

1 **Biodiversity management of organic farming enhances**
2 **agricultural sustainability**

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20 **Supplementary Materials list:**

21 Supplementary Tables S1-S9

22 **Tables S1** Comparison of net benefits per unit area between Biodiversity Management
23 of Organic Farming (BMOF) and chemical farming (CF).

| Content | BMOF | CF |
|--|--------|-------|
| Crop land (ha) | 6.7 | 8.7 |
| Apple orchard (ha) | 0.3 | 0 |
| Cattle breeding land (ha) | 1.3 | 0 |
| Cash forest (ha) | 0.4 | 0 |
| Total land (ha) | 8.7 | 8.7 |
| 8-year average labor inputs (\$ ha ⁻¹) | 1,763 | 974 |
| 8-year average total inputs (\$ ha ⁻¹) | 24,596 | 5,251 |
| 8-year average total outputs (\$ ha ⁻¹) | 36,489 | 7,186 |
| 8-year average total net benefits (\$ ha ⁻¹) | 11,893 | 1,935 |
| Net benefits ratio of BMOF to CF (BMOF/ CF) | 6.1 | |

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25 **Tables S2** Detailed list of crop inputs and outputs for Biodiversity Management of

26 Organic Farming (BMOF) and chemical farming (CF).

| Details of Crop Inputs | | | | | |
|-------------------------------|---|--|--|---|--------------|
| Content | Details | Price Schedules | BMOF Amount (\$ ha⁻¹) | CF Amount (\$ ha⁻¹) | |
| | Transportation fare for organic fertilizer | 3.23 \$ CAR ⁻¹ *22.5 CAR ha ⁻¹ | 72.6 | 0.0 | |
| | Rotary tillage fare before winter wheat seeding | Mechanical rotary tillage, 121.05 \$ ha ⁻¹ | 121.1 | 121.1 | |
| Machine | Fare for soil preparation and seeding | 96.84 \$ ha ⁻¹ | 96.8 | 96.8 | |
| | Combine harvester for winter wheat | 193.68 \$ ha ⁻¹ | 193.7 | 193.7 | |
| | Combine harvester for corn | 193.68 \$ ha ⁻¹ | 193.7 | 193.7 | |
| | Fare for corn thresher | 12.11 \$ ha ⁻¹ | 12.1 | 12.1 | |
| | Solar energy light-traps depreciation costs | 322.8 \$ light ⁻¹ , 1 light ha ⁻¹ , 5 years for 1 light | 64.6 | 0.0 | |
| | Sum | | | 755 | 617 |
| Irrigation | Requirements for irrigation to government | 217.89 \$ ha ⁻¹ *2 | 436 | 436 | |
| | Composting | 2 labor ha ⁻¹ , 9.68 \$ labor ⁻¹ | 19.4 | 19.4 | |
| | Loading and tedding Organic fertilizer | 15 labor ha ⁻¹ | 145.3 | 0.0 | |
| | Irrigation | 9 labor ha ⁻¹ | 87.1 | 87.1 | |
| | Spray insecticide for winter wheat | 4.5 labor ha ⁻¹ | 0.0 | 43.6 | |
| | Air baskets in wheat | 7.5 labor ha ⁻¹ | 72.6 | 72.6 | |
| | Corn artificial seeding | 18 labor ha ⁻¹ | 174.3 | 174.3 | |
| | Spray herbicide for corn | 7.5 labor ha ⁻¹ | 0.0 | 72.6 | |
| Labor | Spray insecticide for corn | 6 labor ha ⁻¹ | 0.0 | 58.1 | |
| | Drainage for corn | 4.5 labor ha ⁻¹ | 43.6 | 43.6 | |
| | Manual weeding | 15 labor ha ⁻¹ | 145.2 | 0.0 | |
| | Corn harvest | 18 labor ha ⁻¹ | 174.4 | 174.4 | |
| | Cleaning up cornstalk | 21 labor ha ⁻¹ | 203.3 | 203.3 | |
| | Peeling of corn | 15 labor ha ⁻¹ | 145.2 | 145.2 | |
| | Corn threshing | 2 labor ha ⁻¹ | 19.4 | 14.5 | |
| | Air baskets in corn | 3 labor ha ⁻¹ | 29.1 | 29.1 | |
| | Sum | | 130 labor ha ⁻¹ | 1,259 | 1,138 |
| | | Cost for organic fertilizers | 75cube ha ⁻¹ , 4.84\$ m ⁻³ | 363.2 | 0.0 |
| Fertilizer | Cost for chemical fertilizers | 14.53 \$ for winter wheat, 8.07 \$ for corn | 0.0 | 338.9 | |
| | Sum | | 363 | 339 | |
| | Pesticides for wheat seed dressing | 30 bag ha ⁻¹ , 0.4 \$ bag ⁻¹ | 0.0 | 12.1 | |
| Pesticide | Wheat aphids pesticide | 15 bottle ha ⁻¹ , 1.6 \$ bottle ⁻¹ | 0.0 | 24.2 | |
| | Herbicides for corn | 24.21 \$ ha ⁻¹ | 0.0 | 24.2 | |

| | | | | |
|---|----------------------------|---|---------------------------|---------------------|
| | Pesticides for corn borer | 30 bag ha ⁻¹ , 0.32 \$ bag ⁻¹ | 0.0 | 9.7 |
| Sum | | | 0 | 70 |
| Seeds | Cost for winter wheat seed | 0.48 \$ kg ⁻¹ , 225 kg ha ⁻¹ | 109.0 | 109.0 |
| | Cost for corn seed | 3.23 \$ kg ⁻¹ , 30 kg ha ⁻¹ | 96.8 | 96.8 |
| Sum | | | 206 | 206 |
| Total | | | 3,019 | 2,806 |
| Details of Flour Production Inputs | | | | |
| | Details | BMOF (\$ kg ⁻¹) | CF (\$ kg ⁻¹) | Extraction Rate (%) |
| Flour | Grinding wheat flour | 0.023 | 0.023 | 75 |
| Production | Grinding corn flour | 0.045 | 0.045 | 60 |
| | Flour bag | 0.161 | 0.006 | |
| Details of Crop Outputs | | | | |
| | Details | BMOF (\$ kg ⁻¹) | CF (\$ kg ⁻¹) | |
| Products | Wheat flour price | 1.62 | 0.52 | |
| Price | Corn flour price | 1.62 | 0.82 | |
| | Grain bran price | 0.29 | 0.29 | |

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28 **TableS3.**Detailed list of apple orchard inputs and outputs for Biodiversity

29 Management of Organic Farming (BMOF).

| Details of apple orchard Inputs | | | |
|---|--|--|--|
| Content | Details | Price Schedules | Amount (\$ ha⁻¹) |
| Fertilizer | Costs for manure composts | 217.5 cube ha ⁻¹ , 4.84 \$ m ⁻³ | 1,053 |
| Sum | | | 1,053 |
| Transportation | Transportation fare for manure compost | 1.61 \$ car ⁻¹ , 150 car ha ⁻¹ | 242.1 |
| fare | Transportation fare for biogas slurry | 12.9 \$ car ⁻¹ , 9 car ha ⁻¹ | 116.2 |
| Sum | | | 358 |
| Labor | Scrape old bark | 7.5 labor ha ⁻¹ , 9.68 \$ labor ⁻¹ | 72.6 |
| | Pruning | 30 labor ha ⁻¹ | 290.4 |
| | Clean up the branches on the ground | 15 labor ha ⁻¹ | 145.2 |
| | Bagging | 75 labor ha ⁻¹ | 726.0 |
| | Blossom and fruit thinning | 60 labor ha ⁻¹ | 580.8 |
| | Irrigation | 15 labor ha ⁻¹ | 145.2 |
| | Bag removing | 30 labor ha ⁻¹ | 290.4 |
| | Harvest | 30 labor ha ⁻¹ | 290.4 |
| | Pest control | 90 labor ha ⁻¹ | 871.2 |
| | Manure compost application | 165 labor ha ⁻¹ | 1,597.2 |
| | Weeds management | 30 labor ha ⁻¹ | 290.4 |
| | Planting <i>Duchesneaindica</i> | 7.5 labor ha ⁻¹ | 72.6 |
| Sum | | 690 labor ha⁻¹ | 6,680 |
| Irrigation | Requirements for irrigation to government | 217.89 \$ha ⁻¹ *4 | 872 |
| | lime sulphur | | 113.5 |
| | burgundy mixture | 115 \$ per time, 3 times | 345.0 |
| | Biogas slurry | 36.3 \$ per time, 3 times | 108.9 |
| Pest control | sticky card | | 145.3 |
| | Stem residue trap | | 169.5 |
| | Solar energy light-traps depreciation costs (5 years) | 322.8 \$ light ⁻¹ , 9 light ha ⁻¹ , 5 years for 1 light | 581.0 |
| Sum | | | 1,463 |
| Electricity | Pesticide spray | 0.1 \$ per kilowatt-hour | 40.7 |
| | Irrigation | | 26.1 |
| Sum | | | 67 |
| Materials & depreciation costs | Apple paper bag | | 544.7 |
| | The bee reed pipe | | 24.2 |
| | Gasoline for mower | | 84.7 |
| | Mower depreciation costs | | 69.6 |
| | Spray depreciation costs | | 55.5 |
| | Water pump depreciation costs | | 34.8 |

| | | | |
|---------------|-------------------|---------------------------|---------------|
| Sum | | | 814 |
| Others | Orchard lease fee | 807 \$ year ⁻¹ | 807 |
| Total | | | 12,114 |

| Details of apple price of different quality level | | |
|--|-------------------------------------|--------------------------------|
| Quality level* | Conventional (\$ kg ⁻¹) | Organic (\$ kg ⁻¹) |
| 1 | 0.97 | 4.84 |
| 2 | 0.81 | 3.87 |
| 3 | 0.65 | 2.58 |
| 4 | 0.48 | 0.48 |
| 5 | 0.32 | 0.32 |
| 6 | 0.10 | 0.10 |

30 *There are four levels for apple, we sold apple according to quality level.

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33 **TableS4** Detailed list of cash forest inputs and outputs for Biodiversity Management
 34 of Organic Farming (BMOF).

| Details of Cash Forest Inputs | | | |
|--|---|--|--|
| Content | Details | Price Schedules | Amount (\$ ha⁻¹) |
| Materials | Sapling cost | 1.59 \$ plant ⁻¹ , 900 plant ha ⁻¹ | 1,431.0 |
| | Requirements for irrigation to government | 217.89 \$ ha ⁻¹ | 219.9 |
| Sum | | | 1,651 |
| Labor | Tree planting | 100 labor ha ⁻¹ | 645.6 |
| | Irrigation | 9 labor ha ⁻¹ | 87.2 |
| | Harvest | 200 labor ha ⁻¹ | 1,291.2 |
| Sum | | | 2,024 |
| Total | | | 3,675 |
| Details of Cash Forest outputs* | | | |
| Content | Price Schedules | Amount(\$ ha⁻¹) | |
| Woods | 12.91 \$ plant ⁻¹ , 900 plant ha ⁻¹ | 11,621 | |

35 *Cash forest needs 7-8 years to grown, so we only got the harvest one time in 2014.

TableS5. Detailed lists of cattle benefits from Hongyi Organic Farm during the experimental run (2007-2014).

| Years | Cattle capita | Cattle manure production(t ons) | Inputs(\$) | | | | | | | | | | Outputs(\$) | |
|-------|---------------|---------------------------------|---------------|----------------|--------------------------------|--------------------------|----------------------------|------------------|---------------------------|------------------|-----------------------------|--------|-------------|--------|
| | | | Cattle house* | Fodder store** | Residues proceeding machine*** | Residues silage pool**** | Fodder mixing machine***** | Weighbridge***** | Young cattle buying costs | Breeding labor † | Residues proceeding labor § | Fodder | Beef | Manure |
| 2007 | 50 | 263 | 968 | 339 | 303 | 796 | 569 | 520 | 29,052 | 678 | 807 | 5,897 | 53,262 | 1,271 |
| 2008 | 70 | 368 | 968 | 339 | 303 | 796 | 569 | 520 | 40,673 | 678 | 1,130 | 8,255 | 74,705 | 1,779 |
| 2009 | 100 | 525 | 968 | 339 | 303 | 796 | 569 | 520 | 72,630 | 1,356 | 2,018 | 11,793 | 159,786 | 2,542 |
| 2010 | 120 | 630 | 968 | 339 | 303 | 796 | 569 | 520 | 87,156 | 1,356 | 2,421 | 14,152 | 213,048 | 3,050 |
| 2011 | 140 | 735 | 968 | 339 | 303 | 796 | 569 | 520 | 152,523 | 1,356 | 2,825 | 16,510 | 248,556 | 3,559 |
| 2012 | 150 | 788 | 968 | 339 | 303 | 796 | 569 | 520 | 163,418 | 1,356 | 3,632 | 17,690 | 319,572 | 3,813 |
| 2013 | 180 | 945 | 968 | 339 | 303 | 796 | 569 | 520 | 261,468 | 2,034 | 4,358 | 21,227 | 415,444 | 4,576 |
| 2014 | 200 | 1050 | 968 | 339 | 303 | 796 | 569 | 520 | 290,520 | 2,034 | 4,842 | 23,586 | 461,604 | 5,084 |

* Cow house cost was depreciation cost for 20 years, total inputs of house was 19,368 \$.

** Fodder store was depreciation cost for 20 years, total inputs was 6,779 \$.

*** These inputs were depreciation cost for two residues proceeding machine. Total inputs was 3,034 \$ for 10 years.

**** Silage pool cost was depreciation cost for 20 years, total inputs was 15,922 \$.

***** Fodder mixing machine was depreciation cost for 10 years, total inputs was 5,689 \$.

*****Weighbridge was depreciation cost for 10 years, total inputs was 5,195 \$.

† Cattle breeding need average 7 month.

§ Residues proceeding needs 2.5 labor per head

TableS6. Detailed list of chicken and goose breeding inputs and outputs in Hongyi

Organic Farm during the experimental run (2007-2014).

| Years | chicken capita | goose capita | Inputs(\$) | | | | | | Outputs(\$) | |
|-------|-------------------|-----------------|-----------------|------------------|----------------|----------|-------|--------|-------------|--------|
| | | | houses cost* | young chicken | young goose | medicine | labor | fodder | chicken | goose |
| 2007 | 1,000 | 1,000 | 194 | 484 | 1,291 | 161 | 1,162 | 6,391 | 3,669 | 8,312 |
| 2008 | 2,000 | 2,000 | 194 | 968 | 2,582 | 323 | 1,162 | 8,522 | 7,522 | 16,947 |
| 2009 | 1,000 | 1,000 | 194 | 484 | 1,291 | 161 | 1,162 | 6,391 | 202** | 9,038 |
| 2010 | 1,000 | 500 | 194 | 646 | 807 | 121 | 2,324 | 4,261 | 4,083 | 4,600 |
| 2011 | 1,000 | 1,000 | 194 | 646 | 1,614 | 161 | 2,324 | 6,391 | 4,567 | 9,958 |
| 2012 | 1,000 | 1,000 | 194 | 646 | 1,614 | 161 | 2,324 | 6,391 | 5,456 | 10,088 |
| 2013 | 1,000 | 1,000 | 194 | 646 | 1,937 | 161 | 3,486 | 6,391 | 5,508 | 10,588 |
| 2014 | 1,000 | 1,000 | 194 | 646 | 1,937 | 161 | 3,486 | 6,391 | 5,578 | 10,677 |

*Houses cost is depreciation cost for 10 years, total inputs of house is 1,937 \$.

**This year chicken dead due to diseases, only 150 chickens alive.

TableS7.Detailed price list used in different years' calculation.

| Years | Labor* | | Young cattle | beef | Young chicken | live chicken | Young goose | live goose |
|-------|----------------------|------------------------|---------------------|---------------------|-----------------------|---------------------|---------------------|---------------------|
| | \$ day ⁻¹ | \$ month ⁻¹ | \$ kg ⁻¹ | \$ kg ⁻¹ | \$ head ⁻¹ | \$ kg ⁻¹ | \$ kg ⁻¹ | \$ kg ⁻¹ |
| 2007 | 6.46 | 48.42 | 2.58 | 1.94 | 0.48 | 2.72 | 2.58 | 1.66 |
| 2008 | 6.46 | 48.42 | 2.58 | 1.94 | 0.48 | 2.79 | 2.58 | 1.70 |
| 2009 | 8.07 | 96.84 | 3.23 | 2.91 | 0.48 | 2.69 | 2.58 | 1.81 |
| 2010 | 8.07 | 96.84 | 3.23 | 3.23 | 0.48 | 3.03 | 3.23 | 1.84 |
| 2011 | 8.07 | 96.84 | 4.84 | 3.23 | 0.65 | 3.38 | 3.23 | 1.99 |
| 2012 | 9.68 | 145.26 | 4.84 | 3.87 | 0.65 | 4.04 | 3.23 | 2.02 |
| 2013 | 9.68 | 145.26 | 6.46 | 4.20 | 0.65 | 4.08 | 3.87 | 2.12 |
| 2014 | 9.68 | 145.26 | 6.46 | 4.20 | 0.65 | 4.13 | 3.87 | 2.14 |

* Two style of payment for labor force and the price varied in different years.

TableS8. Detailed list of crop yields and apple yields in Hongyi Organic Farm during the experimental run (2007-2014).

| Years | Crop yields of BMOF(kg)* | | Crop yields of CF(kg) * | | Apple yields in different quality levels (kg)** | | | | | | |
|-------|--------------------------|----------|-------------------------|----------|---|---------|---------|---------|---------|--------|--------|
| | Wheat | Maize | Wheat | Maize | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| 2007 | 35,260.3 | 41,002.5 | 53,298.8 | 55,235.2 | 461.3 | 922.5 | 1,845.0 | 3,228.8 | 2,306.3 | 461.3 | 9,225 |
| 2008 | 15,674.8 | 27,388.7 | 52,673.6 | 53,133.4 | 474.8 | 949.5 | 1,899.0 | 3,323.3 | 2,373.8 | 474.8 | 9,495 |
| 2009 | 31,349.7 | 28,349.2 | 54,081.7 | 56,378.3 | 510.8 | 1,021.5 | 2,043.0 | 3,575.3 | 2,553.8 | 510.8 | 10,215 |
| 2010 | 46,690.3 | 54,817.4 | 55,233.5 | 62,190.1 | 492.8 | 985.5 | 1,971.0 | 3,449.3 | 2,463.8 | 492.78 | 9,855 |
| 2011 | 48,074.0 | 47,653.8 | 52,826.0 | 55,571.2 | 495.0 | 990.0 | 1,980.0 | 3,465.0 | 2,475.0 | 495.0 | 9,900 |
| 2012 | 50,162.1 | 53,204.6 | 53,091.9 | 54,901.8 | 402.8 | 805.5 | 1,611.0 | 2,819.3 | 2,013.8 | 402.8 | 8,055 |
| 2013 | 40,763.9 | 35,417.7 | 57,857.5 | 51,622.3 | 427.5 | 855.0 | 1,710.0 | 2,992.5 | 2,137.5 | 427.5 | 8,550 |
| 2014 | 57,587.0 | 68,269.1 | 64,027.7 | 92,787.6 | 452.3 | 904.5 | 1,809.0 | 3,165.8 | 2,261.3 | 452.3 | 9,045 |

*Field land for BMOF crop was 6.7 ha, while land for CF crop was 8.7 ha

**Apple orchard land was 0.3 ha.

TableS9. Labor inputs in the Hongyi Organic Farm during the eight-year run.

| Years | Crops (\$) | Orchard(\$) | Cattle(\$) | Chicken + goose(\$) | Cash forest(\$) | Total(\$) |
|-------|------------|-------------|------------|---------------------|-----------------|-----------|
| 2007 | 5,627 | 1,337 | 1485 | 1,162 | 282 | 9,893 |
| 2008 | 5,627 | 1,337 | 1808 | 1,162 | 0 | 9,934 |
| 2009 | 7,029 | 1,670 | 3374 | 1,162 | 0 | 13,235 |
| 2010 | 7,029 | 1,670 | 3777 | 2,324 | 0 | 14,800 |
| 2011 | 7,029 | 1,670 | 4181 | 2,324 | 0 | 15,204 |
| 2012 | 8,431 | 2,004 | 4988 | 2,324 | 0 | 17,747 |
| 2013 | 8,431 | 2,004 | 6392 | 3,486 | 0 | 20,313 |
| 2014 | 8,431 | 2,004 | 6876 | 3,486 | 774 | 21,571 |