arable area of the six member countries. In Sweden, current plans are to take 1 000 000 ha, approaching 30% of the arable acreage, out of production. All these changes suggest very strongly that primary plant production in the world is well able to meet man's needs and that land resources are available even in highly industrialized countries for further augmentation of output. I share the view expressed by Dr McMeekan in the Hammond Memorial Lecture (McMeekan, 1969) that the agricultural and animal production resources of the world are perfectly adequate to cope with foreseeable demands.

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The role of poultry

By W. BOLTON, *Agricultural Research Council Poultry Research Centre, West Mains Road, Edinburgh EH9 3JS*

Any paper which attempts to forecast the future is bound to be speculative and the author must be prepared to find that all his prophecies have been proved wrong. The best one can hope to do is to look at developments in the immediate past and use these as a factual basis for crystal-ball gazing.

The species of poultry used for the production of human food are the fowl, turkey,

duck, goose, guinea-fowl and quail. Of these, the fowl is used for egg and meat production and one can assess the values of these to the industry, but it is not possible to subdivide the other species. In the United Kingdom the yield to the industry is approximately:

	£ (millions)
Fowls, egg production	150
Fowls, broiler (meat) production	100
Turkeys	30
Ducks	8
Guinea-fowl plus quail	0·5

Fowl egg producers are subsidized by the Government and the British Egg Marketing Board (BEMB) is obliged to buy all eggs offered to it. The BEMB will be wound-up in 1971, after which date producers must make their own contracts with egg packers, and the subsidy will cease to be payable in 1974. The distribution of egg producers in 1968 in England and Wales is shown in Fig. 1 which shows that, except for the densely populated area in Lancashire and Cheshire, it is remarkably even. The corresponding distribution in Scotland is given in Fig. 2.

Fig. 1. Geographical distribution of laying hens in England and Wales, 1967 (one dot = 10 000 layers).

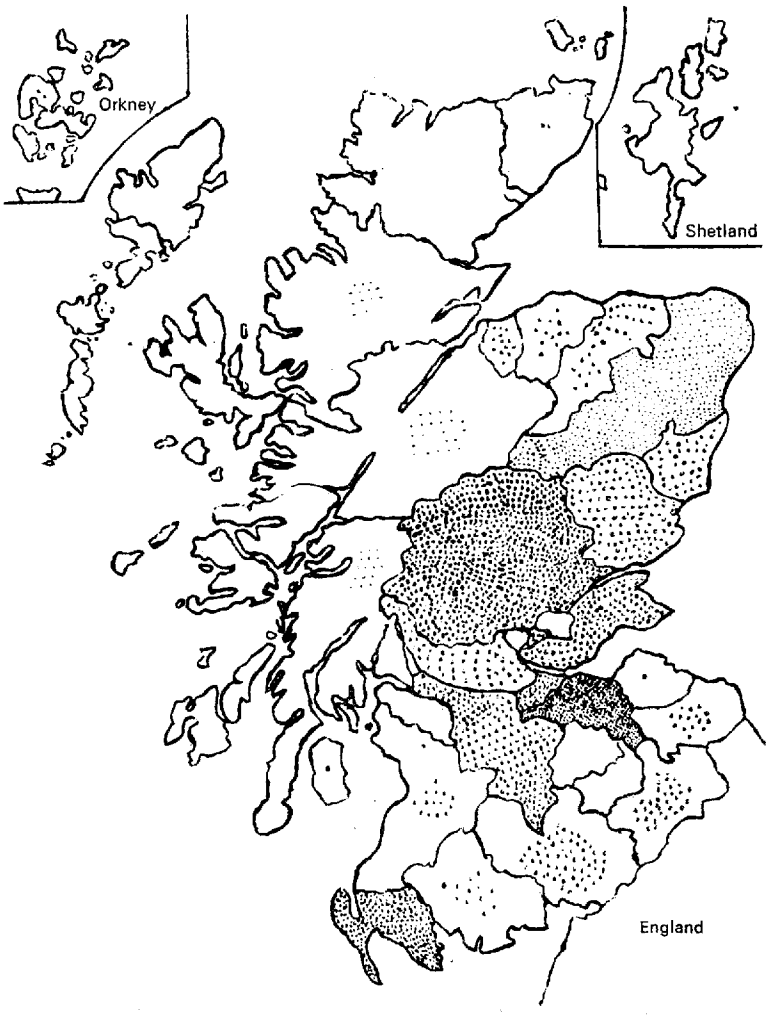

Fig. 2. Total fowls for producing eggs in Scotland, 1968 (one dot = 10 000 layers).

The other branches of the poultry industry are not subsidized and do not have a guaranteed market for their produce. The distributions of turkeys and broilers in England and Wales in 1968, given in Figs. 3 and 4, and for Scotland in Figs. 5 and 6, show that they are located in discrete areas.

At present, the production of fowl eggs exceeds the demand for shelled eggs, and some are broken out and sold as liquid or dried eggs. These egg products have a lower selling price than shelled eggs. It is probable that, after 1971, egg producers will be paid a stated price for a contracted number of first quality eggs with lower prices being paid for those in excess of the contract and penalties for under-supply. It is also probable that a realistic charge will be made for collection, it may well be based on distance from the packing station. Producers near a packing station and those who can spread the collection charge over a large number of eggs will tend to

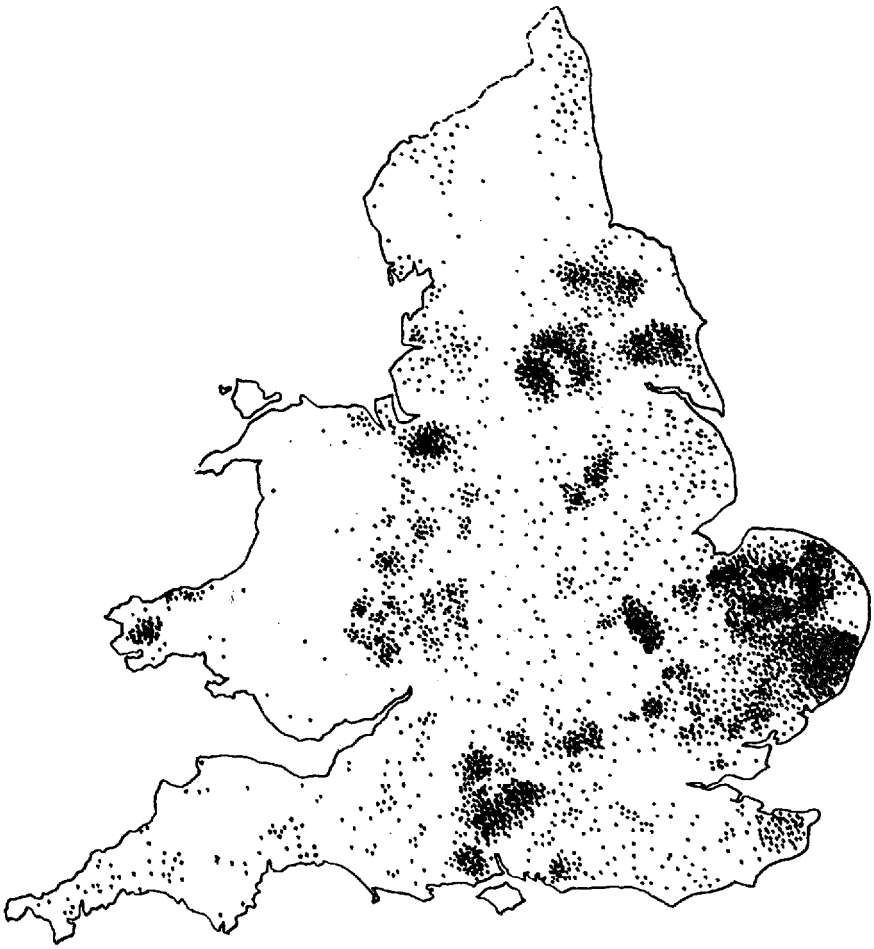

Fig. 3. Geographical distribution of turkeys in England and Wales, 1967 (one dot = 2000 turkeys).

survive; the others may be forced out of business and the pattern of egg production will approach that for broilers and turkeys.

Before the effects of these changes on egg production can be assessed, it is necessary to know the breakdown of egg production. In the spring issue of the BEMB Quarterly Bulletin for 1969, the distribution of the number of cases of eggs per producer sent to packing stations is shown as a percentage (Table 1). (One case contains 360 eggs.) Producers sending forty or more cases per week supplied just over half the total number of eggs. Comparison of these figures with the results from previous years shows that this group had increased from 44·5% in the previous year. It is probable that the process will be accelerated after 1971.

Other tables set out in the BEMB Quarterly Bulletins indicate that increasing numbers of birds are being housed in cages, the reduction being in the numbers on

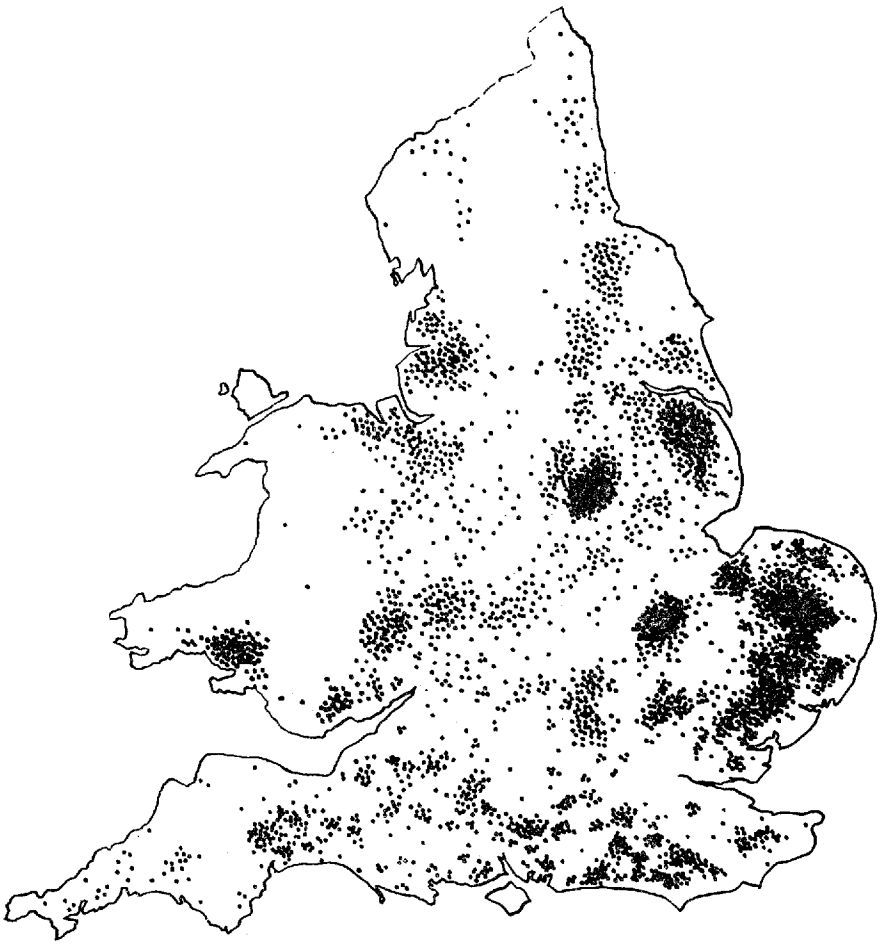

Fig. 4. Geographical distribution of broilers in England and Wales, 1967 (one dot = 50 000 broilers).

Table 1. *Proportion* (%) *of laying fowls by throughput size groups in* 1960, 1966 *and* 1968

Size of throughput (cases of 360 eggs/week)	1960	1966	1968
<1	31·9	10·4	7·7
1 to 6	47·6	22·6	14·3
6 to 40	20·5	30·1	27·5
>40		36·9	50·5
Total	100·0	100·0	100·0

Table 2. *Proportions* (%) *of laying fowls by system of management in* 1960, 1966 *and* 1968

System	1960	1966	1968
Battery	17·1	66·9	80·9
Deep litter	58·7	24·8	13·6
Free range	24·2	8·3	5·5
Total	100·0	100·0	100·0

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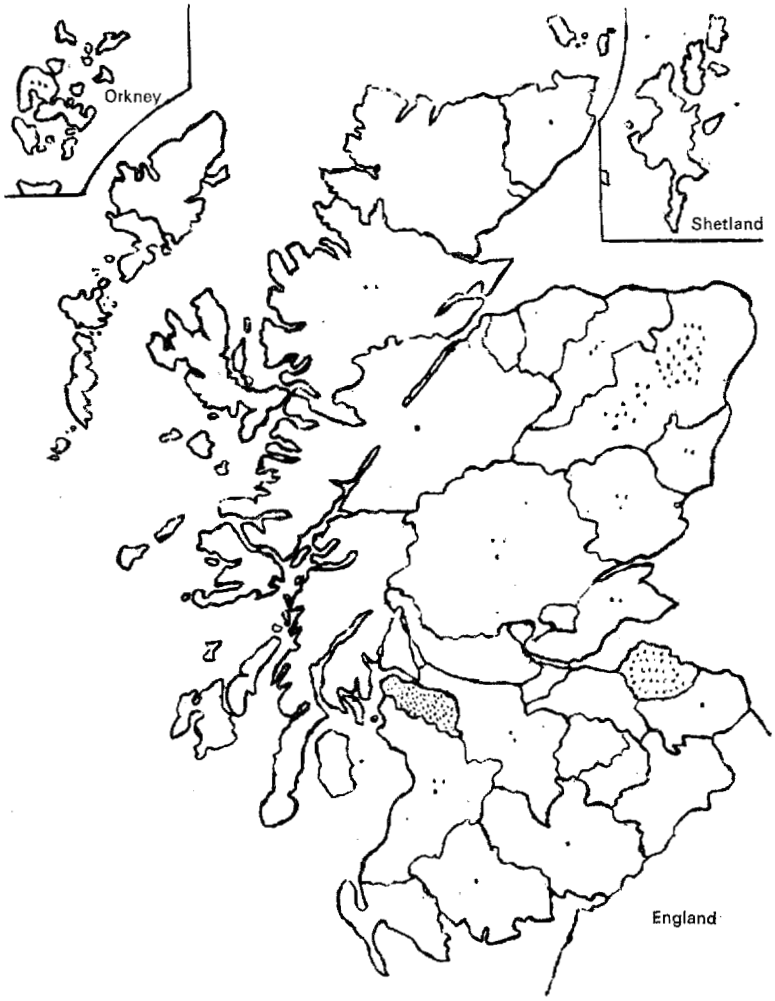

Fig. 5. Geographical distribution of turkeys in Scotland, 1968 (one dot = 1000 turkeys).

deep litter and not in those on free range (Table 2). This trend also seems likely to continue.

Poultry food comprises approximately (% by weight): cereals, 75; vegetable protein sources, 15; and animal protein sources, 7·5. Cereals and vegetable protein sources are also components of the human diet so, for 90% of their food, poultry are in direct competition with the human. The pessimistic view may well be that, unless the increase in the human population can be contained, sooner or later the poultry industry as we know it will become extinct.

The long-term survival of poultry as farm animals seems to be determined by whether or not a replacement for the energy-supplying part of the diet can be found. There are hopeful signs in this direction. The world is becoming deluged with paper, and paper is largely cellulose, a polymer of glucose. It seems feasible to hydrolyse used-paper into glucose and use the glucose as human and poultry food.

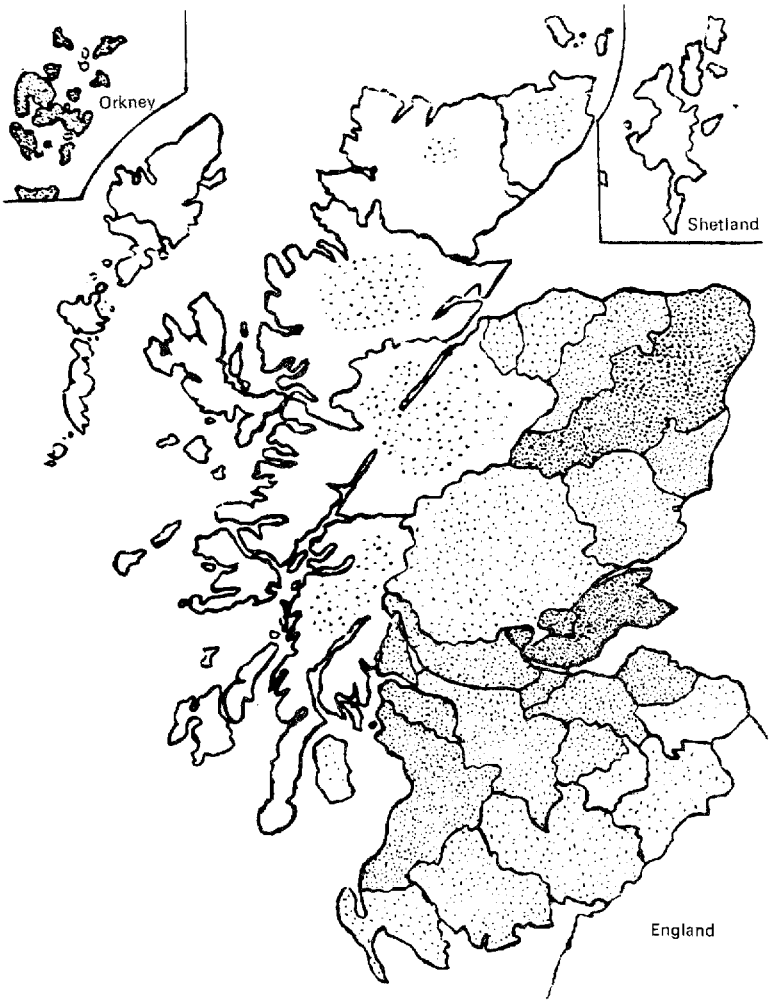

Fig. 6. Geographical distribution of broilers in Scotland, 1968 (one dot = 1000 broilers).

Fowls and turkeys are tropical species. Although they have been in the UK for hundreds of years, there are no wild flocks and it is apparent that they need the help of man to survive. In the past two decades, poultry have moved from living in the open with shelter at night to being maintained indoors from hatching onwards. It will be noted in Table 2 that 95% of laying fowls are now indoors; for broilers, the figure is 100%. Once birds are indoors it becomes possible to supply the heat they need for homeostasis from sources other than food, and work on this is in progress. It has been found that natural light is not necessary and, as it is more economical to heat a multistorey building than one built on a single plane, poultry houses of the future will probably be multistorey. Other possibilities are, below ground level, above other structures and on waste land. In countries where the outside temperatures are higher than those endured by the population of the UK, the amount of

heat needed would be less; it may be needed only at night when a heat pump could be used to supply it.

Ducks and geese are indigenous to the UK and, being waterfowl, could well be housed on or over the sea. In the UK, the problems of pollution seem to rule out housing them over lakes, although in the Far East, e.g. Thailand, ducks live on the ponds under the human's houses. The higher temperatures, herbage and herbivorous fish combine to maintain equilibrium in the ponds. At present, waterfowl form a small proportion of the poultry population. Two reasons for this spring to mind; duck eggs are associated in the public mind with digestive disorders, caused by *Salmonella* species, and the amount of edible meat on a duck or goose is less than that on a fowl or turkey of equal weight. As regards meat-production, there is sufficient genetic variability in the species to permit breeders to select for higher meat yields, as the small amount of selection which has been carried out has demonstrated.

It is true that *Salmonella* can be excreted in the duck egg but with modern intensive housing the chances of the duck becoming infected are about the same as those for the fowl. As egg producers, ducks have advantages over fowls. Fowls appear to have reached a plateau of egg production of about 270 eggs per bird per year; Khaki Campbell ducks can lay 300 eggs per bird per year. Breeding research should rapidly produce strains of ducks that could out-lay strains of fowls and the breakfast egg of the future may well be laid by a duck.

Fowls may also face competition, as producers of meat and eggs, from guinea-fowl and Japanese quail, respectively. Much has been said and written about the lack of flavour of broiler fowls, and attempts to add desirable flavours via the food have been unsuccessful. Guinea-fowls have a gamy taste akin to that of the pheasant or grouse. Until more is known about their nutrition and more work has been carried out on breeding them, it is likely that guinea-fowl will remain a luxury food. Japanese quail become sexually mature at 5 weeks, require much less space than a fowl and can produce twice the annual egg mass of good strains of laying fowl per unit of body-weight. Although quail eggs weigh only 9 g, this is equal to about 7% of the adult body-weight, for comparison, the eggs laid by a modern light body-weight strain of fowl represent about 3·5%. The cost of rearing the birds is therefore less than that of fowl, and the efficiency of conversion of food to eggs is higher. They should be regarded as serious competitors of the fowl in the not too distant future. Due to the low body-weight, the birds after lay would probably be disposed of by making them into a protein-rich poultry food.

In the poultry industry today the by-products are manure, dead birds, offal from poultry dressing stations and incubator refuse. A large proportion of all except the manure is being processed into a protein-rich animal food. It has been mentioned that egg producing units, which yield the most valuable manure, are likely to be found in more discrete areas than at present. Under these conditions, drying the manure to form a food for ruminants becomes practical and it is expected that this practice will increase. It is also likely that the other by-products will all be collected for processing into animal food. Poultry manure contains all the cellulose of the

original food and up to half the crude protein, mainly as urates. When dried, it has been found to be a useful food for ruminants. If cattle and sheep farmers can be persuaded to make the maximal use of this product, at least one of the poultry farmers' problems, that of manure disposal from birds in batteries, will be solved to the mutual benefit of both parties.

Replacement of part of the energy potential of food by external sources of heat was mentioned earlier. Such replacement would not affect the need of the bird for protein, vitamins or minerals. Whereas vitamins and minerals can be, and are today, supplied as pure substances, proteins are added as protein-rich supplements. When new sources of protein are developed, it is wise to make prolonged tests with animals before they are used as human food; for this reason, protein from organisms grown on oil residues is being used in poultry diets. Poultry are of particular value for such testing: their rate of reproduction is rapid, large numbers of offspring can be produced from one pair of parents, embryonic development can be followed without surgical operation on the dam, large numbers can be maintained in a small space and the initial cost per animal is low. Once a new source of protein has been shown to be free from adverse effects, it may well be many years before it becomes an accepted article in the human diet. During this time, poultry can be used to convert it into readily accepted products.

In developing countries, poultry have many advantages over other farm animals. There are very few bans on their consumption on ground of religion. Eggs are produced ready-wrapped and have a better shelf-life than meat and milk. The live animal can be carried home, thus keeping the meat fresh. The rate of reproduction is rapid, and one breeding hen can produce one hundred daughters in a year, thereby permitting a rapid spread of improved strains. Most of the developing countries are situated in the warmer regions of the globe, where housing can be extremely simple: a few posts, wire netting and some form of roof to provide shade. The success of domestic poultry keepers during the Second World War indicated that fowls can thrive on household scraps and a minimal amount of supplemental food, and that they do not need the modern-style houses to yield a reasonable number of eggs, yet they respond to good feeding, housing and management by increased growth rates and egg production. Throughout the ages men and women have indulged in personal adornment in which feathers have featured prominently; thus in New Guinea, poultry feathers, either naturally coloured or dyed, are being added to the head-dresses formerly made of bird-of-paradise plumes. Feathers are also used as lures when fishing and the fish offal can be used to feed the birds.

Despite the pessimistic view mentioned earlier, poultry, using the word in its true sense to include all farm-fed birds, seem to have a bright future. Changes in the industry will undoubtedly be necessary to meet changes in farm economics. The poultry industry, which coined the term agribusiness, pioneered internal integration; it will probably pioneer the fuller integration of livestock production that present technological and economic factors appear to make both possible and desirable.

I thank Dr R. Coles, Chief Poultry Officer of the National Agricultural Advisory

Service, for permission to publish the figures giving the geographical distributions of poultry in England and Wales, and Mr T. Whittle, West of Scotland Agriculture College, for permission to publish those relating to Scotland.

The future of animals as sources of human food

Pigs—whither?

By R. BRAUDE, *National Institute for Research in Dairying, Shinfield, Reading*

The production of food for man always has been, and always will remain, the biggest industry and also the biggest challenge to man's ingenuity.

Efficient animal production, with the emphasis on 'efficient' will remain an important integral part of agriculture, and I have no difficulty in foreseeing a rosy future for it, particularly for pig production. If the pig industry is capable and willing to exploit its potential to the utmost, then no other meat-producing animal, or bird and, most probably, none of the synthetic challengers (whenever they come) would be able to dislodge the pig from a dominating position.

On this occasion, I need only put forward the case for the pig, and can leave comparisons with other species to others. The tables which follow are self-explanatory and require only a few comments. Tables 1 to 6 are based on official sources.

In Table 1, information is given on the past, present and expected pig population in this country, as related to the human population. The prediction for the next two decades assumes that the increase in requirements caused by the increase in human population will be totally covered by home production. A small decline, 10% per decade, in imports of pork and pork products appears to me a desirable development. The arguments supporting it cannot be expanded here.

Table 1. *Human and pig populations (millions) in the United Kingdom*

Year	Human	Pig	
		Actual	Slaughtered per year
1934–8	46·8	4·6	
1958	51·7	6·5	
1968	55·0	7·8	12·5
1978*	57·5	9·2	14·7
1988*	60·0	10·7	17·1

*Assumptions for each decade: (1) to cover population increase of 250 000 per year; (2) to cover 10% increase in consumption of pork and pork products; (3) to cover 10% reduction in imports; (4) calculations of number of pigs slaughtered per year are based on proportion slaughtered in 1968.

In Table 2, the pig population in the United Kingdom is related to that in the world. It will be seen that during the last 30 years the world pig population increased at a faster rate than in the UK. It is expected that this trend will continue.