The Contribution of Gambir (Uncaria gambir roxb) Based Agroforestry System on Regional Development in Pakpak Bharat District, North Sumatra Province, Indonesia

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Abstract. Gambir (Uncaria Gambir Roxb.) is one of the non-timber forest product commodities developed by Pakpak Bharat society has beneficial for the health and raw materials of the industry. This research aims to determine the contribution of gambir to the local economy, identifying the district production base of gambir commodities as well as characteristics of spreading gambir commodities to support the economic development of the Pakpak Bharat District. The study was using secondary data of time series from 2015 to 2019. Location Quotient (LQ) was used for localization and specialization analysis, as well as for basic service ratio (BSR) and regional multiplier (RM) analysis. The results showed that the region of the gambir commodity base based on the production indicator consists of Salak sub-district, Sitellu Tali Urung Jehe sub-district, Pergetteng Getteng Sengkut sub-district, and Tinada sub-district. The gambir community forest is not concentrated in one region but is scattered in several sub-districts. Pakpak Bharat District also does not specialize in gambir community forest. Gambir commodities can support plantation activities and the regional economy in Pakpak Bharat District. The existence of the gambir community forest supports economic activity in the form of the multiplier effect generated for the sub-districts in Pakpak Bharat District. The multiplier effect is generated in the form of increasing community income and the absorption of manpower both in the plantation subsectors and other sectors.

1. Introduction

Agroforestry systems were defined as a dynamic, ecologically based, natural resource management system that, through the integration of trees in farm- and rangeland, diversifies and sustains smallholder production for increased social, economic, and environmental benefits [1]. Gambir (Uncaria gambir Roxb.) is a non-timber forest product cultivated by an agroforestry system [2].
Gambir contains catechins and catechutannic acid which are useful for medicine, antioxidants, and raw materials for the pharmaceutical, antimicrobial, cosmetics, and food industries [3,4]. Indonesia is the world’s main supplier of gambir, 80% of gambir production is exported abroad from Indonesia. Gambir has the potential to be developed as an export commodity because it has long time durability and can be harvested sustainably [5,6].

Gambir is a tropical plant that grows a lot in the highlands of Sumatra island, including West Sumatra, Riau, and North Sumatra province. One of the gambir bases in North Sumatra is the District of Pakpak Bharat. Pakpak Bharat District has an export contribution of 80.85 percent of the total gambir production in North Sumatra Province [7]. In 2019, the production of gambir in Pakpak Bharat District was 1,957 tons with a planting area of 1,577 hectares [8]. Pakpak Bharat District has 8 sub-districts that cultivate gambir commodities. Based on Statistic Center Board (BPS), Pakpak Bharat District, the largest gambir cultivation area is located in the Sub-district of Sitellu Tali Urung Jahe, Salak, and Pargetting Getteng Singkut, respectively [8]. Differences in planted area and production indicate that there are differences in the potential of gambir in each region depending on the conditions of each region. The development of gambir commodities can be carried out if the distribution of base and non-base areas of gambir commodities is known. Location quotient/LQ can be used to explore base areas that have the potential to be further developed [9]. In this case, LQ is used to determine how much the level of gambir specialization sectors or leading sectors, base location, concentrated location, and supporting capacity of development.

Based on the background, the study of potential regional development for the gambir commodity as well as analyze gambir commodity spread in Pakpak Bharat District has been never reported previously. The objectives of this study identified the contribution of sectors (gambir), base location production of gambir commodity, gambir commodity spread, as well as supporting capacity of the gambir commodity on the regional economic and development in Pakpak Bharat District.

2. Materials and methods

The study was using secondary data issued by Statistic Center Board/BPS Pakpak Bharat District. The time series data from 2015-2019 consists of gambir and other commodity production data in each sub-district in the Pakpak Bharat District. Location Quotient/LQ was used to identify the location basic and non-basic of the gambir commodity. The formula of LQ was followed equation below [9,10]:

\[ LQ = \frac{Y_i/Y}{Y_i/Y} \]

In equation (1), \( LQ \) is location quotient for gambir i in the sub-district, \( Y_{ij} \) is a number of gambir production in sub-district-i, \( Y_i \) is a total number of all commodity production in sub-district-i, \( Y \) is a number of all commodity production in Pakpak Bharat District, and \( Y_i \) is a number of all commodity Production in Pakpak Bharat District. The decision making criteria of location base or non-base based on the value of LQ. LQ is non-negative value (\( LQ \geq 1 \)) means the location (sub-district) is gambir production basic. In other words, the gambir commodity production not only meets the supplying the self region, but also supplying to others region. LQ is a negative value (\( LQ < 1 \)) means the location is not gambir production basic. In other words, the gambir commodity production is only supplying for the self region.

Furthermore, the characteristic of gambir commodity spread was using specialization and localization analysis. Localization coefficient and specialization coefficient were calculated based on equation 2 and 3 [11]:

\[ \alpha_i = \frac{S_i}{N_i} \times \frac{\sum S_i}{\sum N_i} \]

\[ \beta_i = \frac{S_i}{N_i} \times \frac{\sum S_i}{\sum N_i} \]

In equation (2) and (3), \( \alpha_i \) is localization coefficient of gambir commodity, \( \beta_i \) is specialization coefficient of gambir commodity, \( S_i \) is a gambir commodity production in sub-district-i, \( N_i \) is a gambir commodity production in Pakpak Bharat District, \( \sum S_i \) is an amount of all commodity production in sub-district-i.
production in sub-district-i, $\sum N_i$ is an amount of all commodity production in Pakpak Bharat District. The decision making criteria of localization coefficient were based on value of localization coefficient. The $\alpha_i$ is non-negative value ($\alpha_i \geq 1$), means it concentratred gambir commodity in one sub-district. The $\alpha_i$ negative value ($\alpha_i < 1$), means it spread/scattered gambir commodity in Pakpak Bharat District. The decision making criteria of localization coefficient were based on value of specialization coefficient. The $\beta_i$ is negative value ($\beta_i \leq 1$), means specialized gambir commodity in one sub-district. The $\beta_i$ negative value ($\beta_i < 1$), means specialized gambir commodity in Pakpak Bharat District. The role of strategy commodity as base commodity on development capacity for community welfare was using basic service ratio/BSR and regional multiplier/RM analysis. The equation of BSR and RM were followed below [12, 13]:
The price of gambir is tend decrease in 2019 (Figure 2). The higher price of gambir is IDR 35,306 /kg and the lower price is IDR 24,677/kg. The lower of price was influencing farmer to cultivation and harvesting of gambir. Yildirim and Kose [19], stated that the participation of local representatives is important in diversifying products as well as creating public awareness. The participation of local community was a factor to increase the NTFP as well as increase a price of the product.

### Table 1. Location quotient (LQ) analysis based on basic sector indicator of gambir commodity in Pakpak Bharat 2015-2019.

| Sub-district                  | LQ value |
|------------------------------|----------|
|                              | 2015  | 2016  | 2017  | 2018  | 2019  | average |
| Salak                        | 2.52  | 2.63  | 0.95  | 1.60  | 1.35  | 1.81    |
| Sitellu Tali Urung Jehe      | 0.79  | 1.54  | 2.02  | 1.74  | 1.48  | 1.52    |
| Pagindar                     | 0.26  | 0.11  | 0.07  | 0.01  | 0.01  | 0.09    |

3.2. Basic Gambir Commodity

Table 1 shown that the LQ analysis for gambir commodity using production indicator approach for 2015-2019. There were four sub-district as a basic sector for gambir commodity (Salak, Sitellu Tali, Pergetteng Getteng Sengkut and Tinada), and four sub-district as a non-basic sector for gambir commodity (Pagindar, Sitellu Tali Urung Julu, Kerajaan and Siempat Rube). The basic sector for gambir shown that the sub-district has higher produce of gambir compared to total gambir production by Pakpak Bharat District. The fact indicated that gambir sector as a NTFP was very important in regional economic development in Pakpak Bharat district. The four sub-district of basis gambir can fulfill human need in local area as well as larger area in Pakpak Bharat or regional area. The difference of commodity production influenced by have land suitabililty, climate and supporting topography [20,21].
Specialization has positive s.

Rahmat et al., [12] described that the basic sector (gambir) also interpreting that the each sub-district have production surplus for supply to other sub-district, local market, regional market, national market as well as export abroad. The export of NTFP especially gambir would be financial opportunity for basic sector and converted to be natural resources to increase economic regional.

3.3. Gambir Localization and Specialization

Localization analysis was to identify concentrated gambir commodity in sub-district Pakpak Bharat District shown in Table 2. Based on the result of the analysis, gambir commodity managed by community forest in Pakpak Bharat has not concentrated in one sub-district, but it scattered in several sub-district. The sub-district have positive localization coefficient value were Salak, Sitellu Tali Urung Julu, Pergetteng Getteng Sengkut and Tinada sub-district, respectively. However, the value localization coefficient does not over 1 ($a_i > 1$). This indicates that the four sub-district had higher produce of gambir compared to other sub-district. The scattered of gambir production can provide opportunity for economic regional development.

| Sub-district                  | Localization coefficient |
|------------------------------|---------------------------|
|                              | 2015 | 2016 | 2017 | 2018 | 2019 | average |
| Salak                        | 0.36 | 0.52 | -0.02 | 0.25 | 0.17 | 0.34    |
| Sitellu Tali Urung Julu      | -0.14 | -0.29 | -0.32 | -0.40 | -0.45 | -0.27 |
| Pergetteng Getteng Sengkut   | 0.35 | 0.21 | 0.56 | 0.35 | -0.47 | 0.29    |
| Kerajaan                     | -0.05 | -0.09 | -0.17 | -0.11 | -0.28 | -0.05 |
| Tinada                       | 0.20 | 0.28 | -0.22 | -0.05 | -0.36 | 0.02    |
| Siempat Rube                 | -0.13 | -0.09 | -0.31 | -0.41 | -0.47 | -0.23 |

The characteristic of NTFP sector influenced by price, market as well as demand, economic characteristic, demography and forest resources [22]. This characteristic is influencing gambir development as a leading sector in Pakpak Bharat. The fluctuation of gambir price, market and demand should be controlled by government through the establishment of market institutions. The economic characteristic, demography and agroforestry system may be improved by organizing local producers into cooperatives, which can help them to improve their market bargaining power [22].

Specialization analysis aims to identify what region produce one commodity or more. The Specialization coefficient of gambir commodity shown in Table 3. There were not sub-district that specialized produce gambir commodity, because all specialization coefficient value were not over than 1. This indicates that there were diversification of commodity which it cultivated by community of forest. However, there were three sub-district that it has positive specialization coefficient value namely Salak, Sitellu Tali Urung Jehe, and Pergetteng-Getteng Sengkut, respectively. Commodity diversification will increase profits for forest communities as a economic regional development [23], [24]. This can explain that gambier farmers do not only rely on gambier commodities, but there are other commodities that can be developed further.
Table 3. Specialization analysis of Gambir based on production indicator of Pakpak Bharat 2015-2019

| Sub-district                  | 2015     | 2016     | 2017     | 2018     | 2019     | average |
|-------------------------------|----------|----------|----------|----------|----------|---------|
| Salak                         | 0.36     | 0.52     | -0.01    | 0.25     | 0.17     | 0.26    |
| Sitellu Tali Urung Jehe       | -0.05    | 0.17     | 0.33     | 0.30     | 0.23     | 0.20    |
| Pagindar                      | -0.18    | -0.29    | -0.30    | -0.42    | -0.49    | -0.33   |
| Sitellu Tali Urung Julu       | -0.14    | -0.29    | -0.32    | -0.40    | -0.46    | -0.32   |
| Pergetteng-Getteng Sengkut    | 0.35     | 0.21     | 0.56     | 0.34     | -0.48    | 0.20    |
| Keraja                        | -0.05    | -0.09    | -0.17    | -0.12    | -0.29    | -0.14   |
| Tinada                        | 0.20     | 0.28     | -0.22    | -0.05    | -0.36    | -0.03   |
| Siempat Rube                  | -0.14    | -0.09    | -0.31    | -0.41    | -0.48    | -0.28   |

3.4. Gambir Commodity Carrying Capacity for Regional Development of Pakpak Bharat

The contribution of gambir commodity on regional development of Pakpak Bharat District can be identified by basic service ratio/BSR dan regional multiplier/RM analysis. The increase of the regional development marked by increase number of basic region. BSR and RM analysis will show how far the contribution that it given to regional development by gambir basic commodity.

Figure 3 shown that index of BSR and RM. The higher and lower BSR value were 29.94 and 0.30, respectively. The BSR values (> 1) shown that gambir commodities able to supporting regional economy in Pakpak Bharat District (2016-2019). In other hands, Pakpak Bharat District has an able gambir basic region for services need non-basic regional development [13]. For example in 2019, the BSR value of 29.94 means that 1 part from gambir production is used to fulfilling needs self region (basic region) and 28.94 for fulfilling needs other regions (non-basic region) such as inter-district trading or abroad export.

![Figure 3. Histogram Index basic and non basic ratio based on BSR and RM value](image)

The higher and lower RM value were 1.03 (in 2019) and 4.34 (in 2015), respectively. The RM values (> 1) shown that gambir commodity able to supporting economic values of other commodity as multiplier effect for other sub-district in Pakpak Bharat District. In other hands, the effect of multiplier was generated by increasing income community or employment in cultivated gambir as well as secondary industry of gambir [12]. For example in 2019, the RM value of 1.03 means that 1 part from gambir production is used to fulfilling needs local area (basic region) and 0.03 for fulfilling human needs other region (non-basic region).

4. Conclusion

Gambir (*Uncaria gambir* Roxb) as a non-timber forest product/NTFP support economic development, increasing community income, and increasing employment number. The basic sector concentrated of production gambir in Pakpak Bharat District were Salak, Sitali Urung Jehe, Pergetteng Getteng
Sengkut and Tinada sub-district. The commodity of gambir was not localized and specialized on one region, but it scattered in Pakpak Bharat District.

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