SAFE USE OF URBAN AND INDUSTRIAL WASTEWATER IN AGRICULTURE

Prof. H.C. Joshi

Division of Environmental Sciences
Indian Agricultural Research Institute
New Delhi - 110012
Phones 25841490(O), 27942992® 9313056502(M) ;
e-mail hcj_env@yahoo.com

Concerns

12 elements

- **Wastewater**
- **Operator**
- **Volume**
- **Nutrients**
- **Sodicity, salinity**
- **Toxicity**

- **Environment**
- **Soil**
- **Surface water**
- **Groundwater**
- **Human and Livestock health**
- **Public amenities**
- **Native vegetation**
- **Cultural heritage**

Rationale for agri-utilization of industrial efluent

✓**The conventional approach of in-plant treatment of industrial wastewater even up to secondary and tertiary and its disposal in surface water does not provide an environmentally compatible solution to wastewater management.**

✓**Agricultural utilization of wastewaters offers a low cost alternative. In doing so the manorial and irrigational potential of various types of wastewaters which invariably have a considerable economic value in context of present energy and nutrient crisis and also water conservation need to be primarily considered.**

Provided……

- **It is important that potential toxicants present in the wastewater should be identified.**

- **A wastewater agro-cycling package should have inherent safety mechanism so that the resultant product in the form of food grain, fodder or allied products such as milk or meat should be safe for consumers and the sustainability of agro-ecosystems.**

- **To ensure safety it is imperative that industrial wastewater should not be allowed to discharge on land outside the framework of widely tested agronomic package supported by well devised monitoring protocol.**

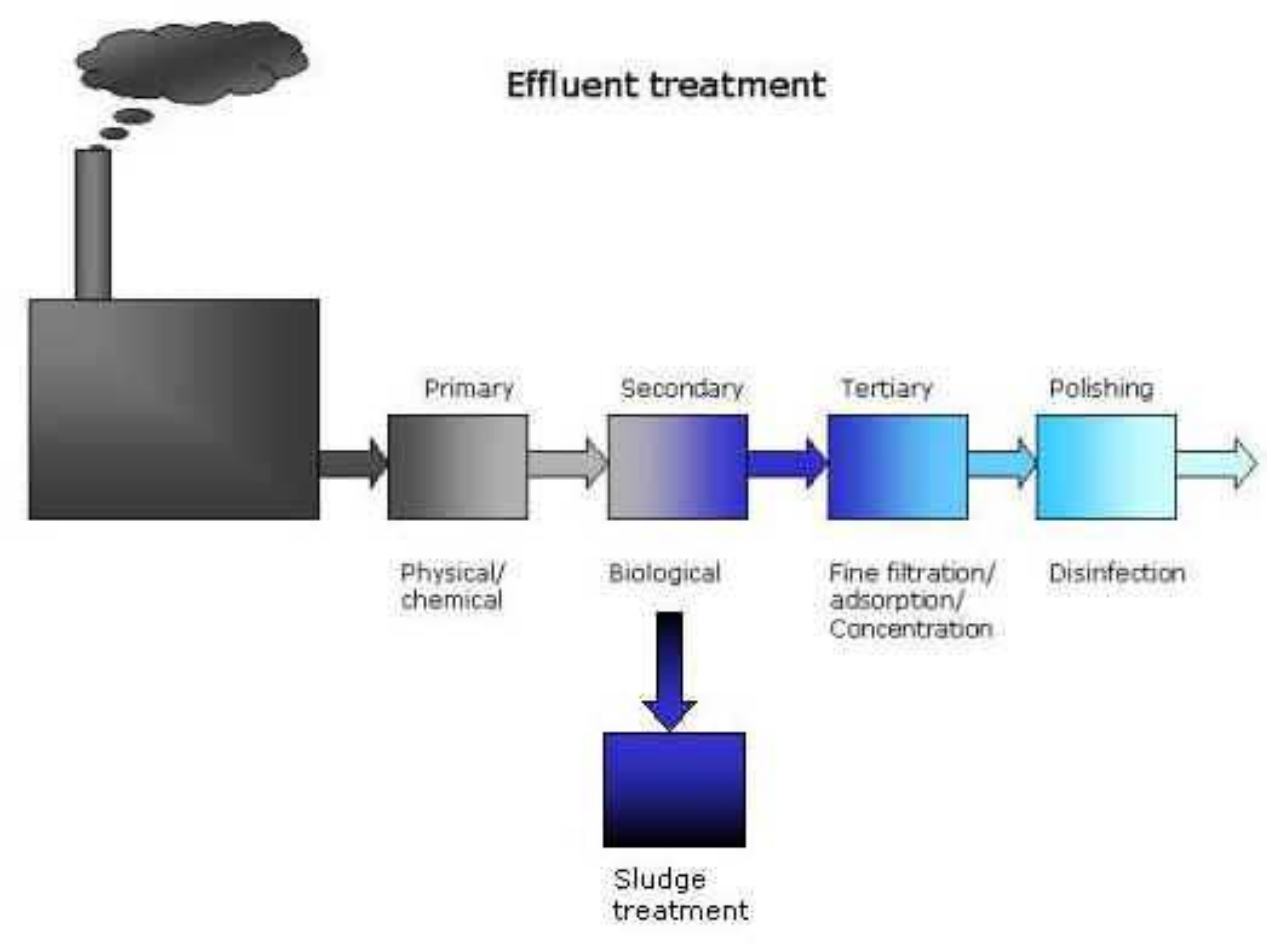
Environmental aims of a good effluent irrigation system

- Use the resources effectively.
- Protect the land
- Protect the groundwaters
- Protect the surface waters
- Protect the community amenity

Potential wastewater sources suitable for irrigation

• Sewage	100 BCM
• Sugar distillery industry	0.04 BCM
• Pulp and paper mills	0.6 BCM
• Total precipitation	4000 BCM
• Total untapped water	2400 BCM

Industrial waste water treatment using various technologies



Advantages of an environmentally friendly effluent irrigation system

Less sludge **Wastewater for irrigation requires lower levels of treatment than for stream discharge, which yields another benefit--less sludge. Lagoon systems are often used to renovate wastewater before reuse. Lagoon systems have low labor requirements and no routine sludge handling requirements.**

Expediency and cost effectiveness **Being a long distance from a receiving stream may motivate a community to consider irrigation. Because excavating and laying long sewer lines can be the most expensive aspect of a wastewater treatment system, irrigating wastewater on nearby land may be more affordable.**

Nutrient value **When tied to irrigation, the nitrogen and phosphorus present in wastewater are considered valuable nutrients rather than contaminants. Because treated wastewater can be irrigated on turf, timber, and field crops, a number of irrigation sites can be considered, such as golf courses, parks, plant nurseries, and farm fields.**

Maximum permissible limits for industrial effluent discharges (in mg/litre)

Parameter	Into inland surface waters Indian standards: 2490(1974)	Into public sewers Indian Standards:3306(1974)	On land for irrigation Indian Standards: 3307 (1974)
pH	5.50-9.00	5.50-9.00	5.50-9.00
Biological oxygen demand (for 5 days at 20°C)	30.00	350.00	100.00
Chemicals oxygen demand	250.00	--	--
Suspended solids	100.00	600.00	200.00
Total dissolved solids (inorganic)	2100.00 0	2100.00	2100.0
Temperature (°C)	40.00	45.00	--
Oil and grease	10.00	20.00	10.00
Phenolic compounds	1.00	5.00	--
Cyanides	0.20	2.00	0.20
Sulphides	2.00	--	--
Fluorides	2.00	15.00	--
Total residual chlorine	1.00	--	--
Pesticides	--	--	--
Arsenic	0.20	0.20	0.20
Cadmium	2.00	1.00	--
Chromium (hexavalent)	0.10	2.00	--
Copper	3.00	3.00	--
Lead	0.10	1.00	--
Mercury	0.01	0.01	--
Nickel	3.00	3.00	--
Zinc	5.00	15.00	--
Chlorides	1000.00	1000.00	600.00
Boron	2.00	2.00	2.00
Sulphates	1000.00	1000.00	1000.00
Sodium(%)	--	60.00	60.00
Ammonical nitrogen	50.00	50.00	--
Radioactive materials	.	.	.
Alpha emitters (milli curie/millilitre)	10-7	10-7	10-8
Beta emitters (as curie/millilitre)	10-6	10-6	10-7

Limitations of an environmentally friendly effluent irrigation system

Discharge requirements

Strict discharge limits for a nearby stream may require a complex treatment process, high electrical, chemical, operational and infrastructural costs

Availability of land

Adverse soil conditions, topography, and land use can increase the land area needed to irrigate wastewater to ensure the protection of public health and the environment.

Soil permeability **Very low soil permeabilities dramatically affect the amount of land needed for a wastewater reuse system.**

Soil water **Excess soil water limits the amount of additional water that can be applied through wastewater irrigation.**

System component **Irrigation system components, such as irrigation pipe, emitters, and pumps, are an added expense to a wastewater treatment system.**

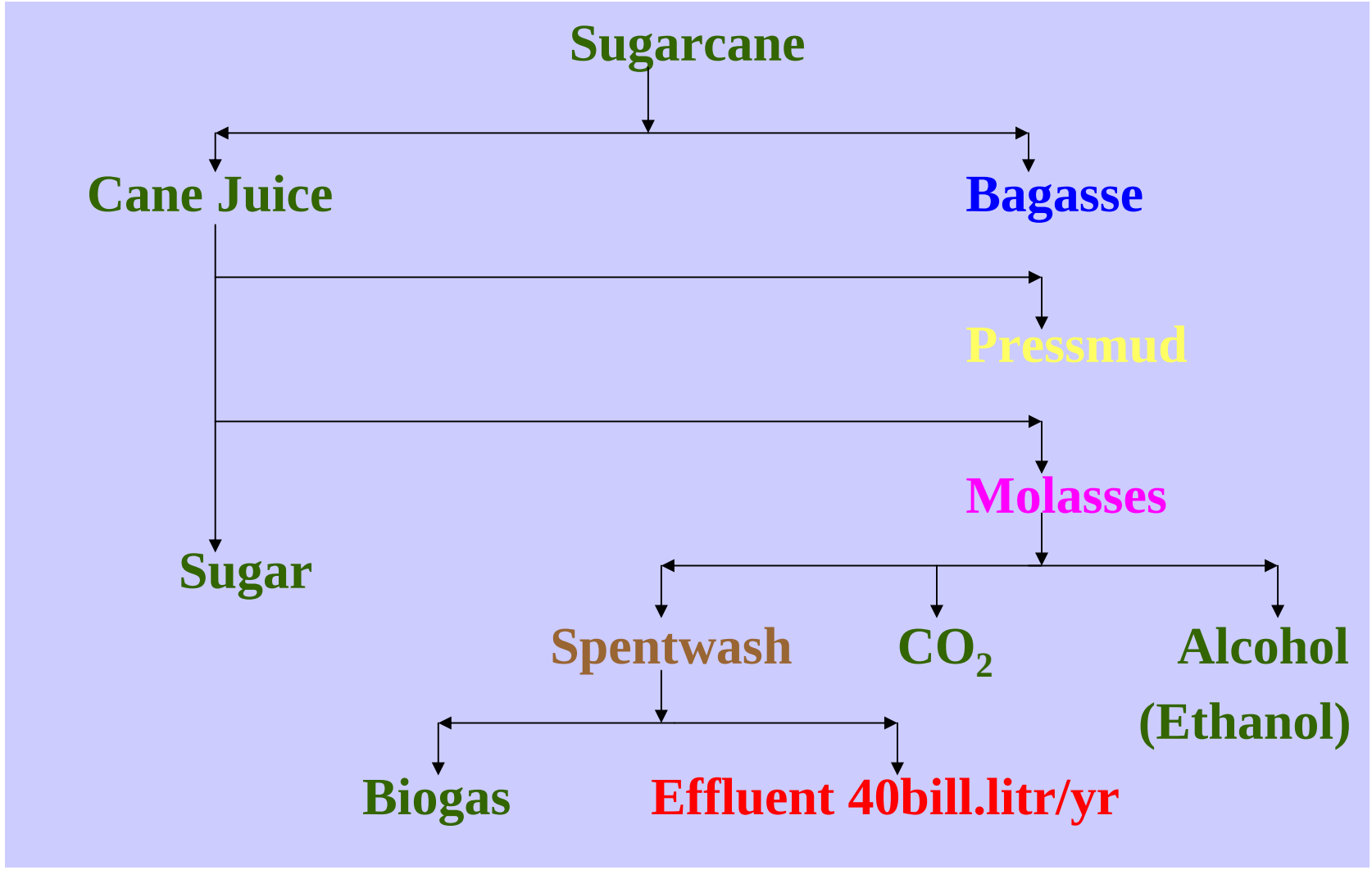
Suitability of water with different constituents for irrigation

Class of water	TDS ppm	Sulphates ppm	Chlorides ppm	% sodium	Boron ppm	EC dS/m	Suitability for irrigation
I	0-700	0-192	0-142	0-50	0-0.5	0-750	Excellent to good
II	700-2000	192-480	142-355	60-75	0.5-2.0	750-2250	Good to injurious. Suitable only in permeable soils. Harmful to sensitive crops
III	2000 Or more	>480	>355	>75	>2.0	>2250	Unfit for irrigation

Suitability of water for irrigation with different values of SAR

SAR	Suitability for irrigation
0-10	Suitable for all types of soils and crops except fort hose crops which are highly sensitive to sodium
10-18	Suitable for course textured or organic soil with good permeability. Relatively unsuitable in fine textured soils
18-26	Harmful for almost all types of soils. Require good drainage, high leaching and gypsum addition.
>26	Unsuitable for irrigation

Sugar Distillery Industry




Distillery effluent : A valuable source of nutrients
N 0.3%
K 1.3%
S 1.2%
P 0.01%
SAR < 2

Economic value (per annum) of distillery effluent

- **No. of distilleries in India** **290+**
- **Total Effluent Generated** **40 bl. Litre**
- **Annual Cost of macro-nutrients**

  N,P,K, & S **Rs 500 crore**
- **Annual cost of micro-nutrients**

  And Organics **Rs 150 crore**
- **Environmental costs** **Rs 800 crore**

Annual environmental cost of distillery effluent discharge into water courses

• Fisheries	100crore
• Water treatment cost	500 crore
• Public health cost	100 crore
• Landescape cost	100 crore
• Total cost	800 crore

Why use distillery effluent in agriculture

- If discharged into water, as is the present practice, it defiles their ecosystem.
- This effluent has been designated by CPCB as the most hazardous pollutant of water bodies.
- It contains huge quantity of macro- and micro-nutrients excavated by sugarcane from the land.

Constraints in using distillery effluent in agriculture

- *Psychological reasons*
- *Abuse of effluents*
- *Absence of proper irrigation network*
- *Research and technological gaps*
- *Lack of extension support from distilleries*

Strategies for safe utilization of PME in agriculture

- To recognize manorial potential of PME.
- Demonstration farms to convince the farmers.
- Farmers' cooperatives to make large land areas available.
- Effective channel design to carry PME to different fields in vast land area up to 500 ha.
- Provision for lined retention ponds.
- Solidification of effluent through composting with pressmud, rice straw or any other filler material


Ferti-irrigation
with
Post
Methanation
Distillery
effluent (PME)

Experiments with distillery effluent under NATP at Gajraula, U.P.

Effect of PME irrigation on rice and maize

Doses	Effect	Rice Saryu (Oudh)	Maize (Gs-2)
No of irrigation	-	4	4
10% PME	Yield Injury biomass	8% increase No green	46% increase No green
20% PME	Yield Injury biomass	19% increase No green	70% increase No green
30% PME	Yield Injury biomass	22% increase No green	48% increase No green
40% PME	Yield Injury biomass	21% increase No green	42% increase No green

Grain Yield (t/ha) of Maize and Wheat crops grown at IARI under PME irrigation.

Treatments	Wheat 94-95 (HD-2285)	Maize 95 (GS-2)	Wheat 95-96 (HD-2285)	Maize 96 (Hyb. Navjyot)	Wheat 96-97 (HD-2285)	Maize 97 (GS-2)
Control	3.65	2.90	2.85	1.54	2.80	2.61
10% PME	5.82	3.14	3.27	1.80	3.06	3.80
20% PME	5.64	3.19	3.26	2.32	2.82	4.44
30% PME	4.73	3.10	3.12	2.18	3.26	3.87
40% PME	4.24	3.18	2.68	1.62	2.61	3.71
CD at 5%	0.88	0.48	0.47	0.33	0.52	0.39

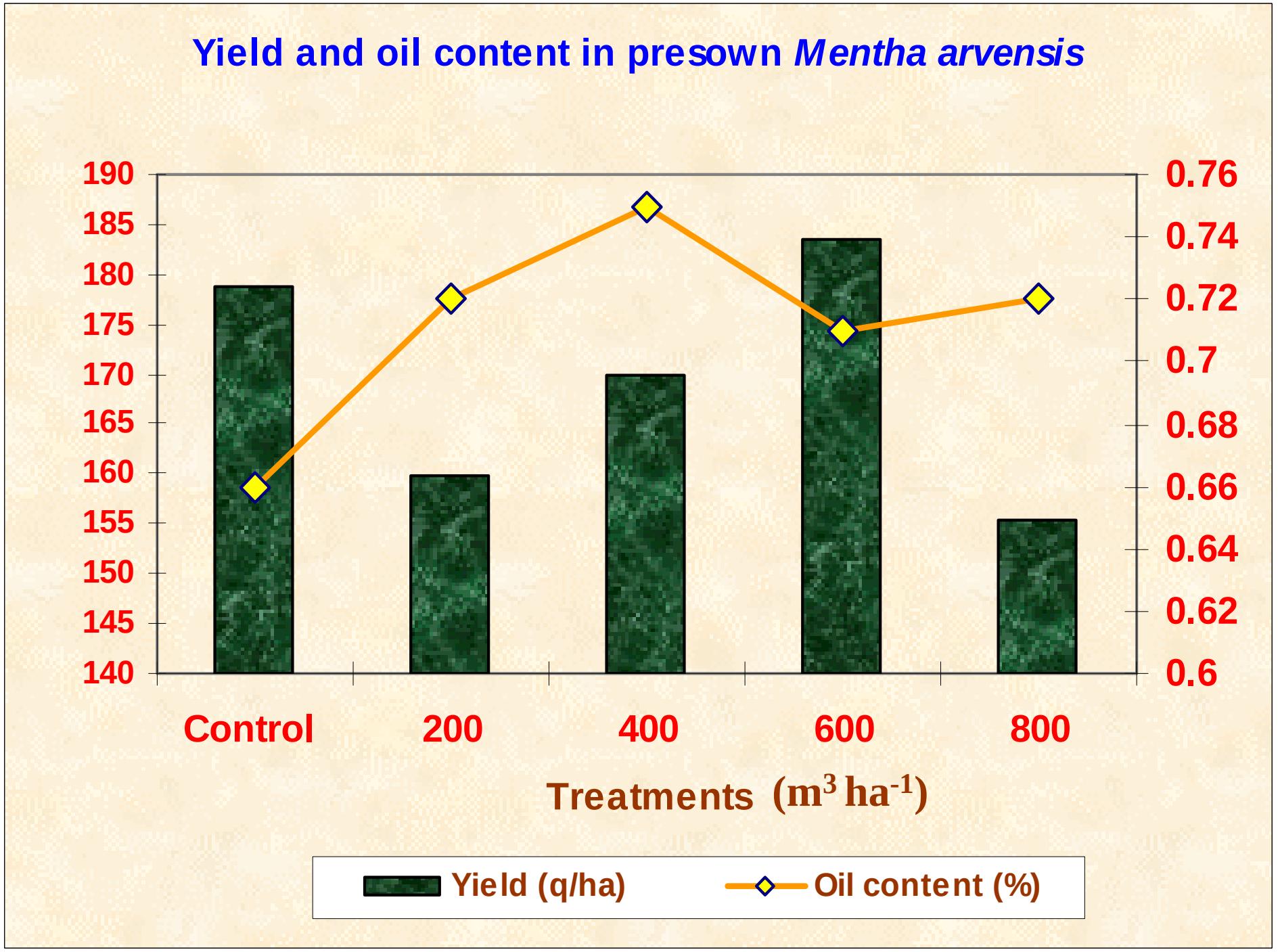
Types of irrigation with distillery effluent (PME)

- **Pre sown Irrigation**
- **200 cubic meter per ha 20-25 days before sowing. Can be applied twice in a year.**
- (Approx. 9 ha required for 1 kld cap.)
- **Post sown irrigation**
- **Mixed with irrigation water (up to10 per cent). Can be given any time after 25 days of crop emergence**

Nutrient deficiency in Indian Soils

								??
						B	B	B
					Mn	Mn	Mn	Mn
				S	S	S	S	S
			K	K	K	K	K	K
			Zn	Zn	Zn	Zn	Zn	Zn
		P	P	P	P	P	P	P
	Fe	Fe	Fe	Fe	Fe	Fe	Fe	Fe
N	N	N	N	N	N	N	N	N
1950	1960		1970		1980		1990	2000

Response of Mentha to PME


Yield and oil content in presown *Mentha arvensis*
190
185
180
175
170
165
160
155
150
145
140
0.76
0.74
0.72
0.7
0.68
0.66
0.64
0.62
0.6
Control
200
400
600
800
Treatments (m3 ha-1)
Yield (q/ha)
Oil content (%)

Response of Marigold to Distillery Effluent


National Agricultural Technology Project
(NATP) on
DISTILLERY WASTE UTILIZATION
IN AGRICULTURE
Division Of Environmental Sciences
Indian Agricultural Research Institute
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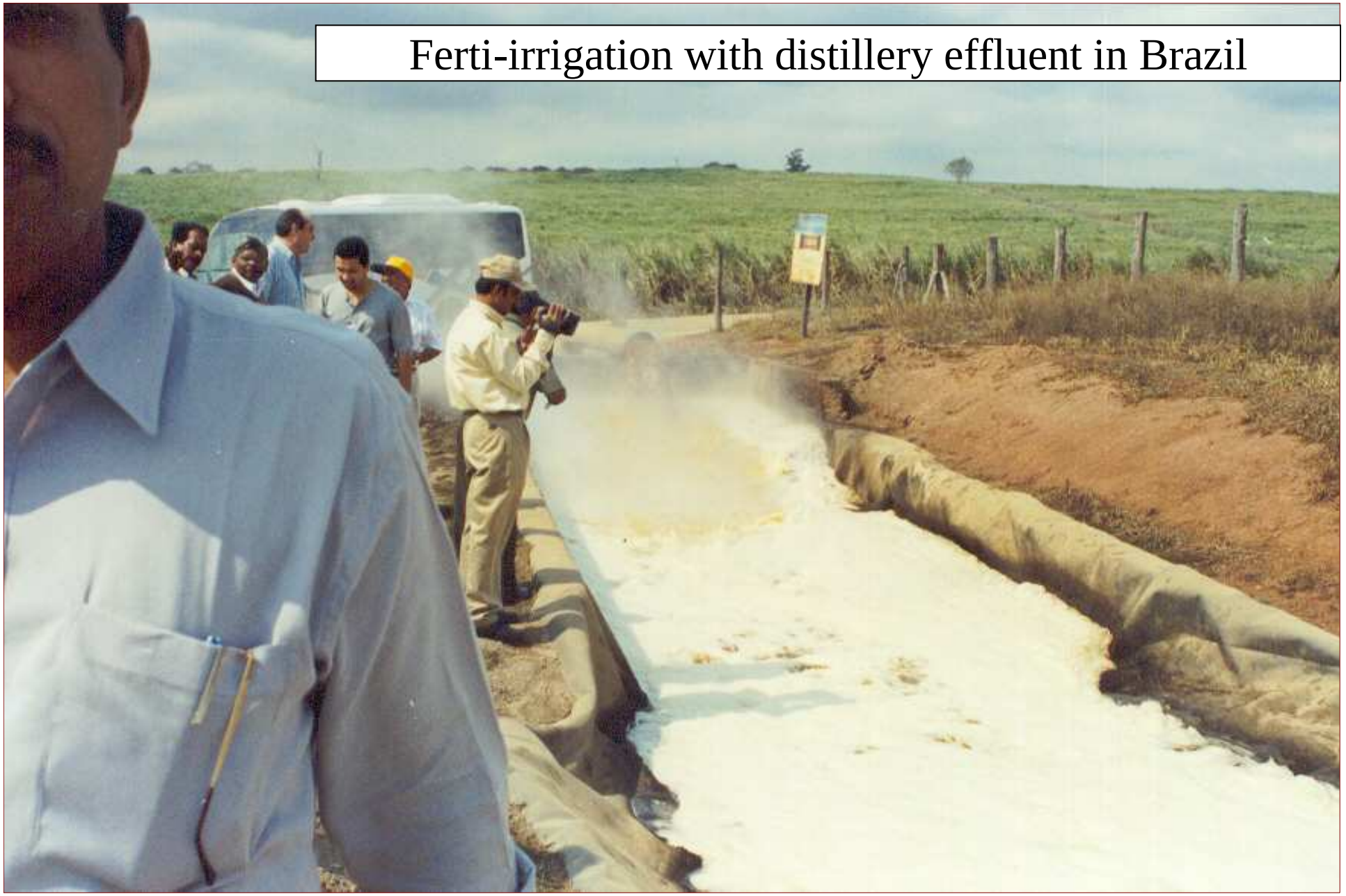
Response of Gladiolus,Marigold and Mustard to Distillery Effluent

Effect of effluent application on soil health

- **Organic content of effluent enhances plant growth.**
- **Its application affects directly or indirectly the functioning and diversity of the system which may be crucial for ecosystem functioning and sustainable agriculture.**
- **For sustainable agriculture there is need to maintain soil quality/functionality/health, which is largely governed by viable, diverse population of function microbial community.**

Agroecosystem responses to ferti-irigation

- **Most of the food crops show good response to pre sown distillery effluent irrigation.**
- **Post-sown irrigation in which plants are directly exposed to effluent, particularly at the higher doses may cause direct injury to the plant due to its high BOD and salt loads.**
- **The addition of effluent increases fertility of the soil.**
- **Effluent application at higher doses causes accumulation of salts, particularly potassium, in the soil profile.**
- **Effluent helps in reclamation of sodic soils.**
- **When applied on the soil, the colour of the effluent is amenable to microbial and photo-degradation.**



Spentwash (Vinasse) flows in HDPE Lined Channel for Spray Application on Farm Lands through Aspirator

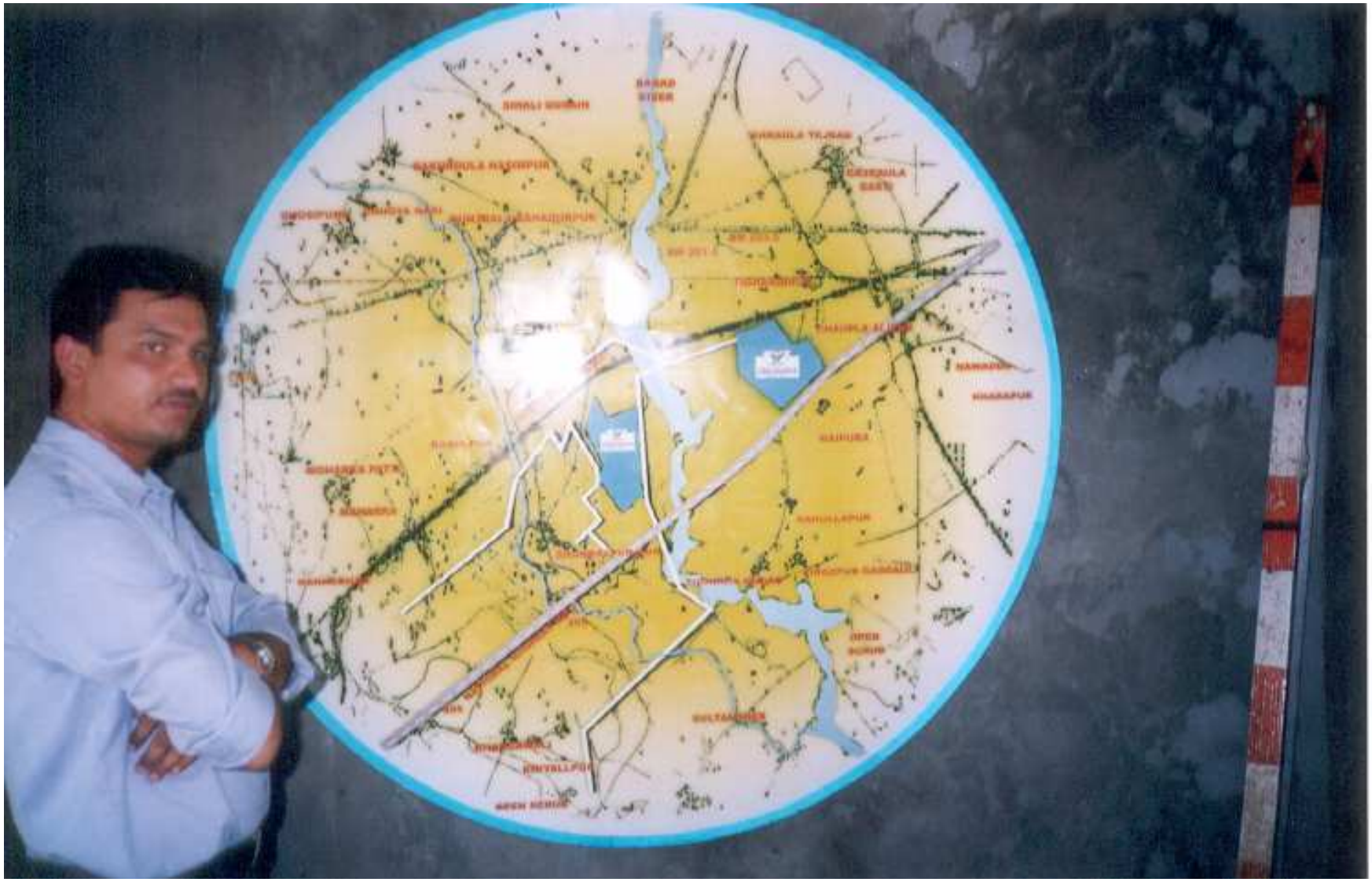
Temporary channel formed during application to supply spentwash for spray application by Aspirator

Wherever Spentwash Channel is not present, Spentwash is transported through twin Tankers (30KL capacity each)

Spentwash Aspirator draws spentwash from lorry tankers for spraying

Aspirator spray gun spraying spentwash to cover 200 feet radius. Spentwash spray wets the sugarcane trash and top soil and accelerates *insitu* trash composting in addition to nutrients supply to ratoon crop of sugarcane

Ferti-irrigation plan of Jubilant Organosys at Gajraula



Using tankers to carry effluent to the site

Under ground channel with valve on top

Mixing effluent with water

Why irrigation with treated wastewater ?

Treated water serves as an extra source of water available for irrigation

Irrigation adds significant polishing treatment to the effluents

Disposal of the treated waste water via irrigation may be the cheapest disposal alternative.

Disposal of the treated waste water via irrigation has minimal impact on the environment

Thank You