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Agricultural Futures in England and Wales and Implications for the Environment

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Purpose

Agriculture in the UK and Europe as a whole is facing an uncertain future as the factors that have shaped it over the last 50 years are realigned in the face of changing priorities. In this context, this study explored possible future scenarios for agriculture in England and Wales through to 2050 in order to identify implications for the environment and possible policy interventions and research priorities to help promote sustainable agriculture.

Agriculture: Driving Factors are Realigned

Agriculture in the UK and Europe as a whole is experiencing unprecedented change as the drivers which have hitherto shaped the characteristics of the farming sector are realigned. How these factors, such as government policy, technology and international trade, will change in future is difficult to predict. Scanning the long term horizon for agriculture is useful if it can help us prepare for, and indeed influence, possible futures. A number of future scenarios for agriculture in England and Wales were explored[1] in order to identify features that might be of concern and actions that might be taken now to make the future, however it turns out, better than it otherwise might be.

How to Promote Sustainable Agriculture?

The specific objectives were to identify and explain:

(a) possible long term futures for agriculture in England and Wales,

(b) the implications of these outcomes for the environment, and

(c) policy interventions and research priorities to help promote sustainable agriculture.

In the process, a further objective was to develop a conceptual framework in which possible agricultural futures could be explored.

From Historical Analysis to Simulation Models of the Future

Figure 1 summarises the research method.

A review of trends over the last 50 years identified the main drivers, processes, outcomes and consequences of changes in agriculture in England and Wales. Drawing on this understanding, scenarios were constructed to span the range of possible alternative agricultural futures. The framework used by the UK Foresight Programme[2] was applied for this purpose, distinguishing futures in terms of social values and governance.

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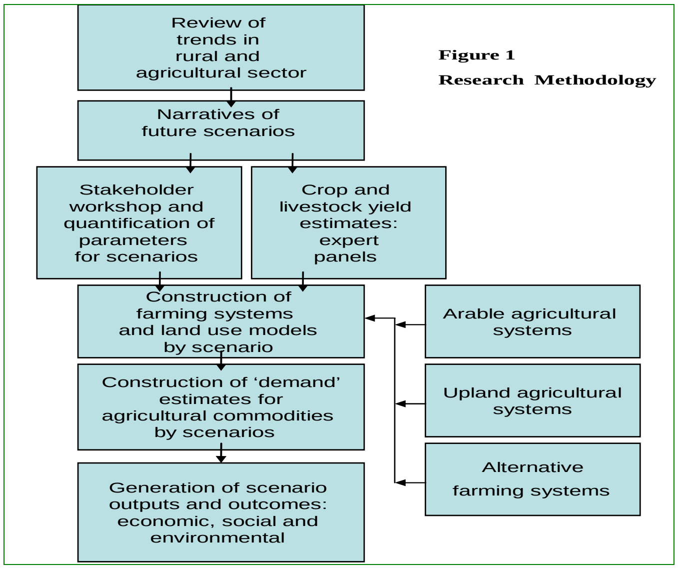


Figure 1: Research Methodology

These two dimensions produce four quadrants (Figure 2), each of which is a distinct scenario, namely: World Markets (WM), Global Sustainability (GS), National Enterprise (NE) and Local Stewardship (LS). A fifth scenario, Business as Usual (BAU), assumed a continuation of the trends apparent in 2002. Beginning with 2002 as the 'current' base year, the study set out to map these possible futures through to 2050.

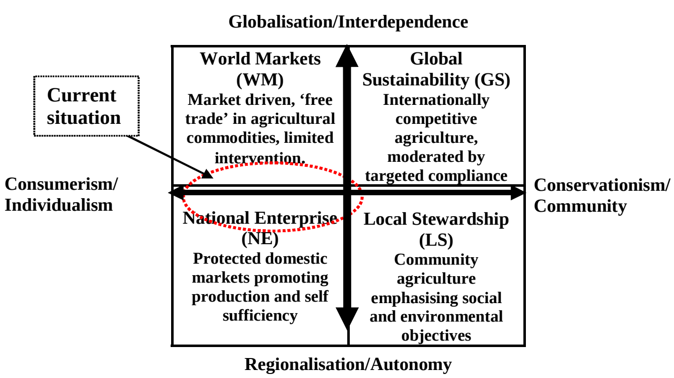


Figure 2: Agricultural Scenarios

A workshop, attended by 27 participants from major stakeholder groups, was held to derive values for indicators to represent the main differences amongst the scenarios, such as commodity prices, agricultural subsidies, farmer motivation and crop yields.

Estimates of long term future yields for crops and livestock were obtained in collaboration with researchers on a parallel project (Prediction of Yields into the 21st Century)[3].

The demand for agricultural commodities in England and Wales was estimated for each of the future scenarios through to 2050 according to assumptions regarding economic growth, population growth, consumer spending on food, changes in consumer preferences, production of bio-fuels and net import and exports of agricultural commodities. The impact of crop by-products on animal feed requirements was also considered.

As a result, the proportion of total domestic consumption supplied by producers in England and Wales was estimated.

Drawing on narratives and quantitative indicators, computer based models of farming systems were constructed: one model focused on relatively intensive crop and livestock systems for lowland farming, and another on extensive, mainly upland grassland. Estimates of regional land use required to produce the crop and livestock commodities referred to above were derived for each scenario through to 2050, as well as commodity prices (which balanced commodity demand and supply), farm incomes, employment and selected environment outcomes. Each scenario was then judged against current perceptions of sustainability to identify aspects of futures which might give rise to concern.

Results of Scenario Analysis

Separate estimates, subsequently aggregated, were derived for intensively farmed lowland areas and extensive grassland in mainly upland areas.

Lowland Intensive Farming

Table 1 shows the variation in selected indicator values for lowland farming for each scenario.

Agricultural Productivity – what makes it high or low?

Total agricultural production is highest for NE which promotes self-sufficiency through intensive farming. Prices and incomes obtained by farmers (and by implication prices for consumers) are highest where production is constrained to protect the environment, notably under GS and LS. Commodity prices are lowest under BAU, WM and NE, in the latter case probably calling for direct income support from Government, as was the case in the UK prior to accession to the EU.

	Weighted prodn	Weighted price	Nitrate leaching	B´grass herbicide	Soil erosion	N fertiliser	P fertiliser	K fertiliser	Water	Profit	Labour	Energy
Curr	100	100	100	100	100	100	100	100	100	100	100	100
WM	106	69	139	79	60	112	105	106	60	51	52	89
GS	134	183	135	126	92	126	119	116	85	124	90	107
NE	140	90	205	100	78	152	148	150	118	74	93	119
LS	109	248	108	102	98	104	106	108	138	130	109	99
BAU	118	60	138	81	96	110	111	108	70	63	71	95

Table 1: Relative Values of Selected Indicators by Scenario, 2050 (including energy crops)

How much land needs to be used?

Figure 3 shows the estimated proportion of land available for lowland agriculture occupied by relatively intensive farming under each scenario. Variations in land use amongst scenarios arise due to differences in future yields per hectare and in the total demand for home-grown agricultural commodities. Land required for intensive farming declines as a percentage of current land use under WM, BAU and NE (all with energy crops).

However, there is insufficient land to meet the demand for agricultural commodities including energy crops under GS and LS. Exclusion of energy crops reduces areas of intensive land use but there appears to be a shortage of land under the LS scenario.

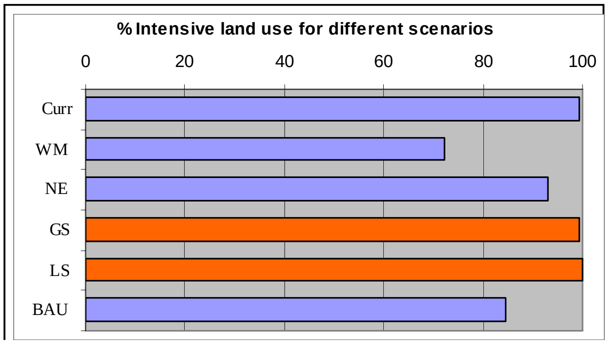


Figure 3: Lowland Land Use in England and Wales by Scenario, 2050

What about the environmental footprint?

The environmental 'footprint' of market driven scenarios such as WM and NE is moderated by the release of land from intensive farming which can be used for other purposes, such as extensive farming, nature conservation and forestry. However, where environmental requirements constrain yield potential, as with LS, there is pressure on land resources, and, in the absence of imports, food supply deficits could arise. Scenarios with 'surplus' land could support further extension of bio-fuel, but this is likely to increase pressure on marginal land.

Use of alternative technologies

An analysis of alternative technologies, namely, integrated crop management, alternative mechanisation, reduced tillage and genetically modified crops, showed that these methods can enhance profitability but vary in terms of environmental burden.

Extensive Grassland Farming

The disadvantaged uplands

Areas of land not suited to intensive arable and livestock farming because of conditions of soils, topography, altitude and related factors were treated as suitable for extensive grassland. Although they include some lowland areas, they mainly comprise areas designated as 'uplands' that are relatively disadvantaged. They are assumed to meet that part of the demand for domestic beef and sheep which cannot be met by land in the intensive lowland sector.

Effect of changes in stocking rates

Table 2 shows the estimated stocking rates in the uplands by region. Increased productivity results in reduced average upland stocking rates under most scenarios, particularly under WM, providing opportunity for restoration of natural vegetation and environmental gain. Under LS, however, a shortage of capacity in the lowlands increases pressure on the uplands, a theoretical doubling of upland stocking rates.

	Current (head/ha)	BAU	WM	GS	NE	LS	Current (head/ha)	BAU	WM	GS	NE	LS
	Beef						Sheep					
North East	0.64	140	56	61	110	253	3.5	78	70	102	172	128
North West	1.01	116	44	61	73	253	5.55	65	55	102	114	128
Yorks & Humber	0.92	128	51	61	103	253	5.05	72	64	102	160	128
East Midlands	0.77	114	61	63	76	261	4.21	64	77	105	119	132
West Midlands	1.45	130	53	61	73	253	7.92	73	66	102	114	128
Eastern	0.79	101	37	61	73	253	4.3	56	47	102	114	128
South East	0.65	101	37	61	73	253	3.54	56	47	102	114	128
South West	0.83	101	37	61	73	253	4.52	56	47	102	114	128
Wales	0.77	116	40	63	80	253	4.2	65	50	105	124	128

Table 2: Upland Stocking Rates (head/ha) of Beef Cattle and Sheep (expressed as index of current stocking) by Scenario, 2050

The effect of changes in stocking rates on upland vegetation and habitat was modelled. On this basis, WM and GS offer potential environmental gain compared to BAU, whereas LS reduces environmental quality due to increased stocking.

Employment scenarios

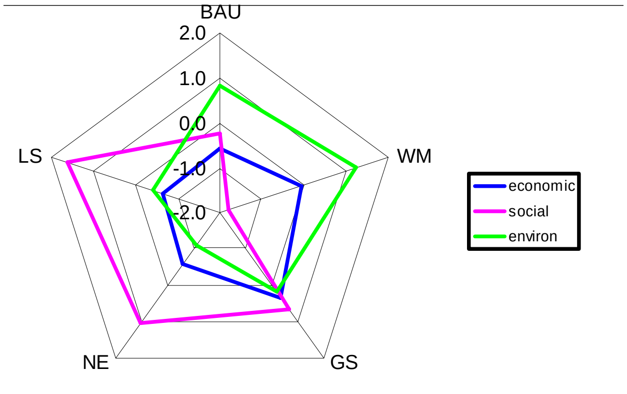
Labour employment in the uplands is affected in similar proportions to that of stocking rates, with large decreases under WM.

Sustainability Appraisal

The quantitative results of the analysis were used to assess the performance of alternative futures in terms of economic, social and environmental criteria (and related indicators) that reflect current views of sustainability, namely:

- **economic criteria** – income, value added, food security, subsidy dependence, food prices and production;
- **social criteria** – employment, support for rural, family farms and uplands, and social use of land;
- **environmental criteria** – use of fertiliser, pesticides, water, leaching, erosion and energy use, bioenergy production, biodiversity and upland pressure.

Figure 4 summarises the results of sustainability appraisal. For the assumptions made, overall economic performance does not vary greatly amongst scenarios. However, there is considerable variation in social performance due to differences in farm employment and incomes, especially in upland areas. There is also variation in environmental performance amongst scenarios. Those that release land from agriculture offer some aggregate environmental advantage, but burdens are likely to be high in intensively farmed areas. The LS scenario, though reducing the intensity of environmental effects, requires a much expanded farmed area, with increased pressure on marginal areas, including uplands.



Scores based on model outcomes, weighted by relative policy importance

Sce-nario	Eco-nomic	Social	Environ-mental	Aggregated with equal weight
BAU	-0.6	-0.2	0.8	**0.0**
WM	-0.1	-1.8	1.2	**-0.2**
GS	0.3	0.7	0.2	**0.4**
NE	-0.6	1.1	-1.1	**-0.2**
LS	-0.7	1.6	-0.4	**0.2**

Figure 4: Sustainability Appraisal of Future Agricultural Scenarios for England Wales, 2050

Farming Communities Endangered by Climate Change and Politics

Different agricultural futures appear to present common challenges for policy makers, namely: how to balance the various economic, social and environmental objectives under each scenario; how to reduce the environmental pressures of market oriented scenarios, and; how to improve the economic performance of environmentally benign ones. Given the strategic importance of food security and preventing the irreversible loss of natural assets, there is a need under all scenarios to reduce the potential vulnerability of rural areas and farming communities, including that associated with impacts of changes in global climatic and political conditions.

From a research perspective the study confirms the need for a better understanding of:

- the influence of policy, markets, technology and environmental (including climatic) change on rural land use and agricultural practices;
- the effect of land use, farming systems, technology, and farmer behaviour on the state of the rural environment and the various services it provides;
- the potential role of science, technology and farmer knowledge to enhance sustainability of farming;
- the economic and social consequences of possible futures that justify intervention.

The analysis confirms the need to continuously review the main purposes to be served by the farming sector, including food security, bioenergy, biodiversity and environmental services, livelihoods and public health. It confirms that policies are needed to integrate these multiple objectives, consistent with social preferences and styles of governance. Scenario analysis can inform strategic decisions made now by government and corporate organizations on issues such as technology development that are likely to prove beneficial under a range of possible futures.

This research has progressed the analysis of scenarios from descriptive narratives through to quantitative assessment. There is considerable scope to refine scenarios to capture the complex relationships between farming and the environment which operate on different spatial and temporal scales. Scenario analysis has the potential to support ongoing dialogue amongst key stakeholder groups, including farmers, food processors, regulators, policy makers, conservation managers and consumers, as they pursue individual and joint interests in sustainable futures.

Sources and References

- Morris, J. et al. (2005) Agricultural Futures and Implications for the Environment. Main Report, Technical Report and Supporting Appendices. Defra Research Project IS0209. Bedford: Cranfield University. Available at http://www.cranfield.ac.uk/sas/staff/publications/agfutures%20tech%20report%20final%20v2.pdf
- OST (2002) UK Foresight Futures 2020: Revised Scenarios and Guidance. London: Office of Science and Technology, Department for Trade and Industry.
- Sylvester-Bradley, R. and Wiseman, J. (eds.) (2005). Yields of Farmed Species, Constraints and Opportunities in the 21st Century. Nottingham: Nottingham University Press, UK. 651 pp.