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Nutrient management challenges of China

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**Global Partnership on Nutrient
Management (GPNM)**



Outline

Overview of China's agriculture and food security

Nutrients management: emerging challenges

Possible solutions for the future

Outline

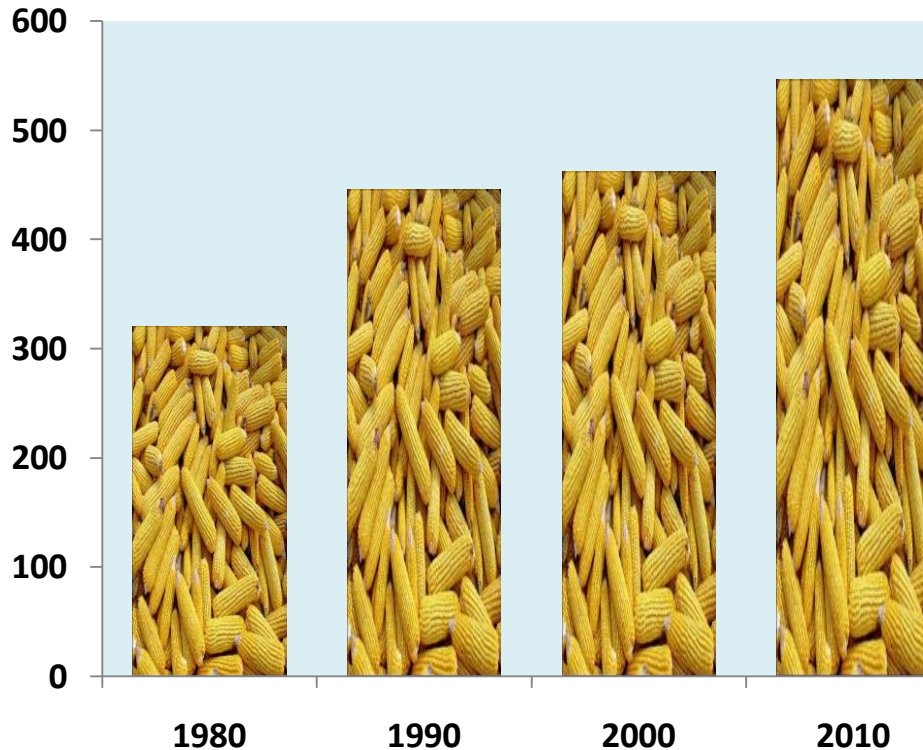
Overview of China's agriculture and food security

Nutrients management: emerging challenges

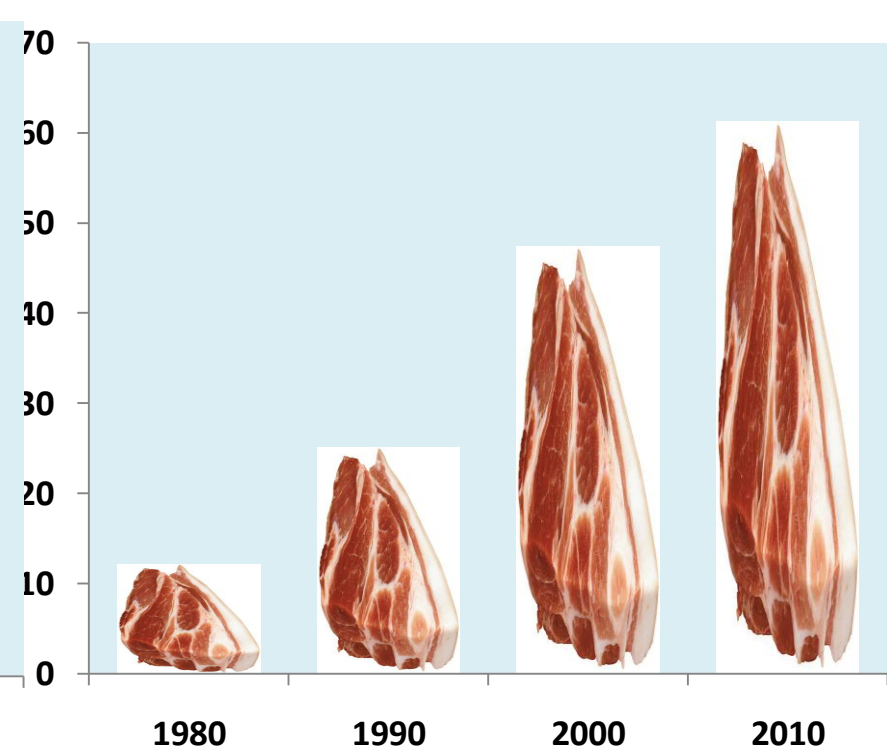
Possible solutions for the future

China's Agriculture & Food Security – A success story

Grain production
(million ton)

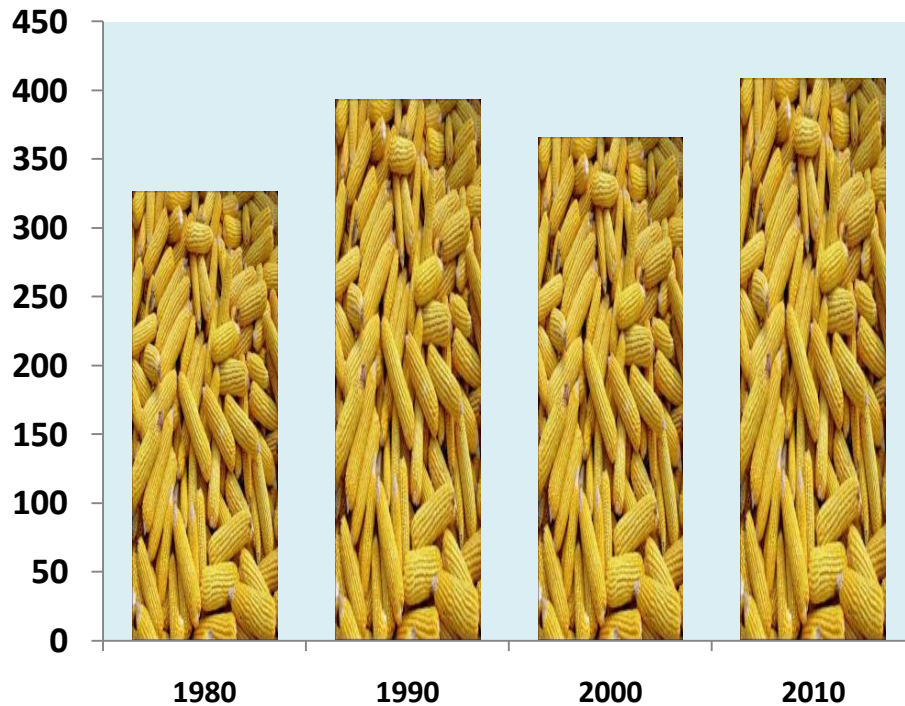


Meat production
(million ton)

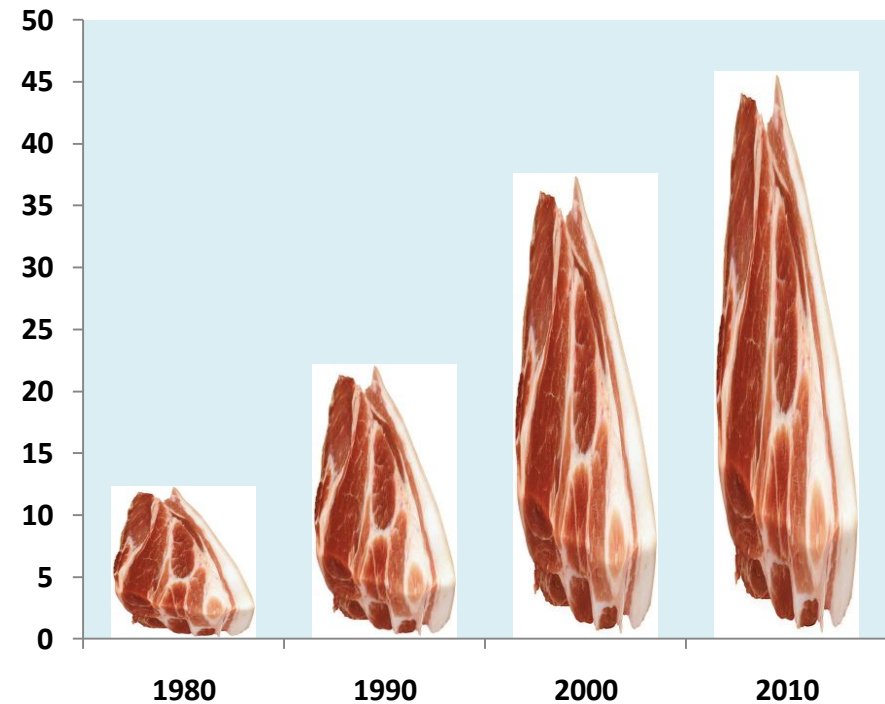


China's Agriculture & Food Security – A success story

Grain per capita (kg)



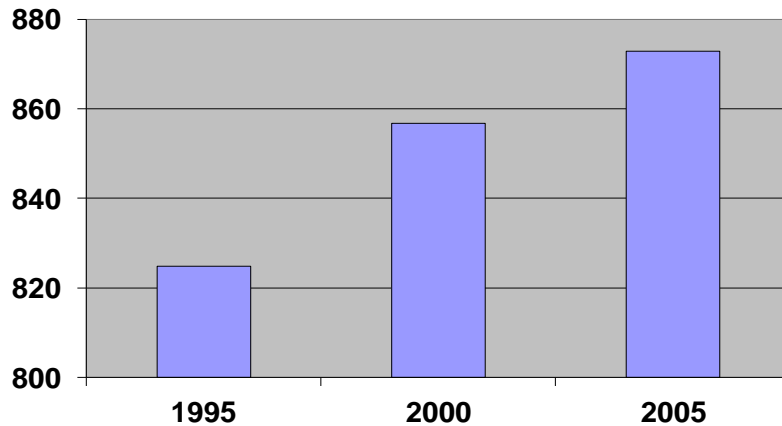
Meat per capita (kg)



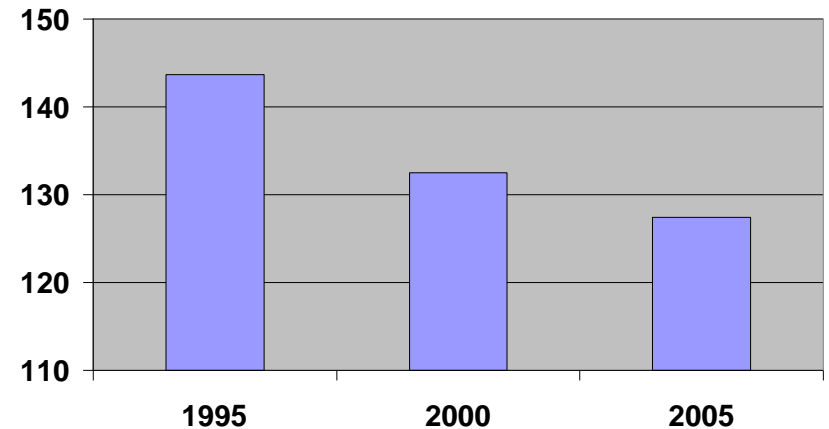
China's Agriculture & Food Security – A success story

Number of undernourished persons (millions)

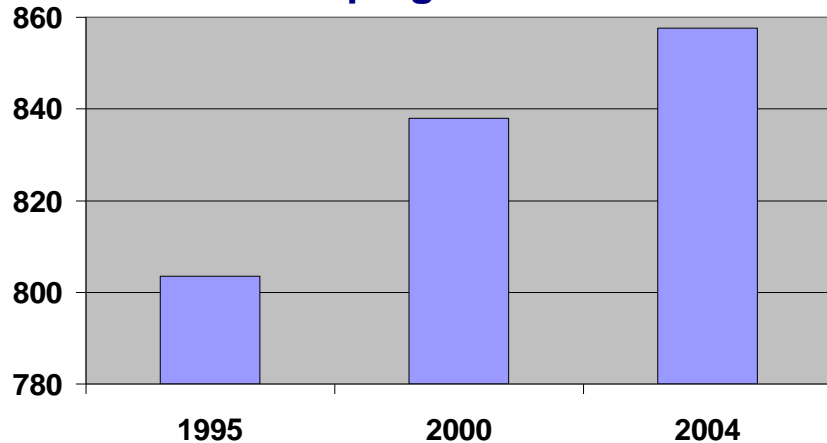
World



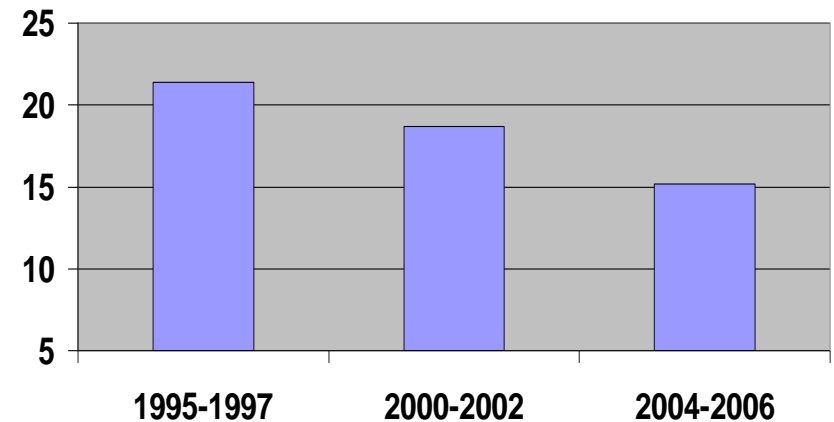
China



Developing countries



Developed countries



Pollutants from China's agricultural production

discharged into water systems

| | | |
|----------------|----------------|----------------------------|
| COD | 13.2 Mt | 44% of nation total |
| Total N | 2.7 Mt | 57% of nation total |
| Total P | 0.3 Mt | 67% of nation total |

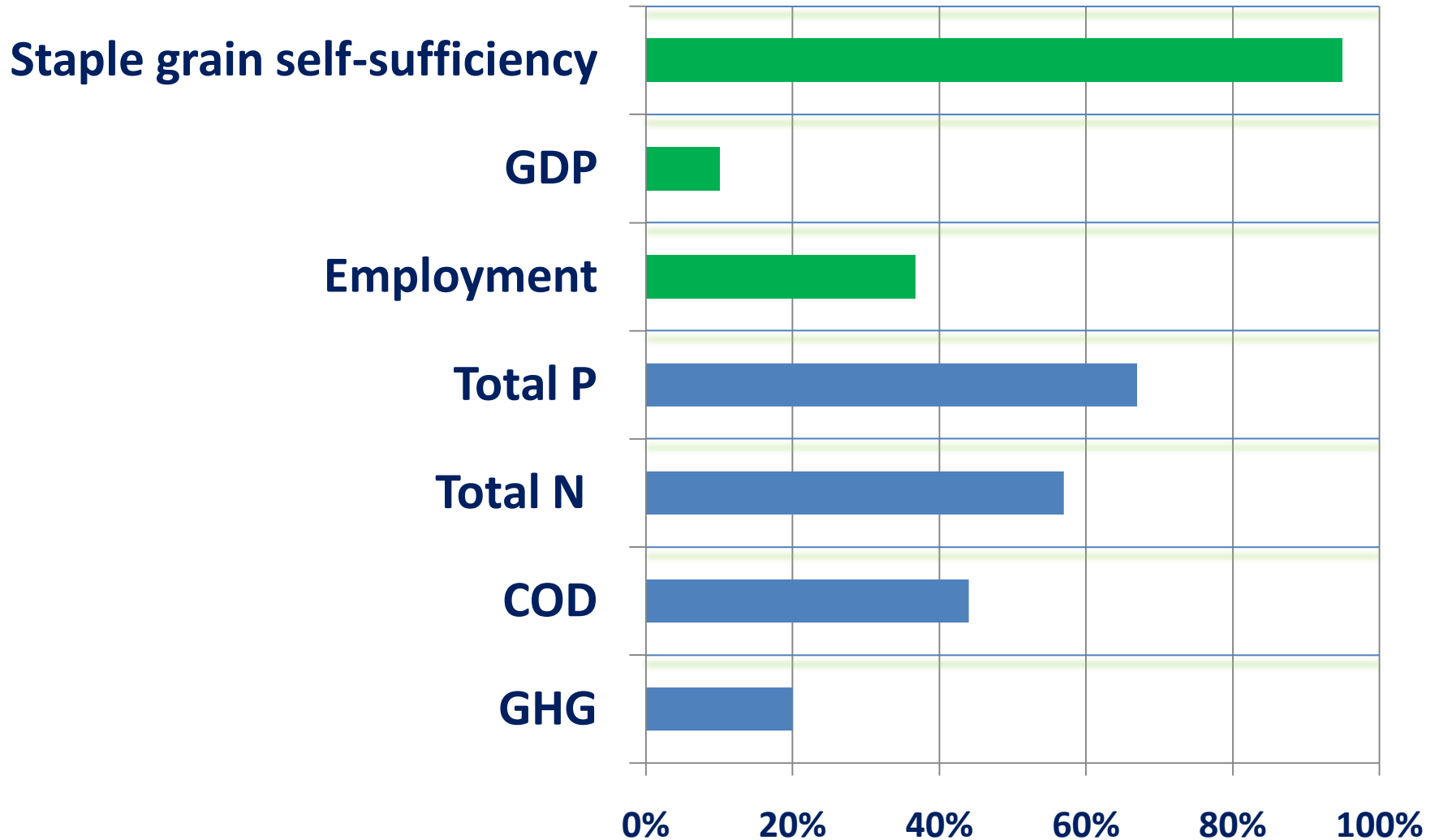
from crop cultivation

| | | |
|----------------|---------------|---------------------------|
| Total N | 1.6 Mt | 59% of agriculture |
| Total P | 0.1 Mt | 38% of agriculture |

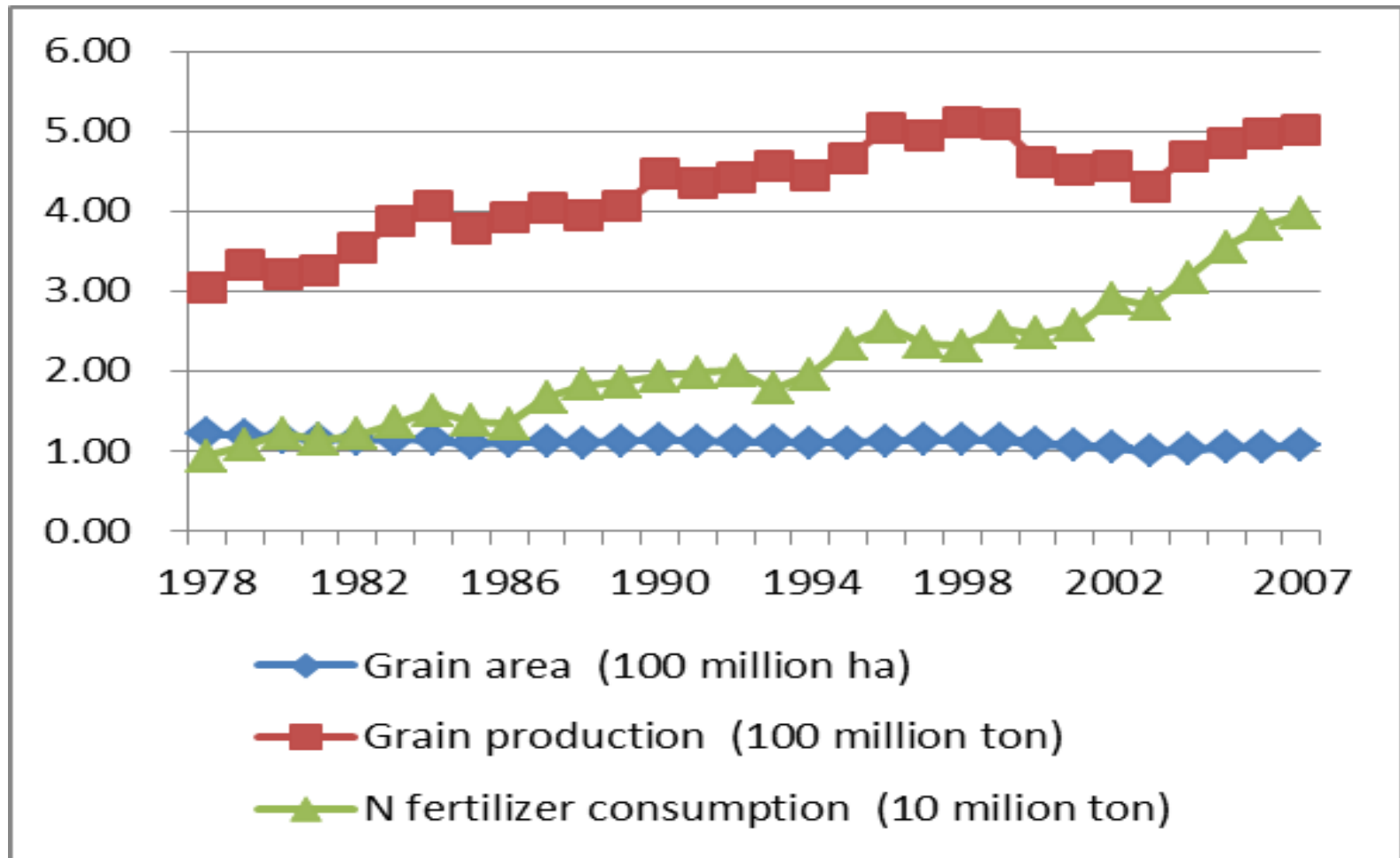
from livestock

| | | |
|----------------|----------------|---------------------------|
| COD | 12.9 Mt | 96% of agriculture |
| Total N | 1.0 Mt | 38% of agriculture |
| Total P | 0.2 Mt | 56% of agriculture |

China agriculture's contribution to the economy and the environment



Grain production, synthetic nitrogen fertilizer inputs and cropped area 1978-2007



Fertilizer N “overshoot”

| | Fertilizer N applied kg ha ⁻¹ | | Excess % |
|----------------------|---|-----------------|-------------|
| | Optimum for region | Farmers average | |
| Rice (Taihu) | 200 | 300 | 50 |
| Wheat (Taihu) | 153 | 250 | 63 |
| Wheat (NCP) | 128 | 325 | 154 |
| Maize (NCP) | 158 | 263 | 66 |

Ju *et al* (2009) *PNAS* **106**, 3041-3046

Outline

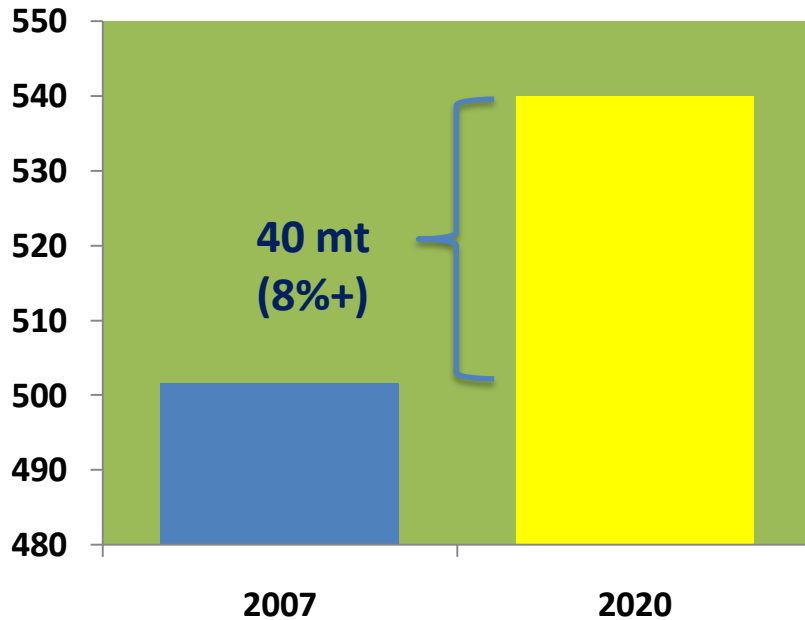
Overview of China's agriculture and food security

Nutrients management: emerging challenges

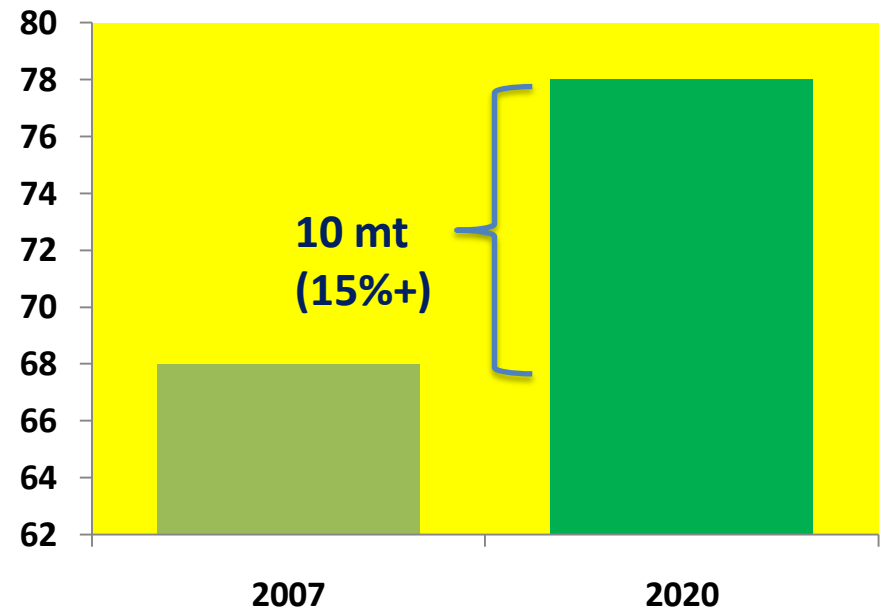
Possible solutions for the future

Nutrient management emerging challenges: food demand

Grain



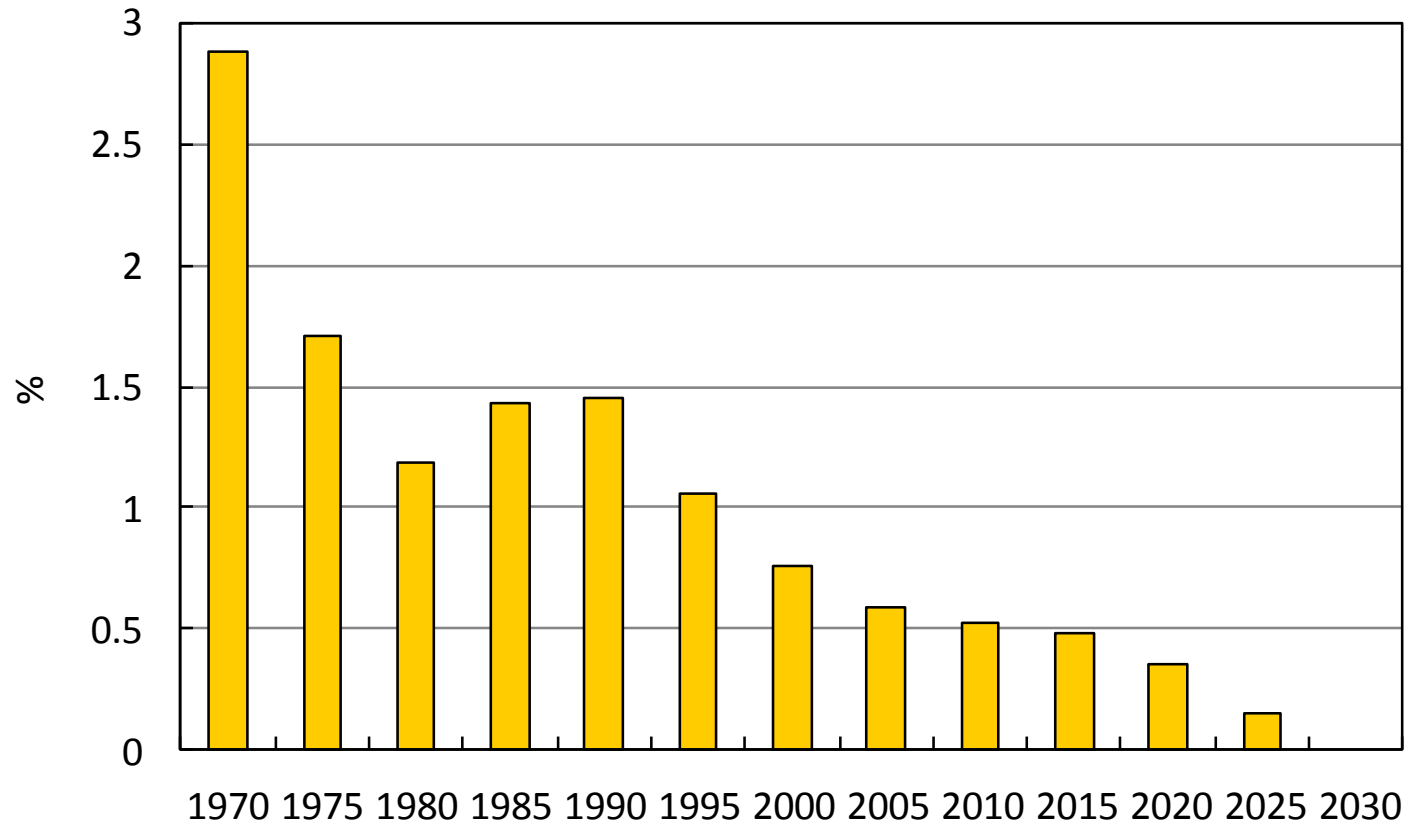
Meat



NDRC, 2008, Mid-long term food security plan

Nutrient management emerging challenges: food demand

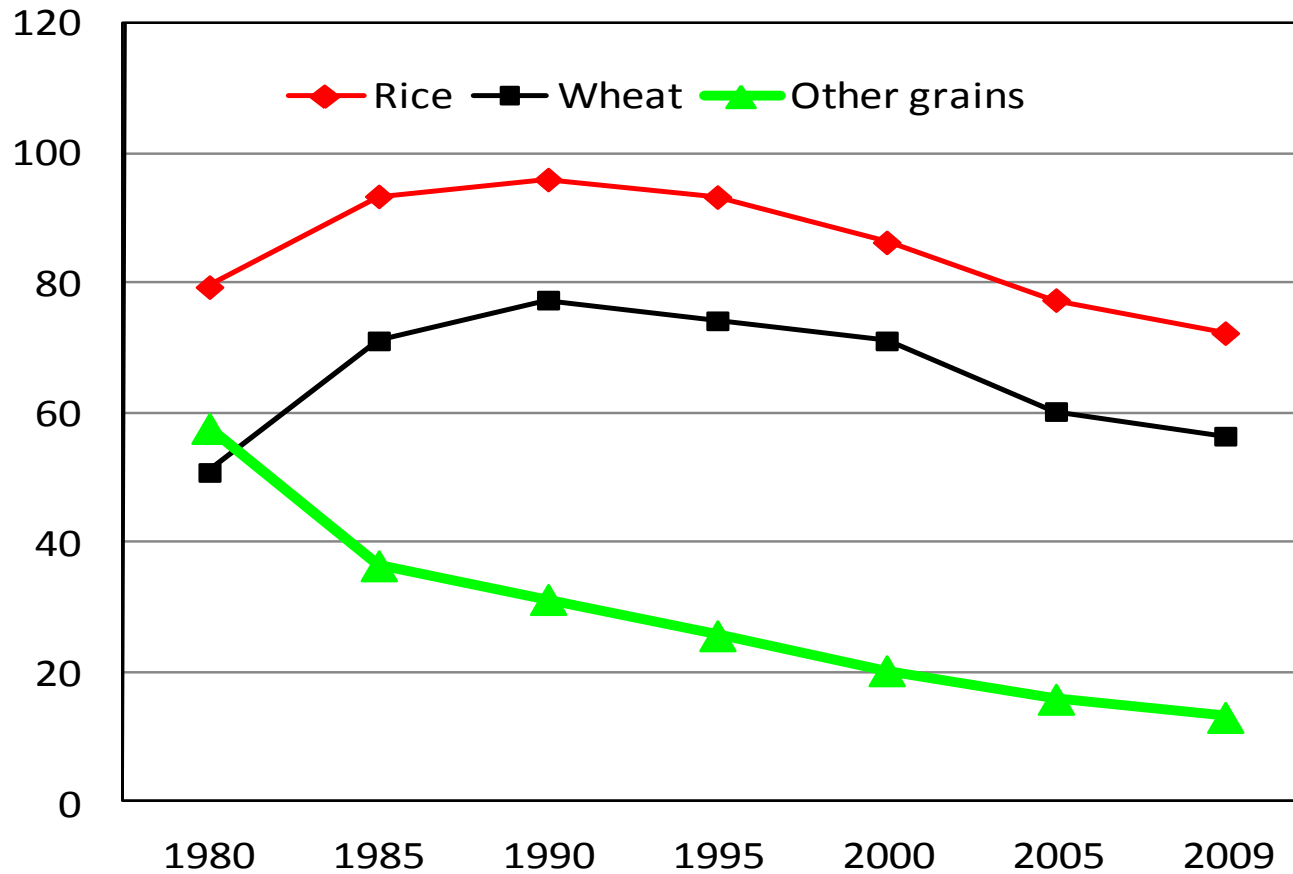
The long-term decline in population growth rate



Nutrient management emerging challenges: food demand

Change in Consumption pattern

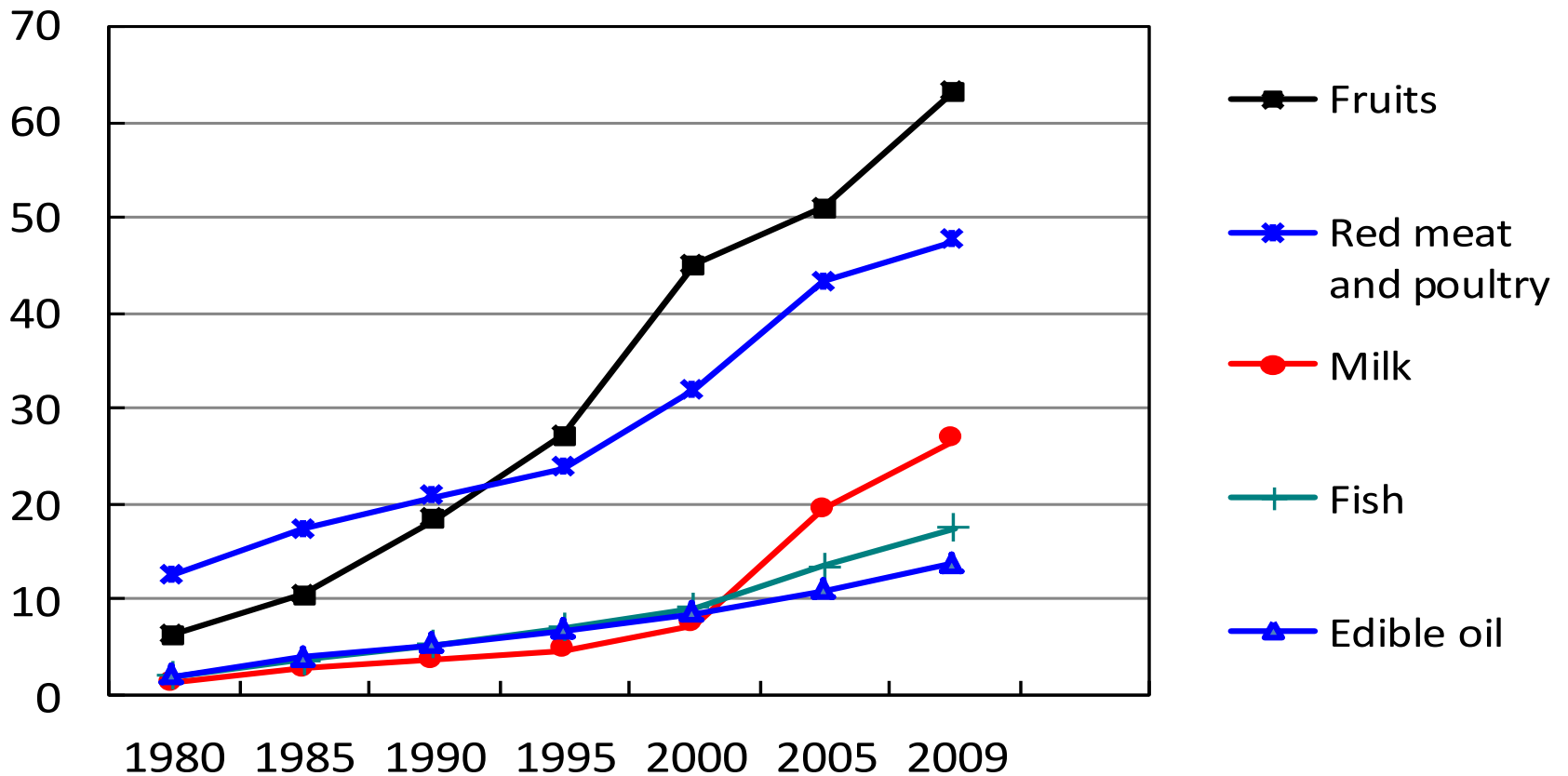
Per capita grain consumption (kg/person)



Nutrient management emerging challenges: food demand

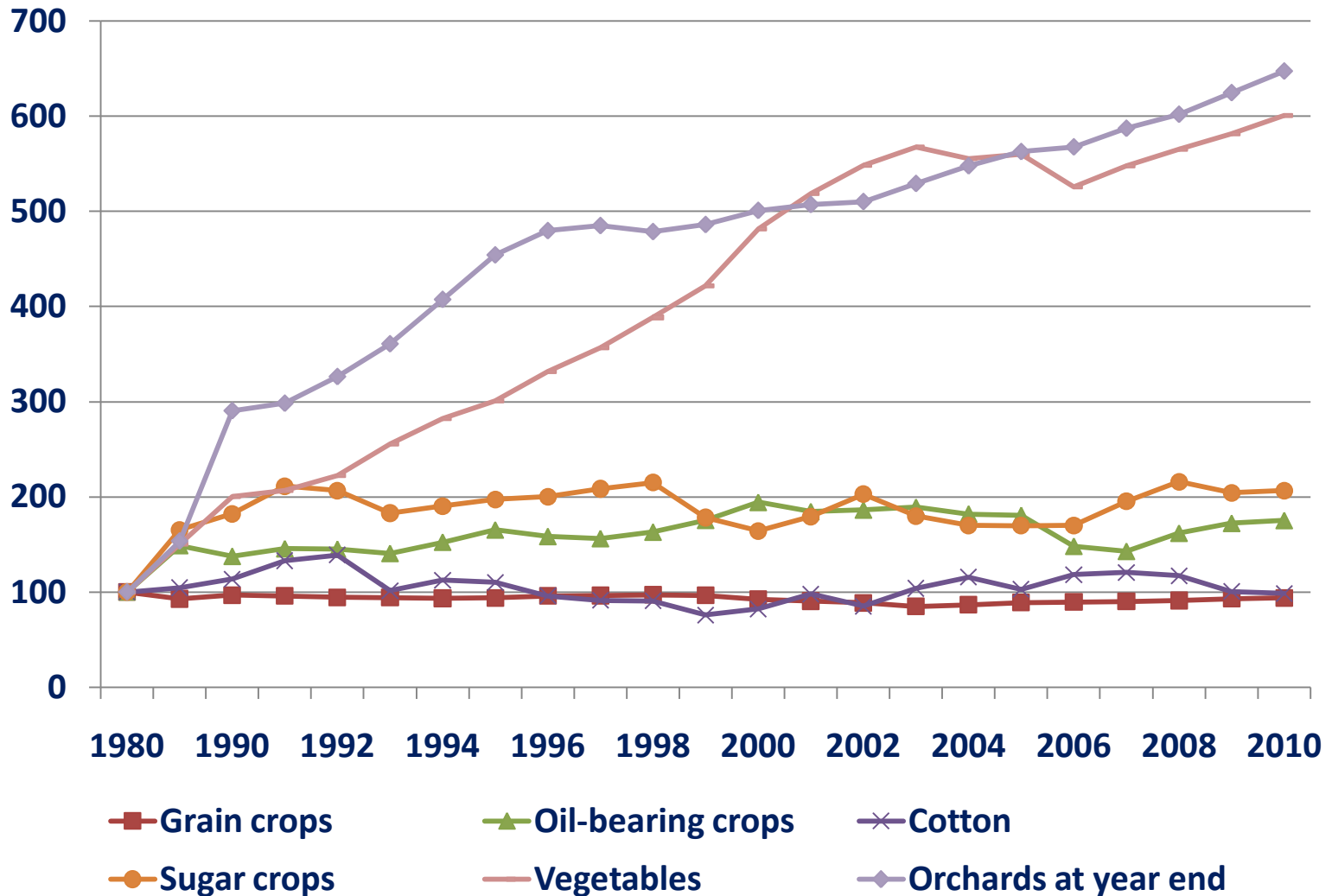
Change in Consumption pattern

Per capita non- staple consumption (kg per year)



Nutrient management emerging challenges: food demand

Change in sown areas of various crops (1980 as 100)



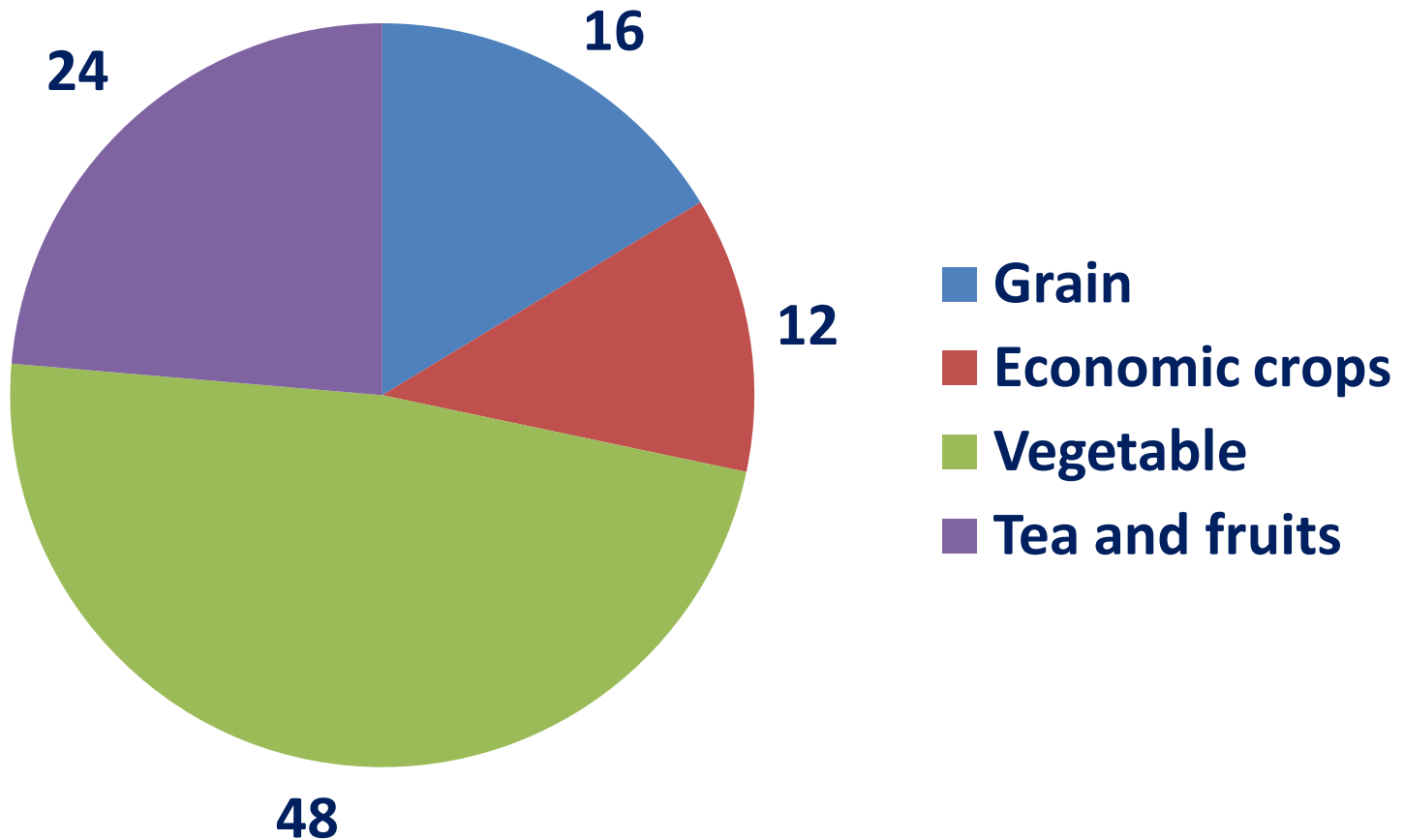
Nutrient management emerging challenges: food demand

Fertilizer consumption by crops during 1998–2008

| Year | Grain | | Economic crops | | Vegetable | | Tea and fruits | | Total | |
|------|-------|------|----------------|------|-----------|------|----------------|------|-------|-------|
| | Mt | % | Mt | % | Mt | % | Mt | % | Mt | % |
| 1998 | 26.76 | 71.0 | 4.22 | 11.2 | 3.64 | 9.7 | 3.05 | 8.1 | 37.66 | 100.0 |
| 2008 | 28.72 | 57.8 | 5.66 | 11.4 | 9.41 | 18.9 | 5.89 | 11.9 | 49.68 | 100.0 |

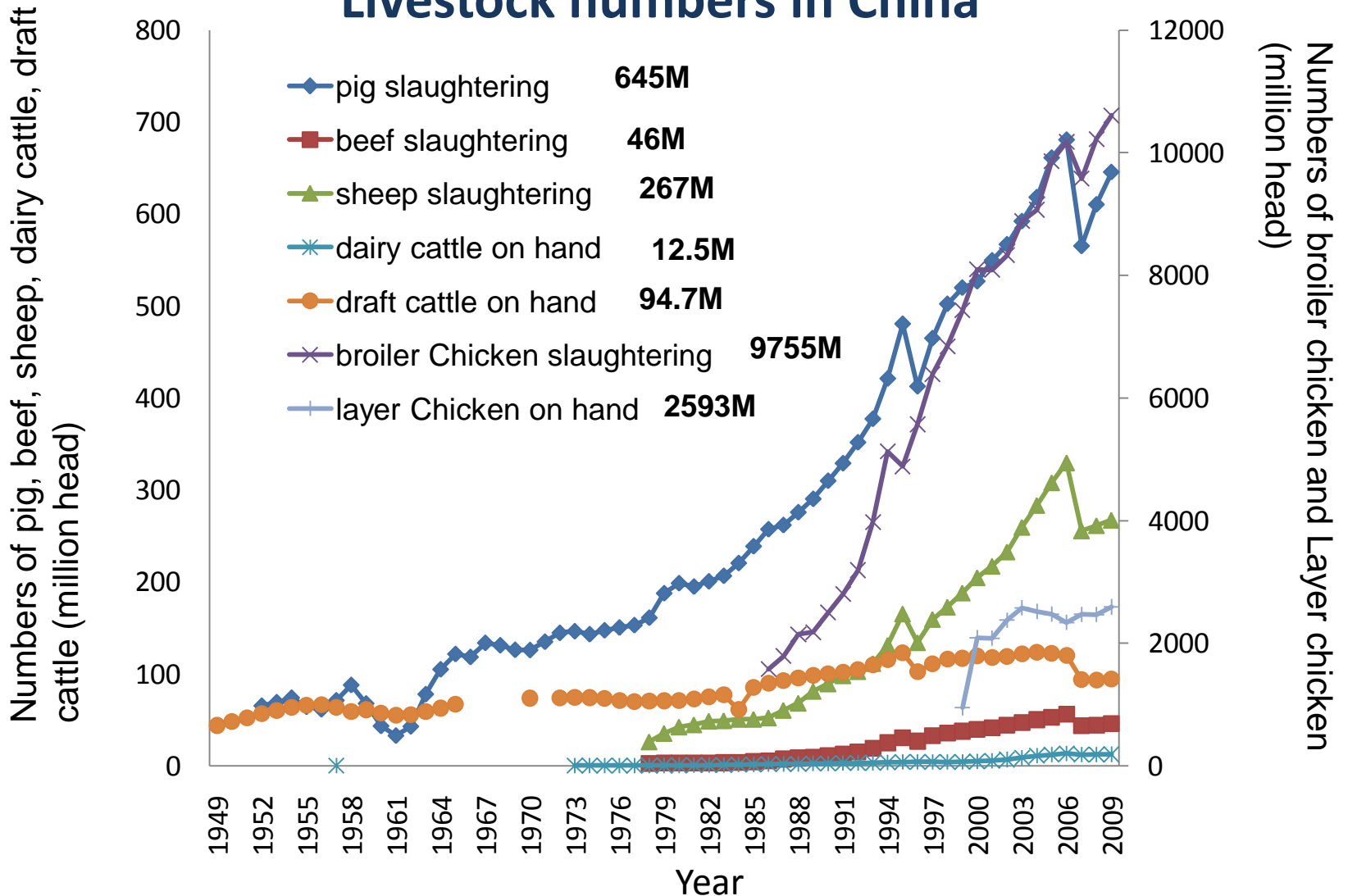
Nutrient management emerging challenges: food demand

Contribution to increased fertilizer use in 1998-2008, (%)



Nutrient management emerging challenges: food demand

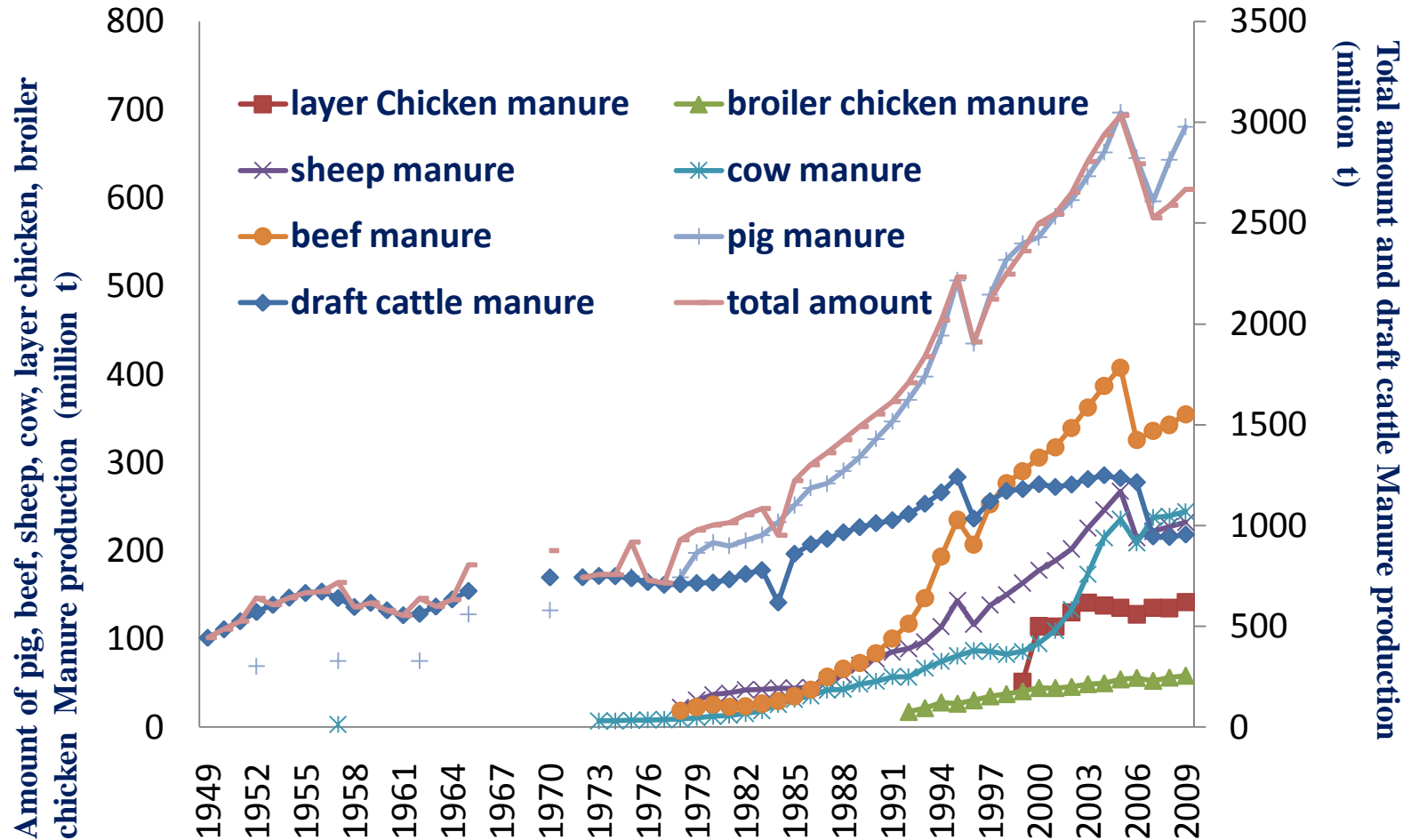
Livestock numbers in China



Since 2007, there are some changes in Statistical Definition.

Nutrient management emerging challenges: food demand

Manure generation in China

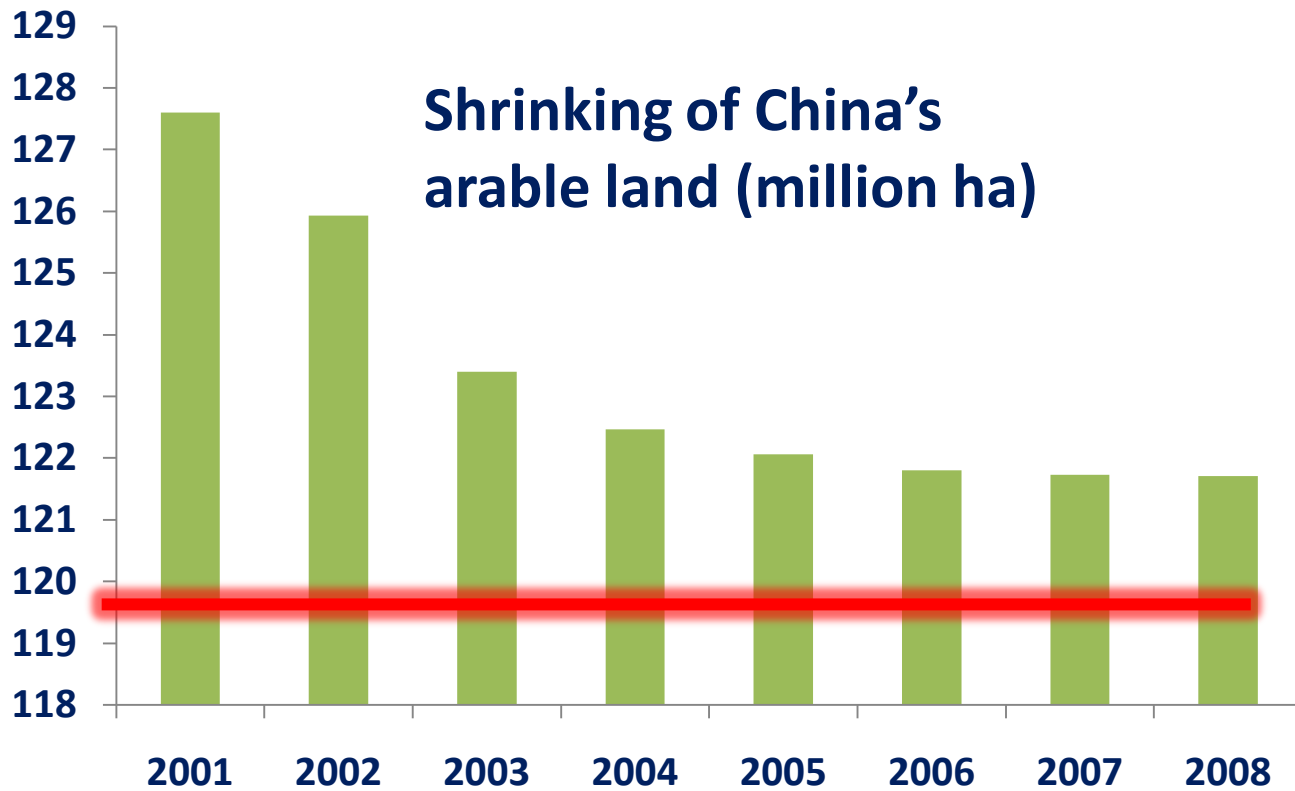


Nutrient management emerging challenges: food demand

Management of manures in China

- 3060 million tonnes (fresh weight) of livestock manure was generated in China in 2010.
 - The N, P₂O₅ and K₂O content *ca. 14 million, 10.2 million and 12.0 million tonnes*, which worth *ca. 201,300M RMB*;
- Manure is commonly over-applied to horticultural crops, particularly greenhouse vegetables and fruit, which causes negative environmental impacts;
- The barriers for effective management of manure, compost and digestate include lack of labour to transport and apply to the field; lack of knowledge of the nutrient content and availability; and inadequate labelling of e.g. composted manure products;

Nutrient management emerging challenges: urbanisation



Nutrient management emerging challenges: urbanisation

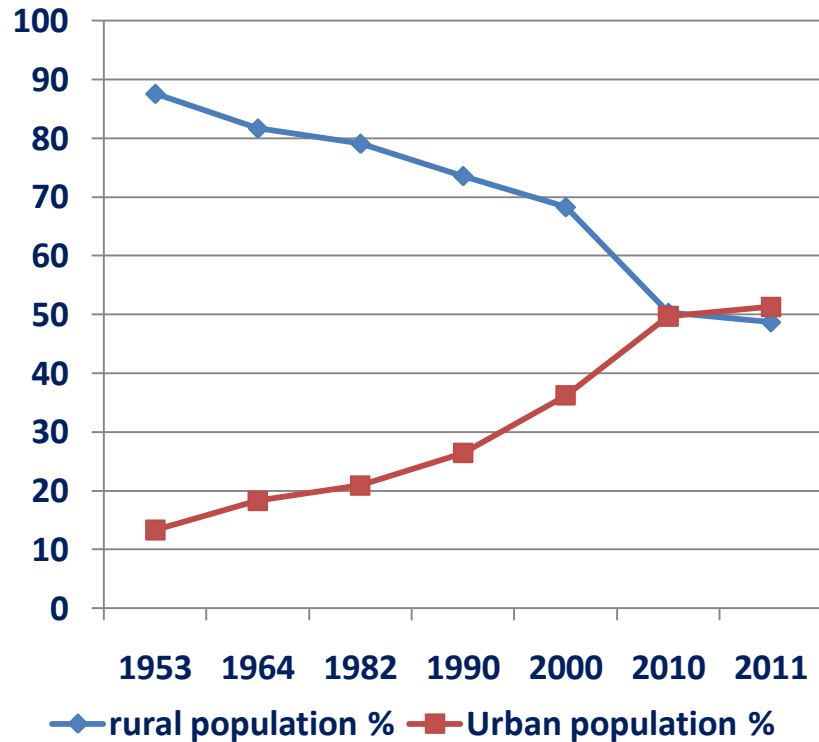
Labour – lack of skilled and aging



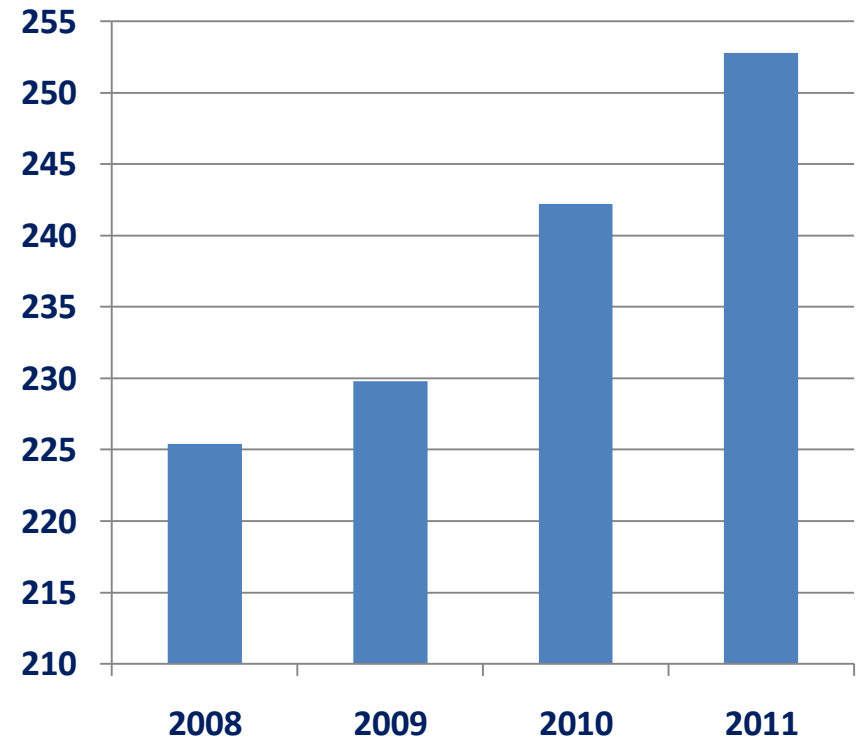
Nutrient management emerging challenges: urbanisation

Rural urban labour migration

Change in Urban and Rural Population

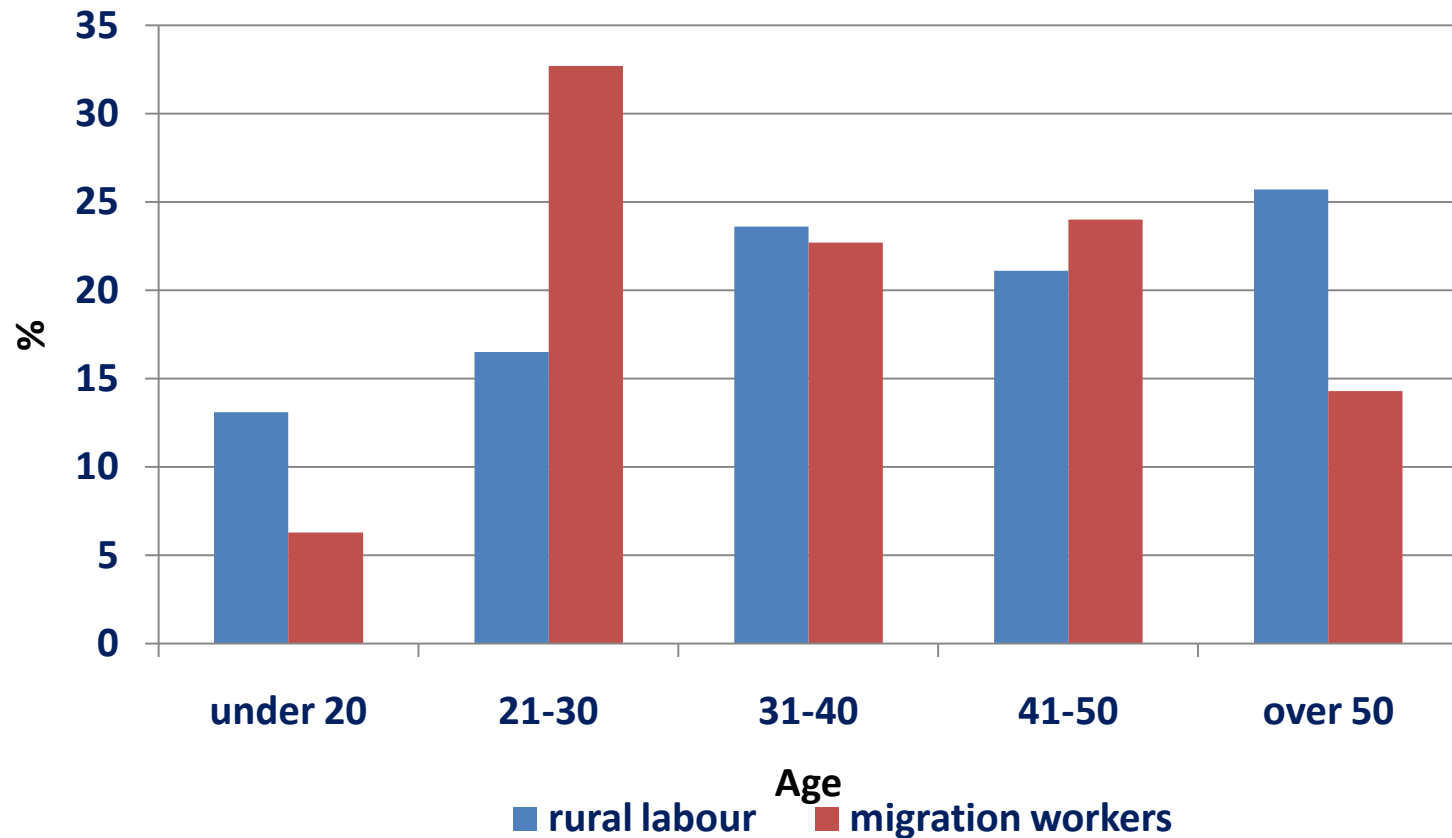


Migrant Workers (million)



Nutrient management emerging challenges: urbanisation

Age of rural labours and migration workers



Nutrient management emerging challenges: urbanisation

Rural income composition

Household Income and distribution (yuan, %)

| Dryland wheat system | Average | 1 st quartile | 2nd quartile | 3rd quartile | 4th quartile |
|----------------------|---------|--------------------------|--------------|--------------|--------------|
| Total income | 9728 | 1664 | 6489 | 10442 | 20260 |
| share of crop income | 15 | 33 | 14 | 9 | 3 |

Nutrient management emerging challenges: environmental goal

Towards resource efficiency & climate smart agriculture

By 2015, compared with 2010

- **Agricultural COD reduced by 8%**
- **Ammonia nitrogen emission reduced by 10%;**
- **Fertilizer use efficiency increased by 3%**
- **Over 50% of intensive livestock farm or livestock raising community equipped with waste treatment facilities**

Outline

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Consequences of N overuse -from local to global

Wasted money – reduced net farm income

Soil quality

- Acidification

Water quality (including intl waters)

- Drinking water nitrate limit
- Eutrophication and algal blooms (with P)

Climate change

- N₂O – powerful GHG,
- CO₂ from N fertilizer manufacture



Local private



Global public

What can be done?

Not just technical advice!

- **Many/most farmers now part-time**
- **Non-farm work is more profitable & takes priority – so classic advisory approaches ineffective**
- **Labour shortage at key times**
- **Policies, financial incentives or regulation required to change behaviour**

Example 1

- **Increase N use efficiency**
- **Decrease N losses**

Barriers:

- **Machinery cost**
- **Labour shortage**

- **Sub-surface N application**
 - new machinery
 - ammonia loss greatly decreased
- **Improved timing**
 - not all at planting time

Improved training opportunities

- **Professional service providers (contractors)**
- **Farmer cooperation**

Policy decisions

- **Policies**
- **Financial incentives**

Example 2

- **Increase N use efficiency**
- **Decrease N losses**

Barrier:

- **Increased cost**

- **N inhibitors**

- increase N use efficiency by crop where timing of application is incorrect
- decrease emissions to environment

- **Slow release fertilizers**

- alternative to correct timing

Change fertilizer subsidies

- **Subsidise increased cost *instead* of general fertilizer subsidies**

Policy decisions

Summary of recommendations (1 of 2)

| Outcome | Method of achieving | Policies required |
|--|---|-------------------|
| Decreased N applications | More effective information delivery to farmers | (✓) |
| | Professional service providers promoted | ✓ |
| | Fertilizer suppliers required to provide technical information & training | ✓ |
| | Consider regulatory approaches | ✓ |
| Change timing of N applications | Professional service providers | ✓ |
| | | |
| Sub-surface placement | New machines | |
| | Professional service providers | ✓ |
| N inhibitors | Change subsidies – cover <i>extra</i> cost instead of basic cost of manufacture | ✓ |
| | | |

Summary of recommendations (2 of 2)

| Outcome | Method of achieving | Policies required |
|---|--|-------------------|
| Recycle manures | Continue to promote “organic fertilizers” | |
| | Better labelling | ✓ |
| | Training | |
| | Manure management & recycling included in planning of CAFOs | ✓ |
| | | |
| Integrated water and nutrient policies, practices & advice | “Fertigation” where appropriate. Subsidies for initial equipment costs. | ✓ ✓ |
| | | |
| Slow release N | Change subsidies to cover <i>extra</i> cost | ✓ |
| | | |
| Nitrate-based fertilizers | Fertilizer manufacture changes | ✓ |
| | Safety in handling & storage | ✓ |

More details see SAIN Policy Briefs:

No1. Improved Nutrient Management in Agriculture – A Neglected Opportunity for China’s Low Carbon Growth Path

No2. Greater food security and a better environment through improved nitrogen fertilizer management

No5. Policies and technologies to overcome excessive and inefficient use of nitrogen fertilizer: delivering multiple benefits

No6. Improving manure nutrient management towards sustainable intensification in China

<http://www.sainonline.org/english.html>

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