Ecological Hygiene & Organic Farming

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In India, people have a high sense of cleanliness. (Kuil. anecdote)
Unfortunately, also an utter disrespect for the commons – which are either encroached, or used as dumpsites or shitting fields.
There is an obvious and well-proven need for improved cleanliness in handling of drinking water and food – not for a increased use of disinfectants and biocides, disposable plastic gloves and hairnets. However, the least educated – the cheapest labour force – are in charge of midday meals in village schools and in charge of toilet hygiene. (anecdote H.C.)
Disinfectants – and biocides (life-killers) e.g. insecticides (pesticides) and bactericides – are in sync with our sense of cleanliness to which we have been brain-washed.

Mottos & slogans, rituals & symbolic gestures, teaching & learning by rote and without understanding – these are not enough.

The broom and the toilet.

(Present GoI funding for toilets)
Before we can “bring sanitation to the field”, we need to bring it “out of the closet”
...and get the Dalits out of the sewers.

Anecdote of a job offer – status & the educated.

Basics first: nutrients & microbes
Cycle of nutrients

H₂O, C, N
The human body: 30 elements, 29 recognized as needed for the functioning of the organism, one (aluminium) is not understood.

More substances found – up to 52; functions not understood, possibly contaminants.

H and O as H₂O, C, N, P (phosphate 0.7 kg), Ca (1.5 kg) – almost 99% of body mass.
S, K (150 g), Na (100 g), Cl (100 g), Mg (30 g) – another 0.85%.
F (20 g), Fe (3-5 g), Zn (4 g), Cu (0.1-0.15 g);
Mn (8 mg) – in all cells, inside mitochondria.
Co (1-2 mg) – essential for Vit B 12.
Mo (molybdenum), a constituent of flavoproteins, essential trace element, in all cells; (occurs in nature mainly in North America and in Norway; used in steel industry, radio technology, electrical heating systems).

J (iodine), Cr (chromium), Se (selenium), Ba, Sr (strontium), As (arsenic), Cd, Al, Au (gold – 0.2 mg), Hg (mercury), Ru (rubidium), Sn (zinn).
In nature, substances are cycled in biogeochemical pathways; sustainable organic farming recognize these cycles and tries to make optimum use of cycling.

This implies

- The use of organic matter: crop residue, compost*, mulch, green manure, animal dung
- Promoting microbial life in soils
- Developing humus-rich topsoils that are habitats for microorganisms and small life forms (e.g. earthworms),
- (topsoils) which can hold and store water, and
- which can be huge “sinks” of carbon.
The challenge of civilization:
1) Cycling nutrients between human settlements and farming, and
2) Containment of excreta-borne pathogens.
The challenge of civilization
A missing link in public hygiene: Ecological hygiene

Generally, cleanliness is identified with sterility*.

History of surgical hygiene:
State of surgery in 1860s
Joseph Lister (1827-1912); the beginning of aseptic surgery: the biocide & disinfectant phenol*, C₆H₅OH, carbolic acid. >> surgery
Robert Koch (1843-1910) isolates Mycobacterium tuberculosis in 1881/82, Vibrio cholerae in 1883. >> microbiology
The presence of “germs” or microorganisms through time

“Big Bang” – beginning of universe
   14 billion years ago (bya)
Beginning of solar system 4.6 bya
Earliest unicellular organisms – 3.8 bya
Appearance of multicellular life – 1.5 bya
Of life on land – 500 mya
Of flowering plants – 240 mya
Of mammalia – 200 mya
Of primates & – 85 mya
Of homo sapiens –
   1 mya to 200,000 ya
Human settlements
   & agriculture – 12,000 ya
Co-existence of microorganisms with(in) our bodies

The “human microbiome” – 16 papers published in June 2012 by scientists of the “Human Microbiome Project Consortium” (80 institutions) – the mapping of microorganisms. By 2013 in total about 10,000 species identified; in the intestines about 4,000 species; in the vagina – about 300 species, changing with the menstrual cycle and pregnancy.

Species on one person’s tongue differ from species on the same person’s guts much more than from another person’s tongue – body’s landscapes comparable to different biotopes.
Co-existence of microorganisms with(in) our bodies

The “human microbiome” –
in total about 10,000 species identified.

Number of microbes (in & on the human body) equal to, or higher than, number of body cells. (One estimate of organisms in the gut: 700 trillion.)

Genes of microbes (in human body) may outnumber human genes severalfold.

Contact with certain soil microorganisms in early life is crucial for the development of neuro-transmitters in the brain.
Co-existence of microorganisms with(in) our bodies


“As we looked at belly buttons we saw a terrible, yawning, richness of life. The average belly button hosted 50 or so species and across belly buttons we found thousands of species (and as we sample more belly buttons, we continue to find more species). The vast majority of these species are rare. Right away something struck an ecological chord. The belly buttons reminded me of rain forests. In some tropical rain forests, even though there are many species of trees, a few species are both present in most forests and common when present. Those species have been called oligarchs; the belly buttons seemed to have oligarchs too.”
Co-existence of microorganisms with(in) our bodies

Estimated microbial population on & in our bodies:
$10^{10}$ (10 billion) on the skin
Co-existence of microorganisms with (in) our bodies

Estimated microbial population on & in our bodies:
$10^{10}$ (10 billion) on the skin
$10^{12}$ (1 trillion) on mucous membranes

Compare with ads for mouthwash and toothpaste
Co-existence of microorganisms with(in) our bodies

Estimated microbial population on & in our bodies:
$10^{10}$ (10 billion) on the skin
$10^{12}$ (1 trillion) on mucous membranes
$10^{14}$ (100 trillion, maybe 700 trillion) in the intestines
Benefits from microorganisms

In our bodies:
• Protecting our bodies from pathogens
• Training our immune system
• Facilitating nutrient uptake & production of nutrients (vitamins)
• Producing anti-inflammatory substances

In nature:
• (Re)cycling all biomass*
• Stabilizing atmosphere, climate, and oceans*
• …
Training the immune system – this is how it is done
Training the immune system
Hygiene – surgical / medical
in the operation theatre:
The relevance of the use of “germicides”, bactericides, etc. when opening the body surgically, or when the body surface has been opened by trauma.

Hygiene – ecological:
For daily body hygiene,
In our households,
In our environment.
Only mildly outside the focus:
Damage done by agro-biocides, pesticides, bactericides, fungicides, herbicides:
Only mildly outside the focus: The war on microorganisms – comparable with the war on terrorism – breeding a lot of new enemies.

Antibiotica-resistant and multi-drug resistant bacterial strains on the rise, in the world, in India, also in Puducherry.
Recommendable for places with insufficient water supply or high groundwater table: Urine-diversion-dry toilets (UDDTs) as built by EcoPro in Tindivanam-Bootheri.
Refer to the global scenario of nutrient losses from soils* and eutrophication of water bodies and oceans:

Ocean eutrophication and anoxic shore zones – due to sewage from industrialized animal breeding, fertilizer run-off, domestic sewage*…).
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Thank you for your attention.