Mechanization of rice production and challenges in China

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1 Status of rice production

2 Requirement of Mechanization

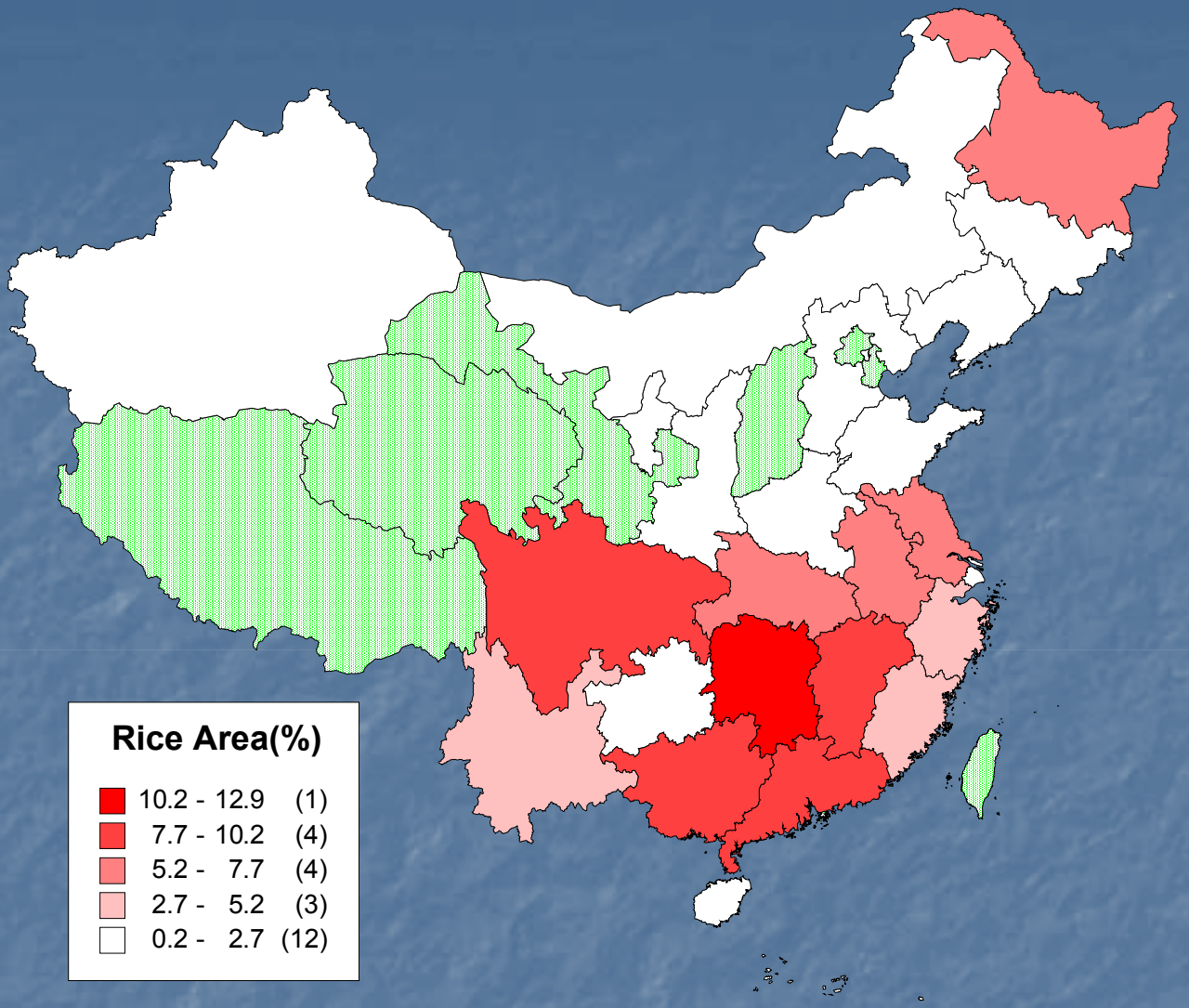
3 Mechanization of rice prod.

4 Rice planting methods

5 Rice planting by machine

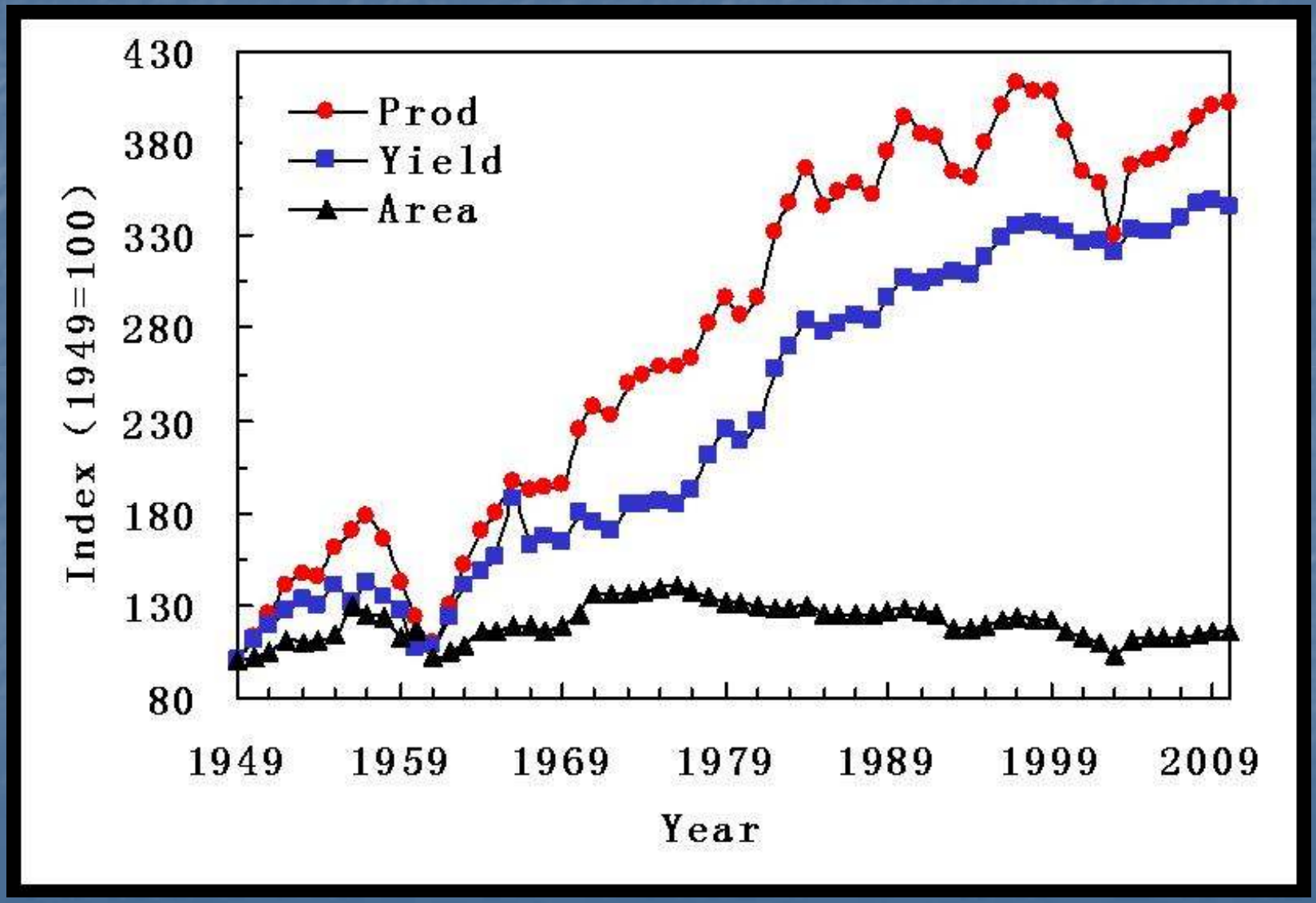
6 Challenges

1 Status of rice production

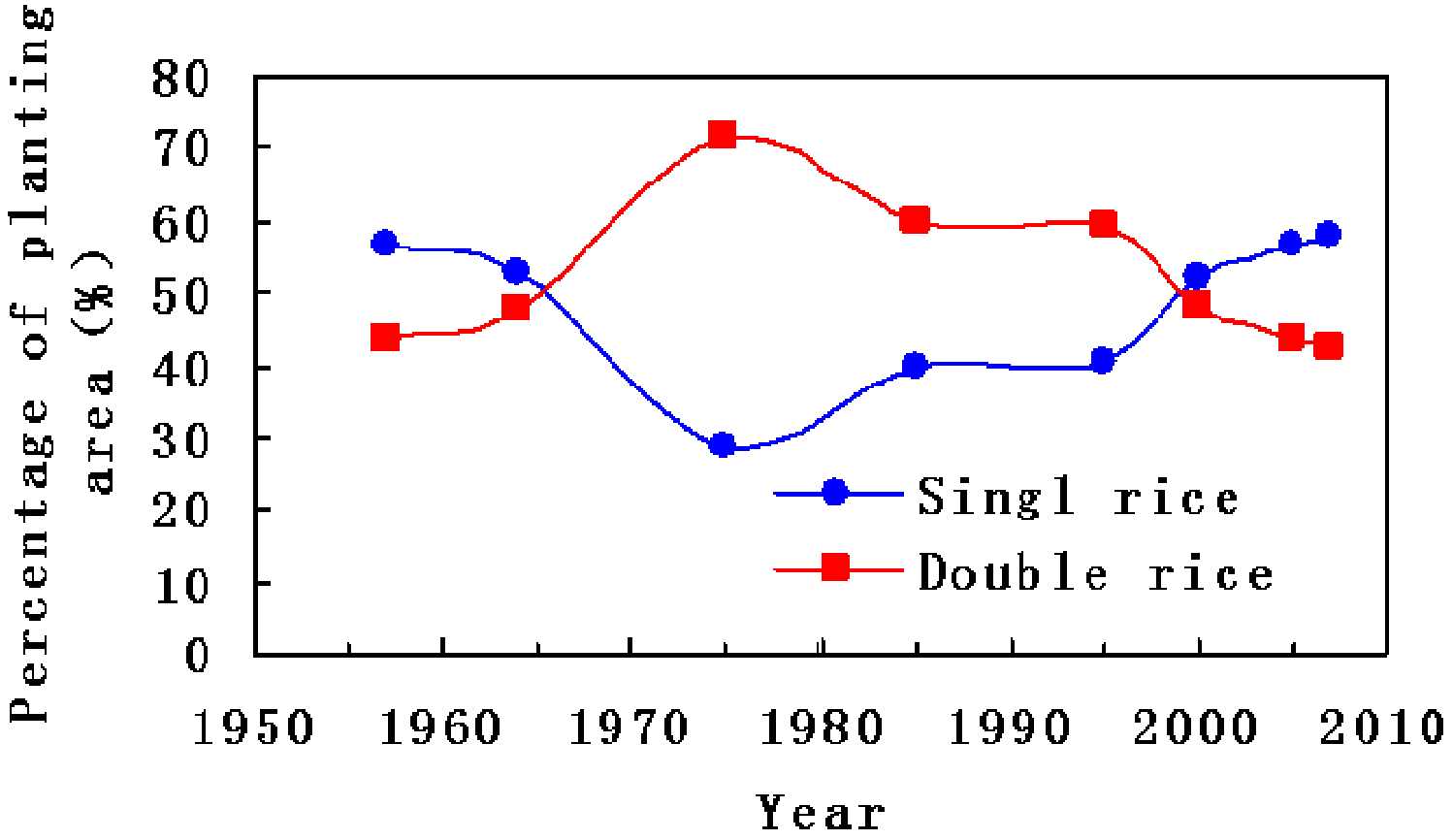


Percentage of provincial rice planting area over Chinese national rice area (2001)

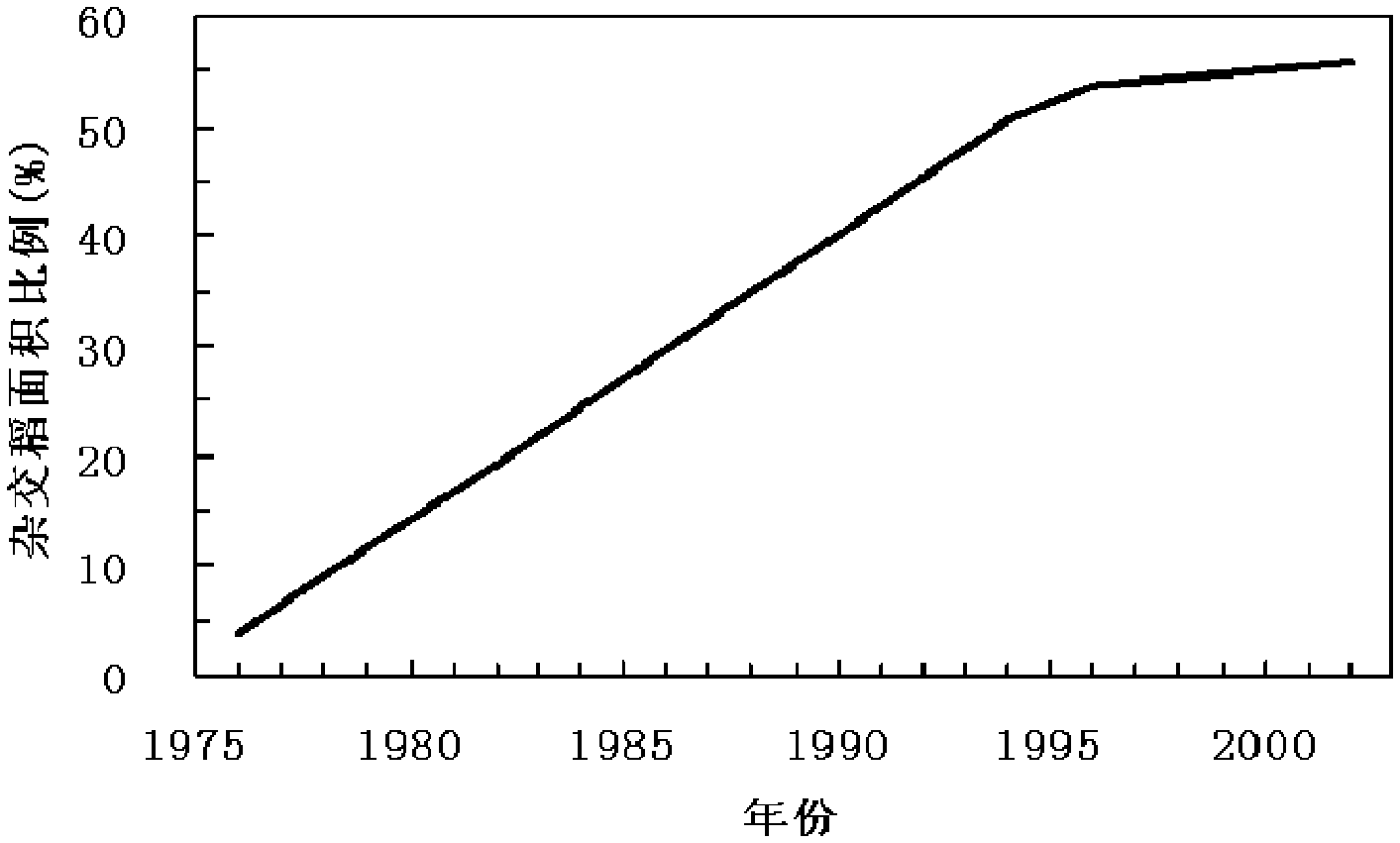
Area, yield and production



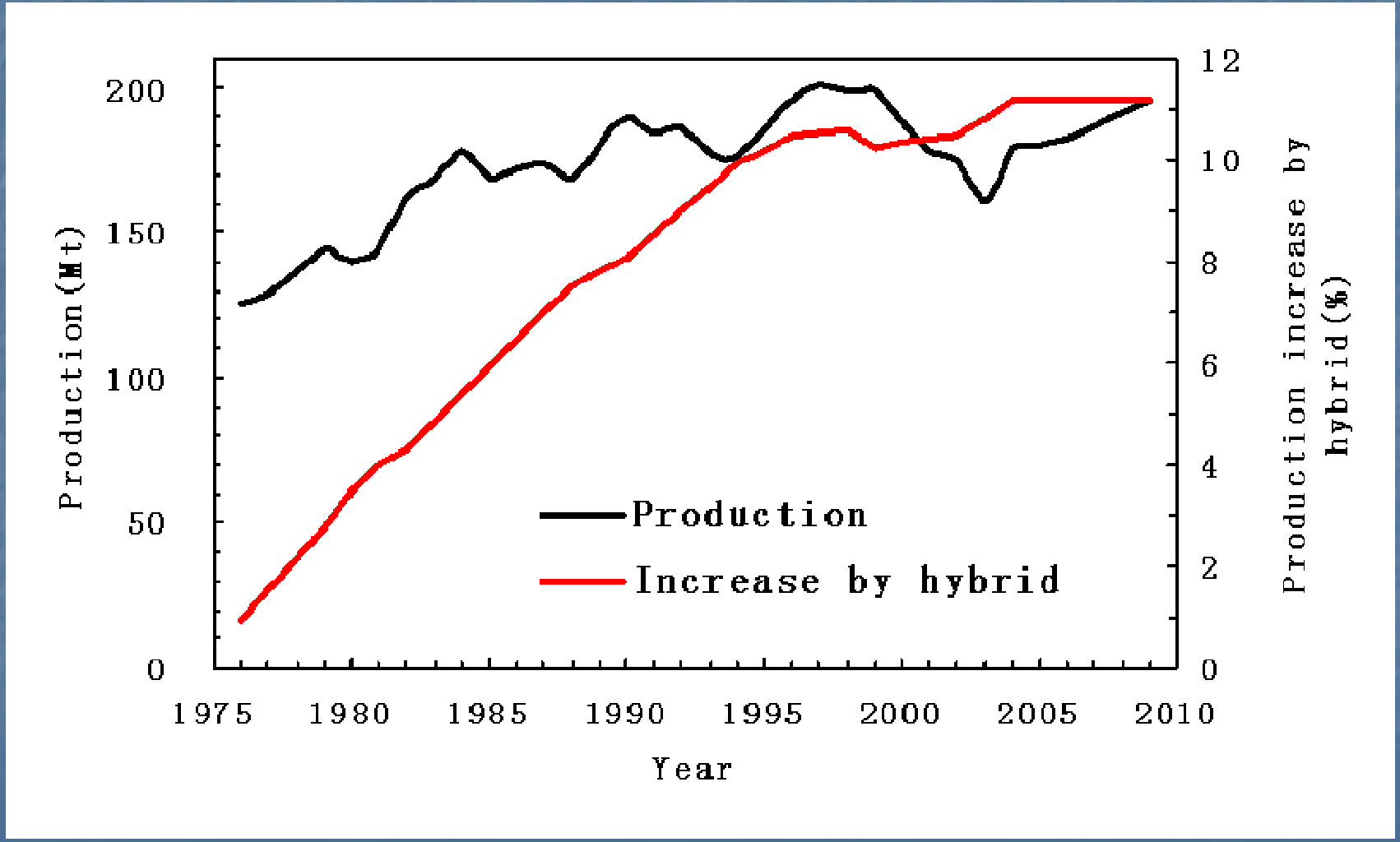
Rice cropping system

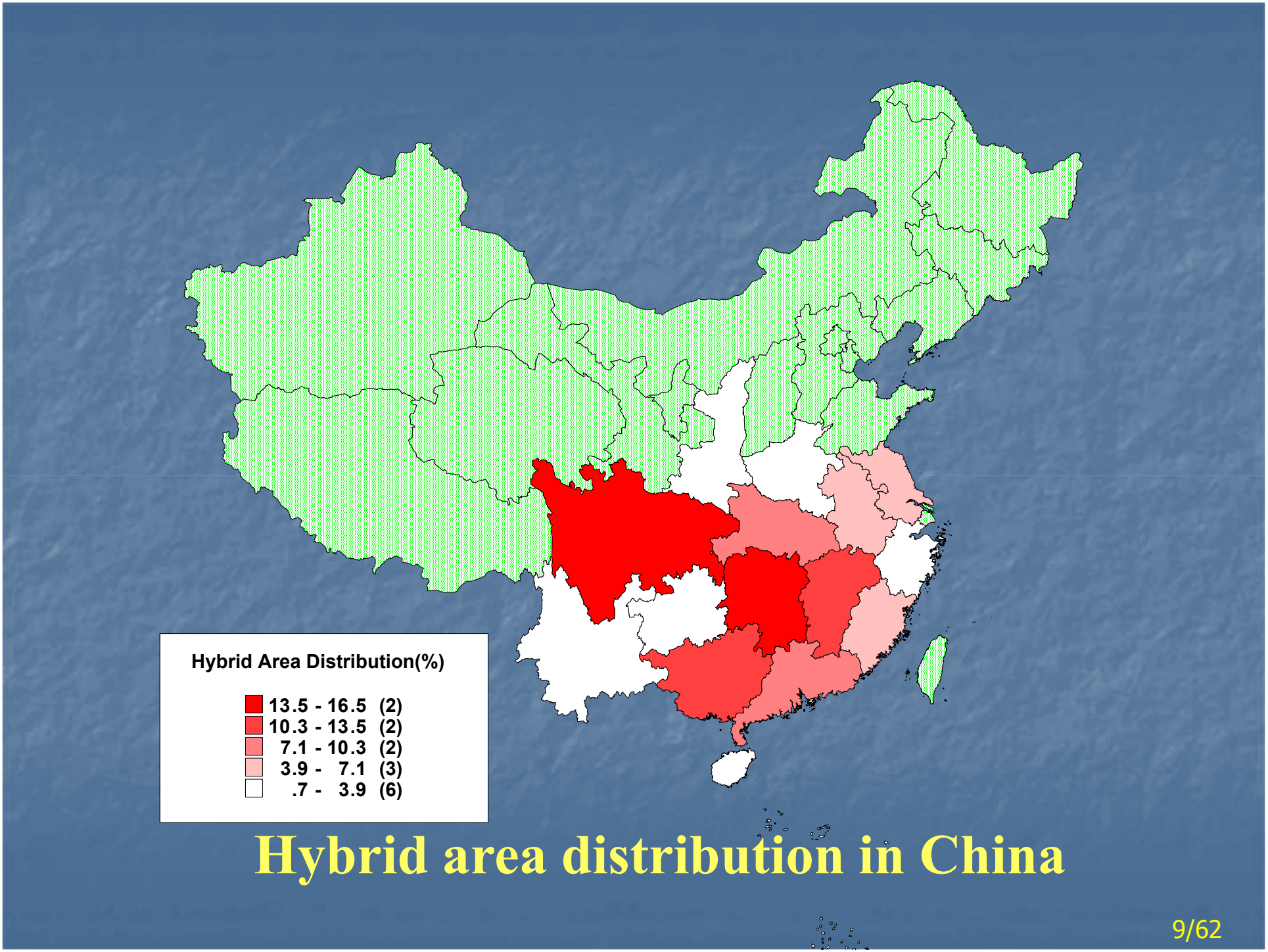


Hybrid rice



Contribution of hybrid rice to rice production in China





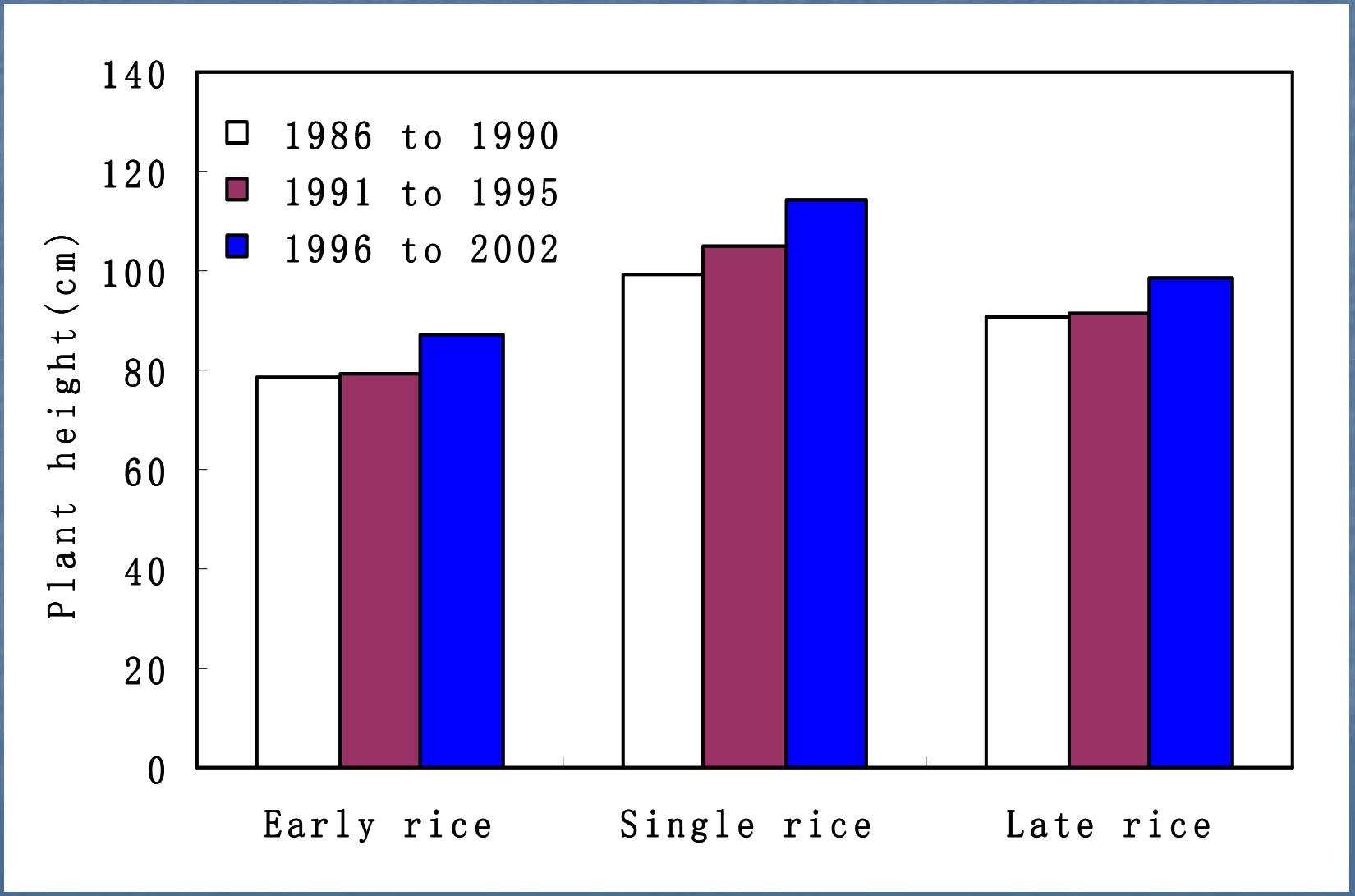
Hybrid area distribution in China

Change of plant type of variety

Traits of Japonica varieties released in Jiangsu

Period	Growth duration (day)	Plant height (cm)	Panicle (no/m^2)	Total grain (no/panicle)
1980-1985	143	69	396	92
1986-1990	145	69	396	93
1991-1995	149	71	370	101
1996-2000	152	98	363	109
2000-2002	152	99	321	122

Plant height of Indica varieties released in region of Changjiang river



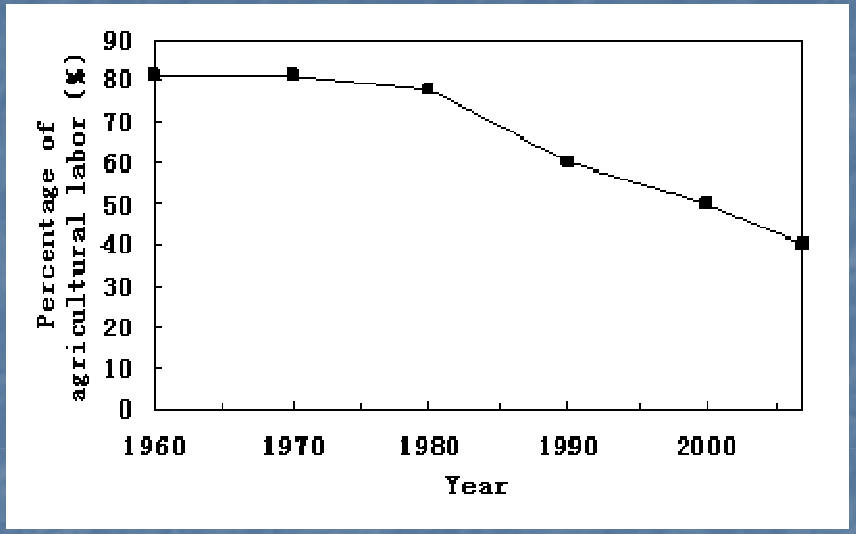
Panicle character of Indica varieties released in region of Changjiang river

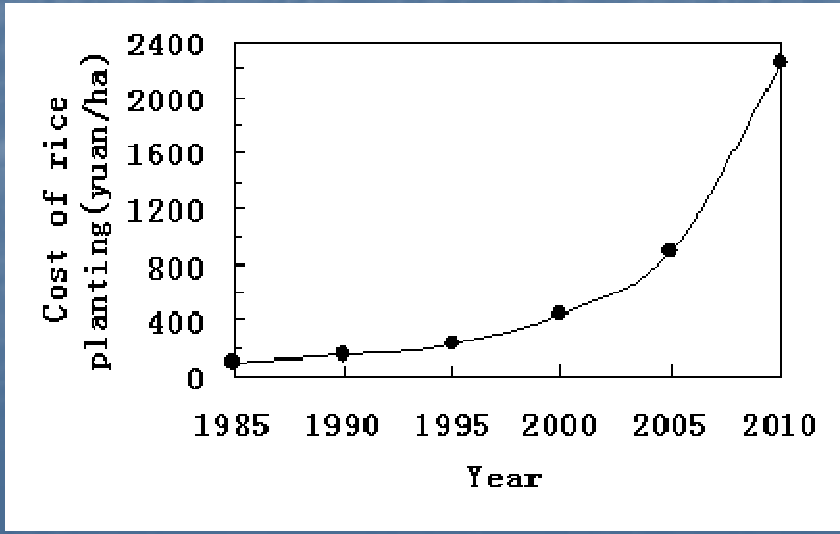
Season	Period	Panicle (no/m2)	Grain number (no/panicle)
Early rice	1986 to 1990	421(100)	75.9(100)
	1991 to 1995	393(93)	81.0(106)
	1996 to 2002	360(85)	101.3(133)
Single rice	1986 to 1990	354(100)	104.5(100)
	1991 to 1995	310(87)	130.7(125)
	1996 to 2002	260(73)	155.2(148)
Late rice	1986 to 1990	343(100)	87.8(100)
	1991 to 1995	337(98)	96.9(110)
	1996 to 2002	288(83)	120.1(136)

2 Requirement of mechanization

2.1 Labor shortage and higher labor cost

- Agri labor transfer
- Higher labor cost
- Delay management time
- Effect on profit
- Strong requirement





2.2 Larger scale rice farm

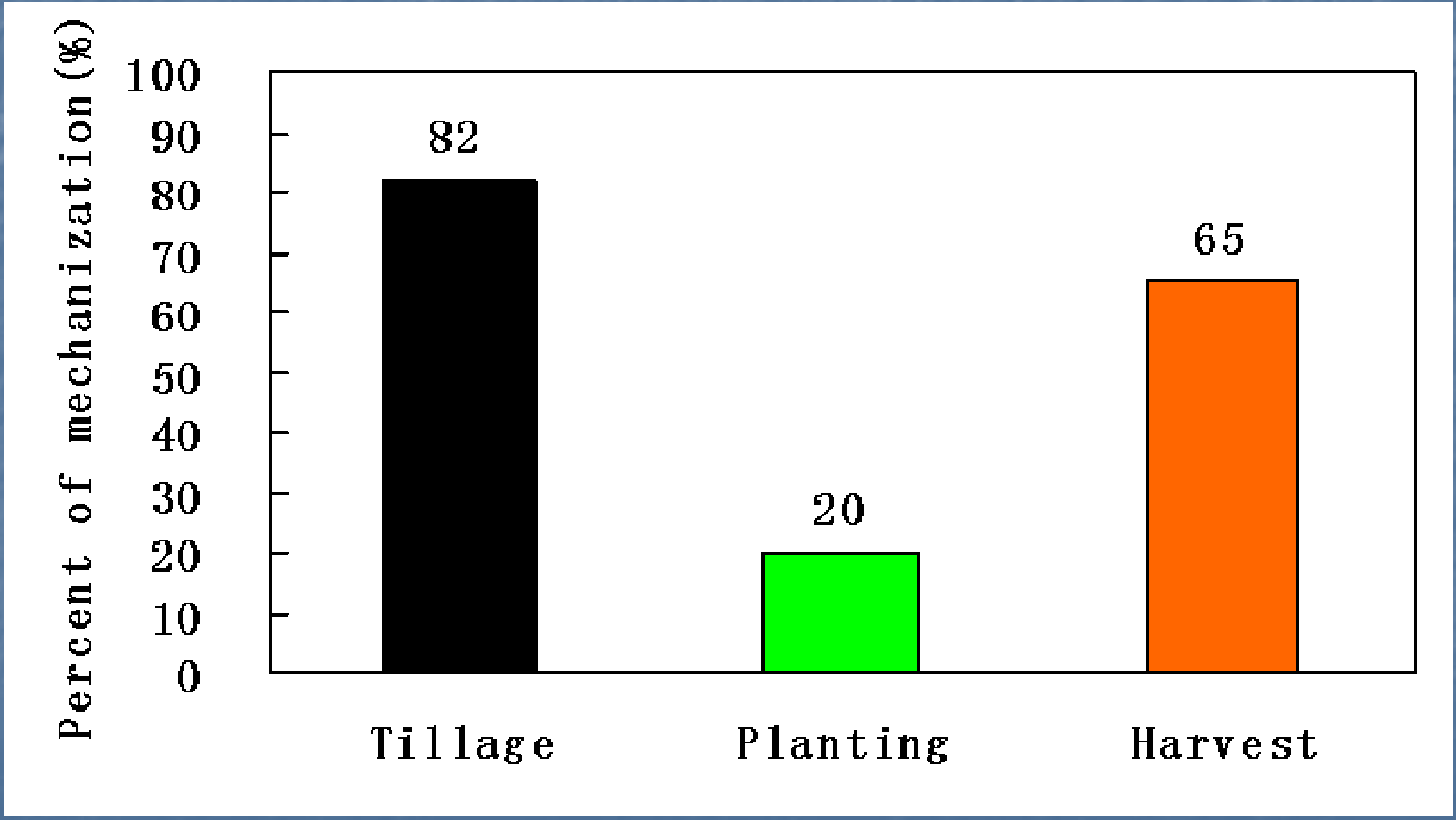
- Large-scale rice farm through land shift
- Low rice profit from small rice farm
- Rice cooperative farm
- Rice management contract(social service)

2.3 Lower labor productivity

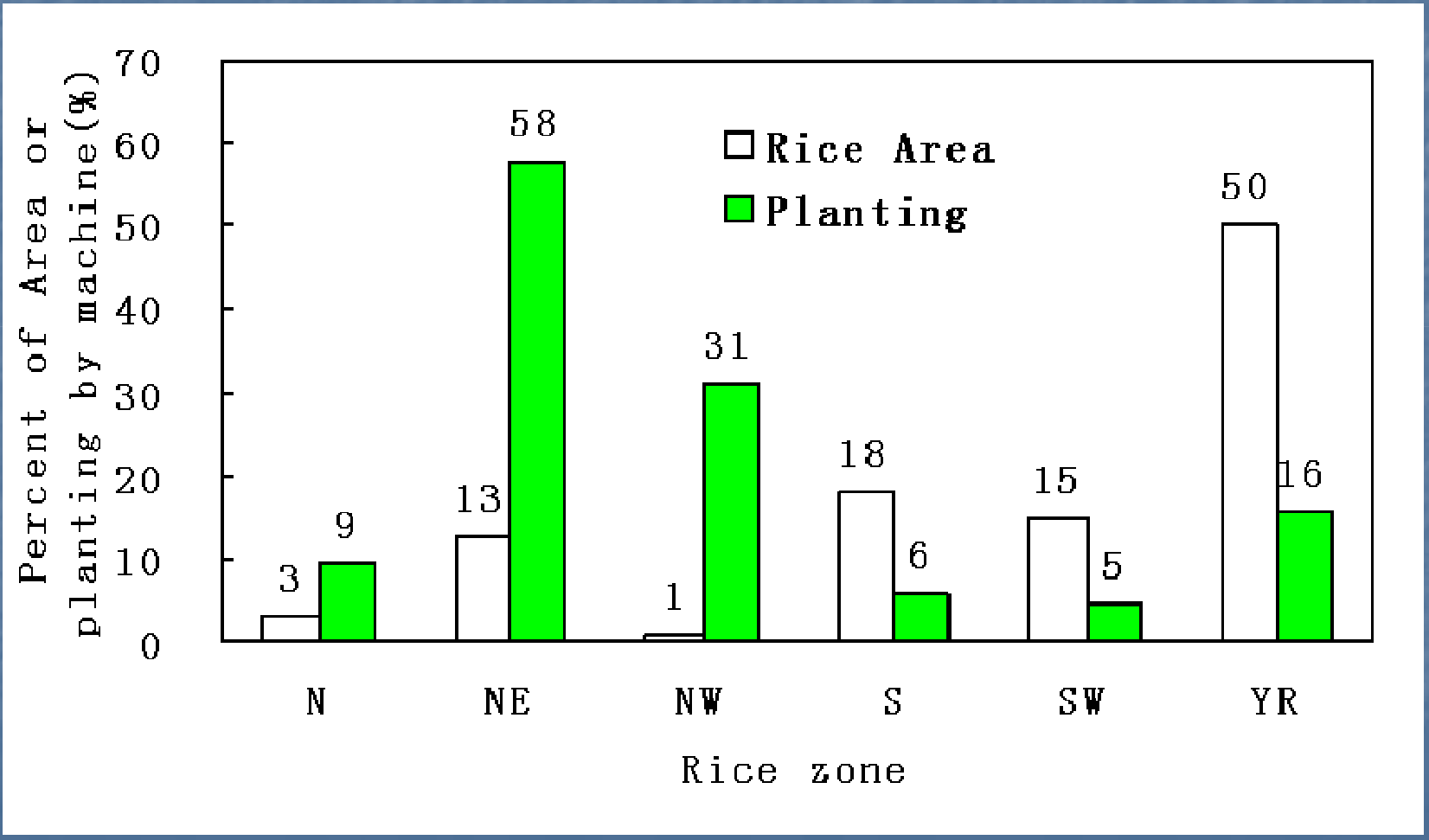
Country	Labor time (hrs/ha）	Relative percent（%）
China	960	100
Japan	19	2.0
Korea	20	2.1
USA	15	1.6

3 Mechanization of rice production

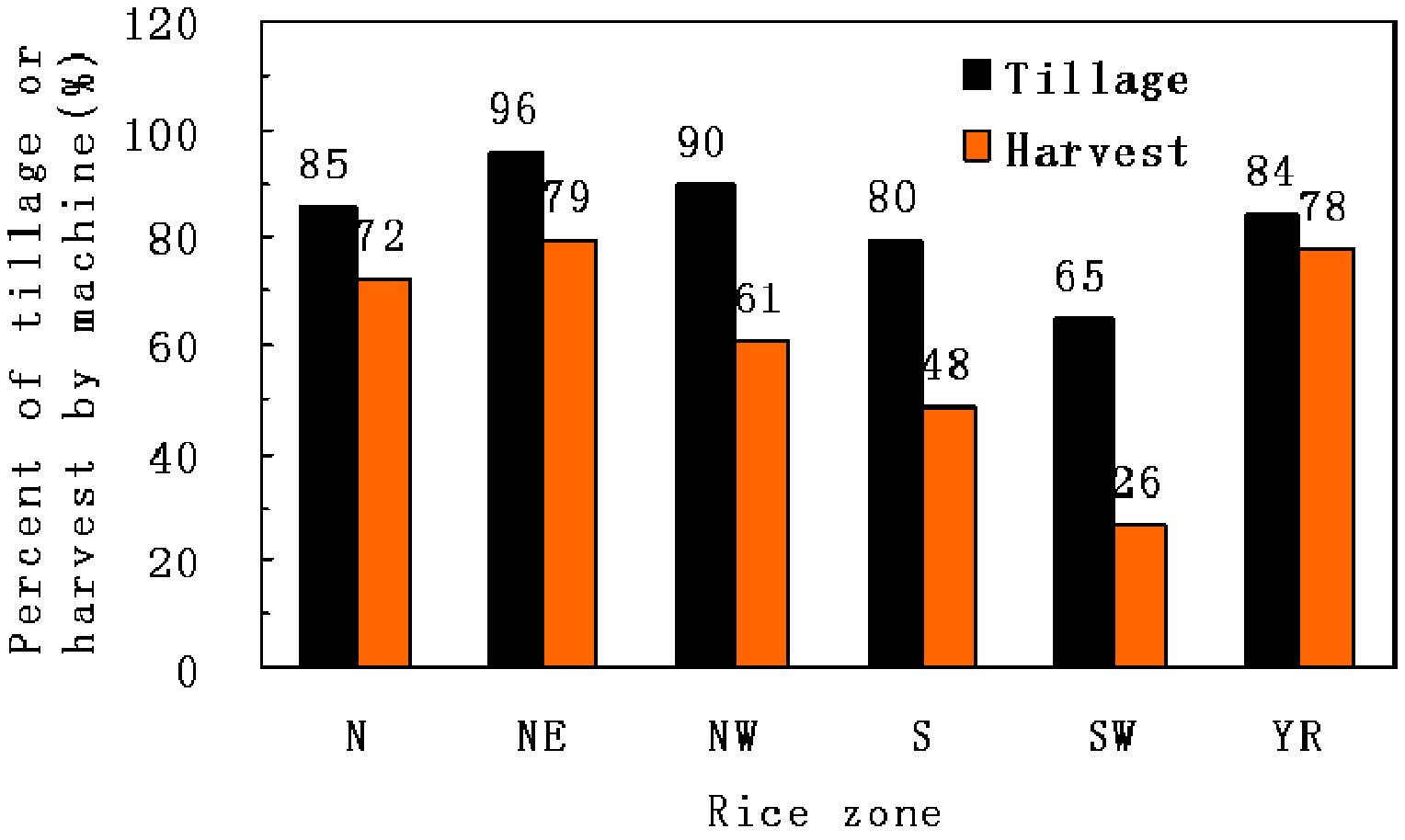
3.1 Mechanization percentage of rice production in country



3.2 Percentage of rice area and machine planting in rice zones



3.3 Mechanization percent of tillage and harvest in rice zones



3.4 Tillage

- Rotation
- Harrow and level

3.5 Ditch digging

3.6 Fertilization

- Basal fertilization
- Dress fertilization

Transplanter with fertilization

3.7 Pesticide and herbicide spraying

- Tractor
- Plane

diversified type of sprayers

- Personal sprayer
- Higher pressure spraying

3.8 Harvest

Combine harvester with straw cutting

4 Rice planting methods

4.1 Planting types

1. Hand transplanting
2. Seedling throwing
3. Direct seeding
4. Machine transplanting
5. Ratoon rice

Hand transplanting

- High cost
- Low efficiency
- Delay planting time

Seedling throwing

- Labor saving
- Higher efficiency
- Enough basic seedling per unit

Direct seedling

- Low labor cost
- Growth season limite
- Higher cost of weed control
- Unstable seedling establishment
- Lodging
- Early senescence

Machine transplanting

- Strong requirement
- Seedling mat transplanting
- Introduced from Japan and Korea

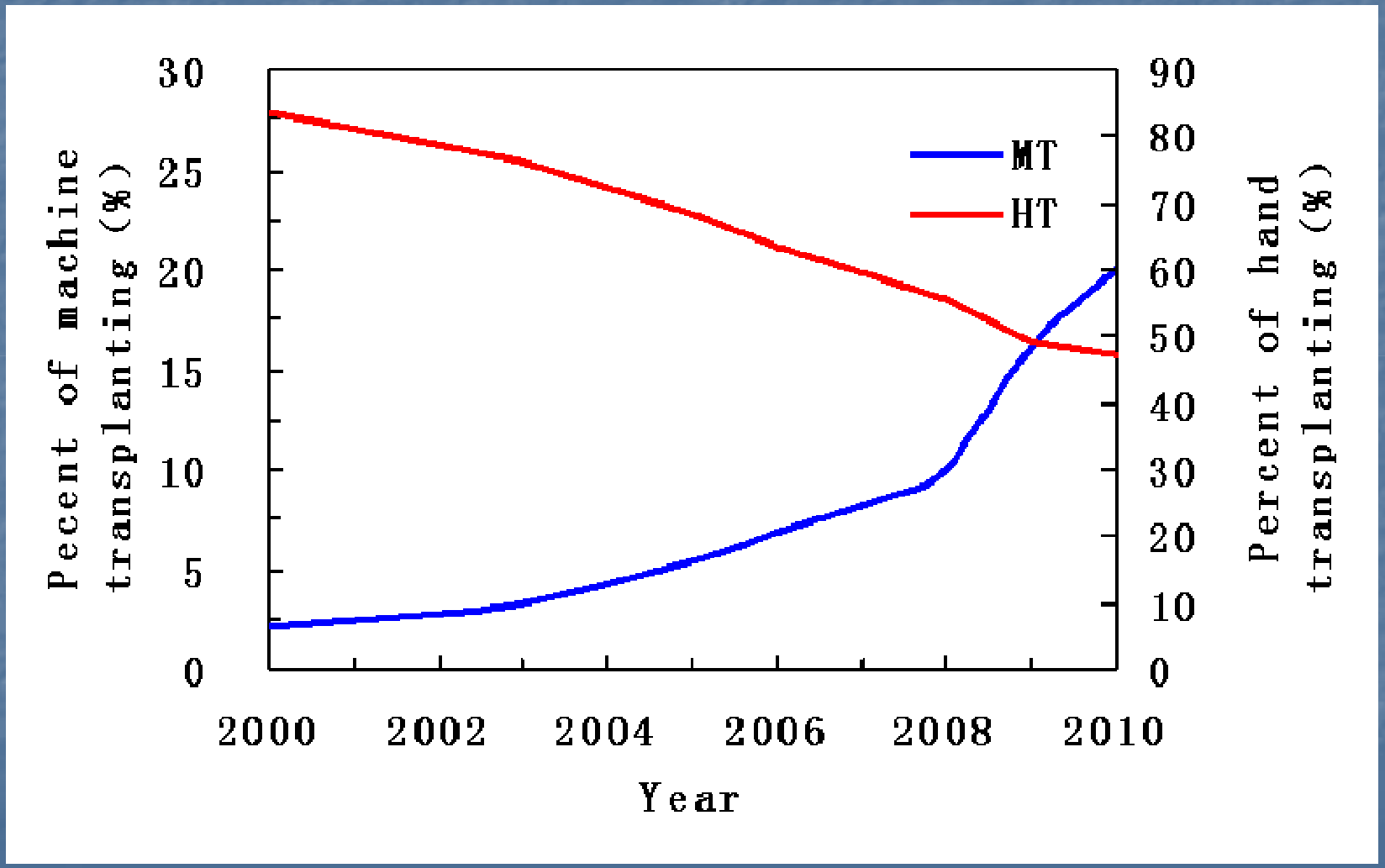
Ratoon rice

Hand harvest to protect stubble

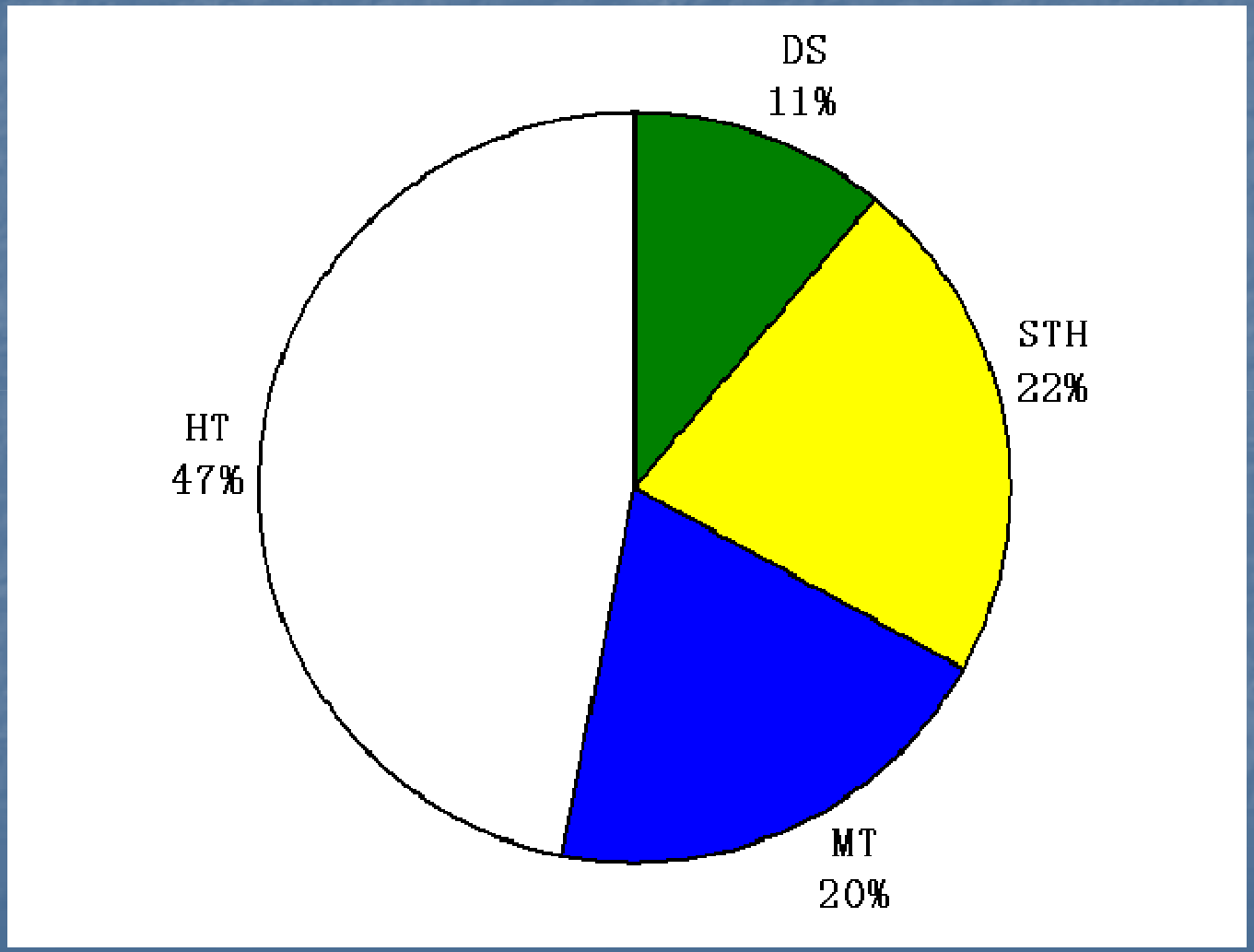
Hand harvest

Machine harvest

4.2 Change of planting methods



Percentage of main rice planting methods



5 Rice planting by machine

5.1 Rice transplanting by machine

Development of machine TR

- Washed seedling transplanting by machine
- Developed in 50’s

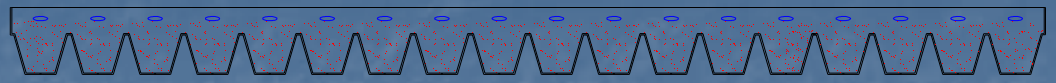
- Seedling mat transplanting by machine
- Developed in 70’s

Types of Machine TR

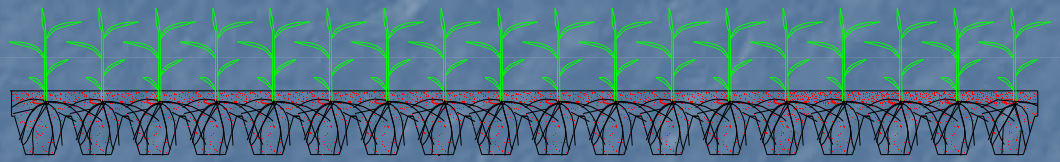
- Mat Seedling transplanted by machine developed in Japan
- Pot seedling putted by machine developed in Japan
- Pot-mat Seedling transplanted by machine developed in China

Comparison among type of Machine TRs

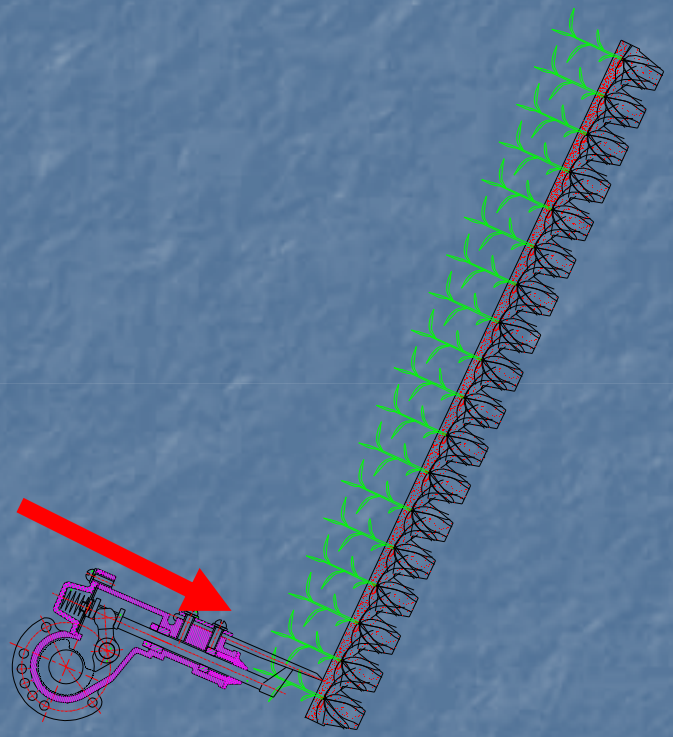
Type	Advantage	Disadvantage
1 Mate seedling	❑ Easy management	❑ Severe damage ❑ Uneven ❑ Long recover
2 Pot seedling	❑ Less TR shock ❑ Uniform ❑ Short recover	❑ Low efficiency ❑ Higher cost ❑ Diff. in seedling
3 Pot-mat seedling	❑ Less TR shock ❑ Uniform ❑ Short recover	❑ More time to pulling



sowing



Pot-mat seedling



transplanting

- Short green-returning period
- Uniform seedling per hill
- Early tillering

Sowing machine

- Machine sowing system
- Field sowing by machine

Seedbed

- Paddy field
- Upland

Machine transplanting

- High speed transplanter
- Hand hold transplanter

Growth stage of rice transplanted by machine

Machine transplanting

- Main rice planting method in China
- Other rice planting methods, including hand transplanting, direct seeding (also machine seeder), seedling throwing, used in specific rice area
- Different kinds of machine transplanting to be developed to adapt to rice systems and conditions
- Seedling raising method is key point in machine transplanting

5.2 Rice direct seeding by machine

Dry seeding

- High speed seeder
- Hand tractor seeder

Wet or water seeding

broadcasting

Direct seedling -- drill

No water rice direct seeding

- High seed rate per unit
- Low seedling establishment rate, 30%
- High percentage of hybrid, 60%
- Small rice filed

Main limitation of direct seeding

5 limiting factors

- Growth season limitation
- Unstable seedling establishment
- Higher cost of weed control
- Lodging
- Early senescence

6 Challenges

6.1 Hybrid seed production

In Asia

In United Sates

6.2 Machine transplanting

- Large amount of seeds per unit, high cost of seed for hybrid
- Short seedling age to limit growth duration of CV
- Few varieties used for to late rice in double rice system
- Lower seedling quality and short suitable transplanting period, normally 2-4d
- Requirement of large amount of seedling soil

6.3 Integration of agronomy and mechanization

- Machine design based on agronomic requirement
- Machine planting
  - Seedling raising, CV traits, Management
- Special machine needed
  - Machine for hybrid seed production
  - Ditch digger
  - Seeder in field for MT
  - Combine harvester with straw cutting
  - Ratoon rice

6.4 Research Priority

- Suitable variety and its traits
- Cropping system
- Seedling raising
- Suitable row distance of MT adaptable to rice seasons, CV type, hybrid seed production
- Crop management, fertilizer, water, pest control and natural disaster mitigation


Thank you