Forage seed market analysis in Vietnam

INITIATIVE ON Sustainable Animal Productivity

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1. Introduction

The rapid expansion of animal-protein markets in Asia, coupled with the socioeconomic importance of livestock for communities in northern Vietnam, has further driven national and provincial governments to prioritize development policies aimed at modernizing and transforming the livestock sector (Dung et al., 2020; Decision No. 1520/QD-TTg issued on October 6, 2020 by the Prime Minister; Pham et al., 2020; Hansen, 2018). Consequently, technology-driven solutions and innovations aimed at improving the diets and nutrition of cattle, buffalo, and pigs have become essential to enabling the transition toward sustainable and inclusive livestock systems.

The SAPLING initiative (Sustainable Animal Productivity for Livelihoods, Nutrition, and Gender Inclusion) under the CGIAR Initiative in Vietnam (2022 and 2024), aimed improve the value chains of pigs and cattle in the Northwest Highlands (NWH) region. To address the challenges of low productivity, the initiative targeted farmers by providing training on technical innovations in breeding, feed and forage management, and animal health. The Feed and Forages (F&F) component focused at transforming livestock feeding and nutrition practices to overcome challenges such as feed shortages during winter and dry seasons, the low nutritional quality of livestock feed (often reliant on native pastures and crop residues), and the lack of knowledge and skills in forage management and feed technologies (Hammond et al., 2021; Tran et al., 2023).

The F&F innovation portfolio was designed around two key pillars and employed a context-specific and participatory approach (Tran et al., 2023; Atieno et al., 2021a). The first pillar aimed to enhance animal nutrition by training farmers (TOFs) and trainers (TOTs) in techniques such as feed processing and preservation, improved utilization of crop residues, and optimized feeding regimes for cattle, buffalo, and pigs. The second pillar, developed in parallel, focused on encouraging the adoption of improved forage varieties that offered high yields, superior nutritional content, and tolerance to cold climates (Atieno et al., 2021b).

Then, studies on the adaptation and scaling of improved forages varieties have emphasized their suitability for local conditions and their role in enhancing productivity, economic benefits, and sustainability for small and medium-scale farmers. However, an equally important aspect is understanding the structure of the seed market. Analyzing the seed market allows for the identification of opportunities for farmers to access or adopt new varieties, sheds light on the key competitors hindering adoption and their influence and provides valuable insights for developing effective scaling strategies. This knowledge can support governments, private companies, and project implementers in strategically introducing and positioning new seed varieties in the market.

This report takes a qualitative approach to examine the forage seed industry in Vietnam through the lens of Porter's Five Forces framework (Porter, 2008). A multistakeholder perspective is employed to capture the diverse viewpoints of those directly or indirectly involved in the production, commercialization, and technological development of these seeds. The stakeholders interviewed include retail companies, seed companies in the production and development sector, research and development national institutional, and buyers.

The highlight indicated that the forage seed industry in Vietnam is facing substantial challenges, including declining demand, market stagnation, and increasing competition from informal traders. Over the last five years, demand for grass seeds has fallen by 30–40%, largely due to a slowdown in the beef market and the widespread practice of self-propagation among smallholder farmers. While demand for biomass maize remains strong, especially for dairy farms and feedlots, interest in high-quality forage grasses has decreased significantly. Informal traders offering cheaper seeds of unknown origin have further disrupted the market, reducing price expectations and undermining quality standards. As a result, seed prices have dropped by 20–30%, with about 60% of seeds lacking traceable origins.

Vegetatively propagated grasses dominate among smallholders due to their ease of cultivation and low cost, but their limited nutritional value constrains livestock performance. Meanwhile, biomass maize has become

increasingly important for large-scale livestock operations due to its high productivity, steady demand, and suitability for silage production. However, fragmented landholdings, a lack of national seed standards, and stringent regulations on imported varieties continue to limit market efficiency and innovation. Targeted support for smallholders, investment in research and development, and enforcement of seed market regulations are critical for addressing these issues and sustaining future growth.

2. Materials and methods

A qualitative approach was employed to analyze the market for forage seeds in Vietnam. The focus of the analysis was on the primary forage varieties used for cattle feed. Additionally, the study explored opportunities for hybrid varieties and forages, including legumes and grasses, which had been trialed during the project implementation (Table 1).

Recognizing that forages can be propagated using various reproductive materials, this study applied a broad definition of the term 'seed.' This definition encompassed all types of reproductive material, including true (sexual or botanical) seeds as well as vegetative materials such as cuttings, rhizomes, stems, or grafting materials (Abizaid et al., 2016; Andrade-Piedra et al., 2020).

Table 1. Portfolio of feed and forage innovation tested and promoted in the SAPLING project.

Selection of preferred forages varieties: Farmer-led forage trials	**Validation, adaptation, training, and knowledge transfer of forage technologies: Demo-farms**	**Testing new varieties: multilocation trials**
- Mun River Guinea - *Megathyrsus maximus* cv. Mun River - Mombasa Guinea - *Megathyrsus maximus* cv. Mombasa - Mulato II - *Urochloa hybrid* cv. Mulato II - Taiwanese Green Elephant Grass - *Cenchrus purpureus* - *Stylosanthes guianensis var. guianensis* cv. Ubon stylo - Fodder maize variety NK7328s - *Zea mays* (NK7328/ NK7328s)	- Mun River Guinea - *Megathyrsus maximus* cv. Mun River - Mombasa Guinea - *Megathyrsus maximus* cv. Mombasa - Mulato II - *Urochloa hybrid* cv. Mulato II - Taiwanese Green Elephant Grass - *Cenchrus purpureus* - *Stylosanthes guianensis var. guianensis* cv. Ubon stylo - Fodder maize variety NK7328s - *Zea mays* (NK7328/ NK7328s) - VA06 – *Cenchrus purpureus cv.* VA06 (Napier Rice bean – *Vigna umbellata*	<u>Legumes from Thailand:</u> - *Crotalaria juncea* (Sunn hemp) - *Crotalaria ochroleuca* - *Clitoria ternatea* - *Lablab purpureus* <u>Urochola hybrids from Grupo Papalotla:</u> - *Urochloa* (syn. *Brachiaria*) *hybrid* cv. Cayman-BH1 - *Urochloa ruziziensis* x *U. decumbens* x *U. brizantha* – Camello - *Urochloa hybrid* cv. Cobra-BH2 - Mestizo-BH4 - *Urochloa ruziziensis x U. decumbens x U. brizantha – Okapi*

Source: Atieno et al., (2021b); Tran et al., (2023).

Data collection applied key informant interviews (KII) using a multistakeholder approach to analyze the forage seed market. Different interview protocols were designed according to the stakeholder types and their specific connections to the seed industry. These stakeholders included retailing private companies, research and development institutions, large private companies engaged in production and wholesaling, and buyers (dairy and feedlot companies, and cooperatives). A total of 21 KIIs were conducted (Table 2).

The sampling process utilized a combination of purposive and quota sampling methods to capture the diverse range of stakeholders involved in the forage seed industry. Given the complexity of these business landscapes, a selective approach was used to ensure a comprehensive understanding of stakeholder experiences.

Predetermined quotas were established for each stakeholder category, with a minimum gender representation of 30% in every group. The focus was on stakeholders engaged in seed harvesting and production, seed selection and innovation, and seed distribution.

The initial list of stakeholders for the interviews was compiled during the SAPLING intervention through local authorities and local partners' consultation, and further outreach was facilitated through collaboration with a senior scientist at the National Institute of Animal Sciences (NIAS). Snowball sampling was employed to expand the list, particularly to identify buyers and private companies. The interviews were conducted in Vietnamese, and after translated to English for analysis. The NIAS´s senior scientist played a key role in translating protocols from English to Vietnamese, gathering data, and providing feedback throughout the process.

Table 2. Sample size by stakeholder category, gender, and brief description.

Category	Participants	Women	Men	Description
Dissemination, distribution, and trade	5	3	2	The stakeholders interviewed in this category represent four companies and one seed distribution agent. One company is a large enterprise, while the others are small—to medium-sized businesses. The agent corresponds to a level 1 leader.
Seed selection and innovation + seed production	11	3	8	The interviewed stakeholders include two major companies engaged in research and development of forage varieties for commercial production, as well as nine research centers. Although the primary mandate of these research centers is not directly related to the commercial production of seeds, they perform this function to a lesser extent, focusing on vegetatively propagated materials and certain grass seed varieties.
Buyers	5	1	4	The interviewed buyers represent medium to large companies engaged in livestock activities such as the importation of specialized breeds from Australia for fattening, milk production, and animal feed production.
Total	21	7	14	

The data were analyzed using the content analysis method, supported by N-Vivo software to organize and explore information based on pre-established categories. These categories were derived from Porter's Five Forces Framework for Industry Analysis (Porter, 2008), which was adapted specifically for the forage and maize seed industries and their various stakeholders across the value chains (Figure 1). This framework offers a comprehensive approach to understanding the competitive environment in which organizations operate and interact to deliver products or services. By examining the competitive forces that influence any industry and its value network, it becomes possible to assess the structure of the industry, identify patterns that impact its participants, and pinpoint key factors necessary for achieving successful competitive positioning (Ghemawat & Collis, 2010).

Porter's framework sheds light on the profitability of an industry and its capacity to enhance consumer access to the products or technologies it offers, thereby guiding strategic planning efforts. Importantly, it emphasizes competition for value creation, rather than focusing solely on rivalry among existing players, prompting an examination of broader competitive forces in the industry environment (Ghemawat & Collis, 2010). During the data analysis process, new sub-categories emerged and were subsequently integrated into the analytical framework to capture additional insights.

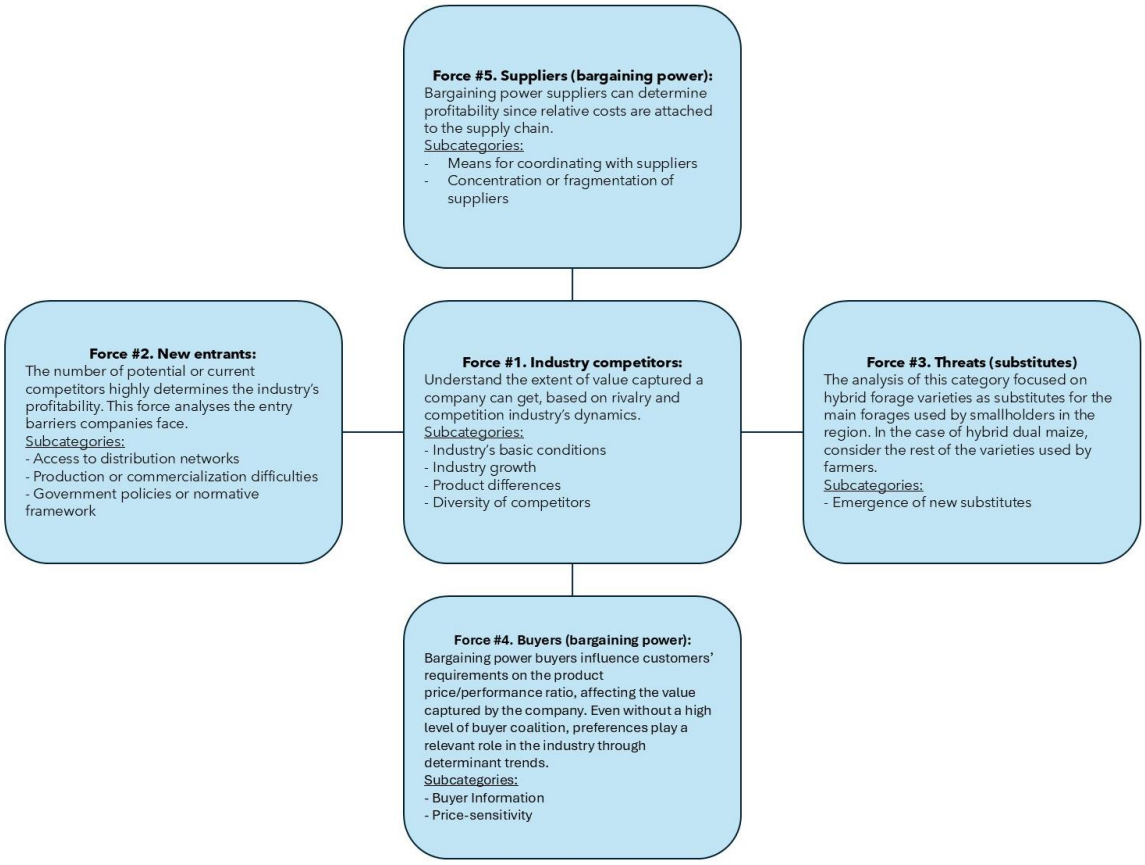

Figure 1. Categories of the framework analysis.

Source: adapted from Ghemawat & Collis (2010) and Porter (2008).

2.1. Limitations of the research

This study focused on key stakeholders engaged in the forage seed sector in Vietnam. Among these are retail companies (large, small-medium size, and individual agents), national research institutes, private producer and wholesaling companies, and buyers. While the findings are based on the authors' interpretation of participant experiences and perceptions and are not intended to be applicable nationwide, they provide meaningful insights into the functioning of this market. The study indicates requirements for sustainably intensifying livestock systems in Vietnam, particularly in the northwest highlands, using innovations in animal feeding as a strategic entry point. These insights also contribute to scaling such efforts and advancing the project's overarching goals.

3. Results

3.1. Force #1. Industry competitors

A. Industry basic conditions

Seed selection and innovation + seed production

- Companies:

The functions of the interviewed companies include importing, testing, researching, selecting, distributing, and developing commercial forage grass varieties for both the national and international livestock industries. Their portfolio focuses primarily on hybrid grasses, F1 hybrid sorghum, oats, biomass maize varieties, and hybrid and pure rice varieties. Specific maize varieties include VS201, QT55, LT888, NK7328, DH1795, and the multipurpose

hybrid VN10. Grass varieties in their portfolio feature Mombasa Guinea Grass (large-leaf lemongrass), Ruzi Grass (used as animal feed or soil cover in livestock farming or construction projects), Paspalum, Mulato II, and new Guinea Grass varieties. For stem cuttings, their main offering is Elephant Grass, which is produced primarily on demand. According to these companies, the cultivation of perennial grass varieties has shifted from extensive to intensive systems, with increased emphasis on the nutritional composition of the crops. Sorghum varieties in their portfolio include OPV88 Super BMR and VFS99.

Thes two companies maintain experimental research areas for activities such as selection and trial planting of forage crops, including maize, grass varieties, and sorghum. Additionally, one company has designated areas in the South-Central Coast region for seed production of forage materials. These companies do not engage in retail distribution directly; instead, they focus on production and wholesale activities through agents and other companies that handle retail, or they supply directly to large dairy farms. Their supply chain is a mix of imported seeds and locally produced seeds. Depending on the proportion of these sources in the supply matrix, the seed price may or may not reflect fluctuations in the beef market or the dynamics of the Thai market.

One notable challenge is the lack of industry-wide or government-issued standards for evaluating the quality of grass seeds. Currently, grass seeds are assessed only according to each company's internal standards and product commitments with their partners. One company reported applying the following criteria to evaluate seed quality: (1) Cleanliness: 98%, (2) Humidity: <12%, and (3) Germination rate: >75%.

- Research entities:

The activities carried out by the research centers include researching and testing new forage varieties, conserving and renewing genetic resources such as sorghum and legumes, and offering training courses through agricultural extension channels or in collaboration with national development projects. These initiatives often involve demonstration models, hands-on training, and techniques for cultivation and silage making. In addition, the centers provide veterinary medicines and breeding technologies.

Before introducing a new variety to the market, the centers conduct an in-depth analysis of the current forage crops used by farmers. They evaluate factors such as climatic and soil conditions, the local production of green forage crops, and the willingness of farmers to adopt new pasture varieties. Based on this analysis, two to three varieties with the highest potential are recommended. Once the seeds are imported, trials lasting three to five years are conducted to study their suitability. Farmers are then invited to observe the performance of the new varieties, and if they find them suitable, these varieties are included in the proposals of specific programs for their formal introduction.

Although not their primary role, the centers also produce and supply vegetatively propagated grass varieties, such as Elephant Grass, VA06 (a hybrid Elephant Grass), Taiwanese Green Elephant Grass, Pangola Grass (for hay), rhizomes, and Guinea Grass varieties like Mombasa and Decumbens. They also produce seeds for varieties such as Ruzi Grass, Leucaena (mainly intercropped with tea or coffee), Hamin Guinea Grass, TD58 Grass, and Mombasa. While these varieties have been present in Vietnam for a long time, the certification status of many remains unclear.

When farmers cannot find a desired variety in the center's catalog, the centers often connect them with a network of suppliers to fulfill their demand. However, seed production has proven challenging, with most efforts now focused on producing cuttings. One of the interviewed centers also imports forage seeds for retail distribution within the country, selling them through agents, companies, and livestock farms. Before distributing seeds to growers, the center reevaluates germination rates and conducts small-scale pilot plantings to assess adaptability to local weather, climate, and soil conditions. Seeds are assessed based on the center's internal standards rather than official standards issued by ministries or crop departments. Imported grass varieties, mainly from Thailand (e.g., Guinea Mombasa, TD58), are noted for their ease of cultivation, low maintenance requirements, and drought resistance. Although the center engages in seedling production, the available area is insufficient, prompting contracts with foreign countries for production and subsequent importation to Vietnam.

Since mid-2024, Green Elephant Grass has gained significant interest among farmers. Despite not being formally registered, approximately 100 tons were sold in 2024 alone. The pricing of the varieties produced by the centers is determined by several factors, including scarcity, on-site production costs, market demand, and buyer preferences. For instance, the Taisu 1 variety is widely available and covers hundreds of hectares, while Taisu 3,

which has more buyers but limited availability (only a few hectares), is priced higher. The price of Green Elephant Grass is also significantly higher than other hybrid Elephant Grasses. Transportation costs, which account for 30–40% of the total price, further influence pricing decisions.

Another variety that has gained attention in government development programs is Pangola Grass, introduced from Cuba for hay production, especially during the dry season. However, hay production is challenging due to its dependence on local natural conditions. As one interviewee noted, "*If the grass is cut and exposed to rain, it will be damaged, and its quality will decrease*" (Research Institution, personal communication, September 5, 2024). Pangola Grass produces more than 20 tons/ha/year, its resilient roots can regrow multiple times and only require replacement after several years. It is particularly suitable for feeding bulls, horses, and goats.

One key advantage highlighted by interviewees is that the centers often hold more prestige among buyers compared to other local or external sources. This reputation allows them to avoid significant investments in product promotion. Buyers also prefer sourcing from the centers because they can ensure the quality of the grasses, as well as specific characteristics such as the absence of pesticides or herbicides. This is especially valuable for livestock production programs with sustainability commitments, such as Vingroup's horse breeding initiatives.

Regarding conservation efforts, forage grasses are not considered a priority crop, and no significant activities have been conducted in this area, especially after 2019, when funding for such initiatives was reduced. Furthermore, regulations and management approvals from crop production and livestock departments are more complicated for forage grasses than for other crops.

Distribution, dissemination and trade of forage seeds

The operating model of retail companies is based on the import and distribution (wholesale and retail) of forage seeds and other inputs for the livestock industry. These include veterinary products and equipment (e.g., artificial insemination tools, breed supplies such as cow and buffalo semen straws, etc.), vitamins, and nutritional supplements (e.g., mineral licks, hay, and calf milk, etc.). Some of these companies also provide technical support services to their clients for growing green forage when requested. Regular communication and technical assistance are maintained with large farms that are consistent customers. One interviewee, whose primary clients are small producers, noted that "*about 50% of customers buying seeds need technical advice on what to plant or which type is suitable for their soil*." This highlights that while small-scale producers often lack the necessary knowledge to address how to improve livestock feeding.

According to interviewees, the most commercialized grass seed varieties in the Vietnamese market include Mombasa (*Megathyrsus maximus* cv. Mombasa), Paspalum seed varieties, Ruzi seeds (*Urochloa ruziziensis*), Mulato II (*Urochloa hybrid* cv. Mulato II), Stylo (*Stylosanthes guianensis*), Maize varieties, Sorghum Sudan, and Alfalfa (*Medicago sativa*). These seeds are imported from Thailand. Additionally, commonly propagated varieties using vegetative propagation (stem cuttings) include Taiwanese green elephant grass and VA06, which are sourced directly from local producers' farms in Vietnam.

The prices of grass seed varieties have decreased by 20-30% in the last five years, currently averaging around 500,000 VND per kilogram, depending on the type. This decrease is attributed to both the reduction in the cattle market and the increased supply of seeds through informal channels. In some areas, seed prices are even lower than those of floating goods (seeds sold without origin documentation). An interviewee highlighted that this has led to approximately 60% of seeds on the market being of unknown origin. Due to the reliance on imported seeds, official market prices are influenced by the performance of seed harvests in Thailand and its suppliers (including seed producers in Laos). This reflects a limited agency capacity and dependence on the international market. Prices for grass cuttings have also dropped by over 50%, from 5,000 VND/3-eyed piece to 2,000 VND/3-eyed piece, as more people are producing them, increasing availability in many regions.

The minimum import volume required to source seeds from Thailand is 10 tons per year. Large companies (e.g., Vietseed, Nam Thai, and Nong Long Tin) handle direct imports due to their high sales volumes, while smaller retail-focused businesses rely on bulk imports made by larger companies. Typically, large firms import seeds once a year, whereas smaller companies re-import a few dozen kilograms on an as-needed basis. Direct imports via official channels must comply with several regulations, including: 1) the seed variety must be recognized by the Department of Crop Production, 2) a plant quarantine license issued by the Plant Protection Department is

required for all shipments, and 3) customs and other importation requirements must also be fulfilled. One interviewee noted that the diversity of forage seed varieties in Vietnam is still limited, as many varieties have not yet been approved by the Department of Crop Production. In contrast, biomass maize varieties are already recognized for free circulation within the country. Among these, CP varieties have demonstrated the best market response and are currently achieving a strong market position.

For direct imports from Thailand, quality control includes requiring the Thai seed supplier to provide certificates of origin and germination test results for seed lots before importation and conducting retests (sowing tests) to assess germination rates upon arrival in Vietnam. Some large companies have available land for testing and comparing seed varieties from different suppliers. The minimum acceptable germination rates for Mombasa seeds are 80-85%, while for sorghum are 60-70%. Germination tests are only conducted for seed-propagated materials; vegetative materials do not follow the same quality control protocols.

Forage seed production in Thailand is seasonal, with harvesting taking place in December. Processing and sales begin at the start of each year, with imports typically occurring between March and April, aligning with the planting season in Vietnam: Spring in the North during March to May, and early rainy season in the South, late April to early June. Annual import volumes are determined based on past market demand, sales records, and data from distribution agents.

According to interviewees, during the early 2000s, livestock farmers (goats, cattle, buffalo raisers) struggled with feed availability and access to affordable, high-quality forage seeds. Some businesses that were interviewed had emerged to address this need. Currently, the market has diversified its distribution channels, including 1) online sales, 2) collaborative networks enabling nationwide coverage, and 3) physical stores, although less common. Digital platforms like YouTube, Facebook, and Zalo are widely used for product promotion and introducing new seed varieties.

The hierarchical distribution model used by large companies consists of three levels:

1. Level 1 Dealer: A single dealer in each region receives seeds directly from the company. It is responsible for market research, introducing new varieties, and organizing seminars and demonstrations.
2. Level 2 Dealers: Operate in smaller areas within the region, acting as intermediaries between Level 1 dealers and end clients (e.g., retail stores or large farmers).
3. Retail Stores: Sell directly to farmers and customers.

The sale agent interviewed noted that sales agents working under this system promote products, manage orders, and deliver seeds to customers, earning commissions on sales. He also distributes seeds from large companies such as VinaSeed, Thai Binh Seed, Charoen Pokphand Seed Company Limited - CP, Viet Trung, among others.

B. Product differences

According to the interviewees, some key features of the most popular forage varieties in the Vietnamese market are summarized in Table 3:

Table 3. Advantages and disadvantages of the most commercialized or promissory forage varieties in Vietnam, according to the stakeholders' views.

Forage variety	Advantages	Disadvantages
Elephant grass varieties (e.g., green, purple, TD58)	(+) Lots of water (+) Little hair (+) Soft plant suitable for fresh eating rather than making silage (+) high crude protein content, 12-15%	(-) cannot be produced industrially (-) high stem moisture, must be propagated by cuttings (-) Has not been formally registered (-) Green elephant grass cannot be planted too far away from the livestock or

	(+) average yielding (fresh weight) reaches 250-350 ton/ha/year, and with good care can reach 400-450 ton/ha/year	too steeply, because it is difficult to transport and harvest (-) Green elephant grass not suitable for dry conditions
Taiwanese Green Elephant Grass	(+) High productivity to meet farmers' feeding demands. (+) Hairless grass. (+) Soft stems. (+) Sweet taste. (+) Grows on a variety of soils, especially in midlands and mountainous areas in the North (+) Requires little care and is easy to grow	(-) Less nutritious compared to seeding grass varieties. Farmers grow other grasses simultaneously to ensure better nutrition.
Elephant grass VS19	(+) High biomass yield (+) Low cultivation costs (+) Good tillering sprouting (+) Late flowering but lots of hair (+) Selected from nature (collected, discovered) (+) Suitable for the definition of specialized biomass energy crops (+) Can be harvested regularly (+) Has uniform raw material quality	(-) Hard to plant (-) It is not registered for copyright because the sales volume is low, not profitable
Dwarf elephant grass (Guatemala)	N/A	N/A
Guinea Mombasa	(+) Softness. (+) Highly nutritious: 8–12% protein on poor soil and 12–16% on nutrient-rich soil. (+) Suitable for various livestock and poultry. (+) Fast growth (25–30 days; slightly slower in the dry season). (+) High productivity (20–40 tons of dry matter/ha). (+) Perennial: roots last 4–6 years before re-sowing. (+) better drought resistance than VA06 (+) Commonly used in the South and Central regions (+) if grows intensively, can give a yield equivalent to elephant grass	(+/-) Suitable for highlands but competes with sugarcane and pineapple cultivation. (-) Unsuitable for low-lying land, because isn't tolerate waterlogging.
New Guinea grass (Mun River)	(+) Easy to wilt and drying for silage (+) Highly productive (+) Softness (+) Easy to grow (+) Regenerates strongly and good germination rate (+) Resistant to trampling and drought (+) Can be intercropping, and prevents soils erosion (+) Selected and registered for protection by the Department of Crop Production (Ministry of Agriculture and Rural Development), and is under process for being tested, development planting guide and entity managements standards.	(+/-) Suitable for large and full mechanized farms.
Paspalum	(+) Can withstand waterlogging; often grown in rice fields/lowlands. (+) Can be harvested 6–8 times per year.	(-) Lower productivity than Guinea Mombasa (180–200 tons/ha/year).
Mulato II	(+) Higher nutrition than Guinea grass. (+) Suitable for dairy cows, goats, and fattening cattle. (+) Good drought tolerance due to deep, wide roots.	(-) Hairy and itchy during harvest. (-) Unsuitable for fish farming.

Ruzi grass	(+) Growth for feeding animals or soil covering (+) Roots grow well (+) Helps to prevent soil erosion (+) Suitable for construction projects (+) Can be growth in areas with poor nutrition (+) High protein contents 12-13% (+) Average yield reaches 80-100 tons/ha/year	N/A[1]
Alfalfa + Stylo	(+) Highest nutritional value among legume grasses. (+) Suitable for alluvial land. (+) Softness (+) easy to cut and have a high digestibility rate	(-) Low productivity (80–120 tons/ha/year).
Sudan Sorghum	(+) Good nutrition (second to legume grasses). (+) Softness and sweet taste. (+) Suitable for silage storage. (+) High productivity (300–350 tons/ha/year).	(+/-) Requires good soil; competes with maize and sugarcane. (-) Short lifespan (2–3 harvests/year, withering in 6–8 months). (-) Roots require frequent replanting. (-) Difficult to growth. The plant, being of template origin, struggles to adapt to Vietnam´s tropical conditions. (-) Low yield that reaches only one-third of its potential due to unsuitable environmental conditions. (-) High levels of light exposure, elevated temperatures, and humidity, especially in northern mountainous provinces, adversely affect crop performance. (-) The prevalence of root fungus reduces yields and compromises plant health.

Distribution, dissemination and trade of forage seeds

In the Vietnamese market, two types of seeds are available: officially imported seeds, which come with certificates of origin, are carefully selected, and treated against insects; and seeds from informal channels, which are unprocessed and generally cheaper. The price difference between seeds from these two channels can range from 20–40%.

In addition, vegetatively propagated varieties are typically obtained directly from farmers. In some cases, companies may produce these varieties on their own land when available. However, one company noted that the supply of grass cuttings is insufficient. The company rarely buys fresh cuttings from other provinces because transportation costs increase the price, making it less competitive and less attractive to customers.

One initiative from an interviewed company involves promoting the NLT01 Milkweed variety, a type of elephant grass that has gained popularity in Ha Giang and Ha Tinh provinces, partly thanks to TikTok videos showcasing its performance. Although its growth period from planting to harvest is slower than VA06, it offers other advantages such as being hairless, having large leaves, and forming dense bushes. Currently, the company cultivates this variety in its own gardens for production and distribution. For larger orders, they rely on suppliers from these provinces to meet demand.

Other forage varieties available in the market, aside from those described earlier (Section 3.1-A) and highlighted by the interviewees, include Golf Grass, Thai Green Elephant (higher yield than Taiwanese Elephant Grass but with hairy stems), Giant Tea, and Jade Plant.

For maize varieties, the following were highlighted:

[1] None of the interviewee mentioned the comparatively poor drought tolerance of Ruzi grass.

- **SSC588**
- **AVA3668**
- **LCH9**
- **DH175**
- **Syngenta's NK7328**: Big plants with large corn, small seeds (one seed packet can produce many plants), ideal for winter and spring, has a high yield but the disadvantage is it cannot be planted densely.
- **CP's CP111**: Large plants with big corn, adaptable to all three cropping seasons. If not sold as biomass maize, it can also be harvested for grain.
- **Vinaseed's SC586**: Resistant to pests and diseases, with large plants suitable for all three seasons.
- **DK6919**: Small plants suited for summer and autumn, withstanding hot weather, and can be planted well at high density.

One interviewee noted that Thai hybrid maize varieties perform best during spring and winter due to their adaptation to cooler climates, whereas Vietnamese varieties excel in summer and autumn, as they are more heat-tolerant.

C. Industry growth

Seed selection and innovation + seed production

- Companies:

The recent boom in the livestock products market, coupled with government policies aimed at modernizing the sector, has led to the relatively recent development of large-scale farms (specializing in beef, dairy, goats, sheep, etc.). This shift has significantly increased the area dedicated to planting pastures, subsequently driving up the demand for grass seeds and biomass maize, especially over the past seven to eight years. These developments have transformed traditional systems, which previously relied primarily on Elephant Grass.

However, the interviewed companies report that the demand for grass seeds has decreased by approximately threefold, with a sharp decline observed since 2021. One of the key reasons for this reduction is that grasses do not require cross-pollination, making it easy for farmers to propagate them independently. As a result, farmers often make a one-time purchase and no longer need to buy additional seeds. Furthermore, similar to trends observed by retail companies, the slowdown in the beef market has emerged as a major driver behind the reduced demand for grass seeds.

The slowdown in seed commercialization has research and development in the field of new grass varieties has also declined. The availability of genetic resources is limited, and only a few entities, such as CIAT and SAPLING, are conducting research on forage seeds. According to one interviewee, the introduction of innovative grass varieties relies heavily on research conducted in other countries, particularly in Latin America. As a result, local research efforts have primarily focused on adapting these technologies to the region. Nevertheless, conducting research in the region remains challenging—not only due to the requirements for genetic materials but also because of limited investments, making it difficult to compete with countries that are more advanced in breeding programs.

A new research direction pursued by one of the companies is centered around the development of Elephant Grass VS-19, which has potential as a source of forage material for producing "super-clean" organic fertilizers. This grass can also be processed into fuel pellets, animal feed pellets, and biological padding for livestock. The variety was selected by the company and approved for distribution in 2021. Additional advantages of this variety are outlined in Table 3.

Digital platforms, social media, and advancements in transportation and delivery methods have also been identified as major enablers for the expansion of the forage seed industry. These tools provide the industry with opportunities to reach broader markets and streamline operations.

❖ Research entities:

The structure of forage crop cultivation has undergone significant changes, as noted by research center interviewees. In the plains and high-density farming areas, farmers have transitioned from using old Elephant Grass to biomass maize and higher-quality varieties. In contrast, in areas with poorer soil quality and low-density farming, old Elephant Grass varieties have gradually been replaced by hybrids such as VA06 and Green Elephant Grass. Farms with limited land availability now prioritize varieties that offer high biomass production, superior protein content, and favorable traits such as softness, hairlessness, better palatability, and higher utilization rates per plant. This shift reflects the growing preference for modern, high-performing varieties over older ones.

The introduction of new grass seeds imported from abroad has also been notable, with growing adoption due to the ease of transportation, cultivation (self-propagation), and care, as well as affordable prices. However, despite these developments, stakeholders agree with companies representatives interviewed, that the forage seed sector has experienced a slowdown. Sales of Ruzi Grass seeds and Elephant Grass cuttings have dropped by 30–40%. Moreover, research institutions have not developed or released new varieties, leaving small-scale producers to rely on self-sufficiency. As one interviewee explained:

> *"Five years ago, many projects and households started raising dairy and beef cattle, relying on research units for animals, forage seeds, and cuttings. But now, demand has sharply decreased. Five years ago, we sold 300–400 tons of Elephant Grass per year and several hundred kilograms (200–300kg) of Ruzi Grass seeds. This year, however, we sold only 100 tons of Elephant Grass cuttings*." (Research Institution, personal communication, August 12, 2024)

The livestock sector has increasingly focused on achieving high quality, with goals such as faster growth rates, superior meat quality, and higher productivity. However, the nutritional needs of these animals require temperate grasses (C3 photosynthesis) with higher neutral detergent fiber (NDF) content, as lignin is indigestible. Tropical grasses, by contrast, tend to have higher lignin content. This poses a challenge for Vietnam, as other countries may begin exporting temperate hay to meet this demand.

Stakeholders in this category highlighted several key opportunities and strategies for the development of the forage seed market:

- Mountainous Areas:
  Mountainous regions could benefit from the cultivation of Ruzi, Guinea, and Stylo grasses. These varieties are well-suited to steep terrains, as they can spread and regenerate, effectively replacing low-quality native grasses. Additionally, since mountainous areas have lower carrying capacities (one hectare can support only 4–5 cattle), these drought-tolerant varieties are ideal for small-scale farming and low-density livestock systems.

- Plains:
  Flat areas are more favorable for large biomass crops such as biomass maize and Elephant Grass varieties. The higher carrying capacity of these regions allows for raising 40–50 cattle per hectare, making them well-suited for intensive livestock farming.

- Future Demand:
  As livestock farming expands, demand for forage crops will increase in both quantity and quality. Larger-scale, more systematic, and professional approaches to research, grass planting, and grass processing will be needed. This includes proactive feed production strategies rather than the opportunistic methods typically used by smallholder farmers. Additionally, there will be a growing need for research on forage seedlings, particularly in areas where livestock farming is expanding and forage crops are essential to sustain the sector.

Distribution, dissemination and trade of forage seeds

The interviewees agree that the slowdown in the country's beef market and the cattle demand decrease (around 30–40%), have led to forage prices reduction. One participant noted that the growth of the beef market five years ago encouraged the adoption of high-yielding cattle breeds, such as BBB. This prompted farms to invest in cultivating high-quality grass varieties. However, with the current decline in the cattle market, approximately 50–70% of beef farms have ceased or reduced breeding activities. For the remaining farms who continue with cattle production, after five years of cultivating grasses like Guinea Grass—by which time these grasses have completed

their growth cycle—many are shifting back to growing elephant grass, which offers higher productivity. Compounding the situation, the market has seen an influx of various grass seed types with unknown origins, leading to a decrease in grass seed prices, estimated at 20–30%.

When discussing opportunities in the present and near future, participants identified Taiwanese Green Elephant Grass, VA06, and Guinea Mombasa as the most promising forage varieties in the Vietnamese market. These varieties are favored for their high productivity, ease of cultivation, minimal care requirements, and adaptability to different types of land, including rice paddies and large farming areas.

As the beef market remains stagnant, many farmers have stopped raising cattle altogether or have opted to maintain smaller herds. This shift has reduced interest in cultivating high-yield-nutrition grass varieties. On the other hand, larger farms are increasingly focusing on biomass maize, which is sown and harvested seasonally. This creates a steady demand for maize seeds, as farmers must purchase and replant them every season. Biomass maize is particularly popular among dairy farms and feedlots due to its consistent supply and suitability for large-scale feeding operations.

In this context, hybrid maize varieties play an essential role, as they offer high productivity and meet the demands of large farms. The market features a wide range of companies supplying biomass maize, and every 2–3 years, new hybrid varieties are introduced, providing farmers with innovative options and driving continuous growth in this sector.

D. Diversity of competitors

Distribution, dissemination and trade of forage seeds

The Vietnamese market for forage seeds retail distribution is dominated by 4–5 major players, with Nong Long Tin holding the largest share—around 70% of the market. This company benefits from an extensive network of collaborators, giving it a broad national reach. However, the number of major retail companies in the market has decreased compared to five years ago, dropping from 10 to the current 4–5. This decline reflects a slowdown in the seed market, as highlighted by the interviewed stakeholders.

Besides, the increasing number of traders who offer cheaper and informal forage seeds represents a risk for their companies.

3.2. Force #2. New entrants

A. Access to distribution networks

Seed selection and innovation + seed production

- Companies

As previously mentioned, companies primarily engage in wholesale sales, supplying large retail companies with established distribution networks as well as large-scale dairy and beef farms.

- Research entities

For research centers, distribution logistics are a critical aspect of their operations, as they significantly influence the final price of the forage seeds produced. One center has established satellite points that facilitate seed distribution by reducing transportation costs. Additionally, these centers rely on distribution networks established through partnerships with government development programs or international cooperation projects. They often leverage agricultural extension networks managed directly by the centers or local authorities, enabling seed distribution through provincial and district agricultural departments.

Research centers also benefit from strong recognition among farmers, which enhances their ability to promote their seeds. Farmers learn about the available varieties through the centers' social media platforms (websites, Facebook groups, Shopee, or Zalo) or when accessing other services or inputs for livestock systems provided by the centers, such as genetic materials for animal breeding or veterinary services.

One of the interviewed centers also uses a dealer network or supplies seeds directly to farmers with large farms. Generally, the centers provide technical assistance throughout the planting process, including guidance on planting, care, management, and harvesting, when selling seeds or cuttings.

Distribution, dissemination and trade of forage seeds

As mentioned earlier, retail companies have increasingly relied on virtual platforms such as YouTube, Facebook, Zalo, Shopee, and TikTok to promote and distribute their products. Many of these companies report that digital media and online sales have become their primary distribution channels. This mechanism reduces transaction costs for businesses while providing farmers with easy access to products, which are conveniently delivered to their homes.

The distribution system through dealers also leverages digital platforms. Companies provide training to their collaborators via these online channels, enabling them to promote and sell seeds effectively. Dealers, in turn, use social media platforms to market and sell the products, although this is not their sole method of operation.

B. Production or commercialization difficulties

Seed selection and innovation + seed production

- Companies

According to the companies, Vietnamese market is small and has registration and protection procedures difficult and expensive to meet, making it not easy to entry.

- Research entities

The research entities' representatives identified several limitations that hinder the development of the forage crops seed industry. These challenges are largely tied to political and institutional constraints, as forage crops receive insufficient financial support and are not prioritized within breeding, hybridization, or conservation programs. Farmers, however, continue to demand new varieties. Additionally, there is a degree of conservatism and genetic protectionism that complicates the introduction of new forage varieties. Concerns about the potential invasiveness of certain grasses or the risk of introducing diseases into existing cropping systems make the importation process lengthy, expensive, and bureaucratically burdensome. As noted by the companies interviewed, these procedures limit the availability of genetic materials needed for research and development and are further exacerbated by the lack of coordination between research centers.

National seed production by research centers also faces several challenges, including limited access to sufficient, large land suitable for seed production. Much of the land is fragmented and competes with other prioritized cash crops like rice or maize, which offer significantly higher yields and profits. Consequently, seed production is sometimes outsourced to foreign countries through contracts, which increases costs and makes the process vulnerable to fluctuations in import prices. Additionally, technical capacity for harvesting is constrained, as it remains largely manual, increasing costs and requiring significant labor and resources. Seed yields are low and inconsistent, and the quality of the seeds produced is also unstable, often influenced by adverse climatic conditions.

For smallholder farmers who engage in self-sufficiency practices, storage presents a significant challenge. Many farmers are unfamiliar with proper storage techniques, and while there are efforts to transfer knowledge in this area, implementation remains inconsistent. This results in high levels of waste during processing and storage,

along with a high failure rate. Some stakeholders suggest that developing a market for processed green fodder could attract interest from both large-scale farms and smallholder producers. In the medium to long term, as one interviewee highlighted, *there is potential for by-products and pelleted feed plants to emerge as efficient strategies for livestock feeding*.

The stagnation of the beef market has been consistently mentioned by all stakeholders as a major factor limiting the ability to expand and invest in the development of the forage seed industry.

Distribution, dissemination and trade of forage seeds

The main limitations identified by interviewees for this category in relation to retailing are linked to the diversity of competing agents offering cheaper forage seeds without quality assurance or traceability of origin, which slows the official seed market. One interviewee highlighted that unfair competition also involves cases of counterfeit packaging, labels, and brands, while the response from authorities on this issue has been unsatisfactory.

In addition to these challenges, the decline in the cattle market has been another significant driver of the slowdown in the forage seed market.

Lastly, the reduction in the rural labor force is also noted as a limiting factor for the livestock feed industry. This is particularly evident in maize cultivation, which requires labor multiple times a year, and where the workforce is sometimes insufficient to meet demand.

C. Government policies or normative framework

Seed selection and innovation + seed production

The process of variety testing, registration, and circulation required for the import and production of seeds for sale was explained by one interviewee as follows:

- Testing of plant varieties:
  The testing process includes the following components:
  - Distinctiveness, Uniformity, and Stability (DUS) Testing: Assessing the unique characteristics and consistency of plant varieties
  - Cultivation Value and Use Value Testing: This involves controlled testing, small-scale field trials, and large-scale field trials to evaluate the performance and practical utility of plant varieties.

  The Department of Crop Production coordinates with local units to oversee these testing processes. Upon completion, the Department issues planting licenses and formally recognizes the tested varieties
- Recognition and circulation of varieties:
  Grass varieties are granted indefinite recognition for circulation, whereas rice and corn varieties are recognized for a period of 10 years. Organizations seeking to self-declare the circulation of plant varieties must ensure compliance with the requirements outlined in Article 17 of the Law on Crop Production of 2018.

The interviewee noted that currently, there are no national standards for grass varieties in Vietnam; national standards exist only for crops like corn, soybeans, and rice. For varieties lacking national standards, enterprises are required to declare their own entity standards. While building national standards is costly and time-consuming, entity standards are considered more flexible and precise.

The Department of Crop Production (Ministry of Agriculture and Rural Development - MARD) has authorized the interviewed company to self-declare the circulation of Mombasa Guinea (large-leaf lemongrass), Ruzi, Paspalum, and Mulato II.

3.3. Force #3. Threats (substitutes)

A. Emergence of new substitutes

Seed selection and innovation + seed production

- Companies

According to the opinions of the company representatives interviewed, the most promising seed grass varieties for the growing industrial livestock sector in the country are those that offer higher yields. Grass varieties grown by seeds are particularly well-suited for large-scale, mechanized production, with the ability to expand the cultivated area at a relatively low cost. These varieties are characterized by a high proportion of leaves and soft stems, resistance to trampling, ease of drying, and suitability for processing into various types of green fodder, particularly silage.

However, each type of crop and grass variety comes with its own advantages and disadvantages, which must be carefully considered. For example, while some varieties promise higher yields, they often have lower nutritional quality. Selecting the most appropriate combination of pastures and varieties that complement each other, while also adapting to local conditions such as soil type, climate, and farming practices, is a significant challenge in the country.

One example highlighted during the interviews is New Guinea Grass, which is highly suitable for mechanized livestock farming and large-scale pasture systems. It is easy to dry for silage, has a favorable leaf-to-stem ratio, is soft and low in hairiness, highly productive, drought-resistant, and regenerates robustly, making it ideal for large-scale operations. Another variety mentioned is Ruzi Grass, which not only serves the livestock industry but is also used in construction as a soil cover to prevent erosion. It can be cultivated in arid regions, adapts well to the country's climatic conditions, and shows strong resistance to pests and diseases.

At the small-scale producer level, the variety that has gained the most traction is VA06. Despite its lower nutritional performance compared to Mombasa or Elephant Grass, VA06 remains popular due to its other beneficial traits and adaptability.

- Research entities

The opinions among this group of stakeholders regarding the most promising forage varieties are more varied. One interviewee emphasized that for small-scale livestock farming in mountainous areas, grasses such as Ruzi, Guinea, and Stylo are highly recommended. These varieties adapt well to steep, drought-prone, and eroded soils, and they propagate and regenerate easily. As a result, they offer a suitable alternative to low-quality native grasses, meeting the production needs of these regions. Furthermore, in mountainous areas, there is a need for varieties that support agroforestry practices, particularly those that are shade-tolerant. In contrast, for larger areas and higher-scale production, biomass maize and Elephant Grass are considered more favorable due to their ability to meet productivity and quality demands.

At the small-scale production level, cost-saving is a priority for farmers. They often rely on exchanging planting materials locally or using what is already available, reducing the need to purchase additional grass seeds. For example, Elephant Grass is easy to grow and propagate through cuttings, which are often shared between farmers. The concept of investing in forage seeds for ruminants is not yet widely accepted among small-scale farmers. Only when the idea of livestock farming as an investment takes hold will farmers begin purchasing grass seeds and producing them at scale. Currently, fragmented land ownership poses another limitation; for small plots of land (a few hundred square meters), planting cuttings remains more convenient and practical. However, when farmers have access to larger areas, they may require forage seeds that are affordable, easy to purchase, and capable of reducing labor, at which point buying seeds will become more viable.

One of the research groups interviewed aims to develop the *Mucuna pruriens* (*đậu mèo*) bean plant for sloping lands in provinces like Ha Giang, Bac Kan, and Son La. According to the interviewee, this plant offers multiple benefits: its seeds are resistant to weevils, easy to preserve due to their thick shells, and rich in protein. When properly processed and heat-treated to remove toxins, they can serve as an alternative to fish meal for animal

feed. Additionally, the plant improves soil nutrition, prevents erosion, and is easy to grow and care for. The goal is to utilize *Mucuna pruriens* in mountainous areas both as animal feed and for improving sloping land.

Another interviewee highlighted the growing importance of biomass maize and by-products. These products are gaining relevance due to easier import procedures and financial support through public policies. Additionally, hay and biomass maize are highly competitive, offering a favorable price-to-dry matter ratio, easier preservation, and less dependency on climatic conditions—provided they are stored appropriately.

Regarding the characteristics that new varieties should possess to meet the needs of the livestock sector, the focus is on resistance to cold, drought, salinity, and overall quality. In terms of quality, legume varieties hold significant potential. Not only are legumes uncommon in current livestock feeding systems in the country, but they also offer higher protein content and can be mixed with other grasses to enhance nutritional value. Among the varieties identified as having the greatest potential, one interviewee highlighted VA06, several hybrids of Elephant Grass (such as Dwarf Elephant Grass and Green Elephant Grass, currently imported from China and Taiwan), and Guinea Mombasa. These varieties are well-suited to diverse climatic conditions and provide high nutritional quality.

Distribution, dissemination and trade of forage seeds

The commercialization of seeding grasses has been impacted by competition from seeds of informal origins. While these informal seeds are cheaper, their quality cannot be verified, and their origin is untraceable, further challenging the market.

Vegetatively propagated grass varieties also pose significant competition, particularly in the segment targeting small-scale farmers. Increasingly, these farmers are producing their own vegetative propagation materials. A notable example is Green Elephant grass, which is highly productive, easy to maintain, and available free of charge—either from their own farms or through farmer-to-farmer exchanges. However, while this grass competes effectively in terms of cost and accessibility, its limited nutritional quality prevents livestock performance indicators from reaching their full potential.

In terms of substitute products, the interviewees identified silage, primarily made from biomass maize, as the main competitor to forage (both grasses and legumes). However, the number of companies producing and selling silage to large beef cattle farms nationwide (e.g., in Moc Chau, Thanh Hoa, Hai Duong, and other regions) has also declined. This reduction mirrors the overall slowdown in the beef market. Silage prices have also fallen, making 1 kg of silage cheaper than 1 kg of fresh green grass. Beyond its cost advantage, silage offers additional benefits to farms: it saves time, land, and resources, as it can be purchased ready to use for feeding cattle. However, silage is primarily purchased by large-scale farms, while smallholder farmers continue to grow and produce silage themselves.

In the case of hybrid forage varieties, the interviewees did not identify any new varieties beyond those they currently offer that could pose significant competition. As one interviewee stated, "*the best varieties are already part of the company's portfolio*" (Retailing company, personal communication, September 9, 2024).

3.4. Force #4. Buyers

A. Buyer information

Seed selection and innovation + seed production

- Companies

For companies, their most stable clients are dairy corporations with limited pastureland, such as Vinamilk and Moc Chau. Small pasture areas are not ideal for seed production because they do not allow grass seeds to mature uniformly, requiring manual selection. In contrast, TH Truemilk, another major dairy company in the country, benefits from extensive pastureland that enables the harvesting of batches for screening and removing unripe seeds. However, dairy companies typically rely on their own mixed feed rations and are not entirely dependent on grass, which is only one of the ingredients that can be substituted with biomass maize. Despite this, the demand for green roughage in the country remains high. Even some of these large dairy corporations import feed to sustain their dairy cows.

In addition to supplying dairy corporations, companies primarily sell through agents, making it difficult to track their final customers. In some cases, their products are also exported.

Distribution, dissemination and trade of forage seeds

The customer base of retail forage seed companies includes both large and small clients. Large clients purchase substantial volumes of seeds in each transaction (dozens of kilograms at a time), while small clients, as their name suggests, make smaller purchases of just a few kilograms. These smaller orders range from 100–200 grams to 1–2 kilograms, which are typically sown on plots of 500–1,000 m^2. Regarding farm types, the majority are beef-focused farms, followed by a smaller proportion of farms specializing in milk production.

Consumer preferences, as well as prices, fluctuate depending on the dynamics of the beef market. When beef prices are favorable, producers have greater incentives and resources to invest in higher-quality pastures. Conversely, in periods of stagnation, as seen in the most recent market downturn, producers tend to focus on maintaining varieties that ensure high yields, such as elephant grass.

In the case of biomass maize buyers, these typically include dairy or beef companies with large land areas, or farmers who supply maize or silage to these farms for feeding their livestock, according to the sales agent interviewed.

Buyers

The interviewed buyers represent medium to large companies engaged in livestock activities such as the importation of specialized breeds from Australia for fattening, milk production, and animal feed production. Among the products purchased by these actors are biomass maize, Elephant Grass, and imported Mombasa Guinea Grass.

B. Price sensitivity

Distribution, dissemination and trade of forage seeds

The opinions of the participants indicate that consumers of their forage seeds are highly concerned about the price-to-quality ratio. Initially, many tended to purchase seeds from the informal market. However, after experiencing poor results, they returned to suppliers that offer better guarantees. Similarly, consumers place great importance on having assurances regarding the germination rate of the seeds.

3.5. Force #5. Suppliers

A. Means for coordinating with suppliers

Seed selection and innovation + seed production

- Companies

Some of the key actors with whom companies have coordinated for seed trials, monitoring, and production testing across various ecological regions in the country include the Ba Vi Cattle and Grassland Research Center - Institute of Animal Husbandry, TH Milk Farm (Nghia Dan), Nha Ho Cotton Research, the Agricultural Development Institute, Avanta Vietnam, CIAT Vietnam, the Department of Animal Feed Plants - Maize Research Institute, the Green Food Plants Research Group - Institute of Food Crops, and the Vietnam Academy of Agriculture, which is authorized to produce and supply sorghum seeds for animal feed.

At the international level, identified partners include Desert Sun Marketing (USA), Heritage Seed (Australia), and Ubon Forage Seed (Thailand).

- Research entities

Research entities report cooperating with other research centers such as CIAT-Vietnam, the Ba Vi Cattle and Pasture Center, and the Mountainous Livestock Research and Development Center. Additionally, their operations are supported by state-budget programs and agricultural extension initiatives focused on large-scale livestock farming, which include forage crop development.

These entities regularly maintain contact and exchange information with the Department and Sub-Department of Crop Cultivation and Protection, the District Agricultural Service Center, the District Agricultural Office, and the National Agricultural Extension Center. Lastly, they establish links with companies involved in seed import and export to secure necessary inputs.

B. Concentration or fragmentation of suppliers

Seed selection and innovation + seed production

- Research entities

The genetic material used by research entities comes from a variety of sources. Some materials are self-propagated, including self-improved Elephant Grass and grasses propagated through the centers' programs. Lemongrass seeds are imported from Australia and Thailand, while other seeds are primarily sourced from countries such as the Netherlands, Thailand, the United States, Mexico, Brazil, and New Zealand. These imports include varieties like Alfalfa, Mombasa, and Mulato II.

Additionally, some grasses, such as Guinea Grass, are grown domestically in Vietnam. Ruzi Grass seeds used in Vietnam are imported from Laos, whereas Vietnam exports Mombasa Grass seeds to Laos. This is because Laos does not grow Mombasa Grass, relying instead on Mulato Grass.

Distribution, dissemination and trade of forage seeds

According to participants in the retail seed market, the large companies from which they source their forage seeds (e.g., Vietseed, Nam Thai, and Nong Long Tin) primarily import seeds from Thailand. Among the Thai suppliers, one of the most prominent companies is Ubon Group. Similarly, while maize seeds are also imported from large Thai companies, they are additionally supported by national research agencies, such as the Maize Research Institute, as well as major Vietnamese companies like VinaSeed, Thai Binh Seed, and Viet Trung, which supply locally sourced materials.

4. Principal Remarks

The forage seed industry in Vietnam faces significant challenges, including declining demand, market stagnation, and growing competition from informal traders. Over the past five years, demand for grass seeds has sharply dropped by 30–40%, driven by a slowdown in the beef market, with many cattle farms ceasing or scaling back operations. Additionally, the ease of self-propagation for some grasses varieties, particularly among smallholder farmers, has reduced the need for repeat purchases either to re-sowing or increase the areas. While demand for biomass maize remains strong, especially among dairy farms and feedlots, the overall interest in high-quality forage grasses has diminished.

The contraction in demand has also led to a decline in the number of major retail companies operating in the market. Those that remain face intensified competition from informal traders who sell cheaper seeds of unknown origin. These unregulated alternatives lower price expectations, undermine quality standards, and create a significant threat to formal retail companies. Estimates suggest that seed prices have dropped by 20–30% in recent years, with approximately 60% of seeds in the market being of untraceable origin.

Despite these challenges, the adoption of digital distribution platforms offers a promising avenue for industry growth. Retail companies have successfully integrated platforms like Facebook, YouTube, Zalo, Shopee, and TikTok into their strategies, reducing transaction costs and making products more accessible to farmers. These platforms allow for convenient ordering and delivery, reaching even remote farming communities. Similarly, research institutions leverage extensive distribution networks, collaborating with government programs, international cooperation initiatives, and agricultural extension services. However, fragmented landholdings and the dominance of informal markets continue to limit the efficiency and scale of domestic seed production.

For seed production and development companies catering to large-scale livestock operations or supplying retail companies, the reduction in demand has been particularly acute since 2021. This decline aligns with China's restrictions on beef and cattle imports from Vietnam, which have further shrunk the livestock sector. The downturn has also impacted research and development efforts, with only a few initiatives actively exploring the adaptation and suitability of new forage varieties for the country. Most national research focuses on adapting varieties developed in other regions, particularly Latin America, due to Vietnam's limited breeding and genetic improvement capacity.

Research and development entities and seed companies alike identify regulatory and policy limitations as a significant hurdle. Forage crops receive insufficient financial support and are not prioritized in breeding, hybridization, or conservation programs. Additionally, strict import regulations—intended to prevent invasiveness and disease risks—create bureaucratic and costly barriers to introducing new genetic materials. Despite challenges, one promising variety under exploration is *Mucuna pruriens*, a legume that offers benefits as animal and fish feed (after proper toxin removal) while improving soil nutrition and preventing erosion, particularly need it in mountainous areas. Another variety of interest is Elephant Grass VS19, known for its high biomass yield and adaptability.

The most commercially popular seed-based forage varieties in Vietnam include Mombasa Guinea Grass, Ruzi, Paspalum, Mulato II, and other Guinea Grass varieties. Vegetatively propagated grasses, such as Elephant Grass, are also widely used and traded. Additionally, biomass maize and sorghum have become dominant alternatives for various livestock industries. Companies source seeds from a mix of imports (from Thailand, Taiwan, China, and Australia) and domestic production, with local farmers contributing to the supply of stem cuttings.

Despite the challenges, certain grasses, such as Taiwanese Green Elephant Grass, VA06, and Guinea Mombasa, stand out for their adaptability, minimal care requirements, and high productivity. These characteristics make them suitable for diverse climatic conditions and attractive to farmers. However, the diversification of forage products remains limited, as most varieties face similar challenges, including low yields, reduced nutritional quality, and high input costs. This limitation is not only due to the previously mentioned lack of local research and development capacity but also to stringent legal requirements for importing new varieties. Many grasses have not been approved by the Department of Crop Production, further constraining market options. Additionally, the absence of national standards for grass seeds exacerbates the issue. Unlike rice or corn, grass seeds lack

standardized national regulations, which are both costly and time-consuming to establish. As a result, companies rely on their own entity standards, which, while more flexible, lack the consistency needed for widespread adoption and trust. Nonetheless, once a grass variety is officially recognized for circulation, it benefits from indefinite circulation rights, offering some stability to the market.

Vegetatively propagated grasses, such as Green Elephant Grass, are favored by smallholders for their ease of cultivation and propagation. These grasses are often shared among farmers for free, posing competition to seed-based grasses. However, their limited nutritional quality hinders optimal livestock performance.

In contrast, biomass maize varieties, already recognized for free circulation within the country, have gained significant traction, especially among large-scale livestock operations. Varieties like CP maize have demonstrated strong market performance due to their high turnover and consistent demand. Biomass maize and its by-products, such as silage, are increasingly viewed as substitutes for traditional forage grasses. Silage offers several advantages, including lower costs, ease of preservation, and reduced dependency on climatic conditions, making it particularly attractive to large-scale livestock farms. While smallholders continue to produce their own feed rather than purchasing silage, this product represents an opportunity for expanding the processed forage market.

Despite current challenges, unmet demand for forage crops persists, particularly among smallholders struggling with livestock feed efficiency. As livestock farming expands, demand for forage crops is expected to increase in both quantity and quality. This shift will require larger-scale, more systematic, and professional approaches to research, grass planting, and grass processing. Proactive feed production strategies, as opposed to the opportunistic practices commonly employed by smallholders, will be essential. Additionally, there will be a growing need for research on forage seedlings, particularly in areas where livestock farming is expanding and forage crops are essential to sustain the sector

Targeted support for smallholders through education and capacity-building programs can encourage investment in improved forage seeds, showcasing their long-term benefits for livestock productivity. Expanding the market for processed products, such as silage and pelleted feed, also presents an opportunity for diversification and value addition. Companies focusing on hybrid maize varieties that require seasonal replanting are well-positioned to capture this growing market segment.

Some strategies to overcome these challenges include investment in local research and development. Either breeding, hybridization, or new varieties testing programs should be prioritized to create high-yielding and nutritionally rich forage varieties. This would reduce Vietnam’s dependence on imported genetic materials. Enhanced collaboration between national research institutions and international organizations would further boost local breeding efforts and innovation. Additionally, research institutions and companies should focus on creating forage varieties better adapted to Vietnam’s climate and the dynamism of cattle production practices and markets while addressing the demand for improved yields and nutritional profiles.

Supporting smallholder farmers is another area with significant potential. Capacity-building programs focused on proper storage techniques, cultivation methods, and the benefits of investing in seed-based grasses could empower smallholders to enhance productivity. Subsidizing high-quality forage seeds through government or development programs would also encourage adoption among this group.

Lastly, to improve competitiveness, Vietnam must combat the informal seed trade, which undermines quality standards and price expectations. Stricter enforcement against unregulated seed markets, coupled with enhanced monitoring of quality and origin, would create a fairer market environment. Companies should also focus on product differentiation by developing clear distinctions in terms of yield, nutritional value, and cost efficiency. This would better address the diverse needs of customers and improve market appeal.

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