Vol. 01, No. 2, July 2026, Page 59-72 E-ISSN **3165-438X**

TARANAK Technology and Research in Animal and Agricultural Knowledge

JOURNAL
Technology and Research in Animal and Agricultural Knowledge (TARANAK)

Economic Resilience Through Diversification: Comparative Performance of Goat-Coffee and Goat-Cacao Integration Models in Sloping Agricultural Land Use

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Article Information
Received: September 03, 2026
Revised: October 17, 2026
Online: October 19, 2026

Keywords
Crop-Livestock Integration, Goat, Coffee, Cacao, Sloping Land, Economic Resilience

ABSTRACT

Farm diversification through goat integration with perennial crops may improve economic resilience and reduce land degradation on sloping land. This study systematically reviewed 16 sources comparing goat-coffee and goat-cacao systems. Only three sources reported R/C ratios: 2.67 for goat-coffee in North Sumatra, 1.8 for cacao-livestock farms in West Sulawesi, and 1.3 for the goat component of a cacao-goat farm. These values are not directly comparable, and none was classified by slope. Plantation crops remained the main income source, contributing 66.6–89% in goat-coffee systems and 71.67% in one goat-cacao case. Evidence of erosion reduction was stronger for goat-coffee, whereas goat-cacao research remained limited. No field study directly assessed goat manure effects on soil structure and water-holding capacity across slope classes. Both systems offer potential benefits through income diversification and resource recycling, but further slope-specific economic and soil research is needed.

Keywords: *Crop-Livestock Integration, Goat, Coffee, Cacao, Sloping Land, Economic Resilience*

INTRODUCTION

Sloping agricultural land in tropical regions, including Indonesia, is commonly used by farmers to cultivate perennial plantation crops such as coffee and cacao, which are agro-ecologically better suited to contoured topography than annual crops. However, the use of sloping land for monoculture farming without adequate management of shade trees and cover crops risks land degradation, particularly surface erosion, because the tree component in systems built through an enrichment approach is often placed on the flatter parts of the land while the steeper parts are left

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open (Evizal et al., 2023). At the same time, farmers' dependence on a single commodity also creates household economic vulnerability to market price fluctuations and seasonal crop-failure risk.

Diversification of farming systems through crop-livestock integration (CLI) is one of the strategies widely recommended to address this vulnerability. Goats are considered a livestock component that is relatively well suited for integration with plantation crops on sloping land, since goats are relatively easy to raise, reproduce quickly, can be managed at small to medium scale, and are able to utilize forage from intercrops, weeds, and pruning residues from plantation crops (SMG Sinar Mentari Group, 2026). The integration of goats with plantation crops is essentially a form of crop-livestock system (CLS) that creates a synergistic pattern of enterprise: plantation-crop residues are used as livestock feed, while goat manure is used as organic fertilizer for the plantation crop, thereby reducing the cost of purchased feed and chemical fertilizer while increasing the added value of rural farm-household income (Fitriani et al., 2023).

The two plantation commodities most commonly integrated with goats on sloping land in Indonesia are coffee and cacao. In the goat-coffee system, integration generally occurs through the use of shade trees and legume plants as a source of forage, whereas in the goat-cacao system integration more explicitly relies on cacao pod husks and leaves as ruminant feed material (Dinas Pertanian dan Ketahanan Pangan Daerah Istimewa Yogyakarta, 2025). Nevertheless, the two models have not been widely compared systematically in terms of economic performance or their contribution to sloping-land conservation, so farmers and agricultural extension workers lack an adequate evidence base for choosing the integration model best suited to local agroecological and socio-economic conditions.

The novelty of this article lies in its attempt to systematically compare two goat-plantation integration models that have generally been examined separately in different bodies of literature, by synthesizing economic-performance data (income, income contribution, financial feasibility) and sloping-land conservation data from both models into a single comparative analytical framework. Based on the foregoing, this article addresses three research questions: first, how does the economic performance (income and financial feasibility) of the goat-coffee integration model compare with that of the goat-cacao integration model, based on published empirical evidence; second, how does each model contribute to the conservation of sloping agricultural land; and third, what factors need to be considered in choosing the integration model best suited to strengthening the economic resilience of sloping-land farmers. The article also makes explicit where the evidence is missing, in particular R/C ratios for goat farming integrated with coffee or cacao and the effect of goat manure on soil structure and water-holding capacity on land with defined slopes.

METHODS

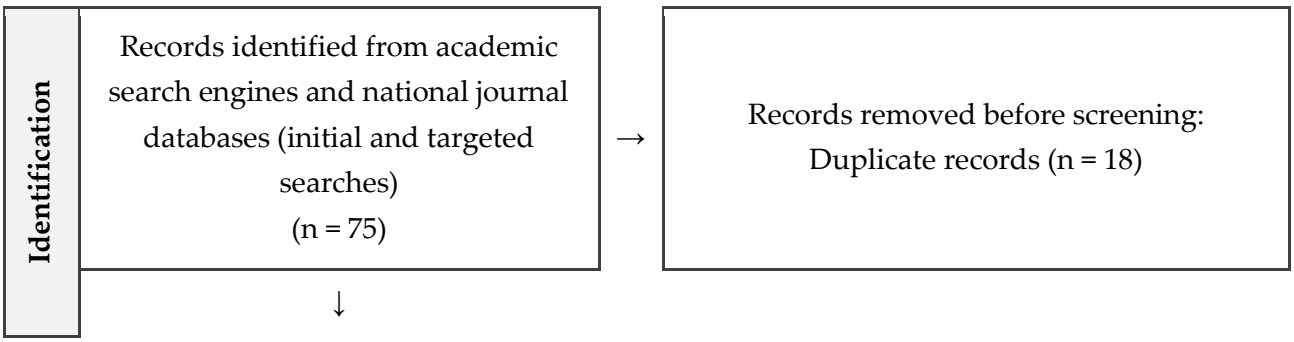
This study uses a narrative-systematic literature review method that adapts the staged selection process of the Preferred Reporting Items for Systematic Reviews (PRISMA) framework, adjusted to the characteristics of the literature available in Indonesian national scientific-journal databases and agricultural research institution publications. This method was chosen because

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primary household-level economic data for both integration models were not collected directly by the authors; the synthesis is therefore based on secondary data that has already been published by previous researchers.

Literature searches were conducted through academic search engines and national online journal databases, using combinations of the keywords: "goat-coffee integration", "goat-cacao integration", "crop-livestock integration goat", "goat farming R/C ratio", "sloping-land agroforestry", and "sloping-land conservation coffee cacao", restricted to publications from 2020 to 2026. Because R/C ratios for integrated systems proved scarce, a second targeted search was run in October 2026 using combinations of "integrated coffee-goat R/C ratio", "cacao-goat integration R/C ratio", and the Indonesian equivalents "integrasi kopi kambing" and "integrasi kakao kambing". A third targeted search addressed soil evidence using "goat manure soil aggregate stability", "goat manure water holding capacity", and "organic manure sloping land aggregate stability". For this soil-evidence search the 2020–2026 limit was relaxed, because very few studies of goat manure and soil physical properties were found. One institutional report without a publication date was also retained, because it was the only source found that reports enterprise-level R/C ratios for goat farming on a cacao-goat farm.

Inclusion criteria were: (1) scientific journal articles, proceedings, or official publications of agricultural research/extension institutions; (2) coverage of economic aspects (income, cost, business feasibility) and/or agronomic-conservation aspects of goat farming and/or coffee/cacao farming within an integrated or agroforestry system; and (3) inclusion of quantitative data that could be synthesized. For the R/C ratio synthesis an additional criterion applied: only studies reporting R/C ratios for goat farming integrated with coffee or cacao were retained, and studies of monoculture (non-integrated) goat-farming enterprises were excluded, because their agro-climatic contexts and husbandry systems differ substantially from plantation-based integration on sloping land. Exclusion criteria also included articles without clear quantitative data, duplicate articles, and articles whose full text could not be accessed. The flow of records through identification, screening, eligibility assessment, and inclusion follows the PRISMA 2020 flow-diagram format (Page et al., 2021) and is shown in Figure 1. Through this selection process, 16 sources were included in the synthesis, comprising 8 scientific journal articles, 2 institutional reports or proceedings, and 6 institutional, extension, or organizational publications used as supplementary technical context.



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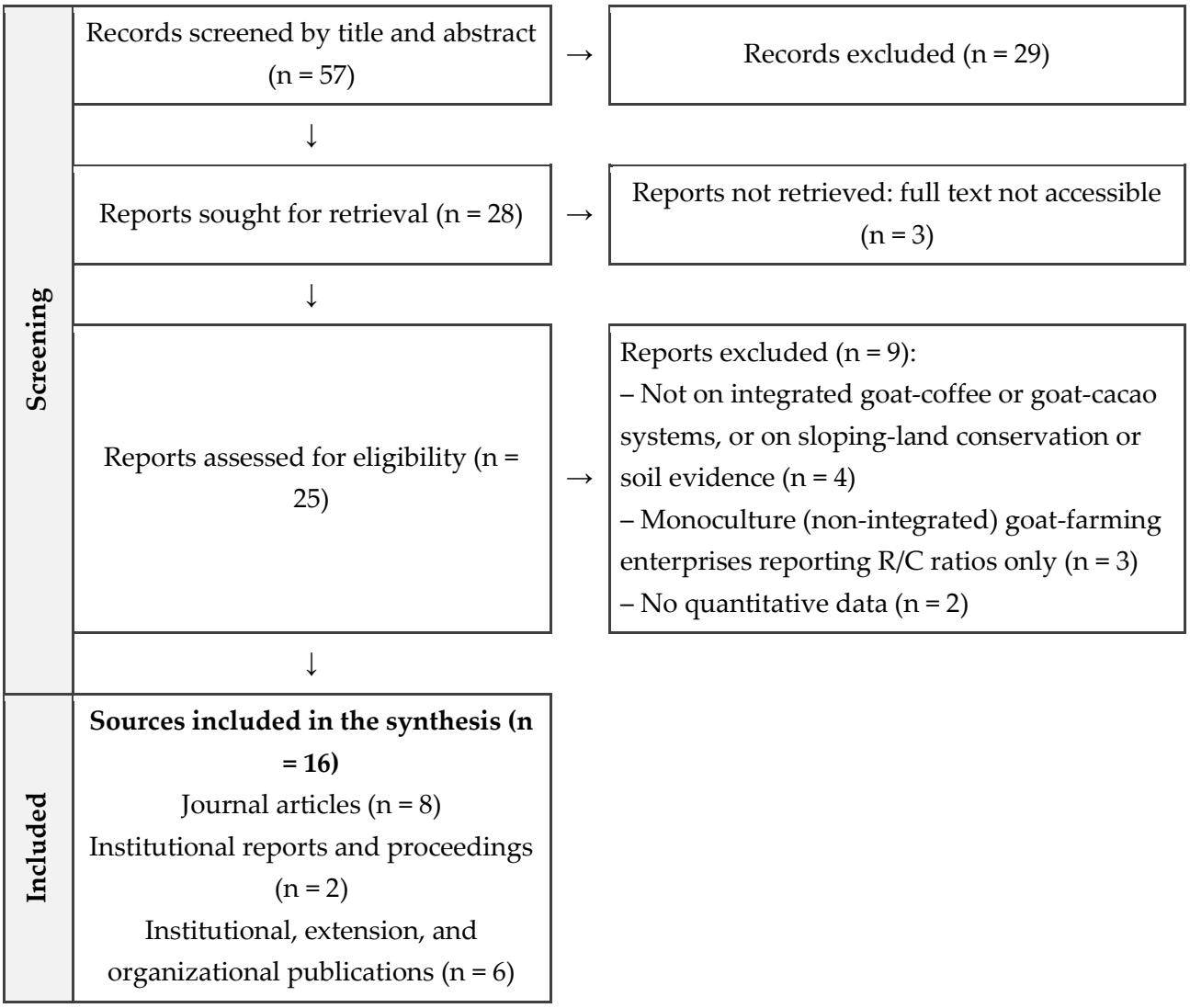


Figure 1. PRISMA 2020 flow diagram of the identification, screening, eligibility assessment, and inclusion of sources (adapted from Page et al., 2021)

Data analysis was carried out descriptively and comparatively in three stages. The first stage involved extracting relevant quantitative data from each reference, including goat-farming income figures, R/C ratio values, the income-contribution structure among components of the integrated farming system, and agronomic data related to sloping-land conservation. The second stage involved tabulating and visualizing the extracted data to facilitate comparison between the two integration models. The third stage involved narrative synthesis to interpret the economic-performance patterns and land-conservation implications of both integration models, which were then discussed within the framework of farm-household economic resilience through diversification.

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RESULTS

1. R/C Ratios of Integrated Goat-Coffee and Goat-Cacao Systems

The R/C synthesis was restricted to studies that evaluated goat farming within integrated systems with coffee or cacao. Studies of non-integrated (monoculture) goat-farming enterprises were not used, because their agro-climatic contexts and husbandry systems differ substantially from those of plantation-based integration on sloping land. Only three sources met this criterion, and their R/C ratios are summarized in Table 1. All reported values are above the feasibility threshold (R/C > 1).

Table 1. R/C Ratios Reported for Goat Farming Integrated with Coffee or Cacao

Model	Source and location	Unit analysed	R/C ratio	Remarks
Goat-coffee	Ginting et al. (2025); Ronggur Nihuta District, Samosir Regency, North Sumatra	Integrated coffee-goat farms (69 farmers, census)	2.67	Integration was associated with 22.63% higher coffee-farm income, a 100% increase in livestock income, and manure purchase costs reduced by up to IDR 316,380 per ha. Farmers were assisted by the Starbucks Farmer Support Center.
Goat-cacao	Putri et al. (2023); Tapango Barat, Polewali Mandar Regency, West Sulawesi	Integrated cacao-livestock farms compared with non-integrated cacao farms	1.8	Traditional management (simple feeding and housing). Income was higher than on non-integrated farms, but the difference was not statistically significant (t-test). The livestock type is not specified in the available abstract.
Goat-cacao	Ministry of Agriculture of the Republic of Indonesia (n.d.-a); smallholder cacao-goat case	1 ha of cacao and an 8-head goat unit, analysed separately	2.4 (cacao); 1.3 (goats)	Enterprise-level ratios, not a whole-system ratio. Net profit was IDR 12,225,000 for cacao and IDR 3,278,500 per year for goats. Undated institutional report.

Note: R/C = revenue/cost ratio; values above 1 indicate financial feasibility. Ratios are not directly comparable because the unit of analysis, region, scale, and cost accounting differ among sources. Monoculture goat-farming studies were excluded.

The integrated goat-coffee system in Ronggur Nihuta District, Samosir Regency, had the highest R/C ratio among the three sources (2.67). In that study, integration was associated with 22.63% higher income from coffee farming, a 100% increase in livestock income, and lower expenditure on purchased manure of up to IDR 316,380 per hectare (Ginting et al., 2025). A related study in the same district reported average incomes of IDR 14,150,186.64 from integrated coffee

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farming and IDR 4,685,738.13 from goat farming (Nainggolan et al., 2024), which is consistent with coffee being the main income source and goats a supplementary enterprise.

For the goat-cacao model, the integrated cacao-livestock farms in Tapango Barat, Polewali Mandar, had an R/C ratio of 1.8 under traditional management with simple feeding and housing. Their income was higher than that of non-integrated cacao farms, although the difference was not statistically significant (Putri et al., 2023). An institutional report on a smallholder cacao-goat farm gave separate enterprise-level ratios of about 2.4 for 1 ha of cacao and 1.3 for an 8-head goat unit (Ministry of Agriculture of the Republic of Indonesia, n.d.-a).

These ratios cannot be pooled or ranked. The Samosir value refers to the integrated coffee-goat system as a whole; the Polewali Mandar value refers to cacao-livestock farms, for which the available abstract does not state the type of livestock; and the institutional report gives component-level ratios. The studies also differ in region, farm scale, level of external support, and cost accounting. To our knowledge, none of the three reported R/C ratios stratified by slope class. The small number and heterogeneity of these data are treated as a research gap in the Discussion section.

2. Income-Contribution Structure in the Goat-Coffee Integration Model

In the goat-coffee integration model, the literature synthesis shows that tree-based farming (coffee and Multi-Purpose Tree Species/MPTS such as pepper, cloves, banana, durian, avocado, and candlenut) dominates the income structure of agroforestry farm households, with goats generally raised on a limited scale as a supplementary enterprise. A study on the contribution of agroforestry to the income of community forestry farmers in the Batutegi Forest Management Unit, Lampung Province, for instance, reported that income from coffee agroforestry contributed 66.6-89 percent of farmers' total income (Manurung et al., 2025), with only a small proportion of respondents developing livestock as supplementary income alongside agroforestry crops. Similar data from a coffee agroforestry farmer group in another community-forestry area reported an income structure of IDR 14,649,631 per household per hectare per year from coffee agroforestry activities, equivalent to 66.6 percent of farmers' total income, and IDR 6,321,690 per household per year from non-agroforestry activities.

In terms of feed, goat integration within coffee agroforestry systems generally relies on forage from legume shade species, such as Indigofera sp., which, in addition to functioning as a deep-rooted coffee shade tree, also has leaves that can be used as livestock feed. This type of legume shade model also supports sloping-land conservation, since shade trees and cover crops help restrain surface erosion on contoured land.

3. Income-Contribution Structure in the Goat-Cacao Integration Model

In the goat-cacao integration model, the literature synthesis shows a more explicit feed synergy compared with the goat-coffee model, because cacao's main residues—pod husks and leaves—are directly used as ruminant feed material (Balai Besar Perpustakaan dan Literasi Pertanian, n.d.; Dinas Pertanian dan Ketahanan Pangan Daerah Istimewa Yogyakarta, 2025). The

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recommended cacao-residue-based feed composition for goats, based on previous research, is 40 percent cacao leaves to 60 percent shade-tree leaves. The principle of cacao-livestock integration emphasizes the handling of both main products and residue products from the two commodities that have market value or use value as feed, thereby creating a synergistic enterprise pattern through the combined efficiency of cacao plantation farming and goat husbandry.

Quantitative data from a financial study of an integrated cacao-goat farming case in a cacao production center reported that average income from the integrated farming enterprise reached IDR 25,794,000 per year, with cacao farming contributing 71.67 percent of that total income, while the remaining 28.33 percent came from non-cacao components, including goat products, liquid and solid organic fertilizer, and other by-products such as mineral blocks made from cacao pod husks (Ministry of Agriculture of the Republic of Indonesia, n.d.-b). A comparison of the income-contribution structure between the goat-coffee model and the goat-cacao model, based on the two most representative studies for each model, is presented in Figure 2.

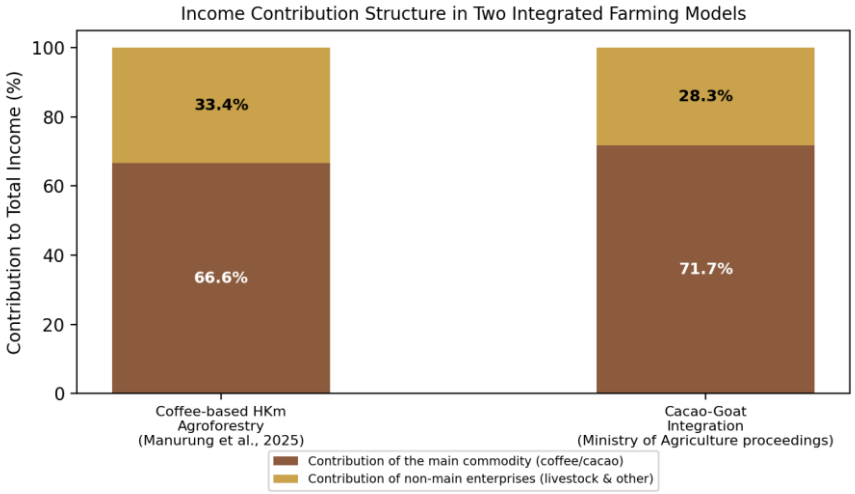


Figure 2. Income-Contribution Structure in the Coffee Agroforestry (HKm) Model and the Cacao-Goat Integration Model (Source: compiled from Manurung et al., 2025; Ministry of Agriculture of the Republic of Indonesia, n.d.-b)

The comparison in Figure 2 shows that the main plantation commodity (coffee or cacao) remains the dominant source of income in both models, with a relatively small difference in contribution (66.6 percent versus 71.67 percent). However, the two data sets come from different research contexts: the coffee agroforestry data reflect the general income structure of community forestry farm households, not all of whom necessarily integrate goats explicitly, whereas the cacao-goat data come from a farming case that was specifically designed as an integration model. This difference in context is one of the limitations of a direct comparison, which is discussed further in the Discussion section.

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4. Contribution to Sloping-Land Conservation

The sloping-land conservation aspect of both integration models was synthesized from literature discussing soil-conservation techniques in coffee and cacao agroforestry. In coffee agroforestry systems, commonly applied soil-conservation techniques include planting shade trees and cover crops such as groundnut, desmodium, or centro to maintain soil moisture and suppress erosion, applying contour terracing, and constructing infiltration trenches (rorak) planted with vetiver to capture water and humus on sloping land (PRCF Indonesia, n.d.; World Agroforestry [ICRAF] Indonesia, n.d.). One report on a sustainable-coffee farmer-assistance program in a sloping-land area reported an erosion reduction of up to 40 percent and an increase in coffee productivity from 800 kilograms per hectare to 1,200 kilograms per hectare over three years of conservation-based agroforestry, although this report is a technical publication from an assisting institution and has not fully undergone peer review, and should therefore be treated as supporting rather than primary evidence.

In cacao agroforestry systems, technical publications on sloping-land conservation generally focus on the dynamic cacao agroforestry (DCA) model, which uses multi-function plants such as pineapple, citronella grass, legumes, and elephant grass to restrain surface erosion, with legume shade species such as Sesbania, Gliricidia, Leucaena, and Calliandra simultaneously serving as a goat-feed source for farmers who integrate cacao gardens with household-scale livestock (Burung Indonesia, 2024). Nevertheless, compared with coffee agroforestry, quantitative evidence on the magnitude of erosion reduction in cacao agroforestry systems integrated with goats remains relatively limited in the literature that could be located, and tends to focus more on feed-residue utilization than on measurable soil-conservation impact.

5. Goat Manure, Soil Structure, and Water-Holding Capacity on Slopes

Both integration models rest on the premise that goat manure returns nutrients and organic matter to the plantation, and the Samosir study reported lower expenditure on purchased manure under integration (Ginting et al., 2025). However, the literature located for this review contains no study that measured the effect of goat manure application on soil structure or water-holding capacity in coffee or cacao gardens on defined slope classes. The evidence that exists comes from controlled laboratory studies using tropical soils from Sri Lanka.

In incubations with Red Yellow Podzolic soil, goat dung improved the water stability of aggregates more strongly than cow dung. However, additions of about 10% goat dung also raised the risk that aggregates would float and be carried away with runoff water, which could increase topsoil erosion (Leelamanie et al., 2013). In a separate experiment on a tropical Ultisol amended with cattle manure, goat manure, or Gliricidia leaves, the water entry value and the water retention at 150 cm suction increased with the water repellency of the amended samples (Liyanage & Leelamanie, 2016). Together, these results indicate that the effect of goat manure on soil structure and hydrology is not uniformly beneficial and depends on the application rate and on soil conditions.

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Neither study addressed slope gradient, slope position, rainfall-driven runoff, or plantation conditions, and both used mixed or sieved soil samples rather than intact slopes. Because gradient and slope position influence runoff and erosion, their findings cannot be assumed to apply to coffee and cacao gardens on sloping land. The conservation contribution of goat manure on specific slopes therefore remains an open question and is taken up as a research gap in the Discussion section.

6. Summary Comparison of the Two Models

A summary of the comparative synthesis of the two integration models, based on the literature reviewed, is presented in Table 2.

Table 2. Summary Comparison of the Goat-Coffee and Goat-Cacao Integration Models

Aspect	Goat-Coffee Model	Goat-Cacao Model
Main feed source for goats	Forage from legume shade trees (e.g., Indigofera sp.), weeds, and intercrops	Cacao pod husks and leaves (recommended composition 40% cacao leaves : 60% shade-tree leaves)
Contribution of the main commodity to income	66.6-89% (coffee HKm agroforestry, Lampung)	71.67% (cacao-goat integration, Ministry of Agriculture proceedings)
R/C ratio of the integrated system	2.67 (integrated coffee-goat system, Samosir; Ginting et al., 2025)	1.8 (cacao-livestock farms, Polewali Mandar; Putri et al., 2023); 1.3 for the goat component (institutional report)
Sloping-land conservation technique	Shade trees/cover crops, contour terracing, vetiver-planted infiltration trenches	Dynamic cacao agroforestry (DCA): multi-function plants, multi-purpose legume shade trees
Quantitative evidence of conservation impact	Relatively more available (e.g., erosion reduction of up to 40%, technical publications)	Still limited, predominantly descriptive-qualitative
Evidence on goat-manure effects on soil structure and water-holding capacity on specific slopes	None located for coffee gardens on defined slopes; laboratory evidence only (Leelamanie et al., 2013; Liyanage & Leelamanie, 2016)	None located for cacao gardens on defined slopes; laboratory evidence only (Leelamanie et al., 2013; Liyanage & Leelamanie, 2016)
Specific technical risk	Coffee price fluctuation; dependence on selecting the right shade species	Theobromine content in cacao husk potentially toxic if fed alone without mixing

Source: synthesized by the authors from the literature cited in the Results section and the Reference list.

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DISCUSSION

The synthesis results show that both the goat-coffee and goat-cacao integration models are essentially consistent with the theory of farm diversification as a strategy for strengthening farm-household economic resilience. Diversifying income sources by adding a livestock component to tree-based farming allows farm households to have more than one income stream that does not depend entirely on the price fluctuations of a single commodity, while also reducing the risk of seasonal crop failure. The R/C ratios above one reported for integrated systems (1.3 to 2.67; Table 1) indicate that adding a goat component to a coffee- or cacao-based farming system was financially feasible in the cases studied. A plausible mechanism is that much of the goats' feed requirement in both models can be met from forage and plantation-crop residues available on the same land, and that manure replaces part of the purchased fertilizer, as reported for Samosir (Ginting et al., 2025). Because only three sources are available, however, this finding should be read as indicative rather than general.

A clear research gap emerges from the economic evidence. Specific R/C ratio data for goat farming integrated with coffee or cacao are extremely limited: only three sources were located (Table 1), covering three provinces and using different units of analysis, and to our knowledge none reported R/C ratios stratified by slope class, shade-tree composition, or farm scale. R/C ratios are available for many non-integrated goat-farming enterprises elsewhere in Indonesia, but they were deliberately not used here. Such enterprises are often evaluated in lowland or coastal settings, under husbandry systems in which feed is purchased or produced separately, and their agro-climatic conditions and cost structures differ substantially from those of goats kept under coffee or cacao canopies on sloping land. Transferring those ratios to integrated plantation systems would overstate the certainty of the evidence. Future studies should report R/C ratios for the integrated system as a whole and for each enterprise, state whether cash or total costs were used, account for manure and forage as internal flows, and record slope and elevation, so that goat-coffee and goat-cacao systems can be compared on equivalent terms.

Nevertheless, there is a difference in the character of synergy between the two models that has implications for their development strategy. In the goat-coffee model, feed synergy is indirect—achieved through shade trees and intercrops specifically selected to serve a dual function as shade and feed source—so the success of integration depends heavily on the correct choice of shade species from the outset of garden establishment. In the goat-cacao model, feed synergy is more direct, because it utilizes cacao's main residue (pod husks and leaves), which is produced routinely throughout the production cycle, so in theory it is more easily adopted in already-producing cacao gardens without requiring a fundamental reconfiguration of the shade-tree composition. Nevertheless, using cacao residue as feed requires technical care, because the theobromine content in cacao pod husks can potentially be toxic to rumen microbes if fed alone without being mixed with other feed materials, so farmers need technical knowledge of proper ration formulation.

In terms of sloping-land conservation, the greater availability of quantitative evidence for coffee agroforestry compared with cacao agroforestry integrated with goats likely reflects the larger

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number of studies and sloping-land assistance programs based on coffee compared with cacao in the literature that could be located, rather than indicating that cacao is agronomically less suited to sloping land. Both commodities essentially require appropriate shade-tree management and soil-conservation techniques to be cultivated sustainably on contoured land, so this evidence gap is better understood as a research gap rather than as an indication of one commodity's intrinsic agronomic superiority.

The conservation evidence shows a second gap. Goat manure is a central link in the circular logic of both models, yet no study located for this review measured its effect on soil structure or water-holding capacity in coffee or cacao gardens on defined slopes. The laboratory evidence available suggests that effects depend on application rate and soil conditions: goat dung improved aggregate stability, but high additions raised the risk of aggregate flotation and erosion (Leelamanie et al., 2013), while water entry and retention varied with the water repellency of manure-amended soil (Liyanage & Leelamanie, 2016). On slopes, where runoff and erosion alter soil organic matter and structure, these responses may differ with gradient, slope position, and canopy cover. Future work should therefore compare manure rates, including no-manure controls, across defined slope classes (for example gentle, moderate, and steep) and slope positions in coffee and cacao gardens. Suitable measurements include aggregate stability (mean weight diameter), bulk density, porosity, infiltration, field capacity, and available water, together with runoff and soil loss on bounded plots where feasible. The labor and cost of carrying and spreading manure uphill should be recorded as well, because it links the conservation question back to the R/C ratio.

The income-contribution comparison in Figure 2 needs to be interpreted with caution, given the limitations of the available data. The coffee agroforestry data used reflect the general income structure of community forestry farmers, not all of whom explicitly practice goat integration, whereas the cacao-goat data come from a farming case study specifically designed as an integration model. Consequently, a direct comparison of the percentage contribution values in the two models is not entirely equivalent (not fully apple-to-apple), and the only conclusion that can validly be drawn is that in both models the main plantation commodity remains the backbone of income, while goats serve as a significant additional source of income diversification rather than a dominant component. This finding is consistent with the view that the success of agroforestry farm diversification is strongly influenced by the area of land cultivated and the diversity of plant species managed by farmers, so optimizing goat integration needs to take into account the scale of land owned by farmers in order for its contribution to total income to become more significant.

The practical implication of these findings is that the choice between the goat-coffee and goat-cacao integration models for sloping-land farmers should not be based solely on a paper comparison of economic value, but should also take into account the agroecological suitability of the land, market access for each plantation commodity, farmers' management capacity and technical knowledge in managing residue-based feed (particularly caution regarding anti-nutritional content in cacao residue), and the availability of technical assistance for applying appropriate sloping-land conservation techniques. Developing policies and extension programs that integrate economic and

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land-conservation aspects simultaneously will be more effective in encouraging the sustainable adoption of both integration models among sloping-land farmers.

CONCLUSIONS

Based on the literature synthesis conducted, it can be concluded that both the goat-coffee and goat-cacao integration models on sloping agricultural land show feasible economic performance in the cases studied, with the few available R/C ratios for integrated systems ranging from 1.3 to 2.67, and both provide a significant income-diversification contribution to farm households, even though the main plantation commodity (coffee or cacao) remains the dominant source of income, contributing 66.6-89 percent in the goat-coffee model and 71.67 percent in the goat-cacao case study reviewed. The goat-cacao model shows a more explicit feed synergy through the use of cacao pod husk and leaf residues, while the goat-coffee model is supported by relatively more available sloping-land conservation evidence in the literature reviewed, although this gap more likely reflects a research gap than an intrinsic difference in agronomic superiority. Specific R/C ratio data for goat farming integrated with coffee or cacao remain extremely limited and are not directly comparable across studies, which is identified as a research gap.

Both integration models have the potential to strengthen the economic resilience of sloping-land farmers through income diversification and the circular use of local resources between the crop and livestock components. The appropriate choice of model for farmers should take into account local agroecological suitability, commodity market access, farmers' management capacity, and the availability of technical conservation assistance. Given that most of the evidence synthesized in this article comes from partial local case studies, further empirical research specifically comparing the economic performance and conservation impact of the two integration models under equivalent agroecological conditions and operating scales, including slope-stratified R/C ratios and field studies of how goat manure affects soil structure and water-holding capacity on land with defined slopes, is strongly recommended to strengthen the evidence base for formulating policy recommendations on the development of integrated farming systems on sloping land in Indonesia.

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