

Session 3: Food Security and Sustainable Crop Production

Soil Resources and Sustainable Crop Production

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Soils are fundamental to supporting plant, animal and human life on Earth. For sustainable crop production, it is necessary to maintain our soils *in situ* and in a healthy and fertile state. This is proving to be an increasingly difficult and challenging task. Although food is the focus of our meeting, we must remember that soils also support the production of other essential materials such as fibre for clothing and bedding and timber for fuel and housing.

Soil is a finite natural resource limited by the area of land. Although soils of one type or another cover most of the land area, many of the soils cannot be used for agriculture because they are; too dry, too wet, too cold, too shallow, too toxic. As a result only about 10-12 percent of the Earth's soils have no natural limitations in terms of agricultural production. Therefore, we are dealing with a very limited resource base for the production of food and other commodities. In addition to their limited area, soils are also subject to degradation and loss due principally to erosion by wind and water but also physical (eg. compaction, loss of structure) and chemical degradation (eg. salinity, toxic contamination).

Although erosion is a part of the natural geological process, there is no doubt that the rate and extent of soil erosion and degradation have increased as a result of human activities. These include overgrazing, excessive cultivation, farming of unsuitable land and contamination through industrial activity. It has been estimated that as much as two billion hectares globally of arable and grazing land is affected by moderate to severe degradation, whilst around seven million hectares of farmland are permanently lost year. Whilst new soil is formed by natural weathering, the process is slow and it takes several hundreds of years for a new soil to develop. In many areas the rate of erosion greatly exceeds the rate of soil formation. An additional issue is that large areas of highly fertile soils are removed from production as cities are created and expand due to burgeoning populations.

Against this background, many new or growing global threats and demands have emerged over the last decade to place further pressure on our soil resources. These include:

- Increasing population;
- Impact of climate change;
- Use of plants to produce biofuel;
- Sequestration of carbon by soils;
- Increasing demand for animal protein
- Competition for water.

Of these, only carbon sequestration by soil presents a win-win opportunity, all of the other issues pose a threat to the capacity of the soil to produce sufficient food for our growing population. For example: climate change will lead to changes in cropping practice, frequently with less rainfall; biofuel production could lead to competition in the use of land for food production; animal protein requires around three times as much area as cropping to produce the same amount of plant protein; and the competition for water will increase so that less will be available for use in irrigated agriculture.

A further complication is that the amount of land suitable for cultivation is not evenly distributed around the world, not only with respect to area but particularly with respect to population density. The impact of this uneven distribution is evidenced by the large areas of land in the tropics being cleared and burnt in South America and South-East Asia due to the heavy pressure on land resulting from increasing demand for food by rapidly increasing population. This has resulted in the loss of 10 percent of tropical deciduous forests and up to 60 percent of tropical rainforest with severe environmental consequences. In contrast, the area of forested land in Europe and Russia showed small but significant increases over the same period.

What is the outlook for the future? With changes in agronomic and cultivating practices, soil degradation can be arrested and reversed so that the loss of productive soils can be minimised. The price of food needs to be maintained at a level so that soils are not over-exploited and farmers are able to maintain the health and fertility of their soils. The higher food prices would be an investment in our collective future. Also, cities should be built on poor soils rather than the best soils.

It is worth noting that agriculture has made massive advances in efficiency and productivity over the last century driven largely by the use of fertilisers, improved machinery and mechanisation and agrochemicals. However, there is an upper, biological limit on what can be achieved by these means. Modelling suggests that the same operating paradigm will enable agriculture to feed a population of 8.5 billion by 2025 but it is less clear that increased food production could be continued further without a major change from the current production paradigm or, perhaps more importantly, a limit on human population growth.

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Academic Degrees

- 1999 FTSE, Australian Academy of Technological Science and Engineering, Australia
- 1979 FRSC, Royal Society of Chemistry, U.K.
- 1979 C. Chem, Royal Society of Chemistry, U.K.
- 1968 Ph.D., University of Birmingham, U.K.
- 1965 BSc. (Hons), University of Birmingham, U.K.

Field of Study
Soil and Environmental Science