# Variables that Influence in Management of the Cikapundung Sub-Watershed

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## Article

## Abstract

The Cikapundung Sub-Watershed is a source of clean water for people living in Bandung City. The Cikapundung Sub-Watershed has several main problems, such as land change, landslides, and land damage. Many efforts have been made to improve the conditions of the Cikapundung sub-district by the government, the community, and Non-Governmental Organizations (NGOs). However, these efforts have not achieved satisfactory results. This occurs due to the inaccuracy of handling by each stakeholder regarding the variables that influence the conditions of the Cikapundung sub-district. This research aims to determine the variables that have the most influence on the management of the Cikapundung Sub-Watershed. This research uses Micmac analysis to identify the most influential variables within an ecosystem. From the research results, it appears that whether indirect influence or indirect influence, the variables of Society Participation and Local Wisdom are the most influential variables in the management of the Cikapundung sub-basin. These two variables are in a position that has a strong influence on other variables and has a low level of dependence on other variables.

*Keywords:* sub-watershed; cikapundung; important variable; micmac analysis.

## Introduction

The Cikapundung Sub-Watershed is part of the Citarum Watershed which has an area of around 434.43 km2. The Cikapundung River has its headwaters around Mount Bukit Tunggul and Mount Pangparang in Bandung Regency. For Bandung City, the Cikapundung River is one of the sources of clean water used by the local water company, Tirtawengi Bandung City. Local water company, Tirtawengi Bandung City, has served around 75 percent of the clean water needs of the people in the city of Bandung.

Changes in the upstream area of the Cikapundung River that occurred from 2001 to 2008, especially the reduction in forest area, significantly reduced the conservation function (Rizka Maria, 2014). The land changes have an impact on increasing erosion and land damage (Adysa *et al*., 2023). As the Cikapundung River also flows through the city of Bandung, this results from pollution in the Cikapundung River caused by household

waste. In overcoming the problems above, many efforts have been made by the community and government, such as implementing the vegetable crop conservation farming business model in the former Cikapundung Sub-Watershed (Sutrisna *et al.*, 2012), implementation of green infrastructure technology approaches (Damayanti, 2019; Suhana & Hindersah, 2022).

This watershed management activity has been carried out for a long time, but the results achieved have not been optimal (S. P. Nugroho, 2003). Conflicts often occur in river basins between efforts to preserve the environment as a catchment function and efforts to maximize built-up areas (Ekasari *et al.*, 2022). One approach that can be taken to identify is using the Micmac method. The Micmac method was developed by Godet as a component of "Strategic Foresight," which focuses on development scenario analysis. Patterns of relationships between variables in Micmac can occur when two variables interact directly or when there is a connecting variable that has an impact on both. Micmac, among other things, involves three fundamental steps: identifying elements (variables), describing relationships between variables, and identifying important variables (Godet & Roubelat, 1996). This variable mapping has been widely used in various case studies, such as identifying factors that cause flooding (D. Ariyani *et al.*, 2022), identification of regional development (Suryade *et al.*, 2022), and identification of watershed management needs (Nopriani *et al.*, 2022). With the need for watershed management so that its management can run well, it is necessary to identify the influential variables in managing the Cikapundung watershed.

## Research Method

The research flow can be seen in Figure 1. In conducting this research, the first step taken in using Micmac analysis is to determine the variables. There are several ways to determine the variables, namely: identifying variables based on the results of other research or literature studies, sorting, and selecting variables. The variables can be determined based on the results of literature studies and adding variables based on observations and analysis results. After determining the variables, each variable is discussed with several experts to produce a variable importance assessment matrix.



*Figure 1 Flowchart of the Research*

An important variable in sub-watershed management is Landcover Change, in the area it turns out that land change in the Cikapundung sub-district reduces the conservation function (Rizka Maria, 2014). Society Participation is an activity where residents are asked to play an active role in an activity (Fardani *et al.*, 2023), Society Participation is one of the important factors in watershed management, namely the community's ability and willingness (Ankesa *et al.*, 2016), experience and communication (Husodo *et al.*, 2021). Apart from Society Participation, the use of Local Wisdom can be a solution for river watershed management (Jaenudin Nurdiana, 2021). Not only from the community side but

also from the government side is necessary to manage this sub-basin, the government can make policies that support watershed management (N. Ariyani *et al*., 2020; Sulistyaningsih *et al*., 2021). Apart from the things above, Forest Encroachment by the people who live in the area can reduce the hydrological function and erosion of a watershed (Sugandi & Hamdanah, 2019). From the literature study that has been described above, there are five important variables in the management of watersheds, which are: Society Participation, Landcover Change, Policy, Local Wisdom, and Forest Encroachment, as shown in Table 1.

**Table 1**

**Research Variable**

| No | Variable | Symbol |
|----|----------|--------|
| 1 | Society Participation | SP |
| 2 | Landcover Change | LC |
| 3 | Policy | PL |
| 4 | Local Wisdom | LW |
| 5 | Forest Encroachment | FE |

Based on the variables above, an assessment is carried out by experts in their field regarding the level of influence between one variable and another variable with the classification:
1. No influence with symbol 0,
2. weak influence with symbol 1,
3. medium influence with symbol 2,
4. strong influence with symbol 3, and
5. potential to influence with symbol P.

The results of this assessment produce a matrix that describes the level of influence of one variable to another, which will later become input for the Micmac analysis. Through the Micmac analysis, all these variables will be assessed to determine which variable has the most influence compared with another variable. There are three outputs in Micmac analysis, which are: the variable that is the main variables that are influential and dependent; mapping the relationship between variables and the relevance of these variables in explaining a system; and revealing the cause and effect chain of a system (Fauzi, 2019). The output of the Micmac program is a description of the relationship between variables which will then be analyzed and produce influence variables, relay variables, dependent variables, and excluded variables. Influence Variables are variables that are very influential with little dependence, often also known as determinant variables. This variable is important to the system because it has the potential to be a determining factor. Relay Variables are variables that influence system behavior but are also highly dependent, and they are often considered a system instability factor. Dependent Variables are variables that have high dependence and influence. These variables are quite sensitive to changes in influence variables and relay variables. Excluded Variables are variables that have little influence and little dependence.

## Results & Discussion

As a result of interviews with several experts, an assessment matrix was obtained as shown in Figure 2. From this assessment, it can be seen that the Society Participation variable has a strong influence on Landcover Changes and Forest Encroachment, as well as the Landcover Changes variable is strongly influenced by Forest Encroachment. Regarding the Landcover Changes variable, experts assess that this variable will have a strong influence on Forest Encroachment. This Policy

variable has a strong influence on Society Participation. Meanwhile, Local Wisdom has a moderate influence on almost all variables. The Forest Encroachment factor has a strong relationship to Landcover Changes and has the potential to influence Society Participation.

| . | 1 : Society Participation | 2 : Land Cover Changes | 3 : Policy | 4 : Local Wisdom | 5 : Forest Encroachment |
|---|---|---|---|---|---|
| 1 : Society Participation | 0 | 3 | 0 | 1 | 3 |
| 2 : Land Cover Changes | 0 | 0 | 2 | 1 | 3 |
| 3 : Policy | 3 | 1 | 0 | 0 | 1 |
| 4 : Local Wisdom | 2 | 2 | 2 | 0 | 1 |
| 5 : Forest Encroachment | P | 3 | 2 | 1 | 0 |

*Figure 2. Expert Assessment Matrix Regarding the Influence Between Variables*

The results of the matrix above, it is entered into the Micmac software to see the level of influence of each variable. There are two output results, namely direct influence and indirect influence. From the matrix, it can be seen that all of the experts being interviewed, conclude that the Society Participation variable has large numbers of value to Landcover Changes variable and Forest Encroachment variable. From the government side, which has a policy that controls the Cikapundung Sub-Watershed, all of the experts say that the score for the Local Wisdom variable is small, this can be interpreted to mean that government policy does not have much value for local wisdom. From the Landcover Changes variable, all the experts say that the Landcover Changes variable has a big number impact on Forest Encroachment. In the matrix, there is a P value in the Forest Encroachment variable to the Society Participation variable. This means that the Forest Encroachment variable will have a Potential Influence (P) on the Society Participation variable, because sometimes when forest encroachment is already happening, several local people will emerge to improve the environment.

## Direct Influence

Direct influence is an analysis of conditions whose impact will be immediately felt. In direct influence, the first analysis carried out is a direct map as shown in Figure 3. To validate the output results from this analysis, it can be seen that the distribution of variables is in three different quadrants, which form the letters "L" (there is at least one variable in each of the three quadrants). With these conditions, it can be stated that the output from this analysis is valid.
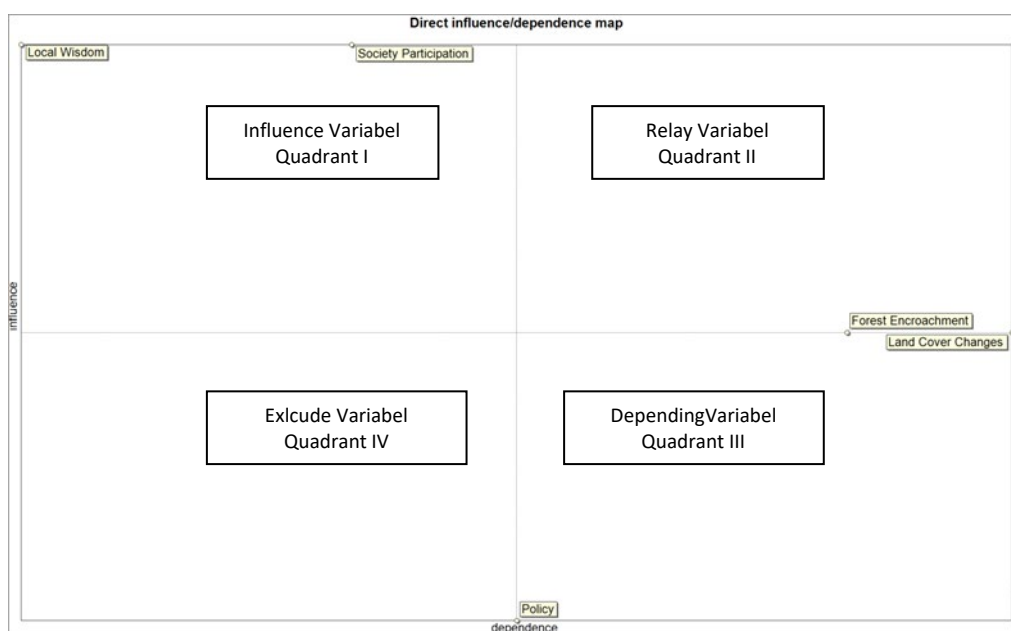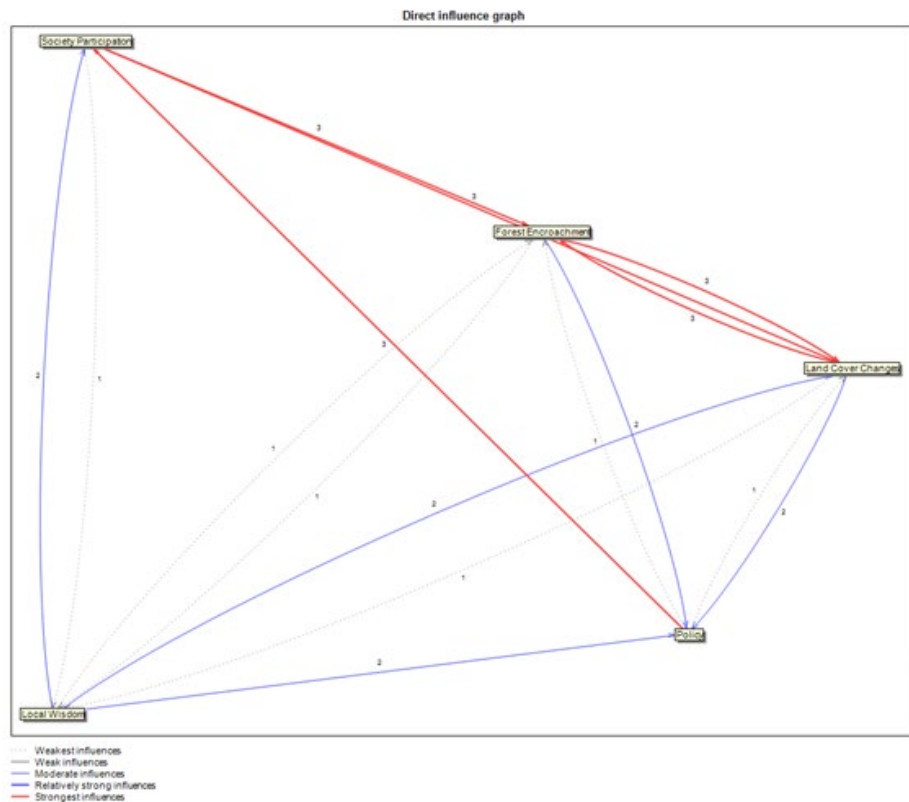
*Figure 3. Direct Influence Map*

From Figure 3 above, it can be seen that four quadrants describe direct influence. From the Figure above, it can be concluded as follows:

1. Quadrant I is a variable that has a strong influence and a low level of dependence on the management of the Cikapundung Sub-Watershed. These variables are Local Wisdom and Society Participation. It can be said that two of these variables have a great impact on the control of the management of the Cikapundung Sub-Watershed. Society Participation is a variable that has a direct influence on watershed management. In the Cikapundung Sub-Watershed, the community plays an active role in maintaining environmental conditions. The Society Participation variable also does not depend much on other variables. This is because the Society Participation variable can run alone without any relationship with other variables. Another variable in this quadrant is the Local Wisdom variable. This variable also has a big influence on the management of the Cikapundung sub-district. There are many habits of the people around the Cikapundung sub-district that have been carried out for generations which support environmental sustainability in the Cikapundung sub-district. The Local Wisdom variable does not depend much on the existence of other variables. This is because the Local Wisdom variable has been passed down from generation to generation by the residents. The variable in this quadrant is the main variable that must be driven to maintain the continuity of the Cikapundung Sub-Watershed.

2. Quadrant II is a variable that has a high influence and has a high level of dependence which is called a relay variable. Therefore, this variable has instability where every change in this variable definitely has an impact on other variables in the management of the Cikapundung Sub-Watershed. This variable is Forest Encroachment. This variable is a source of problems in watershed management. As the Forest Encroachment variables increase, the quality of management and the environment in the Cikapundung Sub-Watershed will decrease. This variable is dependent on other variables, for example, if Society Participation or Policies are increased, then the Forest Encroachment can be eliminated.

3. Quadrant III is a variable that has low influence and high dependence which is called a dependent variable. This variable will not influence other variables in the management of the Cikapundung Sub-Watershed. These variables include changes in Landcover and Policies. These variables are strongly influenced by other influential variables. Therefore, it is necessary to strengthen two variables, namely Local Wisdom and Society Participation in order to the changes in Landcover to not occur. For Policy variables, this management does not have too much influence, considering the enforcement of regulations and the lack of officers in the Cikapundung Sub-Watershed area.

*Figure 4. Direct Influence*

Figure 4 shows a mapping of the direct influence relationship between variables. It can be seen that the red line is a line that depicts a very strong relationship. This means that the two variables are related to other variables. From the figure above, it can be seen that the Society Participation variable has a very strong influence on the variables of Forest Encroachment and Landcover Change. If the Society Participation variable can work well in the communities in the Cikapundung sub-district, this will have an impact on the conditions of Forest Encroachment and Landcover Change, both will be reduced if the community actively prevents it. According to Figure 4, the Society Participation variable turns out to have a strong direct relationship with the Policy variable. It can be seen in Figure 4 that the Policy variable influences the Society Participation variable. If seen in the field, policies or regulations made by the government can encourage or mobilize Society Participation.

Society Participation is considered to have a very strong direct influence on the Forest Encroachment variable. This is proven if Society Participation in maintaining the Cikapundung Sub-Watershed is good, then the level of land change will decrease. The Policy variable appears to directly influence the strength of the Society Participation variable. This can be done by drafting regulations or policies whose direction is to involve the community in managing the Cikapundung Sub-Watershed. One of the solutions of the policy in the government is to adopt the local wisdom regulation that occurs in several communities in Cikapundung. One of the government's policies in encouraging communities is to mobilize the Gemricik community, which is an abbreviation for the "Gerakan Masyarakat Cinta Cikapundung." Gemricik is an inter-university campus community forum in the city of Bandung for Cikapundung lovers who have agreed to come together to contribute in the form of analysis, study, thought, and action for community service in their Tridharma duties as lecturers or students to make the Cikapundung River clean.
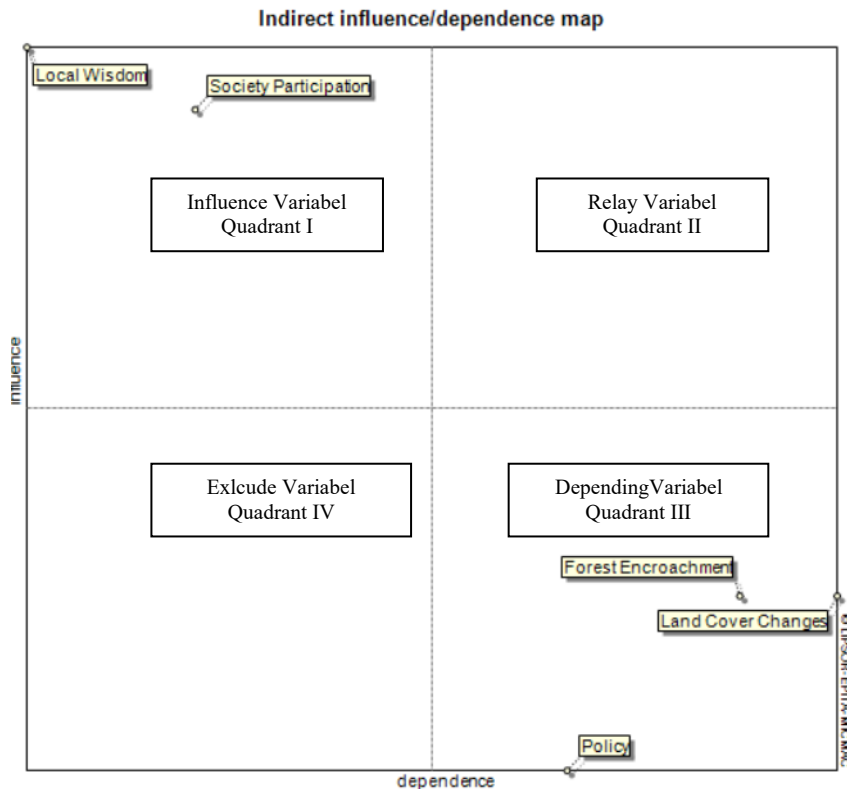
Landcover Change and Forest Encroachment are two variables that strongly influence each other. These two variables are very closely related, as Landcover Change is the result of Forest Encroachment while Forest Encroachment also occurs as a result of Landcover Change. For the Local Wisdom variable, it appears that the relationship has quite a strong influence on various variables, namely Policy, Landcover Change, and Society Participation. However, it is considered that the relationship is quite weak on Forest Encroachment.

Policy variables do not have a strong direct relationship with Forest Encroachment but do have an indirect relationship. This can be seen in the figure above that the Policy variable has a strong relationship with Society Participation, then Society Participation strongly influences Forest Encroachment.

**Indirect Influence**

This indirect influence analysis is an analysis that describes future conditions, where the influence of each variable will only be felt in the future. Indirect influence analysis can be seen in Figure 5.

**Indirect influence/dependence map**

| | | |
|---|---|---|
| Local Wisdom | Society Participation | |
| Influence Variabel Quadrant I | | Relay Variabel Quadrant II |
| Exlcude Variabel Quadrant IV | | DependingVariabel Quadrant III |
| | Forest Encroachment | |
| | | Land Cover Changes |
| | Policy | |

**Figure 5.** *Indirect Influence Map*

From the Four Quadrant graph of direct influence above, it can be concluded as follows:

1. Quadrant I is a variable that has a strong influence and a low level of dependence, these variables are Local Wisdom and Society Participation. Society Participation is a variable that has a very indirect influence on watershed management. The Society Participation variable also does not depend much on other variables, this is because the Society Participation variable can run alone without any relationship with other variables. The Local Wisdom variable also has a strong influence on the management of the Cikapundung sub-district. Many of the habits of the people around the Cikapundung sub-district have been carried out for generations which support environmental sustainability in the Cikapundung sub-district.
2. Quadrant III is a variable that has low influence and high dependence, which is called an excluded variable because this variable will not influence other variables in the management of the Cikapundung Sub-Watershed. These variables include changes in Landcover Changes, Policies, and Forest Encroachment.
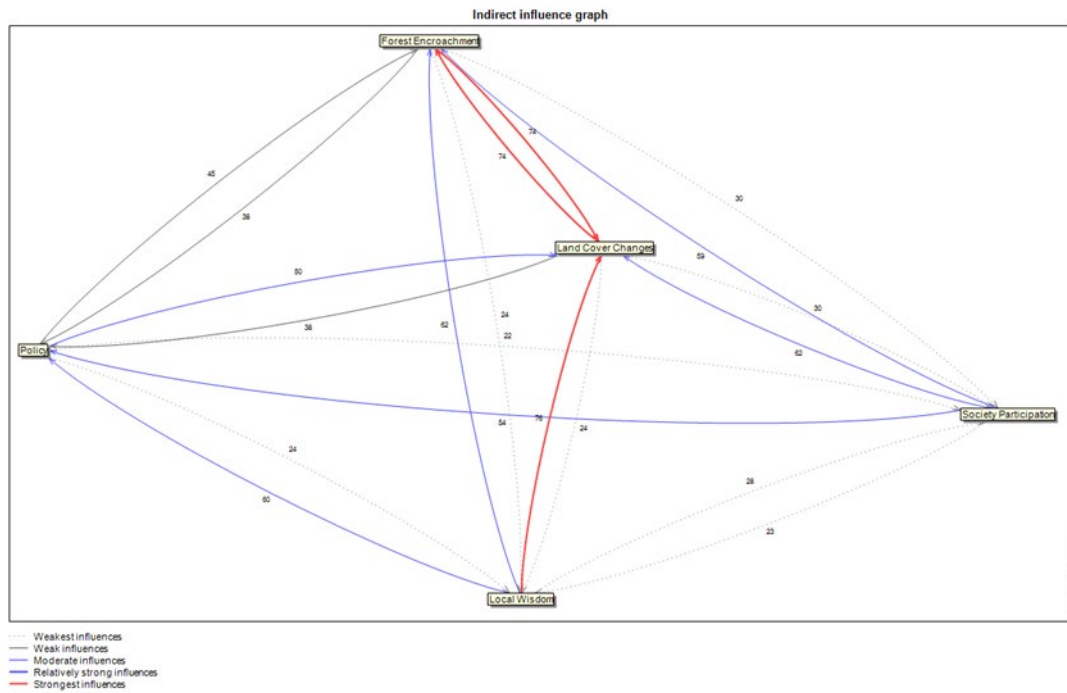
*Figure 6. Indirect Influence*

In Figure 6, it can be seen the relationship between indirect influence with other variables. The Local Wisdom variable has a strong indirect influence on Landcover Change. On the variable of Forest Encroachment and Landcover Change, these two variables strongly influence each other. From the figure of the indirect relationship between variables above, it can be seen that the main key to improving the environmental quality of the Cikapundung sub-district is reinforcement of the Local Wisdom variable. If we look at the existence of Local Wisdom in the upstream area of the Cikapundung sub-basin, there are activities of the Sundanese people that are in synergy with their environment as a reciprocal relationship between humans and their environment.

## Conclusions

Based on the results above, it can be seen that in terms of direct and indirect influence, the variables of Society Participation and Local Wisdom are variables that have a strong and independent influence on the management of the Cikapundung Sub-Watershed, namely as influence variables. To maintain or improve the environmental conditions of the Cikapundung sub-district, these two variables must be the main focus that must be improved.

With the condition of local wisdom starting to fade in many places (Ishak *et al*., 2021), the Local Wisdom of Sundanese people to support watershed management needs to be given more attention. Society Participation is also important in forest management (Astomo, 2020) because the community is a variable that interacts every day with river watershed management. In the city of Bandung, there is a community called Gemricik which is a community that together looks after the Cikapundung sub-district. For the Landcover Change and Policy variables, if seen from the direct and indirect influence analysis, they are categorized as excluded variables because these variables will not have an effect on other variables.

In terms of direct influence on variables, Society Participation has a strong influence on changes in Landcover and Forest Encroachment, while Society Participation is influenced by Local Wisdom. In terms of indirect influence on each variable, Society Participation does not have a strong influence on Local Wisdom. Society Participation is very important and has a strategic value in the management of resources in watersheds (Syafri *et al*., 2020). In watershed management, it is crucial to integrate

local wisdom and traditional knowledge (H. Y. S. H. Nugroho *et al.*, 2023). Policy variables do not directly have a strong influence on the variables of Forest Encroachment and Landcover Change but indirectly have a strong influence on the two variables. In terms of the level of influence of each variable currently, it can be seen that the order is: Society Participation, Local Wisdom, Landcover Change, Forest Encroachment, and Policy. However, in future projections, Local Wisdom will be the most influential variable in forest management.

When comparing the direct and indirect impacts, several relationships between different variables become apparent. For instance, the direct relationship of the Local Wisdom variable. Local Wisdom has a weak power to influence the Forest Encroachment variable but indirectly has quite a strong influence. Another difference is the relationship between Policy and Local Wisdom. Directly, the Local Wisdom variable has a strong influence on Society Participation, but indirectly the Local Wisdom variable has a weak influence on the Society Participation variable.

## References

Adysa, R., Suriadikusumah, A., & Arifin, M. (2023). Identifikasi Lahan Kritis Melalui Pemanfaatan Teknologi Drone Di DTA Cipaheut Pada SUB DAS Cikapundung Hulu. *Sang Pencerah: Jurnal Ilmiah Universitas Muhammadiyah Buton, 9*(2), 529–544. https://doi.org/10.35326/pencerah.v9i2.3170

Ankesa, H., Amanah, S., & Asngari, P. S. (2016). Partisipasi Kelompok Perempuan Peduli Lingkungan dalam Penanganan Sampah di Sub DAS Cikapundung, Provinsi Jawa Barat. *Jurnal Penyuluhan*, 12(2), 105–113.

Ariyani, D., Purwanto, M. Y. J., Sunarti, E., & Perdinan. (2022). Contributing factor influencing flood disaster using MICMAC (Ciliwung Watershed Case Study). *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan, 12*(2), 268–280. https://doi.org/10.29244/jpsl.12.2.268-280

Ariyani, N., Ariyanti, D. O., & Ramadhan, M. (2020). Pengaturan Ideal tentang Pengelolaan Daerah Aliran Sungai di Indonesia ( Studi di Sungai Serang Kabupaten Kulon Progo ) *. *Jurnal Hukum Ius Quia Iustum, 27*(3), 592–614.

Astomo, P. (2020). Partisipasi Masyarakat Dalam Pengelolaan Daerah Aliran Sungai Mandar Berorientasi Lingkungan Hidup. Jurnal Mimbar Hukum, 33(1), 216–241. https://download.garuda.kemdikbud.go.id/article.php?article=2954077&val=26288&title=P artisipasi Masyarakat dalam Pengelolaan Daerah Aliran Sungai Mandar Berorientasi Lingkungan Hidup

Damayanti, V. (2019). Potensi Pengembangan Infrastruktur Hijau dalam Upaya Mewujudkan Cimahi sebagai Kota Hijau Berkelanjutan. *ETHOS (Jurnal Penelitian Dan Pengabdian), 7*(2), 233–243. https://doi.org/10.29313/ethos.v7i2.4560

Ekasari, A. M., Burhanudin, H., & Fardani, I. (2022). Analisis Kualitas Sub DAS Citarum Hulu. *Media Komunikasi Geografi, 23*(1), 44–57. https://doi.org/10.23887/mkg.v23i1.40612

Fardani, I., Kurniasari, N., Syaodih, E., Puspitasari Rochman, G., Pradifta, F. S., & A n i, T. a r l. (2023). Pendampingan Rencana Tata Ruang Desa (Rtrd) Berbasis Perencanaan Partisipatif. *Jurnal Pengabdian Kepada Masyarakat Membangun Negeri, 7*(2), 72–84. https://doi.org/10.35326/pkm.v7i2.3472

Fauzi, A. (2019). Teknik Analisis Keberlanjutan. In *Jakarta (ID): PT. Gramedia Pustaka Utama.* PT. Gramedia Pustaka Utama. https://books.google.com/books?hl=en&lr=&id= snKpDwAAQBAJ&oi=fnd&pg=PP1&dq=sampah+implementasi+formulasi+tantangan+pe merintah+kebijakan+strategi&ots=lCAE9LrUHp&sig=gTf3VG1HRBs5b_KsrZiBJtSQ9Do

Godet, M., & Roubelat, F. (1996). Creating the future: The use and misuse of scenarios. *Long Range Planning, 29*(2), 164–171. https://doi.org/https://doi.org/10.1016/0024-6301(96)00004-0

Husodo, T., Wulandari, I., Megantara, E. N., Shanida, S. S., Kuncoro, D. D., & Ratningsih, N. (2021). Partisipasi dan Persepsi Masyarakat Desa Cinunuk dalam Pengelolaan Sampah. *ETHOS: Jurnal Penelitian Dan Pengabdian Kepada Masyarakat, 9*(2), 192–203. https://doi.org/10.29313/ethos.v9i2.6984

Ishak, A., Fauzi, E., Firison, J., Miswarti, & Sastro, Y. (2021). Fading local wisdoms of upland rice varieties in situ conservation in South Bengkulu Regency (case in Pino Raya subdistrict). *IOP Conference Series: Earth and Environmental Science, 733*(1), 1–7. https://doi.org/10.1088/1755-1315/733/1/012031

Jaenudin Nurdiana, D. (2021). Social Capital dan Etika Lingkungan Dalam Komunitas Pemberdayaan Masyarakat Pada Wilayah Sungai Citarum. *Coopetition : Jurnal Ilmiah Manajemen*, 12(3), 373–380. https://doi.org/10.32670/coopetition.v12i3.713

Nopriani, M., Fauzi, A., & Nuva, N. (2022). Analisis Prospektif untuk Keberlanjutan Pengelolaan TPS 3R di Kota Pangkalpinang. *Jurnal Pendidikan Tambusai, 6*(3), 13791–13808. https://doi.org/10.31004/jptam.v6i3.4504

Nugroho, H. Y. S. H., Sallata, M. K., Allo, M. K., Wahyuningrum, N., Supangat, A. B., Setiawan, O., Njurumana, G. N., Isnan, W., Auliyani, D., Ansari, F., Hanindityasari, L., & Najib, N. N. (2023). Incorporating Traditional Knowledge into Science-Based Sociotechnical Measures in Upper Watershed Management: Theoretical Framework, Existing Practices and the Way Forward. *Sustainability, 15*(4). https://doi.org/10.3390/su15043502

Nugroho, S. P. (2003). Pergeseran kebijakan dan paradigma baru dalam pengelolaan daerah aliran sungai di indonesia. *Jurnal Teknologi Lingkungan, 4*(3), 136–142.

Rizka Maria, H. L. (2014). Pengaruh Penggunaan Lahan Terhadap Fungsi Konservasi Airtanah di Sub Das Cikapundung. *Riset Geologi dan Pertambangan - Geology and Mining Research, 24*(2), 77–89.

Sugandi, D., & Hamdanah, H. (2019). Effect of Forest Encroachment in Cisangkuy Sub Watershed. *IOP Conference Series: Earth and Environmental Science, 286*(1), 1–6. https://doi.org/10.1088/1755-1315/286/1/012025

Suhana, A. Y., & Hindersah, H. (2022). Penerapan Konsep Green infrastructure dalam Mencegah Erosi di Kawasan Sub DAS Cikapundung. *Bandung Conference Series: Urban & Regional Planning, 2*(2), 308–316.

Sulistyaningsih, T., Nurmandi, A., Salahudin, S., Roziqin, A., Kamil, M., Sihidi, I. T., Romadhan, A. A., & Loilatu, M. J. (2021). Public policy analysis on watershed governance in Indonesia. *Sustainability (Switzerland), 13*(12), 1–21. https://doi.org/10.3390/su13126615

Suryade, L., Fauzi, A., Achsani, N. A., & Anggraini, E. (2022). Variabel-Variabel Kunci dalam Pengembangan Kawasan Ekonomi Khusus Pariwisata ( KEK ) Berkelanjutan di Mandalika , Lombok Tengah , Indonesia. *Jurnal Kepariwisataan: Destinasi, Hospitalitas dan Perjalanan, 6*, 16–30. https://doi.org/10.34013/jk.v6i1.327

Sutrisna, N., Rahmat, A., Pengkajian, B., Pertanian, T., & Barat, J. (2012). Pemilihan Model Usaha Tani Konservasi Tanaman Sayuran Hulu Sub-Das Cikapundung, Bandung Utara Model Selection Of Vegetable Farm Conservation Sub-. *Jurnal Pertanian Agros, 14*(1), 114–124.

Syafri, S., Surya, B., Ridwan, R., Bahri, S., Rasyidi, E. S., & Sudarman, S. (2020). Water Quality Pollution Control and Watershed Management Based on Community Participation in Maros City, *South Sulawesi, Indonesia. Sustainability, 12*(24). https://doi.org/10.3390/su122410260