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THE CIRCULAR ECONOMY PRACTICES OF THE TAPIOCA STARCH INDUSTRY IN NORTHEASTERN THAILAND

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The circular economy can play an essential role in sustainable business management. The adoption of circular economy practices among firms is a solution to their negative impact on society and the environment that increases from their operation. In Thailand, the tapioca starch industry is considered one of the largest food processing industrial sectors. The rapidly growing industrial activities have been causing water and pollution problems. These challenges require an approach that has the potential to overcome problems and contribute to sustainable development. Therefore, the purpose of this study is to explore how the tapioca starch industry has implemented circular economy principles, which identified issues across the key stages: take, make, and waste. This study used a qualitative research approach, using data collected through semi-structured interviews, complemented with field observations, as well as a review of secondary sources. Semi-structured interviews were carried out with five representatives, who are critical informants and directly involved with CE practices of tapioca starch companies in Northeastern Thailand. The result suggests that the implementation of circular economy principles can achieve organizational sustainability. Top management support is the primary motivator for organizations to embrace circular economy practices. The tapioca starch industry is coupling its strategic goals with maximum efficiency, reducing waste, and most importantly, discovering novel sources of revenue that enable both business success and the

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regeneration of the environment. Crucially, for the tapioca starch industry to move towards circularity, they must integrate these strategies across supply chains, rather than limiting them to the organizational stage.

Keywords: circular economy, sustainability, agricultural industry, tapioca starch

1. INTRODUCTION

Sustainability development has been an area of growing concern and attention for businesses and society (Ocicka, Razniewska, 2018). It is also treated as an essential element of supply chain management (Rudnicka, 2016; Yu et al., 2018). Businesses and society face several challenges to tread the sustainability path while ensuring the wellbeing of future generations (Lozano et al., 2018). In particular, the agro-food industry can play an essential role as the provider of food and fuel for humans (Kamali et al., 2017). A rapidly growing population, declining agricultural land, climate change, food, water, and energy security demand have led to increased pressure on the agro-food industry to deal with the sustainability of their supply chains (Rasul, 2016; Ozturk, 2017; Allaoui et al., 2018; Awan, Khan, 2021). Tackling these challenges requires an integrated management approach to balance economic growth, environmental protection, and social conditions.

A circular economy (CE) promotes sustainable development, leading to considerable changes in the modern economy (Dobrucka, 2019). Past research showed that CE is a sustainability framework that aims to "maximize resource efficiency and minimize waste". CE will lead to a more sustainable business model that can decouple economic growth and environmental loss (Brydges, 2021). Lavelli (2021) notes that the circular supply chain is focused on the primary production product, by-products and waste and may involve several integrated loops for recovering materials to create social, economic, and environmental value. Zhu et al. (2010) and Casarejos et al. (2018) have suggested that the CE approach promotes continuous economic development without posing significant environmental and resource challenges. In addition, circular food supply chains can potentially generate added-value foods (Lavelli, 2021). Hence, CE has been increasingly seen as a possible solution to pursue more sustainable development (Barros et al., 2021).

In Thailand, the tapioca starch industry is considered one of the largest food processing industrial sectors. Tapioca starch is recognized as a commodity, which has high export potential and improves incomes for actors in the chain

(Masamhaa et al., 2018; Darko-Koomson et al., 2020; Ikuemonisan et al., 2020). The production process of starch from cassava is energy as well as water-intensive. It also generates wastewater and solid waste with a high organic load, leading to significant water and air pollution (Pingmuanglek et al., 2017; Wimolrattanasil et al., 2018). Traditionally, starch wastewater is treated in anaerobic ponds, which require large land areas with limited or no methane recovery, which escapes into the atmosphere, leading to significant GHG emissions and contributing to climate change (Sanchez et al., 2017; Kayiwa et al., 2021). The rapidly growing industrial activities have been causing water and pollution problems (Oghenejoboh et al., 2021). These challenges require an approach that has the potential to overcome problems while contributing to sustainable development.

However, CE practice research is still in the development stage and requires more real case investigations, especially from the tapioca starch industry context. These gaps, and the challenges facing the tapioca starch industry, call for research in different contexts. This study aims to investigate how the tapioca starch industry has implemented circular economy principles, which identified issues across key stages: take, make, and waste, drawing on semi-structured interviews, complemented with field observations, as well as a review of secondary sources. Semi-structured interviews were carried out with five representatives from five tapioca starch companies in Northeastern Thailand. The interviewees were all from top managerial positions, who are critical informants and directly involved with CE practices. This paper contributes to the growing literature by investigating the implementation of CE initiatives in the tapioca starch industry. The adoption of CE practices will not only help the industry with their waste management but also will recover value in value chains.

2. METHODOLOGY

To answer the research question, this study applied a qualitative research approach, using data collected through semi-structured interviews, complemented with field observations, as well as a review of secondary sources. Semi-structured interviews were carried out with five representatives from five tapioca starch companies in Northeastern Thailand. The selection of samples was based on purposive sampling so that those chosen for interviews were from various positions and company sizes. The interviewees all belong to top managerial posts and are familiar with CE practices. Semi-structured interviews and field observations were conducted between April and May 2021.

Table 1. Summary of research participants

Position	Business	Company size
deputy managing director	family business	large
general manager	family business	large
general manager	family business	medium
managing director	affiliated company	medium
CEOs	joint venture	small

Source: own study based on survey in 2021.

Data analysis was performed for two themes: i) an introduction to the linear economy in the industrial process of tapioca starch and ii) how the tapioca starch industry has implemented circular economy principles, which identified issues across key stages: take, make, and waste. The results were validated by triangulation, with interview analyses, secondary data, and observations.

To conduct the interviews, researchers followed an interview guide that focused on how the tapioca starch industry implements circular principles. Interviews typically began with questions about the industry, its product and process. The second set of questions addressed the industry's sustainability challenges and how the tapioca starch industry has implemented circular economy principles, which identified issues across key stages: take, make, and waste.

3. RESULTS

This section introduces the identified CE practices for the tapioca starch industry according to interviews with management, field observations, and, as mentioned, in documents and reports. The practices have been classified into three key stages: take, make, and waste, based on the manufacturing process of the tapioca starch industry. The results show that interviewees' awareness and attention were on CE practices that are linked to achieving sustainable development goals and a competitive advantage. In addition, the adoption of CE practices will not only help the industry with their waste management but also will recover value in the value chain.

This study will look into these two issues. Firstly, by giving a brief introduction to linear economy in the industrial process of tapioca starch. Secondly, by providing information on how the tapioca starch industry has implemented circular economy principles, which identified issues across key stages: take, make, and waste.

3.1. Linear Economy

In the linear model, the tapioca starch industry extracts native starch or modifies starch, which is subsequently processed into products by other companies.

The complete stepwise process can be divided into four main stages: (i) preparation (peeling and washing); (ii) rasping/pulping/grating; (iii) recovery (starch sedimentation, washing, dewatering, drying); and (iv) finishing (milling and packaging) (Tumwesigye et al., 2016).

The process begins with the reception, weighing, and unloading of the roots. In an industrial starch plant, root-laided trucks are weighed by platforms which then tilt to unload them using a front hydraulic lift. After the unloading process, a vibrating screen expels the excess earth and impurities from the roots. The product is then transported to the hopper, stored, and fed to the washing-peeling system. Most of the water used in the washing-peeling process is produced during a later industrial stage: the starch separation process. The resulting effluent is directed into the treatment lagoons while the peeled roots are transported by a conveyor belt to the crushing stage. This next stage is achieved by a rotating cylinder that works at high speeds, breaking up the cells and subsequently releasing the starch. The outcome is a crushed pulp that must undergo another process that separates the starch from the cassava fibers using rotating conical sieves. After the sieving, a higher starch-concentrated pulp continues the process while the obtained fibers are pumped to a tank that stores them together with cassava husk and peels. This residual biomass is beneficial as it can be used as animal fodder. Meanwhile, the starch-rich pulp undergoes an additional concentration stage. In this stage, the pulp is fed from the top of the equipment, and the centrifugal force separates a solid concentrate, mainly starch, and a liquid effluent, mostly water. The resulting water is reused in the previous process, which efficiently decreases the water consumption of the whole process. The surviving water within the solid starch must be removed. To do so, first, a mechanical treatment is performed using a hydro cyclone or centrifugal dewatering equipment. The second treatment consists of drying. A flash dryer is customarily used. It consists of an air filter, a heat exchanger, an exhaust fan, and a pipe. The final stage has a dust washing system, which decreases the quantity of starch that is lost within the air. The ultimate product is starch with moisture content from 12% to 14%, ready to be packed and commercialized (Sanchez et al., 2017). The tapioca starch production process is presented in figure 1.

In an economy like this, the raw material is in continuous demand and non-renewable resources will inevitably be depleted at some point in time in this economic model. According to some interviewees, the implications of material scarcity are already evident in the form of volatile markets and raw material prices. To the individual company this means uncertainty regarding raw material prices. Material scarcity is not the only consequence of the linear production

paradigm. The negative environmental impacts are also considerable, including climate change, destruction of natural habitats, and generation of waste. Hence, the notion of a circular economy proposes potential solutions to some of these challenges.

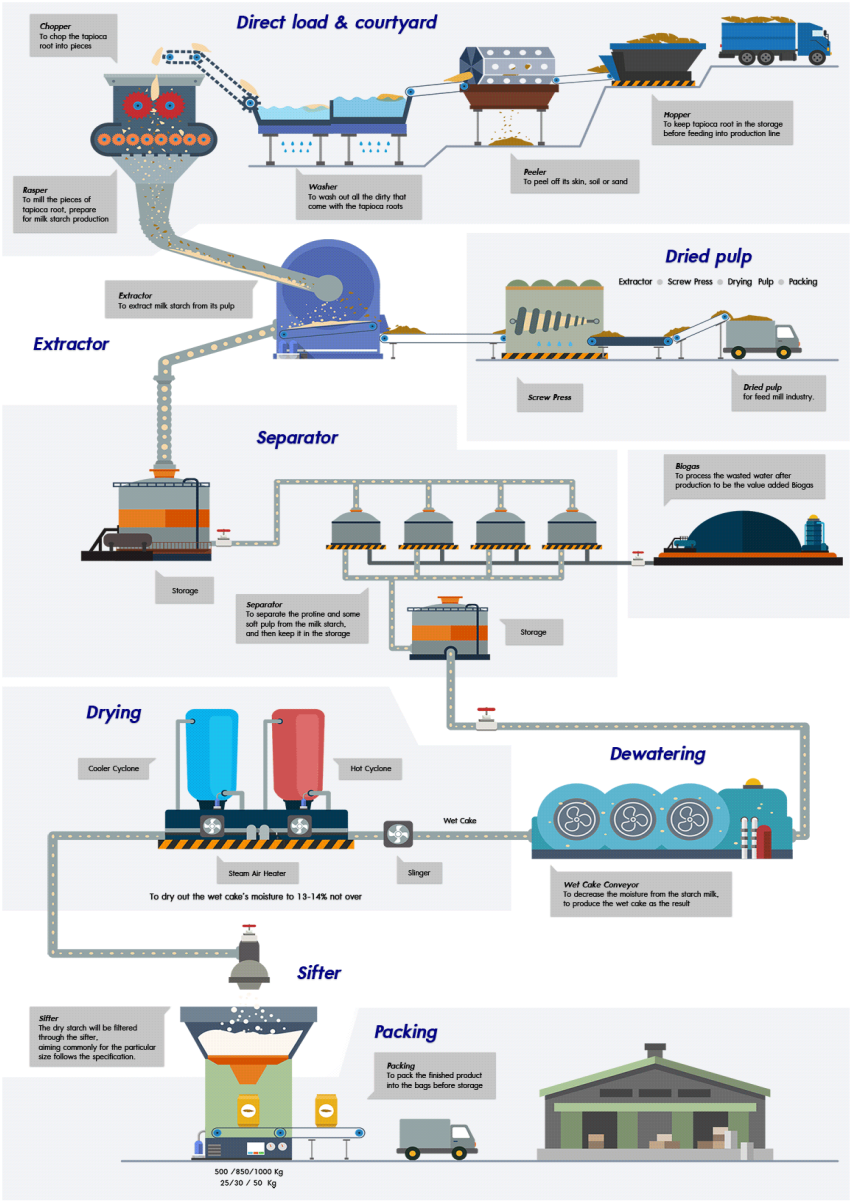

Fig. 1. Tapioca starch production process (Sonish Starch, 2021)

3.2. Circular Economy

The interviewees asserted that CE principles have great potential for their organization. The implementation of circular economy principles can achieve organizational sustainability and improve economic, social, and environmental performance. Top management support is the primary motivator for organizations to embrace circular economy practices. In addition, interviewees mentioned CE practices focusing on optimizing the use of resources especially in terms of energy and resource efficiency (such as raw materials, energy, and water). Those practices were described as having the potential to improve the efficiency of the manufacturing process of the tapioca starch industry and thus reducing the consumption of resources (e.g. water, energy) as well as cutting down emissions and waste. This results in a reduced environmental impact of the organizations' activities.

3.2.1. Take

The first stage to consider is "take". The tapioca starch industry extracts raw materials to make new products, and the raw material is cassava roots. In terms of raw material supply, the tapioca starch industry is concerned about securing raw materials for the continuity of its industrial activities.

3.2.1.1. Procurement

The tapioca starch industry has improved the skills and productivity of farmers who are producers of the industry's sustainability such as new cassava varieties and the drip irrigation system, as the interviews showed that: "This industry will search for new cassava varieties and distribute it to the farmers". There are training activities held to increase yields per rai (unit of area equal to 1,600 square meters) through technology transfer of cassava production, learning gardening, production input access such as drip irrigation systems, soil pH value measurement, tailor-made fertilizers, cassava varieties, subsoil plows blast, etc., as the interviews showed that: "This industry held activities on cassava cultivation and transferred information from experimental plots such as how to increase yields per rai by using cassava wastes along with the utilization of the drip irrigation system during the cultivation season". As a result, the industry could efficiently plan production materials in terms of quantity and quality and increase raw material security for food and energy industries. While the community could mitigate the shortage of food sources, the farmers could increase cassava yields, their income, and reduce the cost of production. An increase in agricultural yields not only reduced the water footprint and environmental cost but also increased employability for the community members and improved the community's economy as mentioned in the interviews with the executives, as the inter-

views showed that: “This industry’s primary goal is in improving its ‘upstream’ or the cassava farmers through projects to discipline them in increasing yield, reducing the cost of production, learning gardening and cultivating on bigger plots”. However, there is still a ‘gap’ of knowledge which needs to be filled.

3.2.1.2. Raw materials use

The tapioca starch industry increased its cassava extraction efficiency by improving its extraction machines to reduce waste and increase usable flour from centrifuge machines. The industry also reduced water use, but this did not affect the product quality.

3.2.2. Make

At the stage of making, activities and processes used to produce a product in the tapioca starch industry can impact a community. Hence, the tapioca starch industry redefined productivity and redesigned activities along the value chain, such as redefining energy use and resource use. The result is that the industry earns a profit, achieves cost savings, and solves societal problems while providing the company with productivity and better performance in the value chain.

3.2.2.1. Energy use

The tapioca starch industry has improved its power usage through better technology, recycling, and cogeneration. Moreover, the tapioca starch industry used sewage water and cassava waste to produce alternative biofuel for the baking process of tapioca starch to replace stove oil, which was relatively costly. The rest of the biofuel would be used for electricity generation either for domestic use or selling it to the Provincial Electricity Authority, as the interviews showed that: “This industry uses sewage water from the production process to produce biofuel to replace relatively costly stove oil. The rest of the biofuel is used to generate electricity for domestic use or sold to the Provincial Electricity Authority”. Using biofuel as alternative fuel rather than stove oil reduces the cost of production and reduces greenhouse gas. As a result, the tapioca starch industry and community would maintain their mutual benefits. The industry saved its fuels, production costs and generated income from electricity sales while the community benefited from minimal emissions of greenhouse gases and other environmental impacts. The following statements from the interviews support this claim, as the interviews showed that: “When we produce biofuel, we reduce pollution and environmental cost. Biogas is made of methane, which causes global warming because one molecule of methane sucks heat 21 times compared to carbon dioxide. Therefore, when we use methane for baking the flour, it emits carbon dioxide, which only sucks heat one time compared to methane. This is a 20 times reduction in the greenhouse effect”.

3.2.2.2. Water use

The tapioca starch industry depends on a tremendous amount of water as the main source of its production process. Almost all of the used water will become sewage or polluted water. Most tapioca starch industries produce an average of 200 tons of flour per day, emitting 3,000-4,000 cubic meters of polluted water with BOD as high as 6,500-12,600 milligrams. In the past, the industry operated an open-well wastewater treatment system that consumed large land areas and emitted an intolerable smell to nearby communities. Later, wastewater treatment technology was developed and used to generate power or biogas. This method took up a smaller land area, did not cause a foul smell, and the biogas could replace stove oil while at the same time generating electricity.

3.2.3. Waste

The tapioca starch industry is exploring ways to support more sustainable development and reduce waste. Therefore, they applied the 3Rs principles (i.e., reduce, reuse and recycle), converting this waste into valuable products and environmentally-friendly energy.

Firstly, the wastewater from the production process was used to make biogas, as the interviews showed that: “This industry is using wastewater to produce biogas as an alternative fuel to stove oil”.

Secondly, the wastewater treated in the final well was used for domestic cultivations such as eucalyptus and cassava. Besides, treated wastewater was reused domestically, leading to water conservation, reducing the water footprint and cost of production while generating more income from electricity sales, as the interviews showed that: “Up to 30% of water is saved by the industry by recycling the treated water inside the factory”. Consequently, the farmers and local communities benefited by a water conflict alleviation between the communities and industries as mentioned by the executives, as the interviews showed that: “A small experiment was conducted by planting banana trees around the treatment wells. Surprisingly, the banana tree grew well, and there were plenty of big-sized bananas”.

Thirdly, the industry adapted by-products from the production process (e.g., roots, rootstocks, soil, sand, cassava waste, etc.) for cultivation (e.g., additional substances in soil, biofertilizer, mushroom spores, etc.), and these would be sold to farmers at low prices. Cassava waste is the largest-in-quantity by-product from tapioca flour production. Waste would be put on sale as ingredients for animal feed or electricity generation. Therefore, the industry could reduce the cost of production and generate additional income from the by-product sale. At the same time, the farmers and local community benefited from cassava waste, which was used for cultivation and animal feed to reduce production costs. This claim is supported by the following interviews with executives, as the interviews showed

that: “Villagers use newly produced cassava wastes from the industry’s washing process on their farms to increase protein and bacteria necessary for making loam. There is a plan to co-create low-priced fertilizers with the university”, “50% of tapioca fiber is sold for animal feeds; while 50% goes to the biofuel fermented well”.

In addition, the tapioca starch industry took social issues or needs into consideration as focal points for product development, such as health issues, nutritional status, safe food access, environmental effects, etc. Hence, the community and industry both benefited from such an operation as a win-win situation. The tapioca starch industry added value to the products and increased the cassava price and tapioca starch price, which would lead to price stability throughout the supply chain. Additionally, considering the social issues and needs as keys for product development further enhanced the opportunity for the products to access new markets. The community can access healthy, nutritious, and safe food as well as eco-friendly products, as the interviews showed that: “In today’s world, the consumer is focused on health status and health motivation. People are scared of chemical ingredients, and they want to live longer. These ingredients are involved in various kinds of food, so we research and develop keeping consumer awareness in mind”.

“We will look at two points of view here – social needs and customer demands. Firstly, we will evaluate the social trend of whether people are having health issues, so we will launch products to respond to such demands. Also, we sell B2B, so we listen to our customers, and their need for products made from agriculturally sustainable ingredients”.

“If the customers care for their health, the question is ‘will I be able to launch products that can respond to their needs?’ For example, if you eat food rich in carbohydrates and it boosts your digestive system or helps you stay full longer, you will eat less and will not get fat”.

Finally, to move forward towards implementing circular food supply chains in the tapioca starch industry, it has developed a cassava cluster. The cassava cluster has a prominent role in cooperating with farmers, government, educational institutions, trade associations, and tapioca starch factories. The cooperation enhanced the exchange of information, knowledge, experiences, up-to-date technology transfer, community, industry-level research and development, and value-added cassava products. Nevertheless, the cassava cluster development has only been in its initial stages, and it only targets cassava farmers who are ‘upstream’ producers. With continued development, the cassava cluster will further strengthen cooperation between public and private sectors, eventually leading to sustainable growth, quality, and efficiency of the industry. The industry benefited from having business partners while the farmers and local communities benefited from up-to-date agricultural technology transfer. Furthermore, through knowledge and skill development, the farmers could earn more income and sustain a better quality of life, as mentioned in the interviews with the executives, as follows: “cluster development creates

cooperation between the private and public sector and the university so we can apply such knowledge, experiment with it, and transfer it to farmers. Thus, we have a chance to exchange, suggest, and receive better cooperation".

However, corporate leadership was the essential factor in driving forward CE within corporations. Indeed, most CE projects are initiated from within the companies. Therefore, senior leadership's commitment and steering on the subject is vital for its successful implementation.

4. DISCUSSION

The circular economy can play an essential role in sustainable business management of the tapioca industry, and it can be seen throughout an organization. The tapioca starch industry is coupling its strategic goals with maximizing efficiency, reducing waste, and, most importantly, discovering novel sources of revenue that enable business success and the regeneration of the environment. Adopting circular thinking might enable an organization to obtain more sustainable results while reducing its impact. For instance, making a supply chain more circular allows companies to lower the environmental and social impact not only for the company itself but also throughout the entire supply chain. In addition, companies with more circular practices can reduce tangible costs such as material usage and waste disposal and intangible costs such as the potential negative reputation of companies that disregard sustainable practices. However, to implement circular food supply chains in the tapioca starch industry, a thorough rethinking and reorganizing of the whole management system is necessary. For example, the by-product recycling strategy should not be conceived and implemented within a single food company, such as the company that converts by-products into new food ingredients; conversely, it should be harmonized among all of the actors interconnected within a circular supply chain to improve both efficacy and transparency. In addition, achieving equitable distribution of costs and benefits of circular supply chain implementation remains a challenge.

Limitations to this study; the results of this research were limited to the terms of context, in this case the tapioca industry. As to its contributions, this study contributes firstly by providing academics with a coherent view of the relationship between a circular economy and business models, particularly by identifying the impact of the circular economy across different business areas. The practical contributions of this study lie in providing practitioners and organizations with insight on where the adoption of a circular economy might affect business the most. Further and future studies expect to clarify how the tapioca starch industry has implemented circular economy principles beyond the company level.

LITERATURE

Allaoui, H., Guo, Y., Choudhary, A., Bloemhof, J. (2018). Sustainable agro-food supply chain design using a two-stage hybrid multi-objective decision-making approach. *Computers and Operations Research*, 89, 369-384.

Awan, U., Khan, S.A.R. (2021). Mediating role of sustainable leadership in buyer supplier relationships: supply chain performance: an empirical study. *LogForum*, 71(1), 97-112.

Barros, M., Salvador, R., Prado, G., Francisco, A., Piekarski, C. (2021). Circular economy as a driver to sustainable business. *Cleaner Environmental Systems*, 2, 1-11.

Broman, G., Robert, K. (2017). A framework for strategic sustainable development. *Journal of Cleaner Production*, 140, 17-31.

Brydges, T. (2021). Closing the loop on take, make, waste: investigating circular economy practices in the Swedish fashion industry. *Journal of Cleaner Production*, 293, 1-8.

Casarejos, F., Bastos, C.R., Rufin, C., Frota, M.N. (2018). Rethinking packaging production and consumption vis-a-vis circular economy: a case study of compostable cassava starch-based material. *Journal of Cleaner Production*, 201(10), 1019-1028.

Darko-Koomson, S., Aidoo, A., Abdoulaye, T. (2020). Analysis of cassava value chain in Ghana: implications for upgrading smallholder supply systems. *Journal of Agribusiness in Developing and Emerging Economies*, 10(2), 217-235.

Dobrucka, R. (2019). Bioplastic packaging materials in a circular economy. *LogForum*, 51(1), 129-137.

Ikuemonisan, E.S., Mafimisebi, T.E., Ajibefun, I., Adenegan, K. (2020). Cassava production in Nigeria: trends, instability and decomposition analysis (1970-2018). *Heliyon*, 6, 1-9.

Kamali, F., Borges, J., Meuwissen, M., Boer, I., Lansink, A. (2017). Sustainability assessment of agricultural systems: the validity of expert opinion and robustness of a multi-criteria analysis. *Agricultural Systems*, 157, 118-128.

Kayiwa, R., Kasedde, H., Lubwama, M., Kirabira, J.B. (2021). The potential for commercial scale production and application of activated carbon from cassava peels in Africa: A review. *Bioresource Technology Reports*, 15, 1-15.

Lavelli, V. (2021). Circular food supply chains-impact on value addition and safety. *Trends in Food Science & Technology*, 114, 323-332.

Lozano, F.J., Freire, P.A., Guillen Gozalbez, G., Jimenez Gonzalez, C. (2018). New perspectives for green and sustainable chemistry and engineering: approaches from sustainable resource and energy use, management, and transformation. *Journal of Cleaner Production*, 172, 227-232.

Masamhaa, B., Thebea, V., Uzokwe, V.N.E. (2018). Mapping cassava food value chains in Tanzania's smallholder farming sector: The implications of intra-household gender dynamics. *Journal of Rural Studies*, 58, 82-92.

Ocicka, B., Razniewska, M. (2018). Food waste reduction as a challenge in supply chains management. *LogForum*, 14(4), 549-561.

Oghenejoboh, K.M., Orugba, H.O., Oghenejoboh, U.M., Agarry, S.E. (2021). Value added cassava waste management and environmental sustainability in Nigeria: A review. *Environmental Challenges*, 4, 1-14.

Ozturk, I. (2017). The dynamic relationship between agricultural sustainability and food-energy-water poverty in a panel of selected Sub-Saharan African Countries. *Energy Policy*, 107, 289-299.

Pingmuanglek, P., Jakrawatana, N., Gheewala, S.H. (2017). Supply chain analysis for cassava starch production: cleaner production opportunities and benefits. *Journal of Cleaner Production*, 162(20), 1075-1084.

Rasul, G. (2016). Managing the food, water, and energy nexus for achieving the sustainable development goals in South Asia. *Environmental Development*, 18, 14-25.

Rudnicka, A. (2016). How to manage a sustainable supply chain? The issue of maturity. *LogForum*, 12(4), 203-211.

Sanchez, A.S., Silva, Y.L., Kalid, R.A., Cohim, E., Torres, E.A. (2017). Waste biorefineries for the cassava starch industry: new trends and review of alternatives. *Renewable and Sustainable Energy Review*, 73, 1265-1275.

Sonish Starch (2021), http://www.sonishstarch.com.

Tumwesigye, K.S., Oliveira, J.C., Sousa-Gallagher, M.J. (2016). Integrated sustainable process design framework for cassava biobased packaging materials: critical review of current challenges, emerging trends and prospects. *Trends in Food Science & Technology*, 56, 103-114.

Wimolrattanasil, T., Thepanondh, S., Sattler, M.L., Laowagul, W. (2018). Quantitative evaluation of cleaner production and environmental policy toward the co-benefit of greenhouse gas and odor reduction: case study of Tapioca starch industry. *Clean Technologies and Environmental Policy*, 20, 2333-2343.

Yu, Z., Golpira, H., Khan, S.A.R. (2018). The relationship between green supply chain performance, energy demand, economic growth and environmental sustainability: an empirical evidence from developed countries. *LogForum*, 14(4), 479-494.

Zhu, Q., Geng, Y., Lai, K. (2010). Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications. *Journal of Environmental Management*, 91, 1324-1331.

PRAKTYKI GOSPODARKI O OBIEGU ZAMKNIĘTYM W PRZEMYŚLE SKROBI TAPIOKOWEJ W PÓŁNOCNO-WSCHODNIEJ TAJLANDII

Streszczenie

Gospodarka o obiegu zamkniętym może odegrać istotną rolę w zrównoważonym zarządzaniu przedsiębiorstwem. Przyjęcie praktyk gospodarki o obiegu zamkniętym przez firmy jest próbą rozwiązania problemu ich negatywnego oddziaływania na społeczeństwo i środowisko. W Tajlandii przemysł skrobi tapiokowej jest uważany za jeden z największych sektorów przemysłu przetwórstwa spożywczego. Szybko rozwijająca się działalność przemysłowa w Tajlandii powoduje problemy związane z zanieczyszczeniem wody i środowiska. Wyzwania te wymagają podejścia, które ma potencjał przezwyciężenia problemów i przyczynienia się do osiągnięcia zrównoważonego rozwoju. Dlatego też celem niniejszego opracowania jest zbadanie, w jaki sposób przemysł skrobi tapiokowej wdrożył zasady gospodarki o obiegu zamkniętym, co pozwoliło zidentyfikować proble-

my na kluczowych etapach: pobieranie, wytwarzanie i zjawisko marnowania. W niniejszym opracowaniu zastosowano jakościowe podejście badawcze, wykorzystując dane zebrane za pomocą wywiadów częściowo ustrukturyzowanych, uzupełnionych obserwacjami w terenie, a także przeglądem źródeł wtórnych. Wywiady półstrukturalne przeprowadzono z pięcioma przedstawicielami firm produkujących skrobię z tapioki w północno-wschodniej Tajlandii. Wyniki sugerują, że wdrożenie zasad gospodarki cyrkularnej może być rozwiązaniem pozwalającym osiągnąć zrównoważony rozwój organizacji. Wsparcie najwyższego kierownictwa jest głównym motywatorem dla organizacji do przyjęcia praktyk gospodarki o obiegu zamkniętym. Przemysł skrobi tapiokowej łączy swoje cele strategiczne z maksymalną wydajnością, redukcją odpadów, a co najważniejsze, z odkrywaniem nowych źródeł przychodów, które umożliwiają zarówno sukces biznesowy, jak i regenerację środowiska. Aby przemysł skrobi z tapioki mógł przejść na gospodarkę o obiegu zamkniętym, musi zintegrować te strategie w całym łańcuchu dostaw, a nie ograniczać je tylko do etapu organizacyjnego.

Słowa kluczowe: gospodarka o obiegu zamkniętym, zrównoważony rozwój, przemysł rolniczy, skrobia z tapioki