

EURASIAN JOURNAL OF BUSINESS AND MANAGEMENT

www.eurasianpublications.com

A MODEL FOR THE DEVELOPMENT OF THE SEAWEED AGRO INDUSTRY IN THE SOUTHEAST MALUKU DISTRICT OF INDONESIA

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Abstract

Here we aimed to create a model of seaweed agro-industry development in the Southeast Maluku district of Indonesia. Data collected from respondents (n = 250) included information related to agro-seaweed, seaweed farming, and seaweed product marketing. Data collection included primary and secondary data sources, while the methods of analysis used structure model equations. We tested eight factors that influence the development of agro-seaweed industries in the southeast Maluku regency, namely, raw materials, human resources, technology, markets, infrastructure, policy, institutional, and capital, and concluded that all proposed hypotheses are proved correct because the value critical ratio ≥ 1.96 , only the facilities and infrastructure factors were identified as significantly affecting the development of an agro-seaweed facility in southeast Maluku. We also found that optimal development of an agro-business in southeast Maluku will depend on relevant local government support and require cooperation between the internal local government, academia, the private sector, and the public. Development of human resources through formal and informal education programs directed at local business and focused on seaweed-based products will help to build business continuity by avoiding collusion and nepotism. Increased cooperation will also be required between government, employers, and the fishery community to monitor the sustainability and environmental impacts of the seaweed agro-industry in this region.

Keywords: Model Development, Agro-Industry Seaweed, Development Strategy

1. Introduction

Similar to other marine commodities, seaweed is increasingly being intensively cultivated. The Southeast Maluku district of Indonesia has a potential cultivation land area of 5,103 ha. Seaweed production in this region has been steadily increasing; total production of dried seaweed increased from 3,126 tons in 2009 to 7,350 tons the following year. However, this increased production has yet made a significant contribution to neither regional revenue nor increase the welfare of the fishermen and seaweed cultivators. With proper agro-industry development, wealth is expected to be generated for fishermen/farmers and local entrepreneurs, ultimately encouraging the economic growth of the region. Therefore, the proper implementation of a suitable agro-industry development model for seaweed will be critical for the future of the Southeast Maluku district.

2. Research Methodology

2.1. Data Collection

This study was conducted over 10 months, from March to December 2015, in the district of Southeast Maluku, Maluku Province. Data were collected from respondents (n=250) somehow connected to agro-fishery (including agro-seaweed, seaweed cultivation and marketing of seaweed products) development. The data addressed factors associated with the development of agro-seaweed (raw materials, human resources, technology, markets and marketing, infrastructure, government policy, institutional and financing). The number of respondents is within the range recommended for the use of structural equation modeling (SEM) (minimum of 100 and maximum of 400 respondents) (Hair et al. 1998).

Primary data included direct observation and questionnaires, including confirmation and re-checking the answers of the respondents. Respondent's data was collected in two stages: 1) determination of the sample groups and; 2) interviews with respondents. Samples were taken by purposive random sampling. This method is done using questionnaires and immediately conducted interviews to respondents were selected as the study sample. Data and information obtained is the result of direct conduct interviews with respondents. The questions were formatted as a Likert scale (1–5, strongly disagree to strongly agree).

Secondary data was obtained indirectly from interviews or observations, as well as data retrieved from multiple records (published and unpublished); for example, from local government agencies (Department of Fisheries and Marine Resources, Department of Cooperatives and SMEs).

2.2. Data Analysis and Model Development

Data were processed by first grouping data addressing similar activities. Hair et al. (1998) proposed several steps in the use SEM for analyzing the causal relationship between exogenous and endogenous factors. The initial step is the development of an SEM hypothetical model, i.e., a model that has a theoretical justification or draft, which can then be verified (or rejected) based on empirical data. Thus, researchers must first perform a series of scientific explorations (e.g., through literature review) in order to obtain justification of their theoretical model (Solimun, 2002).

Next, it is necessary to create a path diagram to allow researchers to better understand the relationship of causality to be tested. If a causal relationship exists that is inappropriate, multiple models can be tested by SEM to identify the most appropriate. A structural equation detailing the causal relationships between factors (also referred to as constructs) can be generated as follows:

$$\text{Endogenous factors} = \text{Exogenous factors} + \text{Error}$$

$$\text{with a structure of: } Y_1 = \beta_1 Y_2 + \beta_2 Y_3 + \beta_3 Y_4 + \beta_4 Y_5 + \delta_1$$

where Y1 is the endogenous factors, Y2 is the exogenous factors, B is the weight regression and δ is the disturbance term (error).

Only the covariance or correlation matrixes were used as input data for the overall SEM estimation. Kline *et al.* (2001) have suggested using the covariance matrix when testing a theory by SEM. The following steps were used to test for problems of identification:

The model was estimated repeatedly using different starting values (1); and the tested model was estimated and the coefficient value of one variable was recorded (2), so that the next coefficient could be determined as a fixed factor or variable, followed by re-estimation.

The suitability of the model was evaluated using a goodness of fit index, as follows: 1) the data was evaluated to determine if meeting the assumptions of the SEM; 2) conformance testing and statistical tests; and 3) size analysis (analysis used measure is right or not).

Once passing the above analyses, model interpretation and modification were performed. Interpretation of the use of SEM is not to produce a theory, but tested models that have a foothold theory are right and good. If the interpretation of the residuals generated models through observation residual standard variable has a value greater than an establish threshold, the model is acceptable and there is no need for subsequent modification. However, if the model fails the interpretation stage, modifications can be made so long as these are supported by sufficient theoretical justifications.

Finally, based on eight identified factors, we generated an agro-industry development strategy for seaweed in the Southeast Maluku district. The results of hypothesis testing conducted on 8 of these factors, we can determine which factors are significant and not significant, then a significant factor and it will become an important concern in efforts to develop agro-industry seaweed in Maluku district southeast, Maluku, Indonesia.

3. Results

3.1. Suitability of the Model

After model confirmatory factor analysis, each of the variables was used to fit the latent constructs, so that the full SEM model could be analyzed.

The Structural Equation Model for Seaweed Agro-Industrial Development in Southeast Maluku is shown in Figure 1.

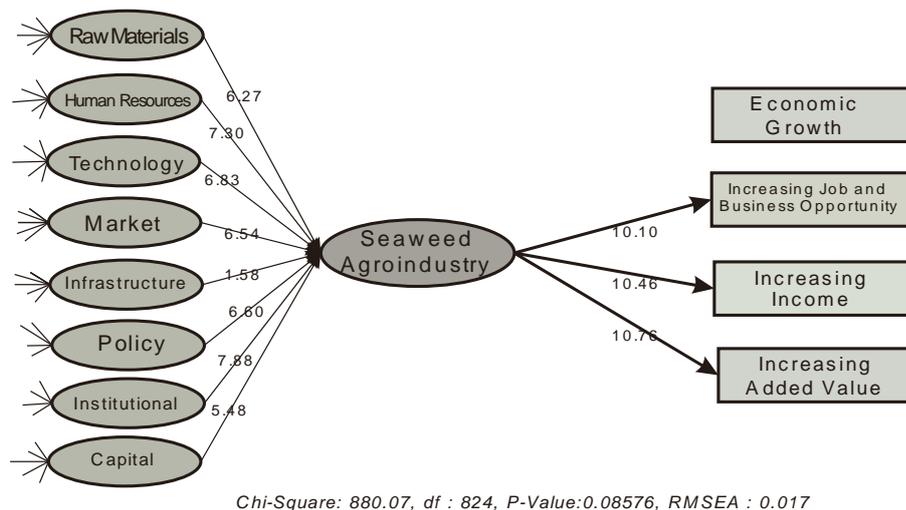


Figure 1. Structural Equation Model for Seaweed Agro-Industrial Development in Southeast Maluku

Based on the results of tests performed on this model by using a 5% significance level (0.05), indicating that the model used is Fit and significant. Chi-square significance tests of the model returns a value of 880.07 ($P > 0.05$). Further index values, including RMSEA (root mean

square error of approximation), GFI (goodness of fit index), AGFI (adjusted goodness of fit index), NFI (normed fit index), NNFI (non normed fit index), IFI (incremental fit index), RFI (relative fit index), PGFI (parsimony goodness of fit index), RMR (root mean square residual), CN (Critical N), were within acceptable limits. Index eligibility for the testing of model suitability is shown in Table 1.

Table 1. Index eligibility for the testing of model suitability

No	Suitability Index Model Against Data	Terms A Model Fit	Analysis Results	Evaluation Model
1	Chi-square	<1418.57	880.07	Good
2	Significance probability	≥ 0.05	0.086	Good
3	RMSEA (root mean square error of approximation)	≤ 0.08	0.017	Good
4	GFI (goodness of fit index)	≥ 0.90	0.86	Marginal
5	AGFI (adjusted goodness of fit index)	≥ 0.90	0.84	Marginal
6	NFI (normed fit index)	≥ 0.90	0.90	Good
7	NNFI (non normed fit index)	≥ 0.90	0.98	Good
8	IFI (incremental fit index)	≥ 0.90	0.98	Good
9	RFI (relative fit index)	≥ 0.90	0.89	Marginal
10	CFI (comparative fit index)	≥ 0.90	0.98	Good
11	PGFI (parsimony goodness of fit index)	≥ 0.90	0.75	Moderate
12	RMR (root mean square residual)	≤ 0.05	0.05	Good
13	CN (critical N)	≥ 200	235.48	Good

3.2. Hypothesis Testing

Based on our analysis of the seaweed agro-industry development model and the influencing factors (H1, H2, H3, H4, H5, H6, H7 and H8), the proposed research hypotheses were confirmed (CR>1.96 at a = 0.05), only the facilities and infrastructure factors (H5) were identified as significantly affecting the development of seaweed agro-industries in Southeast Maluku. The Hypothesis testing suitability is shown in Table 2.

Table 2. Hypothesis testing

H	Hypothesis	Criteria	C.R Results	Results
H1	Seaweed agro-industries will be positively influenced by raw materials	≥ 1.96	6.27	Accepted
H2	Seaweed agro-industries will be positively influenced by human resources	≥ 1.96	7.3	Accepted
H3	Seaweed agro-industries will be positively influenced by technology	≥ 1.96	6.83	Accepted
H4	Seaweed agro-industries will be positively influenced by the market	≥ 1.96	6.54	Accepted
H5	Seaweed agro-industries will be positively influenced by infrastructure	≥ 1.96	1.58	Rejected
H6	Seaweed agro-industries will be positively influenced by policy	≥ 1.96	6.60	Accepted
H7	Seaweed agro-industries will be positively influenced by institutional	≥ 1.96	7.88	Accepted
H8	Seaweed agro-industries will be positively influenced by capital	≥ 1.96	5.48	Accepted

Seven factors influence Important against seaweed agro-industry development in Southeast Maluku that is raw materials, human resources, technology, market and marketing, policy, institutional and capital. Important components of the factors that influence the development of seaweed agro-industry in Southeast Maluku are shown in Table 3.

Table 3. Important components of the factors that influence the development of seaweed agro-industry in Southeast Maluku

Hypothesis	Factors that influence against seaweed Agro-industry	Important components that influence and value Critical Ratio (CR)	Impact on the seaweed agro-industry affected
H1	Raw Materials	X1 (Availability of raw materials) = 13.00 X2 (The quality of raw materials) = 13.83 X3 (Payment raw materials) = 11.69 X4 (Prices of raw materials) = 13.86 X5 (The supply of raw materials) = 12.73	
H2	Human Resources	X6 (Mental and Discipline) = 12.35 X7 (Training opportunities and technical assistance) = 12.62 X8 (Level of education) = 11.94 X9 (Business experience) = 12.82 X10 (Employment) = 13.52 X11 (Productivity) = 13.17	
H3	Technology	X12 (Technological conditions) = 12.02 X13 (Technological development) = 11.13 X14 (Quality of production) = 11.96 X15 (Packaging technology products) = 11.97 X16 (Innovation technology) = 11.47 X17 (Methods and technological procedures) = 13.52	
H4	Market and Marketing	X18 (Network marketing) = 12.22 X19 (Diversification of products) = 11.67 X20 (Market access) = 13.09 X21 (Sales growth) = 12.74 X22 (The price of the product) = 13.53 X23 (subscriber growth) = 12.60 X24 (marketing information) = 11.95	Y1 (Economic Growth) = 10.01 Y2 (Increasing Job and Business Opportunity) = 10.10 Y3 (Increasing Income) = 10.46 Y4 (Increasing Added Value) = 10.76
H5	Infrastructure	X25 (Transportation) = 6.88 X26 (The processing plant seaweed) = 5.75	
H6	Policy	X27 (Government deregulation) = 13.44 X28 (Construction of the processing plant seaweed) = 13.73 X29 (The provision of capital plant and equipment seaweed) = 13.17 X30 (Development of the region 's fishing industry) = 11.59 X31 (Services and business permits) = 13.12	
H7	Institutional	X32 (Support marketing agencies) = 10.54 X33 (Support institutions capital) = 9.64 X34 (Support the extension services and development human resources) = 10.43 X35 (Support research institutions) = 11.57 X36 (Return on working capital of business) = 11.02	
H8	Capital	X37 (Venture capital adequacy) = 12.56 X38 (Access and obtain capital requirements) = 12.28 X39 (Sources of capital business development) = 13.27	

3.3. Development of a Seaweed Agro-Industry

Seaweed agro-industry cannot be separated from the seaweed processing industry, making it necessary to support the entire institutional network to foster growth and development. According to Giyatmi (2005) factors affecting the development of Marine Fisheries Agroindustri (raw materials, human resources, technology, capital, markets, government policies, infrastructure and institutional information). In the development of seaweed agro-industry, Ma'ruf (2002) suggests the need to establish a system of harmonization between the supply of raw materials, human resources, capital, legal, institutional and marketing systems, as well as the need for dissemination of research results by local government, research institutions and the private sector.

3.3.1. Influence of Raw Materials on Agro-Industrial Development of Seaweed

Raw materials was identified as a very significant factor for the development of agro-industry seaweed ($CR=6.27, \geq 1.96, \alpha = 0.05$). Here, the variables used to measure the impact of raw material were: availability of raw materials (X_1); quality of raw materials (X_2); payment of raw materials (X_3); the price of raw materials (X_4); the supply of raw materials (X_5).

The raw materials coefficient was identified as being very influential on the development of seaweed agro-industries in Southeast Maluku, principally because of the large potential cultivation area (5,103 ha), of which only 2,373.62 ha (42.39%) is currently utilized. The recent growth of seaweed production in Southeast Maluku has been Dried seaweed production continued to increase from year to year (in 2009 production is 3,126 tons, in 2010 increased to 7,350 tons). This shows that the availability of raw material seaweed is always abundant, so the supply of raw materials remains smooth is likely to be smooth and continuous, resulting in the availability of good quality and reasonably priced seaweed.

3.3.2. Influence of Human Resources on Agro-Industrial Development of Seaweed

Human resources was identified as having a very significant effect on the development of seaweed agro-industries in Maluku ($CR=7.30, \geq 1.96, \alpha = 0.05$). In theory, the human resource is a determination of agro-industrial seaweed, meaning that the higher the value of human resources to be able to influence the development of agro-industries seaweed. The variables used to measure human resources in this study were: mental and discipline (X_6), training opportunities and technical guidance (X_7), education level (X_8), business experience (X_9), employment (X_{10}) and productivity (X_{11}).

Human resource values indicated the quality of effort given by a person within a certain time to produce goods and services. In Southeast Maluku, we judged the quality of the effort given in the seaweed agro-industry to be good, as indicated by the quality and quantity of the work already being done. Although the seaweed business is largely depend on orders, production continues even when orders are low, with the produce being marketed in the local area.

3.3.3. Influence of Technology on Agro-Industrial Development of Seaweed

Technologies were also identified as influencing the development of seaweed agro-industrial development ($CR=6.83, \geq 1.96, \alpha=0.05$). In theory, higher values for technology would be able to help in the development of seaweed agro-industries. The variables used to measure the technology status of the region were: technological conditions (X_{12}), technological developments (X_{13}), the quality of production (X_{14}), packaging technology products (X_{15}), technological innovation (X_{16}), methods and technological procedures (X_{17}).

Technology is an important device that converts the resource base into the desired goods and services. One possible ways of improving product competitiveness is to increase the levels of technology in company operations (Said et al. 2001). Southeast Maluku has a high level of technology around the existing seaweed agro-industrial, which is continually advancing

in quality of production, packaging technology, technological, technology innovation and technological methods. For example, innovations have allowed the production of seaweeds of good shape and flavor, as well as being well packaged (e.g., the dodol seaweed variety of flavors, seaweed syrups, Enbal grass seaweed, seaweed meatballs, seaweed puddings with a variety of colors, as well as fruit ice seaweeds).

3.3.4. Influence of the Markets and Marketing on Agro-Industrial Development of Seaweed

The market was also identified as having a significant effect on development of the seaweed agro-industry in Southeast Maluku (CR=6.24, ≥ 1.96 , $\alpha=0.05$). The variables used to measure the status of the market and marketing were: X_{18} (Network pemasaran); X_{19} (product diversification); X_{20} (market access); X_{21} (sales growth); X_{22} (product prices); X_{23} (subscriber growth) and X_{24} (marketing information).

Marketing is a social and managerial process in which individuals and groups obtain their needs and desires by creating, offering and exchanging things of value. In Southeast Maluku, the potential market for seaweed agro-products is principally in the vicinity or nearby Ohoi which also has an established seaweed agro-industry. Moreover, the prices of products offered can be reached (purchased) by the consumer in southeast Maluku district the products offered are also able to compete with other processed products in southeast Maluku district, so that access to the processed seaweed market is likely to continue to grow.

3.3.5. Influence of Infrastructure on Agro-Industrial Development of Seaweed

Infrastructure was found not to significantly influence the development of seaweed agro-industries in Southeast Maluku (CR=1.58, ≤ 1.96 , $\alpha=0.05$). The variables used to measure transport infrastructure were: transport (X_{25}) and a seaweed processing factory (X_{26}). As expected, each of these variables was found to positively influence infrastructure.

Infrastructure does not affect the development of the seaweed industry. This is because the processing plant was established that medium and large well that is a relief from the central government (Ministry of Industry) and the local government district Malra until now not operating optimally so cannot contribute in giving maximum added value to the product of seaweed. In addition, most large-scale seaweed agro-industrial enterprises in Kab Malra are small-scale (home industry). While not widely used for transportation for the marketing activities of agro-products seaweed because the marketing area of agro-products mostly in the area around the place of business.

3.3.6. Influence of Policy on Agro-Industrial Development of Seaweed

Policy was found to significantly influence the development of seaweed agro-industries in Southeast Maluku (CR=6.60, ≥ 1.96 , $\alpha=0.05$). The variables used to measure policy were: government deregulation (X_{27}), the construction of processing plants (X_{28}), provision of venture capital and seaweed processing equipment (X_{29}), the development of the region's fishing industry (X_{30}), services and business permits (X_{31}).

Policy can influence the development of the seaweed industry principally because of deregulation/regulation, which reflects the government's policy in Southeast Maluku District to support the agro-industrial seaweed by controlling the price of raw materials of between 9,000/kg to 16,000/kg, followed by construction of seaweed processed plants. These policies are aimed at increasing the income of fishermen cultivators, so that the marketing of seaweed products will be improved (price and quantity of production). In addition, the government has also been providing venture capital and seaweed processing equipment for the community groups in the region's seaweed production center since 2010. Southeast Maluku regency government simplify permits for small entrepreneurs based seaweed, Southeast Maluku District Government in developing agro - seaweed industry from upstream to downstream The Southeast Maluku district has divided its territory into several industrial areas and aquacultures,

thus enabling each region, including the Ohoi coast, to develop their territory according to its potential.

3.3.7. Influence of Institutional Factors on Agro-Industrial Development of Seaweed

Institutional research outputs was identified as having a significant effect on the development of seaweed agro-industries in Southeast Maluku (CR=7.88, ≥ 1.96 , $\alpha=0.05$). The variables used to measure institutional support were: marketing agency (X_{32}); institutional support capital (X_{33}); support the extension services and development (X_{34}); support research institutes (X_{35}).

Institutional factors can influence the development of the seaweed industry principally because the universities and research institutes in the region conduct much research (technological and social economy) related to the development of seaweed agro-industries. In addition, many locals have been trained in the form of community service for the community farmers and agro-industry effort seaweed research institutions from the local educational institutions (Polytechnic State Fisheries Tual and other research institutions such as Indonesian Institute of Sciences). The institutions that organize technical and vocational training have done much to equip local workers with the skills required by the labor market and the management of micro and medium enterprises by local government agencies. Capital or financing institutions have also helped to develop the agro-industrial enterprises in the district. The role of the marketing department of marine and fisheries of Southeast Maluku regency in developing agro-industry seaweed is to provide market information to producers and sale of processed seaweed products.

3.3.8. Influence of raw materials on agro-industrial development of seaweed

Capital was found to significantly influence the development of seaweed agro-industries in Southeast Maluku (CR=5.48, ≥ 1.96 , $\alpha=0.05$). The variables used to measure capital were: return of business loans (X_{36}); venture capital adequacy (X_{37}); access and obtain capital requirements (X_{38}); and capital resources business development (X_{39}).

Capital in the small industries can be defined as the amount of money used in conducting business activities. Generally, capital used in the development of small industry comes from the founders themselves or family loans. Capitalization influences the development of seaweed agro-industries in Southeast Maluku because most of the industries in the regency are small-scale and medium enterprises that do not require much venture capital that can be obtained with assistance from local government, cooperatives, banks and equity.

3.4. Agro-Industry Development Strategy Seaweed

Agro-industry development strategy seaweed in Southeast Maluku District of Indonesia among other necessary measures to optimize the eight factors that shape the development of agro-industrial model of seaweed in Southeast Maluku regency, because each factor significantly influences the other. As a rationale for the development of agro-industry strategy seaweed in Southeast Maluku regency, among others:

1. Improved support positively and optimally from Southeast Maluku regency government related agro-industry development seaweed. Better cooperation between the local government, academia, the private sector, the state-owned enterprises and the public is also required. To increase government support for the industry in this region, we propose:

- a. Improvements in the performance of the marketing institutions that already exist within the department of fisheries.
- b. Greater involvement of academia in the efforts of seaweed agro-industry.
- c. Fixing deregulation to support seaweed agro-industry business development activities.
- d. Development of the seaweed agro-industry infrastructure.

2. Improvement and development of human through formal and informal education programs aimed at the seaweed agro-industry will be needed to foster business continuity by avoiding collusion and nepotism. We propose that human resources in the area can be increased by:

- a. Involving training centers and academia to provide education and training relevant to the processing and cultivation of seaweed.
- b. Providing a crash course for entrepreneurs in seaweed (aquaculture and processing) and other aspects of the fishing business (management, finance, marketing and technology).
- c. Improved the training in aspects of production, so that HACCP (Hazard Analysis & Critical Control Point) quality products are produced to meet customer's standards.
- d. Improving cooperation between the government and the fishery community in order to monitor the sustainability and environmental friendliness of the seaweed agro-industrial enterprises.

3. To increase the rate of improvement and monitor the sustainability and environmentally friendliness of the seaweed industry will require cooperation between the government, the fisheries and the community. To achieve this, we propose the following measures:

- a. Improving and developing the M&E activities of the seaweed agro-industry by involving academia.
- b. Assistance and venture capital for business development that really should be given based on the results of monitoring and evaluation is done so it really falls into the hands of a professional businessman and equipment / machinery which must be given in accordance with the conditions of the field and the results of monitoring and evaluation.
- c. Creation of seaweed appropriate and environmentally friendly agro-industry technologies.

4. Conclusions and Recommendations

4.1. Conclusions

Chi -Square Testing Results indicate level of significance = 880.07 And Value Probability (p) = $0.08576 \geq 0.05$. The seven factor model developed here can be used to plan and predict the development of the seaweed agro-industries in the region.

In developing the agro-industrial enterprises in Southeast Maluku district of Indonesia grass then alternative strategies performed positively is Improved and optimal support of the local government related to the development of processed seaweed products. Better cooperation between the internal local government, academia, the private sector and the public will also be required, as will improvement and development of human resources through formal and informal education aimed at seaweed-based businesses, thereby fostering business continuity by avoiding collusion and nepotism. Increased cooperation between the government, employers and the fishery community will also be required to monitor the sustainability and environmental friendliness of the seaweed industry.

4.2. Recommendations

Based on these findings, we propose that agro-industrial enterprises seaweed in southeast Maluku district mostly small and very simple organizational structure. For that we need intervention from government and the private sector in developing the business which include: improvement of organizational management, provision of venture capital, human resource training and development of facilities and infrastructure already available, especially the operation of seaweed processing factory that has been built by the government. In addition, the

available infrastructure requires improvement and the local processing plant should be made operation as soon as possible.

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