CERTIFICATE

No : E.2.g/835/FPP-UMM/VII/2021

ICoN-BEAT

We hereby confirm that

Joko Triwanto

Has participated as **oral presenter**, with the titled:

Management of Agroforestry and Water Resources Towards Socio-Economic Conditions of The Community, Case on Gubugklakah, Poncokusumo, Malang, East Java, Indonesia

at

2nd International Conference on Bioenergy & Environmentally Sustainable Agriculture Technologies

July 28th, 2021

University of Muhammadiyah Malang, Indonesia

Dr. David Hermawan
Dean Faculty of Agriculture and Animal Science

Dr. Damat
Conference Convener

Co-hosting Partners : ILCAN BIORE

Management of Agroforestry and Water Resources Towards Socio-economic Conditions of the Community, Case on Gubugklakah, Poncokusumo, Malang, East Java, Indonesia

Joko Triwanto[1,*], *Nugroho* Tri Waskitho[1], *Yesmika* Faranis[1], and *Nakama* Eichiro[2]

[1]Department of Forestry, Faculty of Agriculture and Animal Science,
University of Muhammadiyah Malang, Jl Raya Tlogomas No 246, Malang 65144,
East Java, Indonesia
[2]Japan International Forestry Promotion and Cooperation Center, Bunkyo City,
Koraku, 1 Chome−7−12 Rinyu Building 5F Tokyo, Japan

Abstract. The dependence of the community around the forest area on utilizing natural resources is dangerous for the sustainability of the forest area. The research aimed to determine the effect of the management of agroforestry, water resources conservation, and drinking water supply system on the socio-economic conditions of the Gubugklakah community. The study was conducted from January to March 2020 in Gubugklakah, Poncokusumo, Malang district, East Java, Indonesia. Data collection with a Likert scale questionnaire with 100 forest farmers as respondents. The variables consist of agroforestry management, conservation of water resources, drinking water supply system, and socio-economic condition of the community. Data were analyzed using by Structural Equation Model. Data analysis shows that agroforestry management influences the socio-economic state with a 0.45 path coefficient, the drinking water supply system controls the socio-economic condition with a 0.44 path coefficient, and water resource conservation influences the socio-economic situation with a 0.15 path coefficient. The research concluded that the management of agroforestry and drinking water supply systems affect the socio-economic conditions of the Gubugklakah community, and water resources conservation did not affect the socio-economic conditions of the Gubugklakah community.

Keywords: Community, environmental sustainability, forest conservation improve welfare, socio-economic.

* Corresponding author: joko.fpumm@gmail.com

1 Introduction

The dependence of the community around the forest area on utilizing natural resources is dangerous for the sustainability of the forest area [1]. For this reason, the community's welfare around the forest area needs to be improved so that the community can participate in protecting the area [2, 3]. Agroforestry is the solution [4] because it can improve people's welfare while conserving forests. Most agroforestry systems are practiced globally, such as forest farming, buffer riverbank strips, multipurpose trees, and silvopasture [5, 6]. Agroforestry can also be found in Europe [7]. The potential of agroforestry systems to provide economic, environmental, and social benefits in Europe has been demonstrated by national research programs and European Union research projects [7–11]. The function of agroforestry [12, 13] can be expected because of the composition and arrangement of plant and tree species in one plot of land [14, 15]. Agroforestry [16] systems provide and have the value given by communities to all their products over some time [17, 18]. According to Marsden [12], agroforestry systems benefit the environment and contribute to positive impacts on biodiversity and nutrient cycles. Agroforestry systems positively affect biodiversity (flora and fauna) when compared to arable land by increasing structural richness, especially in vacant agricultural landscapes [19].

The existence of drinking water supply system technology will significantly help the community to get clean water. Accelerate system adoption and environmental sustainability for the future [20, 21]. Income, the community's economy with agroforestry-based land management, will significantly contribute to community income to reduce the burden for the community's basic needs that occur in a sustainable manner. Water conservation is crucial to support agroforestry management and community drinking water needs.

The aimed of this research to determine the effect of agroforestry management, water resources conservation and drinking water supply systems on the socio-economic conditions of the Gubugklakah community.

2 Methods

This research was conducted from January to March 2020 in Gubukklakah village, Poncokusumo sub-district, Malang Regency, East Java, Indonesia. Analysis of the research data using the multivariate method of the SEM (Structural Equation Model) [22] technique using the Warp PLS program. According to Latan [23] the SEM is a second generation multivariate analysis technique that combines factor analysis and path analysis, allowing researchers to test and estimate simultaneously the relationship between multiple latent independent variables and multiple latent dependent variables with many indicators and testing models with mediator and moderator effects, models in non-linear form and measurement errors.

Data collection with a Likert scale questionnaire with 100 forest farmers as respondents. The variables consist of agroforestry management, conservation of water resources, drinking water supply system, and socio-economic condition of the community. Testing the validity and reliability of the data is done with convergent and discriminant reality. Convergent validity can be assessed using indicator reliability, composite reliability, and average variance extracted. Discriminant validity by comparing the root value of each statement's AVE (Average Variance Extracted) with the correlation between statements and other statements. The variable is declared valid if the root value of AVE is greater than the correlation between statements and other statements. Data were analyzed using by SEM [24].

3 Result and discussion

3.1 Agroforestry on Gubugklakah

Geographically, Gubugklakah is a village located on at coordinate 7˚21' - 7˚31' LS and 110˚10'- 111˚40' BT the slopes of Mount Bromo with a hilly topography relatively located on the forest's edge. The total area of Gubugklakah village is 384 ha. Dry land is the only land that plays a significant role in developing Gubugklakah village. The type of crops planted is influenced by the level of agroforestry development with the forestry plant *Pinus merkusii* Jungh et de Vriese. The types of crops include *Brassica chinensis* L., *Daucus carota* L., *Brassica oleracea* L., *Capsicum annuum* L., *Solanum tuberosum* L., *Allium sativum* L., *Coffea* spp, *Colocasia esculenta* (L.) Schott, and *Zingiber officinale* Roscoe.

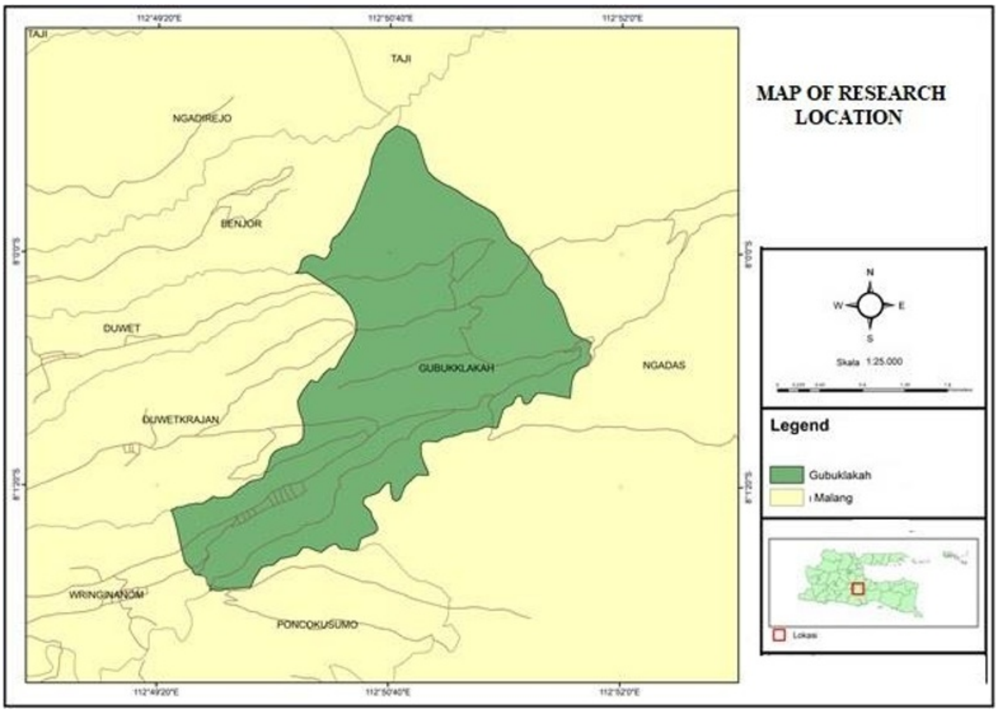

Fig. 1. Gubugklakah village.

The classification of respondents based on the number of members at the level of agroforestry land area is presented in Table 1.

Table 1. Number of family members at the level of agroforestry land area.

Number of family members (person)	Agroforestry land area		Total	
	< 0.5 ha	0.5 to 1 ha		
	Amount	Amount	Amount	%
< 3	41	2	43	43
4 to 6	47	9	56	56
> 7	1	0	1	1
Total	89	11	100	100

Source: primary data processed in 2020.

Based on the data in Table 1, it can be seen that most of the farming communities in Gubugklakah village (89 %) own less than 0.5 ha of land and have between 4 and 6 family members.

3.2 Validity and reliability

The results of validity and reliability are presented in Table 2.

Table 2. Validity and reliability.

Variable	AVE	Cronbach's alpha	Composite reliability
Drinking water supply technology	0.54	0.792	0.843
Water source ecology	0.248	0.367	0.649
Agroforestry	0.168	0.743	0.770
Social economy	0.338	0.664	0.769

Based on Table 2, the AVE values of all variables meet the requirements, then the Cronbach's alpha and composite reliability values (more than 0.60). This data is a table of validity and reliability of the four variables used in the structural analysis of the equation model. (1) The drinking water supply technology variable has an AVE of 0.54, Cronbach's alpha of 0.792, and composite reliability of 0.843, (2) The water source ecology variable has an AVE of 0.248, Cronbach's alpha of 0.367, and a composite reliability of 0.649, (3) The agroforestry variable has an AVE of 0.168, Cronbach's alpha of 0.743, and a composite reliability of 0.770, (4) The social economy variable has an AVE of 0.338, Cronbach's alpha of 0.664, and a composite reliability of 0.769.

It can be seen that all variables meet the AVE requirements with values above 0.5. In addition, Cronbach's alpha and composite reliability also meet the requirements with values above 0.6. This shows that all variables have good validity and reliability in the structural analysis of the equation model.

3.3 Structural equation model

The results of the structured equation model test are presented in Table 3.

Table 3. Structural model test results.

Effect between variables	Path coefficient	Std error	*P* value	Note
Drinking water supply technology > social economy	0.44	0.089	< 0.001	Significance
Water source ecology > social economy	0.15	0.096	0.056	Not significant
Agroforestry > social economy	0.45	0.089	< 0.001	Significance

Source: data processed with Warp PLS 6.0, 2020.

Table 3 shows that drinking water supply technology and agroforestry management affects socio-economic conditions (P value < 0.05). At the same time, the ecology of water resources does not affect socio-economic conditions (P value > 0.05).

For each independent variable, the path coefficient, std error (standard error), and *P* value of the results of the regression analysis are reported. (i) Drinking water supply technology has a path coefficient of 0.44 with a std error of 0.089 and a *P* value of less than 0.001 which indicates high significance, (ii) Water source ecology has a path coefficient of 0.15 with a std error of 0.096 and a *P* value of 0.056 which indicates a not significant (not significant) relationship between this variable and social economy, (iii) Agroforestry has a path coefficient of 0.45 with a std error of 0.089 and a *P* value of less than 0.001 which indicates high significance.

4 Conclusion

The research concluded that the management of agroforestry and drinking water supply systems affect the socio-economic conditions of the Gubugklakah community, and water resources conservation did not affect the socio-economic conditions of the Gubugklakah community.

References

1. M. Savari, H.E. Damaneh, H.E. Damaneh, Arab. J. Geosci., **13**,513: 1–13 (2020) http://dx.doi.org/10.1007/s12517-020-05519-z
2. A. Ullah, A.S. Sam, A.R. Sathyan, N. Mahmood, A. Zeb, H. Kächele, Sci. Total Environ., **772**:145613 (2021) https://doi.org/10.1016/j.scitotenv.2021.145613
3. E. Meijaard, T. Santika, K.A. Wilson, S. Budiharta, A. Kusworo, E.A. Law, et al., Conserv. Sci. Pract., **3**,e189: 1–4 (2021) http://dx.doi.org/10.1111/csp2.189
4. C. Mbow, E. Toensmeier, M. Brandt, D. Skole, M. Dieng, D. Garrity, et al., Agroforestry as a solution for multiple climate change. In: *Climate change and agriculture*. D. Deryng (Eds). London: Burleigh Dodds Science Publishing (2020). p.339–374. https://doi.org/10.1201/9781003047704
5. M.W. Jordon, K.J. Willis, W.J. Harvey, L. Petrokofsky, G. Petrokofsky, Forests, **11**,12: 1–25 (2020) http://dx.doi.org/10.3390/f11121321
6. V. Ayyam, S. Palanivel, S. Chandrakasan. Agroforestry for livelihood and biodiversity conservation. In: *Coastal ecosystems of the tropics-adaptive management*. V. Ayyam, S. Palanivel, S. Chandrakasan (Eds). Singapore: Springer Singapore (2019) .p.363–389. https://doi.org/10.1007/978-981-13-8926-9_16
7. S. Kay, C. Rega, G. Moreno, M. den Herder. J.H.N. Palma, R. Borek, et al., Land Use Policy, **83**: 581–593 (2019) https://doi.org/10.1016/j.landusepol.2019.02.025
8. L.G. Smith, S. Westaway, S. Mullender, B.B. Ghaley, Y. Xu, L.M. Lehmann, et al., Agric. Syst., **197**: 103357 (2022) https://doi.org/10.1016/j.agsy.2021.103357
9. M. Sollen-Norrlin, B.B. Ghaley, N.L.J. Rintoul, Sustainability, **12**,17: 1–20 (2020) http://dx.doi.org/10.3390/su12177001
10. G. Low, T. Dalhaus, M.P.M. Meuwissen, Agric. Syst., **206**, 103606: 1–12 (2023) https://doi.org/10.1016/j.agsy.2023.103606
11. M.R. Mosquera-Losada, M.G.S. Santos, B. Gonçalves, N. Ferreiro-Dominguez, M. Castro, A. Rigueiro-Rodriguez, et al., Front. For. Glob. Change, **6**,1127601: 1–11 (2023) https://doi.org/10.3389/ffgc.2023.1127601
12. C. Marsden, A. Martin-Chave, J. Cortet, M. Hedde, Y. Capowiez, Plant Soil, **453**: 29–44 (2020) https://doi.org/10.1007/s11104-019-04322-4
13. S. Li, C. Zhu, Y. Lin, B. Dong, B. Chen, B. Si, et al., J. Clean. Prod., **317**: 128453 (2021) https://doi.org/10.1016/j.jclepro.2021.128453

14. M.O. Padovan, F.F. Nogueira, F.G. Ruas, A.C.C. Rodrigues, M.F. Arco-Verde, Agrofor. Syst., **96**: 235–248 (2022) https://doi.org/10.1007/s10457-021-00655-1
15. S. Fahad, S.B. Chavan, A.R. Chichaghare, A.R. Uthappa, M. Kumar, V. Kakade, et al., Sustainability, **14**,22: 1–25 (2022) https://doi.org/10.3390/su142214877
16. A. Pantera, M.R. Mosquera-Losada, F. Herzog, M. den Herder, Agrofor. Syst., **95**: 767–774 (2021) https://doi.org/10.1007/s10457-021-00640-8
17. C.d.B.Q. Gonçalves, M.M. Schlindwein, G.d.C. Martinelli, Sustainability, **13**,11397: 1–20 (2021) https://doi.org/10.3390/su132011397
18. D. Khadka, A. Aryal, K.P. Bhatta, B.P. Dhakal, H. Baral, Forests, **12**,3: 1–20 (2021) https://doi.org/10.3390/f12030358
19. S. Boinot, G. Fried, J. Storkey, H. Metcalfe, K. Barkaoui, P.É. Lauri, et al., gric. Ecosyst. Environ., **284**: 106584 (2019) https://doi.org/10.1016/j.agee.2019.106584
20. S. Hoffmann, U. Feldmann, P.M. Bach, C. Binz, M. Farrelly, N. Frantzeskaki, et al., Environ. Sci. Technol., **54**,9: 5312–5322 (2020) https://doi.org/10.1021/acs.est.9b05222
21. M.A. Alim, A. Rahman, Z. Tao, B. Samali, M.M. Khan, S. Shirin, J. Clean. Prod., **248**:119226 (2020) https://doi.org/10.1016/j.jclepro.2019.119226
22. J.J. Thakkar. Applications of structural equation modelling with AMOS 21, IBM SPSS. In: *Structural equation modelling. Studies in systems, decision and control, vol 285*. J. Kacprzyk (Eds). Singapore: Springer Singapore (2020). p.35–89. https://doi.org/10.1007/978-981-15-3793-6_4
23. H. Latan. *Model persamaan struktural teori dan implementasi AMOS 21.0.* [The structural equation model of the theory and implementation of AMOS 21.0.]. Alfabeta, Bandung (2013). p.211. [in Bahasa Indonesia]. https://openlibrary.telkomuniversity.ac.id/pustaka/18645/model-persamaan-struktural-teori-implementasi-amos-21-0.html
24. N. Sudibjo, R.K. Prameswari, Heliyon, **7**,6: 1–8 (2021) https://doi.org/10.1016/j.heliyon.2021.e07334