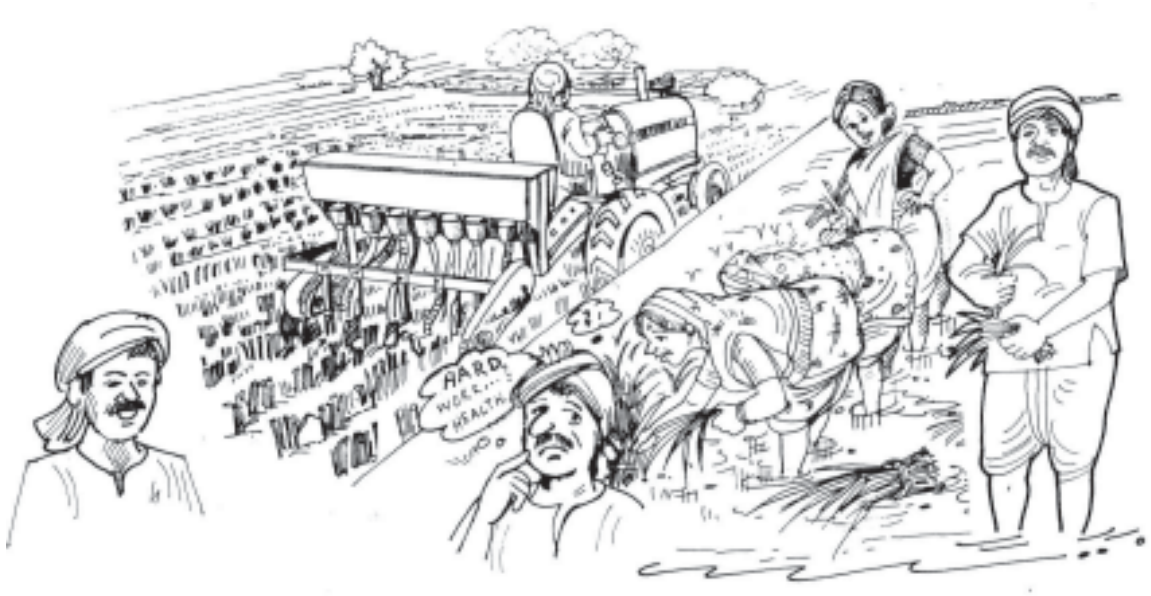
Alternatives to Puddling and Manual Transplanting

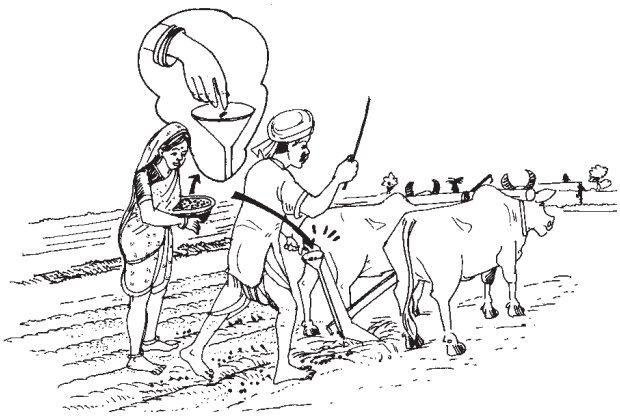


Puddling of soil and manual transplanting of 4-6 week old rice seedlings is a tradition. However, this system is labor-intensive and requires a lot of water and power at critical peak times of the season. Long-term experiments suggest that continued puddling of fields for rice destroys soil physical properties and negatively affects yields of both the puddled rice and the following crop. Alternative technology options are needed that can be used to substitute for this drudgery-ridden and costly manual transplanting method.

Puddling	
Advantages	**Disadvantages**
• Reduces soil permeability • Preserves aquatic, anaerobic conditions • Controls weeds, improves water and nutrient availability • Facilitates transplanting	• Destroys soil aggregates • Breaks capillary pores • Disperses fine clay particles • Lowers soil strength in the puddled layer • Plow pan (compacted layer) resists root penetrations of following crop • Causes waterlogging • Forms large clods in finer-textured soils preventing seed-soil contact • Forms impermeable clayey layer on the surface in coarser soil

Efforts are underway to search technology options to achieve alternative crop systems establishment. The following systems are being reached and have the potential to **replace the puddling** in the ricefields.

Alternatives to Puddling



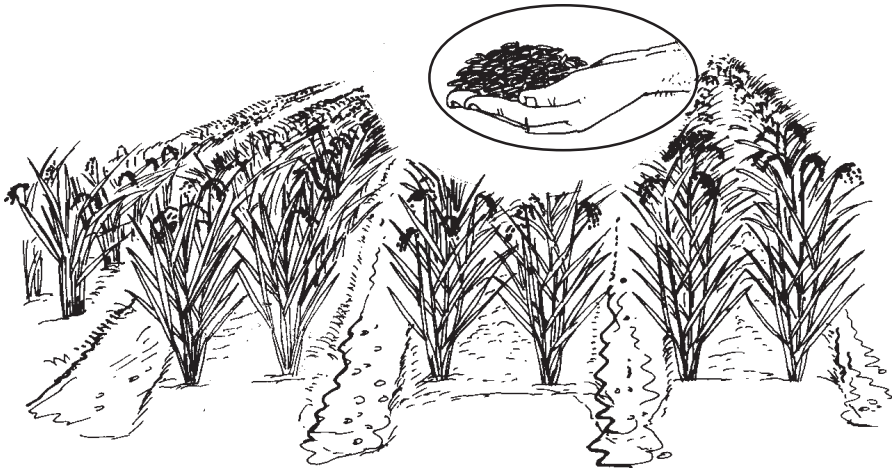
Dry-Seeded Rice

Growing rice without puddling with the possibility of intermittent flooding is called dry-seeded rice. In this system, rice is grown like any other upland crop with seed placed in the soil with or without plowing but not puddled plowing when the soil is flooded. This system delays the seed to seed time in the field and does not have weed problems that need effective control. Weed control is a major issue and scientists are finding ways to overcome this.

Growing rice with this method, after an upland crop, will result in better soil properties for establishment and growth. Saving of water by not puddling will depend on soil texture and how water is managed for the upland rice crop. Direct-seeded rice may need extra water early in the rice growth to help control weeds, but will use less water after the crop is established. Fertilizer chemistry will be different but in dry-seeded rice, the crop will be able to utilize the nitrates lost when soils are puddled. In aerobic conditions, availability of some micronutrients like zinc and iron may be a problem.

Dry-seeded Rice

Advantages	Disadvantages
● Better yield of the crop.	● More difficult weed control
● Saving on water	● Zinc and iron may become a problem
● Less drudgery and less labor needed	● More insect (termites) and disease problems



For actual seeding of rice without puddling, the Chinese hand tractor seeder and the Pantnagar drill could be used.

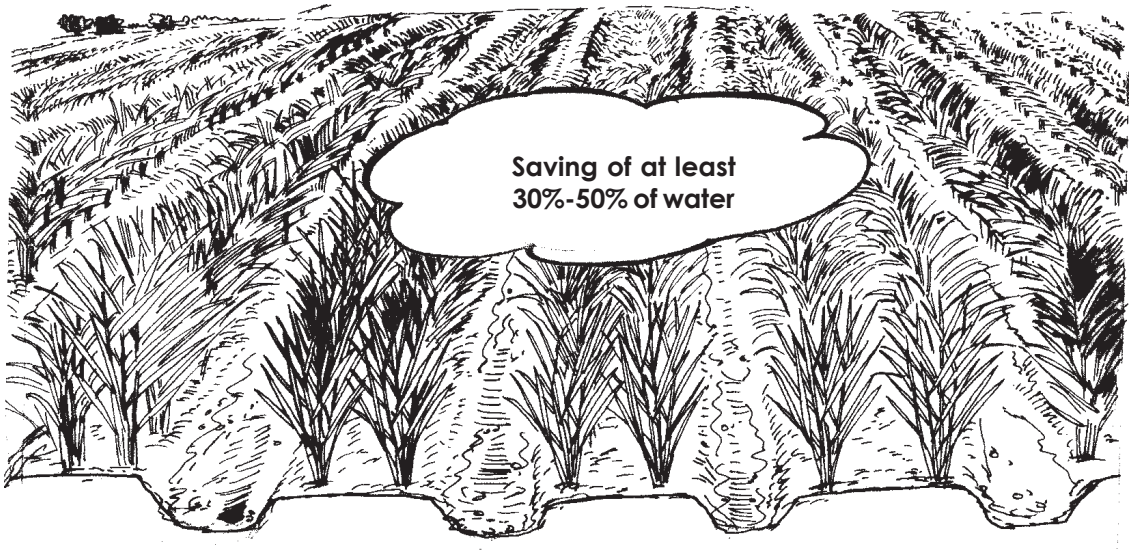
Zero-Till Rice

Another sub-system of dry seeded rice is zero-till rice. In this system, weeds are allowed to germinate and then controlled with a non-selective herbicide like *Glyphosate.* A zero-till drill is then used to seed the rice. Because the soil is least disturbed in this method, fewer weeds germinate.

Bed-Planted Rice

This practice is very similar to the bed planting as done in the wheat crop. It has been tested by the Rice-Wheat Consortium (RWC) partners and farmers with success. In this method, beds are prepared afresh or the beds prepared for the previous wheat crop are used for seeding. The older beds are reshaped before use and rice is planted as a dry-seeded crop or transplanted in the form of seedlings. Although data is not yet available, both systems seem to be equally effective.

Farmers have given a positive feedback on this system. According to them, saving of water has been the main advantage. As compared to the flat system, there is a saving of at least 30%-50% of water. The movement of the tractor in the furrows (bottom) may have made the soil compact and reduced water percolation to some extent. Impact of this kind of compaction of soil is yet to be established through long-term research.



Weeds are still a problem and need integrated management to control them. Besides enjoying the advantages of controlling weeds through direct seeding, mechanical weeding can also help reduce the weed menace. However, this is only possible when the field is dry enough to allow movement of tractor in the furrows.

Bed planting makes fertilizer placement, weeding and spraying easy. Farmers have to remedy the problems of zinc deficiency and iron chlorosis in some fields. Termites often appear in the fields and have to be controlled.

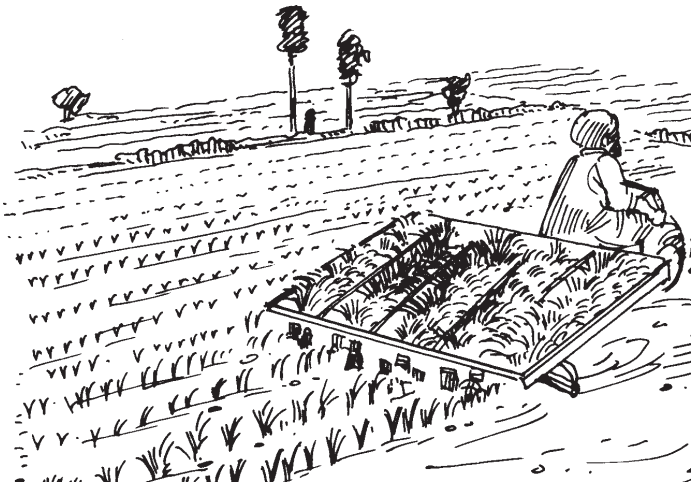
Bed planting is more successful in case of **hybrid rice** as it has the capacity to use nitrate nitrogen better. Plants recover very fast and produce tillers profusely. Use of plastic bubble sheet to raise single hybrid seed seedling-plugs may be one way to get higher yields and save on costly hybrid seed.

Alternatives to Manual Transplanting

Replacement of manual transplanting is necessary to save labor, cost, time and reduce the drudgery of growing rice. Three systems have been suggested to replace manual transplanting.

Mechanical Transplanter

This equipment has been developed in Japan, Korea and China in response to decline in availability of labor. This system involves raising rice seedlings in a mat form. Several such mats are raised for transplanting purposes. The mats are placed in a specially devised machine used to plant the seedlings in the field at pre-determined spacing. Farmers in the IGP have been advised to use the Chinese model as it is ten times cheaper than other models. Manual system is still being tested.



The key to success of this system is the raising of the seed mats. This may have to be done commercially so that the cost of production could be reduced. Even landless laborers could be tapped for this purpose. Settling time after preparing the field and water level in the field are the key factors for the success of the mechanical rice transplanting, though it would not be an issue in mechanical transplanting on zero-tilled soil.

Wet-Seeded Rice and Drum Seeder

In this system, the field is puddled and then sprouted seeds are placed on the wet soil. This is either done by broadcasting the seed or by using a drum seeder. Wet seeding is more popular in Asia as it reduces labor cost. Improved availability of new rice varieties for direct seeding and also effective herbicides for weed control has helped making this system more popular. Wet seeding is more eco-friendly as seeds are sown in rows which facilitates the use of rotary/conical weeders. Periodic inter-row cultural operations for weeding may also aerate the root zone.

In spite of the advantages, this system extends the field-time for growing rice. This is an important consideration where triple cropping is used or the climate is cooler.

There are two types of wet seeding:
(a) surface or aerobic seeding; and
(b) sub-surface or anaerobic seeding.

Surface or Aerobic Seeding

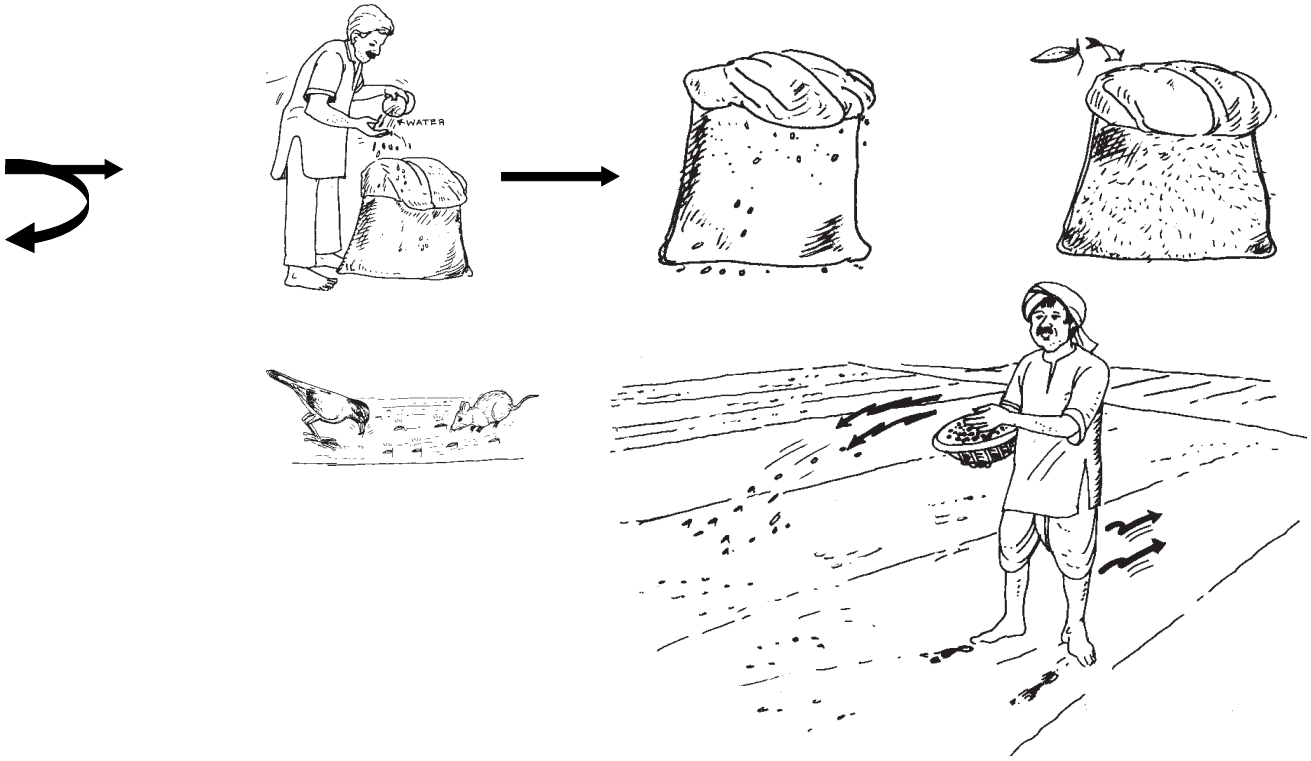
In this method, pre-germinated seeds are sown on the surface of well-puddled soil. This is done preferably one day or at the most two days after the last puddling and levelling has been done. The technique involves uniform broadcasting of seeds either by hand or by a motorized sprayer. Alternatively, a drum seeder can be used to sow the seeds in rows. High quality, clean seeds are soaked for 24 hours in case of hand-broadcasting and only for 12 hours in case of drum seeding.

How to Pre-germinate the Rice Seed

- Incubate the seed for 12 hours.
- Take out after the seed imbibes moisture.
- Heap the seed and cover with gunny bag.
- Water the bag frequently.
- After 24 hours, it will germinate and radical will come out.

In case of hand-broadcasting, the person sowing the seeds either by hand or drum, has to walk backwards. He has to avoid making too many depressions in the soil so that water does not accumulate in them and rot the seed. Seeds in this method lay only half buried into the soil thus exposed to damage by birds, rats, snails, ants, etc. Torrential rain or longer dry weather will easily spoil the seed.

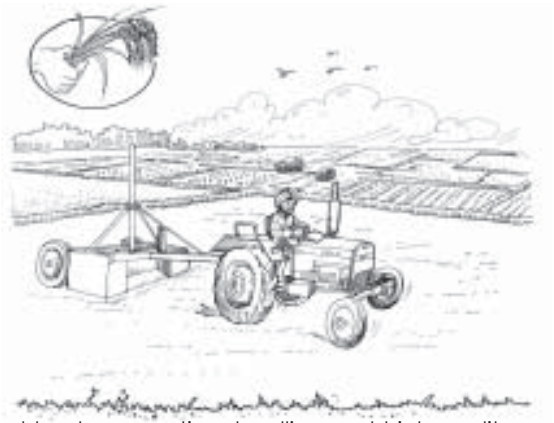
Seed rate varies from 100 to 150 kg/ha for broadcasting and half as much for drum seeding.



Sub-Surface or Anaerobic Seeding

The main aim in this method is to broadcast the seeds and provide a protective cover over the seeds against damage by weather conditions and/or pests. This can be achieved by broadcasting the pre-germinated seeds after puddling and allowing a thin layer of mud to settle on them. Alternatively, pre-germinated seeds can be sown in rows one to two days after puddling by an anaerobic seeder fitted with furrow openers and closers. Seed rates are similar to that of surface seeding.

Crop Establishment by Wet Seeding



Good land preparation, levelling and high quality seeds are vital for a successful crop stand.

Keep the soil saturated with flush irrigation (but not flooded) to facilitate seedling emergence and early growth. Later, the water level can be increased to 5-10 cm as the crop grows.

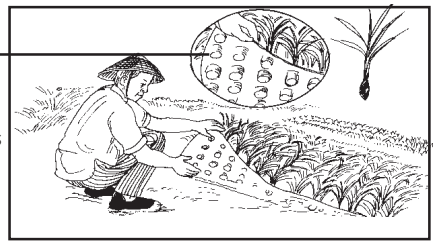
Use pre-emergence herbicides or inter-row cultivators in row-seeded rice to control weeds.

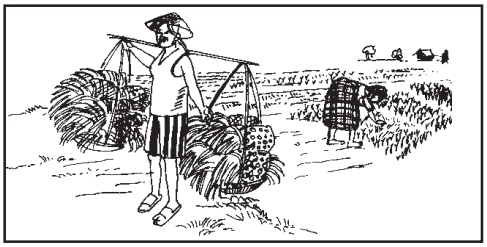
Apply N in three split doses at 21, 35 and 49 days after seeding. Practice pest management as in other transplanted rice.

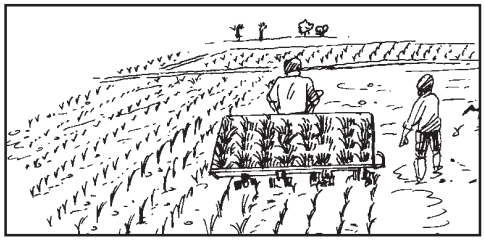
Broadcast Seedlings

This is an innovation from China. In this system, seedlings are prepared on plastic bubble sheets on raised beds. The seedlings thus prepared are lifted easily along with some soil (these are known as plugs) and used for either broadcasting or transplanting in the soil. The seedlings are thrown in the air and they fall in the muddy soil with the heavier roots facing downwards. Thus, the seedlings penetrate and get encased in the soil reducing the transplanting shock period. A mechanical blower is also available to help in broadcasting the seedlings. This system when used for sowing hybrid seed, specially on beds, has been proven very productive.

There is a hole at the base of each bubble to allow roots to penetrate and get nutrients and water from the raised beds on which the sheets are placed. The raised beds need to be properly fertilized to provide the needed nutrients.







Plastic bubble sheets for this purpose were brought from China by the RWC for conducting experiments. Although the results are satisfactory, yet the scientists are in the learning phase. Technology of gap filling and evenly spreading the seedlings has to be worked out. Seedlings must be prepared on the raised beds as wide as the plastic sheet and need to be placed in the shade. They are easy to uproot and transport to the field.

Adapted from:

Hobbs, P. R., R. K. Gupta, J. K. Ladha and V. Balasubramanian. 2000. Crop Establishment and Management: New Opportunities. Paper Presented at the International Workshop on Developing an Action Program for Farm-Level Impact on Rice-Wheat Systems of the Indo-Gangetic Plains. 25-27 September 2000. New Delhi, India.

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