System of Rice Intensification (SRI) and Other Natural Rice Farming Approaches






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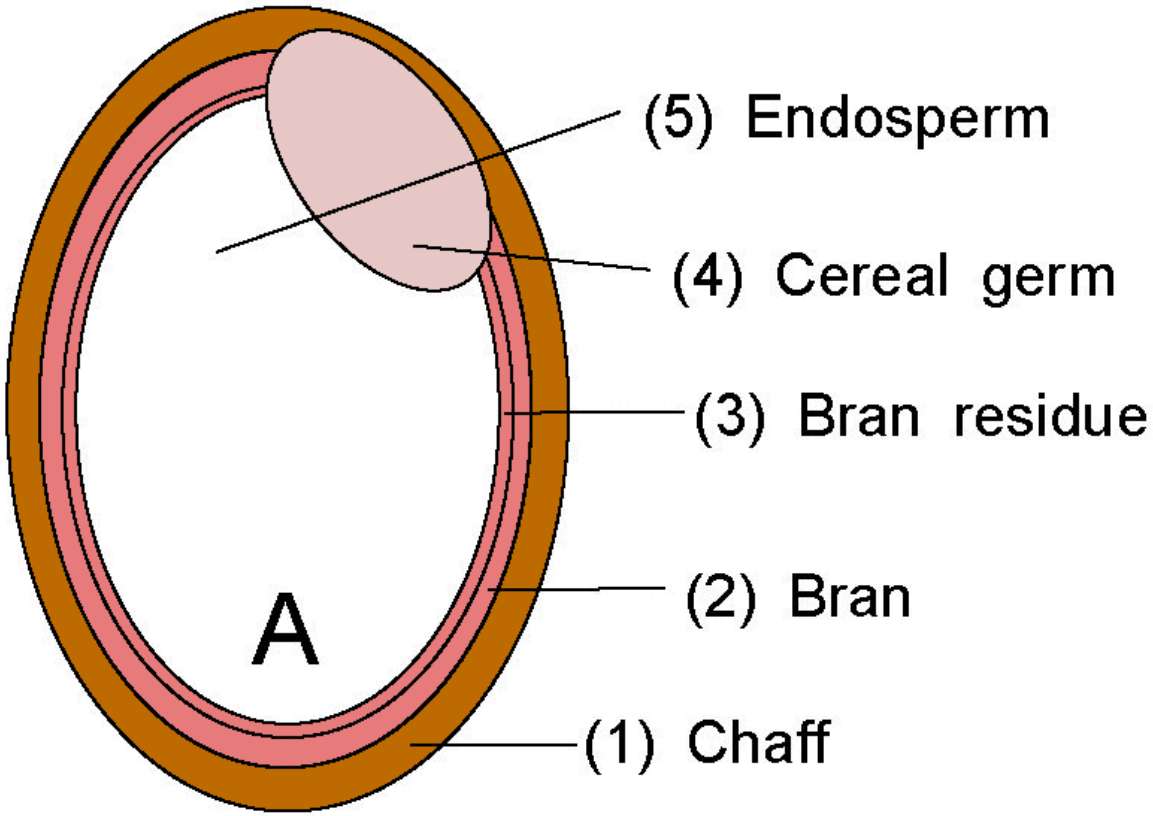
KNOW YOUR RICE

- Rice, a monocot, is the most important staple food for a large portion of the world's population
- The world's second largest grain crop (after corn)
- The most important grain with regard to human nutrition and caloric intake, providing 1/5 of the calories consumed by all humans

Wikipedia; Rice http://en.wikipedia.org/wiki/Rice

KNOW YOUR RICE



http://upload.wikimedia.org/wikipedia/commons/7/72/Rice_Animation.gif

KNOW YOUR RICE

How rice compares with other grains nutritionally

Synopsis of Staple food composition	Amaranth	Wheat	White Rice	Sweet Corn	Potato
Component (per 100 g portion)	Amount	Amount	Amount	Amount	Amount
water (g)	11	11	12	76	82
energy (KJ)	1554	1506	1527	360	288
protein (g)	14	13	7	3	1.7
fat (g)	7	10	1	1	0.1
carbohydrates (g)	65	52	79	19	16
fiber (g)	7	13	1	3	2.4
sugars (g)	1/7	0.1	>0.1	3	1.2
iron (mg)	7.6	6.3	0.8	0.5	0.5

http://en.wikipedia.org/wiki/Rice

Key Types of Rice

White rice is created by milling away the bran (all of the husk as well as the germ). White rice, which keeps longer, lacks some important nutrients.

http://en.wikipedia.org/wiki/Rice

Key Types of Rice

Brown rice is unmilled or partly milled rice which as a mild nutty flavor, is chewier and more nutritious than white rice. Will go rancid more quickly because the germ (which is removed to make white rice) contains fats that can go bad. All types of rice can be eaten as brown rice.

Wikipedia http://en.wikipedia.org/wiki/Brown_rice

Key Types of Rice

The grains of **long-grain rice** (having high amylose – a starch component) tend to remain intact after cooking.

Key Types of Rice

Glutinous rice (*Oryza sativa* var. *glutinosa* **or** *Oryza glutinosa***;** also called **sticky rice**, **sweet rice**, **waxy rice**, **botan rice**, **biroin chal**, **mochi rice**, and **pearl rice**) is a type of short-grained Asian rice that is especially sticky when cooked.

http://en.wikipedia.org/wiki/Glutinous_rice

Key Types of Rice

Red rice is a type of non-glutinous long grain rice. It is similar to brown rice in that it is unpolished with the color of the bran being red, purple or maroon. Only the husks of the rice grains are removed during the milling process, retaining all the nutrients, vitamins and minerals intact in the bran layer and in the germ.

http://en.wikipedia.org/wiki/Red_Cargo_rice

Types of rice

Purple or black sticky rice is typically used for desserts

Key Types of Rice

Basmati rice a variety of long grain rice grown in India and Pakistan, notable for its fragrance and unique flavor

http://en.wikipedia.org/wiki/Basmati

Types of Rice

Thai jasmine rice, sometimes known as *Thai fragrant rice*, is a long-grain variety of rice that has a nutty aroma and a subtle *pandan*-like flavor. The grains will cling when cooked, though it is less sticky than other rices as it has less amylopectin. It is also known as Thai Hom Mali.

http://en.wikipedia.org/wiki/Jasmine_rice

Key Types of Rice

Japanese rice is a short-grain variety of rice (*Oryza sativa var. japonica*) which is characterized by its unique stickiness and texture.

http://en.wikipedia.org/wiki/Japanese_rice

Key Selections of Rice

Upland rice landrace

HYV in NE India

Golden Rice

Key selections of rice seed include:

- **Landraces** – Locally adapted; lower yields; diverse – endangered.
- **High-Yielding Varieties** (HYVs) – Dev. during Green Revolution in 1960s – by 1998 HYVs covered about 70% of rice growing areas (FAO). Agricultural chemical inputs required.
- **GMO rice** – Varieties genetically modified to be resistant to herbicides; Golden Rice – Can biosynthesize beta-carotene, a precursor of pro-vitamin A in the edible parts of rice. None in commercial production yet.

Rice By-Products

Rice husk for bedding

Charred rice husk for soil amendment

Rice husk used as fuel for gasifier stoves

Rice hulls (or **rice husks**) are the hard protecting coverings of grains of rice. In addition to protecting rice during the growing season, rice hulls can be put to use as building material, animal bedding, fertilizer or soil amendment, insulation material or fuel.

http://en.wikipedia.org/wiki/Rice_hulls

Rice By-Products

Village rice mill

Rice bran

Bran is the hard outer layer of grain and consists of combined aleurone and pericarp. Bran is particularly rich in dietary fiber and essential fatty acids and contains significant quantities of starch, protein, vitamins and dietary minerals. Rice bran is a by-product of the rice milling process (the conversion of brown to white rice). Rice bran can be processed into a healthy oil and is used as livestock feed or feed supplement.

http://en.wikipedia.org/wiki/Bran

Rice By-Products

Straw for mushrooms

Multi-purpose rice straw

Rice straw mulch

Rice straw is used as animal feed, mulch, medium for mushroom production, building material and insulation. Some farmers recycle straw back into the paddy soil.

Rice Production Ecology



Rice can be grown in different environments, depending upon water availability

- **Lowland, rainfed**, which is drought prone, favors medium depth; waterlogged, submergence, and flood prone
- **Lowland, irrigated**, grown in both the wet season and the dry season
- **Deep water** or floating rice
- **Coastal Wetland**
- **Upland rice**, known for its drought tolerance

http://en.wikipedia.org/wiki/Rice

Global Rice Production Concerns

Rice yield growth has slowed considerably in recent years and has failed to keep up with population growth, leading to shortages and higher prices that have adversely affected the poor. This was demonstrated by the food crisis and the rice price spike experienced in 2008 (IRRI). Factors leading to slowed global rice production include:

- **Rising temperatures** during the past 25 years have already cut the yield growth rate by 10-20 percent in several locations (IRRI).
- **Urbanization** (less land devoted to rice production).
- **Increased pest pressure** (e.g., brown planthopper); often due to over fertilization of crops and increased pesticide resistance.
- **Decreased water availability** (climate change and overuse).
- **Increased salinity** (increased saltwater intrusion).
- **Rising farm debts** and **falling income** resulting in fewer farmers.

Upland Rice Production

Traditional shifting or swidden production

Upland Rice Production

Burning slashed vegetation

Hand tilled hill fields

Cleared/burned swidden fields

Land preparation:

- Clearing land (cutting vegetation)
- Burning
- Tillage (generally on land with brief fallows)

Upland Rice Production

In SE Asia, teams of men and women seed upland rice by hand

Upland Rice Production

Sowed upland rice seeds

Mixture of upland rice, legume, melon and brassica seeds

In addition to the establishment of upland rice, mixtures of other traditional hill field crops are included (e.g. chili peppers, sesame, crawling legumes, melons, grain sorghum, pigeon pea)

Upland Rice Production

Mid-rainy season upland rice crop

Sweet potato growing within upland rice

Mixed crop of upland rice And grain sorghum

Growth and maturation of upland rice and associated crops.

Upland Rice Production

Harvesting upland rice with a sickle

Sheaves of upland rice stacked temporarily

Cleaning rice grains after milling and before cooking

Harvesting and processing grain of upland rice

Conventional Lowland Irrigated and Rainfed Rice

Dry season rainfed paddy in northern Thailand

Irrigated rice in production

Conventional Lowland Irrigated and Rainfed Rice

Preparing beds for seeding

Seedlings almost ready to transplant

Seedling Production

Conventional Lowland Irrigated and Rainfed Rice

Plowing with “iron buffalo”

Harrowing with real buffalo

Plowing with a tractor

Rice paddy tillage

Conventional Lowland Irrigated and Rainfed Rice

Uprooting seedlings from nursery after a few weeks of growth

Seedlings transferred to paddy

Seedlings transplanted by hand – spacing roughly 20 cm apart

Transplanting Rice

Conventional Lowland Irrigated and Rainfed Rice

Fertilizing and spraying insecticides

Conventional Lowland Irrigated and Rainfed Rice

Rice stink bug

Weed infested rice field

Pest issues in rice

Conventional Lowland Irrigated and Rainfed Rice

Harvesting with hand sickles

Hand threshing

Temporary stack of sheaves

Traditional rice harvest

Conventional Lowland Irrigated and Rainfed Rice

Combining

Threshing

Mechanized rice harvest

Conventional Lowland Irrigated and Rainfed Rice

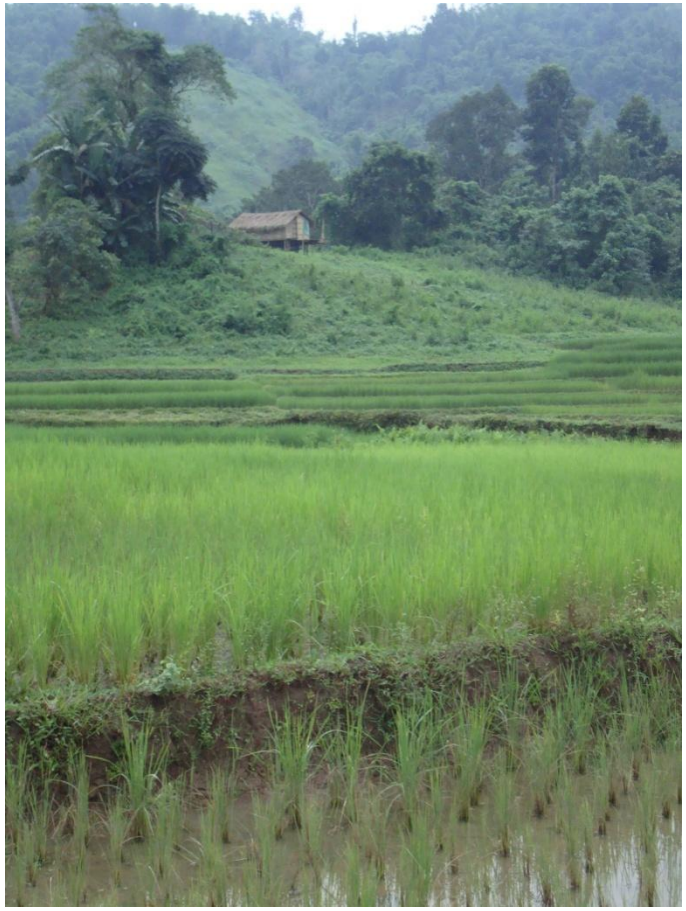
Collecting rice straw

Grazed dry season paddy

Burning fields

Common post-harvest management practices

SRI: System of Rice Intensification



The **System of Rice Intensification** (SRI), an unconventional approach to rice production that has spread throughout many parts of the world since the late 1990s, is comprised of a set of flexible management practices. The practices are summarized as follows:

- **Shallow (1-2 cm) transplanting** of strong, young seedlings that are uprooted and quickly moved from moist but well-drained seedbeds.
- Transplanting of 1-2 seedlings per hill at **wider-than-usual spacings**, between 25 x 25 cm (9.84 x 9.84 in.) and 50 x 50 cm (19.66 x 19.66 in.), ideally in a square pattern or in straight rows to facilitate weeding.
- **Alternate flooding and drying** of the field during the period of vegetative growth.
- **Early and frequent mechanized weeding** to control weeds and to aerate the soil.
- **Adding nutrients** to the soil, preferably in **organic form.**

SRI: System of Rice Intensification

SRI rice production requires less:

- **Water** – uses half the water required by conventional rice production
- **Rice seed** to produce seedlings - 5-10 kg seed/ha instead of 50-100 kg)
- **Land** – due to higher SRI yield per land unit
- **Production cost** (fewer inputs)

SRI: System of Rice Intensification

With SRI, according to CIFFAD/Cornell, there are higher:

- **Yields** (50-100% more)
- < production cost + > yields = > **farm income** (average profitability increase of 73% among farmers in different countries)
- **Resistance** to biotic and abiotic stresses, particularly drought.

http://ciifad.cornell.edu/sri/yielduphoffrpt505.pdf

SRI: System of Rice Intensification

Why SRI's "less is more" practices work:

Conventional rice plant vs. SRI

- Transplanting smaller seedlings means **less damage** to rice root systems and quicker recovery time.
- Wider planting distances and single transplants means **less competition** (more growing space). This often results in hills of single plants with 20, 30 tillers (stalks) or more compared to hills of multiple plants of only 10-15.
- Less flooding with occasional weeding means **more aeration** for root systems.
- Organic soil inputs means **better soil structure** for improved root development

SRI: System of Rice Intensification

Henri de Laulanie (1920-1995) was a French Jesuit father who was responsible for developing the rice cultivation system in **Madagascar** known as the **System of Rice Intensification (SRI)**

http://en.wikipedia.org/wiki/Henri_de_Laulanie

SRI Origins in Madagascar

SRI: System of Rice Intensification

Applying a uniform 3-4 cm layer of soil mixture on banana leaves or plastic sheet

Scooping up small seedlings (less than 14 days old)

Nursery at 12 days

SRI Rice Seedling Nursery Management

SRI: System of Rice Intensification

Compost from animal bedding

Sunn hemp green manure cover crop

Organic nutrients can be added to paddy fields in various forms including:

- **Compost** (however, bulk production, transportation and application can be challenging)
- Recycled **rice straw** and/or **rice husks**
- Certain **green manure cover crops** can be grown in the paddy during the early rains and incorporated at least one month before rice is planted

Incorporating mung bean

Rice husks applied to paddy

Rice straw is sometimes recycled

SRI: System of Rice Intensification

To facilitate establishment **widely spaced seedlings** and to make subsequent weeding easier, well defined rows (grids) are made for transplanting single small seedlings per hill.

SRI: System of Rice Intensification

Flooded field

During the growth and development of the SRI rice crop, the field is **flooded only occasionally** (3-4 times). Otherwise, to allow more access of air to the root system, it is recommended that the fields remain unflooded to the point of the surface of the soil cracking.

Drying paddy soil

Maturing SRI field

SRI: System of Rice Intensification

Modified weed whacker

Rotary weeders incorporate weeds into the soil and help aerate the rice root system

Weeding required 2-3 times per season

SRI: System of Rice Intensification

If managed well, SRI rice produces more tillers with more grain-bearing panicles. In India and elsewhere, SRI bears 2-3 weeks earlier than conventional rice.

SRI Criticisms and Weaknesses

SRI critics have claimed:

- increased yields are due to "poor record keeping and unscientific thinking”
- lack of details on the methodology used in trials
- lack of publications in the peer-reviewed literature

However, many institutions are carrying out SRI-related research and beginning to publish in peer-reviewed journals

Additional SRI weaknesses and concerns:

- More suited to poor, small and marginal farms – considered too labor intensive for extensive rice farms.
- Due to planting efforts and weeding, requires more labor than conventional rice production (at least initially).
- Water level management can be difficult, especially under rainfed conditions and low areas where drainage might be difficult
- Access to adequate amounts of organic fertilizer can be a challenge (may need alternatives such as green manure cover crops)

Variations on SRI

Integrated Crop Management (ICM) is a variation of SRI. Distinctive aspects of ICM include:

- Rice seedling transplant age of **18-20 days** compared to 10-12 days for SRI
- Seedling planting **distance of 20 x 20 cm** (7.87 x 7.87in.) compared to 25 x 25cm (9.84 x 9.84 in.) or more for SRI
- **2 seedlings per hill** compared to 1 seedling per hill for SRI
- Related to water management, providing **intermittent irrigation** compared to allowing only moist conditions for SRI

Variations on SRI

Broadcast rice in Cambodia

Direct seeded rice can also be grown organically and managed similar to conventional SRI rice

Drilled rice in northern Thailand

Conclusion

Successful applications of SRI have shown that farmers can raise their paddy yields by 50 to 100% or more, while using fewer farm inputs, especially water. While failed field trials also exist, it is important to note that SRI is still a ‘work in progress’ and evolving, and should be adopted to local conditions and traditions (Word Bank Institute)