order 'institutional risk' of blame rather than first order societal risk to environmental health and safety from biomass burning [6].

For example, the concern about meeting assessment targets and blame avoidance shaped how inspectors sanctioned. Performance targets drove inspectors in C2 to impose sanctions symbolically rather than simply abandon penalties as in C1. Different from other five counties, including X2 that had the worst air quality, C2 assigned penalty quotas to towns—large towns were expected to issue at least 5 penalties and small towns just 2— to counter the inspectors unwillingness to sanction. As one official explained, "*that's decided not by our agricultural department but the county leadership… Large [towns] for 5 and small for 2. They want penalties anyway*." As a result, its town governments and grassroot inspectors were induced to forge penalty records and used the town budget to pay the bill.

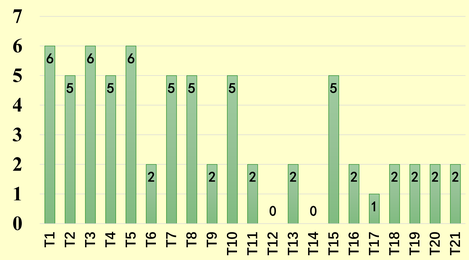

Figure 6 Sanction records of 21 towns in C2

Conclusion

Contrary to popular understandings of China's party-state as highly top-down and evenly coercive in governance, implementation and enforcement of pollution control policies are highly heterogeneous. We confirm political geography's view that local scales matter, but show that local variations are also shaped by the national accountability and the 'scaling-in' process of departmental politics that the geographical scholarship has long ignored. This project can also advance the knowledge about how developing countries control biomass burning and more broadly air pollution control that is important to public health and sustainability globally.

References

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