Project work on

Estimation of the Potential of Nitrogen and Phosphorus Recovery from Human Waste in the Whole Country and the IIT Campus

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Section-2

Introduction

Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. As we all know, the rate of exhaustion of our existing natural resources is quite alarming, because of which we will end up borrowing the resources of our future generations. So, the success of Sustainable Development is a very important facet of our advancement.

One very important aspect of carrying out the Sustainable Development model is the prevention of wastage of resources as well as to ensure that the extraction of as many useful resources as possible from all kinds of disposed wastes. One such example is the retrieval of nutrients from human excreta. As we all know, what we lack the least around us is human wastes. When such common wastes offer potential for the recovery of nutrients from them, we have to use them to the fullest. This problem has been addressed in a recent research paper (**Mihelcic, 2011**) published in the journal *Chemosphere,* where estimates have been reported on the potential recovery of nutrients, especially Nitrogen and Phosphorous from human urine and feces.

This important material flow is quite closely tied to the proper sanitation facilities as well as urbanization. In places with proper sanitation facilities, the retrofitting of the existing facilities has to be considered so that these resources can be extracted smoothly. Whereas, in contrast, places with poor sanitation facilities have to plan to integrate with the growing technology so as to fully extract the potential from the human wastes. If utilised properly, the amount of phosphorus extracted can meet up to 22% of the current global demand.

In this report, we will estimate the potential recovery of Phosphorous from human urine and feces in the whole country as well as the IIT, Kharagpur campus in the present time as well as in the year 2030, which is the targeted year of the completion of Sustainable Development Goals.

Estimation of the potential recovery of Nitrogen & Phosphorus

Urban protein consumption

- Total protein = 70.35 grams / capita / day
- Plant protein = 46.00 grams / capita / day

Phosphorus content = 0.011 x (total protein + plant protein)
= 0.011 x (70.35 + 46.00) grams / capita / day
= 1.28 grams / capita / day

Nitrogen Content = 12.32 grams / capita / day

i) Present Time(2019)

a) Whole Country:-

Population = 1,369 millions

Urban population = 0.34 x 1,369 millions
= 465.46 millions

Total phosphorus = 1.28 * 465.46 * 10^6 grams/ day
= 595.79 tons/day
= 217,462.9 tons/year

Total Nitrogen = 12.32 * 465.46 * 10^6 grams/ day
= 5734.47 tons/day
= 2,093,080.5 tons/year

b) IIT KGP:-

Population = 22,000

Total phosphorus = 1.28 * 22 * 10^3 grams/ day
= 28.16 kg / day
= 10.28 tons/year

Total Nitrogen = 12.32 * 22 * 10^3 grams/ day
= 271.04 kg / day
= 98.92 tons/year

ii) Year 2030

a) Whole Country:-

Population = 1,369 * $(1 + 0.01)^{11}$ millions
= 1,527 millions

Urban population = 0.5 x 1,527 millions
= 763.5 millions

Total phosphorus = 1.28 * 763.5 * 10^6 grams/ day
= 977.28 tons/ day
= 356707.2 tons/year

Total Nitrogen = 12.32 * 763.5 * 10^6 grams/ day
= 9406.32 tons/day
= 3,433,306.8 tons/year

b) **IIT KGP:-**

Population = 29,630 (Calculated from the previous growth pattern)

Total phosphorus = 1.28 * 29.63 * 10^3 grams/ day
= 37.92 kg / day
= 13.84 tons/year

Total Nitrogen = 12.32 * 29.63 * 10^3 grams/ day
= 365.04 kg / day
= 133.24 tons/year

Reference

- **An analysis of protein consumption in India through plant and animal sources** (https://assets.publishing.service.gov.uk/media/5ae82173ed915d42f7c6bc6b/LANSA_Working_paper_24_Priya_Rampal.pdf)
- **Students Statistics** (https://www.iitsystem.ac.in/?q=studentstatistics/userview)
- **Global potential of phosphorus recovery from human urine and feces** (http://usf-reclaim.org/wp-content/uploads/2014/03/Chemosphere_phos_mihelcic.pdf)
- **India Population (2020)** (https://www.worldometers.info/world-population/india-population/)