

## OVERVIEW OF SOIL MANAGEMENT ISSUES IN THIS UN YEAR OF SOILS 2015

Professor John Wibberley, TAA SW *Soils – where the answers lie* Conference: RAU Cirencester, October 15<sup>th</sup> 2015

**Introduction:** An annual World Soil Day was initiated by the UN on December 5<sup>th</sup> 2014 but 2015 has all year to celebrate Soils! Since soils yield 95% of our global diet, plus many other ecosystem services (carbon capture, water filtration and storage, ‘culture’, *terroir*...) it is self-evident that they’re the basis of all farming systems and ‘where the answers lie’ gifting true sustainability. Long ago the Psalmist (65:9) wrote wisely of The Creator, ‘*You care for the land and water it; You enrich it abundantly*’. As with a farming business, it is not the precise amount of organic matter that soils contain so much as its turnover rate that indicates dynamic fertility and soil health. **Fertility** is the ability of a soil to produce and go on producing useful crop yields. It is at the very heart of the delivery of sustainability in practice. **Threats** to soil health include erosion, exhaustion, pH imbalance, salinisation, wetness, drought, contamination and infestation with weeds, pests and diseases. **Solutions** offered by good soil management (i.e. proper land husbandry) to these respective issues include:- soil conservation, soil nutrient management, pH adjustment (often to 6.5), proper irrigation management, drainage, moisture conservation and/or irrigation and positive soil health through proper weed, pest and disease prevention and control, together with avoiding pollution (Fig.2).

**Status:** Worldwide, around one-third of all farmed soils are reckoned by the FAO to be degraded to varying degrees, and this proportion is increasing. Soil degradation may be due to erosion, compaction, soil sealing, salinisation, depletion of soil organic matter and nutrients, acidification, pollution and other processes caused by unsustainable land management practices. Furthermore, while world population grew by some 30% between 1990 and 2010, soil losses are estimated at some 24 billion tonnes of fertile soil each year (equivalent to 3.4 t/year/person on earth). José Graziano da Silva, Director General of FAO, notes, “It can take up to 1,000 years to form one centimetre of soil (1 tonne per hectare per year), and with 33% of all global soil resources degraded and human pressures increasing, critical limits are being reached that make stewardship an urgent matter.” Urbanisation led to loss of some 705,000 hectares of British rural land between 1945-1990, and building is now leading to loss of some 1400 hectares per year from UK agriculture. Globally, some 2 hectares of soil per minute (300 acres an hour!) are sealed over by expanding cities. Furthermore, although some undergrazing by sheep is possible, covering productive fields with solar panels exacerbates this loss of productive land – notwithstanding their sound short-term business sense given recent UK energy grants, and the appeal of generating renewable energy.

**Significance:** Soils are reckoned to contribute some 25% of the world’s biodiversity, with their myriad micro-organisms (more than the global human population of 7.25 billion in a level teaspoonful of normally fertile loam) plus the larger contributors such as the humble yet noble earthworm (Fig.1). Our forebears were not far out in reckoning the potential productivity of a pasture in terms of meat, wool and milk being proportional to the population of earthworms within its underlying soil! The International Union of Soil Sciences reckons that there are over 100,000 different types of soil – that’s biodiversity indeed! We need to recover the concept of *terroir* as they say in French! The hefting of particular breeds of sheep – and of types within them – to particular soils and their associated climates contributes hugely to the rich agricultural biodiversity within the UK; not forgetting our notable heritage of crop ecotypes such as Suffolk’s Kersey wild white clover or Kent’s variant of the same species. In this connection, I have just read and commend superb books on these themes by farmers:- *Counting Sheep: a celebration of the Pastoral Heritage of Britain* by Philip Walling (2015, Profile Books, London, 266 pp.) and *The Shepherd’s Life: a tale of the Lake District* by James Rebanks (2015, Allen Lane, Penguin, 293 pp.).

**Fig.1. Soil Fertility: encouraging beneficial & minimising detrimental microbiological activity**

BENEFICIAL MICROBIAL ACTIVITY	DETRIMENTAL MICROBIAL ACTIVITY
Decomposition of Organic Matter (OM)	Competition for limited soil nutrients
Mineralisation (release of soil nutrients)	Denitrification: yielding global-warming gases
Special chemical changes e.g. nitrification	Natural toxin production in anaerobic soils
Aggregation (thus improving soil structure)	Some are themselves pathogens or pests
Antibiotic production (detering pathogens)	
Nitrogen-fixation ( <i>Rhizobia</i> & free living)	
Toxin breakdown (degrades applied biocides)	

In general, conditions favouring beneficial microbiological activity also favour crop root systems and thus consistent good yields, with the special case of paddy soils for wetland rice.

## Management

Good farmers worldwide are cherishing and striving to care for their soils while obtaining optimum productivity from them by means of correct cultivations, appropriate planting techniques, strategic use of cover cropping and suitable crop rotation. Many are now challenged with sustainable intensification. Fig.2 attempts to summarise an overview of issues in soil management. For proper land husbandry, I was taught 3 great principles of soil management by my late great Professor E. Walter Russell at Reading<sup>1</sup>, which apply everywhere but are especially applicable to tropical soils:-

1. **Maintain Soil Cover** (mulch; cover crops) particularly with loose, light soils on erodible sites.
2. **Keep the nutrients in** by maintaining vigorous nutrient cycles and nutrient management planning.
3. **Keep the weeds out**; easier said than done in the case of such recalcitrant ones as blackgrass! However, regular timely weedings, perhaps while singing weeding shanties in teams in resource-poor farming communities can more than double yields as this writer's research with *Sorghum* and dryland rice in Nigeria showed 40 years ago.

**Conservation Farming (CF)** is an overall soil management system that is gaining ground worldwide (Indo-Gangetic Plain, Southern Africa, Brazil and elsewhere in South America, North America, Australia, as well as in parts of continental Europe, and here in the UK). It is also called Conservation Agriculture – CA, and often historically called Minimal Tillage or Reduced Cultivations in the UK, though this is not the full CF approach. **CF** has a set of associated practices that are combined together:- it links reduced early cultivation, seed and nutrient placement, mulching and rotations. Its efficacy lies not only in saving the operational/energy costs of traditional cultivations (by moving only some 15% of soil by contrast with overall tillage) but also in conserving moisture which can substantially increase yields in dry seasons and drought-prone climates. In such situations, farmers have doubled or even trebled yields quite commonly with proper **CF** adoption where ample nutrition is maintained using composts, manures and fertilisers.

**CF** offers a disciplined but adaptable management approach. **CF** benefits of Water and Organic Matter Conservation combined with soil structural improvement are cumulative but rely on enough previous crop yield and thus proportionate root activity and enough healthy mulching matter residues to use for the next crop. However, minimal cultivation tends to change weed ecology needing more initial in-crop weed control and maybe more perennial, especially grass weed control later.

### Summary: Fig.2. Overview of Soil Management Issues

THREATS	SOLUTIONS
EROSION	CONSERVATION PRACTICES
EXHAUSTION	NUTRITION
pH IMBALANCE	LIMING TO 6.5 USUALLY
SALINISATION	IRRIGATION MANAGEMENT
WETNESS & COMPACTION	DRAINAGE & SUBSOILING
DROUGHT	CF : IRRIGATION
INFESTATION	CONTROL WEEDS, PESTS, DISEASES
CONTAMINATION	POLLUTION CONTROL

Our challenge is to consider these issues in more depth and approach their management as reflective practitioners, not just for the next harvest but for the grandchildren!

<sup>1</sup> *Soil Conditions & Plant Growth* (Longmans – many editions)