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A comparative analysis of cattle-oil palm plantation policies in Indonesia and Malaysia: Towards greater effectiveness and efficiency

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ABSTRACT

Indonesia and Malaysia, as the world's leading palm oil producers, have national policies to integrate cattle with oil palm plantations (SISKA and PINTAR) to enhance sustainability and food security. Despite the documented benefits and technical viability, these policies have failed to achieve widespread adoption, particularly among large-scale enterprises. This study employs a comparative policy analysis framework to diagnose the causes of this implementation gap. Our findings reveal that policy underperformance is not a failure of intent or design, but of execution, stemming from two core issues: an overly program-oriented approach that prioritizes activities over measurable outcomes, and inadequate multi-stakeholder partnerships that lack trust and shared value. The study concludes by translating these diagnoses into actionable recommendations for policymakers, urging a shift towards outcome-based incentives, robust monitoring systems, and more equitable collaboration models to bridge the gap between policy ambition and on-the-ground reality.

1. Introduction

The Food and Agriculture Organization of the United Nations urged nations to intensify their efforts to promote agroforestry (combining the production of crops or livestock with forestry or plantation), which has the potential to assist millions of people to break the poverty cycle, stop environmental damage, and guarantee global food security (United Nations, 2013). Indonesia has promoted this initiative through the SISKA program since 2005. It was later strengthened by Minister of Agriculture Regulation Number 105 of 2014, which integrated the Oil Palm Plantation Business with the Beef Cattle Cultivation Business (Permentan). Meanwhile, Malaysia initiated a comparable effort in 1993 through the PINTAR program (Ruminant Livestock Integration Project with Permanent Crops, including rubber and oil palm plantations), as part of the National Agricultural Policy 2 (1992–2010, NAP 2).

According to 2022 projections, oil palm plantations were expected to reach 15,380,981 ha in Indonesia (Directorate General of Estates, 2021) and 5,674,742 ha in Malaysia (MPOB, 2022), suggesting that both countries were well positioned to implement oil palm–cattle integration programs. The integration program can increase the population's standard of living, given that a substantial number of oil palm smallholders account for 41.48% and 26.15% of the total area of oil palm farms in Indonesia and Malaysia, respectively. Additionally, due to the size of their oil palm plantations, year-round access to a plentiful supply of animal feed sources unaffected by seasonal changes is possible (Pinardi et al., 2020). The by-products of oil palm plantations, such as oil palm fronds, palm kernel meal (PKM), and solid decanter, contain valuable nutrients and can be utilized as feed for beef cattle (Hanum, 2023).

Ironically, beef production remains insufficient in Indonesia and Malaysia due to the lack of quality feed for livestock. According to Statistics Indonesia (2022), Indonesia was projected to require 695.39 thousand tons of beef in 2022, whereas domestic production of beef and buffalo meat accounted for only 436.70 thousand tons (62.80%). As a result, Indonesia will continue to rely on cattle imports from countries like Australia, India, New Zealand, and the United States. In 2021, Indonesia imported 214,658 tons of beef (Director General of Livestock and Animal Health Services, 2022). During the last five years, Indonesian beef imports increased by an average of 17.92%. The situation in Malaysia is much worse; the nation's capacity to meet domestic beef demand is declining, from a self-sufficiency rate of 24.2% in 2016 to only 18.9% in 2021, necessitating the government to spend RM 2.4 billion on meat imports that year (DVS, 2022a).

In the last decades, several oil palm plantations in both countries have begun adopting integrated systems with ruminant livestock such as

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cattle, goats, sheep, or a combination thereof (Azhar, Tohiran, et al., 2021). This program has been reported to potentially increase farmers' income by improving daily cattle weight gain and palm fruit production (Devendra, 2011; Gabdo & Abdlatif, 2013; Suyatno et al., 2021). Indeed, this program is considered a critical step toward sustainability due to its benefits for increased productivity, income diversification, improved resource efficiency, enhanced food security, and greater resilience to climate change (Álvarez et al., 2024). In line with efforts to promote rural and national economic growth, previous studies have shown that integration programs provide both economic (Edwina et al., 2019; Ismail & Wahab, 2014; Paggasa & Abdillah, 2022) and social benefits (Hanifah & Wasito, 2021) for farmers. The initiative is also advantageous for the sustainability of the environment because it can reduce the use of chemical herbicides and inorganic fertilizers, boost biodiversity on plantations, and optimize land use to prevent deforestation, which will result in the loss of biodiversity and carbon stocks (Azhar et al., 2017; Azhar, Nobilly, et al., 2021; Azhar, Tohiran, et al., 2021; Grinnell et al., 2022; Kristiana et al., 2018; Tohiran, Nobilly, Zulkifli, et al., 2019). Through this integration, environmentally friendly products can also be created, such as biogas and organic fertilizers made from cow manure and biourine (Silalahi et al., 2020). Similar initiatives have also been implemented in several other developing countries, such as agro-pastoral systems in Africa (Herrero et al., 2010) and silvopastoral systems in Latin America (Murgueitio et al., 2011), demonstrating the relevance of crop–livestock integration to sustainability and rural development.

Despite having proven benefits, the program has not operated at its best in Indonesia and Malaysia. Smallholders have embraced the integration idea, but major businesses remain hesitant to adopt it (Azhar, Tohiran, et al., 2021), which prevents both countries from fully implementing the system. To ascertain the reasons for the integration system's inadequacy in both countries, this study aims to provide a comprehensive analysis of the integration of oil palm plantations and cattle production, examining its context, content, impact, and key actors in both Indonesia and Malaysia. To the best of our knowledge, no previous research has systematically examined integration policy frameworks in Indonesia and Malaysia. Therefore, the findings of this study are expected to provide lessons for relevant stakeholders—particularly policymakers in Indonesia and Malaysia—to review and improve existing integration policies to enhance their effectiveness. Beyond the national context, this study also aims to enrich global understanding of sustainable palm oil production, climate-resilient agriculture, and progress toward the United Nations Sustainable Development Goals (SDGs), including zero hunger (SDG 2), responsible consumption and production (SDG 12), and climate action (SDG 13).

This study explores aspects that have not been widely compared, particularly the implementation of cattle–oil palm integration policies in Indonesia and Malaysia. While several studies have discussed the technical aspects and environmental benefits of such integration, there has been limited investigation into how these policies are designed and why they have not performed as expected. The novelty of this research lies in addressing these policy design and performance gaps. However, the study also has its limitations. One of the main constraints is the inability to directly capture the stakeholders' perspectives in the program, as the research relies solely on secondary data. The absence of field visits and interviews may have led to the omission of important insights, especially from farmers and companies. Furthermore, since the study focuses on national-level policies, local initiatives and regional differences in implementation could not be fully captured.

2. Methods

This study adopts a qualitative policy analysis approach, utilizing a modified version of the framework introduced by Gagnon and Labonté (2013), which consists of five analytical elements (see Fig. 1). Moat et al. (2013) define the first element, *context*, as the underlying conditions that shape policy decisions, guide policy processes, and facilitate actors' engagement in policymaking. The second element, *process*, encompasses the sequential stages of policy development, including agenda setting, formulation, implementation, and evaluation (Manazir, 2023). The third element, *content*, focuses on the substantive components of a policy—its formal documents, guidelines, and directives that define its intent and scope (Zhou et al., 2022). The fourth element, *impact*, concerns the extent to which the policy achieves its objectives, thereby offering insight into program effectiveness, which is closely linked to the quality of policy implementation (Chowdhury & Panday, 2018). Finally, the fifth element, *actor*, includes individuals (e.g., parliament members, ministers, or specialized journalists), groups within administrative structures, legal entities (e.g., associations, private companies, or trade unions), and social groups (e.g., farmers or buyers) that influence or are affected by policy decisions (Knoepfel et al., 2011).

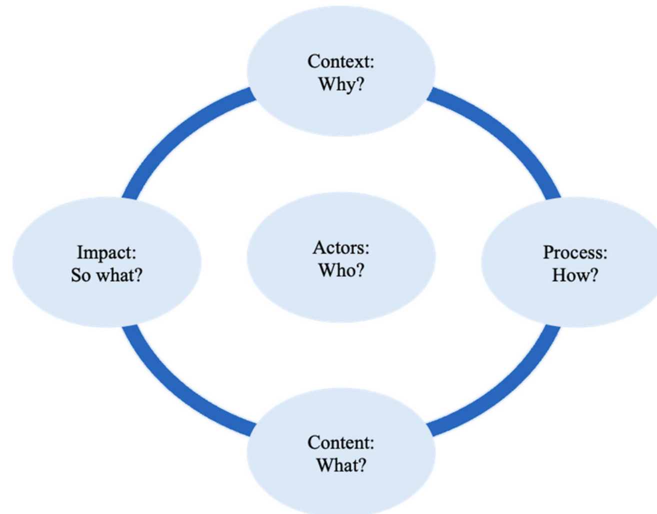

Fig. 1. Policy analysis framework (Gagnon & Labonté, 2013).

The analytical framework illustrated in Fig. 1 guides the organization of this paper. Section 3.1 (Results) examines the *context* element, discussing the significance and urgency of integrating cattle and oil palm in both countries. Section 3.2 (Results) addresses the *content* element, reviewing the main policy features and regulations. The subsequent Discussion section integrates analysis of *impact* and *actors* through the lens of McConnell's policy performance theory, as these elements are best understood through interpretive analysis of implementation outcomes rather than standalone presentation. The *process* element is examined throughout the Discussion as it intersects with both policy implementation and actor dynamics.

To conduct this analysis, we relied on secondary data, organized according to a clear hierarchy of evidence to ensure rigor and transparency. Peer-reviewed scholarship anchors the analysis and establishes factual baselines, theory, and any causal claims. Official government sources from Indonesia and Malaysia define policy content, objectives, and actor roles, and provide verified statistics. International datasets and reports supply comparative context and independent indicators. Finally, policy communication and media, including news items, practitioner outlets, and non-governmental organization (NGO) briefs, are drawn on sparingly to illustrate stakeholder positioning or public discourse and are not used to substantiate scientific facts or causality. This layered sourcing strategy underpins the study's credibility and replicability.

Thematic analysis was then conducted by systematically sorting the extracted information from the above sources into the pre-defined framework elements (context, content, impact, actors). Data from higher-tier sources (e.g., scientific literature and official statistics) were given precedence in establishing facts and drawing conclusions. In contrast, claims based on lower-tier sources (e.g., press releases) were explicitly flagged and used only for their appropriate purpose, such as illustrating stakeholder perspectives.

By adopting this framework, the study aims to comprehensively analyze the integration of oil palm plantations and cattle production, examining its context, content, impact, and key actors. Using secondary data sources enables an extensive review of existing policies and relevant information on the topic. By thoroughly exploring these elements, this study contributes to a deeper understanding of the challenges, opportunities, and implications of integrating oil palm plantations and cattle production in Indonesia and Malaysia.

The works of Pressman and Wildavsky (1984) and Mazmanian and Sabatier (1983) provide the foundation for implementation theory, which emphasizes the gap between policy formulation and its implementation. This approach examines the extent to which institutional capacity and coordination mechanisms influence the outcomes of cattle–oil palm integration policy. This study draws on McConnell's (2010) policy failure theory to understand policy weaknesses across three interdependent dimensions: *program*, *process*, and *political*. A policy becomes unsuccessful not only because it does not achieve its intended objectives (*program* dimension), but also when its implementation processes are fragmented, poorly coordinated, or lack stakeholder participation (*process* dimension), or when it loses legitimacy and political support (*political* dimension). McConnell argues that policy underperformance can stem from any of these dimensions and that success requires alignment across all three. This framework is particularly relevant for analyzing why Indonesia's SISKA and Malaysia's PINTAR programs have achieved limited adoption despite sound technical design.

Structurally, this framework offers a comprehensive and systematic approach to analyzing policies from multiple perspectives, ranging from context to the actors involved. Its flexibility is also an added value, as the framework can be applied to cross-country comparative studies and adapted to each country's specific characteristics. In addition, the framework helps organize secondary data in a focused, transparent manner and facilitates the identification of weaknesses in the policy implementation process. However, this framework also has several weaknesses that may reduce the reliability of the analysis results. It cannot capture interactions among policy elements; for instance, the relationship between actors and impacts cannot be explored in depth. The framework also does not accommodate potential future policy changes. Finally, its reliance on formal documents risks misalignment with on-the-ground realities, particularly in capturing local or community perspectives.

3. Result

3.1. *The shared context: the strategic imperative for integration*

This section addresses the *context* element of the policy analysis framework, examining the underlying conditions that shape the rationale for cattle–oil palm integration in Indonesia and Malaysia.

There are several reasons why Indonesia and Malaysia must continue to strengthen their oil palm integration programs. *First*, both countries are the world's leading palm oil producers, and the expansion of oil palm cultivation remains one of the main drivers of deforestation and biodiversity loss in Southeast Asia (Brookfield & Byron, 1990; Geist & Lambin, 2002; Sayer et al., 2012; Vijay et al., 2016). In Indonesia, approximately 54% of new oil palm plantations were established on areas that had been forested in 1989, while in Malaysia, the proportion was around 40% (Vijay et al., 2016).

Second, oil palm plantations frequently rely on significant amounts of herbicides to control weeds (Alam et al., 2015; Ashton-Butt et al., 2018; Otieno et al., 2016; Qaim et al., 2020; Shevade & Loboda, 2019). Fertilizer application is also one of the most significant cost components in mature oil palm cultivation, accounting for approximately 20–25% of total production expenses (Corley & Tinker, 2016). Excessive fertilizer and pesticide use increases production costs and contributes to avoidable greenhouse gas (GHG) emissions. Deforestation and forest degradation account for a substantial share of such emissions, with degradation responsible for about 10–40% and deforestation for 60–90% of net carbon releases (Houghton, 2012). These figures underscore the importance of preventing further forest conversion to oil palm plantations and minimizing agrochemical overuse within existing plantations (Tohiran, Nobilly, Maxwell, et al., 2019).

Third, there is a decreasing amount of agricultural land available for animal grazing due to numerous land conversions, making it difficult for livestock producers to obtain animal feed, which can account for up to 70% of the total cost of raising cattle (Silalahi et al., 2019). With 17, 983 ha, Malaysia has a limited amount of land suitable for animal grazing (Kementerian Pertanian dan Keterjaminan Makanan Malaysia, 2015). This data explains why most livestock producers in Malaysia are content with traditional farming, which involves raising their animals on a small scale with limited grazing acreage (Hashim, 2015). With 4,204,213 members, smallholder farms are responsible for more than 98% of Indonesia's livestock, providing up to 78% of the national cattle supply. The DVS (2021) reports a similar pattern in Malaysia, where approximately 92% of livestock breeders are smallholders. Small farms tend to follow specific patterns, including 1) capital shortage; 2) low production input; 3) limited marketing network; 3) poor livestock innovations (Ariff et al., 2015); 4) animals utilized as life savings; 5) cattle kept in towns with plenty of people and kept behind dwellings; 6) limited livestock rearing acreage forces farmers to look for feed in remote locations; 7) farming has been a family business for generations; and 8) if they lack the funds to make a purchase, the farmer is brimming with ideas for profit-sharing schemes (Putra, 2022). Families raising their animals for savings typically make up smallholder farmers. These savings will cover their anticipated living expenses. In general, they only have a few heads available for breeding, roughly fewer than ten.

Fourth, the expansion of oil palm plantations will lead to higher waste production, accounting for 45–46% of total processing output. Previous studies have reported that oil palm by-products may contain measurable levels of crude protein, fiber, and fat, although the values differ substantially across studies (Table 1) (Hanum, 2023). The

Table 1
Nutritional value of palm oil by-products before fermentation.[a].

Feed Nutrition	POS[1]	PKC[2]	PKM[2]	EFB[3,4]
Dry matter (%)	90	88.57–91.42	91.75–96.3	–
Crude protein (%)	9.6–15.52	16.23–16.86	16.6–20.04	3.7
Crude fat/Ether extract (%)	10.5	4.12–6.82	7.59–8.63	3.2
Crude fiber (%)	11.5–32.9	15.12	12.29–15.47	48.8
Ash (%)	9.25	4.47–6.58	3.88–7.56	0.26
Calcium (%)	0.50–0.97	0.25–0.27	–	–
Phosphorus (%)	0.17–0.75	0.33–0.46	–	–
Lignin (%)	–	15.1	–	10–34.37
Cellulose (%)	–	35.55	–	22.2–65
Carbohydrates (%)	–	47.71	–	–
Gross energy (kcal/kg)	3315–4470	4153	4872	–
Metabolizable energy (kcal/kg)	1125–1593	0.0025–0.0027	2423–2792	–

[a] Values are reported from different studies and are not directly comparable due to variations in processing techniques, sampling conditions, and analytical methods.

Source: [1]Sinurat (2003) and Ginting & Krisnan (2005), as cited in Saleh et al. (2021); [2] Cerveró et al. (2010), Keong (2004), Alshelmani et al. (2017), Mustafa et al. (2004), Fadil et al. (2014), Akinyeye et al. (2011), and Alimon (2004) as cited in Azizi et al. (2021); [3]Wong and Zahari (1992) and Zahari et al. (2000) as cited in Zahari et al. (2012); [4]Sarwono et al. (2014), Wirasnita et al. (2015), Yavari et al. (2017), Parshetti et al. (2013), and Idris et al. (2010) as cited in Windiastuti et al. (2022).

nutritional composition of oil palm by-products reported in the literature varies considerably depending on processing methods, maturity stage, and measurement techniques. Therefore, Table 1 presents the ranges reported in previous studies rather than standardized feed composition values.

Fifth, the rising trend in beef consumption in both countries is driven by population growth and changing dietary preferences. However, national beef production has been unable to keep pace with rising demand, leaving imports as the primary means of meeting domestic demand. Several factors contribute to the persistently low level of domestic beef production. The livestock industry remains dominated by smallholders, while land-use changes have reduced access to grazing areas and feed resources for smallholder farmers (Ariff et al., 2015). Moreover, younger generations are increasingly reluctant to engage in farming. Adverse weather conditions, particularly during the dry season, often lead to feed shortages, resulting in underfeeding and reduced reproductive performance. The livestock sector is also perceived as less profitable due to high production costs, especially for feed and labor. Additionally, the geographical dispersion of livestock hubs, which are often located far from markets, increases transportation costs to slaughterhouses and further limits profitability (Wiguna & Inggriati, 2015).

Sixth, Alit Artha Wiguna & Tatik Inggriati (2015) and Bogor Regency (2019) found that the high rate of productive female cattle slaughter—accounting for approximately 28% of all cows slaughtered daily in Indonesia—significantly constrains the growth of the national cattle population. Several factors drive the slaughter of productive females: (1) farmers' urgent need for cash to cover household expenses; (2) lower purchase prices for female cattle compared to bulls, despite similar meat prices; (3) the prevalence of slaughtering outside government-supervised abattoirs; and (4) profit-oriented slaughterhouses that lack incentives to prohibit the killing of productive cows. Wiguna and Inggriati (2015) further noted that this practice results in severe population losses, with up to 60 potential calves lost for every 100 productive females slaughtered, making it one of the most detrimental factors to cattle population sustainability.

According to the Indonesian Ministry of Agriculture, there were 18.55 million head of beef cattle in Indonesia, comprising 5.9 million bulls and 12.6 million females. Of the bulls, only 1.8 million were suitable for slaughter, with approximately 90% processed through slaughterhouses. Among around 417 thousand mature heifers, those eligible for slaughter were generally unproductive. Given that only about 2.1 million beef cattle were available for slaughter, the estimated total meat production amounted to 370 thousand tons (Sapibagus, 2021), far below Indonesia's annual beef demand of more than 700 thousand tons. Consequently, despite an annual increase in cattle numbers, Indonesia continues to rely on imports of live cattle and frozen beef to meet domestic demand.

On the other hand, Malaysia has a cattle population of over 721 thousand but produces only 36.8 thousand tons of beef annually—far below the national demand of 179.6 thousand tons. To bridge this gap, the government imported approximately 169,000 tons of beef in 2021 (DVS, 2022a). This situation requires urgent attention and coordinated action from both governments, particularly given that smallholder farms continue to dominate the livestock sector in Indonesia and Malaysia.

The integration of cattle into plantations represents a promising strategy to enhance sustainability, as it promotes a mutually beneficial relationship between livestock producers and plantation managers while helping to mitigate issues such as deforestation, grazing-land scarcity, and herbicide dependence (Azhar, Nobilly, et al., 2021; Grinnell et al., 2022; Nobilly et al., 2022). On the one hand, oil palm plantations can serve as a valuable source of forage, providing grasses (28.2–37.5%), broad-leaved species (37.5–42.9%), leguminous plants (12.5–15.6%), and ferns (7.1–12.5%) (Ismail & Wahab, 2014). Conversely, cattle are advantageous because they produce manure as a natural fertilizer and help control weeds.

The extensive oil palm plantations in Indonesia (>15 million hectares) and Malaysia (5.6 million hectares) present a significant opportunity for agricultural integration, with the potential to enhance national beef production through silvopastoral systems. A critical factor for the success and sustainability of such systems is determining an appropriate stocking density, which is not a fixed value but a function of dynamic biophysical and managerial variables, including forage biomass, cattle breed, liveweight, sex, and age.

Empirical data underscore this variability. Field studies in Malaysia report stocking rates ranging from 0.10 to 0.30 Tropical Livestock Units (TLU) per hectare (where 1 TLU = 250 kg liveweight), corresponding to approximately one small adult Kedah-Kelantan cow (≈250 kg) per hectare under typical forage conditions (Grinnell et al., 2022). These findings highlight that simplistic, fixed-rate estimates—such as the administrative ceiling of two heads per hectare stipulated in Indonesia's Permentan—should be interpreted as regulatory guidelines rather than robust biophysical standards. Optimizing stocking rates within these ecological carrying capacities is essential to maximizing productivity without compromising system sustainability.

This integration offers a viable pathway to improve domestic beef sufficiency when properly managed. Typical dressing percentages demonstrate the productivity of such systems; for instance, Priyanto et al. (2019) report a range of ≈41–60% for Indonesian local breeds, while Coyne et al. (2019) note a range of ≈49–56% for international beef breeds. Beyond direct meat production, the strategic integration of cattle into oil palm landscapes aligns with the sustainable intensification paradigm. It contributes to achieving at least 11 out of 17 SDGs: 1 (no poverty), 2 (zero hunger), 3 (good health and well-being), 6 (clean water and sanitation), 8 (decent work and economic growth), 9 (industry, innovation, and infrastructure), 10 (reduced inequalities), 12 (responsible consumption and production), 13 (climate change), 15 (life on land), and 17 partnerships for the goals (Azhar, Tohiran, et al., 2021).

3.2. The content element: policy design and regulations

This section addresses the content element of the policy analysis framework by examining the formal policies, regulations, and technical guidelines governing cattle–oil palm integration in both countries.

3.2.1. Cattle-oil palm plantations policy in Indonesia

The SISKA program in Indonesia is formally governed by the Permentan issued in 2014 (Indonesian Minister of Agriculture, 2014), although implementation began as early as 2005. The regulation defines the integration of oil palm plantations with beef-cattle farming as a unified, mutually beneficial business model aimed at optimizing resource use within plantation areas. Through this approach, plantation by-products such as palm kernel cake (PKC) and palm oil sludge (POS) are utilized as cost-effective animal feed. At the same time, cattle manure and biowaste are processed into organic fertilizer and biogas to enhance soil fertility and reduce reliance on chemical inputs. Fig. 2.

The regulation allows the system to be implemented by both smallholders and plantation companies, depending on the size of the land. Smallholders with fewer than 25 ha may adopt intensive or semi-intensive integration systems, while plantations of 25 ha or more can implement intensive, semi-intensive, or extensive systems (Fig. 2). Integration in plantation areas smaller than 25 ha must be registered with the regent or mayor through the local plantation office. In contrast, integration in areas of 25 ha or more requires a plantation business license. The regent or mayor licenses plantations within a single regency or municipality, whereas the governor authorizes those spanning multiple administrative regions within the same province.

In practice, the intensive system refers to full-time stable-based housing (zero-grazing), where cattle are continuously kept in enclosures and fed mainly with plantation by-products. The semi-intensive system involves controlled grazing from morning until late afternoon, followed by stabling at night. Meanwhile, the extensive system applies rotational

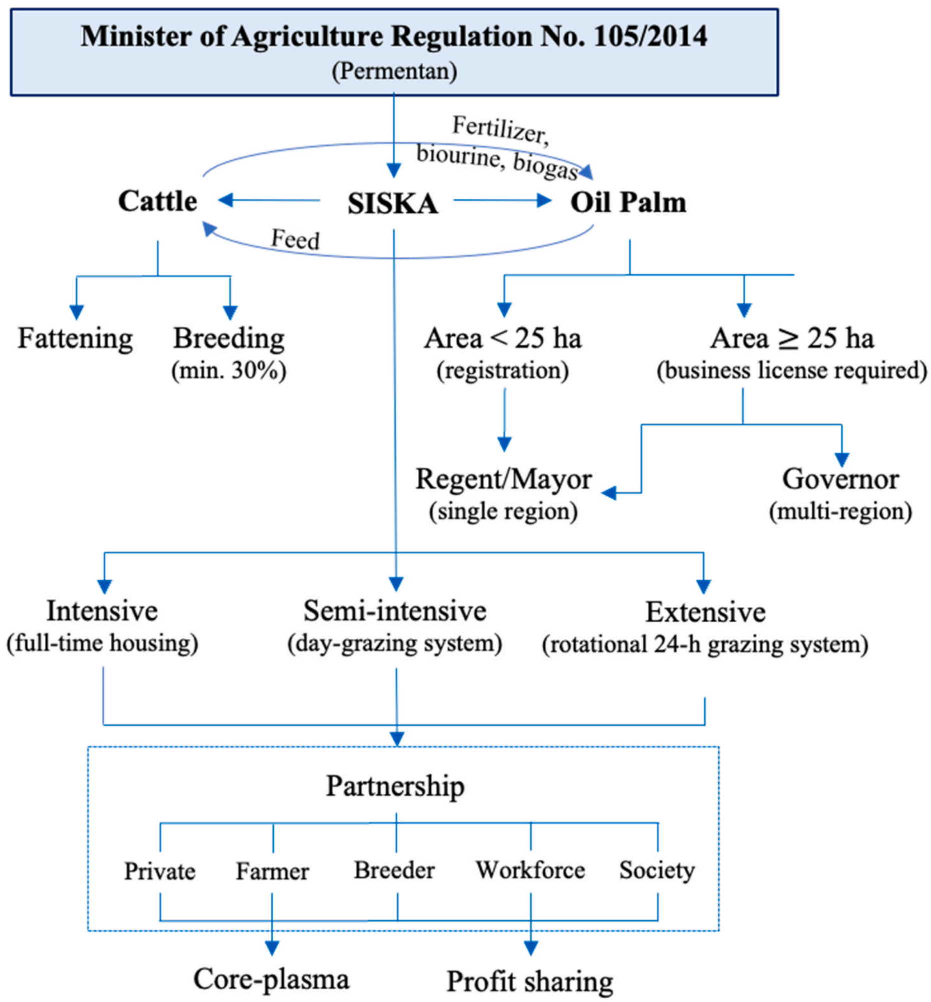

Fig. 2. SISKA Policy Based on Permentan in Indonesia (source: author's illustration).

grazing throughout the day within fenced plantation plots, allowing each plot at least 60 days of rest to regenerate forage. The Permentan also specifies a maximum stocking density of two cattle per hectare and emphasizes the need to balance breeding and fattening, requiring that at least 30% of the herd be allocated to breeding to ensure the long-term sustainability of production.

In the field, a commonly preferred breed is the native Balinese cattle, known for its high adaptability and reproductive performance, with an estimated birth rate of around 80% (Sumbar Province, 2016). While the Permentan recognizes breeding and fattening activities, it primarily provides technical guidelines for good oil palm and beef cattle cultivation practices and lacks detailed provisions for breeding management. Overall, the integration model establishes a synergistic system in which cattle benefit from plantation by-products as feed while contributing to plantation sustainability by recycling organic waste into fertilizers and renewable energy sources.

The integrated system applies only to plantations already in production; however, the Permentan does not specify the age at which oil palm trees are considered productive. As a result, opinions vary regarding the appropriate stage for integrating cattle breeding systems into plantations. Woittiez et al. (2017) note that oil palms remain immature from planting until around two to three years of age, when they begin producing harvestable fruit and their canopy remains open. In contrast, the East Kalimantan Plantation Office (2014) suggests that oil palm trees should not be used for extensive integration patterns until they are at least seven years old, and that participation in integration programs should begin only after the trees reach two to three years of age. During this immature phase, the applicable integration model is an intensive system, in which grass from oil palm plantations is harvested and used as cattle feed.

The Permentan promotes collaboration, including core-plasma and profit sharing, to successfully implement the SISKA program. The core-plasma system comprises giant corporations that serve as the core and must support micro, small, and medium-sized businesses as the plasma (Indonesian Presidency, 2021). Core companies provide land, tools, technical advice, technology advancement, financing, and assistance to increase business productivity. Plasma farmers are expected to enhance their management skills and performance for optimal results (Puteri & Kurniawan, 2017; Setiawan et al., 2019).

3.2.2. *Cattle-oil palm plantations policy in Malaysia*

Fig. 3 Malaysia's cattle–oil palm integration policy is coordinated under the Ministry of Agriculture and Food Industries through the DVS and the Malaysian Palm Oil Board (MPOB). Both agencies jointly promote the integration of ruminant production within oil palm plantations to increase national beef self-sufficiency and improve land-use efficiency. This initiative aligns with the national Ruminant Industry Development Plan and the PINTAR program, which aim to utilize oil palm areas for dual-purpose crop and livestock production. Unlike Indonesia's Permentan, Malaysia's framework develops through coordinated technical standards and government-supported schemes rather than a single regulation. The DVS provides farm accreditation, veterinary inspection, and biosecurity oversight, while MPOB manages land-use coordination and plantation participation. Integration projects are

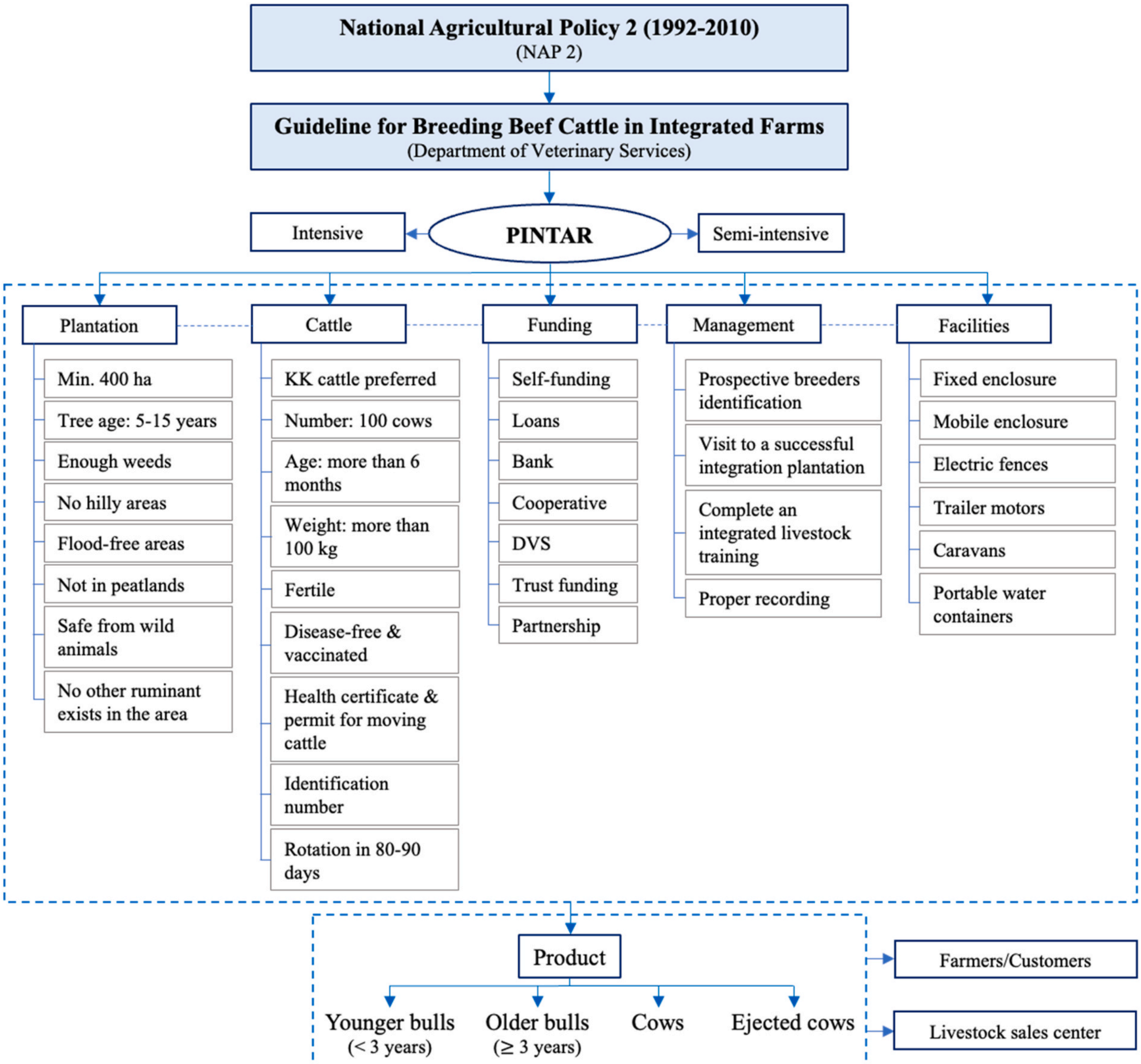

Fig. 3. PINTAR Guideline in Malaysia (source: author's illustration)
Note: KK = Kedah–Kelantan; DVS = Department of Veterinary Services.

implemented through federal and state-level agencies, often in collaboration with government-linked companies, private plantations, or smallholder clusters.

In contrast to Indonesia, Malaysia's integration policy, guided by the DVS, emphasizes the use of grass in oil palm plantations for cattle feed. Malaysia adopts a dual approach to cattle–oil palm integration, applying different management systems based on land scale and production objectives. KK cattle are the main local breed used in these integration systems, valued for their strong disease resistance and adaptability to tropical conditions. For smallholdings of approximately 10–20 ha, the MPOB promotes the intensive system through its Technology Transfer Series (TT No. 519), where cattle are stall-fed with cut-and-carry Napier grass (*Pennisetum purpureum*) and PKC. This zero-grazing model aims to optimize feed efficiency and control breeding and health management within limited land areas. Financial analysis of this intensive model demonstrates an internal rate of return (IRR) of 19% and a payback period of six years over a ten-year investment horizon, based on 50 breeding cows in a 10-ha operation (Tohiran et al., 2012). This model supports smallholders seeking to diversify income while maintaining plantation productivity.

Conversely, the DVS under the PINTAR program recommends a semi-intensive rotational grazing system for medium- and large-sized estates, where cattle graze within subdivided paddocks for one day per plot in a three-month rotation (DVS, 2022b). Earlier MPOB guidelines (TOT Nos. 96 and 410) support this system, which is technically suited to plantations with more than 100 cattle and 400 ha of mature palms (DVS, 2022b; Tohiran et al., 2012), representing a lower density than Indonesia's SISKA system. Within the PINTAR framework, the DVS recognizes two viable management methods—intense and semi-intensive—while excluding the extensive system (Fig. 3). These two complementary models illustrate Malaysia's adaptive policy framework, which scales from smallholder-intensive systems to estate-level semi-intensive operations, aligning technical management practices with land size and resource availability.

The breeding industry typically adopts a semi-intensive design, whereas fattening enterprises commonly use intensive systems. In the semi-intensive model, cows, bulls, and calves are kept and managed together within the same herd. This system produces weaned bull calves, heifer calves aged over six months or weighing more than 100 kg, and breeding cows maintained under controlled feeding conditions. In contrast, the intensive system involves only a single class of livestock—young males or females aged over six months or weighing more than 100 kg—managed as a single group. To prevent inbreeding, stud bulls should be replaced approximately every three years. The DVS also prescribes systematic record-keeping for every farm, covering data on birth, death, grazing rotation, weighing, sales, purchases, treatments, and daily activities. Economic assessments of the semi-intensive PINTAR system indicate an IRR of 27.6% and a payback period of less than five years over a 10-year project period (DVS, 2022b). Beyond financial viability, the PINTAR framework enhances environmental sustainability by reducing weed growth, lowering herbicide use, and recycling organic nutrients. These features demonstrate how the PINTAR model integrates productivity, efficiency, and ecological balance in Malaysia's plantation-livestock sector.

4. Discussions

This section analyzes the impact, actors, and process elements of the policy analysis framework by examining how the governments of Malaysia and Indonesia have incorporated the cattle–oil palm integration approach into a range of policy initiatives. Since 1992, Malaysia has acknowledged a national integration program under NAP 2, in which DVS outlines regulations in a manual that all participants must abide by. Meanwhile, Indonesia began implementing the system nationwide in 2005, and in 2014, a ministerial decree made it official.

Although the two countries' integration policies have been national programs for some time, Indonesia and Malaysia have nevertheless had trouble recruiting participants. After more than three decades of the PINTAR initiative, only 12–15% of the total number of oil palm plantations in Malaysia are currently participating in the integration program. Similarly, although exact figures are unavailable, Indonesia's SISKA program—launched nearly two decades ago—has shown limited progress. The slow uptake of these integration schemes is evident in the continued rise of beef imports (HS Codes 0201 and 0202) in both countries (UN Comtrade, n.d.), indicating that domestic production has not kept pace with increasing consumption (Fig. 4).

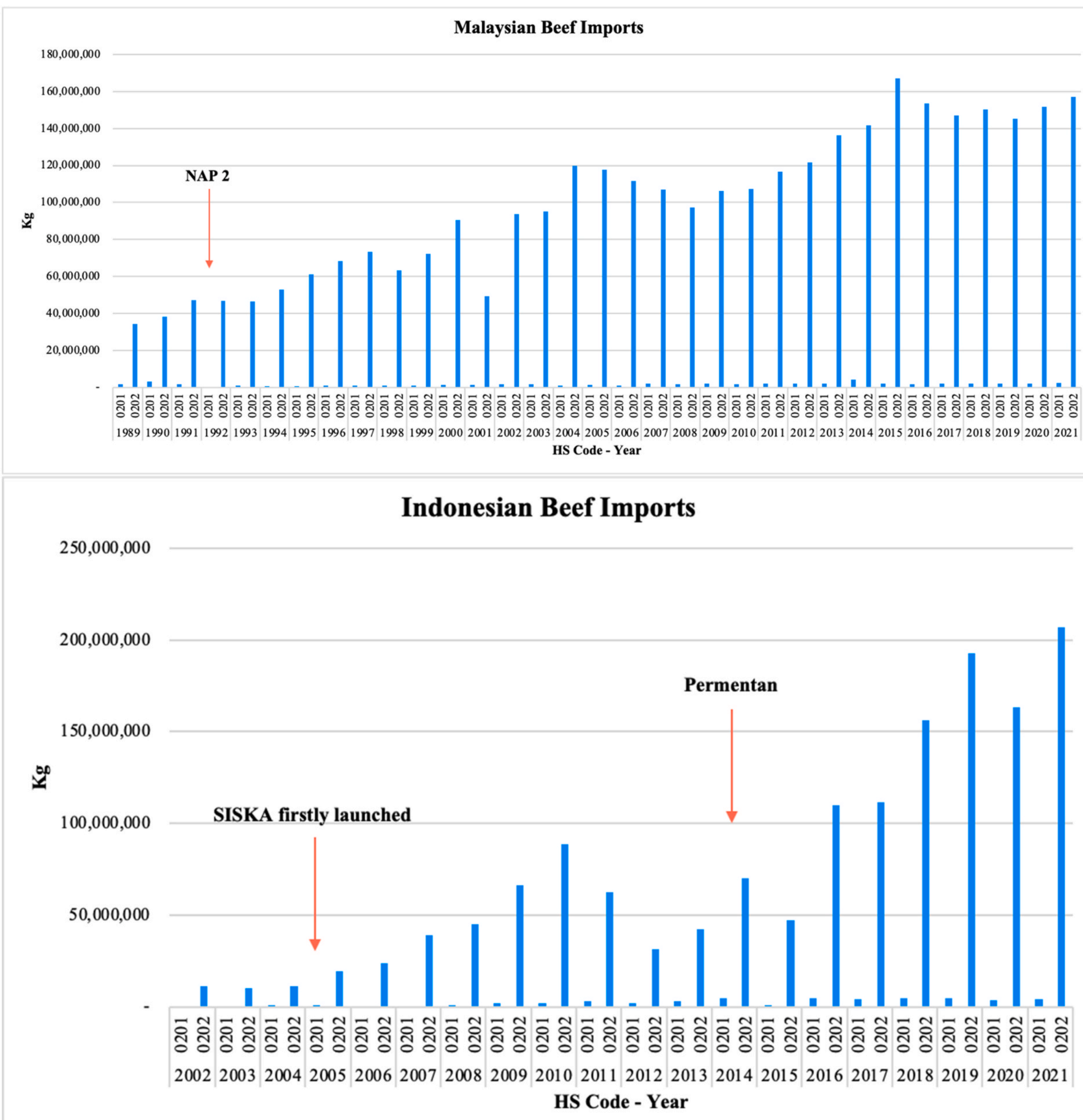

Fig. 4. Beef imports in Malaysia and Indonesia (UN Comtrade, n.d.)
note: NAP = national Agrofood policy; SISKA = Sistem Integrasi Sapi Kelapa Sawit.

On the other hand, the harvested area of oil palm plantations (Fig. 5) expanded significantly in both countries, albeit at different scales. In Malaysia, the harvested area increased steadily from 1.67 million hectares in 1989 to 5.14 million hectares by 2021, reflecting a fourfold growth over three decades before reaching a plateau after 2013. In contrast, Indonesia's expansion has been far more rapid: from 2.79 million hectares in 2002[1] to 15 million hectares in 2021, making it the world's largest producer (FAOSTAT, 2024). The continuous expansion of plantation land underscores the growing importance of the oil palm sector in both economies. However, the relatively slow adoption of cattle–oil palm integration indicates that land availability alone has not translated into proportional livestock integration.

McConnell's (2010) three-dimensional framework helps explain why Indonesia's SISKA and Malaysia's PINTAR programs have underperformed despite their technical soundness. The challenges faced by both countries can be examined through two complementary perspectives that align with the *impact* and *actors* elements of our policy analysis framework. The first is an overly program-oriented approach, in which governments focus on launching schemes and technical guidelines without establishing measurable outcomes, adaptive monitoring, or feedback loops—reflecting a shortfall in the *program* dimension that directly relates to policy *impact*. The second concerns ineffective partnership or inadequate collaborative action, where weak institutional linkages, asymmetrical power relations, and limited private-sector engagement undermine legitimacy and coordination—typifying weaknesses in the *process* and *political* dimensions that center on the *actors*. Together, these perspectives illustrate how the absence of outcome-driven design and inclusive collaboration constrains the long-term success of integration initiatives.

4.1. Impact element: policy performance and implementation gaps

This section evaluates the *impact* dimension of the policy analysis framework through McConnell's *programmatic* lens, with particular attention to the relationship between policy design and substantive outcomes. Evidence suggests that, in both countries, the integration agenda has been operationalized primarily through activity-based targets rather than outcome-based performance indicators. As a result, implementation has tended to privilege program expansion and administrative deliverables over measurable improvements in productivity, adoption, or sustainability. Consistent with McConnell's account of *program underperformance*, such emphasis on inputs and symbolic achievement limits opportunities for effectiveness, feedback integration, and policy learning.

Malaysia's integration program, for instance, is founded on the assumption that grass availability determines feasibility, with limited attention to feed diversity or nutritional balance. The integration system is unsuitable for plantations that have been intensively weeded and lack ground grass. Key elements in the success of cattle development include the availability of feed and feeding procedures that balance livestock nutritional needs. Feeding animals a single type of feed, such as grass or forage, cannot meet their dietary requirements. According to Amin (2014), malnutrition adversely affects animals by delaying puberty, raising the likelihood of farm failure, and causing infertility. Nevertheless, feed requirements increase as cattle are reared for more extended periods.

In contrast, Indonesia's Permentan does not refer to using grass but instead focuses on using palm oil by-products, such as POS, PKC, PKM, and empty fruit bunch (EFB), as domestic animal feed. The fundamental challenge, particularly for smallholder cattle farmers, lies in the difficulty of obtaining palm-oil by-products for feed, especially PKC and PKM, which are commonly controlled by large feed companies or exported, leaving little available for local use (Silalahi et al., 2018). However, EFB is not very suitable for animal feed, as it has a low protein content and a high lignocellulose content, which negatively affect digestibility (Table 1). While lignocellulose can be reduced through fermentation (Suhartini et al., 2022), this treatment increases costs and leaves the low protein content unchanged. The transport costs per kg of protein will be more than three times those of PKM and PKC. The use of POS as animal feed is limited because it has lower ME and protein density than PKC and PKM, which will also lead to transport costs per kcal ME from the mill to the smallholder that are almost twice those of PKC and PKM (Table 1).

Indonesia's Permentan similarly codifies technical requirements for integration but neglects mechanisms to evaluate productivity gains, adoption rates, and farmer welfare. Rather than learning from outcomes, the emphasis on compliance with program guidelines illustrates a structural bias toward programmatic outputs.

These tendencies reveal what McConnell (2010) describes as a "narrow conception of success," in which visible policy instruments—such as the issuance of regulations and technical manuals—are mistaken for genuine effectiveness. Consequently, both governments have achieved *partial process success* through policy formulation and enactment, but *limited program success* in achieving measurable, sustainable integration outcomes, such as higher cattle productivity, increased feed availability, or greater farmer participation.

Programs for integration in Malaysia and Indonesia also place much emphasis on integrated land, in addition to feed-related challenges. On the one hand, Malaysia typically adopts a capital-intensive strategy that requires large-scale integration (minimum 400 ha), which poses a significant challenge because it can prevent small-scale plantations from contributing to the success of governmental initiatives. In Malaysia, smallholders possess at least 26.15% of the country's oil palm farms (organized and independent). On the other hand, Indonesia prefers to take a more inclusive approach, implementing a smaller-scale integration program that welcomes participants with a plantation area of less than 25 ha. However, to ensure that the integration project is successful and results in higher profits for both parties (plantation owners and breeders), the efficiency scale must be considered while determining the minimum land area to be adhered to.

Conceptually, numerous studies have demonstrated that combining oil palm plantations with cattle farming offers several benefits, stemming from their mutually beneficial relationship, including economic, social, and environmental advantages. Indonesia and Malaysia, which have the most significant areas of oil palm plantations in the world (see coverage area in Table 2), are the countries where this integrated system is ideal for implementation. Although this application appears attractive, businesses are unwilling to try this integration. One major factor lies in how animal farming is regulated within integrated plantations. There are just two integration programs available in Malaysia: intensive and semi-intensive. The intensive system is primarily employed for fattening, with cattle kept in stalls throughout production. This arrangement allows farmers to control nutrient intake while minimizing the risk of weight loss from excessive movement and reduced productivity and welfare from heat stress (Lees et al., 2019). An additional advantage of this system is that it enables farmers to detect sick animals more easily and prevent disease transmission, since all feed is supplied through cut-and-carry grass from oil palm plantation areas. However, this system also increases feed costs and requires substantial investment in stall construction.

In a semi-intensive system, cattle graze in plantation areas from morning until evening before being sheltered at night. This arrangement reduces feed costs because cattle can consume grass and palm residues, such as leaves and fronds. It is also more cost-effective for oil palm plantations, as weeding costs are lower. Furthermore, reduced herbicide

[1] The reference years (1989 for Malaysia and 2002 for Indonesia) represent approximately three years before each country's integration policy implementation (Malaysia, 1992; Indonesia, 2005). This alignment is intended to illustrate pre- and post-policy trends in harvested oil palm area rather than to provide a synchronized cross-country comparison.

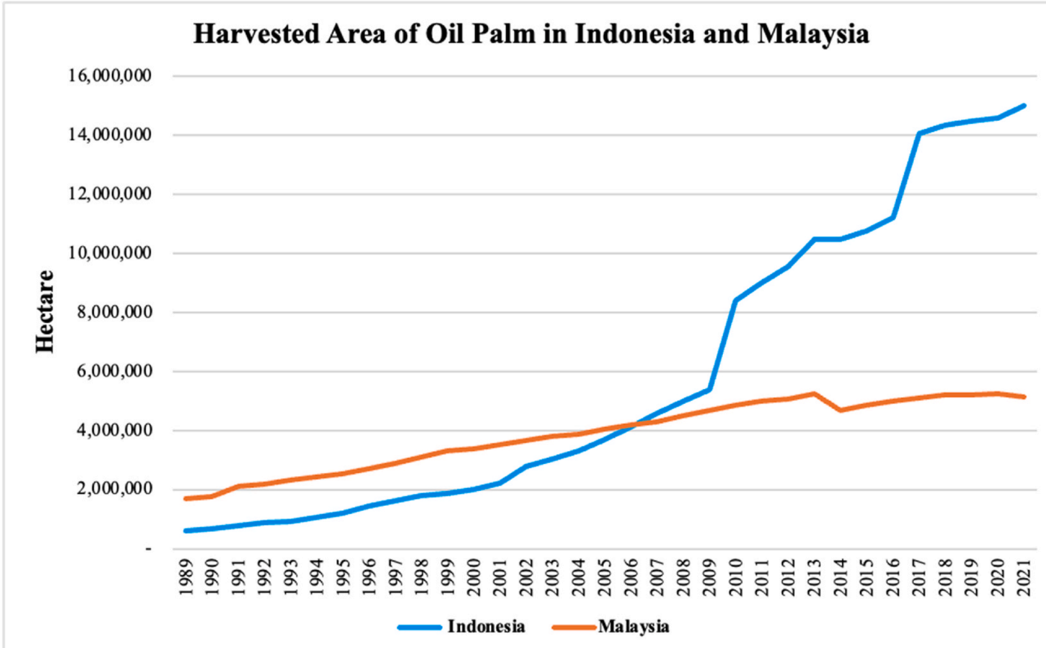

Fig. 5. Harvested area of oil palm in Indonesia and Malaysia (FAOSTAT, 2024).

use lessens the risk of soil degradation and groundwater contamination (Baćmaga et al., 2024; Brar, 2020). Nevertheless, industry stakeholders appear to pay little attention to these environmental benefits.

In addition to the two systems previously discussed, Indonesia also employs an extensive farming model within its integrated plantation program. Under this approach, cattle remain in plantation areas without shelter. Although it reduces stall construction costs, the system is highly vulnerable to cattle theft—particularly before major festivals such as Eid al-Fitr and Eid al-Adha, when demand for meat surges. Cattle theft has become a major challenge in Indonesia's integrated livestock–oil palm system (Bremer et al., 2022). Organized crime groups frequently target livestock and often use firearms, creating insecurity among local farmers and making it difficult for them to respond effectively. Because potential financial losses often exceed the profits expected during the first two to three years of rearing, this issue is a significant reason for local reluctance to engage in livestock production.

To support farmers, policymakers and agribusinesses must address key challenges, including livestock disease control and the limited availability of high-quality supplementary feed, given that most feed still relies on grass. Large plantation enterprises also remain reluctant to join the integration program due to concerns that cattle may damage oil palm crops (Silalahi et al., 2018), particularly under extensive or semi-intensive systems. These constraints illustrate the significant difficulties of sustaining cattle production within oil palm plantations.

The evidence indicates that implementation, not policy design, is the primary barrier. Governments must now focus on closing this implementation gap through a triad of decisive actions: establishing robust monitoring and evaluation to track progress, creating tangible economic incentives for plantation participation, and building effective support systems that empower smallholders with access to capital, technology, and markets.

4.2. Actors and process elements: Coordination and collaboration issues

This section interrogates the *actors'* dimension of the policy analysis framework through McConnell's *process* and *political* lenses, focusing on how fragmented partnerships, asymmetric power relations, and constrained stakeholder participation have shaped implementation dynamics. The analysis highlights persistent collaborative deficits that correspond to weaknesses in both the process and political dimensions of policy performance. Although formal arrangements promote coordination among ministries, plantation companies, breeders, and financial institutions, these partnerships frequently operate without substantive interdependence, mutual trust, or meaningful resource sharing, thereby limiting their capacity to sustain effective implementation.

In Malaysia, capital cooperation schemes rely heavily on financial institutions that are risk-averse toward agriculture, thereby constraining implementation. In Indonesia, core–plasma arrangements exhibit information asymmetry, weak bargaining power, and limited transparency—all symptomatic of a process shortfall, in which implementation networks operate without coherent coordination or mutual accountability.

Such weak partnerships also erode political legitimacy, as smallholders perceive the programs as top-down and inequitable. Successful integration cases in both countries demonstrate that when process coherence and actor collaboration improve, policy credibility and adoption rise correspondingly, illustrating McConnell's principle that sustained legitimacy and stakeholder alignment are prerequisites for enduring policy success.

According to Maryono et al. (2024), collaborative partnerships among agricultural stakeholders can generate synergistic outcomes that exceed what individual actors could achieve independently. Similarly, Hu et al. (2024) found that PPPs have long operated in the infrastructure, education, and healthcare sectors. Nevertheless, their application in the agricultural industry remains relatively new and limited. In China, for instance, agrarian PPPs began only in 2014 and currently account for less than 1% of total PPP projects and investment, reflecting their early stage of development compared to other industries. Despite this limited adoption, agricultural PPPs hold considerable potential to modernize the sector and promote the inclusion of smallholder farmers in sustainable agricultural growth.

Regarding integration initiatives, Indonesian and Malaysian governments encourage parties to work together, from capital acquisition to product marketing. In Malaysia, for instance, capital collaboration can be accomplished through various plans, including loans, banks, cooperatives, trust funds, and partnerships. Most actors involved in the plan selection include financial institutions unwilling to incur risks typical to the agriculture industry, such as pests, droughts, floods, and

Table 2
Comparison of oil palm plantation, cattle industry, and integration system in Indonesia and Malaysia.

Category	Indonesia	Malaysia
1. Oil Palm Plantation		
a. Coverage area (hectare)	2022: 15,081,021 (Directorate General of Estate Crops, 2020)	2022: 5,674,742 (MPOB, 2022)
b. Farming category	● Smallholders (40%): 6,084,126 ha ● Government (4%): 579,664 ha ● Private (56%): 8,417,232 ha (Directorate General of Estate Crops, 2020)	● Private & government (73.85%): 4,190,766 ha ● Organized smallholders (11.77%): 667,868 ha ● Independent smallholders (14.38%): 816,107 ha (MPOB, 2022)
c. Crude Palm Oil (CPO) productivity (ton/ha/year)	2021: 3.74 (Statistics Indonesia, 2022)	2022: 3.25 (MPOB, 2021)
d. Workforce	16.5 million (direct and indirect) Kemnaker (2025)	505,000 (Saad & Doughlas, 2024)
e. Gross Domestic Product (GDP) contribution (%)	3.5 (Ditjenbun, 2022)	2.5 (GDP at constant 2021 price) DOSM (2022)
2. Cattle Industry		
a. Number of cows (head)	2021: 18,552,000 (Sapibagus, 2021)	2022: 721,344 DVS (2022a)
b. Number of breeders	–	50,941 (DVS, 2021)
c. Category of breeders	–	● Commercial: 2% ● Semi-commercial: 6% ● Smallholders: 92% (DVS, 2021)
d. Livestock GDP contribution (%)	2021: 1.5 (Director General of Livestock and Animal Health Services, 2022)	2021: 1.2 (Statista, 2023)
e. Price (per kg)	● Local: IDR 47,583 (producer), IDR 126,483 (consumer) ● Import: USD 3.76 or IDR 57,528 (1 USD = IDR 16,558 on October 17, 2025) ● (Director General of Livestock and Animal Health Services, 2022)	● Local: RM 33.30 (1 USD = RM 4.23 on October 17, 2025) ● Import: RM 17.75 (from India) ● DVS (2022a)
3. Integration System		
a. Benefit	● Increases in FFB yields of approximately 4–5% per ha ● Feeder production cost is 16% lower than for imported cattle ● Cost-saving of around IDR 250,000 per ha ● IRR values increase by 2-3% (IACCB, n.d.)	● Increases in FFB yields by 14% per ha/year ● Weeding costs reduced by 8–60% ● The average maintenance cost decreases by around RM 66 per head per year ● Increases in income by roughly 15–30% ● IRR values range from 25% to more than 50% (Devendra, 2011; Gabdo & Abdlatif, 2013; Latif & Mamat, 2002)
b. Participant	–	2021: 12–15% of the total oil palm plantations (DVS, 2021)
c. Policy/guideline	Permentan	● NAP 2 ● Guide to Breeding Beef Cattle in an Integrated Farm on Permanent Crops
d. Mechanism	● Intensive ● Semi-intensive ● Extensive	● Intensive ● Semi-intensive
e. Introduction year	2005	1992

Note: The farming system, the number of cows, the amount of additional feed supplied, and other factors can affect the benefits differently.

illnesses, or transaction fees covering vast geographic ranges. As a result, although governments in developing countries have undertaken various measures to attract agricultural investment, the sector faces a severe financing gap. This gap is primarily due to limited knowledge of agricultural financial risks and opportunities among lenders and farmers, as well as systemic issues such as risk aversion, asymmetric information, and weak financial infrastructure (Khan et al., 2024).

On the other hand, the profit-sharing and core–plasma schemes are two principal forms of collaboration commonly implemented in Indonesia's oil palm sector. However, numerous studies have shown that the core–plasma model faces persistent structural weaknesses. Companies (*core*) typically control key decisions regarding seed selection, input supply, and marketing, leaving smallholders (*plasma*) with limited participation and bargaining power (Trifosa et al., 2024). Profit-sharing arrangements are often non-transparent, and the actual returns received by farmers are frequently lower than promised (Berenschot et al., 2022). The asymmetrical power relations within these partnerships also result in unequal access to information, weak negotiating positions for farmers, and a lack of long-term planning or replanting support from companies (Trifosa et al., 2024). In practice, this dependency constrains smallholders' autonomy and limits their ability to benefit fully from government-promoted integration programs.

Both Malaysia and Indonesia have participants who have successfully implemented integration schemes. However, their role in promoting broader program success remains limited. In Malaysia, for example, managers or owners must visit a successfully integrated plantation before initiating their own program. Nevertheless, no formal mechanism exists to facilitate the systematic transfer of knowledge and expertise from experienced practitioners to new entrants. A similar issue occurs in Indonesia, where the Permentan mandates local government departments to provide coaching. Combining coaching with practical knowledge and first-hand experience from successful practitioners could significantly enhance program performance. Accelerating the adoption of integration initiatives will depend on experienced practitioners who implement integration effectively and promote it among other business actors.

Active participation across every stage of the policy value chain—from suppliers, farmers, breeders, and managers to veterinary services, farmer groups, traders, marketers, investors, financial institutions, and local communities—is essential for developing an effective integration system. Farmers, for instance, must understand good agricultural practices, including how to manage sick animals without contaminating others. In this regard, adequate infrastructure and the availability of veterinary services are critical for preventing the spread of animal diseases and zoonoses within oil palm farms. Furthermore, in Indonesia, concerns about the spread of *Ganoderma* (stem rot disease) (Sihombing et al., 2020)—believed to be potentially transmitted by cattle, leading to plant mortality and reduced land productivity—remain one of the primary reasons cattle are not permitted in oil palm plantation areas. To reassure plantation owners of the program's safety, Indonesia should adopt Malaysia's animal health certification and livestock identification practices within its integration framework. Implementing these measures could strengthen confidence among plantation owners and accelerate broader support for the SISKA initiative.

Based on the comparative analysis between Indonesia and Malaysia, it is evident that both countries share similar objectives in implementing the cattle–oil palm integration policy. However, they differ in their approaches to application. Both aim to optimize land resources and promote sustainable agricultural and livestock systems. However, their institutional arrangements and operational models vary significantly. Indonesia adopts a more inclusive approach, emphasizing smallholder participation and community empowerment through partnership schemes such as the nucleus–plasma model.

In contrast, Malaysia applies a more structured model, in which the policy is state-regulated and integrated with large-scale plantations, resulting in stronger institutional coordination. Indonesia can draw essential lessons from Malaysia regarding the clarity of policy instruments, technical management standards, and effective and efficient monitoring systems. Conversely, Malaysia can learn from Indonesia's participatory approach, which encourages farmers to develop a sense of ownership and adapt their practices according to local conditions.

4.3. Limitations

One limitation of this study is the absence of primary data collection through stakeholder consultations and feedback from program targets or participants, particularly in Malaysia. This constraint prevents obtaining direct insights into the effectiveness and impact of the policies under investigation. Nonetheless, the research findings lay a solid groundwork for future studies, especially in multi-actor policymaking, continuous policy evaluation, and adaptive strategies to tackle emerging challenges and changing circumstances. Incorporating stakeholder engagement in future research is crucial to comprehensively understand policy outcomes and ensure that policy recommendations are contextually relevant.

Despite these limitations, this study contributes significantly to the existing knowledge. Employing a robust methodology and analyzing secondary data sources sheds light on the integration of cattle and oil palm plantations in Indonesia and Malaysia. Examining key policy elements provides insights into contextual factors, policy processes, content, impact, and the involvement of various actors. It emphasizes the importance of stakeholder engagement, continuous policy evaluation, and adaptive policymaking strategies. Integrating stakeholder consultations and feedback will enhance the accuracy and relevance of findings, foster a comprehensive understanding of policy dynamics, and enable effective policy implementation in response to evolving challenges.

5. Conclusion and policy recommendations

Based on a review of the analytical framework, this study demonstrates that the context and content elements have been relatively well formulated in both countries. However, weaknesses primarily emerge in the impact and the actors' elements. From McConnell's perspective, these shortcomings reflect suboptimal program performance, fragmented implementation processes, and limited political legitimacy.

For Indonesia and Malaysia to harness the full economic, social, and environmental potential of cattle–oil palm integration, a fundamental shift from program-centric to outcome-driven governance is essential. While existing policies have laid a basic foundation, they have failed to trigger large-scale adoption due to two core yet addressable weaknesses: an excessive focus on activities rather than measurable results (a shortfall in the *program dimension* affecting policy *impact*), and the absence of sufficiently structured collaboration (weaknesses in the *process* and *political* dimensions centered on the *actors* element). To translate policy intent into tangible impact, three sets of actionable recommendations are proposed for policymakers, industry leaders, and development partners.

First, governments must shift from program launch to outcome management, prioritizing measurable performance over symbolic activity. This entails establishing clear and quantifiable key performance indicators KPIs that track outcomes such as increases in domestic beef production (kg/hectare), reductions in herbicide use (liters/hectare), growth in smallholder net income, and the expansion of integrated land areas. Robust monitoring and evaluation systems should be implemented through mandatory reporting frameworks and independent assessments that objectively evaluate policy performance and guide continuous improvement.

Second, governments should introduce mandatory integration quotas, requiring large-scale plantation companies (those exceeding 25,000 ha) to integrate cattle on at least 5–10% of their mature plantation areas. This would ensure a baseline level of participation and institutionalize the integration approach across the industry. Targeted fiscal incentives should be provided in the form of tax breaks or subsidized loans to both plantations and smallholders that demonstrably meet integration targets and achieve measurable outcomes, such as reduced herbicide use or improved cattle weight gain.

Third, inclusive and equitable partnerships must be architected to overcome existing trust deficits and participation barriers, particularly for smallholders. In Indonesia, this involves revising Permentan to mandate transparent profit-sharing agreements within core-plasma schemes and to strengthen the role of farmer cooperatives in improving bargaining power and input access. In Malaysia, the large-estate model should be structured to introduce incentive tiers and support mechanisms that deliberately include independent smallholders, who currently manage over 14% of plantation areas. For both countries, blended finance schemes combining public funds with private capital are needed to mitigate financial risks and make credit more accessible for smallholders and cooperatives. Governments should formalize public–private partnerships (PPPs) by establishing clear frameworks that de-risk private investment and facilitate smallholders' access to capital, veterinary services, and premium markets.

Fourth, the knowledge and implementation gap must be bridged by actively facilitating the transfer of expertise and strengthening operational capacity. Governments should establish formal knowledge platforms that connect successful integrated farms with new entrants through mentorship and practical training programs, ensuring that knowledge sharing moves beyond informal field visits toward institutionalized and replicable learning mechanisms. In Indonesia, integrating cattle insurance and security protocols can reduce the risk of theft, while in both countries, promoting feed-processing technologies such as EFB fermentation can transform agricultural waste into reliable and nutritious feed. Additionally, adopting and promoting animal health and sustainability certifications—such as those used in Malaysia's livestock identification system—can provide plantation owners with greater assurance of herd safety and unlock market premiums for integrated products.

By executing these targeted reforms, Indonesia and Malaysia can move beyond a promising yet underperforming concept to create a self-reinforcing cycle of improved farm profitability, reduced environmental impact, and enhanced national food security. Ultimately, the success of cattle–oil palm integration will depend not merely on technical adjustments but on the strength of governance and the genuine collaborative will of all actors involved.

Data availability statement

All data supporting this study are publicly available from UN Comtrade, FAOSTAT, and government ministries as cited in the manuscript. No new data were generated.

Ethics statement

Ethical approval is not applicable to this manuscript.

Declaration of AI-assisted writing

During the preparation of this work, the authors used Grammarly Premium for grammar editing under author supervision. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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