The System of Rice Intensification (SRI) in Islamic Republic of Iran

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1. Introduction

The Islamic Republic of Iran is a vast country, covering 1,648,000 km^2. On account of its highly diverse climatic and soil conditions, only 12.5 million ha are cultivated annually with a wide range of food crops. Wheat, rice and barley are the most important cereals cultivated. Self-sufficiency in the production of agricultural commodities has been taken as a national objective. Commodity production is adversely affected by such inhibiting factors such as traditional modes of production, small-scale operations, irrigation difficulties, lack of appropriate tools and equipment for mechanized farming, and legal and administrative hindrances, all preventing rapid growth of the agricultural sector.

Rice is the second main food item in Iran, after wheat. Rice in Iran is scientifically classified into three categories, according to the physical grain shape and trade value.

- The first group is 'Sadri' (indica type), characterized by very long grains (>7 mm), slender, with or without awn, very high cooking and eating quality, aromatic, good grain elongation, susceptibility to blast and stem borer, and yields about 3.5 tons paddy per ha.
- The second group is 'Champa,' characterized to long grains (6-7 mm), and less market value than the first group, but more resistant to environmental stresses, diseases and insects, with higher yield than the 'Sadri' group.
- The third group is 'Gerdeh' (japonica type), characterized by short and round grains (<6 mm), less market value than the other groups, but more resistant to stresses, and higher yields than groups 1 and 2. In spite of their low yields, local varieties whose yields average 2-4 tons per ha, still occupy 70% of the total rice area because of their excellent quality traits, which are similar to Basmati types.

The amount of polished rice consumed per capita is estimated to be around 34-35 kg per year. Cultivated area and production of rice have fluctuated year to year. The maximum reached so far was in 1998 when cultivated area was 615,000 ha, and production was 2,771,000 tons. In 2000, both area and production drastically declined, to 534,000 ha and 1,971,000 tons, respectively.

Yield of rice is heavily influenced by meteorological condition, insects and disease attacks, agricultural practices like as the selection of variety, and socio-economic conditions. Mazandaran and Gilan provinces (near the Caspian Sea) had 37% and 34% of the harvested paddy area and 40% and 34% for paddy production, respectively. Paddy yield per ha has ranged from 5,458 kg/ha to 2,000 kg/ha, with a national mean value is 4,173 kg/ha.

II. Operation of the System of Rice Intensification (SRI) in Iran

The Agronomy Group of HARAZ Development Technology and Extension Center, encouraged by the deputy minister for extension in the Ministry of Agriculture started SRI practice in 2004 with guidance from the SRI internet home page (http://ciifad.cornell.edu/sri/), and it has continued during 2005 with email contact with Prof. Norman Uphoff at Cornell University.

The main reasons for interest in SRI practice in Iran are as follow:

1- The prevalence of small-scale farms with average rice field ownership about 0.7 ha.
2- Currently high production costs and resulting low income from rice cultivation based on the labor of family members.
3- Water shortages are common in the rice cropping season.
4- Local varieties that have high consumption demand give low yield and are susceptible to blast disease and lodging.
5- Heavy application of agrochemical inputs is contributing to the contamination of water and soil resources.

From what has been experienced with SRI in other countries, these methods of rice cultivation should help deal with all of these problems.

The first SRI practice was done at 2004 on two demonstration fields with 2 ha total paddy area (5000 m^2 in our center and 1.5 ha under farmer management) using a local variety. In the second year, after introducing this method to farmers by demonstration ands FFS activities in our center, we could provide five demonstration fields under farmers' management (3.3 ha) and in our center a paddy field of 6000 m^2. For the latter, an experimental design was used with four fertilization treatments (chemical fertilizer, chicken manure, mixing of chemical fertilizer with chicken manure, and control without any fertilization) and three plant spacings (25x25, 30x30, and 40x40 cm) under factorial design. The varieties used with farmers' practice were: local variety (Tarom), improved varieties (Neda, Fajr and Khazar), and hybrid rice. The variety used in our center under experimental design was Tarom which is a local variety with high quality and usually low yield.

Nursery management and transplanting

Most of the rice nurseries in Iran are managed as wet nurseries, with transplanting done by hand, requiring an average of 13–15 persons per ha. The seed rate is 60–70 kg/ha, and nurseries do not have good drainage. Damping-off and fungal and bacterial disease damage to seedlings under submerged conditions are common. Raising of box seedlings and mechanized rice cultivation is increasing year by year due to high labor costs and difficulties with transplanting by hand. Our center with support from a JICA project (1994-2004) has started land consolidation and mechanized transplanting in Iran functioning as a rice training and extension center. We have reduced the seed rate to 30-40 kg/ha with mechanized transplanting of box-grown seedlings,

while some key farmers have reduced it even to 20 kg/ha. Under SRI practice we reduced the rate to 10 kg/ha with young seedlings.



The box seedling at 3-leaf stage between 10-15 cm -- ready for planting

Traditional transplanting under flooded conditions

Mechanical transplanting

Transplanting under SRI in farmer's field (but without square planting)

Application of chicken manure on demonstration field

Demonstration field at early tillering stage under SRI (one young seedling per hill, wide spacing, chicken manure, and intermittent irrigation with soil aeration)



Heading stage at experimental field under SRI



Farmers' field (2 ha) under SRI practice with local variety and surprising tiller number from single seedling (maximum tiller number reached 93 tillers with 72 productive tiller; 25 tillers achieved with traditional practice)

Farmer's field under SRI near harvesting (local variety)

Comparison of number of tillers and root volume, color and health between SRI (left) and conventional methods (right)

Traditional farmer's field near harvesting

Farmer's field under SRI near harvesting (improved variety)

Comparison of rice panicles under SRI (left) and conventional methods (right)

Results and Discussion

The results given in Table 1 show that SRI practices can increase rice yield due to higher tiller number and panicle number, increasing numbers of grains per panicle, % of ripened grains, root and plant health, resistance to lodging, and tolerance to pest damage. Transplanting of healthy young seedlings, singly and with wide spacing, increased soil microbial activity supported by organic material, and soil aeration appear to be the main reasons for high productivity.

Based on our results, mixing of chicken manure with chemical NPK fertilizer, and 25x25 or 30x30 cm spacing can give highest yields in comparison with another treatments.

Problems:

1- Difficulty of square transplanting by hand using ropes, markers, etc., especially on big plots
2- Problems of water management caused by traditional field layout without separate irrigation and drainage channels for the respective fields.
3- Shortages of water and farmer fear that water supply will not be reliable; also difficulties with drainage of water.
4- Weed control sometimes is difficult but it is not a main problem.
5- Heterogeneity at harvesting time because some panicles were still green due to excessive tillering numbers with different age.

Table 1- Comparison of Rice Yield and Yield Components
between SRI and Conventional Methods
Variety used: Tarom (high-quality, low-yielding local variety)

Demonstration field	Hills / m^2	Panicles/ hill	Grains/ panicle	% Ripened grains	Paddy yield (tons/ha)
Conventional method	16	14	80	84	3,650.0
SRI method	13	27	117.4	85.1	6,080.4
Experimental field	Hills/ m^2	Panicles/ hill	Grains/ panicle	% Ripened grains	Paddy yield (tons/ha)
a1b1	16	10.9	103.8	85.2	3701.6
a1b2	16	19.1	107.0	81.2	6399.0
a1b3	16	18.6	113.7	84.9	6895.5
a1b4	**16**	**20.5**	**110.7**	**80.7**	**7032.4**
a2b1	11	15.6	104.2	85.5	3674.9
a2b2	11	22.3	102.5	83.1	5012.3
a2b3	11	26.4	109.7	86.0	6763.7
a2b4	**11**	**25.8**	**115.4**	**86.7**	**6958.4**
a3b1	6	22.3	104.1	86.1	2871.7
a3b2	6	27.6	113.9	86.9	4115.5
a3b3	6	29.4	120.3	88.9	4697.5
a3b4	6	27.7	118.5	88.7	4223.8

a= Plant spacing: a1=25x25, a2=30x30, a3=40x40
b= Fertilizer treatment: b1=control, b2=chemical, b3= chicken manure, b4= mixing chicken with chemical fertilizer)

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