The Impacts of Eco-compensation on the Farmers' Production Behavior at the Hani Rice Terraces in China

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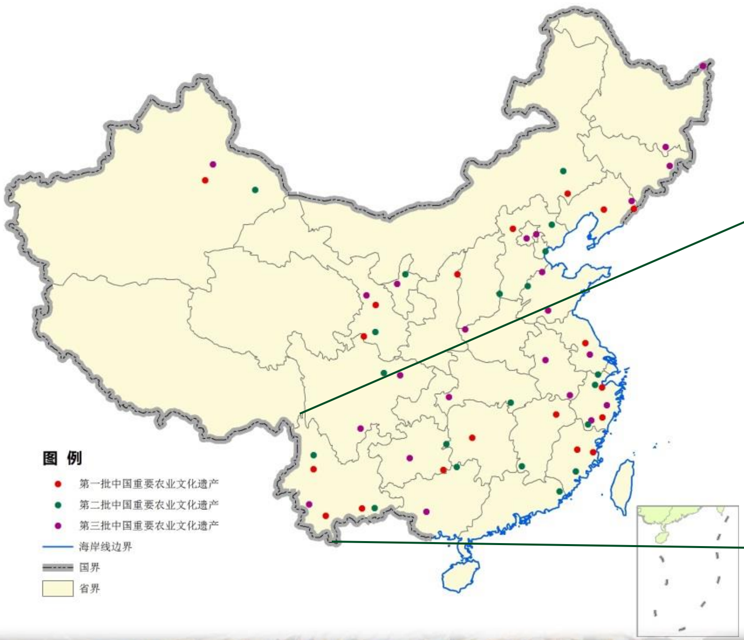
Farmers' production behavior

- Eco-compensation mechanism targeting non-point pollution, can improve the environmental quality of farmland. However, the effect depends on how well the farmers accept, respond to and implement the policies.
- We built a multi-objective production decision-making model to study the impact of eco-compensation standards on the farmers' production behavior and welfare.

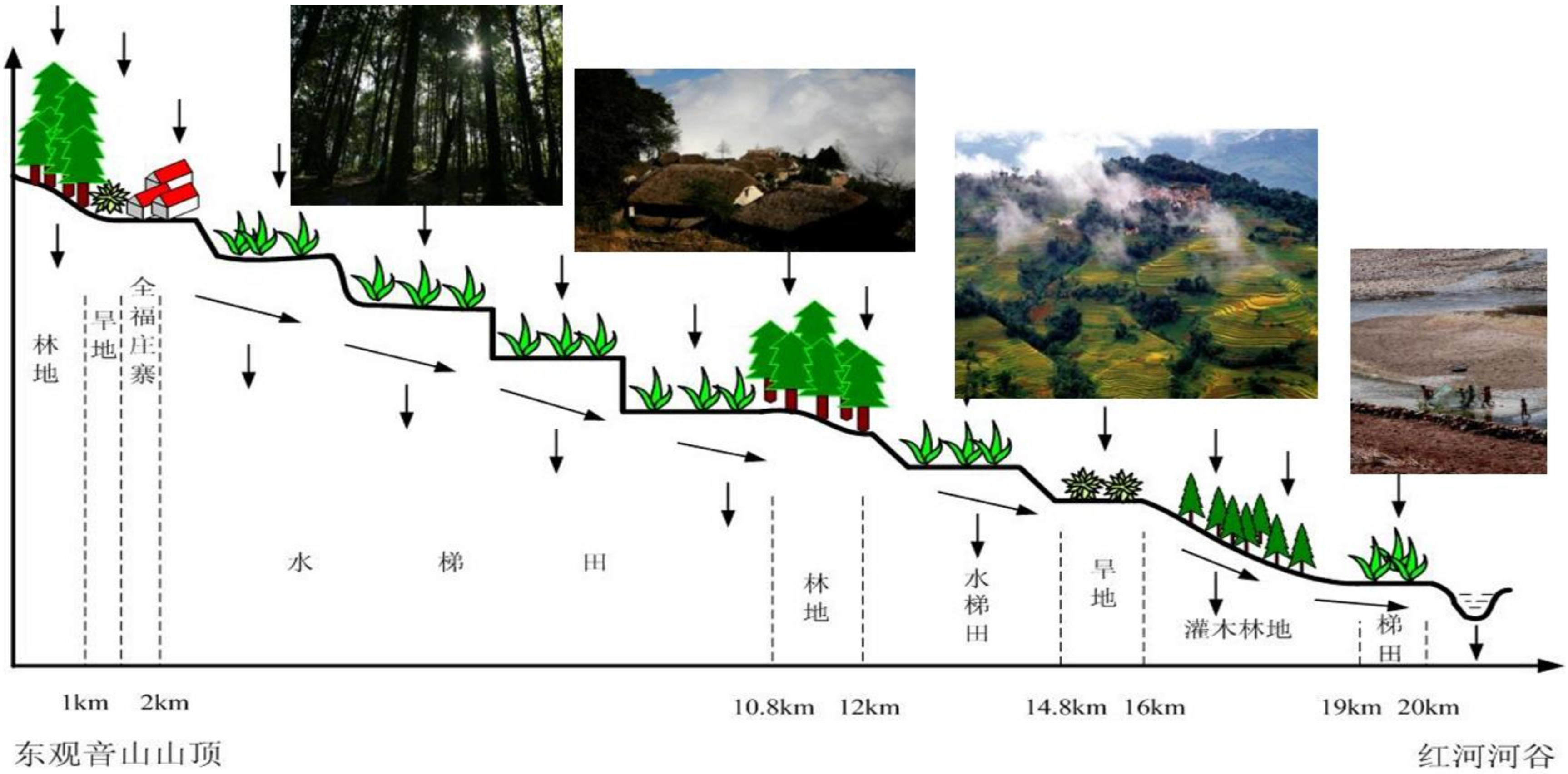
Content

- The study areas
- The methodology
- The analysis
- The conclusion

Hani Rice Terraces（2010. 6）



Rice terraces



Eco-compensation——rice price

- Lower comparative effectiveness of traditional cultivation methods
  - Land has been increasingly abandoned.
  - Pesticide, fertilizer and other chemical usage has increased.
- Eco-compensation
  - Compensation price is 5.68 yuan/kg.

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1. Multi-Objective Production Decision-Making Model

- Predict the farmers' decisions
  - Set utility functions and constraints
  - Simulate the optimal decision-making process
  - Analyze the policies' impacts on farmers' decision

Decision variables

- Plant area
  - paddy, maize, intercropped soybean
- Input
  - labor
  - capital input
    - expenditure on chemicals (fertilizers, herbicides, pesticides, etc.)
    - other capital goods (seeds and farming tools, etc.)

Utility function

- Maximizing profit

$$f_1 = \sum_i a_i [py_i(y_i(\bar{x}_i) - s_i) - \sum_j px_j x_{ij} + E_0 \frac{x^0_{ij,j=chemcap} - x_{ij,j=chemcap}}{x^0_{ij,j=chemcap}}]$$

- Minimizing risks

$$f_2 = -\sum_i \sum_{i'} z_{ii'} a_i a_{i'}$$

- Maximizing the amount of grain retained

$$f_3 = \sum_i a_i s_i$$

- Multi-objective utility function

$$U = \frac{w_1 f_1(\cdot)}{f_1^{0bs}} + \frac{w_2 f_2(\cdot)}{f_2^{0bs}} + \frac{w_3 f_3(\cdot)}{f_3^{0bs}}$$

3. Grouping of farmers

- Farmers are divided into two groups according to the altitude of their farmland.
    - Group A: 107 households at higher altitudes;
    - Group B: 136 households at lower altitudes.
- We simulated the production decisions and income of the farmers in different groups under different eco-compensation standards. The results are then aggregated to obtain the overall result.

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1. Current situation of agriculture

Crop structure

- Planting areas of all crops of Higher Altitude Group are higher than that of Lower Altitude Group.
- The total planting area was 6.7 mu per household for Group A and 4 mu per household for Group B

	Group A	**Group B**
Paddy	3.5	2.4
Maize	1.8	0.7
Intercropped	1.3	1.1
合计	**6.7**	**4.1**

1. Current situation of agriculture

Input and yield

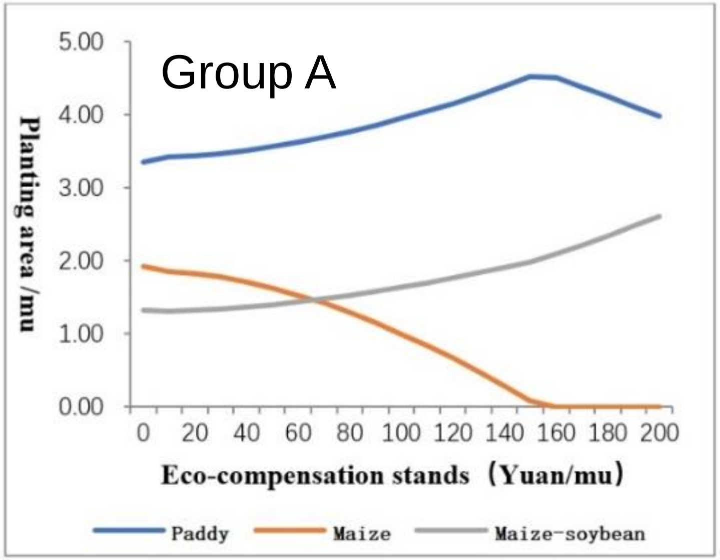
	Yield		Labor input		Chem-input		Other input	
	A	B	A	B	A	B	A	B
Paddy	678.0	851.1	21.6	19.8	146.1	203.5	135.2	139.1
Maize	524.2	576.8	9.3	8.2	127.0	147.2	74.8	81.1
Inter-soybean	133.4	159.7	4.0	3.4	33.5	45.8	42.0	53.0
Inter-maize	508.2	551.7	8.5	7.5	112.6	128.7	70.1	75.9

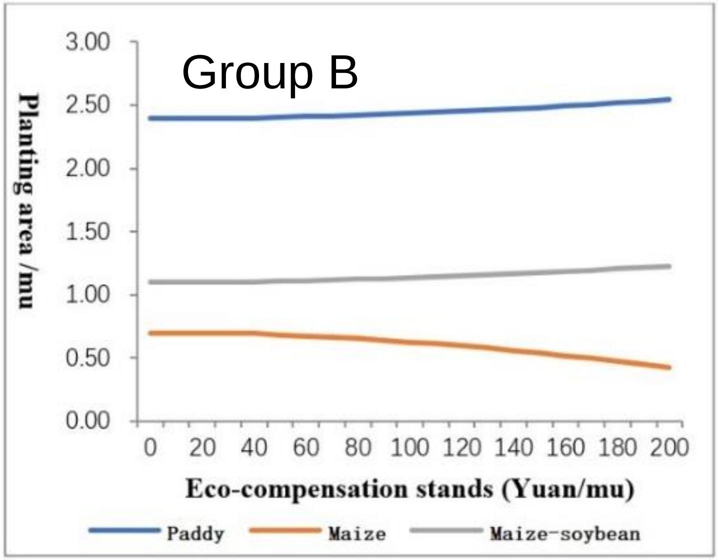
1. Current situation of agriculture

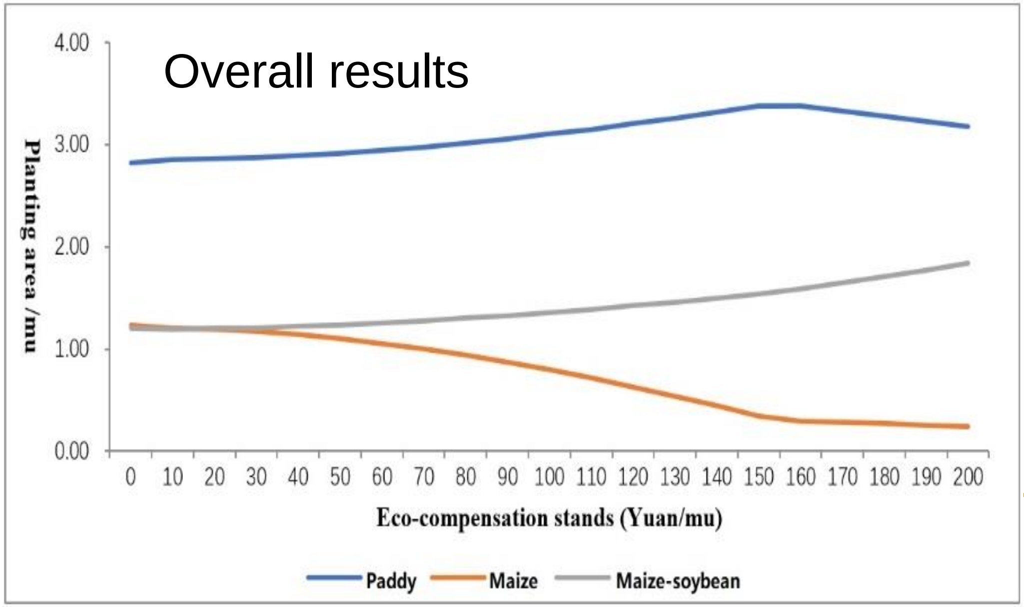
Amount of grain retained by the farmers

	Group A Kg/mu	Group B Kg/mu
Paddy	267.1	72.5
Maize	109.9	148.3
Inter-soybean	73.6	28.4
Inter-maize	181.2	157.1

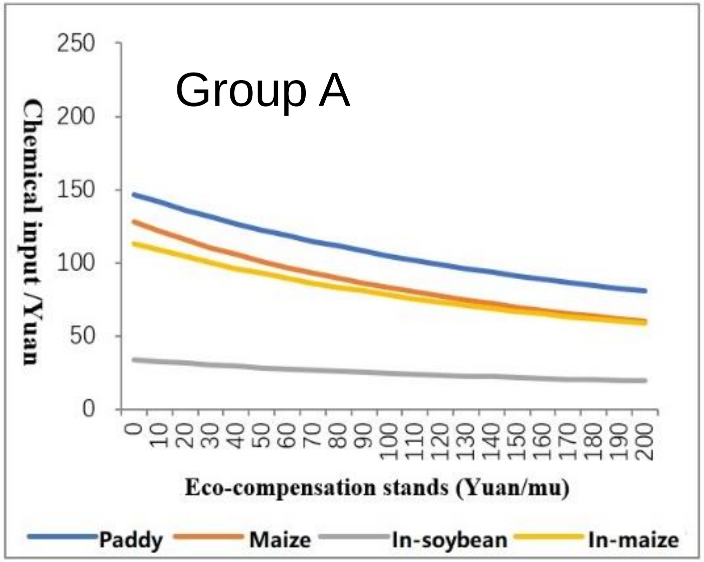
2. Impact of Eco-compensation on crop structure

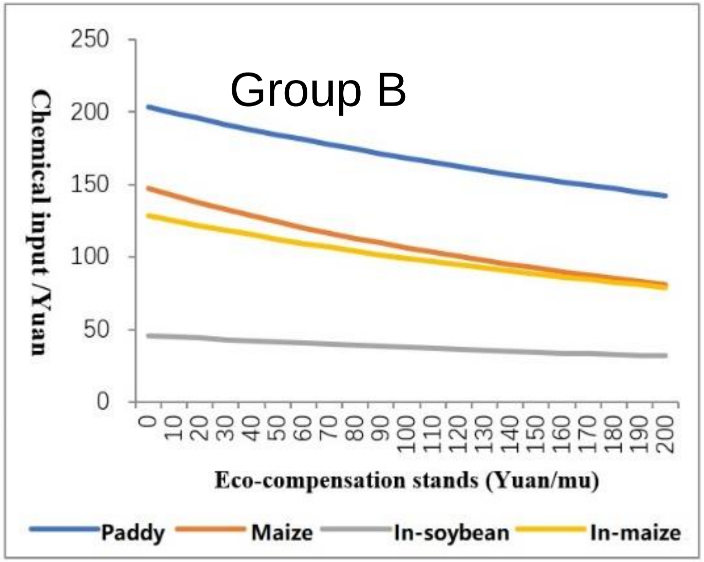


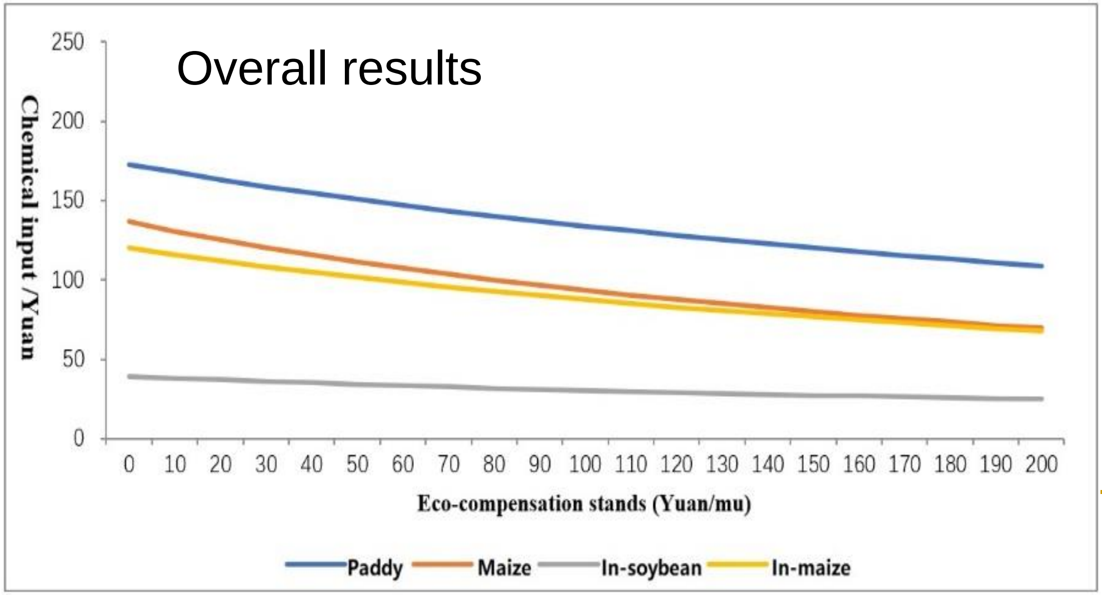




3. Impact of Eco-compensation on chemical use



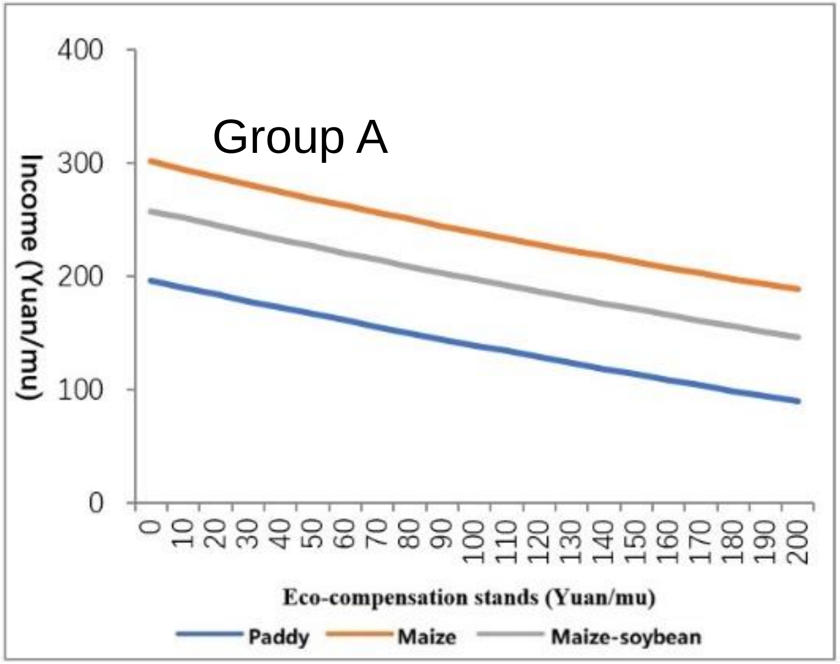


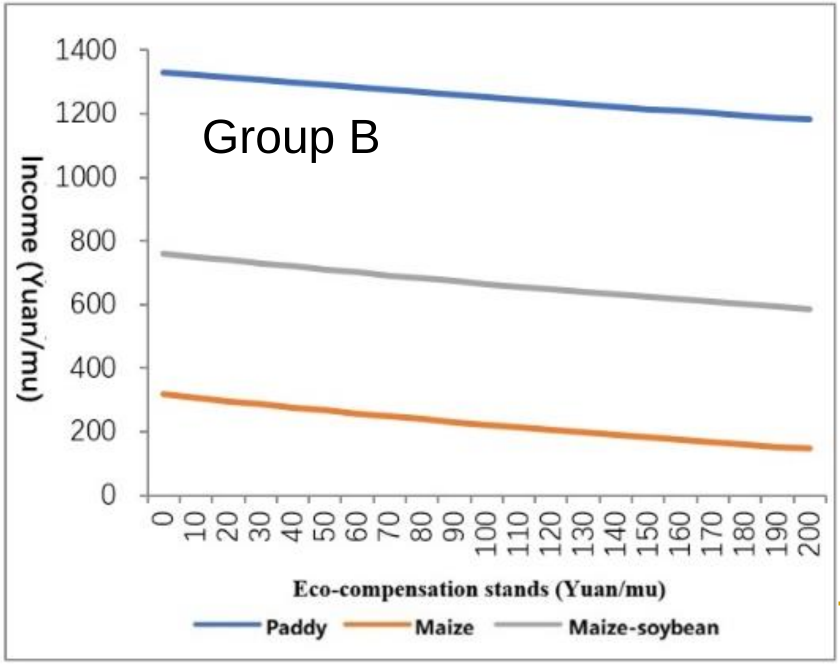


3. Impact of Eco-compensation on income

Planting Income

- Eco-compensation has negative impact on both unit yield and planting income, as it reduces fertilizers and pesticides.

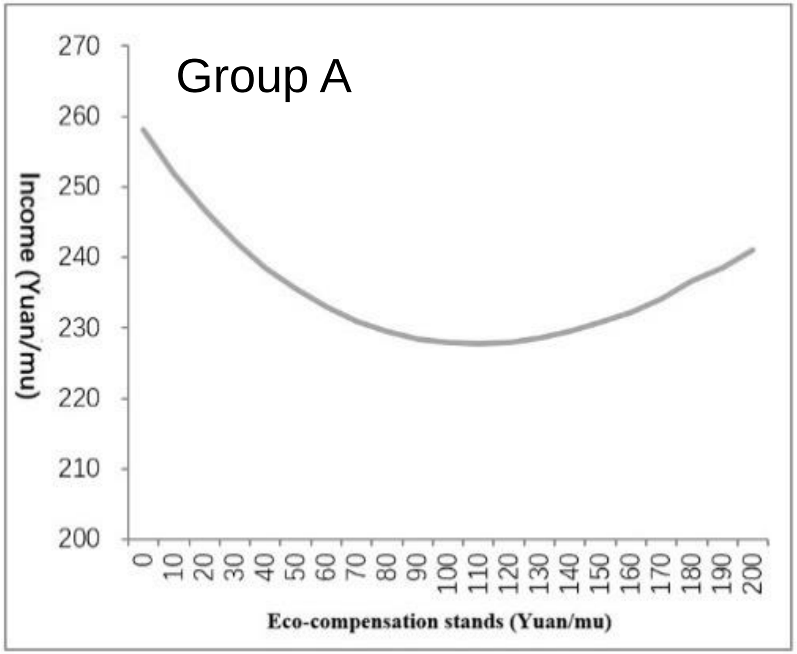


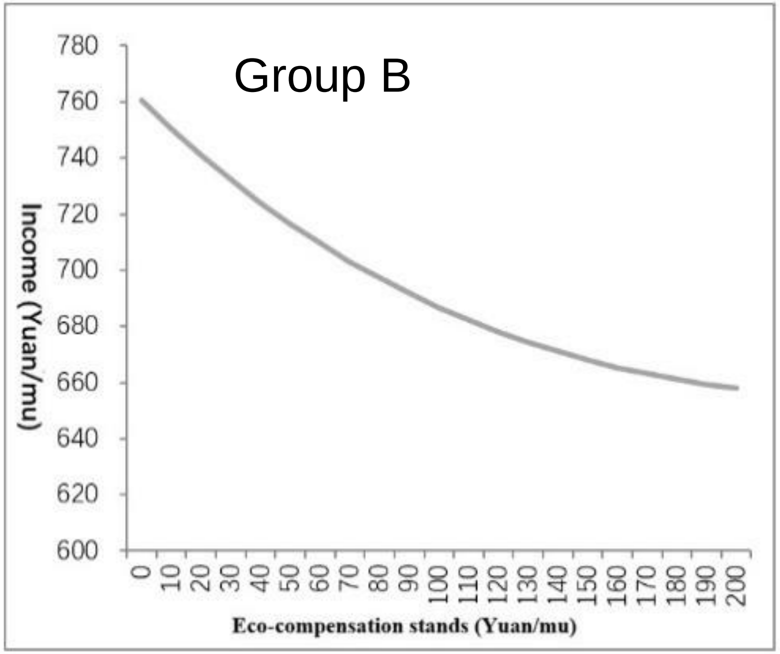


3. Impact of Eco-compensation on income

Total Income

- Eco-compensation affects farming decisions (crop structure, use of chemicals), thus the planting income. This together with the eco-compensation change the farmers' overall income





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Conclusion

- The addition income brought by the eco-compensation policies encourages the farmers even though the policy aimed to reduce chemicals. In pursuit of economic gains, the famers increase labor input and prefer the crop structure with more complicated management but higher yield.
- Whether the eco-compensation can reduce chemicals depends on whether it exceeds the loss caused by the reduction. As it goes up, the use of chemicals becomes less sensitive to it at a fast pace.

Conclusion

- The eco-compensation changes the farmers' planting decisions and thus their planting income. Besides this, the eco-compensation itself also impacts the farmers' total income.
  - The total income of Group A decreases before it increases as the eco-compensation becomes higher. The inflection point is RMB110/mu, which means after this point, the eco-compensation can not only reduce chemicals, but only increase the farmers' total income.
  - For lower altitudes, the reduction of fertilizers and pesticides has significant impact on the farmers' total income.

Thank you for your attention!

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