# Reconstruction of ethno-socioscientific issues in ciu bekonang and its relevance to SDGs in chemistry learning

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**Abstract.** The production of ciu bekonang, a long-standing tradition in Bekonang Village, Sukoharjo, Central Java, has attracted attention due to ethnosocioscientific issues related to product safety, social stigma, and environmental consequences. This study reconstructs the indigenous production practices of ciu bekonang into disciplinary chemistry concepts and evaluates the associated Ethno-Socioscientific Issues (Ethno-SSI) through the primary lenses of SDG 12 (Responsible Consumption and Production) and SDG 8 (Decent Work and Economic Growth), while positioning food security (SDG 2: Zero Hunger) as an indirect implication mediated by household income. A case study methodology was used to collect data through observation, in-depth interviews, and an examination of relevant literature. The reconstruction designates molasses (a by-product of sugarcane, Saccharum officinarum L.) as the primary feedstock subjected to fermentation and subsequent separation processes, including distillation, heating–condensation, fraction separation, alcohol content assessment, filtration, storage, and monitoring. The results show that the production chain helps people in the area make a living and makes the economy stronger (SDG 8). This context also show how important it is to value agro-industrial by-products and to handle and dispose of waste properly (SDG 12). The high alcohol content of ciu bekonang can be bad for health, and there is a social and cultural stigma around alcohol. The waste from making it could hurt the air, water, and soil. For chemistry education, this case provides an authentic Ethno-SSI context to teach fermentation, distillation, and environmental chemistry while engaging students in evidence-based inquiry and argumentation about sustainability.

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## 1 Introduction

Ciu bekonang is a cultural practice and tradition from Bekonang Village, Sukoharjo, Central Java, Indonesia. This cultural practice has become a cultural heritage and symbol of the local village because it has been produced since the Dutch East Indies era by maintaining its traditional methods. The process of processing ciu bekonang has been passed down from generation to generation, so the original skills and knowledge are still maintained (1). Ciu bekonang has a distinctive flavor that is different from other traditional drinks because it is made from sugarcane waste (2). This characteristic makes ciu bekonang famous with its specific raw materials and production process or different from other places (3). The production place of ciu bekonang can attract consumers, tourists, and researchers interested in learning more about ciu bekonang (4).

Ciu bekonang is one of the contexts of Ethno-Socioscientific Issues. Ethno-socioscientific issues are a combination of ethnoscience and socioscientific issues related to cultural, social, environmental, health, religious, and other scientific issues, which are controversial, dilemmatic, and unstructured so that they require discussion, dialog, and debate in solving the problem. Ethno-SSI focuses on scientific issues in a particular community, emphasizing the importance of a contextual approach by considering cultural and social aspects. Ethno-SSI can aim to reconstruct indigenous science into scientific knowledge that can be accounted for in education. This approach can help students understand contextual problems and find solutions by considering many factors.

The Ethno-SSI problem of ciu bekonang is related to several aspects such as health, social and environmental impacts. Ciu is a traditionally processed alcoholic beverage that has the potential to cause several health (2). The production site of ciu bekonang does not have a good quality control standard, and the place tends to be shabby and dirty; the tools and materials used are not hygienic, so it can be at risk of contamination from germs and bacteria that can affect the quality of alcohol and body condition (1,5). Excessive consumption of ciu is also not good for health, especially for alcohol poisoning and kidney and liver diseases (6). The alcohol content set by ciu bekonang producers ranges from 30-45%, which is high enough to cause drunkenness or excessive dizziness (4).

Although ciu bekonang has historical and cultural value, it turns out that some producers do not have official licenses and do not meet the legality standards set by the Indonesian government. Unlicensed producers argue that ciu production is hereditary, small-scale, and does not use modern technology and, therefore, does not have good quality control standards. Ciu bekonang producers should obtain licenses from relevant agencies such as the Industry and Trade Office, the Food and Drug Monitoring Agency (BPOM), and the Health Office.

Producers of ciu bekonang must obtain several licenses to be certified for product safety and quality, especially health standards and regulations on safe alcohol levels. Some producers are reluctant to apply for these licenses because, in addition to the lengthy process, registered alcoholic beverage production is subject to excise tax, which the producer must pay to the state. In addition, the producers must regularly report the quality and food safety standards, so they object to this, especially when they see that the production site is unsuitable and does not meet food hygiene standards.

The production of ciu bekonang has also become a social and religious conflict, as the majority of the population in Indonesia is Muslim. The law of consuming ciu bekonang in Islam is haram or forbidden to consume because it is alcohol. The consumption of ciu bekonang is considered damaging to the community's health, morals and social life. Social conflicts also arise as a result of ciu consumption, which is associated with negative behaviors such as drunkenness, violence, and disrupting order (2). Producers and consumers of ciu are considered to be damaging to society's morals and social order. Consumers of ciu are now also multi-generational, so young people who are familiar with ciu/alcoholic drinks can become addicted. Overcoming these conflicts requires an inclusive and wise approach from the government, stakeholders such as traditional leaders, religious leaders, and the general public so that the ciu bekonang tradition is preserved but still within the prevailing rules and norms and oriented towards the virtues of food, health, and social welfare.

The production of ciu in Bekonang village is a source of social welfare in the field of economy and life for the community, so it becomes one of the concepts of the SDG 12 (Responsible Consumption and Production) and SDG 8 (Decent Work and Economic Growth). From an SDG 12 perspective, Ciu Bekonang is a way to make an agro-industrial by-product (molasses) more valuable. At the same time, it raises important questions about how to process, ensure quality, and manage waste and effluent in ways that don't harm air, water, or soil. From the point of view of SDG 8, Ciu production is a way for people to make a living that helps families make money and makes the local economy more stable. However, it also has problems with legality, workplace safety, and the fact that informal work is more vulnerable. In this context, the implications for SDG 2 (Zero Hunger) are best understood as indirect co-benefits: stability of livelihoods and increases in income may enhance household food access, yet food security is not the principal sustainability domain addressed by the production system. The concept of zero hunger in SDG 2 recognizes that hunger and food insecurity are still global problems and challenges (7). Ciu bekonang production in Sukoharjo can increase sustainable food production because it encourages agricultural practices that utilize waste to be produced inclusively and sustainably so that it can prosper farmers and local communities. Relevant and systematic efforts are needed to ensure that products sold and marketed are sufficient, nutritious, and safe.

Ethno-SSI reconstruction of ciu bekonang is an important step in understanding the integration of social and scientific dynamics that can contribute to food security and sustainable development (SDGs 2 Zero Hunger). The challenge of zero hunger in ciu bekonang requires efforts and solutions to overcome the problems of malnutrition, food security, availability of ingredients, increasing farmers' productivity and income, reducing food waste, and changing to a sustainable food system. The reconstruction of ciu bekonang is important because it can provide knowledge about local problems that can inform how to address food security and the implementation of SDG 2 without hunger. The reconstruction process can link traditional practices with sustainable resource use and help create solutions for balancing food productivity and security. Good resource management in the ciu production process is needed so that the social, economic and food commodity impacts on ciu bekonang can run well and sustainably. The questions of this research are: (1) How the indigenous production practices of Ciu Bekonang be scientifically reconstructed into chemistry concepts?; (2) What are the results of the Ethno-SSI Reconstruction in Ciu Bekonang in the SDGs?.

# 2 Method

## 2.1 Research design and setting

This study employed a qualitative case study methodology to conduct a comprehensive, contextual analysis of a single bounded case  the traditional production of Ciu Bekonang in Bekonang Village, Sukoharjo, Central Java, Indonesia. The case study methodology was chosen because ciu bekonang represents a culturally entrenched practice that intersects with scientific methodologies (fermentation and distillation), socio-cultural conflicts, environmental issues, and sustainability objectives. The sustainability framework in this research emphasizes SDG 12 (Responsible Consumption and Production) and SDG 8

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(Decent Work and Economic Growth), whereas SDG 2 (Zero Hunger) is regarded as an indirect consequence influenced by livelihood stability and household purchasing power.

## 2.2 Participants and data sources

In-depth interviews and site observations of production locations were used to collect primary data. Informants were intentionally chosen to represent a variety of viewpoints and functions within the Ciu Bekonang production and consumption system. We got secondary data from a review of the literature on Ciu Bekonang, Ethno-SSI, and the SDG framing (SDG 12, SDG 8, and indirect implications for SDG 2).

## 2.3 Data Collection Procedure

Data collection procedure are observation and interviews. Non-participant observations were conducted at production sites to record the process stages, tools used, hygiene practices, and how waste and effluent were handled. We used field notes and pictures to record contextual evidence, including the layout, the condition of the equipment, how things were stored, and where things were discharged. Semi-structured interviews looked at (1) knowledge of the process and decision points (fermentation, distillation, separation, and quality checks), (2) perceived risks and safety practices, (3) work and living conditions, (4) barriers to governance and licensing, and (5) environmental practices and community responses. We used secondary sources to double-check scientific explanations, reported risks, and SDG framing that was relevant to responsible production (SDG 12), decent work and livelihoods (SDG 8), and indirect links to food access (SDG 2).

## 2.4 Data analysis

### *2.4.1 Thematic analysis*

The research team compiled a single analytic corpus by integrating field observation notes, relevant documents, and verbatim interview transcripts (when available). Researchers then repeatedly reviewed the materials to understand the case context before conducting open coding line by line to generate initial codes. Coding was both data-driven (reflecting participants' language) and theory-informed, guided by the Ethno-SSI lens and the SDG framing (SDG 12: responsible production and waste governance; SDG 8: livelihoods and work; SDG 2: indirect food access). Initial codes (non-hygienic tools, alcohol testing, licensing barriers, excise burden, income dependence, effluent discharge, stigma, youth exposure, and work safety) were refined through code merging and codebook revision, then clustered into categories such as product safety, regulatory barriers, waste governance, livelihood dependence, and stigma/moral conflict. These categories were synthesized into themes, which were iteratively checked across the dataset for sufficient supporting evidence. Final themes were defined, mapped primarily to SDG 12 and SDG 8, and linked to SDG 2 only when the data indicated an income-to-food-access pathway. Themes were reported using representative quotations (when permissible) and corroborated with observational evidence on process stages, site conditions, and waste practices.

### *2.4.2 Triangulation*

Triangulation was performed across data sources (interviews, observations, and literature) and informant groups (producers, consumers, and experts) to corroborate findings and mitigate single-perspective bias.

### *2.4.3 Context Analysis*

Context analysis was conducted to examine how cultural tradition, informal production practices, regulatory structures, and prevailing social norms interact with the underlying scientific processes (fermentation and distillation) and shape sustainability outcomes. This analysis identified recurring patterns that connect responsible production and waste governance as the core sustainability pathway (SDG 12), livelihoods and work conditions as the primary socio-economic pathway (SDG 8), and household food access as an indirect pathway (SDG 2) that emerges only when livelihood stability and income continuity translate into improved purchasing power for food.

# 3 Result and Dissussion

## 3.1 Scientific Reconstruction of Ciu Bekonang Manufacturing Process

The production process mostly relies on local, non-industrial practices and involves steps that occur one after the other: preparation, fermentation, distillation, filtration, storage, and packaging. This part takes the native steps and turns them into chemical concepts (biochemical transformations and separation techniques) to support Ethno-SSI analysis.

### *3.1.1 Preparation of Tools and Materials*

At the beginning, the basic tools and supplies were ready. The main tools are plastic and iron drums (boilers), a spiral condenser pipe, water hoses, and an alcohol meter. Plastic drums are used for fermentation and for storing distilled liquids. During distillation, the iron drum heats the fermented molasses. The spiral condenser pipe cools the alcohol-water vapor (steam) that forms when the alcohol is heated, so it condenses into liquid distillate. Hoses carry steam from the boiler to the condenser, then carry the condensed liquid to containers that can hold it. Finally, an alcohol meter is used to figure out how much ethanol is in the distillate. Firewood, yeast, water, and molasses are among the ingredients in the process. Molasses, a by product of cane sugar processing, contains many fermentable sugars that microorganisms use as an energy source during fermentation. The fermentation process uses baker's yeast (Saccharomyces cerevisiae), which can convert molasses into ethanol ($C_2H_5OH$). Water is used to thin out molasses to the right sugar level for fermentation and to help cool and condense during distillation. People usually use firewood to heat things up during the distillation stage.

### *3.1.2 Fermentation*

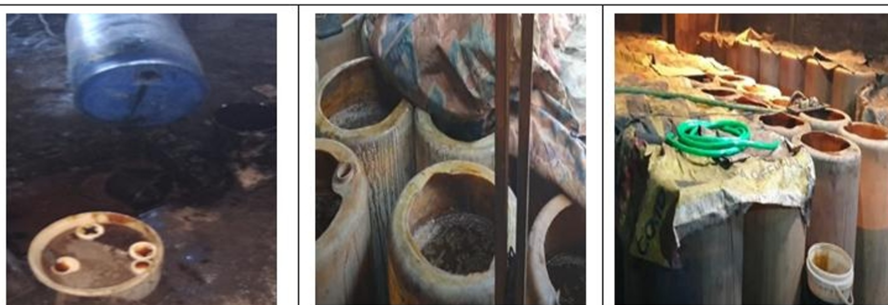
Fermentation in Ciu making is a biochemical process of converting sugar in molasses into alcohol with the help of microorganisms from yeast material (Saccharomyces cerevisiae) (3). The ciu fermentation process takes place in several steps, namely: (1) molasses dilution; molasses has a very high sugar concentration and is very concentrated so it needs to be diluted with water to reach the optimal sugar content for fermentation, which is around 15-20%. In this process, molasses is mixed with water in large drums; (2) yeast is added as much as two tablespoons in each drum in the fermentation process. Yeast (Saccharomyces cerevisiae) will convert cane sugar (sucrose, glucose, and fructose) in molasses into ethanol ($C_2H_5OH$) and carbon dioxide ($CO_2$). The chemical reaction that occurs is:

$C_{12}H_{22}O_{11}$(sucrose)+$H_2O$(water) $\xrightarrow{invertase}$ > $2C_6H_{12}O_6$ (glukose/fructose) $\xrightarrow{zymase}$ > $4C_2H_5OH$ (ethanol) + $4CO_2$ (carbon dioxide).

In this process, sucrose will be broken down into glucose and fructose by the enzyme invertase produced by yeast *(Saccharomyces cerevisiae)*. Then, glucose and fructose will be converted into ethanol and carbon dioxide through alcohol fermentation with the help of the enzyme zymase (8). The following is the reaction:

$C_6H_{12}O_6$ $\xrightarrow{zymase}$ > $2C_2H_5OH$ (etanol) + $2CO_2$ (carbon dioxide).

The fermentation process is carried out in a drum or container that is closed but still allows the fermentation gas to escape. This process lasts for 4-7 days) depending on the temperature and environmental conditions. During the fermentation process, the alcohol content of the mixture will increase while the sugar content will decrease. The carbon dioxide produced will be released into the air during fermentation. The fermentation process of ciu bekonang can be shown in **Figure 1**.



| Transferring molasses to the fermentation drum and adding water | Addition of yeast (Saccharomuces cerevisiae) and covered | Fermentation for 4-7 days until the foam decreases and stirring daily |
|---|---|---|

**Fig.1.** The fermentation process of ciu bekonang.

### *3.1.3 Distillation*

After fermentation, the mixture is distilled to remove the water from the fermentation broth and retain the ethanol. Distillation separates substances by volatility and boiling point (9). The boiler heats the fermented mixture, which causes ethanol-rich vapor to form. The vapor is then sent through hoses to the spiral condenser, where it cools and returns as liquid distillate. Producers often check the temperature of the heating near the boiling point of ethanol (about 78 °C). This is because ethanol tends to vaporize more readily than water at this temperature. The process usually includes (i) heating, (ii) condensation, and (iii) collection and fraction separation to get distillate in the right alcohol range, which is usually around 30–35%. Figure 2 below shows how Ciu Bekonang is distilled.

Sub-microscopic explanation (Distillation). Ethanol and water separate because they have different intermolecular interactions and vapor liquid equilibrium. Water has a strong network of hydrogen bonds, whereas ethanol has weaker cohesive interactions because its ethyl group is nonpolar. When you heat something, the molecules move faster, and the vapor phase has more molecules with higher vapor pressure. This means that the vapor entering the condenser usually contains more ethanol than the boiling liquid. Cooling the condenser lowers the kinetic energy, allowing intermolecular attractions to form again. This produces a liquid distillate with more ethanol than the original mixture.


**Fig.2.** Distillation technology process of ciu bekonang.

### *3.1.4 Filtration/Filtering*

The ciu produced from the distillation process is then filtrated or filtered using a sand and gauze/cotton filter. Filtration aims to separate particles or remnants of insoluble distillation solids. Distillation results contain a relatively high alcohol concentration, and there is still the potential for insoluble particles during the distillation process. In addition, filtration can also improve the quality and clarity of ciu before it is marketed or consumed. Sand is a coarse filter that can capture larger particles or solids (macroscopic), while gauze/cotton is a fine filter to filter smaller particles (microscopic) after filtering with sand. The gauze/cotton also increases the clarity of the ciu product and ensures that the ciu product is pure and free of residue/settle. The filtration process of ciu bekonang is shown in **Figure 3**.

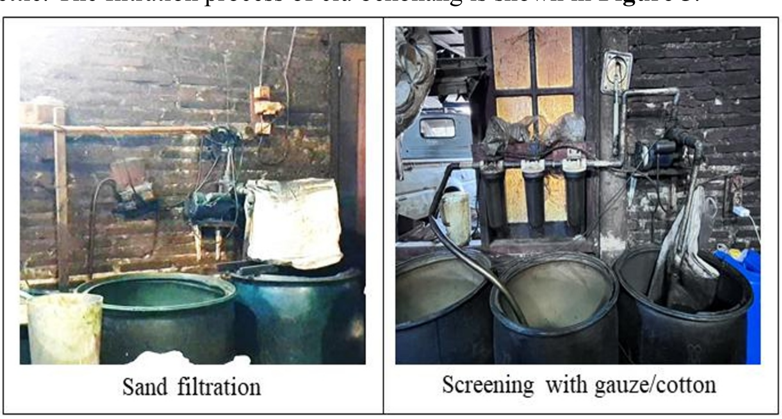
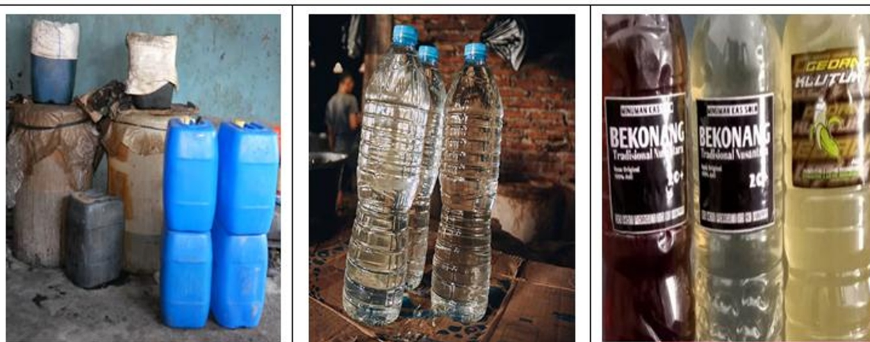



**Fig.3.** Filtration process of ciu bekonang.

### *3.1.5 Storage and Packaging*

The ciu liquid produced from the distillation process is then stored in plastic drums. The result of the distillation process was then measured using an alcohol meter to determine the alcohol content. The way to determine the alcohol content is by pouring 100 ml of ciu into the alcohol meter tube and then dipping the alcohol meter into the distillate. The alcohol level can be determined by the alcohol meter limit that is dropped on the surface of the distillate. If the level of ciu has been confirmed to meet the standard or threshold, around 30-35%, it can meet the marketing standard. The ciu is then transferred to a storage area to be cooled and kept in a closed container to stabilize the flavour. After that, the ciu is ready to be packaged and distributed by other local producers. The storage and packaging process of ciu bekonang can be shown in **Figure 4**.




Ciu Product Storage | Ciu Packaging | Ciu Product Labeling

**Fig.4.** Storage and packaging of ciu bekonang.

## 3.2 Reconstruction of Ethno-SSI Ciu Bekonang in SDGs

Ethno-Socioscientific Issues about ciu bekonang can be linked to SDG 12 (Responsible Consumption and Production) and SDG 8 (Decent Work and Economic Growth). Food security (SDG 2: Zero Hunger) is seen as an indirect effect that may result from stable jobs and higher household purchasing power, rather than as the main goal of sustainability.

**Table 1**. Reconstruction of ciu bekonang from the health aspect

| Research Questions | Indigenous Science | Scientific Knowledge |
|---|---|---|
| What level of ciu is produced and is it safe to consume? | The regulation for making ciu is only at 30-35% and is still safe for consumption. | Alcoholic drinks with 35% ethanol content will have a significant impact on health if consumed excessively, such as liver disease, hypertension, mental disorders, and cancer (6). |
| Why does drinking ciu lead to drunkenness/loss of consciousness? | Because ciu has a high alcohol content of 30-35%. | The ethanol ($C_2H_5OH$) in ciu works as a depressant on the central nervous system that will slow down brain function and affect neurotransmitters to send signals to nerve cells (6). |
| Can drinking ciu lead to addiction? | Yes, ciu causes addiction. Usually people who drink ciu will often drink more. | Alcohol (ethanol) in ciu can affect the psychological and nervous system of the brain by releasing dopamine (feelings of pleasure) thus giving a sensation of euphoria and satisfaction that wants to be repeated (10). |

Responsible production and waste management (SDG 12) From an SDG 12 perspective, the case shows both the value of an agro-industrial by-product (molasses) and the need for responsible processing standards. Field observations showed that some production facilities and equipment are still not up to par in terms of cleanliness, layout, and regular quality control. To make responsible production stronger, we need to make raw materials and tools cleaner, rearrange production areas, and use good manufacturing and sanitation practices. Also, to keep people safe and cut down on harm, there needs to be better monitoring and clearer limits on alcohol content, as well as assurances of product safety. Table 1 shows how the reconstructed health and product safety issues are related to responsible production as an Ethno-SSI concern.

SDG 12 also focuses on the environment. If not handled properly, fermentation and distillation byproducts, wastewater, and other emissions can pollute water, soil, and air. Responsible waste governance is a major Ethno-SSI issue because production waste can either be used as a resource (for example, turned into liquid organic fertilizer and bioenergy or compost/feed when appropriate) or, if it is not treated before being thrown away, it can pollute the area and harm the environment and farming resources. Table 2 gives a summary of the rebuilt environmental problems, and Figure 5 shows the pollution effects that were seen because of poor waste management. The water, soil and air pollution results from the ciu bekonang processing are shown in Figure 5.

**Table 2.** Reconstruction of ciu bekonang from the environmental aspect.

| Research Questions | Indigenous Science | Scientific Knowledge |
|---|---|---|
| Does the waste from the Ciu fermentation or distillation process affect water and soil quality in the surrounding area? | Yes. Many residents complained that the crops in the rice fields had dried up because the water was polluted by ciu waste. The river water turned black, and the soil red. | The fermentation and distillation process produces ciu waste that contains organic matter, alcohol, and other harmful chemical compounds such as methanol and organic acids that can trigger eutrophication, reduce water quality, change pH, and reduce soil quality (9,11). |
| Why can ciu waste cause soil and agricultural pollution? | The ciu waste flows from the sewers into the river, and the river is used to irrigate agricultural fields so they can become polluted. | Ciu waste contains methanol and organic acids that can contaminate the soil so that the soil structure changes, important microorganisms die, and soil fertility decreases (12). Ciu waste accumulating in the soil can potentially cause toxins or toxic effects on plants (13). |
| How can ciu waste be treated to make it more environmentally friendly? | Making organic fertilizer from ciu waste (ciumik), processed into animal feed and biogas. | Solid waste from fermentation (bagasse and molasses) can be processed into compost and animal feed (9). Ciu waste also contains methanol gas, which can be a raw material in bigas/biomass. Waste treatment can be biological, physical, or chemical (14). |

To avoid pollution due to ciu bekonang production, the local government needs support and appeals. The government has an important and strategic role in the ciu bekonang production process to support SDGs 8 and 12. In principle, ciu production must comply with health and environmental standards. The government can regulate the supervision, control, circulation and sale of ciu products. The government needs to implement regulations for more responsible management of ciu waste, especially from its waste products, so as not to pollute the environment on agricultural land and water sources (2,10). The government can take another step by providing innovations in waste processing into liquid organic fertilizer (ciunik) and bioenergy (biogas/biomass). This environmentally friendly and sustainable processing of ciu waste can help achieve food security. The government can also conduct regular inspections and visits to the ciu bekonang industry so that the production process can remain controlled and by set standards. The production of ciu should also have a safe alcohol content limit and a distribution license so that consumers can be confident in buying ciu products on the market (1). With proper regulation, ciu production will not only provide economic benefits, but adequate supervision and control can support food production in the future,


**Fig.5.** Water, soil and air pollution due to ciu bekonang production.

Ciu production in Bekonang Village can support zero hunger by recruiting local people to work in the industry, thus encouraging partnerships between ciu producers and local communities. If well-regulated, ciu production can support the welfare of the local community. Communities can afford better nutritious food if they earn enough income from ciu bekonang production. The economic well-being of these communities can strengthen sustainable food security. However, working in a Ciu factory can be controversial in the community due to the social view of working in an alcoholic beverage production site. This negative stigma can discriminate against workers in ciu bekonang production, so community support is equally important. As long as it does not violate the law and does not conflict with social norms, working in ciu bekonang is fine, especially in creating sustainable economic welfare for local communities. **Table 3** below shows the results of the reconstruction of ciu bekonang science from the social aspect of the community.

**Table 3.** Reconstruction of ciu bekonang in the social field.

| Research Questions | Indigenous Science | Scientific Knowledge |
|---|---|---|
| Are young people consuming ciu? | Yes. Many young people consume ciu, especially teenagers, for fun. | Teenage consumption of ciu can be influenced by social, psychological and emotional factors. Ciu's free and cheap circulation encourages adolescents to explore or try it (15). |
| Is ciu a type of alcohol that is forbidden to consume? | Yes. Ciu is classified as alcohol, but because the level is still low and the production is good, it is halal/allowable for consumption. | The context of haram and haram depends on culture and religion. Consuming alcohol (khamar) in Islam is forbidden in surat al baqarah verse 219, al maidah verse 90, and the hadith of the prophet mentions that everything that is intoxicating is prohibited. |
| Is there a difference between age groups or social status when it comes to Ciu consumption? | No. Young and old, rich and poor, can all consume ciu. | Different views on Ciu consumption are influenced by age, cultural norms/customs, social values, economic conditions, and education (10). The higher a person's social status, the more they will choose to consume legal, good-quality, and hygienic alcohol. |

Ciu bekonang production can support food security to achieve SDGs 8 and 12. This goal can be achieved by sustainable utilisation of local raw materials, safe, healthy and hygienic production systems, ensuring food hygiene and safety standards, and reasonable and environmentally friendly ciu industry waste management can be an effort in supporting sustainable agriculture and the elimination of hunger (SDGs 2). Although ciu production is controversial regarding health, environment, and social aspects, it can be a source of income and innovation in improving food productivity and the welfare of local communities.

## Conclusion

This study advances Ethno-SSI theory by showing how the culturally ingrained and problematic practice of Ciu Bekonang production can be reframed as responsible chemistry knowledge while retaining its controversial social and cultural aspects. The reconstruction focuses on fermentation and distillation as the scientific basis and places the case mostly within SDG 12 (Responsible Consumption and Production) and SDG 8 (Decent Work and Economic Growth). Ciu context also sees SDG 2 (Zero Hunger) as an indirect benefit of having more stable incomes, which makes it easier for families to get food. The results show that keeping jobs and ways of making a living in the area often means dealing with ongoing environmental, product-safety, legal, and working-condition issues. One of the best parts of this case is the story about how to deal with trash. Students can turn waste from production into ciunik (organic fertilizer) and bioenergy (biogas/biomass). The waste-of-resources pathway is a great way to teach environmental chemistry in the context of a circular economy, which goes well with SDG 12 and SDG 8. This case can be explained as an inquiry-based, argumentative, and project-based assignment that includes observations, symbolic representations, and small-scale explanations. This context will help students learn how to use evidence to think about sustainability issues in chemistry class.

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