Summary

There is the prospect of a global population of 9 billion by mid 21st Century. Rising real levels of income, growing constraints on food production from climate change and alternative land use together with an accelerating rate of consumption of non-renewable natural resources in all sectors are likely to restrict food production.

This has led commentators to say that the only way to feed the future population is a move towards sustainable intensification. However, this is more a description of a desirable goal than a means of securing it.

To explore the complex issues that arise it is useful to examine in more detail what is meant by sustainablity and intensity and how they are influenced by other factors.

What is Sustainability?

1. A sustainable economic system is one that can repeat its cycle of pro- duction an infinite number of times without any loss of output. Irrespective of the definition we use,the sustainability of the food and agricultural system depends upon the functioning of the economic and polit- ical system as a whole. The supply of food, fibre and biofuels involve a wide range of economic and ecological sys- tems. It depends not only on what is produced on farms but also the activi- ty of input industries that supply equipment, seeds, fertiliser and crop protection.

The performance of a wide range of downstream businesses from food and cloth processing to retailers and fast food outlets also influence sustainability. It involves, too, the behaviour of people in their homes, where a significant part of the food bought is wasted, and raw material costs for clothes and other consum- ables. To secure the resources needed to continue production businesses have to compete with other users of the same resources – for food this includes directly the demand for fuel, for urban land uses and for leisure activities.

2. Some relief may be found by using resources more efficiently. Within any system there is always scope for improvements that can add to output without any increase in the volume of inputs used. This process can result in a persistent increase in production without increasing the quantity of inputs used. Such improvements may postpone crises but cannot finally avoid them. Significant extension of the time before resource scarcity makes progress impossible depends not only on using current systems better but also on designing, across the whole food/farming system, new less resource consuming systems.

3. Inescapably some resources are fixed in supply so that no system that depends upon them can be regarded as sustainable. This would not matter if the fixed resource were sufficient to meet the needs of the system for mil- lennia ahead. If that were the case the issue would be of intellectual curiosity but no practical significance. Sadly the reality is that some of the resources upon which our society depends are not only fixed in supply but in danger of being exhausted.

Amongst these are fossil fuels, especially oil and min- eral fertilisers. Less prominent but equally constraining, is the ability of the natural eco-system to support the food producing systems that are involved. Concerns about bio-diversi- ty, about desertification and about the impact of changing climate indicate not only a loss of richness in eco-sys- tem services and the aesthetic values of the countryside but also of its capacity to support current levels of food production.

4. Known systems that do not depend on fixed resources deliver low output. Thus the impact of many earlier soci- eties and the Kalahari tribesmen of today on the environment may be minimal and their food system capable of producing current outputs indefi- nitely, as their use of land and natural resources allows these to be renewable and their system sustainable. However, the standard of living that results falls far short of that demanded by the majority of the world's popula- tion.

Intensification

1. Intensification implies a change in systems of production to increase overall output by using a resource that is limiting supply – often simplified to land – more productively. Economic systems tend to do this autonomously for resources that can be bought in the market. As a resource becomes scarce its price is forced up and people look for systems that will increase output by making more use of other sorts of resource – in effect seeking a new technology to deliver the same, more or better outputs without greater use of the limiting resource.

2. However, markets do not recognise the values of what cannot be traded to communities. There are 'external costs and benefits' that do not figure in the decision making process of busi- nesses as they commit resources to production. Such costs include not only matters such as impact on wildlife and landscape but also on the value to the communities that exist at remoter future dates of fixed resources con- sumed now.

Thus, for economic systems to optimise resource use for the community, users should face prices that represent social values as well as the clearing price in today's market place. This might include a value for environmental goods such as habitat and biodiversity. At this level some policy intervention via incentives, or regulation, becomes essential if an acceptable form of intensification is to be applied.

3. The politics are complicated. Intensive farm systems have a bad public press. The popular images are of densely housed animal systems with animals bred and fed solely to minimise the cost per unit of saleable out- put and arable fields drenched with pesticides and fertilisers devoid of any output and arable fields drenched with pesticides and fertilisers devoid of any wildlife.

The image includes distrust of the use of farm chemicals, whether as pesticides or fertiliser that 'force the land to deliver higher yields than are natural', with perceived adverse impacts on soil condition and on bio- diversity. It is therefore important to understand how intensification to secure the output needs of future gen- erations is to become acceptable.

In principle we can intensify the ways in which we use labour, land or capital. The resulting system will be more or less labour, land or capital intensive.

Labour

1. Farming systems that use a high proportion of labour in relation to other inputs are characterised by low levels of income. As economies grow opportunities for labour to earn more in other sectors tend to drive up its cost to farmers and lead to their exit from farming. Farming systems become less labour intensive. Output is maintained by increased use of capi- tal and bought in inputs.

2. Similar pressures exist throughout agricultural and food chains system; both manufacturers and retail food businesses have sought to increase their competitiveness by shedding workers. This is recorded in national statistics as a rise in labour productivi- ty. In the food service sector much of the business is done by

concerns that achieve low labour costs. The number of boutique businesses may multiply, partly to offer differentiated products to consumers and partly to provide an income generating activity for unem- ployed former workers. However they constitute a very small part of the total food system.

3. Even where real incomes are stag- nating there is often little scope to use more labour productively. Population increases in rural areas can result in an added burden the farm household has to carry and under employed workers tend to drift to urban areas in search of work.

Rising population implies that more labour will be available –- although it will include a growing number of old people who cannot cope with hard physical work. Attempts to substitute labour for capital, or purchased inputs, are likely to lead to a fall in production as crop protection and cultivation is less thorough by that means. Thus, although the real cost of manpower may fall, there is little prospect of greatly increasing output by making farming or its related industries more labour intensive.

Land

The purchase of land as an investment has often been justified in terms of 'they are not making any more of it'. In practice the land available for agri- culture declines as the demands of urban communities for housing, for transport and to sustain environmental and leisure needs grow. In a world of rising population and growing real income such pressures can only grow.

b. Even against this background there are situations in mountainous and hilly areas where land once used for farm- ing can no longer compete with the products of farms in more favoured areas. The failure of traditional systems creates problems for local communi- ties and in maintaining the traditional eco-services that such land use provid- ed.

c. The language can be confusing. Adopting productive systems that use more land in relation to other inputs, amounts to adopting more 'land intensive' system but this would be described by most people as moving towards extensive farming. In principle it could happen where the costs of converting unused, or little used land, to agricultural production were offset by the value of output. However, in most farming systems output can be expanded more certainly by applying more 'other' inputs to existing farmed land.

In parts of Brazil and on the margin of farming in areas elsewhere in the world there may be profit in taking land into farming. However, for this the full costs and benefits need to take full account of the social and environmental costs of converting land to agricultural production. These would often make such a move unprofitable.

d. In practical terms, whilst there may be scope for more land intensive sys- tems in some low productivity areas of the world, it is improbable that such changes could contribute significantly to the overall goal of systems that both feed the world and

are sustain- able.

Capital

Capital includes all the outputs of the economy that are not directly con- sumed or wasted. It is used in produc- ing other goods and services. It originates in the unconsumed part of total production so, as economies grow, the available capital increases. The amount of capital available at any time is determined by the level of income and the savings ratio. The higher they are the more capital is available for use in future productive activities.

b. Since it is useful, and always limited in supply, capital has a market price that represents the amount needed to compensate the recipients of income for not consuming all they receive in the current period and the risks they face in allowing other people to make use of their asset. Conventionally this is described as a rate of interest but in addition to the overt financial transactions, substantial amounts of capital are generated by farmers who set aside part of the current years output to provide seed or breeding stock for future use in pro- duction.

c. Capital takes an infinite variety of forms. It is embodied in buildings and machinery that may contribute to sev- eral cycles of production. As working capital it provides inputs such as feed or animal health and crop protection and used up in each cycle. It is embodied in the accumulated skills of all those engaged in production, ranging from those of the farm labourer to the director of research institutions and the CEOs of multinational compa- nies. This intellectual capital is embodied in the goods and services that are produced but it can be carried forward and developed through records and education.

d. As understanding of the fundamen- tal processes involved in production, both physical and social, grows, new ways of using capital to increase or improve the output derived from available resources aredeveloped. In a simplified view we can regard the capaci- ty of the food and farming system to sustain output as a race between the run down of fixed resources and the capacity of capital investment to improve the rate of yield of those resources that remain or to discover new resources.

In the past 200 years investment has hugely increased the productive capacity of the food, fibre, biofuels and farming systems but using systems that have resulted in a decelera- tion of the available supply of some fixed resources. In the process science has also converted some substances that were regarded as non-productive into resources that contribute greatly to current output.

Sustainable intensification is attain- able only in terms of injections of capi- tal that raise productivity at a rate equal to, or greater than, the declin- ing availability of fixed resources. Ultimately this process must be limit- ed, but it extends the ability of humanity to generate a sufficiency of food and other products from the resources that are available. Doomsday is postponed if not eliminated, or world population must decline.

Conclusions

The immediate task and major chal- lenge is to increase output from existing resources by applying known technologies more effectively. In developed countries there is a growing potential for ‘precision farming’, targeting both pesticides and fertilisers more accurately and breeding animals that generate a higher proportion of useful output in relation to the feed they consume.

In developing countries major improvements may be made by using techniques that can more profitably employ the available rural labour. Some of these may relate to the presentation and processing of crops not just to their production. Everywhere economic systems can be used to ensure a better match between consumer demand and the plans of producers.

These developments may ease the immediate problems of resource constraint but in the long run more radical changes will be needed if we are to exploit fully our capacity to cope with the challenges of finite resources and a seemingly unlimited growth of population.

The implication of this analysis is that if we want to turn sustainable intensification from a slogan to a practicality we have to focus on maintaining the flow of capital into innovation in the food, fibre and farming systems. Some of this is a matter for risk bearing entrepreneurs who have the capacity to accumulate the funds needed to invest and the courage to take the risks involved. Such entrepreneurs exist at all levels of the food and farming systems.

Our understanding and exploitation of basic physical, biological, ecological and social systems is a fundamental energiser of the production system. Improvements through research and development enable us to match more closely the uses we make of the resources we control to their value to consumers and society as a whole.

Those values include not only the market prices, but also the social costs and benefits.. The potential here is effec- tively limitless as each advance in knowledge prompts a deeper understanding and new questions.

Such advances can only be applied where there is effective communication. Those who control the use of resources, in government and the private sector need to be aware of what possibilities are emerging. The system of communication should also enable the public to understand the potential of the advances, so as to influence decisions in ways that reflect the true value of those advances. There is no easy solution.

History tells us of many cases where public hostility has frustrated progress, often fanned by the vested interests of companies or pressure groups. The press often seems to trivialise areas of conflicting views and uncertainty into a contest between

the ‘good guys’ and ‘ruthless predatory business men’. This has reduced its ability to act as an effective informer of the public and thus facilitate the attainment of sustainable integration.

If we are to make progress we need a communication system that is inclusive, that encourages new ideas and is more focused on truth than sensation.

Figures

Rows of bamboo canes support young tomato plants. This is rich agricultural land and is used for intensive farming.

1803

Professor Sir John Marsh

29th January 2018

Comments