



Irrigation Solution
RICE
With Jain Technology™



JAIN®

Jain Irrigation Systems Ltd.

Small Ideas. Big Revolutions.®

Rice is the main grain that is consumed in India and other South Asian countries. A hectare of rice in conventional puddle cultivation uses 1300-1600 mm of water per season as per the literature. But in practice, farmers use a greater volume (up to 2000 mm) in many delta areas in India.

The future of rice production which consumes a lion's share of water (85%) used in irrigated agriculture will therefore depend heavily on developing and adopting technologies and practices which will use less water with highest use efficiency. Rice is cultivated usually in a puddled condition with large volumes of water and grown in standing water. The water productivity is hardly 0.15 kg/m³ water, which is very low. Even in SRI (Sustainable rice Initiative) method the total water use is 745-800 mm per ha though this method does away with standing water during the major crop phase.

Similarly, productivity of rice is stagnant (Table.1) and how a change can be brought to this situation. A comprehensive package was tested that could reduce resource use and increase productivity in direct seeded rice which form 28% of the Indian rice cultivation. Jain Irrigation, the most highly water conscious Corporate in the country is working towards food security thru water and energy securities have now tested and released an innovative method for cultivating rice.

Status of rice production in India

Table 1 : Rice production scenario in different states of India

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

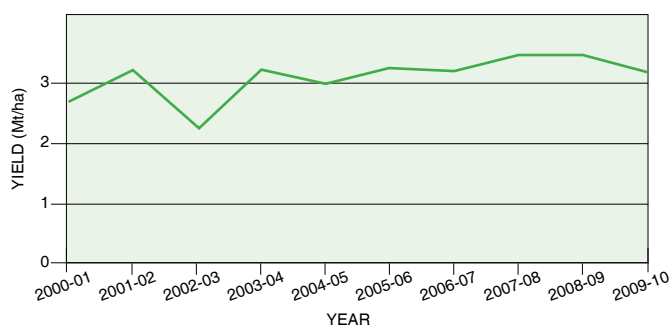


Fig 1 : Productivity of rice in India (2000-10)

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 differences of these practises from conventional practises 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 take 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 irrigation and fertigation by Jain irrigation. More such varieties will be tested and recommended.

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

Month	Pan E (mm/day)	Total water Req. (lit/Day/ha)
Feb 16-28	6.68	18704
Mar 1-15	6.73	40044
16-31	6.82	47740
April 1-15	6.09	56840
16-30	6.53	60947
May 1-15	7.44	70019
16-31	7.57	58878

*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.

Traditional (Puddling) Cultivation Method

Rice fields are first flooded before tillage. Tillage of flooded field is referred to as puddling. In puddling, the top soil is subjected to repeated fine grinding with water. Besides saturating the top soil, an overlying water layer is created and maintained during the transplanting period. Apart from high water use the procedure of puddling has many disadvantages;

- Puddling destroys soil structure
- It reduces percolation rate
- It results in loss of water (Puddling accounts for 20-40% of total water use of rice culture).
- Most of the water used for puddling is lost by drainage.
- It induces high resistance to root penetration
- It causes low porosity and permeability
- It results in the formation of a soil plow pan
- All the above factors restrict root growth.
- It also causes emission of Methane gas. Thus it is supposed to be the creator of Green House Gases.

The only known advantage of flooding for tillage (Puddling) seems to be the control on weed germination.

Because of the demand on water modern technology high light dry sowing of paddy seeds into wet soil (no standing water). Drip irrigation makes the soil wetting easy and water use restricted to crop water requirement alone.



Drip Irrigation - The concept

Drip irrigation is the slow, even application of water at low pressure to the root zone using a net work of plastic tubing placed above the rooting zone (surface drip) or buried among the root branches inside the rhizospheric 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.

We recommend use of rice husk mulch on the beds after seeding. Mulch is applied 2-3 cm thick on the bed surface.

Besides reducing weed growth it also helps reduce evaporation from the soil surface. However this is an optional recommendation.

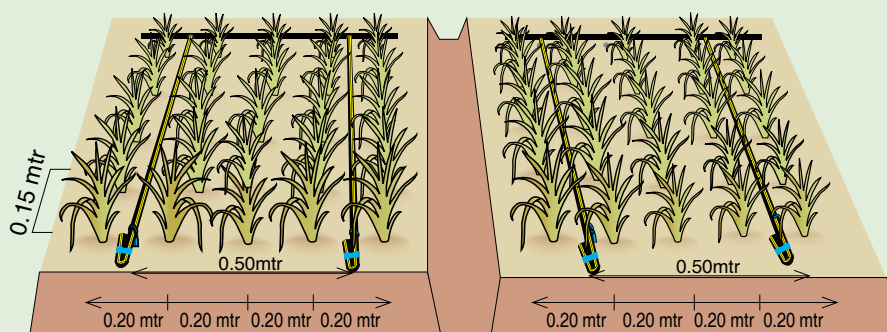
Weedicide application

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.

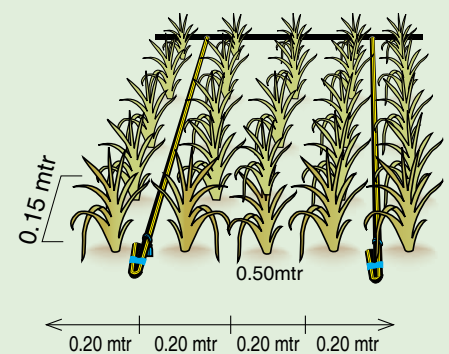
Fertilizer application through Fertigation

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 Drip layout system



BBF System



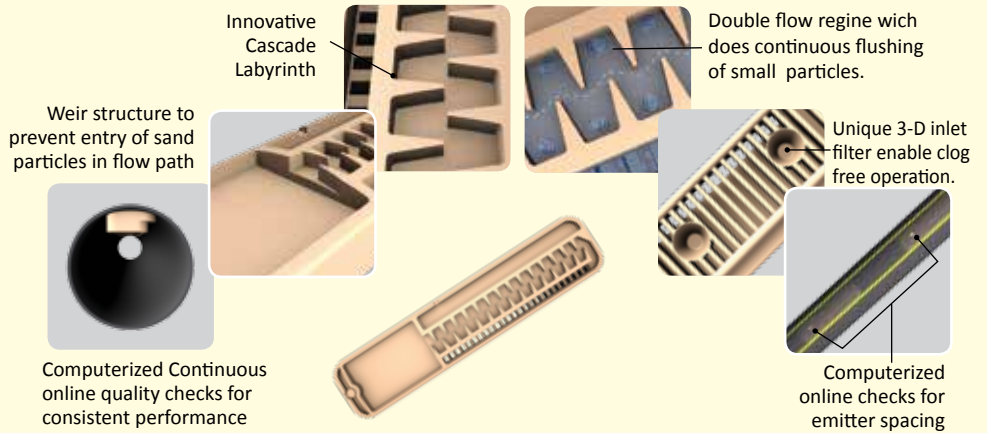
Flat System

ONE STOP SHOP for Your



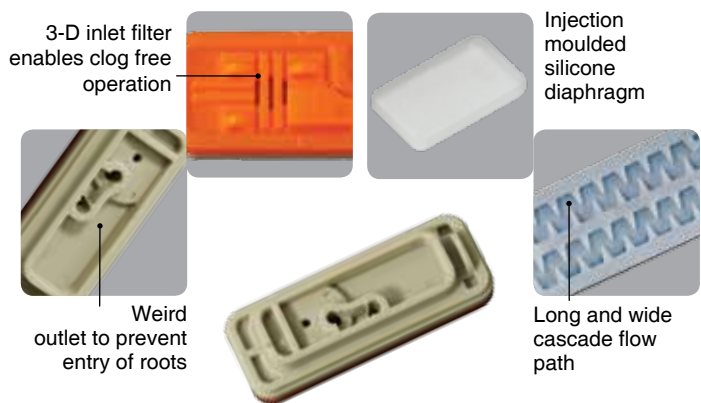
Jain Turbo Excel®

- Five Star rated dripline from worlds reknowned institute IRSTEA (Cemagref), France.
- Available discharge rates - 0.85, 1.2, 1.6, 2.1, 4 lph @ 1kg/cm².
- 12, 16, 20, 25 mm nominal diameter.
- Dripper Spacing 15, 20, 30, 40, 50, 60, 75,90 cms.



Jain Turbo Top™

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

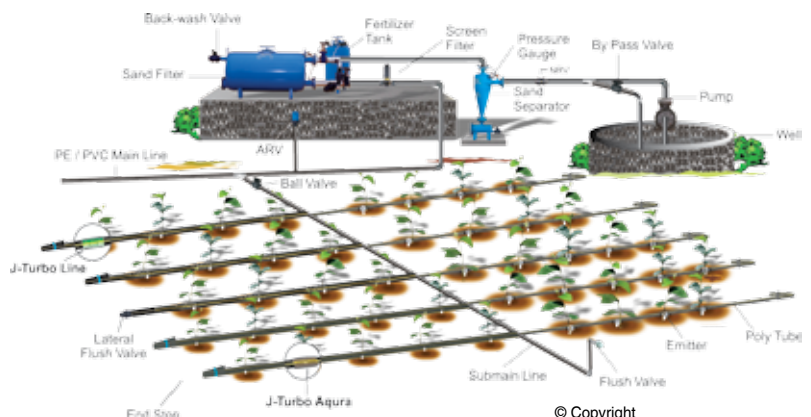


Why Jain Drip Irrigation ?

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.



Micro Irrigation Needs

J-Turbo Line® Super



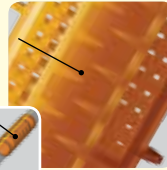
- Available discharge rates (at 1kg/cm²)
12mm - 2.2, 4 lph
16mm - 4, 8 lph
20mm - 2.2, 4, 8 lph
- Available in 12, 16 & 20 mm nominal diameter.
- Suitable for surface as well as subsurface installations.

Straight and wide labyrinth design makes the dripper truly clog resistant.

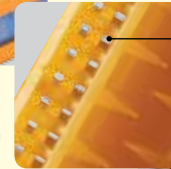
Computerized online checks for emitter spacing



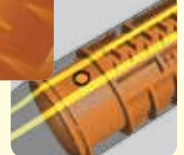
Hydrodynamic through bore design provides least obstruction to flow.



Hydrodynamically designed cascade tooth structure helps to create double flow regime for continuous flushing of dirt.



High precision inlet filters on opposite side prevents entrance of fine particles



Laser Drilled Multiple Outlet Holes

Turboline PC®

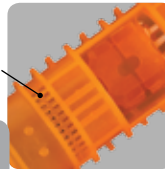


- Available discharge rates - 1.4, 1.8, 2.6 & 4.0 lph within pressure regulation range of 0.7 to 3 kg/cm².
- Injection moulded silicone rubber compensates with pressure and discharge gives uniform performance
- Application on undulating land/ Terrains/ Steep slopes.
- Available in 16 & 20 mm nominal 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.

Diametrically placed multiple inlet filters



Injection moulded silicone diaphragm



Dual outlets to break vacuum & prevents soil suction



Smooth hydrodynamic design minimizes frictional losses & helps for longer lateral running length.

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



Benefits of Jain Drip in Rice Cultivation



- ◆ Enhanced yield upto 50% .
- ◆ Higher and cleaner straw production.
- ◆ Conserving irrigation water up to 66%
- ◆ Conserving energy use for pumping up to 52%.
- ◆ Higher water and fertilizer use efficiency.
- ◆ Incidence of diseases and insects significantly low
- ◆ Early Maturity
- ◆ More Productive tillers
- ◆ Reduced chaffiness & shattering of grains
- ◆ No need for land leveling (prerequisite for flow irrigation).
- ◆ No need for labour use for trimming bunds and plugging breaches to contain water.
- ◆ Intercropping and rotation cropping is possible. Pulse rotation crop will be beneficial.
- ◆ When Direct Seeding (DSR), reduces seed cost.
- ◆ Soil structure is maintained (absence of puddling operation that destroys soil structure).
- ◆ Maintains aerobic condition in the soil.
- ◆ Prevents Nitrous oxide formation .
- ◆ Prevents Methane emission and protects environment as there is no standing water
- ◆ Absence of pollution from leached and washed Nitrate.
- ◆ Reduced humidity in micro climate .
- ◆ Lower mosquito population in the ecosystem as there is no standing water.
- ◆ Improves human health.
- ◆ More sustainable production of Rice.

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 3 : Fertigation schedule adopted in drip irrigated rice in AP* (Fertilizer dose 180:80:80 kg NPK per acre)

	Urea	SSP	MOP	ZnSO ₄	Schedule (urea) kg/day/ac	Schedule (MOP) kg/day/ac
Basal (soil)		500	0	10	-	-
till 10 DAP [§]	65	0	0	-	6.5	-
11-35 DAP	196	0	16	-	7.8	0.64
36-55 DAP	65	0	17	-	3.3	0.85
55-65 DAP	65	0	50	-	6.5	5
65- 70 DAP	0	0	17	-	-	3.4

[§]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

Disease	Visual symptoms	Control Measures
Bacterial Leaf Blight: <i>Xanthomonas oryzae</i> pv. <i>oryzae</i>	Yellowish stripes on leaf blades. Appearance of bacterial ooze on young leaves.	Use optimum doses of fertilizers. (Drip irrigation reduces incidence). Spraying streptomycin sulphate and tetracycline combination 300g +copper oxychloride 1.25 kg/ha
Blast : <i>Pyricularia grisea</i> (<i>P.oryzae</i>)	Infect leaf, neck and node and severe in neck infections spindle shaped spots with ashy center.	Fertigate nitrogen fertilizer. Burning of straw and stubbles after harvest. Seed treatment with <i>Pseudomonas fluorescens</i> @ 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.
Rice tungro virus (<i>RTSV</i> , <i>RTBV</i>)	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	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.
Sheath Blight: <i>Rhizoctonia solani</i>	Lesions on leaf sheaths.	Soil application of <i>P. fluorescens</i> @ 2.5 kg/ha mixed with 50 kg FYM after 30 days of transplanting Foliar spraying of <i>P. fluorescens</i> @0.2% at boot leaf stage and 10 days late.

Insects and control measure

pest	Visual symptoms	Control Measures
Rice Stem Borer <i>Scirpophaga incertulus</i>	Deadhearts, White (grainless) heads wilted tillers, and weak plants.	Use of <i>Trichogramma japonicum</i> @5 card /ha on 30 & 37 days after planting Spray Monocrotophos or Quinalphos @1000ml / ha on 58,65, and 72 days after planting
Brown Plant hopper <i>Nilaparvata lugens</i>	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".	Use optimum doses of nitrogenous fertilizers Apply Carbofuran 3G @ 17.5 kg/ha or Spray Imidacloprid 18.5 @ 100 ml/ha.
Leaf folder (or) leaf roller <i>Cnaphalocrocis mainsails</i> <i>Marasmia patnalis</i>	Leaves fold longitudinally and larvae remains inside. Severe infestation leads to scorchy appearance resulting in crop loss	Clipping of the affected leaves Use optimum doses of nitrogenous fertilizers Release <i>Trichogramma chilonis</i> @ 1, 25,000/ ha thrice Spray carbaryl 50 WP 1 Kg.

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

Irrigation	Flood	Drip
Area, ha	1	1
Water Use, m ³ /ha	23,750	8,000
Yield, kg/ha	7,000	8,500
WUE (Water Use Efficiency), kg/m ³	0.29	1.06
Selling Price of Rice, ₹/Kg	20	20
Income ₹/acre	1,40,000	1,70,000
Value Creation Efficiency, ₹/m ³	5.89	21.25

- 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 1000 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 5,00,000 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 Pioneered 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".

Jain Green Energy division also offers Solar Thermal Water Heating Systems, Solar Photovoltaic, Bio-Gas and Bio-Energy alternate energy solutions.

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 begins 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 System
- 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.

Crop yields depend on climate, soil and management and therefore can't be guaranteed by the company.

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Tel: +91-257-2258011; **Fax:** +91-257-2258111; **E-mail:** jisl@jains.com; **Website:** www.jains.com;

Toll Free: 1800 599 5000

