Rice unlike other crops that man grows is intimately involved in the culture of numerous world societies. In several regional languages the general terms for rice and food or rice and agriculture are synonymous. The rice grain forms an integral part of rituals in Hindu and Buddhist religions. Hence the interlinking of rice with humans is not just as a commodity but as a substance that goes deep into the cultural milieu of the human race.

The much despised relation of rice and water began accidentally. In fact the first records of rice cultivation projects it as a dry seeded crop grown in ends of high land and forests cleared for shifting cultivation. It is in China that the process of puddling soil and transplanting seedlings began in river valleys and low lying areas with likelihood of flood and submergence of rice plants. As transplanting gives a head-start to rice seedlings in their fight with weeds, this method took an easy route of acceptance in other parts of the world, especially in South east Asia where originally rice is grown in dry land conditions.

This historical perspective and the belief that rice would be better off if puddled and transplanted, has brought us to the present situation of excessive use of water for irrigating rice.

A change of this attitude is going to be difficult and time consuming. But a change is all that is needed and the change is needed now!
Precision farming

Precision farming is farming where 1) Timeliness of operations and 2) Precision in quantities of inputs and control measures are practised.

The different steps followed in precision farming varies from crop to crop and differs from conventional practices also varies from crop to crop. In Precision farming of rice we recommend the following steps:

- Planting on raised beds, adopting a plant spacing of 0.2 m x 0.15 m,
- Irrigating with drip following an irrigation schedule and fertilizer thru fertigation scheduling, and
- Weed control by weedicide.

Cultivation Method

Based on the experience Jain Irrigation garnered over a number of field trials, the cultivation method and drip system for rice should have the following components:

- Adopt dry seeded aerobic method of rice cultivation,
- Disc plough the field twice; first East-West and second time North-South directions,
- For rainy season crop, it is advisable to prepare broad bed and furrow (BBF) system that will care of drainage during heavy rain. For rabi and summer crops even flat seed bed is appropriate,
- For BBF system for seeding; Bed width of 1 m, and height of 0.15 m and furrow width of 0.2-0.3 m,
- Sow rice in rows on a broad bed or on flat seed bed.
- Rotavate to break clods on the bed surface to achieve fine tilth.
- Sow seeds at 0.2 m x 0.15 m spacing; 5 rows per bed (in BBF).
- Install drip system.
- Mulch the seeded surface with rice husk.

Rice varieties

Identification of varieties suitable for drip irrigation would take a large number of time consuming experimental trials. However, it is an intelligent assumption that all the varieties so far found suitable for dry seeded cultivation would also be suitable for drip.

Varieties tested under drip fertigation

US 311, Arise 6129, SBH 999 (basmati), 25P25, 25P31, Try-R (2), BPT, Pusa sugandha (basmati), ADT -45, Pusa-2, WGL 32100

Irrigation

Table 2: Water requirement of drip irrigated rice

<table>
<thead>
<tr>
<th>Month</th>
<th>Pan E (mm/day)</th>
<th>Total water Reqt. (lit/day/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb 16-28</td>
<td>6.68</td>
<td>18704</td>
</tr>
<tr>
<td>Mar 1-15</td>
<td>6.73</td>
<td>40044</td>
</tr>
<tr>
<td>16-31</td>
<td>6.82</td>
<td>47740</td>
</tr>
<tr>
<td>April 1-15</td>
<td>6.09</td>
<td>56840</td>
</tr>
<tr>
<td>16-30</td>
<td>6.53</td>
<td>60947</td>
</tr>
<tr>
<td>May 1-15</td>
<td>7.44</td>
<td>70019</td>
</tr>
<tr>
<td>16-31</td>
<td>7.57</td>
<td>58878</td>
</tr>
</tbody>
</table>

*Water requirement will vary with location and pan E and crop planting date

For each location Jain irrigation agronomist will estimate water requirement and based on the design flow will prepare irrigation schedule and train the farmer to apply this precisely.

Status of rice production in India

Table 1: Rice production scenario in different states of India

<table>
<thead>
<tr>
<th>States/UTs</th>
<th>Area (x000 ha)</th>
<th>Irrigated area under rice (x000 ha)</th>
<th>Average Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>3982</td>
<td>1041</td>
<td>3.1</td>
</tr>
<tr>
<td>Assam</td>
<td>2420</td>
<td>111</td>
<td>1.6</td>
</tr>
<tr>
<td>Bihar</td>
<td>3252</td>
<td>1663</td>
<td>1.1</td>
</tr>
<tr>
<td>Chhattisgarh</td>
<td>3854</td>
<td>1169</td>
<td>1.1</td>
</tr>
<tr>
<td>Gujarat</td>
<td>666</td>
<td>383</td>
<td>1.8</td>
</tr>
<tr>
<td>Haryana</td>
<td>1041</td>
<td>1024</td>
<td>3</td>
</tr>
<tr>
<td>Himachal Pradesh</td>
<td>79</td>
<td>48</td>
<td>1.4</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>259</td>
<td>-</td>
<td>1.9</td>
</tr>
<tr>
<td>Jharkhand</td>
<td>1355</td>
<td>76</td>
<td>1.5</td>
</tr>
<tr>
<td>Kamataka</td>
<td>1478</td>
<td>1120</td>
<td>2.4</td>
</tr>
<tr>
<td>Kerala</td>
<td>276</td>
<td>160</td>
<td>2.6</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>1700</td>
<td>232</td>
<td>0.87</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>1513</td>
<td>434</td>
<td>1.5</td>
</tr>
<tr>
<td>Orissa</td>
<td>4479</td>
<td>1908</td>
<td>1.6</td>
</tr>
<tr>
<td>Punjab</td>
<td>2649</td>
<td>2624</td>
<td>4</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>107</td>
<td>43</td>
<td>1.5</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>2050</td>
<td>1907</td>
<td>3.1</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>5578</td>
<td>4073</td>
<td>2.1</td>
</tr>
<tr>
<td>Uttaranchal</td>
<td>302</td>
<td>196</td>
<td>2.1</td>
</tr>
<tr>
<td>West Bengal</td>
<td>5783</td>
<td>2878</td>
<td>2.6</td>
</tr>
<tr>
<td>India</td>
<td>42806</td>
<td>21107</td>
<td>2.04</td>
</tr>
</tbody>
</table>

Fig 1 : Productivity of rice in India (2000-10)
Drip Irrigation - The concept
Drip irrigation is the slow, even application of water at low pressure to the root zone using a network of plastic tubing placed above the rooting zone (surface drip) or buried among the root branches inside the rhizospherical soil at a certain depth from surface. (subsurface drip).

In drip irrigation method, crops are irrigated daily to the precise volume of water equivalent to the evapo-transpiration (ET) of the crop. It is estimated from daily Evaporation data, using crop and canopy coefficients, the latter two factors vary with the age of the crop and the size of its canopy. These are the two factors that affect the volume of transpiration of the plant/crop that changes with growth of the crop. Factoring in of these two coefficients is what makes the water requirement estimate unique to that particular crop at that particular stage of its growth.

Sowing and germination Irrigation
It is essential to pre irrigate and fully wet the broad bed before sowing the seeds. Keep the bed uniformly wet till germination and crop establishment.

Mulching
One of the main issue in dry seeded and drip irrigated rice is the germination and growth of weeds. The standing water in the conventional flooded rice will suppress the weed germination.

Weedicide application
Use of weedicide to prevent weed growth is also plausible. Studies have shown that a pre-emergence weedicide, Pretilachlor sprayed to the seed bed at 1250 ml/ha rate within 72 hours of sowing controls weed infestation effectively.

Fertilizer application through Fertigation
Use of drip technology provides a golden opportunity to apply nutrients as per the need of the crop at each growth stages. In rice also this technology enhances nutrient use efficiency.
Jain Turbo Top™

- Available discharge rates – 1.1 & 1.7 lph
- Injection moulded silicone rubber compensates with pressure and discharge gives uniform performance.
- Anti Syphon feature (optional) prevents suction of sand and silt particles inside the dripper.
- Cascade labyrinth gives strong, self-cleaning turbulence.
- Available in 16 & 20 mm nominal diameter. (12, 16 & 20 mm in Thin Wall option)
- Suitable for surface as well as subsurface installations.

Why Jain Drip Irrigation?

Water is not the only need of the plant. To uptake this water efficiently, it requires proper air-water balance within the root zone. Drip irrigation, with its low application rate, prevents the saturation of water within the root zone and continuously maintains field capacity. This provides a favorable condition for the growth of the plant. Drip irrigation also helps to use fertilizer efficiently. With drip irrigation water can be provided at frequent intervals which helps maintain required soil moisture level within the vicinity of the plant roots. Jain is the pioneer of drip irrigation. Ours is the only company in the world, which fulfills your entire irrigation system requirement under one roof.

Characteristics of drip irrigation

1) Water is applied at a low rate to maintain optimum air-water balance within the root zone.
2) Water is applied over a long period of time.
3) Water is applied to the plant and not to the land.
4) Water is applied at frequent intervals.
5) Water is applied via a low pressure network.
J-Turbo Line® Super

- Available discharge rates (at 1 kg/cm²):
  - 12 mm: 2.2, 4 lph
  - 16 mm: 4, 8 lph
  - 20 mm: 2.2, 4, 8 lph
- Available in 12, 16 & 20 mm nominal diameter.
- Suitable for surface as well as subsurface installations.

Turboline PC®

- Available discharge rates - 1.4, 1.8, 2.6 & 4.0 lph within pressure regulation range of 0.7 to 3 kg/cm².
- Injection moulded silicone rubber compensates with pressure and discharge gives uniform performance.
- Application on undulating land / Terrains / Steep slopes.
- Available in 16 & 20 mm nominal diameter.
- Suitable for surface as well as sub-surface installation.
- Application where ever longer lateral length is necessary.
- Conforming to IS 13488, ISO 8261 Standard.

Widest Choice! Customized Irrigation Solutions

Online Dripper & Spray Heads

Jain Filtration Equipment

Jain Fertigation Equipment

Jain Rainport / Micro Sprinkler

Jain PVC/PE Pipes & Fittings

Automation Equipment
Crop rotation

Drip irrigated rice can be followed by drip irrigated wheat. The rotation crops can be, a second rice, mustard, vegetables, or seed spices. Both the rotation crops are adjusted in their spacing to suit the drip system on the ground.

Fertigation schedule

<table>
<thead>
<tr>
<th>Table 3 : Fertigation schedule adopted in drip irrigated rice in AP* (Fertilizer dose 180:80:80 kg NPK per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
</tr>
<tr>
<td>Basal (soil)</td>
</tr>
<tr>
<td>till 10 DAP$</td>
</tr>
<tr>
<td>11-35 DAP</td>
</tr>
<tr>
<td>36-55 DAP</td>
</tr>
<tr>
<td>55-65 DAP</td>
</tr>
<tr>
<td>65- 70 DAP</td>
</tr>
</tbody>
</table>

*DAP-days after Germination  * Schedule will vary with location.

Integrated Nutrient management

- Incorporate green manures/bio fertilizers
- Nitrogen management by leaf colour chart (LCC)
- Practice fertigation daily.

Integrated Pest Management for Rice under drip irrigation

- Seed treatment with Pseudomonas fluorescens @ 10 gm/kg of seed
- Nursery – Application of Neem Seed Kernel extract (NSKE)@ 5% or neem oil 2 %

- Seedling dipping in Pseudomonas fluorescens @2.5 kg/ha
- Adoption of cultural practices
  a. Selection of Variety
  b. Removal and burning of stubbles of previous crop.
  c. Spacing based on season, variety and location
  d. Leave Rogueing space of 30cm for every 2.5 mtr.
- Use of Pheromone traps for rice stem borer @ 4 per acre.
- Use of light traps for monitoring of pests.
- Release of bio control agents : Trichogramma japonicum for stem borer @ 5 card/ha at weekly interval for 3 times on 28 DAT onwards and Trichogramma chilonis for leaf folder @ 5 card/ha at weekly interval for three times on 42 DAT onwards.
### Diseases and control measure

<table>
<thead>
<tr>
<th>Disease</th>
<th>Visual symptoms</th>
<th>Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial Leaf Blight: <em>Xanthomonas oryzae pv. oryzae</em></td>
<td>Yellowish stripes on leaf blades. Appearance of bacterial ooze on young leaves.</td>
<td>Use optimum doses of fertilizers. (Drip irrigation reduces incidence). Spraying streptomycin sulphate and tetracycline combination 300g +copper oxychloride 1.25 kg/ha.</td>
</tr>
<tr>
<td>Blast: <em>Pyricularia grisea</em> (P. oryzae)</td>
<td>Infect leaf, neck and node and severe in neck infections. spindle shaped spots with ashy center.</td>
<td>Fertigate nitrogen fertilizer. Burning of straw and stubbles after harvest. Seed treatment with <em>Pseudomonas fluorescens</em> @10g/kg of seed or 2.0 g/kg seed with Captan. Spraying of Tricyclazole at 1g/lit of water or Carbendazim at 1.0 gm/lit.3 to 4 sprays each at nursery, tillering stage and panicle emergence stage.</td>
</tr>
<tr>
<td>Rice tungro virus (RTSV, RTBV)</td>
<td>Stunted growth with yellow or orange-yellow leaves. Discoloration of leaf starts from tip downwards. Affects panicle emergence. Most panicles sterile or partially filled grains.</td>
<td>In epidemic areas follow rotation with pulses or oil seeds. In nursery use Carbofuran granules @ 1 kg a.i./ha to control vector population. Spray Mancozeb at 2.5 gm/lit.3 to 4 sprays each at nursery, tillering stage and panicle emergence stage.</td>
</tr>
<tr>
<td>Sheath Blight: <em>Rhizoctonia solani</em></td>
<td>Lesions on leaf sheaths.</td>
<td>Soil application of <em>P. fluorescens</em> @ 2.5 kg/ha mixed with 50 kg FYM after 30 days of transplanting. Foliar spraying of <em>P. fluorescens</em> @0.2% at boot leaf stage and 10 days late.</td>
</tr>
</tbody>
</table>

### Insects and control measure

<table>
<thead>
<tr>
<th>Pest</th>
<th>Visual symptoms</th>
<th>Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice Stem Borer <em>Scirpophaga incertulas</em></td>
<td>Deadhearts, White (grainless)heads wilted tillers, and weak plants.</td>
<td>Use of <em>Trichogramma japonicum</em> @ 5 card /ha on 30 &amp; 37 days after planting. Spray Monocrotophos or Quinalphos@1000ml / ha on 58,65,and 72 days after planting.</td>
</tr>
<tr>
<td>Brown Plant hopper <em>Nilaparvata lugens</em></td>
<td>Nymphs and adults congregate at the base of the plant above the water level (in wet rice). Affected plants dries up and gives appearance called “hopper burn”.</td>
<td>Use optimum doses of nitrogenous fertilizers. Apply Carbofuran 3G @ 17.5 kg/ha or Spray Imidacloprid 18.5@ 100 ml/ha.</td>
</tr>
<tr>
<td>Leaf folder (or) leaf roller <em>Cnaphalocrocis mainsails</em> <em>Marasemia patnalis</em></td>
<td>Leaves fold longitudinally and larvae remains inside. Severe infestation leads to scorched appearance resulting in crop loss.</td>
<td>Clipping of the affected leaves. Use optimum doses of nitrogenous fertilizers. Release <em>Trichogramma chilonis</em> @ 1, 25,000/ha thrice. Spray carbaryl 50 WP 1 Kg.</td>
</tr>
</tbody>
</table>

### Sustainable Rice Production

With drip-fertigation one achieves a sustainable method for rice production. Conservation of water, energy and fertilizer while enhancing yield by 1 to 1.5 ton per ha or more results in a Win-Win situation. We produced 22% more rice using 66% less water; (water use in drip is 8 million liter per ha compared to flood irrigation where it is 23.75 million liter per ha) and using 52% less power for pumping water. More rice is produced per unit input; Water productivity also improved to 500 to 1000 g/1000 liter from a figure of 120 to 290 g/1000 liter.

#### Table 4: Sustainable use of water resources

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Flood</th>
<th>Drip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area, ha</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Water Use, m³/ha</td>
<td>23,750</td>
<td>8,000</td>
</tr>
<tr>
<td>Yield, kg/ha</td>
<td>7,000</td>
<td>8,500</td>
</tr>
<tr>
<td>WUE (Water Use Efficiency), kg/m³</td>
<td>0.29</td>
<td>1.06</td>
</tr>
<tr>
<td>Selling Price of Rice, ₹/Kg</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Income ₹/acre</td>
<td>1,40,000</td>
<td>1,70,000</td>
</tr>
<tr>
<td>Value Creation Efficiency, ₹/m³</td>
<td>5.89</td>
<td>21.25</td>
</tr>
</tbody>
</table>

- Improving yields of rice is imperative to addressing growing food security challenges.
- Improves water use efficiency of rice crop and the value of water. The value creation efficiency in flood method is only ₹ 5.89 per 1000 liter water compared to ₹ 21.25 per 1000 liter in drip.
- Smallholder farmers have an impact on biodiversity and ecosystems and are dependent on them.
- At the same time, improving their practices and water productivity can help better preserve and protect natural resources.
- Improves yield, income and reduces water, energy and fertilizer use of the follower crop after rice also.
- Thus drip-fertigation ensures water, energy and food security in a sustainable manner.
The Corporation

**Global Presence:** Jain Irrigation Systems Ltd. (JISL) derives its name from the pioneering work it did for the Micro Irrigation Industry in India. However, there is more to Jain Irrigation than Irrigation. Now Jain Irrigation is a diversified entity with turnover Rs. 8000 crore. We have a Pan-India & Global presence with 33 manufacturing bases spread over 4 continents. Our products are supplied to over 126 countries with a strong network of more than 11000 dealers and distributors worldwide.

**Micro Irrigation:** The Corporation has pioneered and raised a new Micro Irrigation industry in India and thereby helped harbinger a Second Green Revolution. The Micro-Irrigation Division manufactures a full range of precision-irrigation products and provides services from soil/topographical survey, engineering design, supply, installation and commissioning to agronomic support for millions of farmers worldwide. It is the only company in the world which has the largest basket of product and system solutions that can suit any climatic/topographical/crop conditions. The division’s pool of over 10000 agronomists, irrigation engineers and technicians are well equipped to support the farmer customers across the globe. The company nurtures a sprawling 2300 acre Hi-Tech Agri Demonstration farm and a training Institute.

**Plastic Piping:** Presently, JISL is the largest producer in Asia of PVC and PE piping systems for all conceivable applications with pipes ranging from as small as 3 mm to 2500 mm in diameter and in pressure ratings ranging from 1.00 kg/cm² to 25 kg/cm². JISL has a production capacity of over 5,000 tonne per annum or 8000 km/day of plastic pipes. The Piping Division includes a variety of PVC and PE Fittings catering to irrigation needs of the farmers apart from the urban and rural infrastructure needs. The pipes are manufactured conforming to BIS, DIN, ISO, ASTM, TEC, Australian Standards as well as other customised specifications.

**Plastic sheet** division’s globally marketed products help conserve forests by providing alternatives to wood in the home building market.

**Biotechnology:** The Tissue Culture Division produces Banana, Pomegranate, Strawberry, Guava, Coffee, Sugarcane plantlets and has established vast primary and secondary hardening facilities and R&D labs.

**Green Energy:** JISL Pioneer Solar water pumping systems in the country. Jain Solar water pumping system is a standalone system operating on power generated by Solar Photovoltaic panels which are also manufactured in house state-of-the-art facility. JISL has installed more than 20000 Solar Pumps. All these products are in harmony with the group’s mission, “Leave This World Better Than You Found It.”


**Food Processing:** Jain Farm Fresh Division processes tropical fruits such as Mango, Banana, Guava, Pomegranate into Purees, Concentrates & Juices. The company also has a Dehydration facility which dehydrates Onions & Vegetables. The Company has also launched a range of fruit pulp based retail FMCG Products under the brand of “Jain Farm Fresh”.

Agricultural and Fruit processing wastes from these processing plants are converted to Bio-Energy to partially run the plants. The residue after the Bio-Energy generation is used as an Organic Manure.

**Turn-key Projects:** JISL undertakes Integrated Agricultural Development Projects on Turn-Key basis from Concept to Commissioning with value added services. JISL offers cost effective, down-to-earth solutions for complex challenges backed by our core strength of global knowledge and experience combined with local man-power which is an ideal combination of technology, intelligence and common sense. Whatever be the nature of the project requirement, JISL can assure Total Turn-Key solutions and maximum value for the farmers. It can also undertake Watershed or Wasteland development projects. Such projects normally begin with selection of site, survey of the command area, identification of appropriate crops, designing of the suitable irrigation systems, determination of agronomic practices, use of other hi-tech agro inputs, providing on-going technical services & training and pre & post harvesting techniques, provide assistance for operation and maintenance of the systems. The Company has successfully executed large scale turn-key irrigation projects from conception to completion not only in India but also overseas.

**Jain Irrigation offers following turn-key Solutions:**
- Integrated irrigation solutions
- Integrated agricultural development projects
- Reuse of waste water for agriculture
- Dust suppression
- Lift & Gravity water pipelines
- 24x7 Water Supply
- High-tech Urban Utilities Solutions
- Effluent conveyance & disposal systems
- Gas distribution Systems
- Industrial fluid conveying systems, sewerage lines etc.
- Marine On-shore & Off-shore piping
- Relining and rehabilitation of existing pipelines
- Plumbing Systems
- Solar pumping systems
- Solar water heating projects

In a nutshell, the Corporation is the only ‘one-stop shop’ encompassing manufacturing and marketing of hi-tech agricultural solutions/systems and piping services as well as processing of agri produce. No wonder, it has distinguished itself as a leader in the domestic as well as global markets. The corporate product range improves productivity and adds value to the agri-sector. Conservation of scarce Natural resources, protection and improvement of the environment emerge as a blessed outcome. The reward has been over millions of smiling farmers and scores of customers in more than 126 countries.

**Sustainability:** Every business of JAINS, ensures to create shared value, nurtures the environment and contributes significantly to the Water, Food and Energy security of the World.

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[QR Code for Jain Drip Pipes Mobile App]
[QR Code for Jain Sprinklers Mobile App]
[QR Code for Jain Tissue Culture Mobile App]
[QR Code for Jain Greenhouse Mobile App]
[QR Code for Jain Solar Pump Mobile App]
[QR Code for Nutri Care Mobile App]
[QR Code for Irricare Mobile App]
[QR Code for Naandan Jain Mobile App]