Development of the Teagasc Pig Production Model

TEAGASC researchers have developed the first bio-economic model for pig production in Ireland, as a decision tool to aid farmers in decision making.

Bio-economic models describe the links between the components of economic and biological processes. They are used as tools to predict and understand system behaviour by investigating such links. Several models have been developed for pig production systems in countries such as Australia, France and Belgium; however, due to different structural and procedural practices between countries, it is important to develop a bio-economic model that is capable of simulating the particular Irish pig production and market conditions.

The pig industry is the third most important Irish agri-food sector, after dairy and beef, accounting for 8% of gross agricultural output.

There are around 290 commercial farms in Ireland, and the pig population is estimated at c.1.6 million pigs, including 149,900 breeding sows. This article describes the development of the Teagasc Pig Production Model (TPPM), the first bio-economic simulation model for farrow-to-finish Irish pig farms. The TPPM allows realistic scenarios to be tested before implementation, and thus we expect that it will be used as a decision tool in different aspects of production such as investment, nutrition, welfare and health.

TPPM development

The TPPM simulates the biological and economic performance of a farrow-to-finish commercial pig farm with weekly farrowing batches. To build the model, real Irish data was obtained from multiple sources including the Teagasc eProfit Monitor (ePM), Teagasc research data, and input from members of the Teagasc pig advisory team. The model simulates, on a weekly basis, the annual production of a farm. The model consists of a series of inputs (**Figure 1**), including biological parameters such as herd size, conception and farrowing rate, number of litters/sow/year, number of piglets born alive per litter, and mortality rate for each production stage.

Also, as feed costs represent over 70% of production costs, nutrition was considered the main engine for the model. A growth curve was provided for the model, and net energy and standard ileal digestible lysine requirements, as well as feed intake, were calculated for each production stage based on the estimated weekly bodyweight. Additionally, the model has a built-in least cost feed formulator, which is used to formulate wheat- and barley-based diets with nutritional values appropriate for Irish pig diets. Information on reproduction (e.g., number of services and number of boars for heat detection), labour (e.g., number of employees and number of hours worked per week), infrastructure (number of spaces per stage, energy usage, manure handling, etc.), and income (e.g., finisher and culled sow sales), and their associated costs, are also inputs for the TPPM. These inputs are used to calculate physical outputs (e.g., feed usage and number of pigs slaughtered), and financial outputs (e.g., annual cash flow, profit and loss account, and a balance sheet) (**Figure 1**). Net profit is calculated on a total farm basis, as well as per pig produced and per kg of carcass sold.

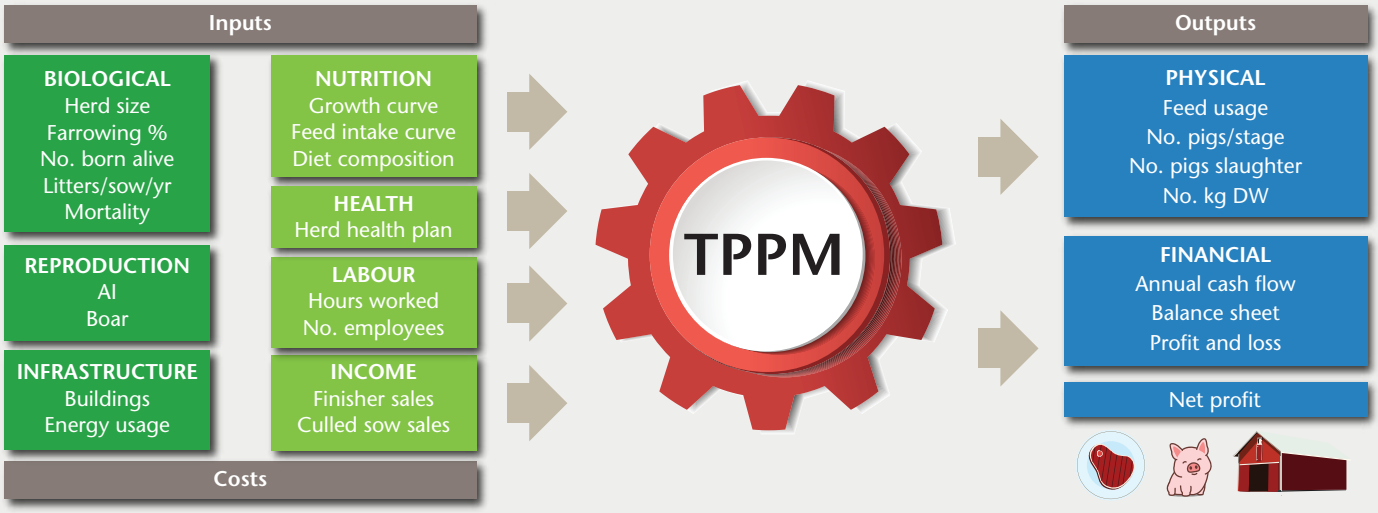

FIGURE 1: Inputs and outputs of the Teagasc Pig Production Model (TPPM).

TPPM validation

Two methods were used to validate the input values used in the TPPM. First, a group of experts (i.e., pig advisors and researchers) evaluated the methodology and values used for the model. Once the experts agreed, a second validation was carried out by comparing TPPM outputs with real farm data from 20 anonymous farms with complete records (e.g., production parameters and financial receipts) from the Teagasc pig ePM. Average biological parameters were calculated using 2016 data for the 20 ePM farms, and used to simulate a farm. Then, results from the simulation were compared to the average performance of the 20 ePM farms. Results from the validation using actual data showed the capabilities of the TPPM to realistically represent Irish pig farms. Physical outputs were almost identical between the TPPM and ePM farms; however, the TPPM produced 1,154 more pigs than the mean number of pigs sold from the 20 ePM farms. This discrepancy likely arose because the animals sold during the first five to six months of the year from the 20 ePM farms were born in the previous year (i.e., 2015), where annual mean number of litters produced per sow per year and number of piglets born alive per litter were lower than in 2016. The TPPM simulated lower variable costs, mainly due to costs associated with gestating and lactating sow feed. Feed usage was similar but the price per tonne for the sow diets formulated within the TPPM was cheaper than the prices reported by the ePM farms. It is possible that farmers provide nutrient values greater than those specified in the National Research Council (NRC) (2012), thereby increasing feed prices. Non-feed variable costs were greater for the TPPM than the average of the 20 ePM farms, mostly due to the on-farm replacement gilts cost, which is not recorded on the ePM system. Income per pig predicted by the TPPM (€27.5) was also similar to the average income per pig of the ePM farm (€27.5 ± 12.45).

TPPM future uses

TPPM simulated results could be used to facilitate decision making to address the challenges that Irish pig farmers face on a daily basis. It is expected that future uses of the TPPM will include investigation of the impact of weaner-finisher diets with different nutrient specifications, and the impact of respiratory diseases such as porcine reproductive and respiratory syndrome and swine influenza on farm performance and profit.

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Reference

National Research Council. (2012). 'Nutrient requirements of swine.' National Academies Press.

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