Eusocial ant nest management, template for land development

GERO BENCKISER*
Institute of Applied Microbiology
Justus-Liebig University
Heinrich Buff-Ring 26-32, 35392 Giessen
GERMANY
gero.benckiser@umwelt.uni-giessen.de

Abstract: The invention of technical N_2 fixation (TNF) opened the way to fertilize urea, NH_4+, NO_3^- plant demands surpassing. An enchased the production sites from the thermodynamic equilibrium moving away and yields significantly increasing soil organic matter (SOM) conversion promotes nitrification through NH_4+ and CO_2 availability in higher amounts. Mobile NO_3^- ions in access formed dislocate towards groundwater. N_2O emissions and land erosion accrete.
Contrastingly demonstrate harvester ants how the nest mound surrounding area can be moved away from the thermodynamic equilibrium with organic matter imports, low in N, fungus farming, and a cleverly devised waste management. NH_4^+ is only limited available, inter alia through N storing in the ant cuticle, and a relatedly limited NO_3^- formation forces the denitrifying microflora to use NO_3^- economically by emitting preferred N_2 instead of N_2O as in N surplus environments.

A long term N cycle concerned research, insights into ant nest organisations and the meanwhile reasonably understood interdisciplinary nature of soils allow designing three dimensional economic (x), ecological (y), socio-cultural (z) Gibb‘s triangle diagrams for finding ways how the complex influences of N overloads could brought to an advancing organic/precision farming N management at high yield conservation and the much more complexity and globalisation facing, agriculture, industry and the public supervising governance to approach less environmental threats and more welfare for each citizen. Farmers and governance concerned endeavours in reaching less N overloads, less land degradation, less climate change are discussed.

Key-Words: - ants, nest N management, farming, e^- acceptor/donator balancing, waste management, governance duties

1 Introduction

Cassava production is a South Indian, Tamil Nadu farmers’ income source. Differently sized, attracted starch from cassava tubers extracting factories installed for becoming more independent from public electricity break downs biogas plants, which are fed with starch rich waste water but the CH_4 yield is not satisfying. The starch factory owners searched for scientific and industrial support in enhancing CO_2 and CH_4 formation efficiency and a positively judged proposal submission on a call of the German Ministry of Education and Research and the Indian Ministry of Science and Technology brought together the Department of Applied Microbiology, Justus Liebig University (JLU) Giessen, the CH_4 into electricity converting German Sterling Motor company, Sunmachine, the Department of Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore, and the Tamil Nadu starch industry partner. Analysing the starch factory waste waters chemically, micro- and molecular biologically it was found that the starch rich waste waters had a wide CN ratio, low sugar and nitrogen contents [1-3]. By adding nitrate as CN ratio narrowing measure the CO_2, CH_4 formation was constructively enhanced as table 1 is explaining.
On the agenda were ideas for enhancing the biogas plants efficiency by CN ratio narrowing and a walk through a tee plantation at Top Sleeves, Western Ghats, border between Tamil Nadu and Kerala, a between 2 trees hanging out of leaves made ball, identified as ant nest uploaded respective interest. Inside of the tree ant nest reside a plant sap (CN ratio 40-100) sucking, N depleted honeydew excreting aphid (mealybug), family *Pseudococcidae*, a honeydew consuming ant, genus *Crematogaster*, and a visiting ant feeding Rufus woodpecker, *Micropternus brachyurus,* which serves the ants as transport vehicle for founding a new colony in larger distant, shade providing trees in commercially, understory grown *Coffea arabica* plantations [4]. The ant nest

N management strategy and my long term N cycling related research experience were summarized in 2 papers focusing on a comparing of ant, human farming and waste treatment [5-7].

Tab. 1: Photosynthesis and N_2 fixation coupled biomass forming, ecosystems from thermodynamic equilibria away moving electron donator/acceptor transfering processes and electrochemical potentials (adapted from [7]).

Redox couples	number of e^- transfers	Eo' (mV)*
fermentations	1-2	-225 - -480
H^+/H_2	2	-411
CO_2/CH_4	6	-276
SO_4^{2-}/H_2S	8	-214
Fe^{3+}/Fe^{2+}	1	-185
O_2/H_2O	4	+818
NO_3^-/NO_2^-	2	+432
NO_2^-/NO	1	+345
NO_2^-/N_2O	4	+818
NO/N_2O	2	+1173
N_2O/N_2	2	+1355

*Eo' = electrochemical potential of energy unit charge (oxidized + ne^- $\longrightarrow$ reduced species)

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2 Ant, human commonalities and differences

Since ants and humans descend from the same virgin cell and assumingly both have learnt to gauge the quality of their respective environments and share thus many commonalities [8-15]. Both cooperate with virus carrying microbes, domesticate plants and animals, pollinate plants, carry out food source protecting pest controls, turn around soil by shaping landscapes and perform a SOM stock refilling waste management [5,6,8,9,11-18]. Interestingly in this context is that ants and N_2-fixing bacteria unveiling similar geographical migration and distribution schemes (Fig 1) [19,20]. Ant waste management crosslinks nest and mound surrounding area with a soil N buffer capacity not surpassing, N runaways' avoiding soil fertility [5,21,22]. The waste management of harvester ants absorbs approximately 10% of all nest duties and contributes to the resistance power of ants [5,8,23]. Superior to ants are agriculturists [25]. They can destroy with conventional farming ant nests (Fig. 1) four times more than with no tillage farming, but in crosslinking farming with the ant mound environment, with villages, cities, landscapes, with the world ants and humans are resembling [5,6,8,1314]. The resistance power of ants convey on cuticle or in pouch-like structures between epithelial midgut cells (bacteriocytes) hatched bacteria and archaea among which are *αβγ-Proteobacteria*, *Flavobacteria*, *Actinomyces*, *Escherichia*, *Salmonella*, *Yersinia*, *Bartonella*, *Pantoea*, *Sodalis*, *Mesorhizobium*, *Agrobacterium*, *Blochmannia*, *Wolbachia* species. The cooperating bacteria allocate sulphate reductase and urease for cuticle sclerotisation, supply amino acids (N, enzymes), vitamins and antibiotics, help digesting imported food, influence the rearing ratio of males

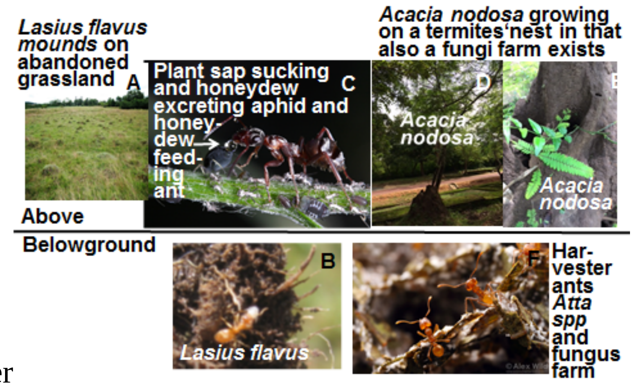

Fig. 1: A: Distribution of Lasius flavus mounds in a meadow near the village Münzenberg, Hesse, Germany (photo Benckiser).
B: A below-ground, with multiple root aphid species cooperating *Lasius flavus* species (BMC Evol. Biol. 12,106 DOI: 10.1186/1471-2148-12-106 (2012); http:// www. biomedcentral.com/1471-2148/12/106)
C: An above-ground phloem sucking, honeydew excreting and the aphid protecting ant species (photo publication authorized by Thomas Griessler, breschniak @gmx.net
D and E: Potentially N_2 fixing *Acacia nodosa* trees growing on or out of a termite nest, Sri Lanka, king palace Polonnaruwa (photos, Benckiser).
F: *Atta cephalotes* leafcutter ant fungus garden in underground chambers (white mold on imported leave material, low in N; Laboratory colony, University Wisconsin; aleanderwild.comhttp://www. alexanderwild.com/Ants/Taxonomic-List-of-Ant-Genera/Atta/).

and females, and favour an entering of mychorrized, plant sap sucking insect punctured plant roots in ant

mounds (Fig. 1) [8,26,27]. Thus ant redundancy occurs only at a "critical minimum" of essential resources (commodity of space, habitat, right type of food or destruction by others; Liebig's law, the principal tenet of population ecology).
Acromyrmex subterraneus or *A. crassispinus* ants, apparently not able to hydrolyse laminarin, xylan and phenol, cooperate with laminarin, xylan and phenol degrading, cellulose, starch, maltose and sucrose not affecting fungi, whereas others as the *Attini* tribe, genus *Atta spp*. learnt evolutionary that broods prosper best when fed with fungal staphylae (3–5% N) and started basidiomycete farming, because the basidiomycete *Leucoagaricus spp* accumulates plant material (CN ratio between 50.6 and 78.7) imported sugars and nitrogen in its hyphae tip bundle, the staphylae, major nutrition source for the brood residing inside of huge nests (Figs 1-3) [5,8,19-24].

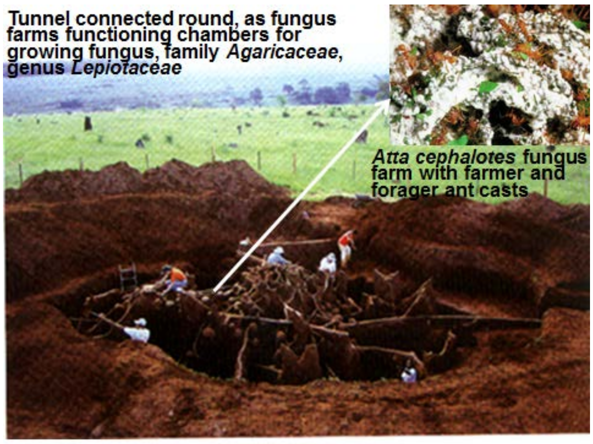

Fig 2: Harvester ant nest, *Atta laevigata*, with tunnel connected round fungus garden accommodating chambers [8] (photos provided and authorized by hubertherz@yahoo.com, Bert.Hoelldobler@asu.edu).

Harvester ant nest construction with tunnel connected fungus chambers (family *Agaricaceae*, genus *Lepiotaceae*) afford a soil excavation of 40 tons and the related soil shifting, comparable to that of many smaller ant mounds in abandoned grasslands shape landscapes as ploughing, road construction, or the building of houses and sheds (Figs. 1,2) [5,29-32]. Spread termite nests over Africa, South America, Asia with 4.4 x 10^{16}, 2.5 x 10^{16}, 1.5 x 10^{18} woody, lignin rich material-digesting termite individuals, respectively, and more than a dozen distinguishable prokaryotic morphtypes subsist as phloem imbibing *Acromyrmex spp*, *Atta spp*, fungus farm supported entirely on food low in N [5,8,29-32]. For the fungus *Acromyrmex spp*, *Atta spp* females must collect in large amounts stressed, cellulose, fibre, phenol, true protein and insoluble N containing plants parts (C/N ratio between 40 and 100) whereby the food quality the fungus farm is requiring has preference irrespective of the plant sap attractiveness for the ant (Fig. 3) [8].

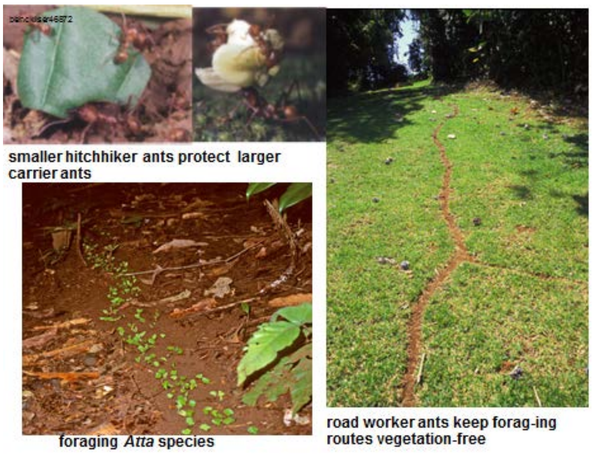

Fig. 3: Self-organized, directed, protected mobility during foraging of leaf cutter ant worker division substructures (photos provided and authorized by hubertherz@yahoo.com, Bert.Hoelldobler@asu.edu [8,34-36]

Harvester ants prevent N restrictions with prokaryotic, fungus support, whereas others as *Camponotus pennsylvanicus* De Geer resolve N restrictions by spraying formic acid into wounds of a prey and digest freed protein macromolecules extraorally, or practice an inter-individual competitive life style as primitive ponerine species, or cover their sugar and urea demands with grass seeds (6% protein) and when grass seeds are missing by stimulating other seeds to germ as *Pogonomyrmex molefaciens*, *Messor pergandei*, or *Camponotus compressus* [5,8]. Latter strategy resembles the waking up of sleeping plant buds by herbivory [37].
Harvester ants and termites farming nourish millions of individuals fungus farm based on limited space since around a million of years or billions of years after physical energy started to transform into biological energy, into fermentation and anaerobic, aerobic respiration (Tab. 1; Figs. 2,3) [8,33-40]. After ant farming humans started to develop a grandiose brain capacity, enabling to evolute from plant and rotten carcass eaters to agriculturists, to think, reflect, cogitate, speculate, and communicate with languages, to decipher Nature's N shortage managing programs [24, 40-42]. Ants still trust in a chemical signal (pheromones), sound, substrate-borne vibration and touch (thigmotaxis) based communica-

tion system by possessing asides the capability to interpret CO_2 concentrations, nest temperatures, honeydew chemistry, to identify substances, released from a Dufour or poison gland. The smelling of hydrocarbons in the outer layer of the hard-shelled cuticles enable to differentiate between nest mate castes, life stages, age, and members of alien colonies and odometry helps in orientation and organizing a leaderless, altruistic living together without grudge and piggishness. The queen is just an egg layer, a fungal symbiont disperser from parent to offspring colonies, not an authority, whereas the sterile *Atta spp* females which not attempt to breed are in charge of constructing 7-8 meters deep, 26.1 to 67.2 square meters sized nests with a well-designed gas (O_2, CO_2) diffusion system (Fig. 2), to forage, to care for the fungus farm, the brood, queen and the males during short times prior to the mating (Fig, 3), and to carry out pest-, waste-management [8]. All these duties witness the emergence of one level of biological organization from another and demonstrate closeness between ant and human societal activities [8-23,33-37,42].

Outside trailing and returning harvester ant waste managing divisions is forbidden to touch ants not involved in waste recycling. This pest control measure (a) supplements (b) a separation of fungus gardens from other nest environments (Fig. 2), (c) an intensive monitoring and early pathogen abatement with filamentous, antibiotic producing on the cuticle carried bacteria, genus *Pseudonorcardia*, (d) a stockpiling of pro-, prebiotic disease suppressing auxiliary microbes, (e) a control of bacteria multiplication with compounds as phenyl acetic acid, keto-acids, alcohols, lactones, long chain fatty acids, plus 20 more carboxylic acids, produced in metpleural glands, and (f) a control of fungal spore germination with the hydroxydecanoic acid, myrmicacin. Very carefully controlled are faecal droplets with which newly established fungus gardens are manured (g) [8,16]. Under germinating and too late detected *Escovopis* spores in contaminated faecal droplets the whole nest community may seriously suffer. Besides the pest control measures mycelial growth, stimulated through plant-derived indole acetic acid (h), a periodical switching to novel fungal cultivars (i), a preserving and dispersing of genetic variable fungal cultivars across many farmer generations (j), and a sharing of domesticated clonal fungi with distantly related ant farmers (k) raise the fungus garden efficiency.

Nowadays biologists, ecologists, physicists, physicians, soil scientists, economists, and political scientists are progressing by having a single atom detecting analytic and steadily increasing computer capacities available in understanding the interdisciplinary nature of soils, the in rhythm functioning enzyme allocations inside of cells, biofilm forming interactions, or the translation of individual chaotic harvester ant movement into directed mobility (Fig. 3; Tab. 1) [43-51]. The algorithms beyond the super organism-like organisation of *Attini* colonies, N cycling, economies and politic are step by step deciphered and the signal to signal adding during foraging group enlargement until directed mobility (rhythm formation) emerges has provided ideas for self-organizing robot flocs and resembles the adding of algorithm to algorithm in the block chain technology (Fig. 4) [52-56]. Is the ant system fully understood researchers may learn from the signal to signal adding of harvester ants how the block chain technology system could be traced back and from the harvester ant N nest management organic/precision farming may get hints how a high productivity can be conserved with a soil buffer capacity, plant demand not surpassing N fertilization [9,42,55-58].

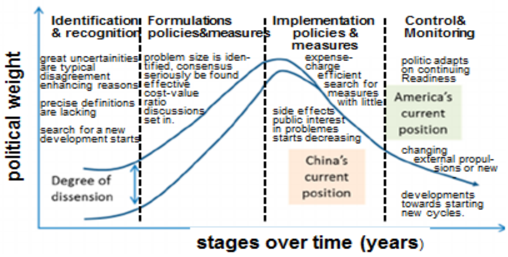

Fig 4: Long wave rhythms in economy and politic (adapted from [52,53].

3 Ant-human N management

3.1 Ant, human approach in electron donator/acceptor balancing

South American myrmicine tribes apparently achieve with a cleverly devised organic matter import and waste management a balanced energy and N budget in their nest environment by being concomitantly able to nourish millions of individuals satisfyingly on limited space (Figs 2,3) [5,16,21,22]. The remodelling of landscapes through foraging starts early in the morning with a few sent out individuals, having to find a remunerative harvesting area. At successful returning signals are released to enlarge the foraging group. Is a signal volume plateau (Vs) reached or surpassed translates spontaneous, individual motor activity or low dimensional ant disorder into directed mobility (Fig. 3). This physiologically predetermined foraging behaviour enables myrmicine tribes to forage huge amounts of fungus preferred stressed, cellulose, fibre, phenol, true protein, insoluble N and inorganic nutrient rich plants parts (C/N ratio between 40 and 100) in an area up to one hectare [5,8]. During the forage activities adult ants imbibe plant sap for the own nutrition and in the gut stored plant sap is shared with intranidal ants by regurgitation. The in rhythms organized foraging, enabling to bring the right number of individuals rapidly and at any time to places of current demand, secures the food for the fungus farm and finally for the ant brood by translocating the imported sugar and N into the staphylae (3–5% N; Figs 1-3) [5,8,31-36].

Asides the nutritional aspect imports the generally much C than N richer N plant material inorganic nutrients which accumulated in the nest environment and attract bacteria, archaea and mycorrhized, sometimes aphid punctured, ant mounds penetrating roots. A plant-microbe-ant nest cooperation develops and helps together with a cleverly organized waste management minimizing nutrient (N) runaways (Fig. 1) [5,6,31-36,43,57-59]. Waste managers, in ant divisions organized as digging and foraging, transport the leftovers of the by 47.7, 9.1, 26.1, 60.8, 10.9, 10.9% degrading cellulose, fibre, phenol, true protein, insoluble N, respectively, residues of excrements and dead ants, and particularly fungus farm wastes out of the nest and deposit them generally near the vegetation free mounds where a SOM stock refilling crosslinks the nest environment with the surrounding world and improves soil fertility [18,56]. The way how ants manage their wastes resembles human society waste treatment particularly before technical N_2 fixation (TNF) invention [14, 15].

As ants invested before TNF individual farmers a long chain of experimental work, supported from the late 18th century on by research institutions, to reach higher yields for nourishing a growing but starving population. They enlarged (a) the food production area (b) did experiments with cereal-legume-root crop rotations and intercropping systems, started (c) with breeding higher yielding, low N input varieties, and manured (d) the fields with organic wastes in order to move them away from the thermodynamic equilibrium [9,11,42, 47,50,51,59, 60; Eduardo Porter, New York Times, May 1, 2015]. After TNF invention the biological N_2 fixation (BNF) inputs doubled and plant demand surpassing mineral (N) fertilizations and tillage intensification stimulated aerobic, anaerobic respiration, fermentation (Tab. 1) and SOM degradation. The crop productivity increased tremendously, NO_3^- started dislocating towards groundwater, climate threatening CO_2, N_2O emissions and an accreting land degrading through erosion promoted to think about how the electron (e-) donator/acceptor ratio in agriculture, vineyards, forestry and gardens could be skilful balanced to reduce N generated environmental constraints [7,36,41-45,51,61-66; UN reports]. Before plant demand surpassing TNF fertilizations organismal communities experienced a long term adaption on N shortage and had learnt to use NH_4^+ economically [41]. Three-bonded atmospheric N≡N, is reduced to NH_4^+ either by transferring e^- and H^+ photosynthesis coupled on N_2 that works at most earth temperature regimes (BNF) or under high oil (energy) inputs, Fe-catalysts, a reaction temperature of 500^{o}C and a pressure of 20 Mpa (TNF). The BNF or TNF introduced NH_4^+ convert autotrophic nitrifying bacteria and archaea to NO_3^- and denitrifying bacteria and archaea return the introduced NH_4^+ majorly as N_2 but with increasing amounts of N_2O after TNF invention into the atmosphere [7]. In the e^- acceptor/donator balanced N cycling chain is the manifold controlled nitrification process key controller. First of all and majorly controls the NH_4^+-, O_2- and CO_2- availability the nitrification process (Fig. 5). Then are the from NH_4^+ by oxidation to NO_2^- and NO_3^- liberated e^- and H^+ subdivided into flow towards electron transport phosphorylation to gain energy and towards CO_2 reduction to form biomass. At third is the nitrification process subdivided into a NH_4^+ to NO_2^- oxidizing nitroso- and a NO_2^- to NO_3^- nitro-group. Latter avoids toxic NO_2^- accumulations. Finally, helps the capability of nitrifying bacteria and archaea to gain additional energy by reducing NO_2^- with NH_4^+ to N_2 and/or by denitrification and to store N as N-acetyl glucosamine, a long-chain cuticle chitin polymer to perpetuate e- donator/acceptor ratio balancing as NH_4^+-, NO_3^-- and N_2O-measurements in human largely uninfluenced ecosystems or in by wide CN ratio plant material imports managed harvester ant nests acceptably indicate (Tab. 1; Fig. 5) [5,7,21,22,31,32]. From Low N input terrestrial ecosystems NO_3^- returns preferred as N_2, less as N_2O into the atmospheric N pool, whereas from often with plant N demand and soil N buffer capacity surpassing amounts of animal manures, industrially and municipally produced sewage sludge, composts or TNF fertilized arable lands, pastures, vineyards, gardens or lumber producing forests, covering around 40% of the land surface, emit rather N_2O than N_2 as related measurements reveal [48,51,61-67]. N over-fertilizations not only enhance SOM degradation but alter also soil acidity, water, oxygen, hydrogen, cofactor availabilities, liberate reactive oxygen species (ROS), and take influence on mobile NO_3^-, N_2O forming bacteria and

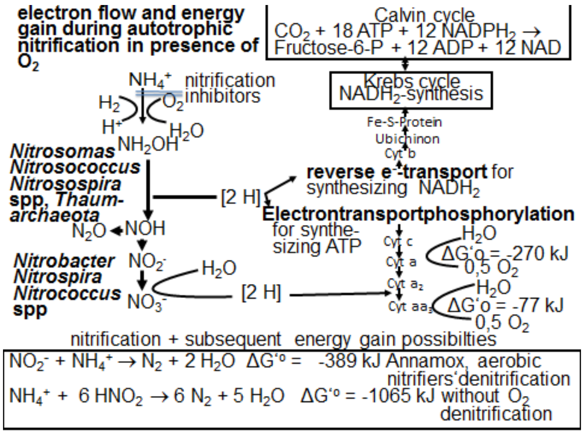

Fig. 5 Denitrification coupled nitrification, key N cycle regulator and model for e- acceptor/donator balancing.

archaea (mesophilic crenarchaeota, phylum *Thaumarchaeota*, species *Nitrosoarchaeum koreensis*, *Nitrosopumilus salaria*, *Nitrososphaera viennensis*, *Nitrosotalea devanaterra*). Access NH_4^+ availability in N-over fertilized landscapes favours nitrate dislocations and a NO_3^- dominated e^- donator/acceptor ratio motivates denitrifying bacteria, archaea and fungi to act with the e^- acceptors NO_3^-, NO_2^-, NO less economically by releasing increasing amounts of N_2O instead to reduce it to N_2 (Tab. 1) [61-69]. The cryptobiotic surviving strategy of long-term on N shortage adapted organisms will change and not adapting organisms will disappear [41,70]. Nitrification inhibiting organic compounds as degradable dicyandiamide and 3,4dimethylpyrazole phosphate can delay NO_3^- formation (Fig. 5) that NO_3^- up taking plants can care for an economic NO_3^- use. The governance supervised organic/precision farming tries to finds ways towards a more plant N demand adapted agriculture by conserving the reached high yield level and the harvester ant N nest management, if fully understood, could give orientation (Fig. 6) [Eurostat yearbook, statistical guide to Europe, European Commission, 2013, epp.eurostat.ec. europa.eu/statistics/index Eurostat_yearbook/de; numerous articles published in organic/precision farming journals].

3.2. Electron donator/acceptor balancing constraints

Not only NH_4^+ and organic matter availabilities influence e^- donator/acceptor ratio balancing but also economic, ecological and socio-cultural actualities strongly the N cycling complexity (Fig. 6). The N cycling complexity facing politic suggests (a) to intensify agriculturally fertile landscapes by giving it up in less fertile areas. Secondly, (b) is recommended to invest in organic/precision farming research by considering the advantages of nanotechnology and commits (c) most related decisions to the actors [72, Nanomaterials Science & Technology Initiative of the Indian Government Department Science & Technology, 2005; European Environment Agency Technical report No 4/2011; Eduardo Porter, New York Times, May 1, 2015].

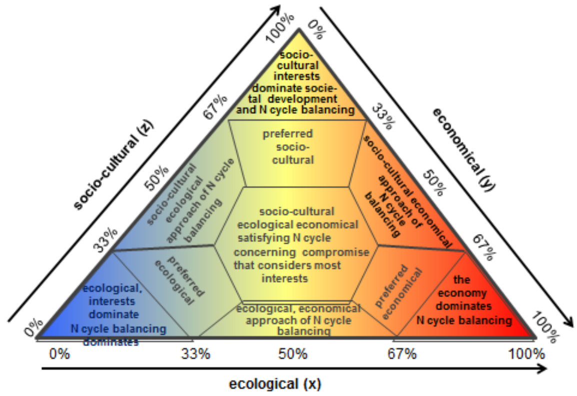

Fig. 6: Three dimension Gibb‘s triangle diagram (x+y+z = 100%), illustrating the economical, ecological, socio-cultural influences on N cycling.

In educating pollution costs, e.g. by threshold surpassing NO_3^- or N_2O amounts, causing persons and companies an effectual measure is pollution tax. A monetary evaluation of measurable malfeasance is apparently possible [Evaluation of measurement data – Guide to the expression of uncertainty in measurement, BIPM, www.bipm.org, 2008; European Environment Agency Technical report No 4/2011]. Difficult or nearly impossible is apparently a monetary evaluation of co-influencing ecological (light; temperature; water; CO_2 concentration; plants, animals, humans, environmental disease; toxins; food web stress) and particularly socio-cultural factors (organisation of income disparity; health, nutritional, educational, industrial, professional items; white-collar to blue-collar ratios; agricultural worker ratios; ethnicity and socio-economic status; discrimination; conformity; geographically mobile to geographically stable subjects ratios: interpersonal, intergroup relations; obedience; norms; etc. appears as nearly impossible [50,52;67; Evaluation of measurement data – Guide to the expression of uncertainty in measurement, BIPM, www.bipm. org, 2008; European Environment Agency Technical report No 4/2011]. Some hope remains in minimizing N over-fertilizations through organic/precision farming: (a) a better understood ant nest N management could be model, (b) the observation that the activation energy of the enzyme nitrogenase in crop rotation extensions with legumes and phosphor mobilizing mycorrhiza is with ∼103 kJ mol^{-1} significantly lower than the ∼210 kJ mol^{-1}, measured under laboratory conditions [23,73,74], (c) success in breeding low N-input varieties is reported [60], (d) nitrification inhibitor stabilized NH4+-fertilizers, delaying autotrophic NO_3^- formation until plants can uptake NO_3^- in larger amounts are marketed [71], (e) biogas plants, enabling a better plant demand adapted organic waste N recycling, and a co-securing of farmers' income and social sustainability through petroleum replacing CH_4 are increasingly installed in rural areas [14,75], and (f) GPS connected machines with nanotechnology based computer-sensor-devices, enabling to approach a more plant demand adapted, soil buffer capacity not surpassing fertilization by precision farming are increasingly in use. The given achievable perspectives towards a better N balancing also the agriculture supervising, public interests balancing, increasingly global acting governance seems to include in their advisements to future ways in (Figs 4, 6, 7) [75, 76; Eurostat yearbook, statistical guide to Europe, European Commission. 2013.epp.eurostat.ec.europa. eu/statistics/index Eurostat_yearbook/de; articles in organic/precision farming concerned journals).

4 The public, administration, industry, agriculture supervising governance

Inequality can be unhealthy for societies and economies as it has been data based shown [52,76]. Inequality —from the patchy distribution of resources among ancient hunter-gatherers to the sheer earning power of capital today— forces societies to decide whether, and how to restrain the in figure 7 illustrated conglomerates of subsystems, interests and globalisation. Biomimetic orientating, increasingly networking scientists across the disciplines physic, (bio-) chemistry, biology, ecology, agriculture, economy, sociology, law or politic support governance by deciphering the algorithms beyond in rhythms occurring processes with nowadays analytic possibilities as isotopic techniques, chrono-, synthetic biological methods, imaging or satellite-connected, high capacity computers which allow an interpretable monitoring of side effects in our largely non-state actors determined, globalizing world where ethic and social responsibility-ensuring is not always principle. Yet, despite all scientific progress the conversion of CO_2–C-, CH_4-C-, NO_3^--, N_2O-sink- into source-ecosystems and income disparity

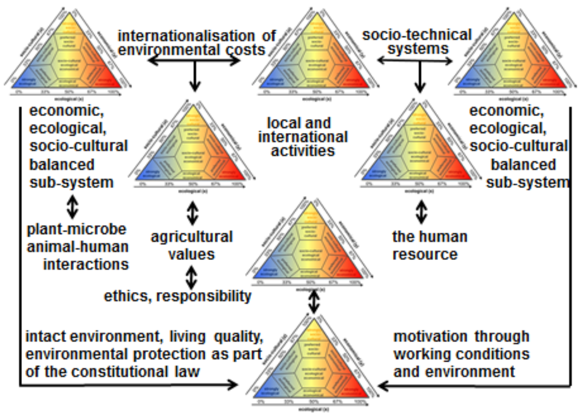

Fig. 7: Three dimension Gibb's triangle diagram illustrating the subsystem complexity in a globalizing world.

continue (Figs. 3,4,8) [53-55,69,77,78]. Though governance tries in a block chain technology-like manner to approach common welfare concerned compromises, the United Nations (UN) and leading scientist continue claiming to approach an e^- donator/acceptor ratio balancing agriculture and less climate, land degradation threatening productions and to minimize inequality [United Nations reports; numerous articles published in organic/precision farming journals]. Already the political philosopher Plato (427-348 B.C.E) and later scientists of the 18th, 19th centuries who started to study the nest organization of eusocial insects more systematically claimed more common welfare (equity, justice) to each citizen (Moeller, Pilzgärten einiger Süd-Amerikanischer Ameisen, in Schimper's Botan. Mitth. aus den Tropen, vi. 1893, cited in the book "Mutual aid, a factor of evolution", first edition, 1902) [80,81].

Helpful in e- donator/acceptor ratio balancing genetic modified organisms (GMO), increasingly constructed under the headline "synthetic biology", could be which apart from their ancestors discharge gasoline precursors, therapeutics, pollutant degrading enzymes or sensor molecules into fermenters. An example provides the 2,4 dinitrotoluole (DNT) into 4-methyl 5-nitrocatechole transforming GMO Burkholderia sp., formerly Pseudomonas cepacia, which possesses aromatic compounds degrading enzymes, repair proteins, vitality buffering chaperones, and an inserted mycotoxin detecting device (Fig. 8). The mold toxins detecting device insert of Burkholderia sp (Fig. 8) allows checking whether the costly GMO works well, ROS overexpressing related suboptimal (inaccurate), or is not able to resist and disappears. The possession of aromatic compounds degrading enzymes, repair proteins, vitality buffering chaperones increases the resistance against ROS, soil enzymatic reactions and DNA modifying feedbacks after being released into a not very hospitable soil environment and being distributed as all inherent bacteria by fungal hyphae-root networks and diffusion processes [69,81,87].

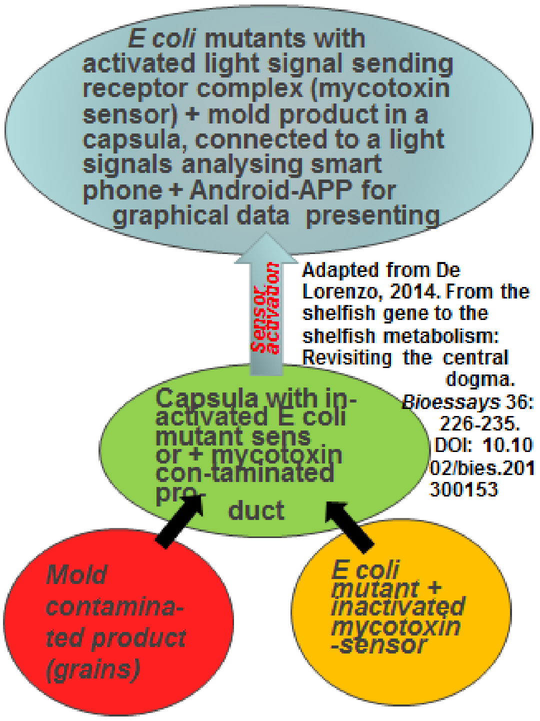

Fig. 8: Burkholderia sp GMO inserted mold mycotoxin signal detecting device to identify mold toxins [adapted from 69].

GMO designed N cycling concerned enable besides an internal-external control, an environmental monitoring, a qualitative, quantitative accurate diagnosis (perception, judgement) that may help overcoming constrained, economically, ecologically, and socio-culturally influenced e^- donator/acceptor ratio misbalances. Since everyone ideally loves to live in a well SOM managed, pollution-free world but in spite of all scientific progress about 60% of our ecosystems are unsustainably maintained and most existing models explain substantial proportions of the ecosystem variation statistically on basis of a few variables [48,50,75,82-84]. As long as primary forests and cold steppes, covering 26% of the earth surface, are converted into arable land and such conversions influence knowingly the world climate GMO support would be a priceless value in putting things right or conservation ecology has its authority [50,70].

5 Conclusions

Electron flows are measurable and toxins can be detected down to lowest concentrations. Short, long wave rhythms beyond cell metabolism, biofilm, ant colony, economy, and politic are identified as system-stabilizing and meanwhile it is reasonably understood that the conversion of 'CO_2–C, NO_3^--N, N_2O-N sink' into 'CO_2–C, CH_4-C, NO_3^--N, N_2O-N source' ecosystems favour consumer-resource interactions, the emerging of physical, chemical, biological gradients and the emission of greenhouse gases will increase. In spite of this trueness a better threat tuning in our non-state actors largely determined world seems to be distant. At least soccer teams seem implementing a leaderless, self-organized, altruistic working together as harvester ant colonies are demonstrating it and correspondingly headlined a German daily news-paper during the last world-championship: alpha animals menaced from extinction – teams prefer flat hierarchies (Alphatiere vom Aussterben bedroht - Mannschaften ziehen flache Hierachien vor; 'Giessener Anzeiger', July 3, 2014, page 38).

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