



Application of BeiDou in Precision Agriculture

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1、 Demand analysis

- Agricultural development is facing severe problems such as high cost, low efficiency and high pollution. It is an inevitable choice to realize cost saving and efficiency increase, energy conservation and environmental protection.
- BeiDou can provide high-precision spatial & temporal navigation information, to provide important technical support for precision agriculture, and to help solve the problems of agricultural development.



Tillage



Seeding and fertilizing



Plant protection



Harvesting

2、 Typical applications

- BeiDou has been applied and popularized on a large scale in the field of agriculture, which has greatly promoted the upgrading of agricultural machinery and the process of agricultural modernization.



1. Auto-steering



2. Precise operation



3. maintenance

(1) Auto-steering of agricultural machinery

- Requirements

- Mechanical harvesting requires improving the accuracy between adjacent rows
- Fertilizer application requires reducing overlap and skipping
- It is necessary to improve land use and reduce labor cost



Harvesting requirement: $\pm 7\text{cm}$

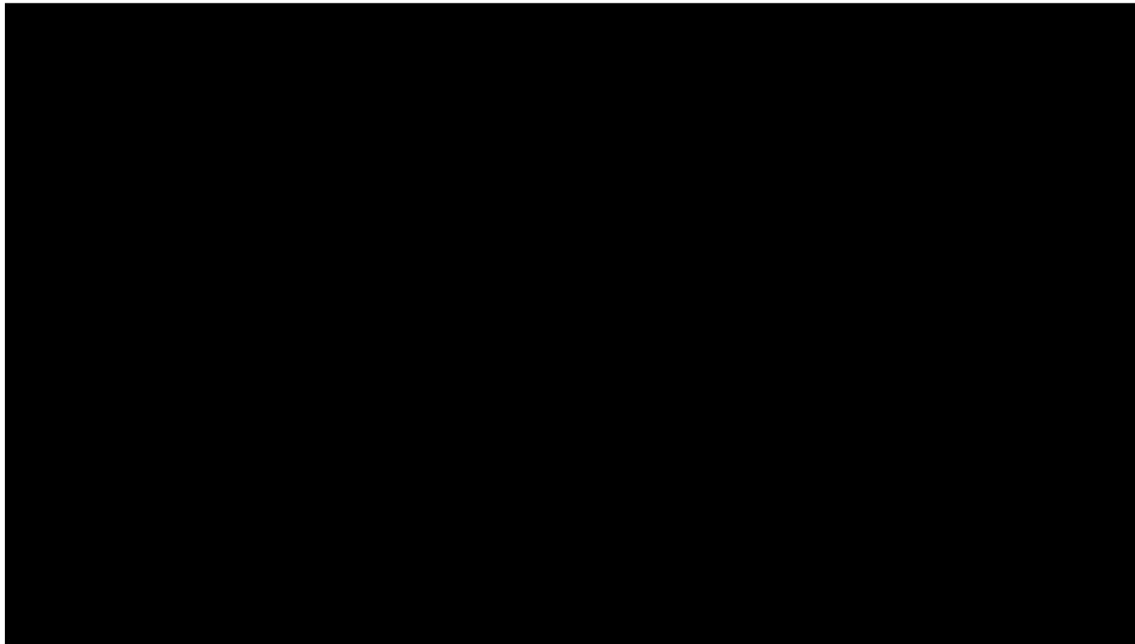


Manual driving: $\pm 10\text{cm}$



Fertilizing: reducing overlap & missing

(1) Auto-steering of agricultural machinery



Composition of auto-steering system

(1) Auto-steering of agricultural machinery

It can ensure the accuracy of ridging, seeding, spraying and harvesting, improve the land utilization, reduce the overlap or skipping of fertilizer and chemical application, prolong the operation time and reduce the labor intensity of drivers.



Guidance with manual control: $\pm 10\text{cm}$

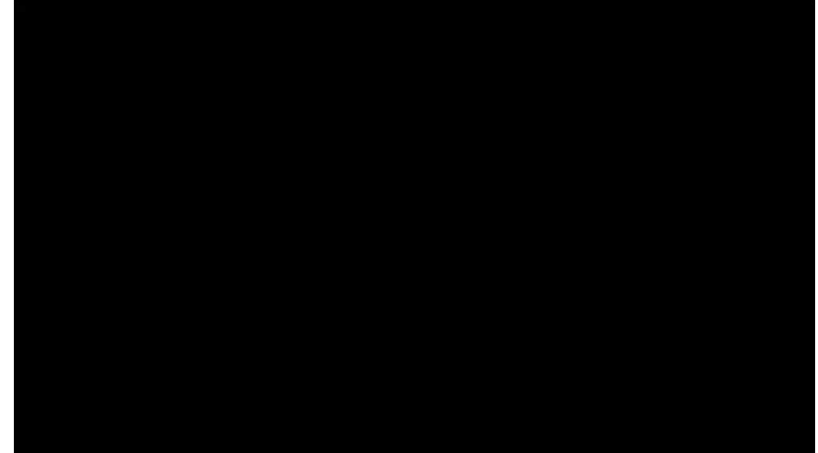
Unable to meet the operation requirements of cotton picking



Guidance with auto control: $\pm 2.5\text{cm}$

4 times the precision of manual driving and fully meets the requirements of cotton picking

(1) Auto-steering of agricultural machinery



The BeiDou based auto-steering technology is the first precision agriculture technology to be applied and popularized on a large scale in China.

(1) Auto-steering of agricultural machinery



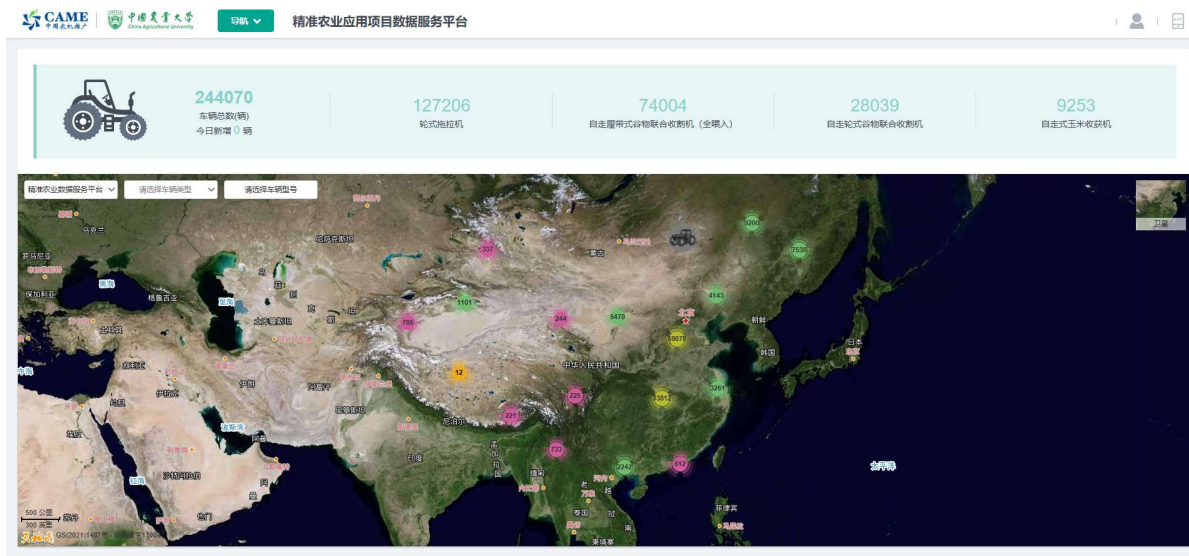
(2) Precision operation of agricultural machinery

Based on the high-precision position of BeiDou, the precision operation (variable-rate seeding, variable-rate fertilization, variable-rate pesticide application and precision harvesting) is realized.



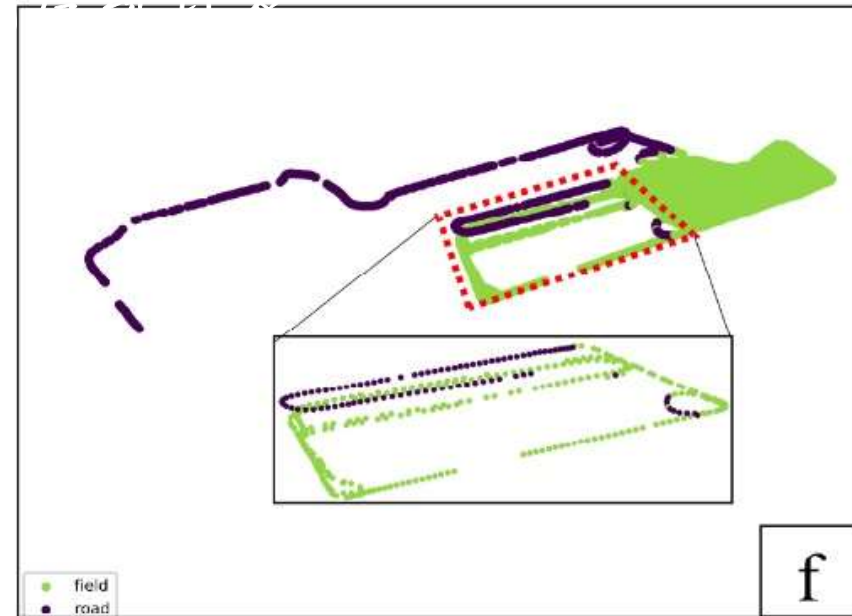
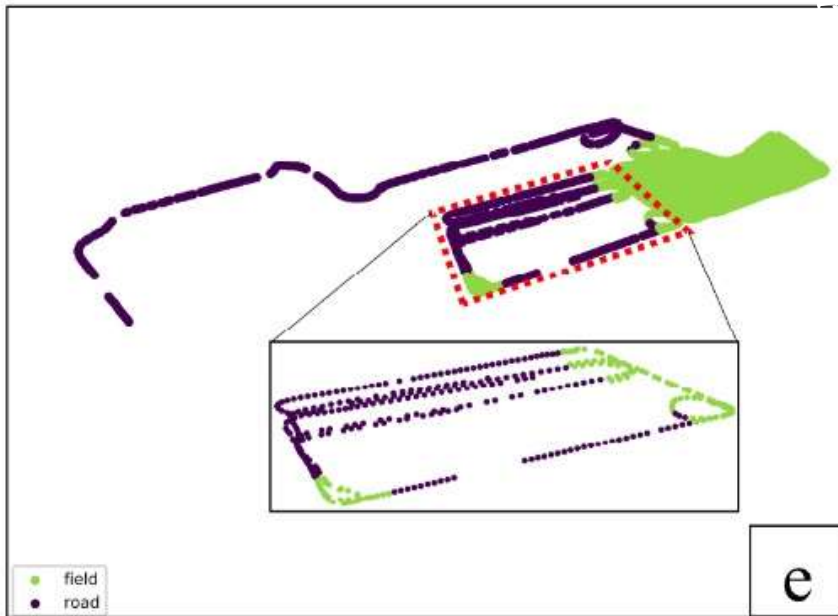
(3) Agricultural machinery management

China Agricultural University has accessed 290,000 BeiDou terminal from various enterprises to form big data for agricultural machinery operation. In the summer of 2021, 27 issues of “*Wheat Harvesting Newsletter*” were produced and released in combination with wheat harvesting.

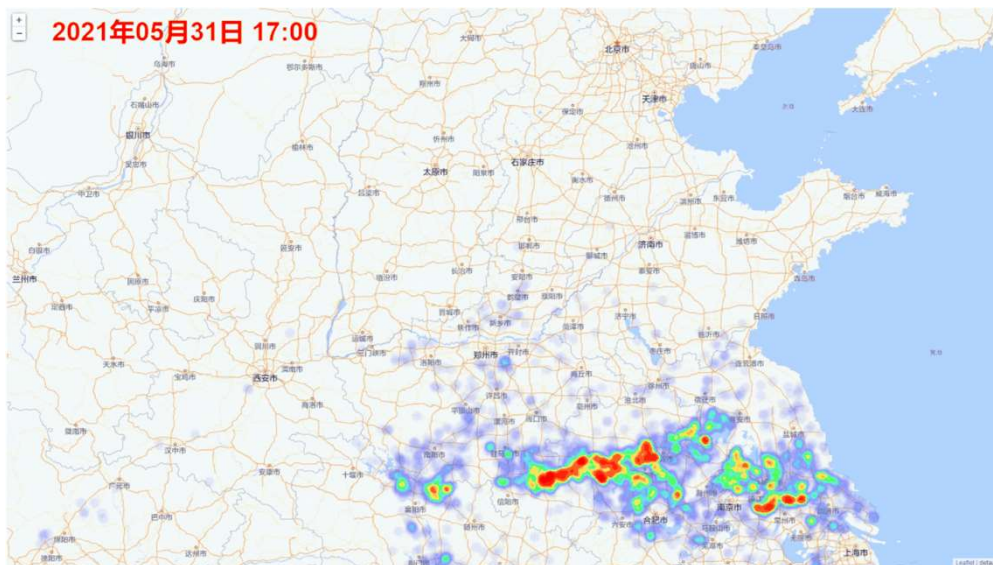


Field-road trajectory segmentation based on direction distribution

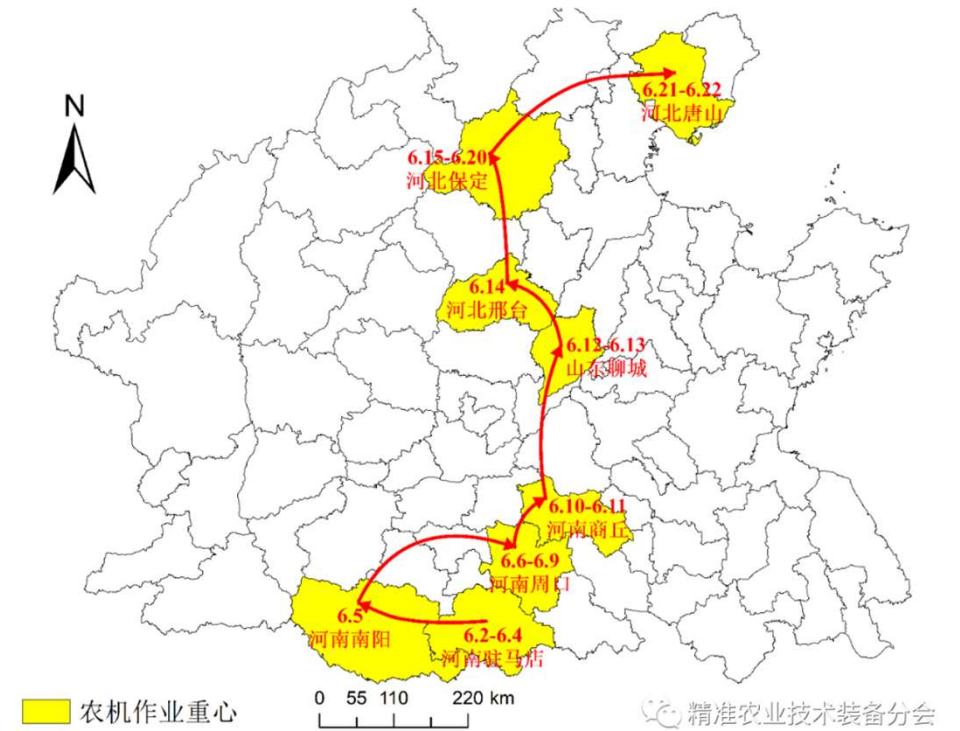
	点			时间			距离		
	Precision	Recall	F1-score	Precision	Recall	F1-score	Precision	Recall	F1-score
Field	97.38	98.99	97.82	95.13	97.81	95.83	97.46	98.42	97.65
Road	96.78	93.01	94.45	96.68	93.47	94.75	97.45	96.56	96.90
Avg.	97.16	96.03	96.20	96.06	95.71	95.43	97.54	97.54	97.35



Operation statistics

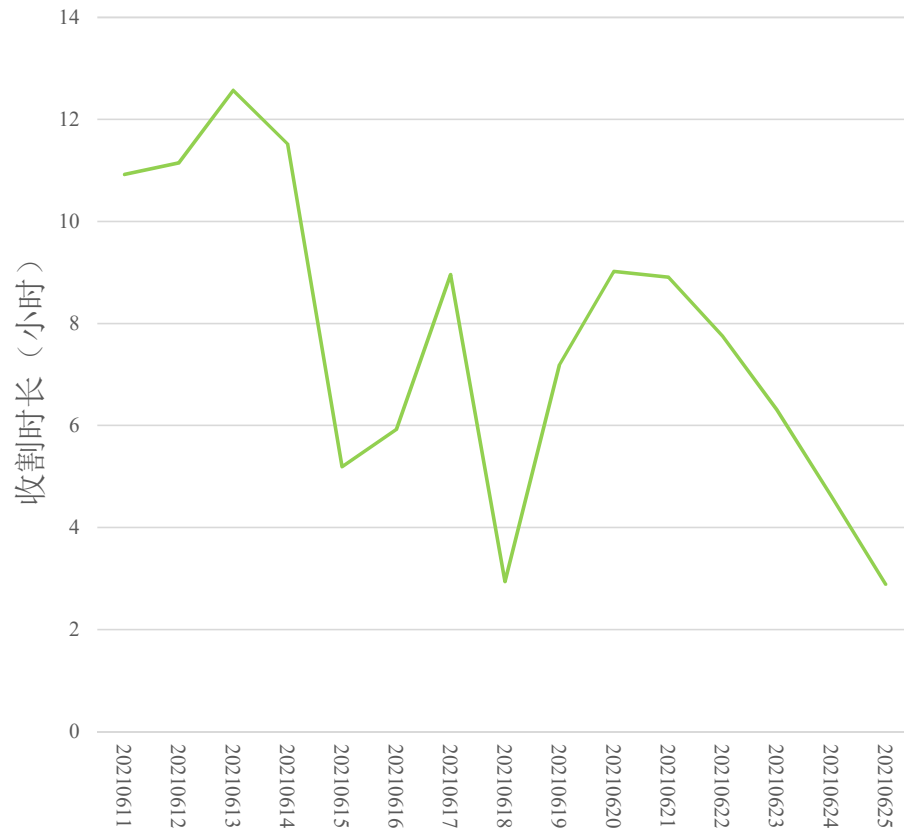


Hot map

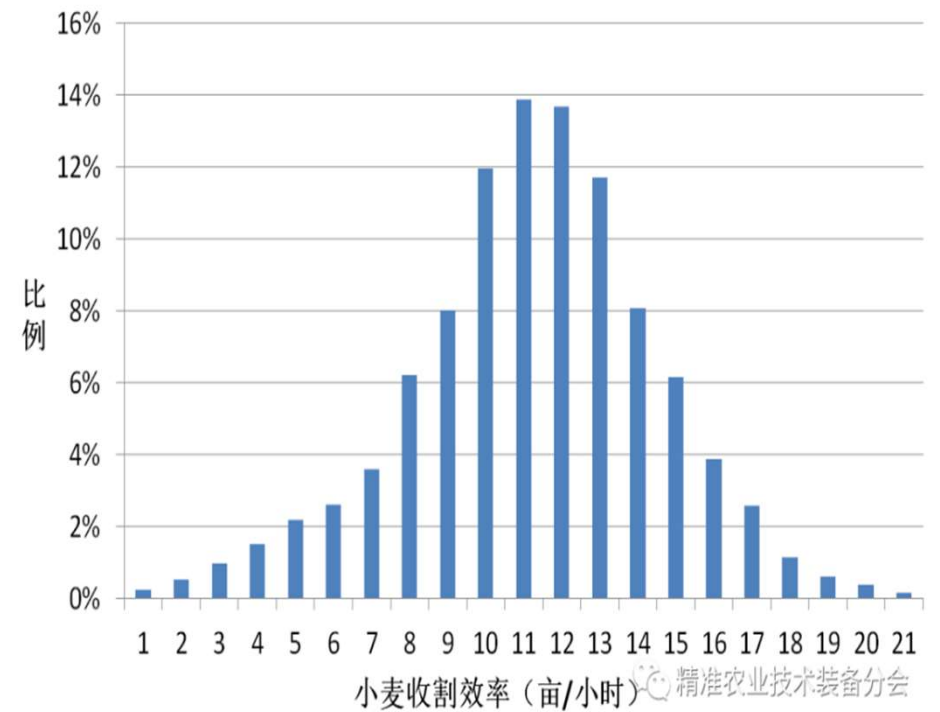


Operation center of gravity

Operation statistics



- Median of harvesting time



- Median of harvest area per day

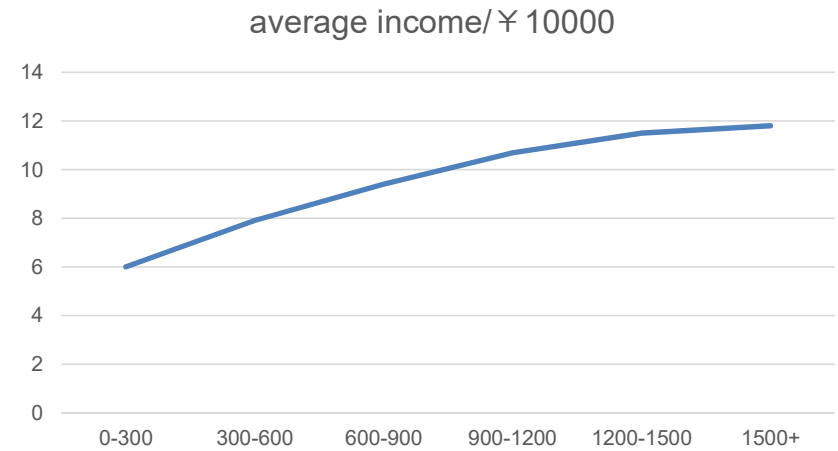
Distance-area-income



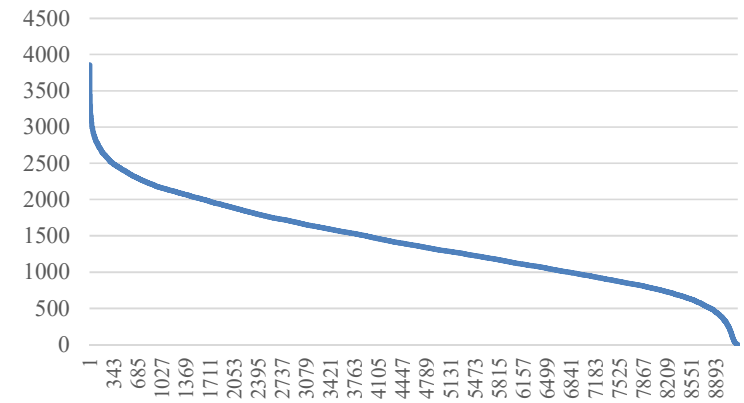
- Trajectory of cross-region harvesting champion



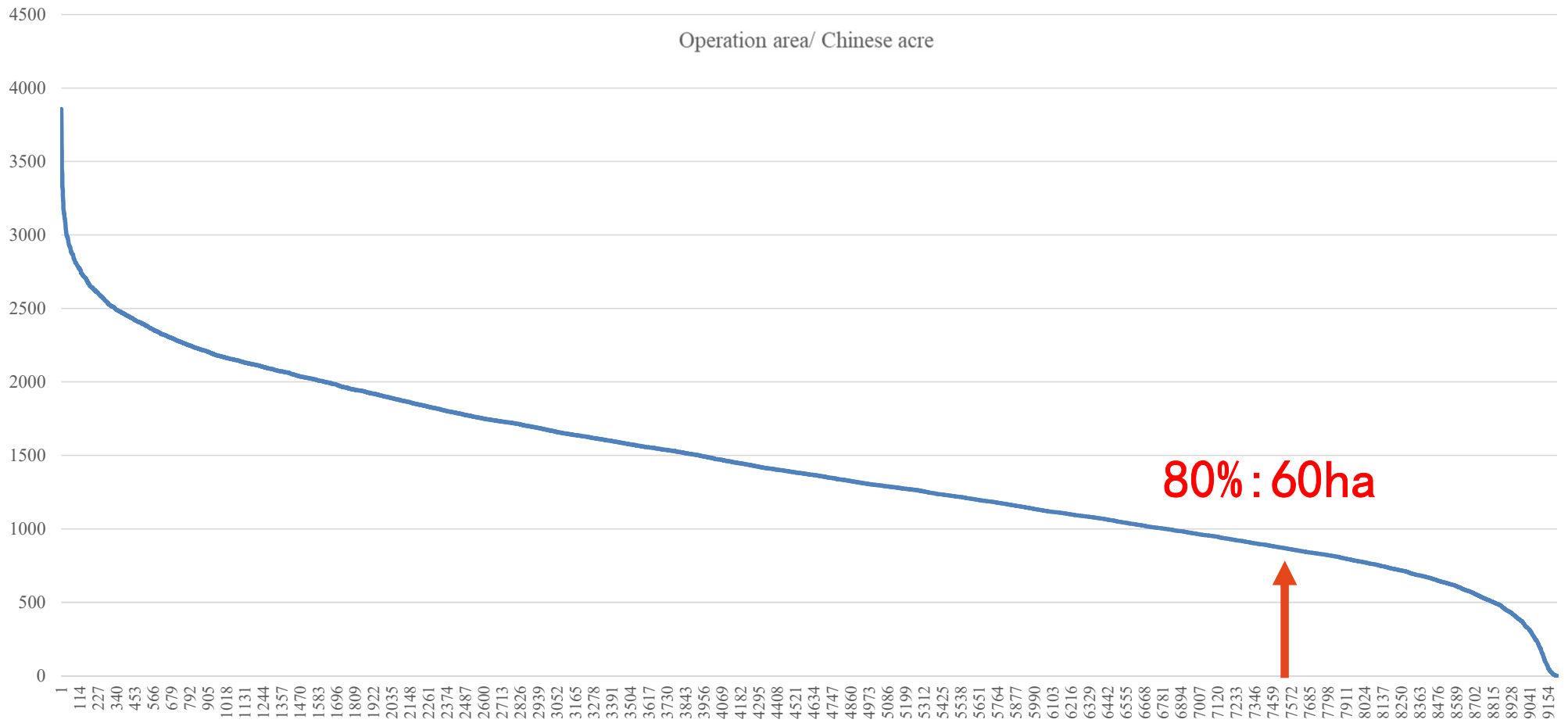
Trajectory



Distance



- Operation area/ Chinese acre



(3) Agricultural machinery operation and maintenance management

Macro: Government sectors



To master the wheat harvest progress as a whole and provide emergency support services such as transportation

Meso: Agricultural Machinery Cooperatives



To track the location and working conditions of agricultural machinery, and allocate accessories and maintenance resources around hot areas

Micro: Operators



Transfer helpers across regions and arrange harvesting operations scientifically and reasonably

To quantitatively evaluate the distribution balance, utilization rate and operation benefit of agricultural machinery in China, to reveal the current situation, characteristics and problems of socialized service of agricultural machinery, and to provide decision-making reference for the optimization of agricultural machinery policy.

Thanks very much!

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