

## **Electronic Supplementary Material**

### Managing manure from China's pigs and poultry – the influence of ecological rationality

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#### ***Appendix S1***

Pig and poultry production prevail in both cases, with 50% and 40% of total livestock production output respectively. Rudong is located in the Eastern coastal area of China, and has a high level of socioeconomic development. In 2009 the per capita incomes in urban and rural areas of Rudong reached 2679 USD and 1177 USD respectively. Zhongjiang County is located in a less developed area, where urban and rural per capita incomes in 2009 were 2140 USD and 843 USD, respectively. Its livestock production output is 1.8 times that of Rudong, while total regional output is only 48% that of Rudong.

Surveys in Case 1 and 2 were conducted in September 2010 and July 2011, respectively. In each county farmers running animal farms were selected from five towns following stratified random sampling with kind of animal and farm scale as criteria. A survey was carried out face-to-face with a structured questionnaire. Prior to the surveys, structured interviews based on an interview guideline with item points were held with environment and agriculture bureaus on county level. The survey contained questions on individuals, number of animals, technology adoption over the last five years, and perceived motives and barriers for technology adoption. Out of 267 surveyed farmers a total number of 258 respondents could be used in the analysis, 130 of which came from Case 1 and the others from Case 2 (non-response of 3.7% in Case 1 and 3.1% in Case 2). Respondents in both cases included farms of all scales. Due to the proportional differences in two cases, it was difficult to create respondent groups with a similar distribution among farm scales. Case 1 respondents came significantly less from household scale farms than those in Case 2, while Case 2 contained few layer hens breeders. The demographic profile of respondents is showed in Table S1.

Table S1 Demographic profile of respondents in two cases

<b>Division</b>	<b>Values</b>	<b>Groups</b>	<b>Percent in Case 1 %</b>	<b>Percent in Case 2: %</b>
Age		<40	10	41
		40~50	55	39
		50~60	16	13
		>60	19	7
Gender		Male	83	69
		Female	17	31
Animal species		Pigs	51	61
		Poultry	49	39
Farm scale		Household scale	12	27
		Medium scale	66	60
		Large scale	22	13
Awareness of negative effect on environment	1	No effect	55	21
	2	A little	14	55
	3	Less serious	20	15
	4	Serious	11	9
Education level	1	Uneducated	1	6
	2	1~6 years	11	18
	3	6~9 years	48	51
	4	9~12 years	32	15
	5	>12 years	8	10
Risk aversion	1	Risk averse	21	4
	2	Neutral	26	59
	3	Risk-taking	53	37

## Appendix S2

Table S2 lists manure collection in two cases. Traditional washing was the main technology applied for pig manure collection, but is less present in larger-scale farms. Manual dry collection gradually became popular after being introduced to Chinese farmers in the 1980s. The other two technologies were barely applied in pig farms. Collection technologies adopted in poultry farms were more diverse. Bedding competed with manual dry collection in large-scale farms. Medium-scale farms in Case 2 were in transition between household- and large-scale farms. Medium-scale farms in Case 1 were a special situation, as they seemed to largely give up conventional routines but did not apply the newest technology. Pig farms of Case 1 use more advanced technologies in all scale groups compared to Case 2.

The distribution of manure handling technologies in the two cases is expressed in Table S3. Although direct discharge of manure to the environment was banned, it was not completely absent in reality. Environmentally sound fertilizer application was unsuitable for most medium- and large-scale farms in both cases. Manure of one pig or fifteen broilers/hens requires one mu land (0.067 ha) to adequately absorb nutrients<sup>1</sup>, but arable land per household was quite limited, about five mu (0.33 ha) on average. Biogas production was the rising manure handling technology in pig farms, while in poultry farms sending manure to industrial plants was dominant. Pig farms practices varied distinctly in both cases: fertilizer application was dominant among farms in Case 1, while biogas was dominant in Case 2, regardless of scale. Poultry farms in Case 1 and Case 2 showed fewer differences in manure handling technologies, except for large scale farms.

Table S2 Manure collection technologies

	Penetration rate: %	Case 1			Case 2		
		Household scale	Medium scale	Large scale	Household scale	Medium scale	Large scale
Pigs	Washing	57	58	55.5	78	71	50
	Manually dry	43	42	39	22	29	50
	Machine dry	0	0	0	0	0	0
	Bedding	0	0	5.5	0	0	0
Broilers & Layer hens	Washing	75	14	25	100	22	9
	Manually dry	25	46	25	0	50	46
	Machine dry	0	20	12.5	0	0	9
	Bedding	0	20	37.5	0	28	36

Table S3 Manure handling technologies

	Penetration rate: %	Case 1			Case 2		
		Household scale	Medium scale	Large scale	Household scale	Medium scale	Large scale
Pigs	Discharge	0	0	5.5	6	7	10
	Fertilizer	88	91	39	48	32	40
	Biogas	0	3	39	46	59	50
	Industry	12	6	16.5	0	2	0
Broilers & Layer hens	Discharge	0	3	10	0	0	0
	Fertilizer	100	36	60	100	18	0
	Biogas	0	2	0	0	4	0
	Industry	0	59	30	0	78	100

## Note

- 1 Li, G. 1999. Environmental Pollution Problems and Implementation of Environmental Standards in Chinese Large-scale Livestock and Poultry Industry. *The Proceeding of Sino-Canadian Seminar on Environmental and Soil Nutrient Management* (in Chinese).