# SMALL-SIZED TIMBER OR LARGE-SIZED TIMBER PLANTATION: A CASE STUDY IN VINH LINH DISTRICT, QUANG TRI PROVINCE

**Vo Thi Hai Hien, Le Dinh Hai, Luu Thi Van**
*Vietnam National University of Forestry*

**SUMMARY**

The local authority and people in Vinh Linh district, Quang Tri province have made many efforts to promote sustainable management of forest plantation in direction of transferring from small-sized timber plantation to large-sized timber plantation. However, the role of household characteristics, social-economic factors and natural factors in forest planting decision of local people are still little understood. In this study, we surveyed 134 households in Vinh Linh district, Quang Tri province, in which there are 55 households planting for large-sized timber and 79 households not planting for large-sized timber. By applying "Cost-Benefit Analysis" method, the result of study showed that plantation for large-sized timber brings more benefits for local people than plantation for small-sized timber. In addition, the result of binary logistic regression analysis indicated that the factors, including: 'Household understanding about policies related to planting large-sized timber', 'Assurance about sources of seedlings', 'Participation of household in FSC project', and 'Support by community related to large-sized plantation activities' significantly influence household's decision on planting large-sized timber in this study area. Therefore, it is essential to make right policies such as supporting policies (e.g. forest land policy, credit policy, technical supporting policy, benefit sharing policy…) in order to encourage and promote small households focusing more on large-sized timber production.

**Keywords: Binary logistic regression, large-sized timber, small-sized timber, Vinh Linh district.**

## 1. INTRODUCTION

In recent years, Vietnamese government have made a number of policies for development of large-size timber production such as Decision 1565/QD-BNN-TCLN, Decree No 774/QD-BNN-TCLN in 2014 and Decision No.38/2016/QD-TTg in 2016 to promote long rotation forest plantation, and transferring the forests from small-sized timber plantation into large-sized timber plantation and practicing sustainable development. Beside that many researches and studies related to large-sized timber plantation, have shown that small household's decision making on "large-sized timber" (or longer rotation) - forest planation were influenced by socio-economic factors, such as community support and group's farmers (Healthcote R., 2002; Nguyen Thi Hoang Hai, 2015); household's characteristics (Nguyen Nghia Bien, 2006; Bhim Adlikari, 2003); knowledge and essential skills of small households (Markku Kanninen, 2013; Nguyen Nghia Bien, 2006; Harrison, S.R. & Herbohn, J.L., 2001); finance status and credit institution (Nguyen Nghia Bien, 2006; Nguyen Thi Hoang Hai, 2015); and natural conditions, accessibility to the farm (Markku, 2013; Tran Thi Mai Anh, 2015).

According to the Ministry of Agriculture and Rural Development (MARD), Vietnam had over 14.4 million ha of forest by the end of 2017, including over 10.2 million ha of natural forests and 4.1 million ha of planted forests (MARD, 2018). According to the report of WWF in 2017, there are only 228.000 ha of certificated plantation, accounted for 2.4% of total planning. Relationships between the relevant mentioned above factors and decision of smallholders for large-sized timber plantation will be important to support the policy makers to make suitable policies for developing sustainable forestry in our country. Suitable policies can encourage small households planting large-sized timber forests instead of planting short rotation and increase more their benefits from planting activities. In this paper, we compared benefits from large-sized timber plantation with that from small-sized timber plantation, and identified the key factors significantly influencing small household's decision for large-sized timber plantation in Vinh Linh district, Quang Tri province.

## 2. RESEARCH METHODOLOGY

### 2.1 Study area

The study area is located in Quang Tri province. The traffic sytem in the region is advantage to create a favourable conditions for the economic cooperation and development. Quang Tri is surrounded by Quang Binh province on the North, Thua Thien Hue province on the South, Laos on the West, and East Sea on the East. The topography of Quang Tri province is very various: including hills, mountains, lowland, coastal sand-banks and islands. Quang Tri province is located in the tropical climate zone with monsoon and affected by west-south dry and hot wind. Vinh Linh, a district of Quang Tri province were chosen as a site for case study.

Vinh Linh shares borders with East Sea in the East, Huong Hoa district in the West, Gio Linh district in the South and Le Thuy - a district of Quang Binh province - in the North. Vinh Linh district has 19 communes and 3 towns. It is a district with characteristics of tropical monsoon climate marked sign of typhoons, floods in winter and hot dry, drought in summer; the temperature difference between the two seasons is about 10 - 20°C. The total population of Vinh Linh is 93.909 people, in which 2.708 people belong to Van Kieu ethnic minority group and the population density is 136 people/km$^2$. There are 195 villages and 25151 households in this district. The percentage of people in labour age (from 15 - to 59 years old) is 69%. The female labours account for 51.37% and male labours account for 48.63%. Average GDP per capita in Vinh Linh district is estimated around 13.1 million VND/person/year. According to the Planning Report "Forest Protection and Development period 210 - 2020" of Vinh Linh district, the land use status in 2020: forest holds 51.1%, agriculture land holds 28.86%, land for other purposes holds 13.90%. The forest land accounts for the highest percentage in production land, it means that forest plantation plays important roles in socio-economic development in Vinh Linh district. Vinh Linh was chosen to be a study site of research because it has almost types of topography and forest plantation practices are very developed. Along with Cam Lo and Huong Hoa district, Vinh Linh is one of threes districts have the highest area of forest plantation. In addition, Vinh Linh is one of districts have the highest planation forest area achieving Forest Sustainable Certificate (FSC) in the province.

### 2.2 Study methods

Large-sized and small-sized timber can be classified by different purposes of use or by the difference in diameter or height of trees or round-woods for certain species. According to Finnish Forest Association of Finland there are two grades of round wood for each tree species: logs, or saw-timber and pulpwood, or small-diameter wood. Pulpwood is derived from small-diameter trees and the crowns of large trees. Large-sized wood of poor quality is also used as pulpwood. Saw-timber log has a minimum - top diameter of 15 cm. In Vietnam, we can find different concept of large-sized timber in some legal documents:

a) Large-sized timber is identified as round-wood having top - diameter equal or larger than 15 cm in decision 744/QĐ-BNN-TCLN: Approved Action Plan Improving Productivity, Quality, and Value of Forests Planted Phase Manufacturing 2014 - 2020.

b) According to the Standard of Vietnam - TCVN 11567-1:2016 - for specific trees species such as Hybrid Acacia (Table 1).

**Table 1. Standards to identify small-sized and large-sized timber of Hybrid Acacia**

| Indicator | Small-sized timber | Large-sized timber |
|---|---|---|
| Rotation | < 10 years | ≥ 10 years |
| Diameter | < 15 cm | ≥ 15 cm |

*(Source: TCVN 11567-1:2016)*

In this study we use the term small-sized timber from forest plantation in the concept of forest plantation for pulp-wood or chip-wood or construction wood with the rotation is short (5 - 6 years) and the large-sized timber from forest plantation with rotation longer than 10 years. Species selected for this study is Hybrid Acacia. In this study, we applied Binary Logistic Regression model to identify key factors affecting decision of small households for "large-sized timber" plantation. The minimum sample size has been calculated by the following formula (Tabachnick & Fidell, 2007):

$$n > 50 + 8*m \quad (1)$$

in which: n is sample size; m is number of independent variables.

In this study, because our binary logistic regression model includes 10 independent variables, the minimum sample size is n > 50 + 8*10 = 130 households. Therefore, we selected 134 households by using criteria in table 2. The sample size of the study is satisfied with the requirement.

The survey was based on the conceptual model for assessing key factors influencing the large-sized timber planting decision of smallholders (Figure 1).

The designed questionnaire was used to collect data on household characteristics and other relevant factors influencing decision of local households on planting large-sized timber. The face-to-face and key person interview were conducted in the study site. Using this method allows us to have more chance to ask detailed questions and open-ended questions to collect important useful information from households. The survey was conducted from 2nd August 2018 to 17th August 2018.

**Table 2. Number of surveyed households in study area**

| | Commune | Vinh Thuy | | | Vinh Chap | | Vinh Long | | Vinh Ha | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Village | Tan Thuy | Linh Hai | Thuy Ba Dong | Chap Dong | Lai Binh | Quang Xa | Thong Nhat | Lam Truong | |
| Plantation | Not large-sized | 10 | 6 | 10 | 14 | 15 | 6 | 8 | 10 | 79 |
| | Large-sized | 11 | 8 | 10 | 3 | 8 | 8 | 2 | 5 | 55 |
| | Total | 21 | 14 | 20 | 17 | 23 | 14 | 10 | 15 | 134 |

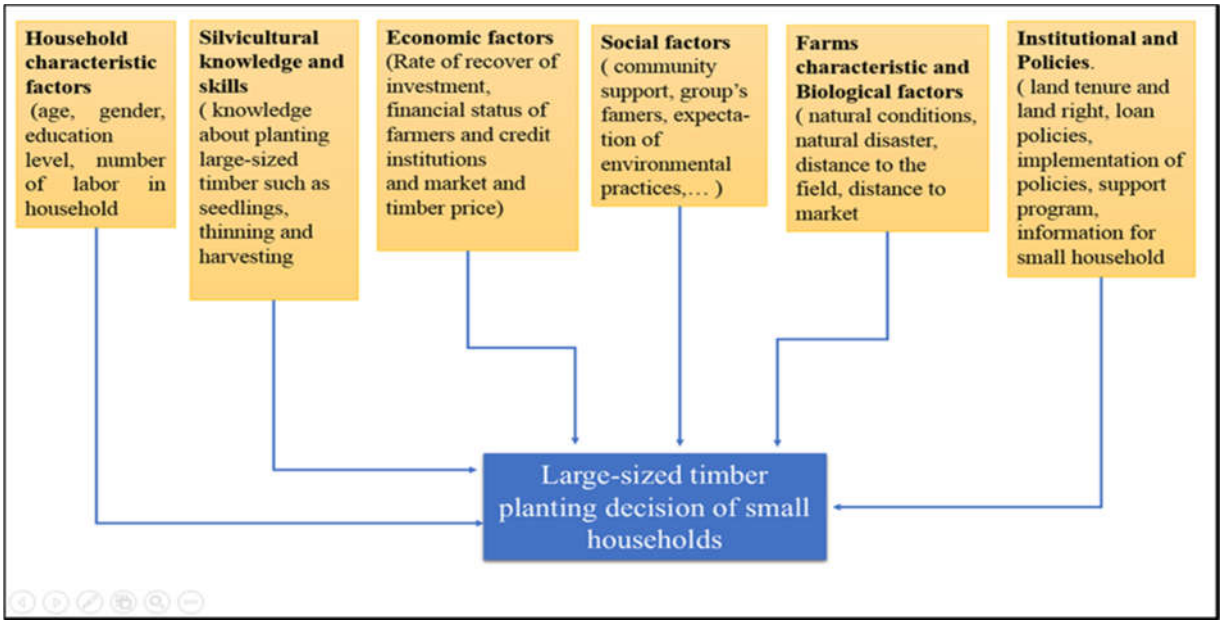


**Figure 1. Conceptual model of potential factors influencing decisions of local households on planting the large-sized timber**

Cost Benefit Analysis was used to analyse financial efficiency for both two groups of households: One group focuses on planting small-sized timber and other group focuses on planting large-sized timber. In this study, three indicators including Net Present Value (NPV), Benefit Cost Ratio (BCR), and Internal Rate of Return rate (IRR) are using for analysing financial efficiency of forest plantation. We assume that rotation of large-sized timber is 10 years and rotation of small-sized timber is 5 years. It means that one rotation of large-sized timber equals to two rotations of small sized timber. Formulas for calculation of NPV, CBR and IRR are described as below:

**(1) Net present value (NVP)** is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting to analyse the profitability of a projected investment or project.

Formula of NPV:

$$NPV = \sum_{i=0}^{n} \frac{B_i - C_i}{(1+r)^i}$$

In which:

$B_i$: Benefit/Revenue obtained by the project in year i;

$C_i$: Cost spent by the project in year i;

r: Discount rate;

n: The time of the project.

If:

NPV > 0 efficient project;

NPV = 0 break even project;

NPV < 0 not efficient project.

**(2) Benefit-Cost Ratio (BCR)** is an indicator used in cost-benefit analysis, to show the relationship between the costs and benefits of a proposed project, in monetary or qualitative terms.

Formula of BCR:

$$BCR = \frac{NPV(B_i)}{NPV(C_i)} = \frac{\sum_{i=0}^{n} \frac{B_i}{(1+r)^i}}{\sum_{i=0}^{n} \frac{C_i}{(1+r)^i}}$$

In which:

$B_i$: Benefit/ Revenue obtained by the project in year i;

$C_i$: Cost spent by the project in year i;

NPV: Net present value;

n: The time of the project.

If:

BCR > 1 efficient project;

BCR = 1 break even project;

BCR < 1 not efficient project.

**(3) Internal Rate of Return (IRR)** is a metric used in capital budgeting to estimate the profitability of potential investments. Internal rate of return is a discount rate that makes the net present value (NPV) of all cash flows from a particular project equal to zero.

IRR calculations rely on the same formula as NPV does:

$$NPV_{IRR} = \sum_{i=0}^{n} \frac{B_i - Ci}{(1+IRR)^i} = 0$$

In which:

$B_i$: Benefit/Revenue obtained by the project in year i;

$C_i$: Cost spent by the project in year i;

IRR: Internal rate of return;

n: The time of the project.

If:

IRR > r efficient project;

IRR = 0 break even project;

IRR < 0 not efficient project.

To determine the key factors influencing decision of households on planting large-sized timber, binary logistic regression model is applied. Binary logistic equation function is as the following:

$$Ln\left[\frac{P(Y=1)}{P(Y=0)}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + B_n X_n$$

In which:

$P(Y = 1) = P_1$: Probability of the household decides to practice large-sized timber plantation; and

$P(Y = 0) = P_0$: Probability of the household decides not to practice that scenario.

$X_1$, $X_2$… $X_n$: Independent variables or factors (Table 3);

$\beta_1$, $\beta_{1...}$ $\beta_n$: Coefficients estimated from the data for independent variables.

**Table 3. Description of variables**

| No | Variable | Descriptions | Status |
|---|---|---|---|
| **Dependent variable** | | | |
| 1 | Decision | Decision of household on planting large-sized timber | 1 = "Yes"<br>0 = "No" |
| **Independent variables** | | | |
| 1 | Education level | The education level of household head | 1 = Primary school;<br>2 = Secondary school;<br>3 = High school |
| 2 | Household ranking | Household wealth ranking | 1 = Poor;<br>2 = Moderate;<br>3 = Rich |
| 3 | Forest land area | Forest land area of household | Continuous variable |
| 4 | Knowledge about large-sized timber | Silvicultural techniques of household head about large-sized timber plantation | 1 = Yes"; 2 = No |
| 5 | Distance to the field | Distance from household to the forest area | Continuous variable |
| 6 | Area of plantation affected by tropical typhoons | Plantation area affected by tropical typhoons | Continuous variable |
| 7 | Sources of seedlings | Assurance about sources of seedlings | 1 = Yes; 0 = No |
| 8 | FSC project | Participation of household in FSC project | 1 = Yes; 0 = No |
| 9 | Support by community | Support by community related to large-sized plantation activities | 1 = Yes; 0 = No |
| 10 | Understanding policies | Household understanding about policies related to planting large-sized timber | 1 = Yes; 0 = No |

*(Source: Based on literature review and Figure 1).*

## 3. RESULTS AND DISCUSSION

### 3.1. Comparison of financial efficiency between planting small-sized timber and large-sized timber

Financial efficiency comparison between planting small-sized timber and large-sized timber is implemented through Cost Benefit Analysis. The total cost and total revenue and cost benefit analysis of two scenarios of forest plantation as shown in the table 4 and table 5.

**Table 4. Cost-benefit analysis for planting small-sized timber plantation**

*(Unit: VND1000/ha; Discount rate = 5%)*

| Year | Total cost (Ci) | Total benefit (Bi) | Bi - Ci |
|---|---|---|---|
| 1 | 9168 | 0 | -9168 |
| 2 | 880 | 0 | -880 |
| 3 | 732 | 0 | -732 |
| 4 | 0 | 0 | 0 |
| 5 | 300 | 45127 | 44827 |
| 6 | 9168 | 0 | -9168 |
| 7 | 880 | 0 | -880 |
| 8 | 732 | 0 | -732 |
| 9 | 0 | 0 | 0 |
| 10 | 300 | 45127 | 44827 |
| NPV | 18,543 | 63,062 | 44,519 |
| BCR | | | 3.401 |
| IRR | | | 45% |

**Table 5. Cost-benefit analysis for planting large-sized timber**

(Unit: VND1000/ha; Discount rate = 5%)

| Year | Total cost (Ci) | Total benefit (Bi) | Bi-Ci |
|---|---|---|---|
| 1 | 10295 | 0 | -10295 |
| 2 | 1442 | 0 | -1442 |
| 3 | 856 | 0 | -856 |
| 4 | 50 | 0 | -50 |
| 5 | 1874 | 25902 | 24028 |
| 6 | 50 | 0 | -50 |
| 7 | 50 | 0 | -50 |
| 8 | 50 | 0 | -50 |
| 9 | 50 | 0 | -50 |
| 10 | 44338 | 247231 | 202892 |
| NPV | 40,721 | 172,073 | 131,352 |
| BCR | | | 4.226 |
| IRR | | | 47% |

The result of cost-benefit analysis indicated that both models planting small-sized timber or large-sized timber have NPV > 0 and both IRR value of 2 models is much higher than discount rate, thus both models have financial efficiency and can bring benefits for local people. However, the NPV value of large-sized timber plantation is 2.9 times higher than that of small sized-timber plantation. In addition, BCR and IRR indicator of large-sized timber plantation is higher than that of small sized-timber plantation. Therefore, we can strongly believe that large-sized timber plantation brings more financial efficiency for local people compared with small-sized timber plantation in Vinh Linh district.

### 3.2. Key factors affecting large-sized-timber planting decision of surveyed households

Binary logistic regression is applied to identify key factors influencing household decision on large-sized timber planting in the study area. The summary model of four independent variables: Household understanding about policies related to planting large-sized timber, Assurance about sources of seedlings, Participation of households in FSC project, Support by community related to large-sized plantation activities, significantly influence household decision on planting large-sized timber or not. The full model containing all predictors was statistically significant, Chi-square value is 142.556, $p < 0.001$ indicated that the model was able to distinguish between respondents who decided and did not decided planting large-sized timber. The model as a whole explained between 65.5% (Cox and Snell R squared) and 88.3% (Nagelkerke R squared) of the variance in the decision of large-sized timber planting, and the correctly classified 94.8% of cases (Table 6).

By applying binary logistic regression model (Table 6), it is statistically determined that there are four key factors that significantly influence on large-sized timber planting decision of local people in Vinh Linh. They include: 'Household understanding about policies related to planting large-sized timber', 'Assurance about sources of seedlings', 'Participation of households in FSC project' and 'Support by community related to large-sized plantation activities'.

Although many variables such as education levels, silvicultural techniques of household heads are consistent with the theory, but when estimating from survey data they are not statistically significant. The main reasons could be local characteristics or the reliability of the data.

**Table 6. Key factors influencing decisions of local households on planting large-sized timber**

| Variable | B | S.E. | Wald | Sig. | Exp(B) |
|---|---|---|---|---|---|
| Constant | -5.09$^{NS}$ | 4.79 | 1.129 | .288 | - |
| The education level of household head | .39$^{NS}$ | .37 | 1.162 | .281 | 1.49 |
| Household wealth ranking | -1.28$^{NS}$ | 1.16 | 1.199 | .273 | .28 |
| Forest land area of households | .08$^{NS}$ | .11 | .489 | .484 | 1.08 |
| Silvicultural techniques of HH head about large-sized timber plantation | .15$^{NS}$ | 1.24 | .014 | .907 | 1.16 |
| Distance from household to the forest area | .00$^{NS}$ | .00 | .676 | .411 | 1.00 |
| Plantation area affected by tropical typhoons | -.03$^{NS}$ | .02 | 1.625 | .202 | .97 |
| Assurance about sources of seedlings | 4.89$^{***}$ | 1.68 | 8.477 | .004 | 132.60 |
| Participation of households in FSC project | 4.80$^{***}$ | 1.82 | 6.947 | .008 | 121.83 |
| Support by community related to large-sized plantation activities | 3.91$^{**}$ | 1.65 | 5.644 | .018 | 49.78 |
| Household understanding about policies related to planting large-sized timber | -6.79$^{**}$ | 3.01 | 5.107 | .024 | .001 |

**Dependent variable: Large-sized timber planting decision by households (1 = Yes; 0 = No):**

**Number of Observation** 134

**Omnibus Test of Model Coefficients:**

- Chi-square 142.556$^{***}$
- df. 10
- Sig. .000

**Model summary :**

- -2 Log likelihood 38.885$^{***}$
- Cox & Snell R Square 0.655
- Nagelkerke R Square 0.883
- Predicted percentage correct 94.8%

*Note: *** p < 0.01, ** p < 0.05, *p < 0.10 (two-tailed tests), NS: Not significant.*

## 4. CONCLUSIONS AND POLICY IMPLICATIONS

Practicing large-sized timber plantation brings a huge benefit for local people as well as environment in Vinh Linh district, Quang Tri province while a range of factors such as household characteristics, institutional, natural conditions and support from local community directly or indirectly influence to the decision of local people on planting large-sized timber. Cost benefit analysis indicated that planting large-sized timber provided more financial efficiency than planting small-sized timber.

The binary logistic regression model was used to identify keys factors having strong influences in decision making of local people. The result of model shows that 'Household understanding about policies related to planting large-sized timber, 'Assurance about sources of seedlings', 'Participation of household in FSC project' and 'Support by community related to large-sized plantation activities' are four key factors that can make changes in decision of local people on planting large-sized timber or not in the study area. Therefore, it is essential to make right policies such as supporting policies (e.g. forest land policy, credit policy, technical supporting policy, benefit sharing policy…) in order to provide farmers with more agroforestry extension activities, better access to good quality planting material and equipment, better access credit systems with low interest rates, develop FSC projects that can provide more opportunities for local households to participate in. Those policies also can help encourage and promote small households focusing more on large-sized timber production.

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# TRỒNG GỖ LỚN HAY GỖ NHỎ: NGHIÊN CỨU ĐIỂM TẠI HUYỆN VĨNH LINH, TỈNH QUẢNG TRỊ

**Võ Thị Hải Hiền, Lê Đình Hải, Lưu Thị Vân**
*Trường Đại học Lâm nghiệp*

## TÓM TẮT

Chính quyền và người dân ở huyện Vĩnh Linh, tỉnh Quảng Trị đã thúc đẩy quản lý và trồng rừng bền vững theo hướng chuyển hóa mô hình rừng gỗ nhỏ sang mô hình trồng rừng gỗ lớn. Tuy nhiên, vai trò của đặc điểm hộ gia đình, yếu tố tinh tế - xã hội và yếu tố tự nhiên trong quyết định trồng rừng của chủ rừng vẫn còn chưa được nghiên cứu nhiều. Trong nghiên cứu này, chúng tôi đã khảo sát 134 hộ gia đình ở huyện Vĩnh Linh, trong đó có 55 hộ trồng rừng gỗ lớn và 79 hộ không thực hiện mô hình trồng rừng gỗ lớn. Áp dụng phương pháp phân tích lợi chi phí (CBA), kết quả nghiên cứu cho thấy rằng việc trồng rừng gỗ lớn mang lại nhiều lợi ích hơn cho chủ rừng so với trồng rừng gỗ nhỏ. Ngoài ra, kết quả của phân tích hồi quy logit nhị phân chỉ ra rằng các yếu tố, bao gồm: Sự am hiểu của hộ gia đình đối với các chính sách trồng rừng gỗ lớn, sự đảm bảo về nguồn gốc của cây giống, sự tham gia của hộ gia đình vào dự án chứng chỉ rừng bền vững, và sự ủng hộ của cộng đồng đối với các hoạt động trồng rừng gỗ lớn, có ảnh hưởng đáng kể đến quyết định trồng rừng gỗ lớn của các hộ gia đình trên địa bàn nghiên cứu. Trên cơ sở đó có thể đề xuất một số chính sách phù hợp (như chính sách đất đai, tín dụng, kỹ thuật, hưởng lợi…) để khuyến khích các hộ dân tập trung vào trồng rừng gỗ lớn.

**Từ khóa: Huyện Vĩnh Linh, mô hình hồi quy logit nhị phân, trồng rừng gỗ lớn, trồng rừng gỗ nhỏ.**

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