the risk σ_i has a small value, the range around the mean E_i will be small and the real value of the stochastic variable $Ri(t)$ will be close to the mean E_i. This will benefit the quantification of the real value and its prediction for the case of decision making in farm management. In the opposite case, if the risk σ_i is a large value, it means that the real value of the stochastic parameter can vary in a wide range around the mean E_i, and the value $R_i(t)$ can be considered to be higher or lower than the estimated mean E_i. This case is not favourable for the management of the farm, since it is determined that there is a significant risk in the use of this variable in management. The real level of this parameter $R_i(t)$ can be in the range $[E_i\text{-}\sigma_i, E_i+\sigma_i]$, which in the case of high risk σ_i can be significantly different from the mean E_i.

The formal analytical relations for describing the mean value and the risk of a stochastic variable are performed with linear and quadratic relations. For a set of N random variables $R_i(t)$, their values are recorded in a discrete set of sequences of n values in time,

$$R_1 = [R_1^{(1)}, R_1^{(2)}, \ldots, R_1^{(n)}]$$
$$\ldots.$$
$$R_N = [R_N^{(1)}, R_N^{(2)}, \ldots, R_N^{(n)}]. \quad (1)$$

These records make it possible to estimate the mean value E_i of the N variables for this time interval 1÷n and the corresponding deviations σ_i^2.

$$E_i = \frac{1}{n}\sum_{k=1}^{n} R_i^{(k)}$$
$$\sigma_i^2 = \frac{1}{n}\sum_{k=1}^{n} (E_i - R_i^{(k)})^2, i = 1 \ldots N. \quad (2)$$

In this way, the risk of the stochastic variable $R_i(t)$ is estimated numerically as the standard deviation σ_i.

Another form of risk quantification is provided by the inequality of probabilities, which is applied with the Value at Risk (VaR) parameter [50]. VaR quantifies the level of risk in terms of the maximum probable loss [47]. There is an attempt to apply the VaR form of risk to resource allocation [51, 52]. The quantification of risk in the formal definition of VaR is applied in supply chain networks [53]. The estimation and use of the VaR formalisation is accepted as a promising way to manage risk [51].

The formal representation of VaR is shown by the density function of the risk index, which represents the return and loss variable in farm management. The positive value of the portfolio return is the farm management profit and the negative value is the loss [54].

The formal models discussed are applied from portfolio theory. This provides a basis for applying this theory to farm management decision making. The aim is to maximise return and minimise risk. The application of elements of portfolio theory can be found in [48], where the components of the portfolio are applied to inventory policy. In particular, risk in the form of VaR is formalised in terms of probabilistic relations. Such a probabilistic form of risk is used in [55] for decision making in inventory control in farm management. In [53], the VaR parameter is used to quantify the risk in the allocation of resources on a farm.

CONCLUSION

The EU's role in mitigating climate change in agriculture is crucial, as it sets environmental standards and co-finances most Member States' agricultural spending.

Ongoing technological development and validation of theoretical aspects and prototypes are contributing to the creation of diagnostic tools for PLF that can detect on-farm problems without manipulating animals (non-contact and non-invasive data collection) or inducing stress, providing the opportunity for early detection of disease outbreaks. In this context, the benefits to farmers include improved decision making, increased interest in the sector among young farmers, and a positive impact on overcoming problems and gaps with the end user by transforming raw data into useful information that can currently only be obtained through expert analysis and interpretation.

This paper reviews and analyses the environmental impacts of current livestock management practices and highlights the critical role of PLF in ensuring the effective application of existing and new information on farms as a potential avenue for reducing environmental impact issues and risks. Strategies and methods to reduce environmental risk situations are considered. Solutions are proposed with an emphasis on PLF as a useful monitoring tool in this regard.

Quantitative risk analysis models based on portfolio theory are proposed. Subsequently, the research will focus on the application of these models to achieve optimal production and environmental performance by minimizing risk situations at agricultural sites.

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