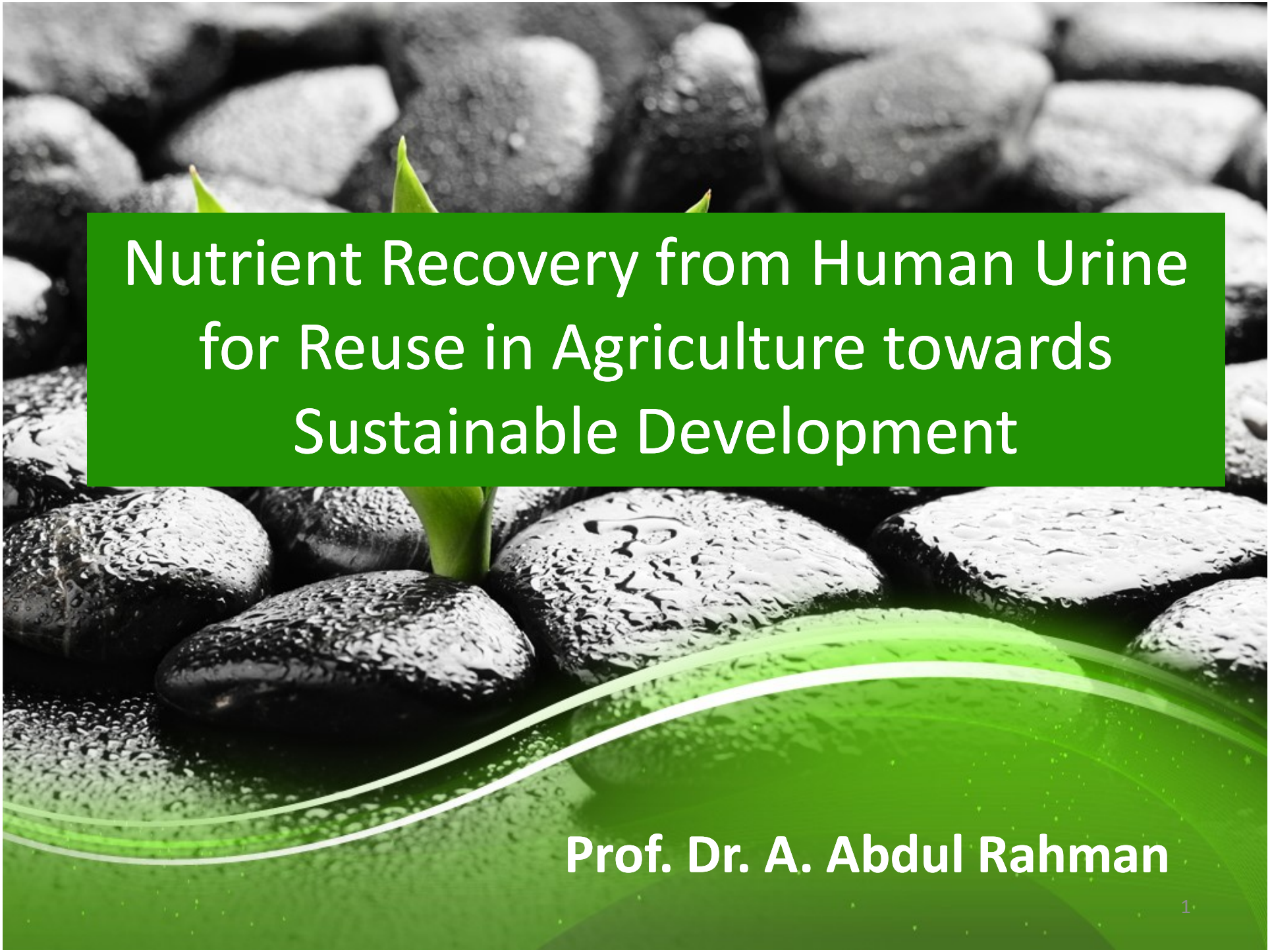

Nutrient Recovery from Human Urine for Reuse in Agriculture towards Sustainable Development

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Objective

- Optimization of reaction conditions on chemical mineralization of nutrients (NPK) from human urine separated using human urine reactor
- A pilot scale recovery unit of nutrients (NPK) by **Struvite** ($Mg(NH_4)PO_4.6H_2O$) using cost effective magnesium source known as bittern, a waste material collected from salt field
- Enhancement of **nutrient value by bio-mineralization** and chemical processing
- Assessing and evaluating the **fertilizing effect** of recovery product

Human Urine Components

- Containing sodium chloride and urea with micronutrients (calcium, potassium, magnesium sulphate and phosphate)
- Free from hazardous chemical compounds or heavy metals
- Quantities of nutrients - **80% of N, 50% of P and 60% of K** when compared to the quantities of nutrients in the mineral fertilizers used in agriculture

Ecological Solution

- Holistic approach to sanitation and water management
- Efficient for resource recovery
- Obstacles for using urine separation technology on a larger scale are still found in the storage, transport and spreading of large amounts of urine
- Recycling sanitized human urine by returning to soil and serves to restore the natural cycle
- Harvesting the nutrients within waste prevents direct pollution caused by sewage
- Loss of nitrogen through ammonia drip system during storage and spreading can be reduced by efficient method of nutrient recovery

Methodology

Technical programme:

- The human urine will be collected, transported and stored in the Urine bank
- Periodical monitoring of the composition will be analyzed
- Optimization of reaction conditions at bench scale level for the mineralization process will be conducted
- The process efficiency and product analysis will be evaluated
- Studying the effect of bio-mineralization using bacteria at laboratory level
- The fertilizing effect of recovered product will be evaluated under laboratory and field level and will be compared with the commercial fertilizers

Urine as Safe Product

- Sterile liquid and considered as a liquid fertilizer
- Contains precious N - 4.6g, P- 2.2g and K - 0.6g
- Urine has a pungent smell and when stagnates, emits foul odor. When properly managed, it will have no smell
- It is estimated that if the urine of about 30 cores of people could produce 1.65 million tones of fertilizers valued about ₹800 cores per annum.
- Further 135 core liters of urine will contain about 6210 tons of Nitrogen, 810 tons of P_2O_5 and 2970 tons of K_2O.

Diluting the urine with water

Spray in the paddy field

Agricultural Aspects

A grown person produces an average of 500 liters of urine and 50 kg / faeces per year. The following table converts this amount into nutrient equivalents for N, P and K: T.e nutrient values of Table 1 can be converted into the fertilizer equivalents.

Table 1: Estimated annual excretion of nutrients per person

	Nitrogen (kg/capita)	Phosphorous (kg/capita)	Potassium (kg/capita)
Urine	2.3	0.3	1.1
Faeces	0.3	0.1	0.4
Total	2.7	0.4	1.5

Table 2: Fertilizer equivalents (kg/capita/year) of annual excretion of nutrients per person

	Complete (14-14-14)	Urea (46-0-0)	MOP (0-0-60)
Faeces	1.60	0.17	0.44
Urine	4.93	3.48	0.52
Total	6.53	3.65	0.96

Estimation Cost – Small Model

- Capital Cost
  - Equipment (Reactor) = ~ ₹ 45,000₹ (1 and 5 lit capacity SS tanks, covering lid, stand, stirrer, power cable)
  - Motor = ~ ₹ 5,000
  - Chemicals = ~ ₹ 5,000
  - Plumbing Work = ~ ₹5,000 (based on the distance)
  - 1 Labour cost

  - **Total cost** = ~ ₹ 60,000 + Labour cost

Field Work Snaps


6 12 2008


1 5 2010

Conclusion

- Possible to capture the majority of **nutrients contained in urine** in the form of solid minerals by adding small amounts of MgO - **struvite** as main component
- Natural zeolites shows an excellent ammonium adsorbent
- Simple, effective, easily manageable and economically viable
- Eco-technology is much in demand all over the world
- In combination with struvite crystallization, most of the phosphorous and potassium and 65-80% of the nitrogen could be recovered
- The mixture of struvite and natural mineral adsorbent has good nutrient qualities and can be used as soil conditioner
- Struvite produced in this system is a well-known slow release fertilizer

Thank You

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