

LETTER TO THE EDITOR

Targets to increase food production: *One Health* implications

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The increasing world population means that there is a requirement to expand global food production. Looking at the Republic of Ireland as an example, the risks and opportunities associated with the expansion of food production are outlined, particularly in relation to zoonoses transmission. A *One Health* approach to sustainable food production is required to avert a potential public health problem associated with increased agricultural expansion.

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There is an unprecedented pressure being placed on the planet to sustain population growth (1) which brings associated challenges. When examining land use and trade off of ecosystem services (i.e. the outputs of the ecosystem from which people derive benefits), there is a balance to be struck in relation to food production and infectious disease mediation (2). The effects on land use and ecosystem services are likely to include increased pressures of agricultural intensification through stocking density of food-producing animals, maximisation of crop yields, and the replacement of semi-natural habitats with agricultural systems that almost exclusively focus on producing food while ignoring other ecosystem services, for example, infectious disease mediation, protection of biodiversity, or climate change regulation. It has been proposed that intensive food production systems that reduce biodiversity may facilitate the emergence and proliferation of zoonotic infections with a number of examples outlined by Jones et al. (3) including pathogenic *Escherichia coli* and *Cryptosporidium parvum*. The biodiversity dilution hypothesis appears to be context and zoonotic dependent as there is no consistent pattern across all pathogens and parasites (4, 5). However, the association of agricultural intensification, in conjunction with environmental change, with zoonotic disease emergence appears to be

consistent (3). The balance between food production and infectious disease mediation, as ecosystem services, within the *One Health* paradigm merits further discussion in the context of the pressures on current and future agricultural production systems.

The Republic of Ireland as an example

Many countries are seeking to increase agricultural output to meet the demands of increasing populations and ensure food security. The Republic of Ireland has documented ambitious targets to increase agricultural output in response to increasing global demands in a report published in 2010 called 'Food Harvest 2020: a vision for Irish agri-food and fisheries' (6). Agriculture is deeply imbedded in Irish society with the agri-food sector accounting for 7% of gross domestic product and it provides almost 7.7% of national employment. It is one of the few indigenous industries, and it has many social, environmental, and economic interactions; so any goals or aspirations around the industry have many externalities. Ireland is well placed to supply agricultural produce to other parts of the globe; currently agri-food provides 10% of Ireland's exports, but increasing output requires examination of the potential adverse consequences on animal and human health and on the environment.

The overarching aims outlined in ‘Harvest 2020’ are an efficient, environmentally sustainable production that delivers significant growth benefiting primary producers, processors, and the food manufacturing sector (6). There are a range of recommendations by sector. For example, the growth of beef sector relates to increasing the value of output by 20% while reducing greenhouse gas emissions. The dairy sector aims to increase output by 50% while reducing greenhouse gas emissions per litre of milk produced.

Risks and opportunities associated with expansion

The disease dynamics associated with different livestock production regimens around the globe differ. However, the situation that is facing the Republic of Ireland appears to reflect a complex disease pattern which creates hotspots for disease shifts as outlined by Perry et al. (7). *One Health* implications will result from the increased stocking rates associated with increasing the herd size of beef and dairy producers which will present challenges for disease control and for managing effluent. This will perhaps lead to greater regionalisation of production systems with increased likelihood of environmental degradation and could ultimately result in increased opportunity for zoonotic emergence (3). The expansion of dairy enterprises, which is undoubtedly well underway, will expose individual herds and consumers to a range of zoonotic infectious diseases. As the bovine population increases there is an associated risk of forward transmission of zoonotic *E. coli* pathotypes into the environment thus impacting public health. Another *One Health* related challenge that may emerge is antimicrobial resistance which is already present in domestic, domiciliated, and sylvatic ecosystems. There are some clear opportunities associated with realising the aims the ‘Harvest 2020’ documents along with associated externalities. These include potential economic returns and increased production efficiencies, which are possible, while maintaining and enhancing food quality and animal welfare standards (8), provided people are cognisant of the risks associated with expansion.

The way forward

The fact that human health is directly related to all the actions concerning the health of food-producing animals has been described (9). However, the model described by Wall 2014 (9) does not adequately consider the role that the environment, a component of the *One Health* paradigm, plays in animal disease mediation nor does the model account for the interaction of food-producing animals and wildlife. The adoption of some of the following *One Health* principals is essential if the aspirations of ‘Harvest 2020’ are to be realised without any negative consequences:

- 1) Interdisciplinary applications of veterinary public health and animal husbandry (9).

- 2) An understanding of ecosystem services within livestock farming systems (10), particularly the trade off between food production and infectious disease mediation (2).
- 3) An integrated approach for the development of grass-based livestock productions systems which adopts the principle that animal performance is dependent on multiple factors, including key biodiversity components and the environment (11).
- 4) Surveillance for pathogens of importance to animal and human health with the ability to rapidly detect the emergence of a new organism.
- 5) A systems-based approach to decision making designed to maintain commercial sustainability of the sector whilst protecting animal, environmental, and public health.
- 6) Effective communication to all stakeholders, particularly those in agricultural production, of the merits of sustainable production in the long term (11).

To understand some of the risks associated with increased food production systems, a *One Health* research agenda is required to address the dynamics between pathogens/parasite interacting at the wildlife–livestock–human interface which is based on the biological, ecological, economic, and social drivers of disease emergence (3). The challenge in the Republic of Ireland is to develop sustainable agricultural production systems that diminish emerging infectious disease risks while meeting the food demand, protecting human health, and conserving biodiversity and other environmental ecosystem services. In conclusion, this food-producing nation needs to adopt a *One Health* approach agricultural production in order to avert a potential public health problem.

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