ICAR SUCCESS STORY

JALOPCHAR™

An Eco-friendly Wastewater Treatment Technology

Dr Ravinder Kaur

Indian Council of Agricultural Research
New Delhi

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नरेन्द्र सिंह तोमर
NARENDRA SINGH TOMAR

कृषि एवं किसान कल्याण,
ग्रामीण विकास तथा पंचायती राज मंत्री
भारत सरकार
कृषि भवन, नई दिल्ली
MINISTER OF AGRICULTURE & FARMERS' WELFARE,
RURAL DEVELOPMENT AND PANCHAYATI RAJ
GOVERNMENT OF INDIA
KRISHI BHAWAN, NEW DELHI

MESSAGE

Water is vital for global food security. Over the years, increased withdrawal of groundwater for various purposes including irrigation has contributed to aquifer depletion, groundwater pollution and soil salinization.

Excessive groundwater extraction coupled with climate change has intensified fresh water stress and resulted in challenges for our country's rain-fed agriculture. NitiAyog classified 256 districts (out of a total of 731 districts) with 1,592 blocks as water-stressed. To tackle this situation, a time-bound mission-mode water conservation campaign, involving various Ministries of the Central and State Governments has been launched in the aforesaid blocks, under the Government of India's Jal Shakti Abhiyan. One of the key components of the Jal Shakti Abhiyan is to facilitate/promote safe reuse of waste-water in agriculture. From India's perspective, as per NitiAyog, approximately 70% of States treat less than half of their waste-waters. Hence, to enable safe re-use of waste waters for meeting country's vast agricultural demand, it is imperative to boost low-cost decentralized waste water treatment technologies.

In this context, I am glad to know that ICAR-Indian Agricultural Research Institute has taken the lead in developing and successfully operationalizing an innovative, decentralized and highly cost-effective waste-water treatment technology, **Jalopchar**™, which has a distinctive edge over the other resource-intensive conventional technologies.

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I compliment the ICAR and the developer of the **Jalopchar™** technology for addressing the country's need and bringing out this success story **"Jalopchar™- An Eco-friendly Waste Water Treatment Technology"** and wish them all success for its pan-India deployment in the times to come.

(Narendra Singh Tomar)

कृषि एवं किसान कल्याण
राज्य मंत्री
भारत सरकार
MINISTER OF STATE FOR AGRICULTURE
& FARMERS WELFARE
GOVERNMENT OF INDIA

सत्यमेव जयते

कैलाश चौधरी
KAILASH CHOUDHARY

MESSAGE

The world is running out of clean and fresh water to feed ever-growing global population. Globally, about 2 billion people, living in the world's drylands are estimated to be impacted by water scarcity. As per Niti Ayog, more than 600 million people in India are facing acute water shortage as critical groundwater resource, which accounts for 40% of our water supply is undergoing depletion at unsustainable rates. Further, in terms of the Water Quality Index, India is currently ranked as 120 among 122 countries.

In the face of water scarcity and climate change, our farming community needs to look for alternatives to irrigate crops. Wastewater is a valuable but an untapped resource till now in many countries. In fact treated wastewater is already emerging as a key component in the overall water management programs of various countries as its judicious use can help reduce water stress and achieve food security. However, unchecked dumping of untreated wastewaters, from domestic, industrial and other such sources, into the basins and the aquifers not only causes irreversible harm but also causes further stress to this precious commodity. It is estimated that 1 litre of wastewater, pollutes 9 litres of freshwater and therefore, there is an urgent need for collection and remediation of wastewater at point-source stage itself. I am happy to note that ICAR-IARI has come out with an innovative wastewater treatment technology, **Jalopchar**™ that has also been set up at CAZRI-Jodhpur, which I have personally visited and have been impressed by its unique and distinctive features. **Jalopchar**™ technology has demonstrated tremendous potential for effective and efficient redressal of the wastewater management challenges being faced by the stakeholders, as evident from its adoption by various Government bodies and private agencies.

I congratulate IARI and ICAR for bringing out this success story "**Jalopchar™ - An Eco-friendly Wastewater Treatment Technology**" and wish them success for its future deployment at pan-India scale.

Kailash Choudhary
Minister of State, Agriculture and Farmers' Welfare
Goverment of India
Krishi Bhawan, New Delhi

त्रिलोचन महापात्र, पीएच.डी.
सचिव एवं महानिदेशक
TRILOCHAN MOHAPATRA, Ph.D.
SECRETARY & DIRECTOR GENERAL

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद
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INDIAN COUNCIL OF AGRICULTURAL RESEARCH
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KRISHI BHAVAN, NEW DELHI 110 001

FOREWORD

Food security and agricultural sustainability is unthinkable without water. However, due to burgeoning population growth, rapid urbanization, more water intensive consumption patterns coupled with climate change and over-exploitation of natural resources, the share of water for irrigation sector has been facing a strong competition. Hence increasing scarcity of water, combined with other factors such as energy and fertilizers, is driving millions of farmers and other entrepreneurs to make use of wastewater. The wastewater recycling and reuse concept, which is already in several countries of Europe and Americas, is slowly gaining ground in India. This is evident from the recent water policy reforms undertaken across industries, municipalities, and residential of India.

In this context the presented sucess story on an innovative and eco-friendly way of decentralized wastewater treatment through the ICAR-IARI's **Jalopchar™** technology would not only sustain agricultural productivity in different agro-ecological regions of the country but would also provide an opportunity for Urban Local Bodies and utilities to reinvent and build low cost and low energy decentralized wastewater management infrastructure. Wide scale adoption of the **Jalopchar™** technology for wastewater treatment and its local reuse - at community, institutional and individual levels would facilitate achieving overall equity and sustainability.

I wish the author all the success in further advancement and dissemination of the developed technology.

Dated the 14th September, 2020
New Delhi

T. Mohapatra

डॉ. अशोक कुमार सिंह
निदेशक
Dr. Ashok Kumar Singh
Director

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नई दिल्ली–110012 (भारत)

ICAR - INDIAN AGRICULTURAL RESEARCH INSTITUTE
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NEW DELHI - 110012 (INDIA)

PREFACE

Water knows no boundaries and can be found at each step of the food chain from farm to fork. As freshwater resources continue to decrease while the demand for food increases, reclaimed wastewater is being increasingly utilized as alternative irrigation water source due to its capacity to sustain food production and farm income, besides increasing resilience to climate change.

In India as sizeable gap exists between wastewater generation and treatment capacity, substantial funding would be necessary to bridge this gap and thereby generate reclaimed wastewaters through expensive, conventional wastewater treatment technologies. In view of the limited sustainability of the conventional wastewater treatment technologies and the financial resources available with the Government, Indian Agricultural Research Institute has developed an innovative eco-friendly wastewater treatment technology named **Jalopchar**™ which can provide an effective and scalable low-cost solution for decentralized wastewater treatment.

I thank Indian Council of Agricultural Research for bringing out this success story and congratulate the author for her untiring efforts in the development and replication of the technology. I hope this success story would provide very useful information to the stakeholders for adopting an inexpensive, effective and sustainable way of wastewater treatment for its safe reuse in agriculture and for improving sanitation and health of diverse eco-systems.

Ashok Kumar Singh

Dated the 22nd September, 2020
New Delhi

Prof. Man Singh
Project Director

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PREFACE

Majority of the river basins in India are experiencing moderate to severe water shortages. Over-exploitation of groundwater, which accounts for around 58% of the total irrigated area in the country, is a major concern. Tanks and wells are increasingly going dry and getting contaminated due to unscientific water harnessing, and water conflicts are increasing. Rivers are also drying up and increasingly declinging in their quality profile due to mixing of domestic and industrial wastewater effluents. As per the latest estimates, the global burden of fresh water pullution due to wastewater is up to 12,000 km^3. Under water scarce conditions, wastewater/low quality water is emerging as potential non-conventional source of water for demand management.

Keeping the aforementioned facts in view, I am of the view that the presented sucess story on **Jalopchar™** - *An Eco-friendly wastewater treatment technology*, would go a long way to facilitate further dissemination and adoption of the technology by a range of stakeholders. At this note, I would not only like to congratulate the author for her persistent long drawn efforts in the development of the **Jalopchar™** technology but would also like to thank ICAR for bringing out this sucess story of the technology developed at Water Technology Centre, IARI.

Man Singh

Dated the 6^{th} October, 2020
New Delhi

Dr. Ravinder Kaur
Former Project Director

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AUTHOR'S NOTE

"Thousands have lived without love, not one without water." – W.H. Auden

Water scarcity already affects every continent. UN-Water has reported that water use has been growing globally at more than twice the rate of population increase and is expected to continue increasing at a similar rate until 2050, thereby accounting for an increase of 20 to 30% above the current level of water use. It is estimated that already about 4 billion people experience severe water scarcity during at least one month of the year. Stress levels will continue to increase as demand for water grows and the effects of climate change intensify. An increasing number of regions are reaching the limit at which water services will be delivered sustainably. It is therefore imperative to think of alternative solutions to meet the water demand. As per UNESCO-WWAP (2017) around 80 % of wastewater, the potential non-conventional water source for the forthcoming water stressed times is being globally returned to the ecosystem without any proper treatment or reuse. UN Sustainable Development Goal No. 6 therefore aims to reduce the untreated wastewater by 50%, while considerably expanding and promoting its recycling and safe reuse by 2030.

Wastewaters adequately treated through on-site cost and energy-effective systems have potential to ease demands from fresh water resources, while focusing on the public health and water quality goals. The major factors that appear to limit the effective treatment and safe reuse / recycling of wastewater, is firstly the overtly unjustified promotion of high-energy and capital / revenue-intensive Centralized Conventional Wastewater Treatment Systems, that have eventually proved to be unsustainable and secondly, the non-availability of economically viable and sustainable decentralized solutions.

In order to address aforesaid limitations of prevailing wastewater treatment technologies and to promote the UN Goal of safe reuse/ recycling of treated wastewaters in agriculture, which is the largest water demanding sector, a dedicated research program for the development of proposed decentralized wastewater treatment technology, namely **Jalopchar™** was initiated in IARI. Starting with conceptualization of a Pilot plant in the year 2010, a full-scale Eco-friendly Water Treatment plant of 2.2 Million Liters capacity, first of its kind in the country was constructed and inaugurated by the then Union Agriculture Minister on 16th July, 2014. Realizing the vast potential and societal benefit of the **Jalopchar™** Technology, the Parliamentary Committee on Agriculture recommended it for national level adoption in Dec. 2014; pursuant to which an Advisory for extending the technology to all States and Union Territories was issued by the Ministry of Urban Development, Govt. of India. Since 2010, the technology has gone through several validations, refinements and up-scaling under various ICAR funded schemes and public/ private consultations. The presented success story is thus primarily focused at introducing the basic principles and features (such as pollutant reduction efficiency, environmental impacts, ecological efficiency, sustainability, scalability and more importantly the revenue generation potential) of this "*Cash from Trash*" technology to its potential stakeholders.

At this note, I would like to express my sincere gratitude especially to our Secretary-DARE and DG-ICAR, Dr. T. Mohapatra, for encouraging me to pen down this success story and for also facilitating on-going replication of the **Jalopchar™** Technology at five (5) sites across the country under the ICAR's flagship Swachhta Action Plan Program. I would also like to place on record my gratitude to Dr AK Singh, Director and Joint Director (Research), IARI for facilitating the commercialization of **Jalopchar™** technology to UP Jal Nigam, Delhi Jal Board, Indian Railways and other public/ private agencies. I am also grateful to Dr. HS Gupta, Former Director, IARI for his strong belief in the success of the technology, during its initial development phases and also for the persistent encouragement thereafter by former Secretary-DARE and DG-ICAR, Dr. S. Ayyappan, all Directors and Jt. Directors of IARI and Project Director, Water Technology Centre, Prof. Man Singh. I duly acknowledge the critical and constructive suggestions made by the learned reviewers, editors and the entire publication team of DKMA, ICAR without which this success story would not have assumed its present shape. In short, I humbly thank all those who directly or indirectly facilitated the up-scaling of technology from Lab to Land!

Ravinder Kaur
Principal Scientist & Former Project Director
Water Technology Centre, ICAR-IARI &
Former Director (Addl. Charge) ICAR-IARI

CONTENTS

Chapter 1

Background and Overview of Technology

Water, food and energy securities are emerging as increasingly important and vital issues for India and the world. Most of the river basins in India and elsewhere are closing or have closed and are experiencing moderate to severe water shortages. Wastewater/low quality water is thus emerging as potential source for demand management. Globally 20-million-hectare agricultural land is irrigated with wastewater and about 200 million peri-urban farmers use these poor-quality irrigation waters for growing diverse agricultural commodities. India is the third largest user of untreated wastewaters in agriculture, after China and Mexico. In India, daily usage of wastewater in diverse agricultural commodities such as vegetables, agro-forestry, fodder, flowers, aquaculture etc. ranges from 2.6 to 817 million litres per day. About 70% of the household economy in India is based on crops grown with wastewater.

About 62 billion litres of sewage is generated daily from Class-I cities and Class-II towns in India which has the potential to increase present irrigable area by at least 1.1 million hectares. However deteriorating wastewater quality has been reported to decrease both crop yield and animal milk production over time. Continuous use of such wastewaters in agricultural lands have also reported extensive heavy metal contamination in soils, surface water bodies and shallow aquifers and thus extensive food chain contamination in most of the peri-urban/ rural areas of India. Dietary intake of contaminated food is known to cause several health problems. In 2002, about 2.4 million people died from water and sanitation-associated diseases, nearly all in developing countries. It has also been resulting in an economic loss of about ₹ 4000 to 6000 per annum, due to direct illness and wage loss due to illness, to farmers practicing sewage farming.

This emphasizes wastewater treatment as an essential pre-requisite for its safe reuse in agriculture. However at present only 31% of the municipal sewage and 21% of industrial wastewater are subjected to any treatment in our country, mostly through conventional technologies. These technologies are associated with high energy and trained technical manpower. As a result, many of these facilities have been reported to be operating at less than 25% efficiency and economically unviable. Many such drawbacks of conventional wastewater treatment technologies have been overcome through the development of the proposed novel, environment-friendly and economically remunerative technology namely, **Jalopchar**™. Instead of the aerators and chemicals, conventionally used in STPs, the **Jalopchar™** technology harnesses the pollutant sequestring potential of the hyper-accumulative emergent wetland plants such as *Typha latifolia, Arundo donax, Phragmites karka, Acorous calamus, Vetiver zizinoids*, etc and the native micro-organisms.

The effectiveness of **Jalopchar™** technology has been validated through its wide scale operationalization as 2.2 million litres per day capacity large community scale sewage treatment facility; 50,000 litres per day capacity combo rainwater harvesting and wastewater treatment facility and 1,500 litres per day capacity rural household facility at the IARI experimental farm along with a 75,000 litres per day capacity rural sewage treatment facility at Pandit Deen Dayal Upadhyay village in Farah, Mathura; 50,000 litres per day capacity sewage treatment facility at All India Women's Conference, New Delhi; 1,00,000 litres per day capacity sewage treatment facility at residential boarding schools under Jawahar Navodaya Vidyalaya at Kansiram Nagar, U.P. and at Palwal, Haryana and 1,00,000 litres per day capacity sewage treatment facility at ICAR-CAZRI, Jodhpur, Rajasthan.

The **Jalopchar™** technology has demonstrated exceptional efficiencies w.r.t. BOD (78 to 88%), turbidity and pathogen load (90 to 99%) as well as nitrate and phosphate reduction (30 to 57%). Unlike conventional STPs, it could also demonstrate exceptional metal reduction efficiencies (57 to 100%), thereby making the so-treated wastewaters completely safe for agriculture / aquaculture.

The **Jalopchar™** technology is associated with about 80-85% lower capital expenditure demand than conventional wastewater treatment technologies as it requires just ₹50 to 65 lakhs for 1 Million litre /day (MLD) capacity facility in comparison to ₹4 Crore or more per 1-MLD required by the conventional wastewater treatment technologies. Further it has extremely low (i.e. maximum ₹0.60 per kilolitre, KL) operational expenditure (OPEX) demand in comparison to the conventional wastewater treatment technologies generally associated with ₹20 or more per KL of OPEX. The **Jalopchar™** technology is also atleast 1500 times more sustainable and causes atleast 33 times lesser environmental stress than the conventional sewage treatment technologies (STPs).

Another noteworthy feature of **Jalopchar™** technology is that unlike conventional wastewater treatment technologies, the proposed technology has capacity to add good value to land being used for wastewater treatment as besides generating sub-surface treated wastewaters for their safe (metal and pathogen free) reuse in aquaculture/ agriculture, the same piece of land can also serve to be used as an eco-park and/ or a source of community revenue generation through integrated *Cash from Trash* particle board, briquette, pellet manufacturing, handicrafts, etc business models.

The technology has been recommended for national level adoption and implementation by the Parliamentary Committee on Agriculture and for extension to 400+ Indian cities by the Ministry of Urban Development, Government of India. As a result, the developed technology is being supported as a country wide applicable model under the Government of India's flagship Swachhtta Action Plan Program (SAP) and is also being replicated across country by both public and private stakeholders in consultancy mode. It has even been selected as a good practice example under the "Safe Use of Wastewater in Agriculture" initiative of the United Nations and as an innovation in Indian Agriculture by the National Skills Foundation of India.The technology bagged the prestigious civilian SKOCH (Platinum) Award under Transformational Innovation Category in 2017.

Chapter 2

Treatment Process

The technology works on Plant – Microbe–Media interactions and thus utilizes natural processes involving emergent macrophytes, media, and the associated microbial assemblages.

In natural environments, microbes live in close association with the plant and media surfaces in the form of multi-cellular aggregates/consortia/clusters called bio-films that assist immobilization/mobilization of pollutants and stimulate their acquisition by plants. Plants uptake and sequester these pollutants in their large root and above ground biomass. Pollutants are also removed through their sedimentation, binding to porous media and precipitation (i.e., through media filtration). Total pollutant removal by such systems is generally the sum of its removal through plant uptake, microbial activity, and media filtration (i.e. precipitation, deposition, and adsorption). In this entire process, macrophytes play an important role as production of biomass serves as food for a variety of organisms, perpetuates different biogeochemical processes, and removes pollutants from wastewater by uptake. Besides, it helps in transporting oxygen from the atmosphere to the rhizosphere and in the release of the carbon compounds (as rhizo-deposits such as exudates, mucigels, dead cells etc.) which are rich in sugars, amino acids, organic acids, siderophores, proteins, and vitamins and are used for the maintenance of habitats for micro-organisms.

Principle

The developed system acts as an artificially maintained bio-filtration system in which adsorption, microbial degradation/ transformation, and sequestration by media of appropriate particle size, depth and stratification and by plants planted in mono/ mixed culture and at appropriate depths/ inter-spacings are the major mechanisms (Fig. 1) that act to trigger the appropriate biogeochemical processes.

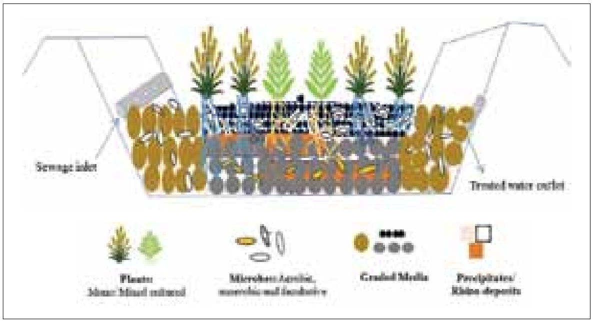

Figure 1: Pictorial depiction of the treatment process

With the wastewater moving at design depth and flow rate through the root-zone of the planted emergent vegetation and its interaction with the native micro-organisms and the planting media, various organic/ inorganic pollutants and heavy metals in the wastewater get transformed, sequestered and thus removed from the influent – wastewaters.

The technology rules out need for the incorporation of any external micro-organisms or any chemical based consumables thereby making the whole wastewater treatment process completely eco-friendly, energy-intensive and associated with no sludge generation.

Unlike the subsurface flow wetland systems, wherein clogging is the major operational and maintenance issue, the proposed technology solution takes care of system clogging by completely eliminating the incorporation of any high CEC-material in the treatment beds, uniformly sheet-distributing the wastewater over the entire treatment zone through the use of multi-perforated influent distribution pipe, intermittent dosing of influent and incorporation of a wastewater collection well for reducing unintentional spill-over of solids from any upstream processes.

Chapter 3

Pollutant Reduction Efficiency

Long-term annual and inter-seasonal pollutant reduction efficiencies of the proposed technology based commissioned wastewater treatment facilities, along with their design hydraulic retention times (HRTs) and land area requirements are illustrated in Table 1 and 2. As evident, the proposed technology could generate treated wastewaters with 90% to 99% reduced turbidity, 99.8 to 99.9% reduced pathogen load, 78 to 88% reduced BOD, 57 to 100% reduced heavy metals and 30 to 57% reduced nitrates and phosphates (Table 1). In general, monsoon seasons (June- Sept; associated with pollutant leaching) were observed to be associated with about 15 to 40% lower pollutant reduction efficiencies than those during pre/post-monsoon and winter seasons (Table 2).

Environmental Impacts

The impact of untreated and treated sewage water on the health and quality of wheat and paddy crops was also estimated. This was assessed in terms of their plant/seed parameters, individual metal translocation patterns and the associated food grain metal sequestration threats. The positive impact of water treatment could be best expressed in terms of the test weight or 100 seed weight of the paddy crop, as it was found to be significantly lower for the crop irrigated with wastewater. Though the total number of tillers and the length of panicles were not significantly different for the treated and the untreated sewage water irrigated plots, yet the total number of unproductive tillers and unfilled seeds per panicle were observed to be significantly higher in the sewage water irrigated paddy crop. These differences were not very evident in case of wheat crop, due to its relatively lower water-demand. However, number of tillers infected with termites and fungi in both wheat and paddy crops were observed to be higher in the sewage water irrigated plots.

Because of considerable lead >> iron > nickel ~ Manganese - contamination in the long-term sewage irrigated site of IARI, the agricultural produce from such plots was found to be totally unsuitable for human consumption (Fig. 2). However, as illustrated in Fig.2, these risks could be considerably reduced over years through continuous irrigations with the proposed technology based treated waters. Long term continuous application of treated waters, in place of the untreated sewage water irrigations were observed to result in significant reductions in both total and bio-available soil -nickel, lead and iron concentrations (Fig. 3). Soil bio-available chromium also decreased from an initial level of 5.71 ± 0.88 mg/kg to 1.57 ± 0.07 mg/kg within two years. Thus, continuous irrigations with treated waters resulted in significantly improved soil / crop - health and food quality.

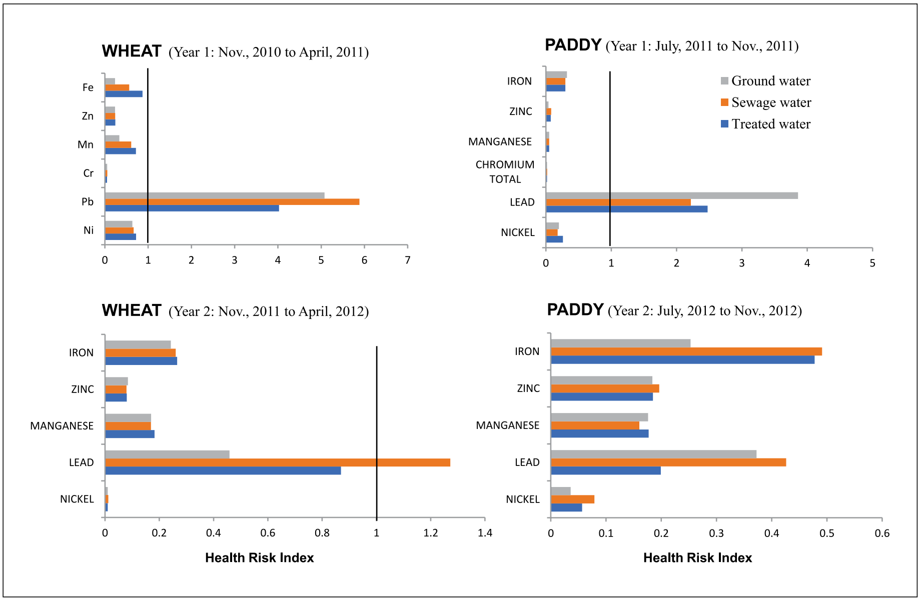

Figure 2: Impact of untreated and treated wastewaters on consumer health hazard in terms of Health Risk Index

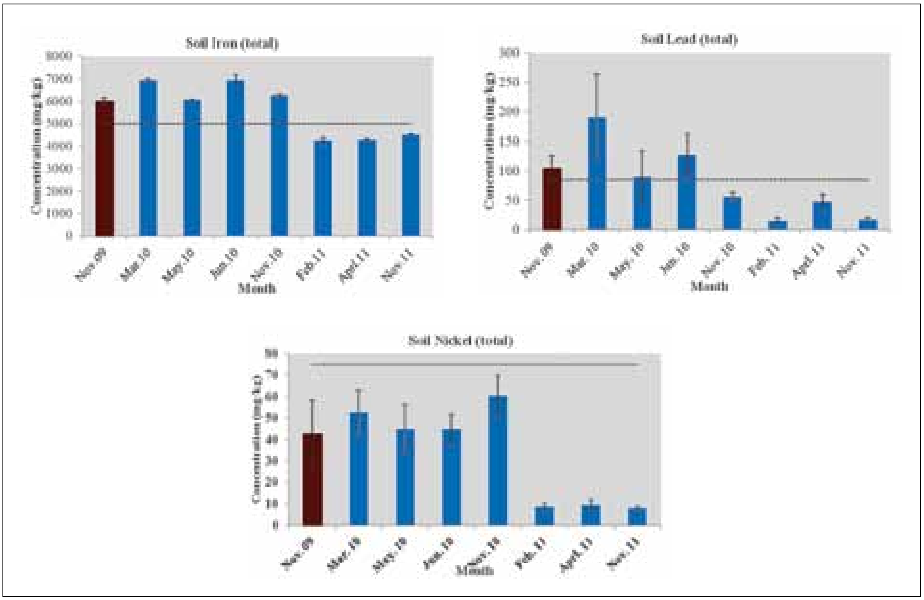

Figure 3: Impact of treated sewage waters on soil metal content in sewage water irrigated agricultural soils

Impacts of the so treated waters were also assessed on the yield and quality of several high value-low volume vegetable crops (*viz.* Okra-Cabbage, during 2014-16, Baby Corn - Lettuce, during 2016-17; Brinjal - Broccoli, during 2017-18 and Green Onion - Turnip, during 2018-19 and Green Onion - Potato,

Table 1: Long-term pollutant reduction efficiencies of the commissioned wastewater treatment facilities

Facility Specifications	Pollutant Load											Microbial Load		
	Turbidity (NTU)	**BOD** (ppm)	**NO_3** (ppm)	**PO_4** (ppm)	**Cu** (ppm)	**Fe** (ppm)	**Mn** (ppm)	**Zn** (ppm)	**Ni** (ppm)	**Cr** (ppm)	**Pb** (ppm)	Total heterotrophs (cfu/ml)	Total coliforms (cfu/ml)	Fecal Coliforms (E.coli, cfu/ml)
1. Community scale urban wastewater treatment facility for augmenting irrigation water supplies at IARI, New Delhi experimental farm **(Period of Operation:** 2012 to 2020; **Design:** *Typha latifolia* based Horizontal Sub-surface Flow; **Capacity:** 2.0 Million Liter; **HRT:** 1.53 days)														
Influent Concentration	**318.16**	**317.34**	12.17	11.11	0.18	**10.99**	**0.56**	1.05	0.17	**0.63**	0.25	3.0×10^6	1.9×10^6	
Reduction Efficiency (%)	97.62	83.60	53.48	38.51	58.35	82.19	47.45	87.86	51.72	57.05	39.49	99.96	99.94	
2. Municipal wastewater treatment facility for augmenting irrigation water supplies at CAZRI, Jodhpur experimental farm **(Period of Operation:** 2019 to 2020; **Design:** *Typha latifolia* based Horizontal Sub-surface Flow; **Capacity:** 1 Lakh Liter; **HRT:** 1.77 days)														
Influent Concentration	**61.50**	**118.33**	10.33	18.73	ND	**7.46**	0.22	1.44	0.07	**0.33**	ND	-	-	-
Reduction Efficiency (%)	93.17	82.68	54.58	31.01	-	82.71	100	89.39	91.67	84.76	-	-	-	-
3. Community scale rural wastewater treatment system for augmenting irrigation water supplies at Pdt. Deen Dayal Upadhyay Dham, Farah, UP **(Period of Operation:** 2017 to 2020; **Design:** *Typha latifolia* + Arundo donax based Horizontal Sub-surface Flow; **Capacity:** 0.75 Lakh Liter; **HRT:** 1.93 days)														
Influent Concentration	**378.79**	**265.69**	22.56	17.72	0.20	**28.04**	**1.18**	0.60	0.22	ND	0.37	8.25×10^5	7.23×10^5	6.3×10^4
Reduction Efficiency (%)	96.81	88.37	57.23	57.23	78.81	92.38	78.26	96.67	77.59	-	90.76	96.18	99.84	99.84
4. Combo - Rainwater Harvesting and Wastewater Treatment System for rainfed sites **(Period of Operation:** 2014 to 2020; **Design:** *Arundo donax* based Vertical Sub-surface Flow; **Capacity:** 0.50 Lakh Liter; **HRT:** 24.21 hrs)														
Influent Concentration	**305.26**	**236.75**	7.35	10.62	0.81	**18.93**	**0.66**	1.83	0.17	0.38	0.34	-	-	-
Reduction Efficiency (%)	95.68	80.12	-123.41*	30.82	89.67	89.86	84.10	95.53	88.64	73.16	85.14	-	-	-
Permissible Concentrations **	NA (< = 20)	<=30	<= 5 to 30	<=0.5 to 50	<=0.2	<=5	<=0.2	<=2	<=0.2	<=0.1	<=5	NA	10^3 to 10^4 MPN/100 ml	NA

** This particular design enriched treated wastewaters with nitrate. Hence such waters should only be used for irrigation purpose, for saving fertilizer input cost.*
*** as prescribed by BIS (1986) and Ayres and Westcot (1985)*

Table 2: Seasonal pollutant reduction efficiencies of representative commissioned wastewater treatment facilities

Facility Specifications	Season	Pollutant Reduction Efficiency (%)										
		Turbidity	BOD	NO_3	PO_4	Cu	Fe	Mn	Zn	Ni	Cr	Pb
1. Community Scale Urban Wastewater Treatment Facility for augmenting irrigation water supplies at IARI, New Delhi experimental farm (Period of operation: 2012 to 2020)												
Design: Horizontal Sub-surface Flow	**Winter** (Dec-Feb)	98.44	84.14	57.42	45.27	50.21	86.29	-	83.30	51.06	59.73	80.35
Capacity: 2.0 Million Liter	**Pre-monsoon** (Mar - May)	98.90	85.37	40.24	-2.85	81.16	86.78	3.94	92.97	-	60.66	31.58
HRT: 1.53 days	**Monsoon** (June - Sept)	95.40	82.35	48.98	16.88	-	63.25	18.66	69.00	46.99	-	45.12
Land req.: 6.45 m^2/KL	**Post monsoon** (Oct - Nov)	97.97	80.02	63.39	13.97	54.59	93.92	73.75	83.65	75.73	21.23	39.87
2. Combo - Rainwater Harvesting and Wastewater Treatment System for rainfed sites (Period of operation: 2014 to 2020)												
Design: Vertical Sub-surface Flow	**Winter** (Dec-Feb)	93.30	79.03	-109.04*	26.02	64.25	91.00	81.46	93.10	92.31	89.32	81.09
Capacity: 0.50 Lakh Liter	**Pre-monsoon** (Mar - May)	97.44	78.09	-54.47	24.68	93.56	91.31	84.93	97.76	78.47	-	93.57
HRT: 24.21 hrs (~ 1 day)	**Monsoon** (June - Sept)	96.77	82.90	-253.0	26.34	-	80.96	84.78	64.58	83.71	42.58	85.98
Land req.: 2.25 m^2/KL	Post monsoon (Oct - Nov)	90.17	82.84	-88.54	30.91	71.00	94.68	92.79	92.41	100	55.66	76.95

** This particular design enriched treated wastewaters with nitrate. As such waters facilitate saving fertilizer input cost therefore this design should only be used for safe recycling/ reuse of wastewaters in agriculture.*

Table 3: Impact of treated vs untreated wastewaters on vegetables crop yields

Treatment	**Yield**							
	Okra (t/ha)	**Cabbage (Boll)**	**Baby corn (t/ha)**		**Lettuce (t/ha)**	**Brinjal (t/ha)**	**Broccoli (t/ha)**	**Green Onion (t/ha)**
			Cob	**Stover**				
Sewage Water (SW)	15.30	160	28.0	39.30	51.40	93.00	60.00	52.10
Treated Water (TW)	13.60	142	23.1	34.30	42.60	82.75	53.50	47.18
Ground Water (GW)	12.30	138	22.1	31.90	40.00	78.00	53.00	41.40
% Change in TW over SW	-0.11	-0.11	-0.18	-0.13	-0.17	-0.11	-0.11	-0.09
% Change in TW over GW	0.10	0.03	0.04	0.07	0.06	0.06	0.01	0.12

Table 4: Impact of treated vs untreated wastewaters on heavy metal and pathogen load in representative vegetables

Pollutant	**Baby corn**				**Brinjal**				**Broccoli**				**Green Onion**			
	GW	SW	TW	% Change in TW over SW	GW	SW	TW	% Change in TW over SW	GW	SW	TW	% Change in TW over SW	GW	SW	TW	% Change in TW over SW
Cu (mg/kg)	28	32	28	**- 13**	9.0	11.7	9.9	**-0.15**	9.5	10.8	10.1	**-0.06**	-	-	-	
Fe (mg/kg)	42	68	49.4	**- 27**	94.0	118	101.5	**-0.14**	122	145	126.7	**-0.13**	-	-	-	
Mn (mg/kg)	18	20	15.8	**- 21**	31.8	41.9	34.9	**-0.17**	39.5	47.0	40.3	**-0.14**	-	-	-	
Zn (mg/kg)	48	58	47.3	**- 18**	30.1	40.2	32.8	**-0.18**	34.6	48.0	34.6	**-0.28**	-	-	-	
Ni (mg/kg)	-	-	-	**-**	1.5	4.2	2.3	**-0.45**	3.6	5.3	4.0	**-0.25**	1.6	3.2	2.1	**-0.34**
Pb (mg/kg)	2.5	5.5	4.0	**- 27**	2.2	4.8	3.1	**-0.35**	5.0	8.8	5.9	**-0.33**	2.1	3.6	2.3	**-0.36**
Total Coliform Count (cfu/g)	$4.3x10^3$	$1.5x10^4$	$4.0x10^3$	**- 73.3**	$2.3x10^2$	$5.4x10^3$	$1.6x10^3$	**-69.5**	63	148	47	**-67.7**	-	-	-	**-**

during 2019-20) under an IARI - inhouse program on 'Safe use of wastewaters in agriculture' and CRP on Water program of ICAR. Although, in comparison to the sewage water irrigated crops, the treated water irrigations resulted in about 10 to 20% reduced crop yields yet these yields were observed to be about 6% more than those obtained through ground water irrigations (Table 3). Further, as compared to the sewage water irrigated crops, the treated sewage water irrigated crops were observed to be having 6 to 45% lower food-metal sequestration and 68 to 73% lower pathogen load (Table 4) based consumer health hazards.

The treated wastewaters at IARI, New Delhi site (as illustrated in Table 1) were also used for aquaculture, as an alternative business model, in collaboration with the Regional Research Centre, ICAR-CIFA, Kolkata and ICAR-Central Institute of Freshwater Aquaculture (CIFA), Bhubaneswar. As a part of this intervention, 2315 numbers of (5g) *Pangus pungus* seedlings were stocked in the treated sewage water pond of 0.3 ha area. Regular monitoring of pond ecology and water quality revealed its moderate natural productivity (GPP: 340-425 mg C/m^3/h and NPP: 150-350 mg C/m^3/h), high DO (8.8 to 14.2mg/l), low BOD (< 30 ppm) and normal pH (7.2).In such condition, fish growth was recorded in the range of 200- 300g, from an initial 5.0g, over 3.5 months of culture and with 80% survival. The pond was harvested with an exceptional fish catch of about 580 kg in 3.5 months (equivalent to 4 tons/ ha/ 9 months). Noteworthy feature of this intervention was that this could be achieved through just 115 kg of supplementary feed, which is below 50% of the normal feed requirement. It was further observed that the heavy metals (viz. Cu: 0.09-0.14 ppm, Fe: 0.97-1.1 ppm;Mn: 0.13-0.17 ppm; Zn: 0.54-0.68 ppm; Ni: 0.38-0.42 ppm; Pb: 0.10-0.44 ppm) as recorded from fish muscle (Table 5) were completely within their safe limits, from the point of view of both fish growth and consumer health.

Table 5: Heavy metal load of fish grown in treated waters generated by IARI wastewater treatment facility

Fish body part / Organ	Heavy metal concentration (ppm)					
	Copper (Cu)	Iron (Fe)	Manganese (Mn)	Zinc (Zn)	Nickel (Ni)	Lead (Pb)
Upper part Muscle	0.09	0.97	0.17	0.54	0.42	0.22
Middle part Muscle	0.09	1.05	0.13	0.58	0.34	0.44
Lower part Muscle	0.14	1.05	0.17	0.68	0.38	0.10
Gills	0.18	2.13	0.95	1.98	0.47	0.48
Lower Gut	0.15	1.92	0.90	0.96	0.35	0.14
Liver	0.18	2.14	0.18	0.87	0.42	0.25
Permissible Limits	30*	100*	1*	100*	70-80**	NA

** as prescribed by FAO/ WHO (1989); ** as prescribed by USFDA (1993)*

Chapter 4

Ecological Efficiency and Sustainability

Emergy analysis, a comprehensive environmental accounting technique, was applied for comparing the ecological footprint and sustainability of the developed solution vs. a comparable conventional sewage treatment system. Emergy analysis of the developed technology solution (Table 6) showed that the renewable resources constituted 54.24% of the total emergy use, with the other half (i.e. 45.76%) contributed by the purchased non-renewable resources such as construction, electricity and maintenance. In the renewable (i.e. local + purchased) resource category, the local (i.e. free) renewable resources contributed the maximum (77.69%) emergy. Purchased renewable resources such as the media and the vegetation, which require service to access constituted only 12% of the total emergy use and were thus the minor component of the total system emergy use. Amongst the purchased non-renewable resource category, the labour-intensive purchased services such as the construction (63.26%) and the annual maintenance (36.47%) contributed the maximum while the electricity, used primarily for pumping out of treated wastewaters, contributed the minimum (0.27%).

Table 6: Emergy budgeting of Jalopchar™ vs. conventional sewage treatment technology

Inputs	Solar Emergy (sej/yr.)	
	Jalopchar™	**Conventional Tech.**
Local renewable resources	1.14×10^{16}	1.82×10^{16}
Purchased renewable resources	3.27×10^{15}	0.00
Purchased non-renewable resources	3.97×10^{16}	7.68×10^{17}
Purchased resources	4.30×10^{16}	7.68×10^{17}
Total resource use	5.44×10^{16}	7.87×10^{17}

In contrast to the **Jalopchar™**, a comparable conventional sewage treatment technology was observed to be associated with far higher (98.26%) purchased non-renewable resource-emergy use. Amongst purchased non-renewable resources, the operational costs such as maintenance (48.10 %) and electricity (28.31 %) contributed the maximum (76.41 %) while the rest 23.59% was associated with the construction activities. As evident from table 6, the contribution of total emergy use from the non-renewable resource in a conventional technology was observed to be about 83 times more than the proposed technology solution of comparable capacity.

Ecological efficiency and sustainability analysis of the developed solution, in terms of a number of emergy indices (Table 7) further showed that it utilizes 27 times more renewable resource than a conventional technolgy and is thus 1500 times more sustainable than a conventional sewage treatment technolgy. The emergy sustainability index (Table 7) infact showed that the **Jalopchar™** technology is associated with 33 times lesser environmental stress than a comparable conventional sewage treatment technology.

Table 7: Sustainability of Jalopchar™ vs. conventional sewage treatment technology

Emergy Indices	Jalopchar™	Conventional Tech.
Emergy Yield Ratio	0.70	0.01
Environment Loading Ratio	1.37	42.19
Renewable Percentage	0.54	0.02
Emergy Sustainability Index	0.51	0.00034

A comparison of the **Jalopchar™** technology with a comparable conventional technology thus revealed clear electrical usage advantages as its electrical energy consumption was observed to be less than 0.3% of a comparable conventional system. The analysis also indicated that the developed solution requires simpler maintenance as the system has no demand for any consumables and largely relies on the ecological action of (native) microbes, media and plants for its efficacy.

Contrary to a general belief that such technological solutions require more land area, the present analysis revealed that the conventional STP (comprising of actual treatment components* along with other support infrastructure *viz.* STP - control office/centrifuge buildings, chemical storage and panel rooms), has about 177 to 332 times larger land area requirement than the proposed technology based comparable wastewater treatment facility with no additional support infrastructure (such as control /chemical storage rooms etc.) requirements. Lower cost and higher use of local resources in such treatment systems thus makes them attractive solutions especially for those developing countries that have so far not invested in expensive centralized sewage infrastructure.

**A conventional STP comprises of the preliminary coarse screens along with grit chamber, oil trap, sedimentation tanks, aeration tanks, clarifiers, sludge drying beds, activated carbon filters and UV disinfection units as the primary treatment components.*

Chapter 5

Expenditure and Revenue Generation

Capital/ Operational Expenditure

In terms of standard cost-accounting, the implemented solution has been found to be associated with about ₹0.545 Crore per MLD of capital expenditure (CAPEX), excluding cost of land, as per 2011-12 cost estimates. About 80 to 90% of total capital expenditure is associated with civil works and media, 8-15% for electrical works and 2-5% for the purchase and incorporation of the appropriate vegetation. The operational and maintenance expenditure (OPEX) for the implemented solution, on the other hand, have been evaluated to be about ₹0.607 per Kilo litre (KL), with approximately ₹0.25 per KL required to meet energy expenses for pumping and incorporation of wastewater into the treatment cells/ beds and ₹0.35 per KL for hiring unskilled manpower. Hence, comparison of the implemented solution with a comparable conventional wastewater treatment technology has shown that the **Jalopchar™** technology is associated with zero energy demand, zero-chemical application, zero-sludge generation, no skilled manpower requirement, and 50 to 65% reduced treatment cost.

Revenue Generation Potential

Depending upon the quality of wastewater to be treated*, the vegetation planted in treatment cells of the **Jalopchar™** technology based fully operational wastewater treatment facility can be harvested and integrated with several revenue generating business models such as Particle Board manufacturing, Energy Briquette/ Pellet manufacturing, Handicrafts (viz. Rope, hat, mat etc. making), etc. For e.g., the 2.2 MLD wastewater treatment facility at IARI could be harvested (once every 3 to 4 months) to yield about 30 tons of dry biomass per annum. The harvested biomass could be transformed into the (termite and water proof) particle boards (16000sq. ft. per annum @ ₹12/ sq. ft.) or into energy-pellets (24,000 kg @ ₹8/Kg) or be sold to the local particle board manufacturing units (@ ₹2000 per ton as dry biomass). Hence the developed technology solution could even be integrated with remunerative *Cash from Trash* business models capable of fetching an annual income of about ₹1.92 lakh from the decentralized low-cost wastewater treatment facility developed at Indian Agricultural Research Institute.

**For avoiding environmental and health hazards, harvested biomass from industrial wastewater treatment cells should not be used for any energy pellets or handicrafts but rather for manufacturing particle boards or allied products for reducing pollutant recycling through its immobilization in the chemicals / resins normally used for manufacturing such products.*

Chapter 6

Scalability and Land Requirement

The readiness and scale of the technology solution is evident from its demonstrative operations at the following sites in the country (Fig.4):

- 1500 liters per day capacity rural household model, with 2 sq. mt. per KL land requirement developed at IARI, New Delhi (Operational since 2009).
- 50, 000 liters per day capacity combo facility for rainwater harvesting and wastewater treatment with 2.25 sq. m. per KL land requirement developed at rainfed site of IARI, New Delhi (Operational since 2014).
- 50,000 liter per day capacity sewage treatment facility developed at All India Women's Conference in New Delhi (India), with 1.08 sq. m. per KL land requirement (Commissioned in 2020 under consultancy mode).
- 75,000 liters per day capacity rural sewage treatment facility operational in a village in Mathura, Uttar Pradesh, with 12.16 sq. m. per KL land requirement (Operational since 2017 under CRP-Water programme).
- 1,00,000 liter per day capacity government school sewage treatment facility developed at residential boarding school of Jawahar Navodaya Vidyalaya at Kansiram Nagar, U.P. through UP Jal Nigam, with 7.24 sq. m. per KL land requirement (Commissioned in 2020 under consultancy mode).
- 1,00,000 liter per day capacity government school sewage treatment facility developed at residential boarding school of Jawahar Navodaya Vidyalaya at Palwal, Haryana through UP Jal Nigam, with 7.24 sq. m. per KL land requirement (Commissioned in 2020 under consultancy mode).
- 1,00,000 litre per day capacity institutional sewage treatment facility developed at CAZRI, Jodhpur, Rajasthan, with 7.35 sq. m. per KL land requirement (Commissioned in 2019 under Swachhtta Action Plan program of MOA&FW).
- 2.2 million litre per day capacity large community scale sewage treatment plant developed at IARI experimental farm, with 6.45 sq. m. per KL land requirement (Operational since 2011).

Figure 4: Representative technology demonstration sites with varying treatment - goals/ designs, capacities, HRTs and land requirements

Additional sites under commissioning:

- 68-Million litre per day capacity Eco-friendly STP for Construction of Polishing Unit for the Work of Creation of New Water Body at Sector 25, Rohini STP under EE(NW)-II of Delhi Jal Board, with 0.25 sq. m. per KL land requirement (in consultancy mode).
- 4.5-lakh litre per day capacity Eco-friendly Wastewater Treatment Facility for M/s RK Overseas Site in Ghilot Industrial Area, Rajasthan, with 2.50 sq. m. per KL land requirement (in consultancy mode).
- 1-lakh litre per day capacity institutional sewage treatment facility at KVK, Shikhopur, Haryana, with 5.5 sq. m. per KL land requirement (under Swachhtta Action Plan program of MOA&FW).
- 1-lakh litre per day capacity institutional sewage treatment facility at IIHR, Bengaluru, with 5.5 sq. m. per KL land requirement (under Swachhtta Action Plan program of MOA&FW).
- 1-lakh litre per day capacity institutional sewage treatment facility at CCARI, Goa, with 1.2 sq. m. per KL land requirement (under Swachhttaa Action Plan program of MOA&FW).

As evident from the aforestated illustrations, the Jalopchar™ technology is quite scalable as it can be used for designing wastewater treatment facilities with varying treatment goals and land area requirements (ranging from 0.25 m^2/ KL, for the DJB site to 12.16 m^2/ KL, for the Mathura site).

Chapter 7

Innovative Aspects

Compared to any conventional wastewater treatment technology of equivalent capacity, the proposed wastewater treatment technology could prove to be completely eco-friendly and innovative in terms of its following attributes:

- Has zero energy, zero-chemical and zero-skilled man power demand.
- Requires no external bio-inoculation, as required by the conventional wastewater treatment technologies.
- Produces zero sludge and hence requires no de-sludging, as required in DEWATS and other conventional technologies.
- The technology is quite scalable and can be designed for varying land areas, depending upon the site-specific design requirements. It requires no anaerobic fixed bed filter/ baffled reactor and baffled treatment cells, as required by other similar technologies. Hence, it has simpler, compacter and (about 66%) lower land demanding engineering design than the conventional technologies.
- It has about 80-85% lower capital expenditure demand than conventional wastewater treatment technologies and about 40-55% lower capital expenditure demand than other similar nature based solutions as it requires just ₹50 to 65 lakh for 1 Million liter /day (MLD) capacity facility in comparison to ₹4 Crore or more per 1-MLD for the conventional wastewater treatment technologies and ₹1.1 Crore or more per 1-MLD required for the similar the decentralized technologies, respectively.
- It has extremely low (i.e. maximum ₹0.60 per kiloliter, KL) operational expenditure (OPEX) demand in comparison to the conventional wastewater treatment technologies with ₹20 or more per KL of OPEX.
- The technology is capable of reducing turbidity and pathogen loads by 96 to 99.9%, BOD by 78 to 88%, heavy metals by 57 to 100% and nitrates/ phosphates by 30 to 57% at hydraulic retention times (HRTs) ranging from < 1 day to around 2 days. Hence, unlike the conventional technologies such as the Reedbed technology, with HRT of 5 or more days, the proposed technology is associated with significantly lower HRTs and lower land/ capital demands.
- Further the proposed technology solution is atleast 1500 times more sustainable and causes atleast 33 times lesser environmental stress than any conventional sewage treatment technology.

Chapter 8

Replication Potential

The technology has been recommended for its extension to 400+ Indian cities by MoUD and for national level adoption and implementation by the Parliamentary Committee on Agriculture of the GoI. It has also been selected as a “Good practice example” under “*Safe Use of Wastewater in Agriculture*” initiative of the United Nations and as an innovation in Indian Agriculture by National Skills Foundation of India.

Following representative public and private sector players, apart from those enlisted in chapter 6 and figure 4, have evinced a lot of interest in replication of the technology solution:

- Andaman Public Works Department, Port Blair
- Bedmutha Industries Ltd., Maharashtra
- Central Jail, Tihar, New Delhi
- Central Water Commission, MOWR-RD-GR
- Delhi Development Authority
- Delhi Jal Board
- Durgapur Steel Plant, Steel Authority of India Ltd., West Bengal
- Enviro Associates & Consultants, Sikkim
- EPCO, Bhopal Centre for Urban and Regional Excellence
- Faridabad Smart City Limited
- Horizon Research, Mathura Road, New Delhi
- HUDA, Gurgaon
- HUDA, Faridabad
- Kendriya Vidyalaya Sangathan, New Delhi
- KRIBHCO, Noida
- Mapsets Engineering Services
- Ministry of Tourism, Art, Culture and Languages
- National Security Guards, Manesar Garrison, Gurgaon
- National Seeds Corporation Ltd., Suratgarh
- Panchayati Raj Public Works, Haryana, Chandigarh
- Patanjali
- Punjab Water Supply & Sewerage Board, Chandigarh
- Rail Coach Factory, Indian Railways, Kapurthala, Punjab
- Re Ventures, West Bengal
- SmartGram: President of India’s Smart Gram site in Gurugram
- Tamil Nadu Water Supply & Drainage Board, Chennai
- UP Jal Nigam
- Uttarakhand Peyjal Nigam, Haridwar
- Vadodara Municipal Corporation

Appendices

Appendix - I

Recommendation by Parliamentary Standing Committee on Agriculture

SECOND REPORT

COMMITTEE ON AGRICULTURE
(2014-2015)

(SIXTEENTH LOK SABHA)

MINISTRY OF AGRICULTURE

(DEPARTMENT OF AGRICULTURAL RESEARCH AND EDUCATION)

DEMANDS FOR GRANTS
(2014-15)

Presented to Lok Sabha on : 18.12.2014
Laid on the Table of Rajya Sabha on : 18.12.2014

LOK SABHA SECRETARIAT
NEW DELHI

DECEMBER, 2014 / AGRAHAYANA, 1936 (Saka)

2014 onward, Directorate is making appeal to all KVKs, SAUS and ICAR institutions to make their campus *Parthenium* free by doing regular management of *Parthenium*. Elaborating upon the issue, the representative of DARE has stated as under :-

> ".....Gajar Grass which we call Parthenium. We are trying to control it but then control measures are really difficult. We have tried chemicals, now we are trying some beetles that can feed on that. All this we are trying. But it requires something like Swachhata Abhiyan which we are thinking. We do need similar efforts for control of Parthenium and Lantana. These two are really major issues. We have technology but to scale it up we require everybody's involvement...."

(9) <u>ECO-FRIENDLY LOW-COST WASTEWATER TREATMENT AND REUSE IN AGRICULTURE</u>

3.35 Agricultural reuse of wastewater, under freshwater scarcity, is fast becoming popular worldwide because it closes the loop between water demand and wastewater disposal and enhances fertilizer security of resource poor farmers. However, due to lack of proper treatment facilities and awareness in developing countries, unplanned application of raw wastewaters is increasing the risk of agricultural sustainability and consumer/environmental health.

3.36 During study visit to IARI, Pusa, the Department has informed the Indian Agricultural Research Institute (IARI) evolved an innovating and eco-friendly wastewater treatment facility in its Delhi campus. The newly created facility utilizes emergent wetland plants (s.a. Typha Latifolia), local media, and native microorganisms, present in natural wastewaters, for treating 2.2 Million Litres per Day (MLD) of sewage waters. The eco-friendly sewage treatment plant (e-STP) is spread over 1.42 hectares and is capable of irrigating 132 ha of IARI farmlands. Long term monitoring of the treatment capacity of so developed wastewater treatment plant of IARI, over last 1.5 years has

Appendix - II

Advisory by Ministry of Urban Development

PRAVEEN PRAKASH, IAS
Joint Secretary & Mission Director (SBM)
GOVERNMENT OF INDIA
MINISTRY OF URBAN DEVELOPMENT

सत्यमेव जयते

प्रवीण प्रकाश, आई.ए.एस.
संयुक्त सचिव एवं मिशन निदेशक (एस.बी.एम.)
भारत सरकार
शहरी विकास मंत्रालय

D.O. No. Q-16011/01/2007-CPHEEO

Dated: 23.3.2017

Subject: **Advisory on a Constructed Wetland based Sewage Treatment System developed by Indian Agricultural Research Institute (IARI), New Delhi-Regarding.**

Sir/Madam,

As you are aware, the Urban Local Bodies (ULBs) are responsible for the containment, collection, treatment and disposal of Sewage as per the effluent discharge standards notified by the State Pollution Control Board (SPCB)/Pollution Control Committee (PCC) and the Central Pollution Control Board (CPCB) under the provisions of Environmental Protection Act, 1986. The existing Sewage Treatment capacity in the country is only about 37 per cent and the rest of the sewage is being discharged with partial/no treatment for which necessary treatment arrangements have to be provided.

One such Sewage Treatment process has been developed by IARI, New Delhi. It is a Low Cost, low energy, and eco-friendly treatment technology based on the wetland processes and found to be very effective for the smaller ULBs generally lacking sewage treatment facility. It is said to require 1.2 to 1.8-acre land (depending upon the site-specific design) for treating one million litres of Sewage per day (1 MLD, about 10,000 population equivalent) with adequate effluent quality for land application (i.e. irrigation) and/or for discharge to water bodies, depending upon the sewage pollutant concentration and the treatment – design of the proposed technology. The technology has less than 1% of the total energy demand of any conventional sewage treatment technology as it requires energy for only lifting the Sewage and the treated effluent, as per the site condition. In terms of standard cost-accounting, the IARI sewage treatment technology is estimated to cost Rs. 0.545 Crore per MLD(million litres per day) of capital cost (CAPEX) and just 60 paise per Kilo litre (KL) for total operational and maintenance cost as it does not require any energy/chemicals for sewage treatment.

I request you to take advantage of this Low Cost, Low Energy and Eco-friendly Sewage Treatment technology developed by IARI. For any support and consultation in setting up such Sewage Treatment System, please contact Dr. (Mrs.) Ravinder Kaur, Project Director (WTC), ICAR-Indian Agricultural Research Institute, New Delhi – 110 012, Telefax: 011-25846790; Mob: 9811041187; Email: pd_wtc@iari.res.in; Website: www.iari.res.in.

With Best Regards,

Yours sincerely,

(Praveen Prakash)

To
Principal Secretary / Secretary,
In-charge of UD/ PHED/Water Supply and Sanitation Departments;
Mission Directors (AMRUT);
Mission Directors (SBM).
} **of All States/UTs, As per List attached**

Copy to:
Joint Secretary & MD, AMRUT, MoUD.
Dr. (Mrs.) Ravinder Kaur, Project Director (WTC), ICAR-Indian Agricultural Research Institute, New Delhi.

Office: 140-C, Nirman Bhawan, New Delhi-110011 ♦ Mob: 9013133636, Phone: 011-23062309, Fax: 23062477
praveenprakashud@gmail.com, praveen.prakash71@nic.in

Appendix - III

Awards

Appendix - IV

Visit of Policy Makers & Dignitaries to Project

Appendix - V

Visit of Policy Makers & Dignitaries to Project




Indian Council of Agricultural Research
New Delhi

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