The future is not what it was: technological perspectives on the future of agriculture

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If we define technology, as UNESCO did in 1985, *as*

`the utilisation of tools, resources and systems to solve problems and to enhance control over the natural and made environment in an endeavour to improve the human condition'

then agriculture is itself technology.

More than that, it has been one of the most profound of human technologies in terms of its impact on human society and history. The neolithic revolution, embracing the domestication of wild crops and animals, the establishment of settled farming communities and, in time, the application of the plough, the yoke and the reaping hook freed human beings from the daily scramble for food.

Increased productivity generated an agricultural surplus, which in turn made possible the support of classes of artisans and intellectuals. The arts and sciences of civilisation could then begin to flourish.

The sophistication of agricultural technology has continued to increase over the millennia, though most rapidly in the present century. Of the wide range of innovations that have vastly enhanced the productivity of agriculture and associated rural industries, the following are worthy of mention:

- the application of powered vehicles for ploughing, planting, harvesting and for the transport of produce to market;
- an increasing diverse and precise battery of chemicals for a range of purposes including the delivery of such chemicals by aerial spraying;
- irrigation systems;
- barbed wire and steel fencing;
- the fruits of plant and animal genetics;
- power tools for activities like shearing; and
- even the use of computer systems to guide the farmer's actions.

We travelled so far along this road that in Australia the labours of only five per cent of the workforce now feeds the rest, with a large surplus available for export. In the last 50 or 60 years the powerful tool of scientific inquiry has been put at the disposal of agriculture. This had resulted in the solution of major problems impacting on plant and animal health, on yields from crops, on the control of populations of pests and similar impediments to ever rising productivity.

The bounty of the land has been bought at a price, namely that of significant environmental degradation. Unwise practices have resulted in salt damage to soils, depletion of soil fertility, loss of soil structure and, in many places, the loss of the soil itself through erosion by wind and water. Since the soil is the basis of all agriculture, such losses are tantamount to running down our capital base.

On the catalogue of unwise practices, consequences of the ease with which some of the technologies can be applied, are over-irrigation, with profound impacts on soil and stream salinity, and poorly targeted aerial spraying of weedicides and fertilisers. This results in waste of valuable resources and contamination of the surrounding environment. High on the list of needed improvements are technologies to deliver such chemicals precisely to where they are need and can be utilised.

The realisation that present agricultural technologies, for all their successes, cannot be applied into the indefinite future without severely constraining the capacity of future generations to feed themselves from the land has given rise to widespread debate over Ecologically Sustainable Development (ESD), where 'development' includes farming. ESD covers a range of interrelated issues, including those of

intergenerational and intragenerational equity, the maintenance of biodiversity and the need for a cautious approach to questions of risk, uncertainty and irreversibility.

For the present discussion, the key consideration is the extent to which technological change can ameliorate, rather than exacerbate, these problems. There is little doubt that in Australian agriculture, as in other spheres, unwise technological choices have been made, and unsuitable practices sustained. Wheat was grown in Australia for more than 100 years before scientific breeding produced strains suited to local conditions. Pastoral industries based on the use of cloven-hoofed animals have done great damage to our fragile soils.

Of the many technological options, some offer greater promise and relevance than others, and are therefore worthy of greater emphasis in research, development and commercialisation programs. Many are already present in Australian agriculture in embryonic forms. Among the many options are:

- biological and integrated pest control to reduce need for chemical agents with their substantial adverse impacts, including residues in food;
- the challenge of nitrogen fixation by non-legumes, to reduce the need for nitrogenous fertiliser and the environmental impacts that follow;
- the deployment of the full armory of genetic manipulation techniques to produce plant and animal species better attuned to both human and environmental needs in terms of yields, nutritional values, climatic tolerance and resistance to disease and pest attack;
- technologies such as the coating of seeds that can deliver agriculture chemicals precisely where need and in the right doses so minimising runoff and other forms of environmental contamination;
- the placing of 'alternative' farming methods such *as* 'organic farming' on a rational basis, to the extent that this is possible;
- approaches to animal nutrition than can both increase animal growth rates and reduce greenhouse gas emissions;
- new procedures and systems for irrigation that both conserve water and reduce salinity problems, and tillage technologies that minimise breakdown of soil structures and loss of vegetation cover;
- investigation of the markets for novel 'niche' crops, including those based around native plants, and of the principles underlying their profitable production;
- the increasing use of remote sensing for land management and the taking of crop inventories;
- the development of ever more precise and sophisticated management methods, including those based on expert systems, in a form suitable for use by rural operators;
- insights into the dynamics of major weather patterns such as the El Nino-Southern Oscillation phenomenon, so making possible meaningful and useful seasonal and yearly predictions of rainfall; and
- insights into rural restructuring that promote economies of scale in developing sustainability and promote vertical integration and value-adding processing.

The wise use of such technological options, as they emerge, can further enhance productivity within a framework of sustainability. To achieve the maximum results, attention must be given to the development of appropriate linkages between performers and end-users of research, and between the various sectors of the national research and development enterprise.

Better still, the research and development needs of rural industry should be placed within a broader framework of national objectives, and then funded in a manner which will deliver the maximum benefit to Australian society, environment and national growth. Such an approach is necessary if Australian agriculture is to thrive in the long term, and to continue to make its contribution to Australian wealth and well being. To achieve this, we will need to change our ways, and to ensure that 'the future is not what it was'.