TOWARDS SUSTAINABLE DOWNSTREAM PRODUCTION: UPSTREAM INNOVATION AND BUSINESS MODEL DEVELOPMENT FOR LOW-GRADED RIBBED SMOKED SHEET NATURAL RUBBER IN THAILAND

a Suteera Chanthes, b Weerasak Sawangloke, c Adisak Pattiya, d Yottha Srithep

ABSTRACT

Objective: This study from Thailand examined business model development to help transform low-graded ribbed smoked sheet (RSS) rubber into cow shoe production targeting dairy farming. With the Industry 4.0 concept of the knowledge-based economy in the central focus, the research objective was to examine both the supply and demand sides for developing a practical knowledge-based cow shoe business model.

Methods: This qualitative research adopted the concepts of knowledge-based entrepreneurship (KBE) and Osterwalder's business model canvas to guide the investigative design. It used documentary analysis, in-depth interviews, and a focus group discussion as the data collection instruments. The data analysis technique was a generic interpretive approach allowing the researchers to analyze the data by constructing codes, categories, and result conceptualization based on the underpinning conceptions of KBE and the business model canvas.

Results: This study confirmed cow shoe production as a potential downstream business for rubber production in Thailand with the possibility of KBE characterization of innovation, growth, and competitive advantage. Cow shoes could be sold throughout the year for cattle nourishing routines to ease the pain from hoof and claw trimming. Critical success factors for KBE development in this business included creating production technology transfer networks, promoting financial and knowledge support from rubber promotional authorities and regional universities, and developing a sustainable ecosystem for rubber production to be linked in the value chain with rubber biofuel and cattle farming industries.

Conclusion: Considering that innovative rubber production was often suggested at the policymaking level, this paper has filled the knowledge gap by delivering a novel practical framework, supported by empirical evidence, to promote KBE in cow shoe business development as a sustainable downstream business.

Keywords: business model canvas, knowledge-based entrepreneurship, rubber business ecosystem, sustainable business development, Thailand 4.0.

---

a PhD in Management, Mahasarakham Business School, Mahasarakham University, Thailand, E-mail: suteera.c@acc.msu.ac.th, Orcid: https://orcid.org/0000-0001-6774-6462
b PhD in Economics, Mahasarakham Business School, Mahasarakham University, Thailand, E-mail: weerasak.sa@acc.msu.ac.th, Orcid: https://orcid.org/0000-0003-4819-6244
c PhD in Chemical Engineering, Faculty of Engineering, Mahasarakham University, Thailand, E-mail: adisak.p@msu.ac.th, Orcid: https://orcid.org/0000-0001-9446-9229
d PhD in Mechanical Engineering, Faculty of Engineering, Mahasarakham University, Thailand, E-mail: yottha.s@msu.ac.th, Orcid: https://orcid.org/0000-0002-7288-8219
**RESUMO**

**Objetivo:** Este estudo da Tailândia examinou o desenvolvimento do modelo de negócios para ajudar a transformar a borracha de folhas com nervuras (RSS) de baixo grau em produção de calçado de vaca visando a produção de laticínios. Com o conceito da Indústria 4.0 da economia baseada no conhecimento no foco central, o objetivo da pesquisa foi examinar tanto o lado da oferta quanto o da demanda para desenvolver um modelo prático de negócio de calçado de vaca baseado no conhecimento.

**Métodos:** Esta pesquisa qualitativa adotou os conceitos de empreendedorismo baseado no conhecimento (KBE) e a tela do modelo de negócios da Osterwalder para orientar o projeto investigativo. Utilizou análise documental, entrevistas aprofundadas e uma discussão em grupo focal como instrumentos de coleta de dados. A técnica de análise de dados era uma abordagem interpretativa genérica que permitia aos pesquisadores analisar os dados construindo códigos, categorias e conceitualização de resultados com base nas concepções subjacentes do KBE e na tela do modelo de negócios.

**Resultados:** Este estudo confirmou a produção de calçado de vaca como um negócio a jusante potencial para a produção de borracha na Tailândia com a possibilidade de caracterização KBE de inovação, crescimento e vantagem competitiva. Sapatos de vaca podem ser vendidos ao longo do ano para as rotinas de alimentação do gado para aliviar a dor de casco e aparar garra. Os fatores críticos de sucesso para o desenvolvimento do KBE nesse negócio incluíram a criação de redes de transferência de tecnologia de produção, a promoção de apoio financeiro e de conhecimento por parte das autoridades promotoras de borracha e universidades regionais, e o desenvolvimento de um ecossistema sustentável para a produção de borracha a ser vinculada na cadeia de valor com indústrias de biocombustíveis de borracha e pecuária.

**Conclusão:** Considerando que a produção inovadora de borracha foi frequentemente sugerida ao nível da formulação de políticas, este documento preencheu a lacuna de conhecimento ao fornecer um novo quadro prático, apoiado por provas empíricas, para promover o KBE no desenvolvimento do negócio de calçado de vaca como um negócio sustentável a jusante.

**Palavras-chave:** tela de modelo de negócios, empreendedorismo baseado no conhecimento, ecossistema de negócios de borracha, desenvolvimento sustentável de negócios, Tailândia 4.0.

1 **INTRODUCTION**

Ribbed smoked sheet (RSS) rubber is an upstream rubber production in the value chain of Thailand's rubber industry. After rubber plantation, the harvested fresh latex is usually processed into either concentrated or dry rubber, the upstream category of RSS rubber. Thai rubber farmers often suffer when the market price of this agricultural product fluctuates (Weerathamrongsupak & Wongsurawat, 2013). When the prices are low, they are...
forced to either sell their rubber at the low prices and face the business loss or store the product, waiting for the prices to go up and bare, increasing storage costs and the gradually losing quality of the rubber. This problem has led Thailand to encourage local farmers to move downstream to increase the value of their production (Rubber Authority of Thailand, 2023).

Various marketable products have been introduced to the farmers as the policymakers are trying to help the farmers enhance their production and business skills and process their upstream production into value-added downstream products to target various industrial sectors such as vehicle tires, auto parts, and construction materials (Doner & Abonyi, 2013; Weerathamronsak & Wongsurawat, 2013). However, the suggested products often require advanced scientific knowledge and technology for product development. Such requirements are regarded as an obstacle to the business development of smallholder rubber farmers with limited knowledge and resources, leading the Rubber Authority of Thailand (2023) to suggest alternative products with less sophisticated technology required. This study chose to examine cow shoe business development targeting cattle uses following previous studies suggesting cushioning products are highly demanded to help ease the pain from foot injuries and infections for cattle animals in hundreds of thousands of farms throughout the country (Chayaratanasilp, 2023; National Science and Technology Development Agency of Thailand, 2023).

The investigative design of this research project was based on conceptualizing knowledge-based entrepreneurship concerning the Thailand 4.0 policy, determining to promote national economic growth based on the Industry 4.0 concept of knowledge-based economy and innovation (Jones & Pimdee, 2017). With the knowledge-based concept in the central focus, the research objective was to examine the business model development for cow shoe production, suggested by previous studies and the policymakers as potential marketable downstream rubber production (Doner & Abonyi, 2013; Rubber Authority of Thailand, 2023; Weerathamronsak & Wongsurawat, 2013). It adopted Osterwalder's business model canvas to provide essential aspects of business development examination (Osterwalder & Pigneur, 2010). Its findings and the theoretical and result discussions could contribute to the knowledge by providing a novel practical framework, supported by empirical evidence, to guide innovative knowledge-based entrepreneurial development to help local rubber farmers move from upstream RSS rubber production towards sustainable downstream business.
2 THEORETICAL FRAMEWORK

According to the National Science and Technology Development Agency of Thailand (2023), technology and national innovation policies are available for promoting innovative rubber production. However, most previous studies in Thailand have focused on product development at the theoretical levels of scientific techniques for processing upstream rubber into value-added downstream products (National Science and Technology Development Agency of Thailand, 2023; Sirisinha, Sae-oui, Such'Ve, & Thapton, 2020); limited attention in research has been paid to business development, particularly on the practical, implementable model. Therefore, this paper aims to fill the knowledge gap by examining the business development of the rubber cow shoe. The primary objective was to examine this upstream innovation development and then deliver empirical evidence to help promote sustainable natural rubber ecosystems in Thailand.

This study adopted Osterwalder's business model canvas (Osterwalder & Pigneur, 2010) as the foundation for examining the business development for rubber cow shoes. The canvas has been widely adopted for studying business development in diverse agricultural industries (Barel-Shaked, 2023; Engelen, von Gagern, & Engelen, 2023), including rubber products (Andren & Hedin, 2018). However, such a model has not been used for rubber cow shoes targeting cattle farming uses in Thailand. Therefore, this research's results were expected to help fill this knowledge gap.

This research project also employed the knowledge-based entrepreneurship (KBE) concept for its investigative framework, consistent with Thailand's recent national economic development policy, Thailand 4.0. This concept focuses on adding value to its economy through innovation and creativity (Jones & Pimdee, 2017; Potjanajaruwit, 2019). According to the Rubber Authority of Thailand (2023), the recent roadmap for rubber innovation is also driven by the Thailand 4.0 concept. Kanellos (2011, p.92) considers innovation essential for firms with KBE and refers to the term KBE as interchangeable with the term "innovative entrepreneurship."

Considering the importance of innovation as a driver of economic growth and development, Akuhwa et al. (2015) outline five essential elements for business development to achieve its KBE: entrepreneurship development, education, innovation and creativity, science and technology, and commercial application. Given the context of this study, rubber production managed with these elements could be recognized as a
knowledge-based entrepreneurial business with the possibility to advance its innovation, growth, and competitive advantage in the industry.

Given the employment of the two concepts, Osterwalder's business model canvas and knowledge-based entrepreneurship, the conceptual framework of this research project was formed as outlined in Figure 1.

Figure 1. The study's conceptual framework of cow shoe business development toward a sustainable rubber ecosystem

<table>
<thead>
<tr>
<th>The supply side:</th>
<th>The demand side:</th>
<th>Knowledge-based entrepreneurship:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- key partners</td>
<td>- customer segments</td>
<td>- entrepreneurship development</td>
</tr>
<tr>
<td>- key activities</td>
<td>- customer relations</td>
<td>- education</td>
</tr>
<tr>
<td>- key resources</td>
<td>- channels</td>
<td>- innovation and creativity</td>
</tr>
<tr>
<td>- cost structure</td>
<td>- revenue streams</td>
<td>- science and technology</td>
</tr>
<tr>
<td>- value propositions</td>
<td>- value propositions</td>
<td>- commercial application</td>
</tr>
</tbody>
</table>

Rubber cow shoe business model canvas

Downstream business with innovation, growth, and competitive advantage

Sustainable KBE cow shoe business ecosystem

Sources: Created by the authors, based on the concepts of the business model canvas (Osterwalder & Pigneur, 2010) and KBE development (Akuhwa et al., 2015).

3 METHODOLOGY

This study used a qualitative research method with a case study design and snowball sampling technique. As outlined in Figure 1, the designed theoretical framework functioned as the case study's investigative boundary nesting the investigation (Yin, 2017). It chose Mahasarakham province as the case's research site, concerning that this province is home to 164 dairy farms membered to two local cooperatives (Cooperative Promotion Department, 2023) to ensure the possible invitations for research participation whose business involved cattle nourishing. Additionally, this province is home to two public universities and also located at approximate distances to five other regional universities in the neighboring province; its location nearby knowledge sources were essential considering the fundamental elements of KBE development requires the
building of knowledge transfer networks to promote innovation development (Hamdani & Salah, 2018). Snowball sampling (Miles et al., 2014), also known as chain sampling (Goulding, 2002), allowed qualitative researchers to initiate the data collection with no specific defining of publication and sampling size; the purpose of the study guided the selection of initial data source then later guided further sources necessary for the investigation.

The unit of analysis was the experience of the studied individuals related to rubber product development or rubber cow shoes in cattle uses. This research analyzed their experiences to provide the basis for proposing a business model development of rubber cow shoes. The data collection fieldwork from January to March 2023 comprised three phases of qualitative data collection and analysis workflow, as outlined in Figure 2.

Figure 2. Three phases of the qualitative data collection workflow

![Figure 2. Three phases of the qualitative data collection workflow](image)

Sources: Created by the authors.

The first fieldwork phase used a documentary analysis to gain background information on using cow shoes in cattle breeding and nourishing. It reviewed public reports and publications provided by the agricultural authorities responsible for cattle promotional policy in Thailand. It also reviewed commercial websites and articles advertising cow shoes to gain insights into the competitive behaviors of existing producers in the market.

Then, the second fieldwork phase used semi-structured interviews containing questions designed and guided by the five elements of the demand analysis: customer segments, customer relations, channels, revenue streams, and value propositions (Osterwalder & Pigneur, 2010). The researchers used open-ended questions asking the respondents' opinions regarding their expectations and cow nourishing experiences, which could relate to cow shoes' use in cattle farming businesses. The interview
respondents were sampled purposively, including three local farmers and two cooperative managers from Mahasarakham Provinces. The semi-structured interviews asked the sampled respondents about their subjective experiences involving cattle well-being and their perspectives on using cow shoes for cattle breeding and nourishment.

Results from the interview fieldwork subsequently guided the researchers to collect additional data required for the proposition for developing a business model for rubber cow shoes on the supply side of Osterwalder's canvas, which included key partners, key activities, key resources, cost structure, and value propositions (Osterwalder & Pigneur, 2010). In the final data collection phase, the researchers conducted a focus group discussion to collect further data to analyze the production possibilities for the supply side from business and production technology aspects. Given the KBE development suggesting the importance of knowledge networks and technology transfer for innovation development, academics, and public rubber promotional personnel were invited as the participants. Six academics from a regional university were invited to participate in this research: two from mechanical engineering, one from chemical engineering, one from business economics, one from management, and one from marketing. An expert from the rubber promotional authority, the Regional Rubber Authority of Thailand (Northeast Office), was also invited to participate in the discussion.

Throughout the data analysis, the researchers also examined the secondary data source using a documentary analysis approach (Yin, 2017). They analyzed public documents and reports provided by government authorities of Thailand at the regional and national levels. The selected authorities were those responsible for rubber production development and cattle breeding promotion. The researchers used a generic interpretive approach to analyze the research data. They constructed codes and categories based on the underpinning conceptions to provide the scope of the data analysis and interpretation of the results (Merriam & Tisdell, 2015). They also employed a coding of conceptual interest technique (Creswell & Creswell, 2017) for conceptualizing the empirical evidence discovered from the studied sites. This analysis technique allowed the researcher to adopt the underlying concepts of the business model canvas (Osterwalder & Pigneur, 2010) and the knowledge-based entrepreneurship development by Akuhwa et al. (2015) to lay the analysis foundation for cow shoes business development in a sustainable rubber ecosystem.
4 RESULTS AND DISCUSSION

Cow shoes could be sold throughout the year for cattle nourishing routines to ease the pain from hoof and claw trimming (Chayaratanasilp, 2023). Furthermore, the interviewed farmers reviewed that the prime season for cow shoe demand was the latter half of the calendar year. Demand for cow shoes increased in the latter half of the year, from July to December. Various reasons were given. First, cattle trades increased during this time of year, known as the rainy and winter seasons, regarded as the best period for cattle fertility. According to Panyasak et al. (2022), cattle fertility is most statically successful during the rainy and winter seasons. As explained by one interviewed manager of a cattle breeding farm, maternal cows transported during this time often suffered from foot injuries caused by the long-standing time on the vehicle.

The second reason was related to foot pain caused by foot and mouth disease in cattle increasingly spreading during the time of year. As Onmueang & Charoenpanyanet (2018) confirm with empirical statistics of their study from Thailand, the disease spread is caused by various factors, including high humidity, cold weather condition, and the density of cows being transported for long distances on the road during this cattle trading season. This reason is consistent with the researchers' calculation based on the documentary analysis of reports they requested from the Department of Livestock Development of the Ministry of Agriculture and Cooperatives of Thailand, see Figure 3.

Figure 3. Numbers of cattle infected by foot and mouth disease from 2018-2022

![Source: Created by the authors, based on the authors' calculation of the database requested from the Department of Livestock Development of the Ministry of Agriculture and Cooperatives of Thailand (2023).](image-url)
4.1 KBE BUSINESS MODEL FOR RSS RUBBER COW SHOE

The researchers scrutinized the primary and secondary research data when analyzing the business model development on the demand side. The primary data was the in-depth interviews with all the participants from the second data collection fieldwork. The secondary data were public reports, cattle nourishing educational documents and websites of the agricultural promotional authorities, and a statistical database for the years 2018-2022 of the cattle industry of Thailand the researchers officially requested from the Department of Livestock Development of the Ministry of Agriculture and Cooperatives of Thailand. They analyzed these qualitative data sources using a generic interpretive approach (Merriam & Tisdell, 2015) to construct codes and categories based on the five elements of Osterwalder's business model canvas comprising customer segments, customer relationships, channels, revenue streams, and value propositions (Osterwalder & Pigneur, 2010). This procedure allowed the researcher to conceptually identify components of each demand analysis element required to fill the canvas, see Table 1.

On the supply side, the researchers based their analysis on the experiences of rubber innovation experts and academics, then complemented by the secondary data analysis of government reports and public documents. The conceptualization of these data sources filled the five elements of the canvas supply side, including key partners, key activities, key resources, cost structure, and value propositions which intersected the analysis made from the demand side (Osterwalder & Pigneur, 2010). As a result, the organization of the findings was placed inside the canvas, both the supply and the demand sides, with shared value propositions for the rubber cow shoe products, as also shown in Table 1.

Akuhwa et al. (2015, p.467) define entrepreneurship development as involving "efforts tailored toward making the entrepreneur (factor of production) enhanced in the economy." Given the formation of the business model, the study examined the KBE development. It discovered various efforts suggested as a practical guide for rubber farmers to become knowledge-based entrepreneurs in the cow shoe business. While analytically filling the business model canvas, see Table 1, using the research data collected from the documentary analysis, the semi-structured interviews, and the focus group discussion, the researchers also scrutinized the five components of KBE: entrepreneurship development, education, innovation, and creativity, science and technology, and commercial application (Akuhwa et al., 2015). These components
significantly shaped the three indicators suggesting the presence of the business's KBE characteristics, as guided by Kanellos (2011), namely, the business's innovation, growth, and competitive advantage.

Table 1. Business model canvas for RSS rubber cow shoes

<table>
<thead>
<tr>
<th>Key partners:</th>
<th>Key activities:</th>
<th>Value propositions:</th>
<th>Customer relationships:</th>
<th>Customer segments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- RSS rubber farmers</td>
<td>- Raw RSS rubber transformation by adding active agents</td>
<td>- Processed rubber that meets the desired specification and quality of the outsold - Practical design - Easy cleaning, sanitation, and care to allow multiple uses - After-sale services for expired or damaged shoes</td>
<td>- No close relationships required - Personal references through networks of farmers, local cattle authorities, or local cattle cooperatives</td>
<td>- Smallholder Cattle breeding farms - Dairy farms - Cattle transporting services - Professional cattle nourishing professionals, i.e., veterinarians, public authorities</td>
</tr>
<tr>
<td>- Knowledge and technology transfer partners, i.e., regional universities and local public authorities for cattle promotion</td>
<td>- Moulding processed RSS rubber sheet into designed cow shoe shapes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Local distributing partners</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Local sales and marketing partners</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key resources:
- Raw RSS rubbers
- Skilled workforce
- Financial support (public initiatives / private investment)

Value propositions:
- Processed rubber that meets the desired specification and quality of the outsold
- Practical design
- Easy cleaning, sanitation, and care to allow multiple uses
- After-sale services for expired or damaged shoes

Customer relationships:
- No close relationships required
- Personal references through networks of farmers, local cattle authorities, or local cattle cooperatives

Customer segments:
- Smallholder Cattle breeding farms
- Dairy farms
- Cattle transporting services
- Professional cattle nourishing professionals, i.e., veterinarians, public authorities

Channels:
- Local cattle supplies shop
- Local cooperatives
- Online Marketing
- E-commerce platforms

Cost structure:
- Material costs: raw RSS rubber supplies (Fluctuating prices based on the world rubber markets)
- Customized molding equipment investment and maintenance costs
- Labor costs
- Marketing costs
- Customer relations costs
- Product distribution costs

Revenue streams:
- Acceptable price ranges per unit are 50 – 350 Baht/piece, depending on the shoe quality
- Increasing demand in the rainy and winter seasons of Thailand, the prime period is July – December
- Suggested demand creation through personal references, especially among local farmers, cooperatives, local cattle promotional authorities, and cattle nourishment professionals

Source: Created by the authors, based on Osterwalder's business model canvas (Osterwalder & Pigneur, 2010).

4.2 INNOVATION

This study discovered that required rubber innovation for processing the low-graded rubber to produce cow shoes was available in the studied regional university. One of the focus group informants, who specialized in mechanical engineering and whose research interest was rubber science and production, confirmed available production
technology to customize low-graded RSS rubber using different chemical substances to help process the rubber into any specified qualities, such as thickness, hardness, durability, or water resistance. He provided examples of substances added to raw RSS rubber using different formulas for transforming rubbers into various specifications ready for further moulding into innovative rubber products; see examples in Figure 4. The quote below was his explanation:

"We do experiments for processing the rubber in our laboratory using various additives, including carbon black, clay, paraffinic oil, Zinc oxide, stearic acid, blowing agent, CBS, and sulfur. If you want to produce cow shoes, I am certain that we can customize a formula to meet the shoe's desired specification."

![Figure 4. Comparing raw low-graded RSS rubber and an RSS rubber sheet after processed](image)

(a) Raw low-graded RSS rubber. (b) Processed RSS rubber
Source: photos taken by the authors from the focus group discussion fieldwork.

Additionally, other engineering academics suggested a direction for developing a sustainable rubber production ecosystem to follow the recent national economic development model of the Bio-Circular-Green economy, known as the BCG economy model (NSTDA, 2023). They revealed available biofuel technology to help transform RSS rubber and outdated products, such as raw low-graded RSS rubber, wastes from the rubber sheet production process, and old cow shoes, into biofuel; see examples in Figure 5.
Considering the variety of raw and wasted RSS rubber potentially being transformed into rubber biofuel with scientifically proven effective use comparable to diesel, this innovative rubber product could later be promoted as marketable downstream rubber products under the BCG model. From the academic perspective, the engineering academics confirmed the possibility of production technology transfer as a university outreach to help promote rubber innovation. This finding agrees with previous studies scrutinizing KBE development in small agricultural commodities in Thailand (Chanthes & Sriboonlue, 2021; Puangprponpitag, 2019), suggesting small local farmers have limited resources for research and development to engage with local higher education institutions to gain access to novel knowledge through university outreach and technology transfer academic services.

The findings also supported the promotion of eco-innovation playing a significant role in Industry 4.0 economic development (Noronha et al., 2023). In addition, similar to a study by Khoruzhy et al. (2023), environmentally friendly production was regarded as a business opportunity for agricultural enterprises to achieve enhanced profitability. Therefore, this paper suggests that local knowledge sources, such as regional universities and rubber promotional authorities, play an essential role in providing innovative production knowledge and technology transfer to help local upstream farmers develop their eco-innovation rubber production under the national initiative of Industry 4.0 and BCG concepts.
4.3 GROWTH

Considering this study examining smallholder cattle farms as the target market segment, the market growth was analyzed based on the number of cattle animals in Thailand. The researchers used the database they requested from a public authority, the Department of Livestock Development of the Ministry of Agriculture and Cooperatives of Thailand, to project the market growth. As presented in Table 2 and its associated graph in Figure 6, the results showed potential growth in this segment.

Table 2. Numbers of cattle animals in Thailand in 2018-2022

<table>
<thead>
<tr>
<th>Numbers of cattle animals (units)</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef cattle</td>
<td>5,445,351</td>
<td>5,871,807</td>
<td>6,230,140</td>
<td>7,582,406</td>
<td>9,394,111</td>
</tr>
<tr>
<td>Buffalo</td>
<td>1,181,023</td>
<td>1,226,785</td>
<td>1,256,074</td>
<td>1,463,022</td>
<td>1,741,141</td>
</tr>
<tr>
<td>Milk Cow</td>
<td>623,427</td>
<td>666,311</td>
<td>707,236</td>
<td>810,605</td>
<td>812,235</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,249,801</strong></td>
<td><strong>7,764,903</strong></td>
<td><strong>8,193,450</strong></td>
<td><strong>9,856,033</strong></td>
<td><strong>11,947,487</strong></td>
</tr>
</tbody>
</table>

Source: Created by the authors (2023) based on the database provided by the Department of Livestock Development of the Ministry of Agriculture and Cooperatives of Thailand (2023).

Figure 6. The growth rate of cattle animals in Thailand from 2018 – 2022

Source: Created by the authors, based on the authors’ calculation of the database requested from the Department of Livestock Development of the Ministry of Agriculture and Cooperatives of Thailand (2023).

4.4 COMPETITIVE ADVANTAGE

This study discovered three sources of possible competitive advantage of cow shoe business development. First, rubber is among the economic commodities the Thai government has enacted promotional policies to help drive the industry in the downstream direction (Doner & Abonyi, 2013; Weerathamrongsak & Wongsurawat, 2013). Financial support was provided to the public authorities for rubber promotion and the academic...
sector for research and development (R&D) promotion. Therefore, Farmers could take advantage of such support to advance their knowledge for production and business innovation. As an interviewed academic whose research interest was agricultural economics explained:

"I recently got a grant to research the rubber business. There are many open calls [for research grants] to encourage rubber business development. I think such funding fulfills both research and academic service missions. We often invite rubber farmers to participate in the research, and then the research results will ultimately benefit their farming and agribusinesses."

The second source of competitive advantage is the existing networks of the business canvas's supply and demand side. According to the public report, as of 2018, Thailand has 109,101 rubber cooperatives by smallholder rubber farmers and 40,615 by beef cattle breeding, buffalo breeding, and dairy farmers (Cooperative Promotion Department, 2023). This paper recommends that KBE cow shoe business development consider these networks as a supporting factor, regarding previous studies suggest personal networks and references as an essential source for agribusiness innovation development in Thailand (Chanthes, 2021; Puangpronpitag, 2019). The rubber network was regarded as a significant source for key suppliers of RSS rubber, and the cattle farming network could help connect the business to its target customers.

This research revealed the third source of competitive advantage as the rubber cow shoes requiring only basic science support and technology transfer considering its small product size and simple produce design. This finding suggested the possibility for the policymakers to encourage the upstream farmers to step further towards the downstream direction with this suggested marketable product. Rubber cow shoe business could be a promising alternative for rubber farmers with limited access to financial support and sufficient capital for the investment, regarded as one of the challenges for starting the downstream business usually faced by smallholder farmers (Doner & Abonyi, 2013; Rubber Authority of Thailand, 2023).

4.5 UPSTREAM RUBBER INNOVATION DEVELOPMENT INTO THE COW SHOE BUSINESS ECOSYSTEM

Given the research findings and discussion, the study ultimately proposed a framework for a sustainable ecosystem of cow shoe business development, as illustrated in Figure 7.
Figure 7 shows that the proposed model for sustainable cow shoe business development requires key partners from not only the industrial but also academic and public sectors. Considering the focus on a knowledge-based economy, the knowledge networks for technology transfer and innovative business development for RSS rubber cow shoes require the involvement of regional universities as the knowledge production and delivery partner and public agricultural authorities of rubber and cattle promotion. The support from these partners is expected to help drive farmers in the upstream industry of RSS rubber to tackle the challenges of lessening market value and eventually becoming low-graded rubber products, causing the farmers to have less competitiveness in the industry. Farmers engaged in the knowledge networks and technology transfer for
promoting cow shoe production as the value added in the downstream rubber industry could upturn their innovation, growth and competitive advantage, potentially becoming a knowledge-based entrepreneurial business. The model suggests key suppliers from low-graded RSS rubber farmers and critical customers from various types of cattle farms, including beef cattle, buffalo and milk cow or dairy farming; see Figure 6 previously showing the growth rate of this potential customer sector.

Furthermore, as guided by the empirical evidence, this study revealed rubber biofuel as an additional related industry to include in the bio-circular-green economic development. It discovered that low-graded RSS rubber of all forms within the value chain of this proposed business model could be used in biofuel production. As the findings suggested, these rubber forms included raw, low-graded RSS rubber, wastes from the rubber sheet production process, and old cow shoes.

Given the business development ecosystem this paper delivered, low-graded RSS rubber could be transformed into a sustainable downstream business with value-added in the rubber value chain while also showing potential to engage with the other two industries namely cattle farming and rubber biofuel to create a sustainable ecosystem under Thailand’s national policy focusing on the BCG economy.

5 CONCLUSION

This paper has presented an empirical study examining practical business development for low-graded RSS rubber, regarded as a type of upstream rubber product in the rubber industry. The research was conducted in a selected province, Mahasarakham, in the Northeast region of Thailand. The research adopted the concept of knowledge-based entrepreneurship (KBE) to guide the scrutiny of innovative business development for rubber cow shoes made of low-graded RSS rubber. It also employed Osterwalder’s business model canvas to guide its examination of the supply and demand elements required to form a business model development.

5.1 CONCLUSION OF THE FINDINGS

The paper has extended the current body of knowledge by delivering a practical model to guide the Thai rubber farmers to develop a downstream business to add value to their rubber production. The empirical evidence was based on the experiences of the target customers, cattle farmers, and the public knowledge providers required for innovative
production, such as university academics and public rubber promotional agencies. This evidence helped to reveal essential components for filling the supply and demand sides of the proposed business model canvas.

The findings confirmed the presence of KBE's five essential elements in the proposed rubber cow shoe business model, including entrepreneurship development, education, innovation and creativity, science and technology, and commercial application. These elements were the basis for the farmers creating business innovation through regional innovation and knowledge transfer networks. The findings also suggested prospective growth of the target market, cattle farming, concerning the increasing number of cattle animals in Thailand.

Furthermore, this paper identified three sources of competitive advantages for upstream rubber farmers interested in the rubber cow shoe business, regarded as the potential downstream development to add value to their rubber production. The first competitive advantage concerned financial and knowledge support from rubber promotional authorities and regional universities, which functioned as the innovation and knowledge source. The second advantage was based on the abundance of existing networks of agricultural cooperatives: the network on the supply side was the rubber cooperatives, while the demand side network, identified as the target market segment for cow shoes, was cattle cooperatives. The third advantage concerned the product specifications of rubber cow shoes requiring relatively low capital for investment and technological levels, compared to other products suggested at the policymaking levels requiring intensive investment and more sophisticated technology.

5.2 THE CONTRIBUTION TO KNOWLEDGE

The results and discussion delivered by this paper confirmed rubber cow shoes made of RSS rubber as a potential alternative to promote the innovative upstream rubber business ecosystem for smallholder rubber farmers with limited resources and knowledge. It has filled the knowledge gap, considering that such innovative downstream rubber production is often suggested at the policymaking level to help farmers in the upstream industry, such as RSS rubber, add value to their production. This paper has delivered scrutinization focusing on policy implications and practical business development. It also considered the BCG economy and eco-innovation development in agricultural development, resulting in a sustainable ecosystem of RSS cow shoe business
model to engage with other agricultural industries linked in the value chain, namely rubber biofuel and dairy cattle farming.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The limitation of this research concerned its primary sources of data. Given the research motivation rooted in a concern for the unstable prices in the upstream rubber market, the study preliminarily positioned the upstream low-graded RSS rubber as the central focus of the research inquiry. Concerning this preidentified choice, the investigative design did not include rubber farmers as a source of the primary data required for forming a business model of cow shoes to target cattle farming uses. Therefore, this paper suggests that future research adopt its proposed model for developing a practical rubber shoe business ecosystem and evaluate its implementation ability. It specifically recommends action research to study rubber farmers as the unit of analysis for examining the model implementation in practice.

ACKNOWLEDGMENT

This research project was financially supported by Mahasarakham University.
REFERENCES


Towards Sustainable Downstream Production: Upstream Innovation and Business Model Development for Low-Graded Ribbed Smoked Sheet Natural Rubber in Thailand


