

Lecture 20
Rice

Oryza sativa, Poaceae or Graminae, Tribe Oryzeae



Rice is the most important world cereal.
It is a staple for over half of the human population and is eaten three times a day in Asia.
Unhusked rice is called paddy rice; (paddy also refers to the growing crop).
Husk is removed by milling (mortar & pestle still used in some areas).
However, unlike wheat where “flour” is used for baking bread and other products, rice grains are usually consumed whole.

History

An ancient crop, native to SE Asia.
Cultivated in China for 5000 years.
Originated from forms of *Oryza perennis*.
Plays an important part of ancient customs, religions, and magical rites.
Rice is a symbol of fecundity and plenty; the custom of throwing rice at newly-weds is borrowed from an ancient eastern fertility rite.

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Uses

Food uses: boiled rice, rice flakes, puffed rice, rice pudding, risotto, ground rice for confectionery, glutinous rice for sweet meats.

Nonfood uses: rice powder, starch, sake (wine), Husks are used as a mix for concrete, rice oil for cooking, straw is used for thatch (poor for feeding). **Note:** rice paper is not made from rice.



Sticky rice for sushi



Rice and curry on banana leaves, Ceylon

Types of Rice

Hill rice:

Upland or dryland rice
Need good rains for 3-4 months

Swamp rice:

Lowland rice
Grown in irrigated or flooded areas

Floating rice:

Grown in areas of deep flooding (up to 0.5 m or more) keeping pace with flooding

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Texture

Hard (vitreous): the main rice of commerce.

Soft dextrinous: glutinous rice (does not contain gluten the protein that causes wheat to rise in bread)
Sticky and cloying in cooking, e.g. pearl rice grown in Japan.
Used for sweetmeats in Japan, molded for sushi.

Americans do not like sticky rice.
(First cooking lesson of new American brides used to be to make each grain of rice abhor its neighbor.)

Instant rice: this rice is precooked, unsticky.

Grain Shape

Extra long	> 7mm	Asian rice
Long	6-7	Asian rice
Middling	5-6	Grown in US, softer than long grain
Short	< 5	

Season

Very early <110 days
Early 110-140 days
Late 150-170 days
Very late >180 days

2001 World Production

Continent	1000 tonnes	Chief countries
World	592,831	
Africa	16,974	Egypt (5,700), Nigeria (3,298), Madagascar (2,300)
North America	12,041	US (9,664), Dominican Rep. (698), Cuba (350)
South America	19,543	Brazil (10,207), Colombia (2,107), Peru (2,019)
Asia	539,842	China (181,515), India (131,900), Indonesia (50,096)
Europe	3,171	Italy (1,222), Spain (888), Russian Federation (497)
Oceania	1,261	Australia (1,239), Fiji (16), Solomon (5)

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Botany

Diploid ($2n = 24$) but triploids and tetraploids also exist.

Freely tillering grass, usually 50–150 cm tall.

Normally self pollinate with outcrossing 0–4.5%.

Indica and other photoperiodic rices have a slow seed dormancy, require 1–3 months rest for maximum germination.

Optimum germination temperature is 30–35°C (86–95°F)

Two Subspecies

<i>Indica</i> Tall leafy High tillering Lodges easily Low response to N Photoperiod sensitive Short day plants (requires short days to flower)	<i>Japonica</i> Short stiff straw Low tillering Resistant to lodging High response to N Photoperiod insensitive Hardy Disease resistant
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Culture

A tropical crop but grown extensively in subtropical and warm temperate climates.

Requires 4–6 months of 68–77°F (20–25°C) and minimum of 50°F (10°C)

Water Requirements

Lowland rice
Requires 800–2400 mm (72–96") of rain, requires 750 mm (30") over 3–4 months.
Cannot tolerate desiccation.

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Upland rice

Requires 500–1200 mm (24–48") of rain.
Typically short day plant but some photoperiod insensitive types ("Green Revolution" rices) are photoperiod insensitive.
Requires 8–10" of soil for root penetration.
Less important than paddy rice.
Popular in Brazil.
Typically is grown under shifting cultivation.
Seed is broadcast or dibbled in.

Floating rice

Grown under deep flooding, can grow 53 cm in 4 days, crop requires 7 months or more.
In Bangladesh can be harvest from boats.

In paddy or swamp rice (wet rice) land is inundated; crop grown in water by flooding.

Usually grown by small holders with 1–5 acres requiring 400 person hours per acre.

Grown during the monsoon in *Am* climates; 2–3 crops can be grown, in some cases as a ratoon crop, that is, by repeat tillering.

There is little fertilization in Asia because a blue-green algae fixes nitrogen with *Azotobacter*, thus wet rice can be grown continuously in a sustainable system.

Soil structure is not a problem.

Planting is usually by transplants which are direct seeded in a nursery.

Two Systems of Wet Rice Cultivation

Traditional Systems

Traditional wet rice is completely grown with hand labor.

Seed (50–60 kg/ha) is sown in small nursery.

Seedlings are transplanted by hand in 30 cm rows when 2 months old in paddies separated by dikes in which water flows by gravity in sluggish current.

Dikes are usually permanent and can be planted to fruit trees in to hold earth in place (China).

Harvest by hand, panicle by panicle.

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Mechanized Systems

Seeded by airplane, or transplanted by machine.

Weeded by chemicals, harvested by combine.

Presoaked seed is planted in fields flooded 2.4–5 cm (1–2") and maintained until plant is 15–20 cm.

Water level is then raised to bring depth to 10–15 cm.

Fields are drained a week before grain is ripe, approximately 3 weeks after flowers.

High fertilization is carried out and good weed control is essential.

Many weeds will not sprout if the field is kept flooded.

Processing (Milling)

Husk must be separated from the seed.

This can be done in a mortar and pestle type apparatus or by machinery.

Grain consists of seed coat and aleurone layers (= bran) and embryo and starchy endosperm.

Vitamin B₁, thiamin is found in the aleurone layers.

Lack of vitamin B₁ leads to the beri-beri disease.

Unpolished rice is called brown rice; does not store as well as white polished rice.

Polishing removes last of the bran and the embryo and thus eliminates all of vitamins.

White polished rice contains starch and little else.

Parboiling is a system to boil the rice in the husk (paddy rice).

This gelatinizes the outer layers of starch and allow it to absorb part of vitamins.

Stores better than unpolished rice.

Storage

White polished rice stores the best

Polished > parboiled > milled unpolished.

Rice Improvement

Main agency is the International Rice Research Institute (IRRI), Los Banos, Philippines.

IR8 = miracle rice (*indica* × *japonica*), fertilizer responsive, lodging resistant, photoperiodically insensitive.

Similar varieties developed in Taiwan by Japanese between 1900–1930.





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Rice Paddies, Bangkok, Thailand

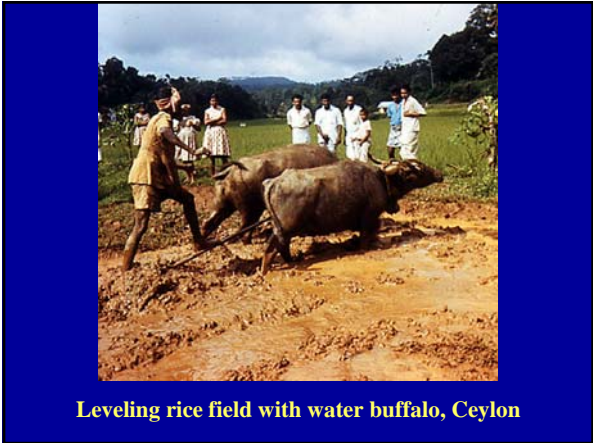




Plowing paddy by hand, Ceylon

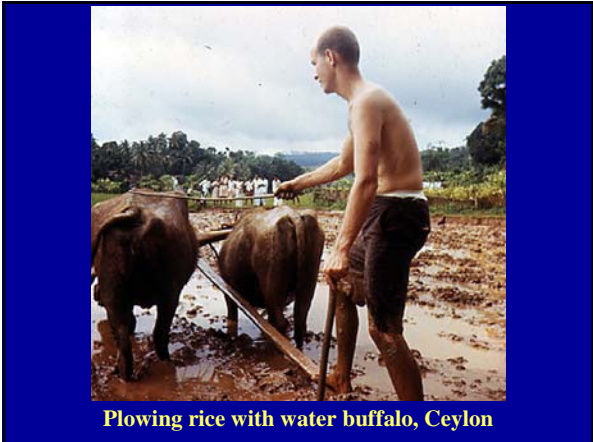
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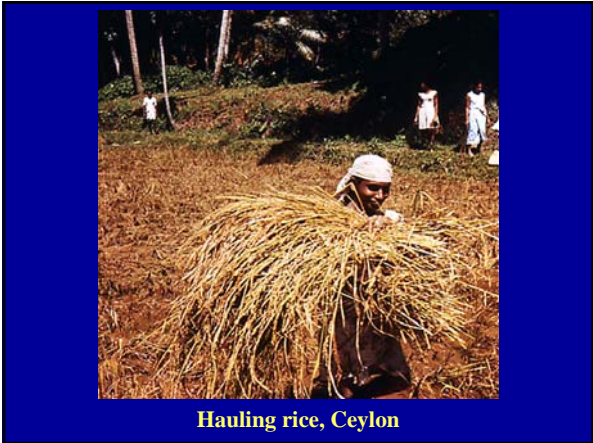






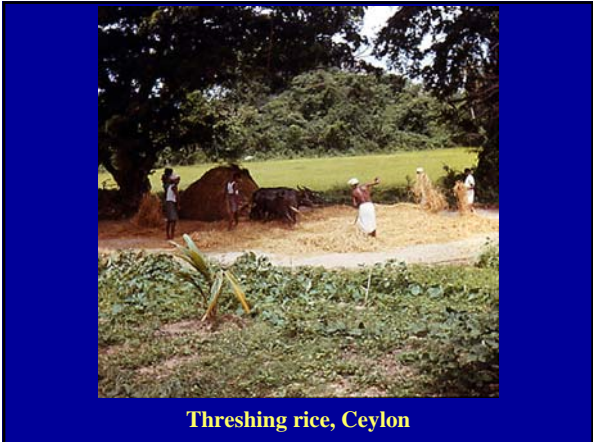
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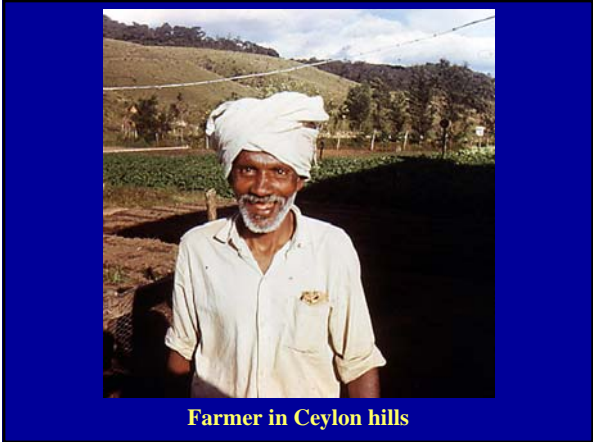




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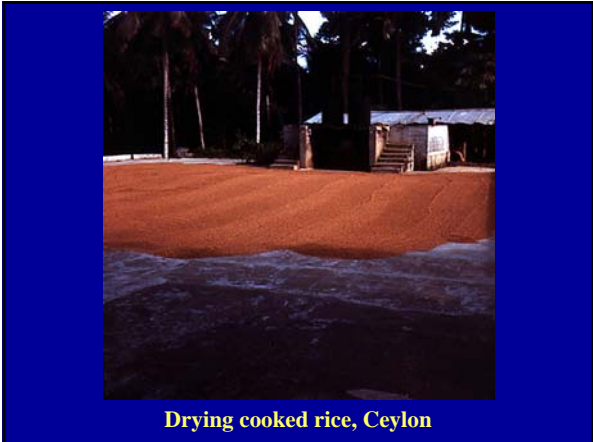
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Rice paddy near Bandung, West Java



Rice paddy, Bali, Indonesia



Rice paddy near Bandung, West Java, Indonesia

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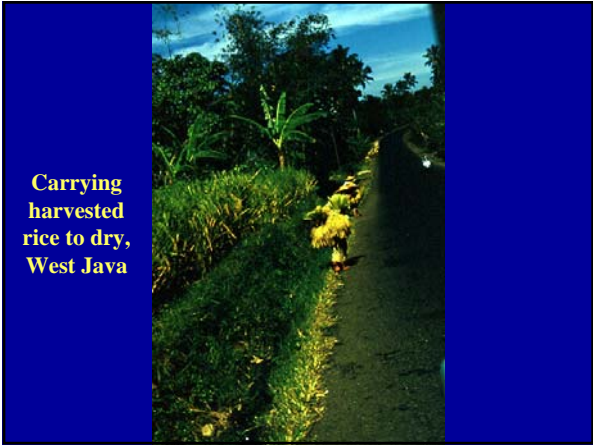






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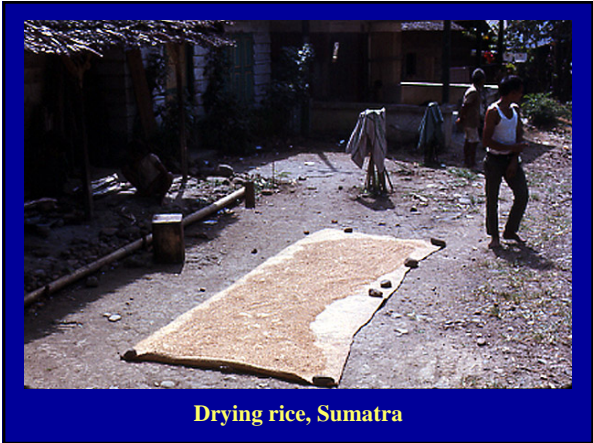






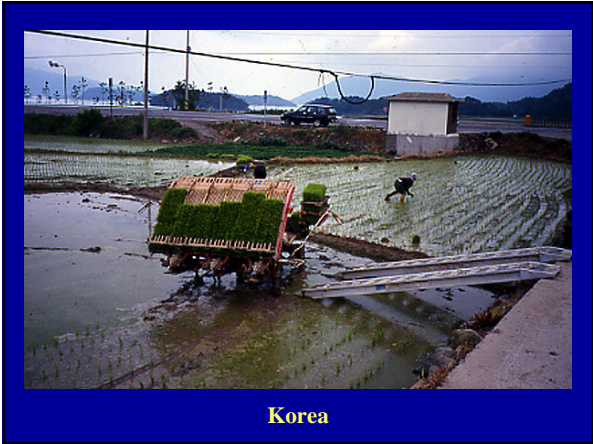
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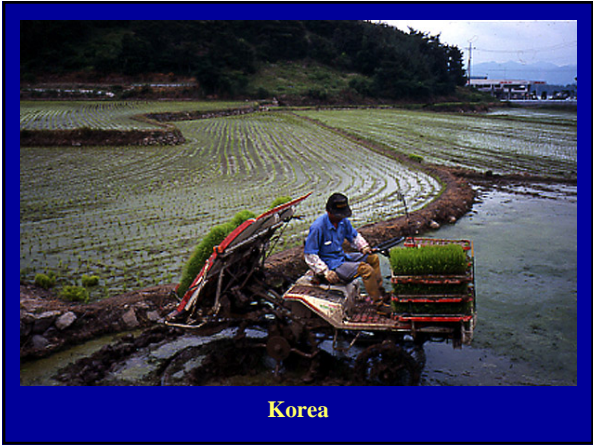






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Korea



Upland rice, dry land plowing, Ceylon

Dryland Rice



Upland rice clearing in forest for rice, Maranhao

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Rice cultivation, Mariana, Minas Gerais, Brazil



Hand threshing of dry land rice, Minas Gerais triangle, Brazil

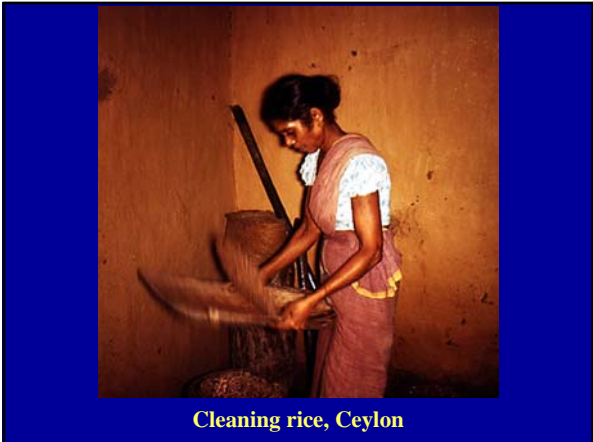


Hand threshing of rice, Minas Gerais triangle, Brazil

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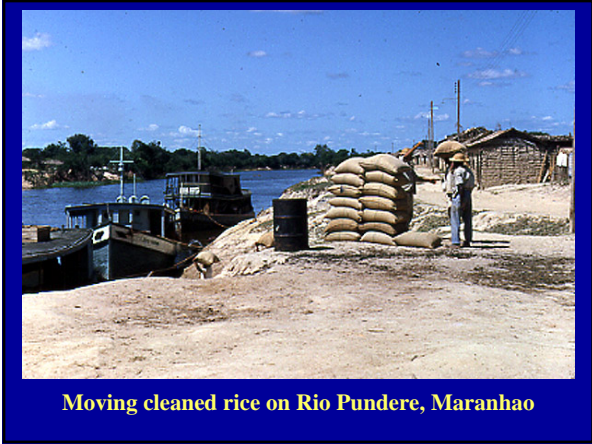
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Carrying rice



Carrying rice harvest, Maranhao

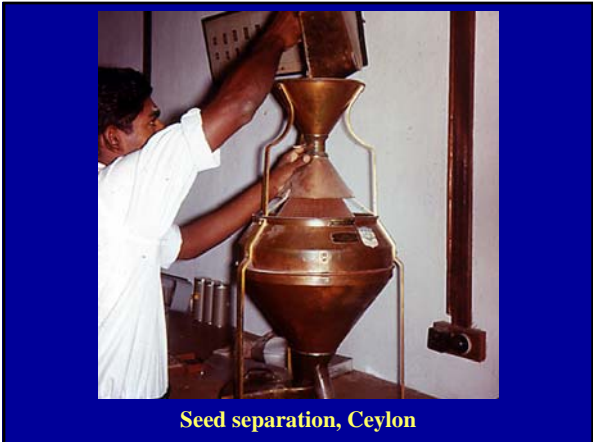


Moving cleaned rice on Rio Pundere, Maranhao

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