ECONOSCITECH INTEGRATION

ISSUE 8

INTERNATIONAL SCIENTIFIC ELECTRONIC JOURNAL

TSUE TASHKENT STATE UNIVERSITY OF ECONOMICS

American University of Technology
Powered by Arizona State University®

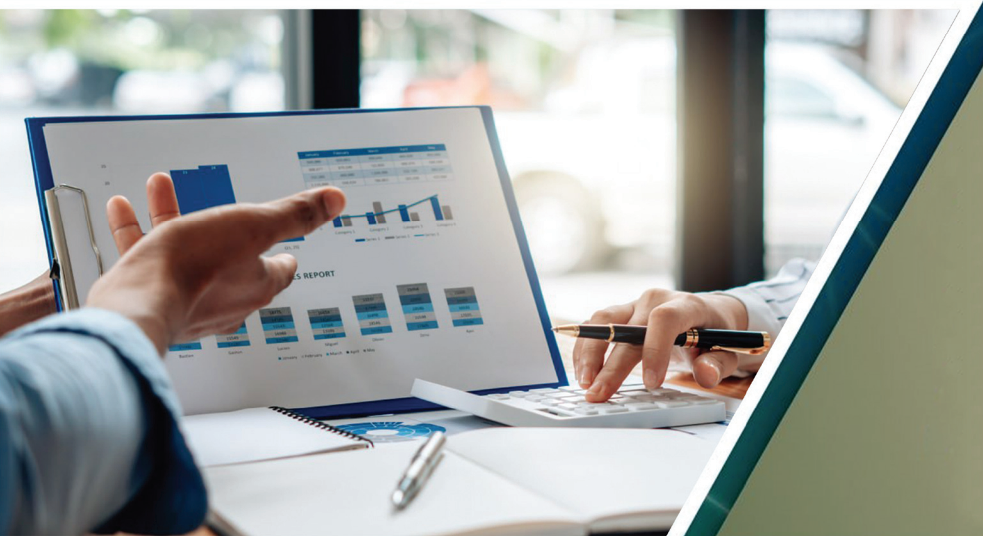
ISSN: 3060-5075

Acceptance of articles

PUBLISHED EVERY MONTHLY

ARTICLE CONTRIBUTORS

PROFESSORS-TEACHERS, SPECIALISTS AND SCIENTIFIC RESEARCHERS.



Google scholar

OpenAIRE

ISSN INTERNATIONAL STANDARD SERIAL NUMBER DENMARK

CONTACT: +998 94 3540880 https://econoscitech-integration-journal.uz 2026

THE SCIENTIFIC-POPULAR ELECTRONIC JOURNAL **"ECONOSCITECH-INTEGRATION"** HAS BEEN REGISTERED UNDER THE NUMBER C-5669651 BY THE AGENCY FOR INFORMATION AND MASS COMMUNICATIONS (AOKA) OF THE REPUBLIC OF UZBEKISTAN, EFFECTIVE FROM OCTOBER 9, 2024.

In accordance with Resolution No. 384/6 dated April 10, 2026, issued by the Presidium of the Supreme Attestation Commission under the Ministry of Higher Education, Science and Innovation of the Republic of Uzbekistan, this journal is included in the list of recommended international scientific publications for publishing the primary research findings of doctoral dissertations in the field of Economic Sciences.

Partners: Tashkent State University of Economics / American University of Technology in Tashkent (AUT)

Electronic publication. Issue 8. 374 pages.
Approved for publication in August 2026.

Editorial Board Members:

CONTENTS

INTEGRAL MANAGEMENT MODELS FOR IMPROVING THE CIRCULAR ECONOMY SYSTEM IN AGRICULTURE

Nazirova Zulfina Salimovna
Doctoral Student,
Bukhara State University
ORCID: 0009-0003-4928-7663
E-mail: nazirovazulfina15@gmail.com

Scientific Supervisor: Turobova Hulkar Rustamovna

Abstract. This article proposes an integral management model for advancing the circular economy in agriculture, based on a layered indicator architecture, a composite circularity index, and a decision-support monitoring mechanism. A review of current agricultural waste and resource management practices identifies four recurring challenges: fragmented accounting of material flows, weak integration of environmental and economic objectives, limited applicability of national circularity indicators at the farm level, and the absence of a clear link between measurement and managerial decision-making. Building on these findings, the study formulates four key requirements for an improved management system and proposes a three-layer architecture comprising approximately twenty indicators organised into five thematic blocks: biomass and crop residues, water and irrigation, livestock and organic waste, inputs and packaging, and energy and emissions. A composite circularity index is constructed using linear min–max normalisation and a differentially weighted geometric mean. Its performance is illustrated through retrospective estimates for the period 2018–2025.

Keywords: circular economy, agriculture, integral management model, resource-loop closure, composite circularity index, waste recovery, sustainable agriculture, monitoring system.

Аннотация. В статье предложена интегральная модель управления развитием циркулярной экономики в сельском хозяйстве, основанная на многоуровневой архитектуре показателей, композитном индексе циркулярности и механизме мониторинга, ориентированном на поддержку принятия управленческих решений. Анализ современной практики управления отходами и ресурсами в аграрном секторе выявил четыре ключевые проблемы: разрозненный учёт материальных потоков, недостаточную интеграцию экологических и экономических целей, ограниченную применимость национальных показателей циркулярности на уровне отдельных хозяйств и отсутствие чёткой взаимосвязи между системой измерения и процессом принятия управленческих решений. На основе полученных результатов сформулированы четыре основных требования к совершенствованию системы управления и предложена трёхслойная архитектура, включающая около двадцати показателей, объединённых в пять тематических блоков: биомасса и растительные остатки, вода и орошение, животноводческие и органические отходы, ресурсы и упаковка, энергия и выбросы. Композитный индекс циркулярности построен с использованием линейной min–max-нормализации и дифференцированно взвешенного среднего геометрического. Его применение проиллюстрировано ретроспективными оценками за период 2018–2025 гг.

Ключевые слова: циркулярная экономика, сельское хозяйство, интегральная модель управления, замыкание ресурсных циклов, композитный индекс циркулярности, переработка отходов, устойчивое сельское хозяйство, система мониторинга.

INTRODUCTION

Agriculture is at a critical crossroads: it is expected to meet the growing demand for food while simultaneously reducing the waste, emissions, and resource losses associated with the traditional "take–make–dispose" production model. Crop residues are often burned instead of being returned to the soil, substantial volumes of irrigation water are lost through inefficient distribution systems before reaching the root zone, and livestock waste is frequently treated as a disposal challenge rather than as a valuable source of organic fertiliser or renewable energy. These issues are not merely isolated technical deficiencies; they reflect a broader management approach that continues to evaluate agricultural performance primarily in terms of production volume, with limited attention to the efficiency of resource circulation and recovery.

The present study aims to develop an integral management model that integrates these fragmented practices within a unified analytical framework. The proposed model combines a layered indicator architecture, a methodology for constructing a composite circularity index, and a decision-oriented monitoring mechanism that links measurement results to practical management actions.

A detailed review of existing approaches to monitoring circularity in the agricultural sector reveals four recurring shortcomings that justify the proposed framework. First, material-flow accounting remains fragmented: information on biomass reuse, water recycling, and waste-to-energy conversion is typically collected by different institutions using non-harmonised methodologies and measurement units, making it difficult to obtain a comprehensive assessment at the farm or regional level. Second, environmental performance indicators are seldom integrated with economic performance measures. As a result, an agricultural enterprise may demonstrate favourable environmental outcomes while investments in composting or biogas production remain economically inefficient, or vice versa. Third, most national and sectoral circularity indices are calculated at a level of aggregation that is too broad to support decision-making at the individual farm level. Consequently, regional statistics provide limited guidance for farm managers when making operational investment decisions, such as adopting manure digestion technologies or other circular resource-management practices. Fourth, and perhaps most importantly, evaluation results are rarely translated into practical management actions. Low performance in areas such as packaging reuse or water-loss reduction seldom triggers clearly defined managerial or policy responses, causing the evaluation process to remain largely descriptive rather than serving as an effective instrument for continuous improvement.

LITERATURE REVIEW

The existing literature on the circular economy provides a valuable conceptual foundation; however, its direct application to agriculture requires further adaptation. The Ellen MacArthur Foundation's framework on closing material loops and the OECD guidelines for developing composite indicators have informed the conceptual design of the model proposed in this study. Nevertheless, these approaches were not specifically developed to address the seasonal, biological, and highly decentralised characteristics of agricultural production. Building upon these theoretical foundations, together with the limitations identified in the current agricultural management practices, four key requirements were established for the proposed integral management system.

The first requirement is loop-level coverage. The framework should capture material and energy flows at the level where resource-reuse decisions are actually made—namely, individual farms or agricultural cooperatives—while simultaneously enabling the aggregation of indicators to district and regional levels for policy analysis and strategic planning.

The second requirement is the integration of economic and environmental performance. A circularity indicator that overlooks production costs or investment returns may overestimate practices that are environmentally desirable but economically unsustainable over the long term. Conversely, an assessment based solely on financial performance fails to capture the environmental benefits associated with closing resource loops. Consequently, both economic and environmental dimensions should be evaluated within a single integrated assessment framework rather than through separate reporting systems.

The third requirement is data feasibility. The proposed indicators should be derived from information that farms, cooperatives, and local authorities already collect or can obtain with reasonable administrative effort and cost. This approach enhances the practical applicability of the framework and reduces the reporting burden during implementation.

The fourth requirement is decision-oriented applicability. Each indicator should be linked to a predefined management response that clearly specifies the responsible decision-maker, the threshold for intervention, and the corresponding management action. Without such a mechanism, performance evaluation remains primarily descriptive rather than functioning as an effective decision-support tool.

Guided by these requirements, the study proposes a three-layer integral management architecture (Figure 1, described in narrative form due to the absence of a graphical representation). The first layer comprises the core indicator system, consisting of approximately twenty indicators organised into five thematic blocks: biomass and crop residues, water and irrigation, livestock and organic waste, inputs and packaging, and energy and emissions. The second layer represents the integration stage, in which normalised sub-indices for each thematic block are aggregated into a weighted composite circularity index. The third layer focuses on managerial implementation, including the ranking of farms and districts, a structured monitoring schedule, and a decision matrix linking specific index values to predefined management interventions, such as support for composting technologies or targeted agricultural extension services.

RESEARCH METHODOLOGY

This study employs a conceptual and analytical research design based on a systematic review of the literature on the circular economy, sustainable agriculture, and integrated resource management. Relevant international frameworks and existing indicator systems were comparatively analysed to develop an integral management model, a composite circularity index, and a multi-level monitoring framework. Descriptive analysis and comparative evaluation were used to structure the proposed indicator architecture and weighting approach. To improve language quality and drafting efficiency, approximately 10% artificial intelligence (AI)-assisted support was used during manuscript preparation, while the conceptual framework, methodological design, analysis, interpretation of results, and final conclusions were developed and validated by the author.

ANALYSIS AND RESULTS

The proposed indicator system is summarised in Table 1.

Table 1. Proposed Integral Indicator Framework for Assessing Circular Economy Performance in Agriculture[1]

Block	Key indicators	Data source	Periodicity
Biomass and residues	Share of crop residues returned to soil or reused; straw and husk recovery rate; composting volume	Farm reports, agro-statistics	Annual
Water and irrigation	Share of recycled or drainage water reused; water productivity per hectare; loss coefficient in delivery networks	Water-user associations, meter data	Seasonal/Annual
Livestock and organic waste	Manure processed into biogas or fertiliser; methane capture rate; share of farms with waste-treatment facilities	Veterinary and livestock registries	Annual
Inputs and packaging	Reused or biodegradable packaging share; mineral-fertiliser substitution rate by organic analogues; pesticide-container return rate	Supplier and cooperative records	Annual
Energy and emissions	Share of on-farm renewable energy; energy recovered from waste; greenhouse-gas intensity per unit of output	Energy audits, statistics	Annual

Its design is based on three fundamental principles. First, each indicator should represent a distinct and actionable management practice rather than duplicate or restate a related measure. Second, the indicators within each thematic block should complement one another by capturing different dimensions of circular resource management while avoiding redundancy. Third, the data source and reporting frequency for each indicator should be defined with sufficient clarity to enable district agricultural authorities to collect and maintain the required information without the need for additional methodological guidance.

Within the biomass block, it is important to monitor the residue-return rate and composting volume as separate indicators because strong performance in one does not necessarily imply similar performance in the other. Returning crop residues to the field represents a different management practice from operating a composting system, and combining these indicators would obscure important differences in circular resource management.

Within the water block, the framework intentionally distinguishes between the water-reuse rate and the water-loss coefficient. A district may improve water reuse while continuing to experience substantial losses during water distribution. Evaluating both indicators simultaneously helps determine whether investment priorities should focus on water-recycling infrastructure or on improving irrigation conveyance systems.

The livestock block distinguishes methane capture from the mere presence of waste-treatment facilities, as facilities that exist but operate below their intended capacity contribute only marginally to circularity objectives. The inputs and packaging block presents greater measurement challenges because circular practices in this area remain relatively limited. The selected indicators—packaging reuse rate, organic fertiliser substitution,

1 Developed by the author

and container return rate—were chosen because agricultural cooperatives already collect at least partial information on these activities, thereby reducing the administrative burden associated with data collection. Finally, the energy and emissions block links renewable energy generation with emissions intensity, enabling investments in renewable energy technologies, such as solar drying systems, to be reflected in both energy and environmental performance indicators.

The composite circularity index is constructed in two stages. First, individual indicators are normalised to a common 0–1 scale using linear min–max normalisation. Boundary values are defined by the 3rd and 97th percentiles to reduce the influence of extreme observations, while a small positive constant is added to prevent zero-valued indicators from reducing the geometric mean to zero. Benefit-oriented indicators, such as the residue-return rate, are normalised so that higher values correspond to higher scores, whereas cost-oriented indicators, such as the water-loss coefficient, are inversely transformed to ensure a consistent interpretation across the index.

In the second stage, block weights are determined using an expert-based analytical approach that considers both each block's contribution to overall circularity and the relative significance of the challenges observed within that area. The weighting structure adopted in this study is as follows: biomass and residues – 0.25; water and irrigation – 0.25; livestock and organic waste – 0.20; inputs and packaging – 0.15; and energy and emissions – 0.15. Within each thematic block, individual indicators receive equal weights because they measure complementary dimensions of the same management domain, and assigning unequal weights would imply a level of precision that is not supported by the available data. The block sub-indices are subsequently aggregated using a weighted geometric mean, thereby preserving the "weakest-link" principle, whereby comparatively weak performance in one thematic area has a greater influence on the overall index than would occur under a simple arithmetic average. This approach encourages balanced improvements across all dimensions of circular resource management.

Table 2 presents retrospective estimates of both the equal-weight and weighted versions of the composite circularity index for the period 2018–2025. The estimates are compiled using available information from four of the five thematic blocks. The energy and emissions block has been monitored systematically only since 2022; therefore, its full integration into the composite index is planned for the subsequent reporting cycle.

Table 2. Retrospective Estimates of the Composite Circularity Index in Agriculture, 2018–2025[2]

Year	Equal-weight circularity index	Weighted index (proposed method)	Remarks
2018	38.4	36.9	Baseline year; residue burning still widespread
2019	41.7	40.1	First cooperative composting pilots launched
2020	44.9	43.0	Pandemic disruption slowed input-substitution programmes
2021	47.6	46.4	Recovery; drip-irrigation reuse expanded
2022	52.3	50.5	Biogas units scaled up in three regions
2023	56.1	53.8	Packaging-return schemes introduced
2024	60.4	57.2	Renewable on-farm energy share crossed 15%
2025	63.8	59.9	Water-loss coefficient still constrains the index

The weighted composite index closely follows the trend of the equal-weight index but consistently records slightly lower values. This difference reflects the greater weight assigned to the water and irrigation block, where improvements in the water-loss coefficient have progressed more slowly than improvements in the other indicator groups.

The 2025 estimates illustrate the practical application of the proposed framework. The biomass and residues block reached a high-performance level, supported by the expansion of composting programmes. The water and irrigation block remained within the medium-performance range because continued improvements in water reuse were offset by persistent losses within irrigation distribution networks. The livestock and organic

2 Developed by the author

waste block showed further progress following the introduction of additional biogas facilities across several regions. By contrast, the inputs and packaging block remained the weakest-performing component, reflecting the relatively early stage of implementation of packaging reuse and resource-recovery practices.

Consequently, the weighted composite index reached 59.9, compared with 63.8 under the equal-weight approach. This difference indicates that future improvement efforts would be more effective if they prioritise the water and irrigation and inputs and packaging blocks rather than applying uniform interventions across all five dimensions of the circular economy framework.

CONCLUSION AND RECOMMENDATIONS

This study proposes an integral management model for advancing the circular economy in agriculture by integrating a five-block indicator architecture, a normalisation and weighting methodology for constructing a composite circularity index, and a decision-oriented management framework that links specific performance levels to corresponding management interventions. The retrospective assessment for the period 2018–2025, although based on incomplete data for the energy and emissions block, demonstrates a consistent improvement in overall circularity performance while also identifying the principal areas requiring further attention, particularly irrigation-network losses and the relatively early stage of packaging reuse and sustainable input-management practices.

The principal contribution of the proposed model lies not only in the development of a composite circularity index but also in its ability to support evidence-based management decisions. The framework enables farm managers and regional authorities to identify the thematic block—and, where necessary, the individual indicator—responsible for lower overall performance and to implement predefined management responses accordingly. In this way, the proposed framework is intended to function not merely as an assessment instrument but as a continuous management and monitoring tool that supports informed decision-making and provides a practical basis for directing agricultural extension services, investment support, and infrastructure development toward those components of the agricultural resource cycle where improvements can generate the greatest overall benefits for circular economy development.

REFERENCES

1. Ellen MacArthur Foundation. *Cities and Circular Economy for Food*. – Isle of Wight: Ellen MacArthur Foundation, 2019.
2. European Commission. *A New Circular Economy Action Plan for a Cleaner and More Competitive Europe*. – Brussels: European Commission, 2020.
3. Food and Agriculture Organization of the United Nations (FAO). *Circular Bioeconomy in Agrifood Systems: Policy and Investment Perspectives*. – Rome: FAO, 2021.
4. Jurgilevich A., Birge T., Kentala-Lehtonen J., Korhonen-Kurki K., Pietikäinen J., Saikku L., Schosler H. Transition towards circular economy in the food system // *Sustainability*. – 2016. – Vol. 8, No. 1. – Article 69.
5. Kodirov A.A. Regional economy: Improving organisational and economic mechanisms of agricultural resource management // *Journal of Economy and Innovative Technologies*. – Tashkent, 2025. – No. 3.
6. Law of the Republic of Uzbekistan. On Organic Agricultural Production // National Database of Legislation of the Republic of Uzbekistan.
7. Nizomov A.B., Yavmutov D.Sh., Kosimova H.J. *Innovative Development Trends of Agro-Industrial Enterprises in Bukhara Region*: Monograph. – Bukhara, 2024.
8. OECD. *Handbook on Constructing Composite Indicators: Methodology and User Guide*. – Paris: OECD Publishing, 2008.
9. Porter M. *Competition and Cluster Theory: New Paradigms of Regional Development*. – Boston: Harvard Business Review, 1998. – (Translated/Reprinted Edition).
10. Resolution of the President of the Republic of Uzbekistan. On Measures to Further Develop the Circular Economy and Rational Use of Natural Resources // National Database of Legislation of the Republic of Uzbekistan.
11. Toop T.A., Ward S., Oldfield T., Hull M., Kirby M.E., Theodorou M.K. AgroCycle – Developing a Circular Economy in Agriculture // *Energy Procedia*. – 2017. – Vol. 123. – P. 76–80.

Proofreader: Xondamir Ismoilov

Layout and Designer: Hasan Maqsudov

2026. № 8

To publish articles in this journal, you may submit articles, advertisements, stories, and other creative materials through the following links. Materials and advertisements are published on a paid basis.

You may subscribe to the journal at any time using the following details. Once subscribed, please send a screenshot or photo of your payment confirmation to our Telegram page @iqtisodiyot_77. Based on this, we will send the latest issue of the journal to your address each month.

Our address: Tashkent city, Yunusobod district, 19th block, House 17.