Know More or Eat Less

PROFESSOR SIR JOHN MARSH

ABSTRACT

We face a truly challenging task to achieve an acceptable level of food security in the future. Food supplies have kept pace with, and at times and in places, outstripped an increase in population from 3 billion to 6 billion in fifty years. Not only has the amount of food kept pace but the quality of the diet has improved. Greater labour productivity on the farm has been possible because jobs that were once done within the farm boundary are now the business of external suppliers. Globally the most productive land is already in use and increased area, where it is possible, will not lead to proportionate increases in output. The food chain is a major user of fossil fuels and water. Contemporary farming can also damage water, soil, biodiversity and is a significant contributor to global warming. The CAP is still needed if non-market public goods are to be authentically taken into account as markets become open to competition but there is little sign of new thinking in the latest proposals. Globally policy failure exacerbates problems rather than relieves them. There is no reason to believe that we have reached the end of productivity increasing technology. If we are to benefit from investment in research we need applied scientists as well as those engaged in more fundamental, pure research. We also need means of bringing new technology into action. Our ability to capture and apply new science depends on society accepting changes that may be uncomfortable and to some seem potentially threatening. New technologies involve risks, some known and others not yet recognized, but less readily recognized are the risks involved in not taking action. Pressure groups, who claim to speak for the public, occupy an important place in assessing and interpreting new technology but they also have agendas of their own.

This is the transcript of the National Agricultural Lecture, given on the occasion of the Royal Agricultural Society of England President's Seminar and Awards Ceremony, held in London on 28th February 2012 (http://www.rase.org.uk/events/conferences/presidents-seminar/index.asp). Sir John received the National Agricultural Award for his services to agriculture at the ceremony. We are very grateful to the RASE for permission to reproduce this paper.

1. Introduction

When I went to University in 1952 food was rationed. We were accustomed to handing over the necessary coupons or a ration book that entitled us, or others on our behalf, to buy the food to which we were entitled. Shortly afterwards rationing came to an end. The initial response was not universal joy but a worry that governments were being irresponsible and we might no longer be assured of the essentials of life. Food security was not just a future issue or one for other people; it was a present practical concern.

When I retired in 1997 agricultural policy sought to limit EU production of cereals by set aside and of milk and sugar by quota. In addition to regulatory restraints on production we spent substantial sums on intervention and export subsidies. It seemed that unrestrained the industry would flood its markets, induce either a catastrophic price collapse or unsupportable budgetary cost.

Today public concern has turned full circle. In real terms food prices have risen, after a half-century of decline. Not long ago Defra minister's speeches highlighted 'sustainability'. Today this has been qualified by 'food security'. The focus is not just sustainable methods of production but increasingly the need for food and farming systems that will provide sustainable and adequate levels of consumption.

This lecture starts with a brief reminder of the extraordinary increase in agricultural productivity that has taken place in the past half-century. That appears to provide good reason to be optimistic about the future. The paper then outlines the multiple reasons for current anxieties. Finally, the paper argues that to enjoy a secure, sufficient and sustainable food supply, the global community must encourage scientific discovery and make careful use of existing and new technologies throughout the food chain; from the farm to the fork.

2. Past successes

The past half-century has witnessed an increase in the supply of food that has often exceeded the growth in demand leading to lower real prices. Food supplies have kept pace with, and at times and in places, outstripped an increase in population from 3 billion to 6 billion in fifty years. In Europe, where consumption per head is already more than needed to sustain health, both supply and demand have levelled off. In the most vulnerable developing countries demand has continued to increase.

Not only has the amount of food kept pace but the quality of the diet has improved. In the poorer countries the consumption of animal products per head has continued to rise although it remains far below that of Europe. Here, the share of livestock and livestock

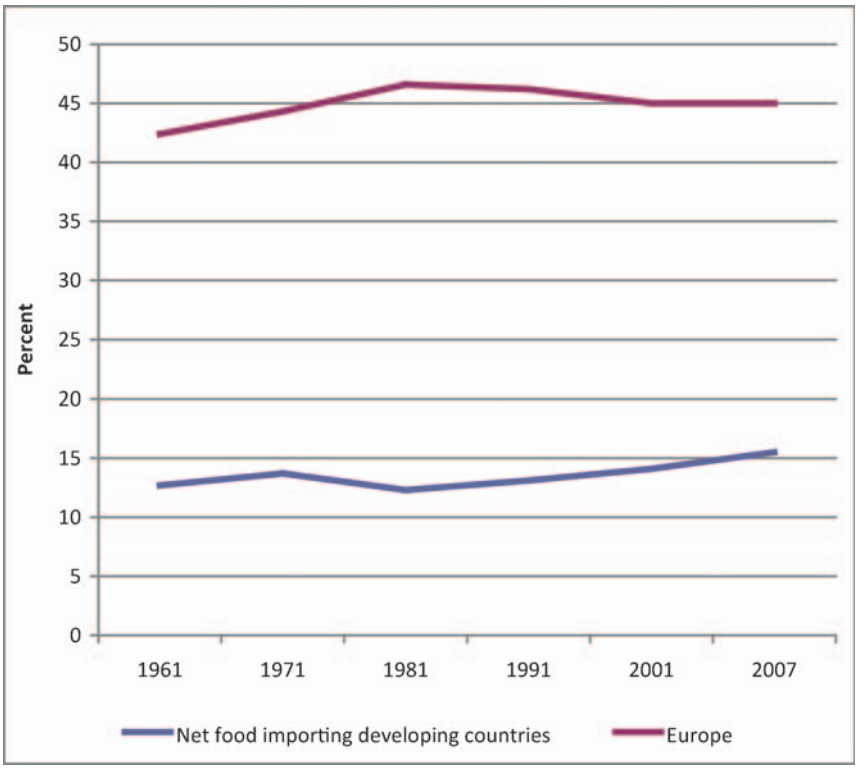

Figure 1: Percentage of Kg/capita/day from animal products
Source: FAO Production Yearbooks

products in total consumption has tended to level off at around 45 kg/cap/day.

Not only has production increased but, resources have been released from farming. A broad indication of the effect of this greater productivity is given by comparing the area of the UK that would have needed to have been planted to deliver the 2009 volume of output if we had only 1946/47 yields.

In the UK and most of the developed world this increase in production has been achieved despite a substantial decline in farm employment.

In the UK the hired labour force has fallen by some 80%. The number of full time farmers has also dropped and an increasing proportion of farms are now part time.

Greater labour productivity on the farm has been possible because jobs that were once done within the farm boundary are now the business of external suppliers. Farmers make use of machinery, fertilisers, purchased feed, pharmaceuticals and improved breeds of plants and animals that are the output of other specialist suppliers. Farm produce, when it leaves the farm gate, is increasingly processed into a diversity of food and other products and reaches consumers, for the most part, through large multiple supermarkets. To make sense of what happens on the farm we have to see it within the context of this larger food chain.

On a global scale, data for land use suggests that there is still a large share of the land area not used for farming. However the most productive land is already in

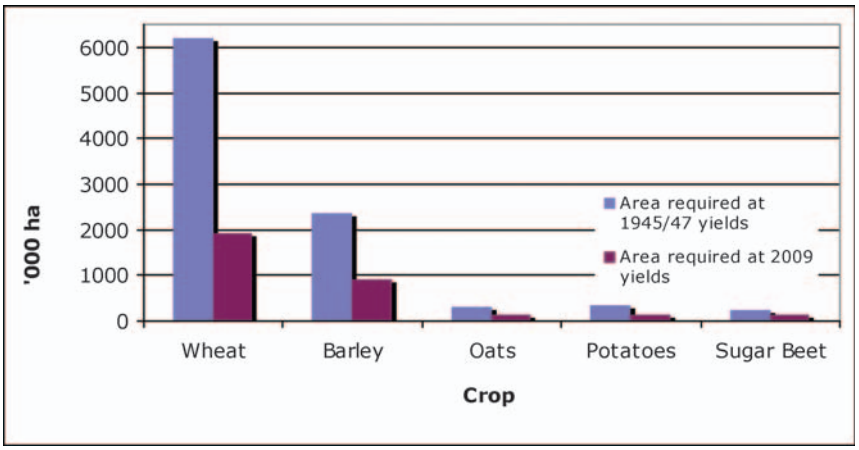

Figure 2: Area required to deliver 2009 levels of output at 1945/7 yields, UK.
Source: Author's calculations based on Annual Cereal Production Survey, Department for Environment, Food and Rural Affairs, UK.

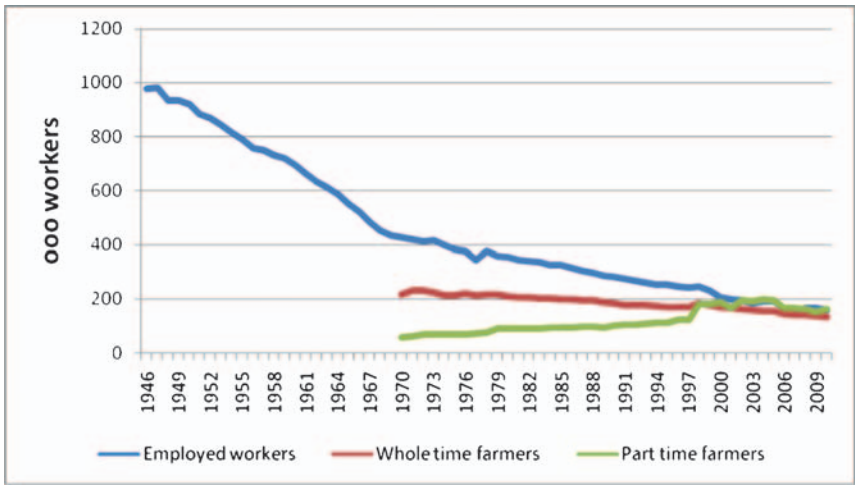

Figure 3: Decline in farm employment, United Kingdom
Source: Agriculture in the United Kingdom, Department for Environment, Food and Rural Affairs.

use and increased area, where it is possible, will not lead to proportionate increases in output. If unfarmed land is brought into cultivation, the environmental cost, in terms of lost forest area, lost habitat and managed water tables is substantial. Still relatively little of the land area recorded forest or grazed rough pasture is suited to more intensive use.

3. Nature's alarm signals

The size of the resource base

The function of farming is to give preference to plants and animals that are of greatest value. In recent decades the volume and value of output from a given area of land has grown through applying new science in a variety of technologies. These include genetic improvement and the use of fertiliser and animal feed. Competing species have been controlled by pesticides and herbicides. The productive potential of the industry has been enhanced by innovations outside agriculture including improved transport infrastructures and the use of IT, what is produced can be more tailored to a diversity of markets and delivered in good condition.

Such high levels of productivity depend upon resources that are non-renewable. The food chain is a major user of energy, mainly from fossil fuels. Growing demand for water for domestic and industrial purposes as well as to supply farm requirements, has already led to some streams running dry and aquifers being depleted at rates that exceed natural replenishment. Increasing production using present production systems will accelerate the decline in reserves of these non-renewable inputs. In resource terms the way we farm now is not sustainable.

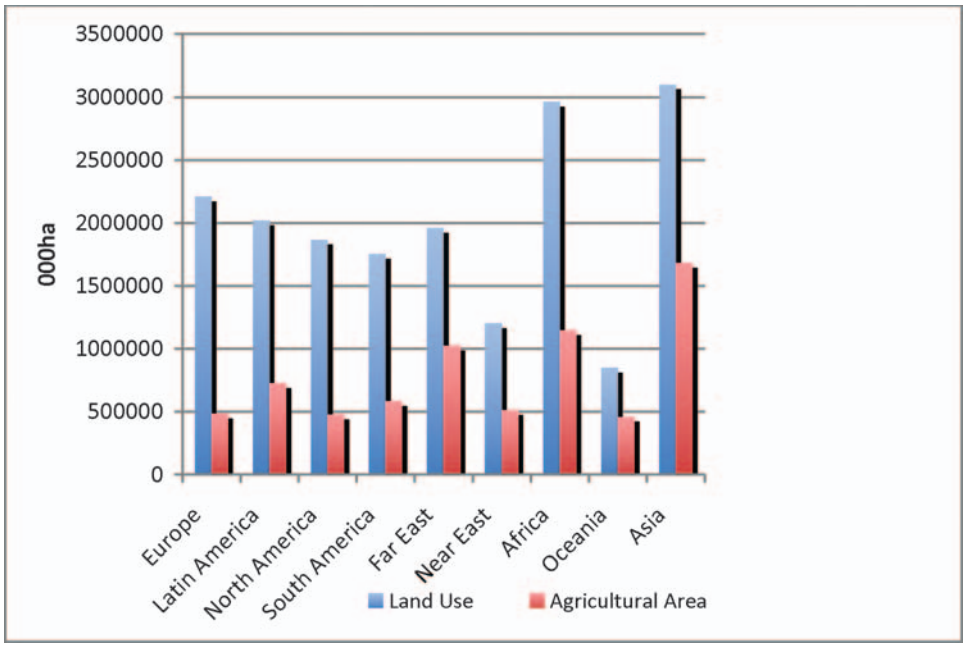

Figure 4: Percentage of land used for agriculture
Source: FAO Production Yearbooks

Damaged resources
Contemporary farming can also damage resources that it is not currently using. Water pollution from run-off fertiliser or animal waste damages aquatic life and imposes heavy clean-up costs on water companies. Inappropriate cultivation leads to soil loss and damages soil quality reducing productive potential. In extreme situations erosion can turn productive land into deserts.

Lost biodiversity
The success of farmers in giving preference to plants and animals that have economic value necessarily changes the underlying ecology of the farmed countryside. Giving preference to 'economic' plants implies lost biodiversity, competing species, both wild and cultivated, may decline below levels critical for survival of the species. Radical changes in habitat destabilise productive systems that traditionally renewed themselves over time. Changes in the balance of soil structure, insect life, plant nutrients and bacterial populations may not only reduce the interest of the farmed landscape but also undermine parts of the natural process upon which farm crops themselves depend.

Climate change
The consensus understanding is that temperatures, which have risen at unprecedented rates in recent years, will continue to rise. In part at least this is attributed to the release of greenhouse gases into the atmosphere as a result of human activity. Such changes will limit food production capacity in some of the major agricultural areas of the world. Agriculture is affected through higher temperatures and major changes in the amount and distribution of rainfall. It is itself a significant contributor to global warming. Attempts to mitigate climate change by limiting the emission of greenhouse gas have to include agriculture. Dairy and beef production are a major source of methane. The ploughing up of previously uncultivated land releases carbon into the atmosphere.

As well as being part of the problem agriculture can also be part of the solution. Plants, especially trees can remove carbon from the atmosphere and biofuels that replace fossil sources of energy help to restrict releases of CO_2.

Policies designed to minimise the release of greenhouse gases and to promote biofuels will condition the economic environment for farming during the coming decades. The impact on food production varies by region but at a global level it will make it more difficult to ensure that food production keeps pace with demand.

4. Social alarm signals

Population growth
Population, some 6 Billion at the turn of the century, is already 7 billion and expected to reach 9 billion by 2050. The increase is likely to be greatest in the poor countries of Africa and Asia where there is already no security of food supply for many people.

In richer countries growth stems more from increased life expectancy than from high levels of reproduction. Not only does a larger population have to be fed but it includes a greatly increased proportion of old people. Such people are vulnerable. They generally cannot generate income from continuing economic activity they impose increasing costs on the public sector for health, pension and welfare.

The impact of rising real incomes
The world's population is not only expected to grow but to become richer. Each generation looks forward to being better off than its predecessors. All governments are expected to foster 'economic growth'. Indeed when the rate of growth falters unemployment and regional inequities threaten social cohesion. Growth can facilitate new, more resource-conserving technologies and it has the capacity to uncover and develop new resources. Without new technology growth that stems from using existing systems more intensely will intensify the problems of resource scarcity.

Rising personal incomes also change the demand for food. Low incomes force people to rely on the cheapest forms of nutrition, mainly vegetable in origin. As incomes grow diet includes more meat and animal products. In terms of nutritional value, animal foods are much more resource intensive. Rising incomes, accommodated by developing technologies have accustomed consumers in rich countries to upgrade their diet by eating more meat. They expect all types of food to be available throughout the year. Processing and distribution systems use resources that simpler systems, where food consumption was more seasonal and local, did not. Whilst such changes may be regarded as 'improvements' in diet they increase the call on resources to feed a given population.

Richer communities also demand more land for activities other than food production. More is needed for housing and the infrastructure of roads and services. Often the land most suitable for development is also amongst the better cropping land. A more affluent and urban population also seeks to impose its views on how the land should be farmed. Farm production is increasingly constrained by a growing array of regulation.

Planning impacts on the freedom of action of farmers
In Sites of Special Scientific Interest, National Parks and Areas of Outstanding Natural Beauty farmers face more detailed requirements and the cost of infringing them may be considerable.

Public goods and private decisions
Traditionally the relationship between farmers and the community has been focused on the price of food and has been regarded as a contest between producers and consumers. Today that is no longer adequate. A richer and more mobile community is not prepared to leave the way in which food is produced to farmers. In addition to food the community benefits from a variety of public goods that are affected by the way land is farmed. These

include accessibility for leisure activities, landscape and the impact of land use on the control of flooding and water storage.

Concerns about food safety

These have led to greater interest in the provenance of food. Supermarket chains need to be sure that the food sold is safe. They seek products that conform to a tight specification, delivered to an agreed timetable and at low cost. They seek to serve market niches such as organic food, locally produced food and ethnic food. They reflect consumers' concerns about animal welfare and the environmental impact. Their purchasing policies substantially determine the shape of the market farmers face.

Apart from market pressures farming is also subject to legislation greatly influenced by concerns of non-farmers. Issues such as wildlife habitat, hunting, animal welfare and battery cages have been highlighted by pressure groups, most of whose members live in towns. Many farmers and country folk share the same concerns but are also aware of the impact of restrictions on farming practice on the viability of many farm businesses. Policies that add to costs but are not applied to competitors may diminish market share, and yet, because products are sourced from farmers in other countries, may simply export the problems they seek to resolve rather than remove them.

Landscapes especially in some of the more mountainous areas are seen as precious and vulnerable. They represent a recreational asset and provide a basis for rural tourism. They depend upon systems of hill cattle and sheep farming that offer low levels of reward to the producer. In response to market forces, younger members of farm families tend to move away and the system that generated the upland landscapes is imperilled. The survival of such systems depends upon income from other sources than the market for food.

5. Political Impotence

The textbook rationale of economic policy is that it exists to correct market failure. Market failure can arise because markets do not effectively relate demand to production. Markets fail where the accumulation of monopoly enables some part of the supply chain to increase profits by shutting out competitors. Where structural characteristics of the industry impede changes in response to new technology or changed markets there is a loss of real income to society as a whole. Market failure arises in agriculture for all these reasons but the most pressing, in recent discussion, has been the failure to value satisfactorily public goods and costs. They provide an orthodox and compelling justification for an agricultural policy that seeks to influence production decisions at each level of the food chain in terms of the entire costs and benefits that are involved.

The Common Agricultural Policy (CAP)

In practice we have the CAP; almost entirely a policy that has become the property of its clients. The economic benefit of the single market, which is the core achievement of the EU, is to allow competition to work. Since the initial member countries had different and generally highly protective agricultural policies the process of creating a single market needed to be phased in, if crises were to be avoided. A CAP is still needed if non-market public goods are to be authentically taken into account as markets become open to competition.

The initial policy resulted in a distribution of benefits between consumers and producers and among member countries that has become entrenched so that change was resisted even when the evidence that a new approach was needed was overwhelming. Throughout the life of the CAP economic growth, technological advance and the opening of world markets demanded sustained structural change if agriculture was to play its full part within the economy of the Union. In fact the policy has continued to support high cost, small scale farming under the label of the 'European Model of Agriculture'. The inability of the CAP to serve the common interest in Europe and to facilitate more internal and external competitiveness has been costly to the rest of the economy but has not removed poverty among farmers and farm workers in substantial areas of Europe.

There is little sign of new thinking in the latest proposals for 2014–20. The proposal to cap benefits to larger producers is yet another way of impeding the adaptation of more competitive systems. The whole business of attaching conditionality to single farm payments reeks of the costly dirigisme that keeps bureaucrats employed at considerable cost to the rest of us. The policy betrays the capacity of pressure groups that have no actual responsibility for running a farm, to influence the terms on which EU farmers operate in a negative manner.

The international dimension

Many of the threats to the world's ability to feed itself can only be credibly tackled on a global basis, not least the issues of energy; its supply, use and generation and the complex problems of living with and seeking to mitigate global warming. The record is not reassuring.

The Doha world trade talks seem to have run into the sand, despite the clear evidence that opening up markets has been one of the primary drivers in achieving real economic growth. Tangles of conflict between national interests and pressure group positions seem to have overwhelmed the important benefits that further moves towards freer trade can still offer.

Similarly international conferences on climate change are more powerful in their rhetoric than in their achievements. There is a deep asymmetry between the commitments made and the progress achieved. This may reflect the sheer magnitude of any effective attempt to reduce emissions in terms of its overall economic impact.

Again conceptually policy intervention seems to be the right way to cope with market failure but in practice, if effective action is not taken by all countries, policy failure may exacerbate problems rather than relieve them.

6. Knowing more

In the years following the Second World War government policy focused on increasing output by the development and application of new productivity increasing technology. In addition to public support for research, resources were deployed to encourage its uptake on farms, in part by subsidies on inputs and prices and in part by advisory services. Much of that machinery has now disappeared but the need to achieve its goals, through appropriate but different mechanisms, is equally pressing.

Reasons for hope

There is no reason to believe that we have reached the end of productivity increasing technology or that we have yet fully applied all we know. In many ways the potential seems greater now than it has ever done before. Today innovation results less from the efforts of extension agencies and much more in the course of trade. Seed breeding companies push forward varieties that perform better. Major developments in the genetic potential of farm animals are the product of specialist companies. Developments emerging from IT and the machinery world make possible precision farming. It is the retail sector that identifies and develops characteristics of products that consumers prefer and makes these preferences effective through linkages with farmers and farming groups.

Innovation on this scale can change the face of farming very rapidly. It is likely to give only secondary consideration to the impact on non-market values. This has become an important responsibility of government. Policy needs to ensure that considerations such as environmental impact and social consequences shape the decision framework within which commercial decisions are taken.

Applying known technology and adopting new methods demands of both government and industry a profound understanding of the processes and their impact on the natural and social environment. Sustaining the scientific capacity of both the industry and government becomes ever more important as the power of new methods to transform landscapes, habitats and the shape of the food and farming industries increases.

As scientific understanding grows it opens up fresh areas in which further research can lead to greater ability to manage the resources we have. At this level there are solid grounds for optimism. In several fields we stand at the threshold of new radical developments.

Developments in genetics have already enabled us to understand how inherited characteristics affect the health, growth and conformation of plants and animals. In doing so it not only enables us to recognise and cope with emerging problems but to breed resistant varieties. Using genetic markers we can be much more precise in securing the target characteristics we value. Using genetic modification we can tailor plants to cope with situations where traditional varieties would be unable to survive.

The development of nano-materials is at an early stage but offers potential for the more effective use of the resources we have in combatting disease and developing more efficient ways of using finite resources.

The development of IT has already changed the way we communicate, the systems we use to control processes and our ability to handle rapidly vast quantities of data. Scientific discovery in this area continues apace and its application into the things we use and the way we behave in our daily lives occurs at a pace many people find disconcerting.

Making use of scientific discovery demands an awareness both of the progress of science and of the world in which it is to be applied. In effect this translates science into technology. If we are to benefit from investment in research we need applied scientists as well as those engaged in more fundamental, pure research. We also need means of bringing new technology into action.

Much new technology becomes effective in agriculture in the form of new, improved inputs, whether of machines, seed or more productive breeding stock. Its application can sometimes take place within existing farming systems and requires no major changes in farming practice. However, much new technology can only be fully exploited by changes in the current structure. We have seen this in the changes in the farm labour force, the consistent move towards larger scale enterprises and the more tightly linked relationships between farmers and their suppliers and customers.

Such changes have impacts on society. In rural communities the pattern of employment has changed. The impact of large-scale arable farming has changed the face of the countryside in major producing areas. New crops appear with major impact on the seasonal appearance of the farmed landscape. New farming methods raise ethical questions about how we treat animals and the exclusion of non-competitive plants and animals. New science and the emergence of large scale animal production raise issues about the safety of food and raise concerns about the loss of variety in the diet as well as biodiversity in the countryside.

In practice our ability to capture and apply new science depends not only on the work of discovery and application to production but on society accepting changes that may be uncomfortable and to some seem potentially threatening. In understanding how such values develop and become powerful we need not only natural science but social science as well.

Facing up to risk

New technologies involve risks, some known and others not yet recognised. We can seek to understand the significance of known risks by calculations of probability. This may give an objective valuation but it may not lead to acceptance. Some risks may be very remote but their potential raises dread to such a level that a new technology will be rejected.

Less readily recognised but potentially of equal concern are the risks involved in not taking action. Reluctance to tolerate risk can waste opportunities to use resources more efficiently. It may also result in benefiting companies in other countries where the risks are accepted.

In such a situation it is important that there should be a monitor whom people trust. In the USA the Food and

Drug Administration seems to possess such authority. In the UK the Food Standards Agency should possess such a role but its advice is often contested by pressure groups that exercise substantial public credibility.

Putting new science into practice

The time span between committing resources to research varies but is often to be measured in decades rather than years. Thus under financial pressure cutting research is attractive – it appears to have little negative impact and makes the accounts look better. In the private sector competition can encourage research when business is good but lead to its abandonment in hard times. Maintaining continuing research, especially more fundamental research, depends heavily on public funding and on funding by private charities. Governments find it hard to fund research where the immediate benefit may be seen in larger profits of private companies. However if a gap is allowed to develop between discovery and application the substantial initial commitment may not deliver the benefits to which it can give rise.

Progress in science that leads to new technology also has to pass the test of public acceptability. It is reassuring that the research community now devotes substantial resources to communication. Pressure groups, who claim to speak for the public, occupy an important place in assessing and interpreting new technology but they also have agendas of their own. Fear is a powerful salesman used by both the media and pressure groups. Stories that all is well or that the risks are negligible are boring. Stories that discredit opposing views catch headlines and influence public judgements. Recent experience relating to climate change has shown how damaging it can be if scientists even appear to cover up information inconsistent with the view it is seeking to explain.

7. Making it happen

The purpose of this lecture has been to recognise that despite past achievements we face a truly challenging task to achieve an acceptable level of food security in the future. It is equally to suggest that there are solid reasons why, if we are prepared to invest in and apply new technology we should not achieve a secure supply of food during the coming century. To make it happen implies a readiness to change that affects every part of society. The discovery and application of new technology involves the whole food chain and the policy community.

Fundamental research makes radically new approaches that may solve old problems possible. The benefits will only be realised if its relevance is recognised. They become effective as they enter into the economic and environmental of business and government. One of the attractions of Agricultural Economics for me and many colleagues was that it was possible both to work in a university and be engaged with the actual issues of management and policy. We were not only concerned with elegant models but with helping government and business to make better decisions. The decline of state advisory systems and the impact of the Research Assessment process in universities have weakened this link. It is reassuring that the Research Councils have taken on board this need. It will however take time in many areas of science for applied science to be equally highly regarded with more fundamental studies.

Society derives benefit from discoveries that can make food production more sustainable only when they are implemented by industry. The market can reward farmers for innovation but this is only part of the benefit or the cost of change to society. This means that new methods often have to face a regulatory hurdle and may only be adopted if they pass the test of both commercial profitability and public acceptability. Attempting to make the social costs and benefits of industrial activity figure in private decisions is complex and controversial. To do so by legislation that reaches the stage of micromanagement of an industry is likely to be clumsy and prove costly. More may be achieved if in the process of disseminating new systems investors recognise the importance of such considerations and incorporate them into their plans.

The media play a major role in the public understanding and acceptance of new technology. It is a misfortune that recent history has been scarred by phrases such as ‘Frankenstein foods’ and promises of ‘miracle drugs’. Such hyperbole sells newspapers and attracts viewers but is deeply damaging to our society. The distortion of the debate that ensues delays and makes more costly technological improvements that may be vital for sustaining a secure food supply. It is good to be able to recognise many excellent science based television programmes that share not just ‘facts’ but convey the excitement and interest scientific endeavour.

In the formation of policy agricultural and food industries pressure groups play a vital role. The most effective engage in science as well as expressing views about science done elsewhere. Necessarily they exist to promote a particular view or interest. That will not matter if they operate within a science environment in which their views are robustly challenged. Part of the need for public investment in science is to enable government to take a balanced view of proposed innovation. If this is missing powerful pressure groups may exercise undue influence over the policy process.

The government has both to recognise the limits of what can be achieved by policy and to provide leadership in thinking about what policy can achieve. Freedom of action is increased where there is a common understanding of the issues. The recent publication on the Future of Food and Farming may not have offered new prescriptions but by focusing minds on the long-term significance current decisions it has enriched the debate on decisions that have to be made today.

From its birth the Royal Agricultural Society of England has had ‘Practice with Science’ as its major purpose. That has never been more needed than now. It is my privilege in this lecture to be able to emphasise its relevance and its contribution not just to the welfare of agriculture but for the whole of our global community.

About the author

Professor Sir John Marsh (john.marsh27@ntlworld.com), winner of the 2011 National Agricultural Award

of the Royal Agricultural Society of England, is an Emeritus Professor of the University of Reading. He was appointed a Research Economist in 1956 and became successively Lecturer and Reader in Agricultural Economics at the University of Reading. In the 1977 he was appointed Professor of Agricultural Economics in the University of Aberdeen and Chairman of the North of Scotland College Economics Group. Between 1984 and 1997 he was Professor of Agricultural Economics; Dean of the Faculty of Agriculture and Food 1986–1989, Head of the Agricultural Economics and Management Department 1985–1991 and Director of the Centre for Agricultural Strategy 1990–1997.

From 1969–1984 he was Secretary to the Agricultural Economics Society and its President in 1985–1986. He is an Honorary Fellow of the Royal Agricultural Society and a Fellow of the Institute of Biology. He is Chairman of the Council of RURAL, (the Society for the Responsible Use of Resources in Agriculture and on the Land), he is Chairman of the Board of the Centre for Dairy Information; a former governor of the Royal Agricultural College, Cirencester, and of the Scottish Crop Research Institute. He is the immediate past President of the British Institute of Agricultural Consultants (BIAC). He was Deputy Chairman of Defra's Science Advisory Council and has acted as specialist adviser to several parliamentary select committees. His academic interests include agricultural and food policy, the development of the common agricultural policy, and the role of research in economic development. He was awarded the CBE in June 1993 and Knighted in the Queen's Birthday Honours List in 1999.