AN AGRICULTURAL ENGINEER'S VIEW OF THE UNIVERSE

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INTRODUCTION

Civilisation as it is today has developed over a long period of time, although most of the changes that are affecting the environment have only occurred in the last few hundred years. The normal mode of operation is to keep on doing what has worked in the past, with some adaptation, but we are beginning to recognise some of the problems this approach is causing. This situation provides many challenges and opportunities for agricultural engineers to make a positive contribution to society. Many factors have influenced the views given in this paper, which is presented as a discussion point rather than as a technical, scientific paper.

IN THE BEGINNING

A long time ago, in what we call the early Stone Age (or even a bit before), human development began. It is not the purpose or intent of this paper to discuss when, how or why development commenced, but I can picture small tribes of people living in relative isolation just beginning to use knives, spears, fire and other tools. As individuals developed these primitive tools they were applying science, as it existed at that time, for the benefit of their society, so I would say that these individuals were the first engineers. Since most early tools were to assist in procuring food it could be argued that agricultural engineering was in fact the first branch of engineering to be practiced.

After some time tools improved and people were able to spend more time doing social things and less time simply surviving, so individuals began to specialise. There were not a lot of people, but occasionally the need to defend a productive piece of land from another tribe would lead to battles and it became necessary to move people and water around the countryside. The need for better weapons of offence and defence gave rise to a group of engineers who specialised in machinery and some of this expertise was also utilised in improving agricultural equipment. Less aggressive engineering types took up the more civil pursuits of developing water supply and transport systems, which were also applied to agriculture, and so the role of agricultural engineer largely fell to the artisans who developed farming equipment in blacksmith and carpentry shops.

I doubt if any of these individuals set out to change the world, each just made a small contribution to making life a little easier in response to the needs of their community.

Life at this stage was still fairly difficult and transport was slow and dangerous, so the world was regarded as big and wild and indestructible, to be subdued for humankinds benefit (Durning, 1997). The human footprint was small and the environment could cope with their efforts and effects, but today we can still find evidence of these early humans in localised areas.

THE INDUSTRIAL AGE

Development continued over a period of several millennia as a greater percentage of the population was freed from the task of food production by the efforts of farmers, engineers and scientists. Each advance made further progress easier in a snowball effect and improvements in medicine assisted population growth. Setbacks like the plagues that swept Europe did occur, but even these promoted some progress, in the form of better sanitation and sewer systems.

Money had been used for a long time to facilitate trade but the development of economics elevated money to the driving force of society. Because the earth appeared limitless in its ability to supply raw materials and absorb wastes an "extract, use, discard" mentality developed and it was a nice simplification to ignore "natural capital", concentrating only labour and capital costs (Prugh et al, 1995). This has led to a push for growth, which appears to create riches. This occurs since conventional economics does not take into account the environmental consequences, which are regarded as externalities.

With the development of steam power and then internal combustion engines using fossil fuels muscle power was replaced by machinery, freeing up even more of the growing population for pursuits other than agriculture. Machinery also greatly increased people's ability to alter the environment and began to cause changes in the atmosphere as carbon previously locked up in fossil fuels was released as carbon dioxide, smoke and other pollutants. Some perceptive individuals saw the consequences of this development but progress continued largely unabated, as most people retained the earlier worldview.

TODAY

Although worldviews are rarely recognised many people today have what Durning calls a "rear view mirror" worldview – they still regard the earth as an infinite resource for exploitation. I find this a bit hard to accept as planet earth's 6.1 billion human population has, on average, just 2.8 Ha of the total land surface each to provide all their water, food, fibre and fuel needs and to share with all the plants, animals, birds and insects of their local environment, as well as the fresh water and marine creatures. Hawken et al (1999) point out that productive land per capita has fallen from 5.7 Ha in 1900 to 1.5 Ha in 1999 (of which 0.4 Ha is arable) while the area of land to support an individual in an industrialised country has risen from 1 Ha in 1900 to 4 Ha in 1999, so we have gone from a surplus of 4.7 Ha per person to a deficit of 2.5 Ha per person in a century. A recent paper, "Tracking the Ecological Overshoot of the Human Economy" published in the Proceedings of the National Academy of Sciences, US, was reported in the press as estimating that humans worldwide are using resources at 120% of the capacity of the biosphere to regenerate those resources.

Faced with mounting environmental problems and considering facts about resource shares like those in the previous paragraph the "forward looking" world view must change to regarding the earth as a limited and fragile resource which must be carefully managed, not exploited for the benefit of the lucky few. A movement in this direction can be seen in the increasing emphasis on "reduce, reuse, recycle", interest in renewable energy and the desire to protect remaining wilderness. While items like "The Earth Charter" (2000) reflect the concerns of some people, many voices are still saying that growth is the answer to the worlds problems and promise that even more growth will provide the resources to save the environment.

THE FUTURE

Technologies currently available can halve input requirements and double outputs for some processes, the so called "Factor 4", and this sort of approach will need to be applied in many facets of human endeavour. Hawken gives examples of how technology available for some years has been applied in innovative ways in the automobile and building industries to give better performance for much less input and usually with similar capital cost and greatly reduced running costs.

It has been pointed out that the "doom and gloom" predictions of the 1970s have not come to pass, so some would say that the same will happen with current global warming and oil shortage forecasts. I think this is a "head in the sand" approach to the facts as it appears to me to be a question of when a major crisis occurs, not if. Incremental technological advances will delay the inevitable, as happened at the end of the last century, but it is time to look actively for more environmentally friendly ways of meeting ecologically sustainable needs if our children and grand children are going to inherit a pleasant place to live. The sooner large numbers of people start to make adjustments to lifestyle the more time we will have to develop workable systems, as each small improvement in the environment will delay the crunch point.

CONCLUSION

Agricultural engineers should adopt some of the emerging techniques to move away from linear "extract/use/discard" systems that overload the earth's ability to supply inputs and absorb outputs (which all join the waste stream sooner or later) to cyclic "reuse, recycle, reduce" systems that mimic natural systems as closely as possible and reduce reliance on fossil fuels. In many cases the new systems will be as productive as the more traditional systems, particularly when the reduced cost of inputs, reduced environmental impacts and the creation of rural employment are considered.

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