

DEVELOPING A CIRCULAR ECONOMY MODEL FOR RURAL SANITATION

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**DEVELOPING A CIRCULAR ECONOMY MODEL
FOR RURAL SANITATION**

by

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CENTRE FOR RURAL DEVELOPMENT AND TECHNOLOGY

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Dedicated
to my father
who always saw me
as a strong and a kind woman
who lived for her family, society and a noble cause.

CERTIFICATE

This is to certify that "Developing a Circular Economy Model for Rural Sanitation" being submitted by Ms Amruta Khairnar-Patil (Entry no. 2016RDZ8355) to the Indian Institute of Technology Delhi for the award of Doctor of Philosophy is a record of original bonafide research work carried out by her under my guidance and supervision. In my opinion, the thesis has reached the standard of fulfilling the requirements of all the regulations related to the degree. The research report and results presented in this thesis have not been submitted, in part or in full, to any other university or institution for the award of any degree or diploma.

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ABSTRACT

In the recent time, toilet access has increased in rural India as a result of government's sanitation campaign over the years. However, sustainable toilet usage still remains a challenge that has led to large number of villagers to slip back to or continue with the open defecation practices. The present thesis examines the drivers responsible for non-usage of sanitation facilities by the villagers in rural Maharashtra from the technological, behavioural and administrative perspectives.

The findings revealed that the technological factors such as poor toilet technology selection, construction mistakes and water scarcity trigger the practice of open defecation among the regular toilet users converting them into occasional toilet users. The rise of occasional toilet users in a village affect the injunctive norms in the village and make the practice of open defecation seem acceptable again. This further encourages regressive behavior among toilet users having pro-open defecation tendencies. In this regard, Rank Correlation Analysis (RCA) of toilet usage pattern of 180 household members revealed that the Karta (i.e. head) of the household has the most influence on sanitation behaviour of other family members. Accordingly, the thesis asserts that all sanitation awareness campaigns should be targeted towards developing pro-latrines intentions among Karta i.e. head of the households.

The surveys conducted among *Kartas* revealed that livelihood security based on farming is their major concern. *Kartas* showed willingness to use toilets that could provide them organic farm manure to increase farm yield and lower farming costs. Based on these inputs a "Modified Eco-san Toilet" was designed with characteristics such as odourless, touch less and waterless interface for toilet usage, toilet emptying and transport of manure collection chambers, user-friendliness for both type of users: wipers and washers, and faster decomposition of human waste through controlled conditions.

The thesis further explores the efforts in the direct of uniting intentions of administration and toilet beneficiaries towards the goal of sustainable toilet usage. In this regard, a "Circular Economy Framework" for human waste recycling was developed to suggest co-ordination among toilet users, administration and farmers for centralized collection and distribution of manure produced through human waste recycling.

The thesis asserts that sanitation development at the village level should be measured based on the three key parameters, i.e. toilet functionality, toilet safety and recyclability of the toilet generated human waste. Accordingly, “Sanitation Development Index (SDI)”based on Functionality Index (FI), Safety Index (SI) and Recyclability Index (RI) was developed to assess sanitation development at village level.

The Modified Eco-san Toilet, Circular Economy Framework and Sanitation Development Index (SDI) developed in this thesis has wider ramifications in the area of health, water, sanitation, agriculture and livelihood security of rural India. Further research may be done in the direction of sanitation marketing of these tools in order to achieve sustainable toilet usage in the broader framework of livelihood security of the proverbial last man of Gandhiji.

संक्षेप

हाल के समय में, सरकार के सफाई अभियान के परिणामस्वरूप ग्रामीण भारत में शौचालय पहुंच में वृद्धि हुई है। हालांकि, सतत शौचालय उपयोग एक चुनौती बना रहा है, जिसके कारण कई ग्रामीण लोग फिर से खुले शौच के अभ्यास में लिपट गए हैं या इसे जारी रख रहे हैं। वर्तमान थीसिस तकनीकी, व्यवहारिक और प्रशासनिक परिप्रेक्ष्यों से ग्रामीण महाराष्ट्र के ग्रामीणों द्वारा स्वच्छता सुविधाओं का अपयोग करने के लिए जिम्मेदार ड्राइवर्स की जाँच करती है।

खोज का परिणाम सूचित करते हैं कि तकनीकी कारक जैसे कि खराब शौचालय प्रौद्योगिकी का चयन, निर्माण गलतियाँ और पानी की कमी, खुले शौच के अभ्यास को बढ़ावा देते हैं जिसके परिणामस्वरूप नियमित शौचालय का उपयोग करने वाले लोगों को अनियमित शौचालय के उपयोगकर्ताओं में बदल देते हैं। गाँव में अनियमित शौचालय के उपयोगकर्ताओं की वृद्धि गाँव में नियमित नियमों को प्रभावित करती है और खुले शौच के अभ्यास को फिर से स्वीकार्य बनाती है। इससे शौचालय उपयोगकर्ताओं में खुले शौच के प्रति आलोचनात्मक व्यवहार को बढ़ावा मिलता है जिनकी खुले शौच के प्रति रुचि होती है। इस संदर्भ में, 180 परिवार के सदस्यों के शौचालय उपयोग के पैटर्न की "रैंक संबंध" विश्लेषण ने दिखाया कि परिवार के कर्ता (यानी मुखिया) परिवार के अन्य सदस्यों के स्वच्छता व्यवहार पर सबसे अधिक प्रभाव डालते हैं। इसके आधार पर थीसिस का दावा है कि सभी सफाई जागरूकता अभियान को परिवार के कर्ता के बीच स्वच्छ शौचालय की इच्छाशक्ति को विकसित करने के लिए लक्षित किया जाना चाहिए।

कर्ताओं के बीच किए गए सर्वेक्षणों ने दिखाया कि खेती पर आधारित जीवन निर्वाचन उनकी प्रमुख चिंता है। कर्ताओं ने यह प्रकट किया कि उन्हें वह शौचालय उपयोग करने के लिए तैयार हैं जो उन्हें जैविक खेत मल की प्राप्ति करने और खेती लागत को कम करने में मदद कर सकते हैं। इन इंपट्स के आधार पर "सुधारित इको-सैन शौचालय" को डिज़ाइन किया गया जिसमें बिना बदबू, स्पर्श रहित और बिना पानी के इंटरफ़ेस के लिए शौचालय का उपयोग, शौचालय खाली करने और मल के संग्रहण कमरों के पार करने के लिए, दो प्रकार के उपयोगकर्ताओं के लिए सजाने और धोने के लिए सजाने और मानव मल के त्वरित अपशिष्ट की निगरानी के माध्यम से मालमाल है।

थीसिस द्वारा सीधे प्रशासन और शौचालय लाभार्थियों की इच्छाशक्ति को सतत शौचालय उपयोग के लक्ष्य की ओर मिलाने के प्रयासों की खोज की जाती है। इस संदर्भ में, मानव मल की पुनः प्रयोजन के लिए "सर्कुलर इकोनॉमी फ्रेमवर्क" विकसित किया गया था जिसमें मानव मल की पुनः प्रयोजन के माध्यम से उत्पन्न होने वाले खाद के संग्रहण और वितरण के लिए शौचालय उपयोगकर्ताओं, प्रशासन और किसानों के बीच समन्वय सुझाया गया।

थीसिस दावा करती है कि गाँव स्तर पर स्वच्छता विकास को तीन मुख्य पैरामीटरों, यानी शौचालय की कार्यक्षमता, शौचालय सुरक्षा और शौचालय उत्पन्न मानव मल की पुनः प्रयोजन के आधार पर मापा जाना चाहिए। इसके आधार पर "स्वच्छता विकास सूची (स्टडी)" को "कार्यक्षमता सूची (एफआई)", "सुरक्षा सूची (एसआई)" और "पुनः प्रयोजन सूची (आरआई)" पर आधारित मापन करने के लिए विकसित किया गया था।

इस थीसिस में विकसित "सुधारित इको-सैन शौचालय", "सर्कुलर इकोनॉमी फ्रेमवर्क" और "स्वच्छता विकास सूची (स्टडी)" का विस्तार से प्रभाव स्वास्थ्य, पानी, सफाई, कृषि और ग्रामीण भारत की आवाज में है। इन उपकरणों की स्वच्छता उपयोग को प्राप्त करने के लिए सफाई विपणन की दिशा में और अध्ययन किया जा सकता है ताकि गांधीजी के कही गई "अंतिम आदमी" के जीवन निर्वाचन के व्यापक संरचना में सतत शौचालय उपयोग प्राप्त किया जा सके।

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ABBREVIATIONS AND DEFINITIONS

SBMG- Swachh Bharat Mission Gramin

OD- Open defecation: The human practise of defecating outside, i.e.in the open, rather than into a toilet.

ODF- Open defecation free: ODF is the termination of faecal oral transmission, defined by no visible faeces found in the environment/ Village and every household as well as public and community institution using safe technology option for disposal of the faeces.

Safe technology option means no contamination of surface soil, ground water or surface water; excreta inaccessible to flies or animals; no handling of fresh excreta and freedom from odour and unsightly condition.

Regular users- villagers whose toilet usage is more than 90 percent.

Occasional users- villagers whose toilet usage is in between 30 to 90 percent.

Nonusers- villagers whose toilet usage is less than 30 percent

Pro-latrine Intentions- positive attitude towards toilet usage.

Target users- specific group of villagers who should use the toilet.

Behavioural barriers- related to one's intention or choice for not using a household toilet.

Behavioural performance barriers/ non-behavioural barriers- inability to perform the toilet usage due to external factors or non-behavioural factors such as lack of water, non-functional toilet

Mother- Female head of the household typically in their motherhood having age within 22 to 59

Father- Female head of the household typically in their fatherhood having age within 22 to 59

AD-1- Kids of the family within 3 to 9

AD-2M- Late adolescents male members of the family within 10 to 21 years of age

AD-2F- Late adolescents female members of the family within 10 to 21 years of age

Senior Citizen- Elderly of the family above 60 years

Karta- Head of the Indian households

UDDT- Urine diversion dry toilet

ECOSAN- Ecology sanitation