

Supplementary Information

Application of Ostrom's social-ecological systems framework in nature reserves: Hybrid psycho-economic model of collective forest management

Xie et al.

Supplementary Table 1. Primary information of the sample nature reserves

	TNR	DNR	GPR
Creation year	1995	1985	1996
Year promoted as PNR	2001	2003	1999
Year promoted as NNR	2014	2005	—
Area (ha)	10,379.7	13,472.4	1509.32
Forest area (ha)	9797.9	12,967.5	1289.83
Collective forest (ha)	7488.1	12,166.4	1289.83
Conservation objects	• ever-green broad-leaf forest ecosystem	• largest and best-preserved <i>P. Taiwanese</i>	• unique forest ecosystem

Source: Authors collected from fieldwork survey

Supplementary Table 2. Questionnaire on collective forest management in national nature reserve

Part I. Regulations on collective forest management in nature reserves

Relevant provisions	Core area	Buffer	Test area
1. Should artificial arbor forests in collective forests can be harvested?	<input type="checkbox"/> Cannot be harvested <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be harvested <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be harvested <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____
2. Should bamboo forests in collective forests be felled?	<input type="checkbox"/> Cannot be felled <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be felled <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be felled <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____
3. Should the economic forest of collective forest be used as a resource?	<input type="checkbox"/> Cannot be used <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be used <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be used <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____
4. Should residential buildings be built?	<input type="checkbox"/> Cannot be built <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be built <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be built <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____
5. Should undergrowth be developed?	<input type="checkbox"/> Cannot be developed <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be developed <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be developed <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____
6. Should under forest farming be developed?	<input type="checkbox"/> Cannot be developed <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be developed <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be developed <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____
7. Should forest tourism be developed?	<input type="checkbox"/> Cannot be developed <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be developed <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____	<input type="checkbox"/> Cannot be developed <input type="checkbox"/> Yes, it does not need approval <input type="checkbox"/> Yes, it does need approval <input type="checkbox"/> Other: _____

Part II. Collective forest management conflicts in nature reserves

Relevant provisions	Core area	Buffer	Test area
8. Has there ever been a conflict that did not allow villagers to cut down plantations?	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____
9. Has there ever been a conflict that did not allow villagers to cut bamboo?	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____
10. Has there ever been a conflict that did not allow villagers to use economic forests?	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____
11. Has there ever been a conflict that did not allow villagers to build houses?	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____
12. Has there ever been a conflict that did not allow villagers to develop undergrowth?	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____
13. Has there ever been a conflict that did not allow villagers to develop under-forest farming?	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____

14. Has there ever been a conflict that did not allow villagers to develop forest tourism?	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, but not serious <input type="checkbox"/> Yes, moderate dispute <input type="checkbox"/> Yes, very serious dispute <input type="checkbox"/> Other: _____
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Part III. Community management and supporting measures of collective forests in nature reserves

Relevant provisions	Core area	Buffer	Test area
15. Should there be a strict degree of management of plantation and natural forests?	<input type="checkbox"/> Yes, same degree for both <input type="checkbox"/> Yes, but not excessive levels of management <input type="checkbox"/> No, management should not be strict <input type="checkbox"/> Different levels are needed for plantations and natural forests <input type="checkbox"/> Other: _____	<input type="checkbox"/> Yes, same degree for both <input type="checkbox"/> Yes, but not excessive levels of management <input type="checkbox"/> No, management should not be strict <input type="checkbox"/> Different levels are needed for plantations and natural forests <input type="checkbox"/> Other: _____	<input type="checkbox"/> Yes, same degree for both <input type="checkbox"/> Yes, but not excessive levels of management <input type="checkbox"/> No, management should not be strict <input type="checkbox"/> Different levels are needed for plantations and natural forests <input type="checkbox"/> Other: _____
16. Are villagers satisfied with the amount of ecological compensation provided to them?	<input type="checkbox"/> Dissatisfied <input type="checkbox"/> Satisfied <input type="checkbox"/> Unclear <input type="checkbox"/> Other: _____	<input type="checkbox"/> Dissatisfied <input type="checkbox"/> Satisfied <input type="checkbox"/> Unclear <input type="checkbox"/> Other: _____	<input type="checkbox"/> Dissatisfied <input type="checkbox"/> Satisfied <input type="checkbox"/> Unclear <input type="checkbox"/> Other: _____
17. Should there be a disbursement mode of ecological compensation amount?	<input type="checkbox"/> Distribution from local government to village committee <input type="checkbox"/> Distribution from local government to villagers <input type="checkbox"/> Distribution from protected areas to village committees <input type="checkbox"/> Distribution from protected areas to villagers <input type="checkbox"/> Other: _____	<input type="checkbox"/> Distribution from local government to village committee <input type="checkbox"/> Distribution from local government to villagers <input type="checkbox"/> Distribution from protected areas to village committees <input type="checkbox"/> Distribution from protected areas to villagers <input type="checkbox"/> Other: _____	<input type="checkbox"/> Distribution from local government to village committee <input type="checkbox"/> Distribution from local government to villagers <input type="checkbox"/> Distribution from protected areas to village committees <input type="checkbox"/> Distribution from protected areas to villagers <input type="checkbox"/> Other: _____
18. Do protected areas authority have funds other than ecological compensation for local village committees?	<input type="checkbox"/> No <input type="checkbox"/> Yes, central financed projects <input type="checkbox"/> Yes, provincial financial projects <input type="checkbox"/> Yes, Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, central financed projects <input type="checkbox"/> Yes, provincial financial projects <input type="checkbox"/> Yes, Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, central financed projects <input type="checkbox"/> Yes, provincial financial projects <input type="checkbox"/> Yes, Other: _____
19. Have you ever supported villagers to	<input type="checkbox"/> No <input type="checkbox"/> Yes, it works very well	<input type="checkbox"/> No <input type="checkbox"/> Yes, it works very well	<input type="checkbox"/> No <input type="checkbox"/> Yes, it works very well

carry out energy conservation and utilization projects such as firewood?	<input type="checkbox"/> Yes, the effect is general <input type="checkbox"/> Yes, the effect is not good <input type="checkbox"/> Other: _____	<input type="checkbox"/> Yes, the effect is general <input type="checkbox"/> Yes, the effect is not good <input type="checkbox"/> Other: _____	<input type="checkbox"/> Yes, the effect is general <input type="checkbox"/> Yes, the effect is not good <input type="checkbox"/> Other: _____
20. Should villagers have support in carrying out forest by-product business activities?	<input type="checkbox"/> No <input type="checkbox"/> Yes, central financed projects <input type="checkbox"/> Yes, provincial financial projects <input type="checkbox"/> Yes, Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, central financed projects <input type="checkbox"/> Yes, provincial financial projects <input type="checkbox"/> Yes, Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, central financed projects <input type="checkbox"/> Yes, provincial financial projects <input type="checkbox"/> Yes, Other: _____
21. Should villagers have support in carrying out forest ecotourism activities?	<input type="checkbox"/> No <input type="checkbox"/> Yes, central financed projects <input type="checkbox"/> Yes, provincial financial projects <input type="checkbox"/> Yes, Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, central financed projects <input type="checkbox"/> Yes, provincial financial projects <input type="checkbox"/> Yes, Other: _____	<input type="checkbox"/> No <input type="checkbox"/> Yes, central financed projects <input type="checkbox"/> Yes, provincial financial projects <input type="checkbox"/> Yes, Other: _____
22. What is the economic situation per capita annual income (yuan)?	<input type="checkbox"/> Less than 6000 <input type="checkbox"/> 6000–10,000 <input type="checkbox"/> 10,000–14,000 <input type="checkbox"/> 14,000–20,000 <input type="checkbox"/> More than 20,000	<input type="checkbox"/> Less than 6000 <input type="checkbox"/> 6000–10,000 <input type="checkbox"/> 10,000–14,000 <input type="checkbox"/> 14,000–20,000 <input type="checkbox"/> More than 20,000	<input type="checkbox"/> Less than 6000 <input type="checkbox"/> 6000–10,000 <input type="checkbox"/> 10,000–14,000 <input type="checkbox"/> 14,000–20,000 <input type="checkbox"/> More than 20,000

Part IV. Conflicts and threats to sustainable development of natural reserve areas

Types of conflict and threat	Core area	Buffer	Test area
23. Is there a lack of talent and ability in nature reserve management	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____
24. Is there a lack of technical and scientific research personnel and inadequate capacity in nature reserves?	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____
25. Is there a lack of science popularization and education talent and	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern

inadequate ability in nature reserves?	<input type="checkbox"/> Other: _____	<input type="checkbox"/> Other: _____	<input type="checkbox"/> Other: _____
26. Is there a lack of law enforcement capacity in nature reserves?	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____
27. Is there inadequate investment in nature reserves?	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____
28. Do villagers meet basic survival needs?	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____
29. Do villagers earn additional forms of income to develop their economy?	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____
30. Does the local government provide economic development incentives?	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____
31. Do national and other major construction projects pose a threat?	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____
32. Are backpackers, tourists, and other outsiders welcome?	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern <input type="checkbox"/> Other: _____
33. Is there a weak ability of nature reserves to support community	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern	<input type="checkbox"/> Serious problem <input type="checkbox"/> General concern <input type="checkbox"/> Not a serious concern

development?

☐ Other: _____

☐ Other: _____

☐ Other: _____

Part V. Evaluation of stakeholders and related work by the nature reserve authority

Stakeholder	Role of nature reserve in sustainable development		
34. Heads and secretaries of village committees in protected areas	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
35. Other members of village committees in protected areas	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
36. Villagers in protected areas	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
37. Village rules and regulations on the utilization of natural resources	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
38. Other family regulations and folk agreements of villagers	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
39. Local township (i.e., township) government	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
40. County (i.e., city) government	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
41. Government functional departments such as tourism	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,

	<input type="checkbox"/> Other: _____		
42. Institutions of higher learning and scientific research institutes carrying out scientific research projects in protected areas	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
43. Business institutions for tourism activities in protected areas	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
44. Protecting tourists in the zone	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
45. Non-governmental organizations developing section universal protection projects in protected areas	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,
46. Community co-management of nature reserves	<input type="checkbox"/> Positive effect, high <input type="checkbox"/> Negative effect, high low <input type="checkbox"/> Other: _____	<input type="checkbox"/> Positive effect, general <input type="checkbox"/> Negative effects, general	<input type="checkbox"/> Positive effect, low <input type="checkbox"/> Negative effect,

Part VI. Key management activities of the nature reserve authority

Management activities	2016	2017	2018
47. Are protected areas and communities working on forest fire prevention?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, what is the effect?	<input type="checkbox"/> Good effect <input type="checkbox"/> Bad <input type="checkbox"/> Generally, no <input type="checkbox"/> Not sure	<input type="checkbox"/> Good effect <input type="checkbox"/> Bad <input type="checkbox"/> Generally, no <input type="checkbox"/> Not sure	<input type="checkbox"/> Good effect <input type="checkbox"/> Bad <input type="checkbox"/> Generally, no <input type="checkbox"/> Not sure
48. Are anti-poaching activities carried out jointly by the reserve and the community?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, what is the effect?	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no

	<input type="checkbox"/> Bad <input type="checkbox"/> Not sure	<input type="checkbox"/> Bad <input type="checkbox"/> Not sure	<input type="checkbox"/> Bad <input type="checkbox"/> Not sure
49. Are protected areas and communities jointly carry out anti-theft and felling activities?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, what is the effect?	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no effect <input type="checkbox"/> Bad <input type="checkbox"/> Not sure	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no effect <input type="checkbox"/> Bad <input type="checkbox"/> Not sure	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no effect <input type="checkbox"/> Bad <input type="checkbox"/> Not sure
50. Should patrol work be carried out in nature reserves?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, what would be the effect?	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no effect <input type="checkbox"/> Bad <input type="checkbox"/> Not sure	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no effect <input type="checkbox"/> Bad <input type="checkbox"/> Not sure	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no effect <input type="checkbox"/> Bad <input type="checkbox"/> Not sure
If so, how often?	<input type="checkbox"/> Numerous times per month <input type="checkbox"/> Once a month <input type="checkbox"/> Once every three months <input type="checkbox"/> Other: _____	<input type="checkbox"/> Numerous times per month <input type="checkbox"/> Once a month <input type="checkbox"/> Once every three months <input type="checkbox"/> Other: _____	<input type="checkbox"/> Numerous times per month <input type="checkbox"/> Once a month <input type="checkbox"/> Once every three months <input type="checkbox"/> Other: _____
51. Should nature reserves be monitored?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, what is the effect?	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no effect <input type="checkbox"/> Bad <input type="checkbox"/> Not sure	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no effect <input type="checkbox"/> Bad <input type="checkbox"/> Not sure	<input type="checkbox"/> Good effect <input type="checkbox"/> Generally, no effect <input type="checkbox"/> Bad <input type="checkbox"/> Not sure
If so, what is the effect?	<input type="checkbox"/> Numerous times per month <input type="checkbox"/> Once a month <input type="checkbox"/> Once every three months <input type="checkbox"/> Other: _____	<input type="checkbox"/> Numerous times per month <input type="checkbox"/> Once a month <input type="checkbox"/> Once every three months <input type="checkbox"/> Other: _____	<input type="checkbox"/> Numerous times per month <input type="checkbox"/> Once a month <input type="checkbox"/> Once every three months <input type="checkbox"/> Other: _____
52. Are poaching incidents punished in protected areas?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, detention cases	Total number:	Total number:	Total number:
If so, sentencing cases	Total number:	Total number:	Total number:
53. Is stealing and cutting incidents penalized within protected areas?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, detention cases	Total number:	Total number:	Total number:
If so, sentencing cases	Total number:	Total number:	Total number:
54. Is occupation of woodland a penalty in protected areas?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, detention cases	Total number:	Total number:	Total number:

If so, sentencing cases	Total number:	Total number:	Total number:
55. Is discharging of pollution punishable within protected areas?	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Yes <input type="checkbox"/> No
If so, detention cases	Total number:	Total number:	Total number:
If so, sentencing cases	Total number:	Total number:	Total number:

Supplementary Data 1. Questionnaire on management and utilization of national nature reserve and surrounding communities and collective forests

I. Basic information of nature reserves

- (1) Name:
- (2) Founding year:
Time of promotion to national nature reserve (year):
- (3) Area (hectare)
Classification I (Zoning):
Classification II (Land type):
Classification III (Ownership):
- (4) Protected objects:
- (5) Should national nature reserves allow access to protected areas? ☐ Yes ☐ No
- (6) Are there human and biosphere reserves? ☐ Yes ☐ No
- (7) What are the relations between protected areas and surrounding communities? ☐ Good ☐ Generally, no concerns ☐ Bad
- (8) What is the relationship between protected areas and local government (i.e., county and municipal level)? ☐ Good ☐ Generally, no concerns ☐ Bad
- (9) What is the government level of the protected area authority? ☐ Rank of section chief ☐ Deputy department director ☐ Section chief ☐ Other
- (10) Number of all staff members of the Bureau of Protected Areas (i.e., persons)
Classification I (preparation): formal____ informal____
Classification II (post): administration____ technology____ Other____
Classification III (education): graduate student____ Undergraduate____ Junior college and high school____ Other____
Classification IV (number of people specializing in community work):____
- (11) Number of vehicles of the protected area authority (i.e., vehicles):

II. Basic information of the area and community where the nature reserve is located

- (1) Names of the counties and cities in which they are located (listed together):____
- (2) Name of the town concerned:
- (3) Number of administrative villages involved (individual):
Classification: All in protected areas:
Economic situation (in the county where the reserve is located): ☐ Good ☐ Generally, no concerns ☐ Bad
Part in nature reserves:____
Economic situation (ibid.): ☐ Good ☐ Generally, no concerns ☐ Bad
Contiguous only to protected areas:____
Economic situation (ibid.): ☐ Good ☐ Generally, no concerns ☐ Bad

- (4) Total population:____
 Classification: protected area:____ Community bordering the reserve:____
- (5) Farthest distance from the village committee in the district to the county center (km):____
 Road conditions: ☐ Good ☐ Generally, no concerns ☐ Bad
 Nearest distance from the village committee to the County Center (km):____
 Road conditions: ☐ Good ☐ Generally, no concerns ☐ Bad
- (6) Sources of village income (the three most important ones):
☐ Manual work ☐ Agricultural breeding ☐ Forestry planting and raising industry ☐ Having another business ☐ Other
 Income sources of surrounding villagers (the most important three):
☐ Manual work ☐ Agricultural breeding ☐ Forestry planting and raising industry ☐ Having another business ☐ Other
- (7) Dependence of villages in the protection zone on resources (i.e., High = 50% of total income, General = 20% to 40%, Low = less than 20%)
 Dependence on wood resources: ☐ High ☐ General ☐ Low
 Dependence on bamboo resources: ☐ High ☐ General ☐ Low
 Dependence on wild medicinal resources: ☐ High ☐ General ☐ Low
 Dependence on wild vegetable and fungus resources: ☐ High ☐ General ☐ Low
 Dependence on flower resources: ☐ High ☐ General ☐ Low
 Dependence on tea resources: ☐ High ☐ General ☐ Low
 Dependence on honey resources: ☐ High ☐ General ☐ Low
 Dependence on other resources: ☐ High ☐ General ☐ Low
- (8) Dependence of villages around the protection zone on resources (i.e., High = 50% of total income, General = 20% to 40%, Low = less than 20%)
 Dependence on wood resources: ☐ High ☐ General ☐ Low
 Dependence on bamboo resources: ☐ High ☐ General ☐ Low
 Dependence on wild medicinal resources: ☐ High ☐ General ☐ Low
 Dependence on wild vegetable and fungus resources: ☐ High ☐ General ☐ Low
 Dependence on flower resources: ☐ High ☐ General ☐ Low
 Dependence on tea resources: ☐ High ☐ General ☐ Low
 Dependence on honey resources: ☐ High ☐ General ☐ Low
 Dependence on other resources: ☐ High ☐ General ☐ Low
- (9) Main energy sources for cooking in villages in the reserve: ☐ Firewood ☐ Electric ☐ Energy ☐ Other
 Main energy sources of stir-fried vegetables in villages in protected areas are as follows: ☐ Firewood ☐ Electric ☐ Energy ☐ Other
 Most important energy source for cooking in the villages around the reserve: ☐ Firewood ☐ Electric ☐ Energy ☐ Other
 Main energy sources of stir-fried vegetables in villages around the reserve are as follows: ☐ Firewood ☐ Electric ☐ Energy ☐ Other
- (10) Are there many illiterate villages in the reserve? ☐ Many ☐ Moderate ☐ Not high
- (11) Are there many illiterate villages around the reserve? ☐ Many ☐ Moderate ☐ Not high

- (12) What is the forestry management capability of villagers in protected areas? ☐ Good ☐ Moderate ☐ Bad
 What is the forestry management ability of villagers around protected areas? ☐ Good ☐ Moderate ☐ Bad
- (13) What is the forestry technical capabilities of villagers in the protected area? ☐ Good ☐ Moderate ☐ Bad
 What is the forestry technical ability of villagers around the protected area? ☐ Good ☐ Moderate ☐ Bad
- (14) What is the proportion of unmarried villagers of age in the protected area? ☐ Many ☐ Moderate ☐ Not high
 What is the proportion of unmarried villagers around the protection zone? ☐ Many ☐ Moderate ☐ Not high
- (15) What is the ability of responsible persons of village committees in protected areas? ☐ High ☐ Moderate ☐ Low
 What is the ability to be in charge of village committees around the protected area? ☐ High ☐ Moderate ☐ Low
- (16) Are there specialized farmer cooperatives in the villages within the protected areas? ☐ Yes ☐ No ☐ Not sure
- (17) Are there farmer professional cooperatives in the villages around the protection zone? ☐ Yes ☐ No ☐ Not sure

III. Basic information of collective forests and their management in nature reserves

- (1) What is the Area of collective forest in the nature reserves (hectares):____
 Classification I: plantation area____ bamboo forest____ arbor forest____ bush____
 Classification 2: economic forest area____ fruit tree____ tea plant____ tea tree____
 Classification III: core area____ buffer area____ test area____
 Classification IV: area of national public welfare forests____ (and compensation standard)____
 area of local public welfare forest____ (and compensation standard)____
- (2) What is the collective forest quality in the protected area (compared with other collective forest quality in the community)? ☐ High ☐ Moderate ☐ Low
- (3) What is the economic value of collective forests in protected areas? ☐ High ☐ Moderate ☐ Low
- (4) What is the proportion of collective forests in protected areas to collective forests owned by villagers? ☐ High ☐ Moderate ☐ Low
- (5) Should collective forests in protected areas have participated in a new round of collective forest right system reform? ☐ Yes ☐ No ☐ Not sure
- (6) Should collective forest in the protected area have signed the entrusted management agreement? ☐ Yes ☐ No ☐ Not sure
 If so, should villagers approve the entrustment agreement? ☐ Yes ☐ No ☐ Not sure
- (7) Should the boundary between collective forests in the area and state-owned forests and other state-owned lands is clear? ☐ Yes ☐ No ☐ Not sure
- (8) Should the boundary between the nature reserve and the surrounding village land (including woodland) is clear? ☐ Yes ☐ No ☐ Not sure
- (9) Should villagers have the right to use collective forests in the protected areas? ☐ No ☐ Yes, fully ☐ Yes, partially ☐ Not sure

IV. Community Co-management in Nature Reserves

- (1) What is the relationship between protected areas and surrounding villages: ☐ Good ☐ Moderate ☐ Bad
- (2) Do villagers understand the nature reserve rules and regulations? ☐ No ☐ Yes, fully ☐ Yes, partially ☐ Not sure
- (3) Should villagers participate in the management of nature reserves? ☐ No ☐ Yes, fully ☐ Yes, partially ☐ Not sure
- (4) Should villagers be willing to participate in the management of nature reserves? ☐ No ☐ Yes, fully ☐ Yes, partially ☐ Not sure

- (5) Should villagers be given the opportunity to participate in the management of nature reserves? ☐ No ☐ Yes, fully ☐ Yes, partially ☐ Not sure
- (6) Have alternative livelihood activities from nature reserves supported local communities? ☐ No ☐ Yes, fully ☐ Yes, partially ☐ Not sure
- (7) When did the community co-management activities start? _____
 Is it still under way? No _____ Yes, not activity content _____
- (8) Should there be a cooperative committee, (if so how active should it be)? ☐ No ☐ Yes, very active ☐ Yes, moderately active ☐ Yes, not very active
- (9) Should there be a resource co-management plan? ☐ Yes ☐ No

V. Events of the nature reserve in the past ten years (Noted at the end of the questionnaire)

- (1) Main scientific research cooperation projects and units?
 Project: National positioning and observation of red soil hilly ecosystem in Changting, Fujian Province
 Cooperation unit: Fujian Agriculture and Forestry University
 Project: scientific investigation of Tingjiangyuan National Nature Reserve in Fujian Province
 Partner: Xiamen University
- (2) Protection organizations (international and domestic) and cooperation contents
- (3) Major events concerning management institutions of protected areas (expansion, institutional reform, etc.)
- (4) Adjustment of functional zoning of protected areas (expansion and reduction, etc.)
- (5) Community management in protected areas (report on community co-management work, major contradictions and conflicts with the community at present)
- (6) Sources of investment in protected areas
- (7) Other Important Issues Restricting the Sustainable Development of Protected Areas