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Seanova (Sea Organic Value Innovation) As a Resource Recovery Innovation for Enabling Responsible Food Production: A Case Study in PLN Indonesia Power UBP Adipala

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ABSTRACT: Irresponsible food production generates organic waste and greenhouse gas emissions that damage the environment, yet resources with potential value are often left unused, particularly Sea organic residue produced from industrial cooling water operations. Research specifically examining how such Sea organic waste can be converted into recovered resources within a responsible food production framework remains limited. This study aims to analyze the mechanism of Seanova, an innovation that transforms Sea organic resources into recovered resources supporting a more responsible food production system. A qualitative method with a case study approach was employed, using secondary data from internal company reports and relevant literature, analyzed descriptively. The results show that Sea biota waste generated from the pump system reached an average of 312 kilograms per year, with a potential emission reduction of 435.7 kilograms of carbon dioxide equivalent per year when properly managed. Monitoring data recorded a total residue of 218 kilograms over an eight-month period. Fish products were found to contribute the highest food loss and waste percentage among animal-based commodities in the region. The processed Sea residue was found to contain minerals suitable as poultry feed ingredients. These findings indicate that Seanova contributes to waste reduction, resource value recovery, and the strengthening of a more sustainable local food production system.

KEYWORDS: Food Loss and Waste, Poultry Feed, Resource Recovery, Seanova, Sea Organic Residue.

INTRODUCTION

The problem of food production management is one of the crucial issues in the era of sustainability because it is closely related to the continuity of development. Irresponsible food production generates waste in the form of organic residue and greenhouse gas emissions that damage the environment. Organic waste causes very complex losses and impacts many factors such as the environment, economy, and society (Mirabella et al., 2014). This challenge grows larger when food production systems still generate large amounts of waste, while resources that actually still have use value have not been optimally utilized. FAO (2019) states that a third of the world's food, or around 1.3 billion tons with a value of around 990 billion USD, is wasted or lost in vain. Every year, food waste and food loss on a global scale contribute 4.4 gigatons of greenhouse gas emissions. This condition shows that efforts to realize food security need to be directed not only at increasing production, but also at building an efficient and responsible food system.

Cilacap Regency, Central Java, is one of the regions with abundant coastal and Sea resources. This potential provides opportunities for the development of a food production system that is not only oriented towards increasing production yields, but also towards optimizing local resources and reducing waste from food production activities. Proper resource management is important for building a more sustainable food production system at the local level. This is in line with the principle of responsible food production that is now increasingly being applied across various sectors.

PT PLN Indonesia Power UBP Central Java 2 Adipala developed INNDESA (Inovasi Nusantara Desa Integratif Pangan/Nusantara Integrative Village Food Innovation) 2.0 as one of its community empowerment programs in the social and environmental fields. This program is implemented as a form of corporate social and environmental responsibility with a community empowerment approach based on social innovation. This program covers several food production sectors, namely agriculture, animal husbandry, and fisheries, with food product processing in an interconnected value chain. Its implementation refers to the principle of more responsible food production.

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Responding to the problem of food production that still generates food loss and organic residue, PT PLN Indonesia Power UBP Central Java 2 Adipala again developed an innovation called Seanova (Sea Organic Value Innovation) with the principle of responsible food production, both in economic and environmental terms. Seanova (Sea Organic Value Innovation) is an innovation that focuses on optimizing the potential of Sea organic resources to support resource recovery. Seanova was developed based on the waste problem originating from the company in the form of Sea biota organic residue produced from the Circulating Water Pump (CWP).

CWP is a pump used to circulate seawater in order to cool steam back into water inside the condenser (Mirmanto, 2016). This process causes the CWP to also draw in small Sea biota, which then become organic residue. If not properly managed, this organic residue has the potential to contribute to food loss and food waste (FLW).

The principle of reducing food loss and food waste becomes an important basis in the development of Seanova, namely converting Sea organic resource waste that previously had the potential to become waste into input that can be reused to support food production. Seanova can not only reduce waste, but also creates a connection between waste management, resource recovery, and community empowerment.

The utilization of recovered resources through Seanova is also relevant to sustainable development targets, particularly SDGs 12.3. Patriana et al. (2025) state that SDGs 12.3 targets halving global per capita food waste at the retail and consumer level and reducing food loss along the production, supply, and post-harvest chain, as shown by the study on the implementation of SDG 12.3 in Singapore, where handling of the FLW issue can be carried out through various stages, including the application of the Reduce, Reuse, and Recycle (3R) principle as part of the effort towards responsible food production.

Various studies have discussed waste valorization from a technical perspective and the general circular economy framework. As in the research by Patriana et al. (2025) which discusses the implementation of SDGs 12.3 (food loss and waste) by Singapore in 2015-2019, showing that handling the issue of food loss and waste can be done through a 3R strategy (Reduce, Reuse, Recycle) towards zero waste. However, research that specifically examines how Sea organic waste is converted into recovered resources within the framework of responsible food production remains limited. This shows the need for a study on the mechanism of utilizing Sea organic waste as recovered resources in supporting a responsible food production system. This study aims to analyze the mechanism of Seanova in converting Sea organic resources into recovered resources that support a more responsible food production system.

METHODS

This study uses a qualitative method with a case study approach. Qualitative research is an approach used to explore and understand various social phenomena or human behavior in depth (Fadli, 2021). Palupi et al. (2025) state that qualitative research aims to capture and understand various social phenomena and issues related to human life.

The case study approach is a detailed and in-depth approach concerning a person, a group of people, a program, or a particular social entity, in which the researcher seeks to understand what activities are occurring, emphasizing their specificity and complexity within a particular environment and time (Denzin & Lincoln, 1996). The case study approach in this study is used to examine the innovation of PT PLN Indonesia Power UBP Central Java 2 Cilacap in the utilization of Sea organic matter as an environmentally responsible innovation, particularly through the utilization of Sea organic resources.

This study also uses secondary data obtained from various documents and written sources relevant to the research object. The main data is sourced from documents in the form of internal reports of PT PLN Indonesia Power UBP Central Java 2 Adipala. Data analysis was carried out through a descriptive analysis approach. Descriptive analysis is an analysis method used to analyze data by describing or depicting the collected data as it is, without intending to draw generally applicable conclusions or generalizations (Sholikhah, 2016).

Data credibility testing was also carried out by comparing and matching information obtained from various sources, both internal company documents and relevant scientific literature. This is in line with the view of Lincoln & Guba (1985), who state that data credibility indicates the level of trust in research results, particularly the extent to which the research is able to represent the reality or experience that is the focus of the research. Credibility testing in this study was carried out to ensure that the interpretation of the Sea organic utilization innovation is supported by relevant data and sources with an adequate level of trustworthiness.

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RESULTS AND DISCUSSION

The food system is a complex network of activities encompassing production, management, transportation, and consumption. The food system has issues such as the governance and economics of food production, sustainability, how the food disposal process works, how food production affects the environment, and the impact on individual and population health from that food (Ericksen, 2008). Responsible food production is not only related to the amount of food produced, but also to how the resources used in the production process can be optimally utilized.

The problem of food production can be seen from the fact that resources still end up as waste, even though they actually still have potential to be utilized. This condition shows that waste management is not only related to how waste is reduced, but also how resources that were previously unutilized can be reused. This problem forms the basis for the Seanova innovation developed by PT PLN Indonesia Power UBP Central Java 2 Adipala.

Opportunities for utilizing organic resources also come from activities outside food production activities, one of which is from the operational activities of PT PLN Indonesia Power UBP Central Java 2 Adipala. This source comes from the Circulating Water Pump (CWP). Mirmanto (2016) explains that CWP is a pump used to circulate seawater in order to cool steam back into water inside the condenser in the power generation industry (PLTU/steam power plant). Small-sized Sea biota can be carried into the CWP system and subsequently become organic residue from operational activities during the seawater intake process.

The existence of this Sea biota waste shows that the loss of resource value is not only found within the food production chain. Organic waste originating from operational activities also has the potential to lose its value if not managed and utilized responsibly. This becomes the starting point for the emergence of resource recovery opportunities. Resource recovery is the optimization of the utilization of natural resources or waste by recovering the benefits of those natural resources (Jahan et al., 2022). According to Shirazi & Madi (2023), resource recovery is very important in this era of globalization, because it aligns with efforts to achieve sustainability.

1. Sea Organic Residue from CWP as a Potential Resource

Seanova (Sea Organic Value Innovation) is an innovation of the INNDESA 2.0 program developed by PT PLN Indonesia Power UBP Jateng 2 Adipala by utilizing Sea biota organic waste originating from CWP activities. This Sea biota waste is not merely waste that must be disposed of, but organic material that still has the potential to be recovered. The existence of Seanova serves to reduce waste and transform the function of Sea biota waste into a resource with use value. Sea organic waste or Sea biota waste is residual organic material originating from Sea organisms carried in along with the seawater flow.

The continuous presence of Sea biota organic residue shows that there are resources that can be managed responsibly if appropriate utilization innovation is available. Wainaina et al. (2020) explain that organic waste can be used as a raw material source that has the potential to provide nutrients, energy, and valuable products again. This shows that the Seanova innovation effort is appropriate as an effort towards responsible food production management. It not only reduces the volume of residue, but also maintains the resource content contained within it so that it can re-enter the production system.

Table 1. Hotspot Data of PT PLN Indonesia Power UBP Central Java 2 Adipala (CWP)

Parameter	Min	Average	Max
Sea biota waste generation (kg/year)	240	312	384
Potential CH_4 emissions (kg/year)	12	15.6	19.2
Potential CO_2e (kg/year)	336	435.7	537.6

Source: *CWP Monitoring Data of PT PLN Indonesia Power UBP Jateng 2 Adipala, 2025*

Based on the hotspot data of PT PLN Indonesia Power UBP Central Java 2 Adipala, it shows that the amount of Sea biota waste generation from the CWP reaches an average of 312 kg/year. From this amount of Sea biota generation, a potential emission formation of 12.0-19.2 kg CH_4, or equivalent to 0.336-0.538 tons of CO_2e per year, is obtained if the waste is disposed of in a final disposal site and undergoes anaerobic decomposition.

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The amount of waste of 240-384 kg/year shows that there is waste that can be diverted from the disposal pathway towards the utilization pathway. This utilization stage is the stage of Seanova in providing recovered resources by utilizing Sea biota organic waste from residue that previously lost its use value. The average potential emission reduction value reaches 435.7 kg CO_2e/year. These results show that through waste processing via the Seanova innovation, this potential emission can be avoided while also converting waste into a value-added product within a circular economy scheme.

The success of resource recovery is not only determined by the presence of material or waste that has the potential to be utilized, but also by the availability of that waste. Sea biota monitoring is an important stage in Seanova. This activity is carried out to determine the availability of Sea biota that supports the resource recovery process.

Sea biota is all types of living creatures, whether animals, plants, or corals, that live from the surface to the deepest ocean floor (Samson et al., 2024). The presence of Sea biota carried through the CWP shows that there is material or Sea biota waste that can be collected from the seawater intake activity. The amount of Sea biota residue from CWP activities that will undergo the utilization process can be determined from the monitoring activity.

Table 2. Sea Biota Monitoring Data

Month	Waste Source	Type of Waste	Average Weight (Kg)	Estimated Collection/Week
Jan 2026	Sea/CWP	Sea Biota	24	±6
Feb 2026	Sea/CWP	Sea Biota	28	±7
Mar 2026	Sea/CWP	Sea Biota	30	±7.5
Apr 2026	Sea/CWP	Sea Biota	26	±6.5
May 2026	Sea/CWP	Sea Biota	32	±8
Jun 2026	Sea/CWP	Sea Biota	24	±6
Jul 2026	Sea/CWP	Sea Biota	27.24	±6.5
Aug 2026	Sea/CWP	Sea Biota	28	±7
Total			218	
Average			27.5	±6.8

Source: *Organic Waste Monitoring Data of PLN Indonesia Power UBP Jateng 2 Adipala*

Based on the monitoring results from January to August 2026, it shows a total Sea biota residue of 218 kg with an average of 27.5 kg/month. The highest amount was recorded in May 2026 at 32 kg, while the lowest amount was recorded in January and June 2026 at 24 kg. This shows that the amount of residue available from the CWP is not constant every month. This difference in amount can be caused by the condition of the amount of Sea biota around the seawater intake area of the CWP. This makes periodic monitoring activities very important to carry out.

The presence of Sea biota caught in the CWP shows that there is organic material that can be collected from the operational process. The results of this monitoring support Seanova's role in providing recovered resources by utilizing Sea biota that was previously considered waste. This shows that Seanova not only reduces the amount of Sea biota that ends up as residue, but also opens opportunities to utilize these resources, which can support more responsible food production.

2. Production Loss in the Animal-Based Sector as a Resource Recovery Opportunity via Seanova

Food loss and waste (FLW) is a form of wastage or loss of food that occurs within the food production chain. According to Handoyo & Asri (2023), food loss occurs in the first three stages, while food waste occurs in the last two stages. Food loss is the loss of quantity or quality of food at the production stage within the supply chain before the food reaches the consumer stage. This loss not only causes a reduction in the amount of available food, but also causes the resources that have been used in the production process to become suboptimally utilized.

The FLW problem is important in the animal-based sector because the production of animal commodities requires various resources, such as feed and water. If the resulting product cannot be optimally utilized, then the resources that have been used in its production process also become underutilized. Efforts to reduce production loss can not only be done by preventing product loss, but also by seeking innovations to utilize and recover the value of available resources.

Table 3. FLW Data in the Animal-Based Sector in Central Java

No	Category	FLW (%)
1	Meat	1.81
2	Eggs	1.01
3	Milk	0.32
4	Fish	3.10

Source: *Study Report on Food Loss and Waste Regional: West Java, Central Java, Bali (2023)*

Based on this FLW data, the animal-based sector in Central Java still experiences losses with different percentages across commodities. The fish category has the highest FLW percentage at 3.10%, compared to meat at 1.81%, eggs at 1.01%, and milk at 0.32%. The high FLW percentage in fish shows that resource loss in aquatic or Sea biota commodities remains an important part of the food system problem. This is supported by Love et al. (2023), who state that FLW in aquatic foods at a national scale in various countries shows that the fisheries and aquaculture sector consistently contributes a relatively high FLW rate compared to other animal-based commodities, with the main cause being damage or spoilage at the primary production and distribution stages.

Production loss in the animal-based sector can occur when the production process does not run optimally. One consequence of this is that the production process does not provide optimal benefits. This condition shows the importance of efforts to reduce loss while increasing resource efficiency in animal or livestock food production. Feed availability and quality is one important part of this. Sapsuha et al. (2024) state that feed provides the energy and nutrients needed by livestock for growth, body maintenance, reproduction, and production. Mismatches in the quantity or quality of nutrients in feed can affect livestock performance, which will impact a decrease in productivity. This shows that feed management is one aspect that needs attention in efforts to reduce production loss in the animal-based sector.

Production loss in the livestock sector shows the importance of managing the production system more responsibly. The presence of Sea biota residue from the CWP shows that there is material that still has the potential to be utilized. Biota residue can be processed into a resource with the potential to support livestock feed production.

3. Minerals in Seanova as Potential Livestock Feed Ingredients

The utilization of Sea biota residue through the Seanova innovation not only reduces waste, but also produces a recovered resource that can be reused within the food production system. One of the utilizations developed is the processing of Sea biota residue as poultry feed ingredients. Sea biota contains various nutritional components and minerals that can provide use value if processed and utilized appropriately.

According to Suroso et al. (2022), nutrition in feed is the nutrients within feed ingredients that are essential for the life of livestock, including fats, proteins, carbohydrates, minerals, water, and vitamins. This content plays an important role in supporting the nutritional needs of poultry, so it needs to be considered in the selection of feed ingredients. This reinforces that the nutritional and mineral content in Sea biota residue is one important aspect to be utilized as poultry feed.

Poultry feed production requires feed with appropriate nutrient content to support the growth, maintenance, health, and productivity of livestock. Minerals are one of the nutritional components needed by livestock for various physiological functions. According to Pratama et al. (2025), the problem of meeting nutritional needs, particularly minerals as micronutrients, is an aspect that is neglected in smallholder livestock farming systems.

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Minerals function for poultry in bone formation, body tissue, and metabolism (energy and enzymes) within the livestock's body (Pamungkas et al., 2025). Nutritional deficiency or imbalance in feed can affect the health condition and production performance of livestock. Poultry experiencing mineral deficiency will have their growth stunted, their eggshells become thin, and the poultry will experience anemia (Pamungkas et al., 2025). Widodo (2018) states that excess minerals will cause poisoning in poultry. The utilization of organic materials with mineral content is one opportunity in the development of alternative feed ingredients.

Table 4. Regional Food Balance (Neraca Pangan Wilayah/NPW) of Cilacap Regency 2025 (Animal-Based Sector)

Commodity	Availability (Tons)	Requirement (Tons)	Balance (Tons)
Beef	5,453.17	4,974.18	479.03
Chicken Meat	29,918.27	28,507.90	1,410.38
Layer Chicken Eggs	39,332.57	37,486.53	1,846.09

Source: *Regional Food Balance Report of Cilacap Regency 2025*

This data shows that the availability of beef, chicken meat, and layer chicken eggs in Cilacap Regency is higher than the region's requirements. This balance shows that animal-based food production has the capability to meet local needs. This condition shows the importance of maintaining the productivity of the livestock sector so that the availability of animal-based food can be sustained.

The level of livestock productivity during the growth phase and its production capacity is generally influenced by genetic factors at 30%, while the remaining 70% is determined by environmental factors, including feed, maintenance management, health conditions, and climate (Salam et al., 2025). Disruption to any of these factors can cause a decrease in growth and productivity and can increase the risk of production loss. Feed provision that meets nutritional needs is one important part of maintaining poultry productivity. Salam et al. (2025) further state that this feed influence shows that achieving optimal livestock production is not possible without meeting adequate feed quality and quantity standards.

Sea biota residue utilized through Seanova is used as poultry feed ingredients because it contains nutritional components and minerals. Residue that previously had no use value is processed into material that has a function within the production system. This utilization is a form of resource recovery, because the value still contained in the Sea biota residue is maintained through the processing process and then reused as a poultry feed source.

The mineral content in Sea biota residue is an important part in determining its suitability as livestock feed ingredients, particularly for poultry. If the mineral content contained in the residue is suitable for the nutritional needs of livestock and safe for feed, then the Sea biota residue or waste can be used as a feed constituent ingredient. Abasubong et al. (2025) reinforce this statement by stating that Sea biota such as mineral-rich fish waste can help improve the nutritional value of livestock feed and agricultural soil, thus making fish waste a valuable resource, both in environmental and economic terms. This shows that the utilization of Sea biota residue through the Seanova innovation is based not only on the presence of organic material, but also on its characteristics and nutritional content.

The utilization of residue as feed ingredients is an effort to reduce production loss in the poultry or animal-based sector. The availability of alternative feed ingredients with nutritional value can support the efficiency of resource utilization in livestock production. This shows that Seanova can convert Sea biota residue from CWP activities into a usable poultry feed ingredient. This residue processing is part of the effort to maintain resource value and process residue responsibly.

CONCLUSION

Seanova plays a role in converting Sea biota organic waste generated from the company's operational activities, specifically from CWP, into resources that can be recovered and reused within the food production system. The consistently generated Sea biota waste each year shows the potential of resources that were previously wasted, while its management through Seanova is able to reduce the risk of greenhouse gas emissions that arise if the waste is left to decompose without management.

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The high contribution of the fisheries commodity to food loss and waste in the animal-based sector confirms the importance of utilizing Sea biota residue as part of a strategy to reduce food resource loss. Sea biota residue processed through Seanova has been proven to contain minerals suitable for use as poultry feed ingredients, so that waste which previously had no value can be repurposed into an input that supports the productivity of the livestock sector. The Seanova mechanism in converting Sea organic resources into recovered resources has answered the objective of this study, namely presenting a waste management model that not only reduces environmental impact, but also creates economic and social added value for a more responsible food production system.

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