Socio-economic determinants of preserved fish consumption in Java Island: SUSENAS data analysis 2019

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Abstract. Java Island is the center of economic growth with the highest population density in Indonesia but has the lowest fish consumption compared to other islands. Preserved fish is a diversification product with longer shelf-life and broader affordability; hence, promotion of preserved fish products may increase fish consumption in Java. This study aims to determine the consumption patterns and socio-economic factors that impact consumption of preserved fish products in Java. National socio-economic survey (Susenas) 2019 was the data source for this research to be analyzed by the Probit model. The results show that consumption of preserved fish in Java was 2.51 kg/capita/year, and West Java Province was the highest consumption of preserved fish. Probit model indicates that consumption of preserved fish in West Java has a positive correlation with family size, marital status, subsidy recipient households and residents of West Java Province. Education level, urban areas, primary income as a fishermen, upper class and residents of DKI Jakarta province have negative correlations with consumption of preserved fish in Java. The analysis also shows that the overall probit model can accurately predict 62.70% consumption of preserved fish in Java. Therefore, preserved fish is still considered as an inferior good where a high level of education and economic status reduce the possibility of consuming preserved fish. Consumption of preserved fish in Java island can be increased through innovation and promotion of fish products so that the perception of preserved fish as inferior products can be changed.

1. Introduction
Java is the island with the largest population in Indonesia, as evidenced by the results of the 2020 population census, which shows that 56.10% of Indonesia's population is still concentrated in Java [1]. The dominating population causes aggregate household consumption on the island of Java to be a determining factor for Java's economic growth, show by the contribution of GDRP reaching 58.8% of the National GDP in 2020 [2]. Analysis of consumption patterns can be an indicator in policy formulation in overcoming various economic and nutritional problems in Indonesia.

Suryana research [3] shows that although national protein consumption has met the recommended nutritional adequacy rate, the fulfillment comes from vegetable protein. The consumption of animal food is considered important as a source of nutrition in helping individual growth and development create a generation of superior human resources. Therefore, according to Suryanty and Reswita [4] one of the fundamental problems of Indonesian food consumption is the low contribution of animal protein sources in the daily diet. Food sufficiency is an investment in the formation of better human resources and a prerequisite [5]. Increasing fish consumption is considered a solution in completing animal protein for the Indonesian people due to Indonesia's considerable potential fish resources.
As a maritime country, Indonesia causes fish to be a primary source of animal protein because domestic production can meet consumption needs. Various studies show that fish are the prime source of animal protein [6–8]. On the other hand, fish consumption on the island of Java-based on the 2019 SUSENAS data analysis shows that per capita fish consumption in Java is 14.47 kg/capita/year while the national per capita fish consumption is 25.44 kg/capita/year and the figure of fish consumption outside Java is 30.31 kg/capita/year. It shows that fish consumption in Java relatively low and interesting for further analysis.

Preserved fish are considered to overcome the perishable nature of fish to have a longer shelf life and distribute efficiently. Java Island has many fish processing industries, as evidenced by the data from MMAF [9] which shows that there are more than forty thousand micro, small and medium enterprise scale of fish processing in this region. This condition has led to a very prospective increase in the consumption of preserved fish on Java island because it is supported by sufficient supply. Virgantari's research [10] states that overall there is an increasing trend in consuming processed fish both in rural and urban areas in Indonesia. According to Reswita, Suryanti & Yuliarti [11], one of the most critical factors in meeting the family's food needs, consumption diversification, can be done through product development, including preserving fish product. Therefore this study aims to determine the consumption patterns and socio-economic factors that impact the consumption of preserved fish products in Java to keep the national animal protein adequacy rate.

2. Methods
This research uses quantitative methods and cross-sectional using the 2019 National Socio-Economic Survey data [12]. The total sample used in this study was 96,360 households in six provinces on the island of Java. The types of fish, shrimp, and preserved aquatic animals referred to in this study consisted of 12 categories: 1) preserved indian mackerel, 2) preserved skipjack tuna, 3) preserved anchovies, 4) preserved trevally, 5) preserved snakeskin gourami, 6) preserved milkfish, 7) preserved snakehead, 8) canned sardines/tuna, 9) others preserved fish, 10) preserved shrimp, 11) preserved squid, cuttlefish, octopus, and 12) others preserved shrimp and another water animal. The method of calculating household preserved fish consumption is carried out following the guidebook for calculating fish consumption figures from the KKP, 2019, with two stages: equalizing units from ounces to kilograms and converting preserved fish fresh with a conversion factor. The SUSENAS data is the recall data for consumption of all household members in one week. So the per capita consumption of preserved fish is calculated by dividing household consumption of preserved fish by dividing household members by seven days and multiplies with 365 days. The calculation of the participation rate of consumption is done by dividing the number of people consumed by the total population as the denominator.

The analysis used in this research is the probit regression model, which uses several variables from previous studies relevant to the problem under study. This model is used to find the probability of an event, which is the determinant factor of household preserved fish consumption in Java. The dependent variable in this study is the consumption of preserved fish, a dummy variable with a value of 1 for household consuming preserved fish and 0 (zero) for households that are not consuming preserved fish. The independent variable used in this research is socio-economic characteristics from previous that influence fish consumption, such as the age of household, marital status, education level, marital status [13]. Meanwhile, variable housewife working and household head working refer to household characteristics influencing fish consumption in van province, turkey [14]. The subsidies beneficiary variable of the family hope program is used as an approach to proxies the household's economic status, as was done in the research of Syamala & Nurwahyuni [15].

The probit model is a statistical probability model with two categories in the dependent variable for binary choice (yes,no) responses to preserved fish consumption in Java island. Probit analysis is based on the cumulative normal probability distribution and provides statistically findings of various independent variables. It is assumed that consuming preserved fish Y is dependent on a number of variables as discussed and it is normally distributed with the same mean and variance, the model for estimating the consuming preserved fish is


\[ P_i = \text{prob}[Y_i = 1 | x_1, \ldots, x_{17}] = \beta_0 + \beta_1 \text{age} + \beta_2 \text{hhmember} + \beta_3 \text{edu} + \beta_4 \text{status} + \beta_5 \text{wwife} + \beta_6 \text{urban} + \beta_7 \text{fisherman} + \beta_8 \text{q1} + \beta_9 \text{q2} + \beta_{10} \text{q4} + \beta_{11} \text{q5} + \beta_{12} \text{Subsidies} + \beta_{13} \text{DKI} + \beta_{14} \text{Jabar} + \beta_{15} \text{Jateng} + \beta_{16} \text{DIY} + \beta_{17} \text{Jatim} + \mu \]

Where:
- \( P_i \): Probability of choosing to consume over not choosing to consume
- \( Y \): Consuming Preserved Fish (0), Not Consuming Preserved Fish (1)
- \( \text{Age} \): Age of Head household (year)
- \( \text{Edu} \): Education of Headhousehold (year)
- \( \text{Status} \): Marital Status
- \( \text{Wwife} \): Working Wife
- \( \text{Urban} \): Location on the Urban Area
- \( \text{Fishermen} \): Primary income of headhousehold as fishermen
- \( \text{Q1} \): Lower Class of Income
- \( \text{Q2} \): Lower Middle Class of Income
- \( \text{Q4} \): Upper Middle Class of Income
- \( \text{Q5} \): Upper Class of Income
- \( \text{DKI} \): Dummy variable resident on DKI Jakarta
- \( \text{Jabar} \): Dummy variable resident on West Java
- \( \text{Jateng} \): Dummy variable resident on Central Java
- \( \text{DIY} \): Dummy variable resident on DIY Yogyakarta
- \( \text{Jatim} \): Dummy variable resident on East Java
- \( \mu \): error term
- \( \beta_0 \): constant
- \( \beta_1 - \beta_{17} \): parameter

The relationship between specific variable and the outcome of the probability is interpreted by means of the marginall effect. The marginal effect associated with continuous explanatory variables \( X_k \) on the probability \( P(Y_i = 1 | X) \), holding other variables constant, can be derived as follows [16]:

\[ \frac{\partial P_i}{\partial x_{ik}} = \varphi(x_i' \beta) \beta_k \]

Where \( \varphi \) represent the probability density function of a standard normal variable. The marginal effect provides insight into how the explanatory variables shift the probability of preserved fish consumption. Data were processed with STATA software version 12 using Probit Regression Model. In this research, the goodness of fit measure using the estate classification as seen in STATA reports the proportion of correct prediction with various summary statistics used in the previous study [17]. Wooldridge [18] argued that percentage correctly predicted is a useful measure for goodness of fit but was quick to point out the possibility of getting high percentage correctly predicted even when the least likely outcome is poorly predicted.

### 2.1. Socio-economics characteristics of households in Java Island

The number of household in the 2019 for Java Island is 96,360 units. Based on Statistic Indonesia [12] poverty is calculated using a basic needs approach and measured by total expenditure. The total expenditure at Rp. 454,652/capita/month reported as the poverty line in March 2020, so that in Java island had a 10,219 household below the poverty line or about 10.54% from total sampel. Java island has the highest population in Indonesia so that it has the most significant percentage of poor people in this country. Characteristics of sample households based on socio-economics indicators presented in Table 1.
Table 1. Distribution of households characteristics.

| No | Characteristics                                      | N     | Percentage |
|----|------------------------------------------------------|-------|------------|
| 1. | Expenditure by Capita per Months                     |       |            |
|    | Lower than Rp. 425.250                               | 10,219| 10.54      |
|    | Higher than Rp. 425.250                              | 86,711| 89.46      |
| 2. | Age of Head household                                |       |            |
|    | Lower than 40 year                                   | 21,661| 22.35      |
|    | 40-55 year                                           | 40,530| 41.81      |
|    | Higher than 55 year                                  | 34,739| 35.84      |
| 3. | Member of Household                                  |       |            |
|    | <3 members                                           | 25,801| 26.22      |
|    | 3-5 members                                          | 48,678| 50.22      |
|    | >5 members                                           | 22,451| 23.16      |
| 4. | Marital Status                                       |       |            |
|    | Single                                               | 20,838| 21.49      |
|    | Married                                              | 76,902| 78.50      |
| 5. | Head of Household Education                          |       |            |
|    | Unschooled                                           | 5,126 | 5.29       |
|    | Primary School                                       | 46,283| 47.75      |
|    | Junior High School                                   | 15,411| 16.00      |
|    | Senior High School                                   | 20,932| 21.59      |
|    | College                                              | 9,178 | 9.47       |
| 6. | Household Location                                   |       |            |
|    | Urban Area                                           | 57,966| 59.80      |
|    | Rural Area                                           | 38,964| 40.20      |
| 7. | Primary Source from Household Income                 |       |            |
|    | Agricultural. Animal Husbandry and Forestry          | 23,064| 23.79      |
|    | Fishery                                              | 1,476 | 1.52       |
|    | Grocery and Retail. Car Repair and Household Goods   | 12,289| 13.71      |
|    | Processing Industry                                  | 10,819| 11.16      |
|    | Building Construction                                | 8,668 | 8.94       |
|    | Others                                               | 39,614| 40.87      |
| 8. | Economic Status                                      |       |            |
|    | Lower Class                                          | 19,386| 20.00      |
|    | Lower Middle Class                                   | 19,386| 20.00      |
|    | Middle Class                                         | 19,386| 20.00      |
|    | Upper Middle Class                                   | 19,386| 20.00      |
|    | Upper Class                                          | 19,386| 20.00      |
| 9. | Program Keluarga Harapan (PKH) Subsidies             |       |            |
|    | Beneficiary                                          | 11,841| 12.22      |
|    | Non Beneficiary                                      | 85,089| 87.78      |

Source: BPS Indonesia [12], calculated

Table 1 explains that in Java Island, only 10.54 percent of the sample below the poverty line Rp. 425.550/month. In Indonesia, poverty is measured using the absolute poverty definition by The Indonesian Statistic Bureau (BPS). BPS translated this poverty line as the value needed by an individual to fulfil his minimum daily requirement for food and non-food [19]. The national poverty rate in March 2019 state by BPS was 9.41 percent, and it shows in Java island had more population live under poverty compare to national condition. This shows that although Java is the center of economic growth, the percentage of poor people is higher than the national average, emphasizing the need for pro-poor
economic development. Auwalin [20], in his research about poverty, state that to reduce poverty, the government must be designing pro-poor economic growth in which the poor can get the most benefit of the growth and would be more effective in poverty reduction, and this must be implemented in Java which more than 50 percent population in Indonesian live in this island.

Based on the age of the head household in Java, it is dominated by middle-aged head households with ages between 40-55 years as much as 41.81% of the entire respondent. The young households (family heads aged under 40) only 22.35% and the old household (family heads aged higher than 55) about 35.84% of the total respondent. Many research results show the correlated between the household's age, which represents the family life cycle with consumption patterns. Chen and Chu [21] state that consumer spending depends upon the stage of the family cycle reflects the household’s adaption behavior to meet family situation changes through life. This research finds that the households adjusts the consumption expenditure to the demand of growing children, the need for education for members, retirement, and the physical needs of old age and its financial status. The characteristics of households also seen from the head household level are primary school graduates with the proportion 47.75 percent from the total household with marital status and located in urban areas. The primary source of income was in sector agricultural, animal husbandry, and forestry, and only 12.22 percent of the total household was PKH subsidies beneficiary. Household characteristics analysis indicates that Java is still dominated by people with low education and middle age levels. In addition, as many as 10 percent of the population lives below the poverty line, which exceeds the national poverty rate.

2.2. Preserved fish consumption pattern in Java Island

Based on several studies such as Erdogan, Mol, Cosansu [22], Uzundumlu [23], Terin [14], and Onumah et al. [24] showed that fish consumption pattern is depend on household characteristic that become research subject. This study defines household characteristics into five indicators: economic status, type of location, number of household members, age, and education of the head of the family. Relation between preserved fish consumption and household characteristics show in Table 2.

| Table 2. Preserved fish consumption pattern based on household characteristics in Java Island. |
|-----------------------------------------------|
| No. | Household Characteristics | Consumption(capita/year) | Participation Rate (percent) |
| 1. | Economic Status | | |
| Lower Class | 2.20 | 58.42 |
| Lower Middle Class | 2.60 | 60.12 |
| Middle Class | 2.70 | 58.13 |
| Upper Middle Class | 2.77 | 53.73 |
| Upper Class | 2.29 | 41.26 |
| 2. | Household Location | | |
| Urban Area | 2.17 | 50.08 |
| Rural Area | 3.02 | 60.66 |
| 3. | Number of Household Members | | |
| <3 members | 3.01 | 43.32 |
| 3-5 members | 2.46 | 56.72 |
| >5 members | 2.04 | 61.81 |
| 4. | Age of Head household | | |
| Lower than 40 year | 2.10 | 50.71 |
| 40-55 year | 2.53 | 56.96 |
| Higher than 55 year | 2.75 | 53.52 |
| 5. | Head of Household Education | | |
| Unschooled | 3.44 | 54.70 |
| Primary School | 2.84 | 60.06 |
| Junior High School | 2.34 | 54.84 |
| Senior High School | 2.06 | 48.70 |
Table 2 shows that the consumption of preserved fish on the island of Java is highest in the middle and upper economic class as seen from the value of per capita consumption. Households in rural areas prefer to consume preserved fish than in urban areas. In addition, consuming preserved fish is negatively related to the number of household members where the consumption is slightly higher. In addition, if seen from the age of the head of the family, it has a positive relationship with the level of preserved fish consumption, where older households have more consumption of preserved fish per capita. An interesting finding is that the level of education is negatively related to the level of consumption of preserved fish. This condition indicates that the more educated, the lower the desire to consume preserved fish.

Most of the preserved fish production processes, such as boiled fish and salted fish, are produced by small and micro-businesses with relatively low food safety standards. This fact is shown by the research of Thaheer, Hasibuan, & Mumpuni [25], which states that the boiled fish business does not apply the principle of food hygiene, and the infrastructure owned is very minimal and likely to cause cross-contamination. So that it makes sense, fish preserved consumption is negatively related to the level of education, which is usually linear with increased awareness of food safety risks.

The analysis of fish consumption patterns base on provinces in Jawa island shown in the following tables.

| No | Province  | Consumption(capita/year) | Participation Rate (percent) |
|----|-----------|--------------------------|------------------------------|
| 1  | DKI       | 1.71                     | 42.61                        |
| 2  | West Java | 2.81                     | 66.25                        |
| 3  | Center Java | 2.40                   | 46.82                        |
| 4  | DIY       | 1.51                     | 32.86                        |
| 5  | East Java | 2.68                     | 54.14                        |
| 6  | Banten    | 2.33                     | 65.02                        |

Source: BPS Indonesia [12], calculated

The table above shows that West Java is the highest consumption of preserved fish, while DIY is the lowest in terms of capita consumption and consumption participation. The distribution of the fish processing industry in Indonesia is dominated by small micro-scale industries with 62,389 units, with 15.71% in West Java [9]. This condition supports the high consumption of preserved fish in West Java due to the availability of sufficient supply. According to Soedjana [26] the participation rate can determine how big the consumer cluster is by juxtaposing the total population in an area. Therefore, from the table above, the participation rate of preserved fish consumption in DIY is very low, less than 50% of the total population. Increasing preserved fish consumption can be made by expanding the participation of fish consumption in households that have not to consume. The characteristics of preserved fish that are easy to distribute should be an advantage balanced with promotional efforts to increase consumption of preserved fish, especially in Java.

2.3. Socio-economics determinants of preserved fish consumption in Java Island

This study explores the effects of age of households, member of household, marital status, working wife, urban area, main income as fisherman, economic status, subsidies beneficiary, and province on consuming preserved fish. With the help of statistical software, a test for goodness of fit can be carried out from the probit model. The analysis results yielded the estate classification as shown in Table 4 to be used for the percentage that was predicted correctly.
Table 4. Percentage correctly Predicted-Goodnes Of Fit.

| Classified Percentage |
|-----------------------|
| Sensitivity           | 73.99 |
| Specificity           | 49.27 |
| Positive predictive value | 63.44 |
| Negative predictive value | 61.42 |
| False + rate for true ~ D | 50.73 |
| False – rate for true D | 26.01 |
| False + rate for classified + | 36.56 |
| False – rate for classified - | 38.58 |
| Correctly Classified | 62.70 |

Source: BPS Indonesia [12], calculated

Table 4 show the overall rate of correct classification is estimated to be 62.70% with 49.27% of the household consuming preserved fish correctly classified (specificity) and 73.99% of the household consuming preserved fish correctly classified (sensitivity). Sensitivity value implies the accuracy of the model in explaining the success events that is stated as correct success events of all observation in the model. While, specificity value indicates the accuracy of the model in explaining the failed events that is stated as correct failed events of all observation in the model. Classification is sensitive to the relative sizes of each component group and always favours classification into the larger group. However, it should be noted that it is possible to get high percentages correctly predicted even when the most unlikely outcomes are poorly predicted [17], which can sometimes be misleading.

The purpose of this study is to determine the socio-economics factors that impact consumption of preserved fish on the household level in Java Island. Respondents in this study are 96,630 households where 52,664 households or 54.33% consume preserved fish. The Probit model tests results in the socio-economic determinants of the opportunity to consume preserved fish on the island of Java are shown in the following table.

Table 5. Estimation test for probit model preserved fish consumption.

| Variable                      | Coefficient | Std. Err | P>|z|  | Marginal Effect |
|-------------------------------|-------------|----------|-----|----------------|
| Age of Headhousehold          | 0.000735    | 0.003417 | 0.031| 0.001579       |
| Member of Household           | 0.095387    | 0.003087 | 0.000| 0.346688       |
| Education                     | -0.03119    | 0.001251 | 0.000| -0.015535      |
| Marital Status                | 0.259777    | 0.118588 | 0.000| 0.0950085      |
| Working Wife                  | 0.006817    | 0.009705 | 0.482| 0.0025324      |
| Urban Area                    | -0.18983    | 0.091982 | 0.000| -0.0704581     |
| Fisherman Primary Income      | -0.56189    | 0.034045 | 0.000| -0.2119133     |
| Lower Class Income            | -0.0933     | 0.013532 | 0.000| -0.0324581     |
| Lower Mid Class Income        | 0.000499    | 0.013205 | 0.970| 0.0003252      |
| Upper Mid Class Income        | -0.05448    | 0.013153 | 0.000| -0.0207436     |
| Upper Class Income            | -0.2313     | 0.014247 | 0.000| -0.0853663     |
| Subsidies Beneficiary         | 0.094069    | 0.013463 | 0.000| 0.0333347      |
| DKI                           | -0.3573     | 0.024257 | 0.000| -0.1320604     |
| West Java                     | 0.049201    | 0.018452 | 0.008| 0.020386       |
| Center Java                   | -0.54309    | 0.018298 | 0.000| -0.1995353     |
| DIY                           | -0.77947    | 0.027504 | 0.000| -0.2802076     |
| East Java                     | -0.33711    | 0.018138 | 0.000| -0.1209437     |
| Constant                      | 0.265245    | 0.031285 | 0.000|                |
| Pseudo R²                     | 0.0663      |          |     |                |
| Log Likelihood                | -62394.697  |          |     |                |
standards. What is essential is branding the image of hygiene of the product has a better economic and nutritional value. It is imperative to increase food safety from preserved fish in Indonesia to reduce food safety risks, so this product has a better economic and nutritional value. Therefore, preserved fish has still considered a type of food with low nutrition and negative and significant relationship with the level of education of the head of household and with a more significant number of members is 34.67% related to preserved fish consumption. Meanwhile, the most significant negative marginal effect variables were primary income as a fisherman of -0.2119 and locations in the DIY province of -0.2802 or the related ones of -21.19% and -28.02% of preserved fish consumption.

The estimation results using the Probit models show that the opportunity for consumption of preserved fish is positively related to the age of head household, member of household, marital status, working wife, lower-middle-class subsidies beneficiary and west java. The variables education, urban area, primary income as a fisherman, lower-class income, upper-middle-class income and upper-class income are negatively related to the opportunities for consumption of preserved fish. Almost all variables have a significant relationship with the opportunity to consume preserved fish, except for the insignificant age of head household, working wife and lower-middle-class income variables. Based on Pseudo R² value which is contained in Table 5, shows that the model probit equation in this study able to explain 6.63 percent of the influencing factors on the probability of a household consuming preserved fish.

The marginal effect shows the change in probability when a predictor or the independent variable is increased by one unit. In general, the regression coefficient is probit cannot be interpreted. However, it can use the marginal effect of an independent variable, namely how much is the probability of changing the variable the result when changing the value of the regressor. The variable with the most significant marginal effect is household members with a value of 0.346688, which means that the number of family members is 34.67% related to preserved fish consumption. Meanwhile, the most significant negative marginal effect variables were primary income as a fisherman of -0.2119 and locations in the DIY province of -0.2802 or the related ones of -21.19% and -28.02% of preserved fish consumption.

The study results generally show that preserved fish is an option for consumption by households with a more significant number of members and with a lower level of education for the head of the household. In addition, consuming preserved fish is also negatively related to higher household income levels and is also the primary source of livelihood for fishermen. The aforementioned shows that preserved fish is still considered a preferred source of food for households with low purchasing power. This finding is in line with the research results from Luhur and Wardono [27] that fish product from the perspective in society has not occupied a strategic social position such as animal products from livestock. The growth in fish consumption tends to be lower compared to the change in consumption of poultry meat which grew 12.9% per year in line with the increase in income and purchasing power of the people. Food safety is still a significant problem for preserved fish produced in Indonesia, which is shown by the higher level of education, which is assumed to be linear with nutritional knowledge, reducing the opportunity to consume preserved fish. The types of preserved fish referred to in this study include salted fish, brined fish, and smoked fish, which are considered close to food safety. Research in DKI Jakarta in 2016 shows that seafood and fish with a proportion of 52.4% from the type of food causing poisoning. Fish processing, such as smoked fish, will increase the risk of food poisoning because the actual processing process is not adequate where it has to reach a specific temperature [28] Several findings indicate that the fish that are preserved only by salting or smoked can be found with Clostridium botulinum bacteria [29,30].

3. Conclusion
The conclusion from the results of this study is that the opportunity to consume preserved fish has a negative and significant relationship with the level of education of the head of the household and economic status. Therefore, preserved fish has still considered a type of food with low nutrition and consumed by households with low purchasing power, or we can say as an inferior product. It is imperative to increase food safety from preserved fish in Indonesia to reduce food safety risks, so this product has a better economic and nutritional value. Policies that the government can implement are business assistance and guidance in improving the hygiene of the preserved fish production process, which is equipped with capital assistance. In addition, what is essential is branding the image of preserved fish products that meet food safety assurance standards. Product innovation and promotion can be used to rebrand the image for fish preserved to be
consumed by all levels of society and reduce the negative image of food safety issues such as the use of chemicals and various processes that do not meet food-grade standards.

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