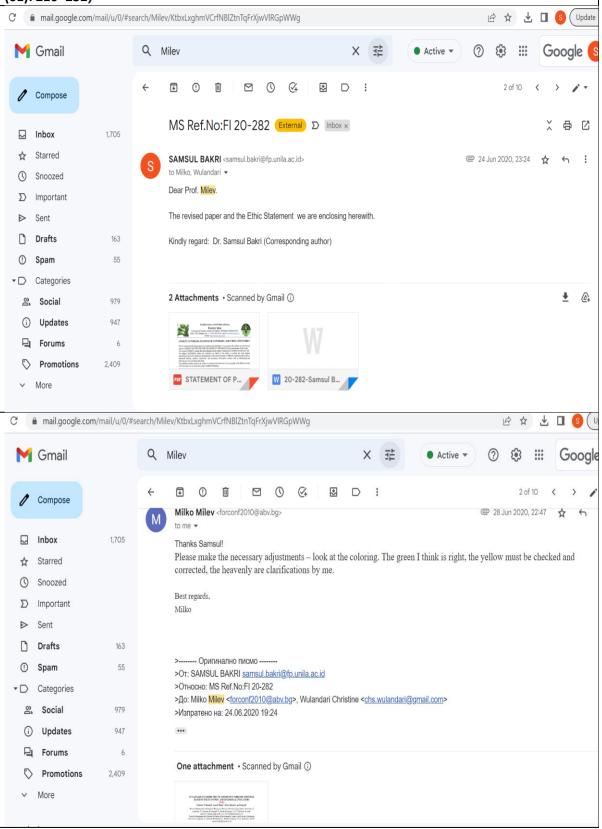
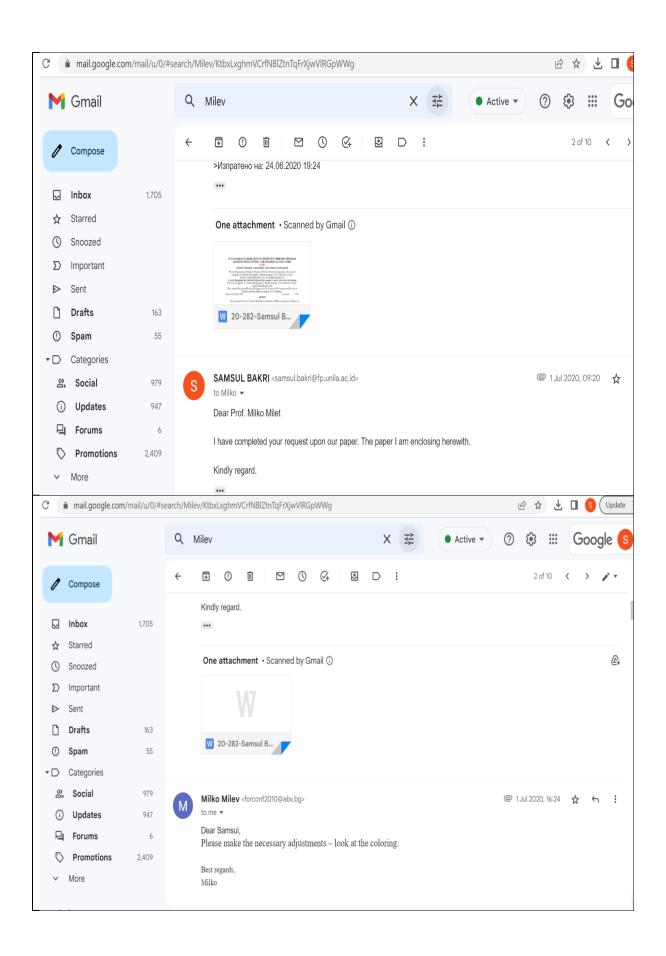
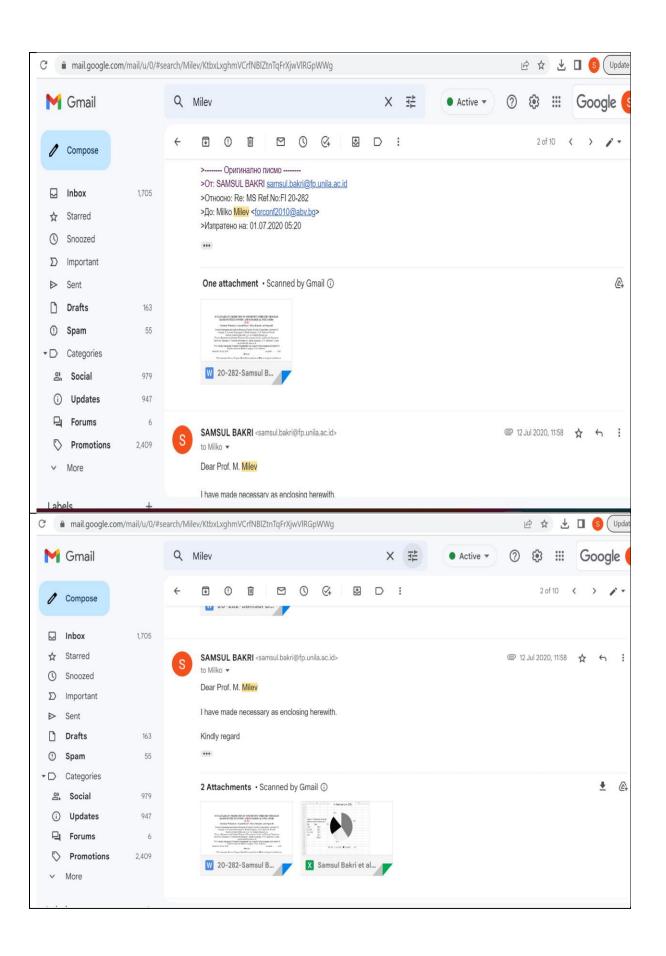
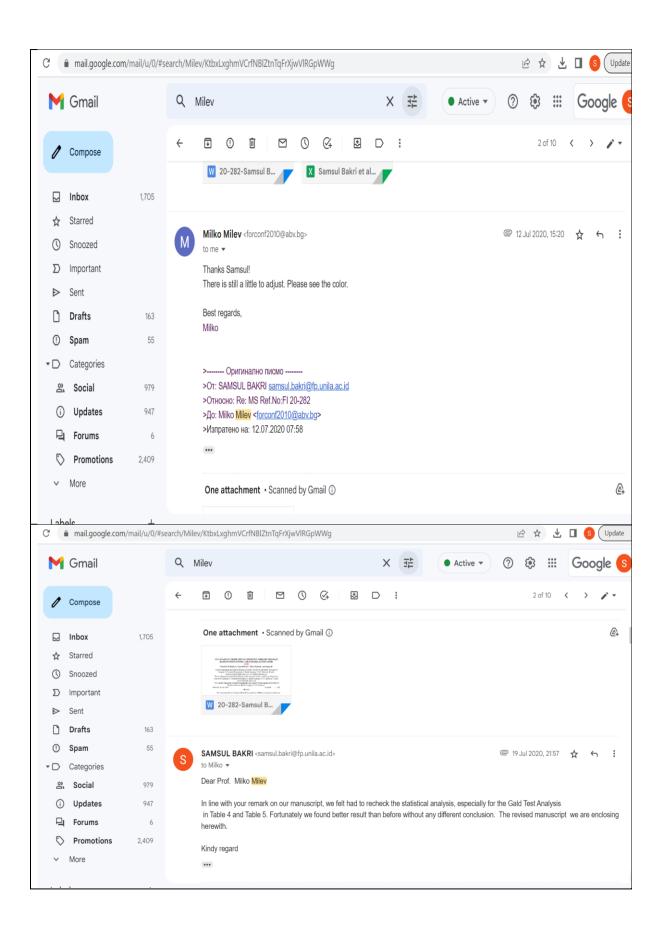
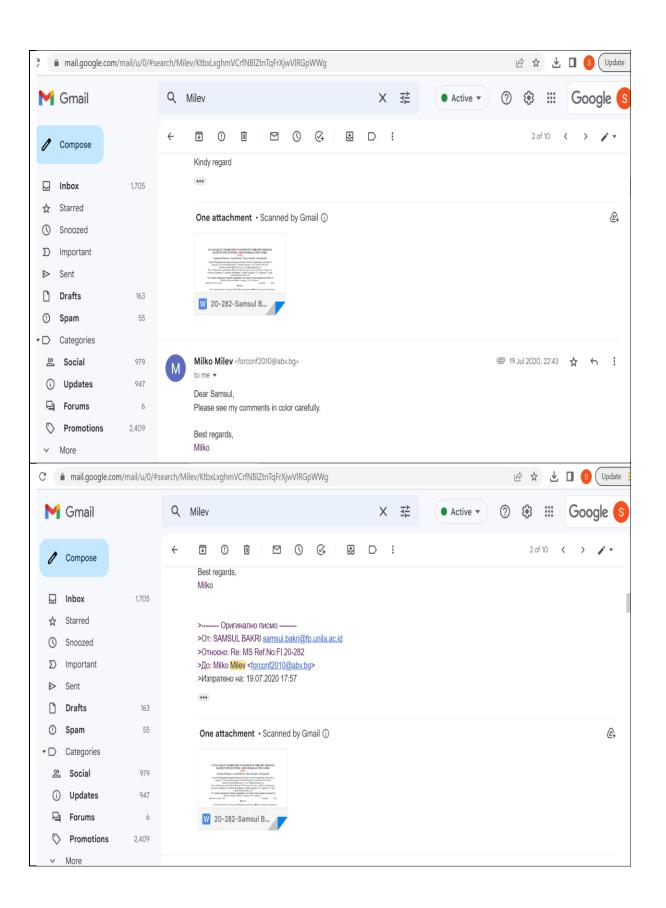
JEJAK KORESPONDENSI_PAPER BERJUDUL Fostering the Sustainability Of Community Forestry Program: Case Study in Lampung-Sumatra (FORESTRY IDEAS, 2021, vol. 27, No 1 (61): 210–232)

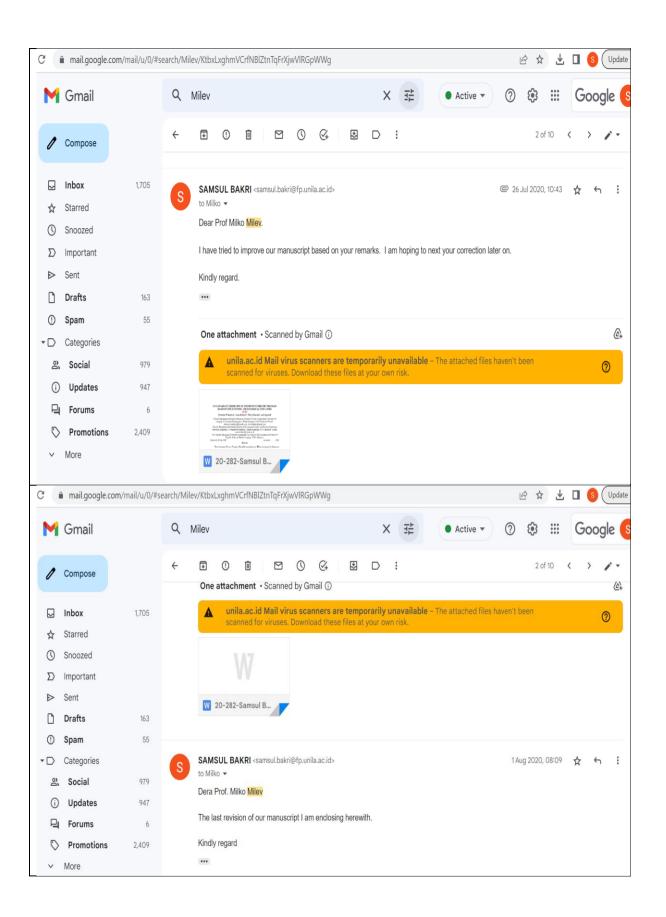


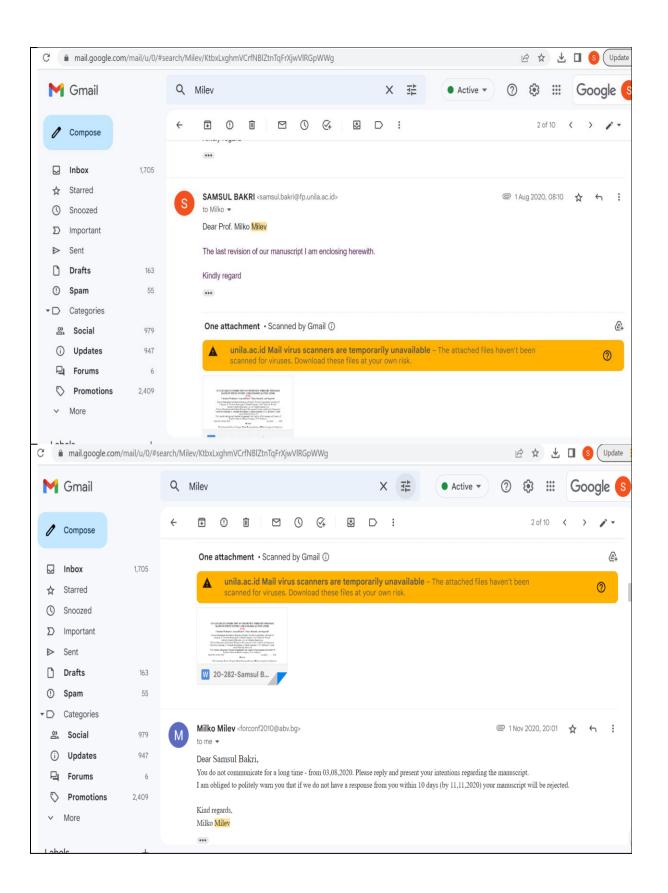


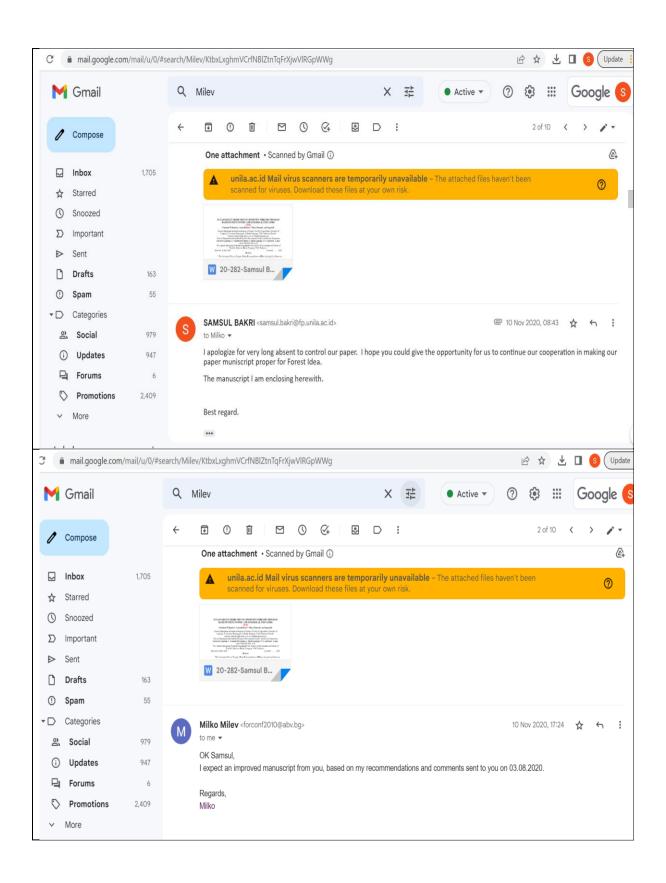


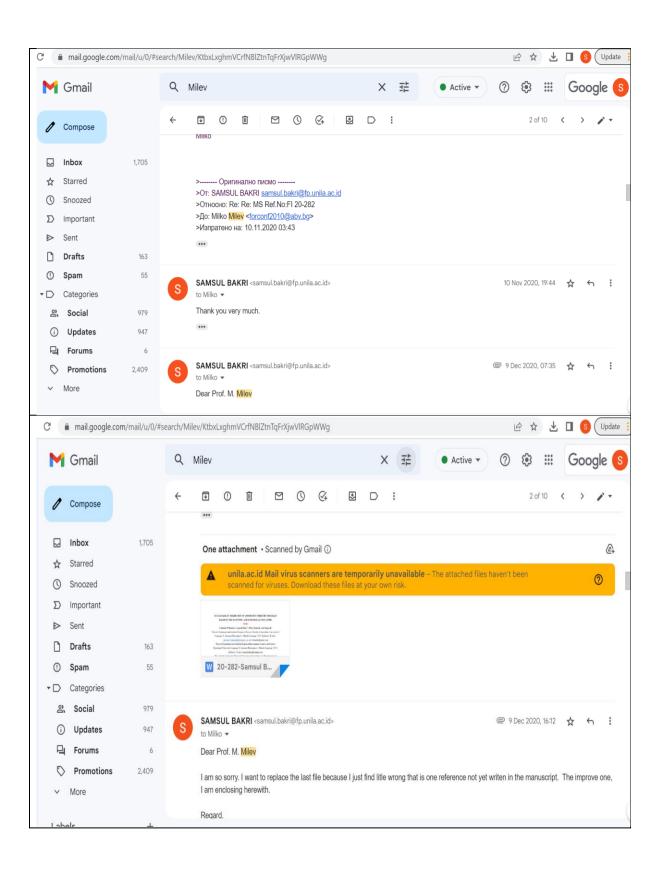


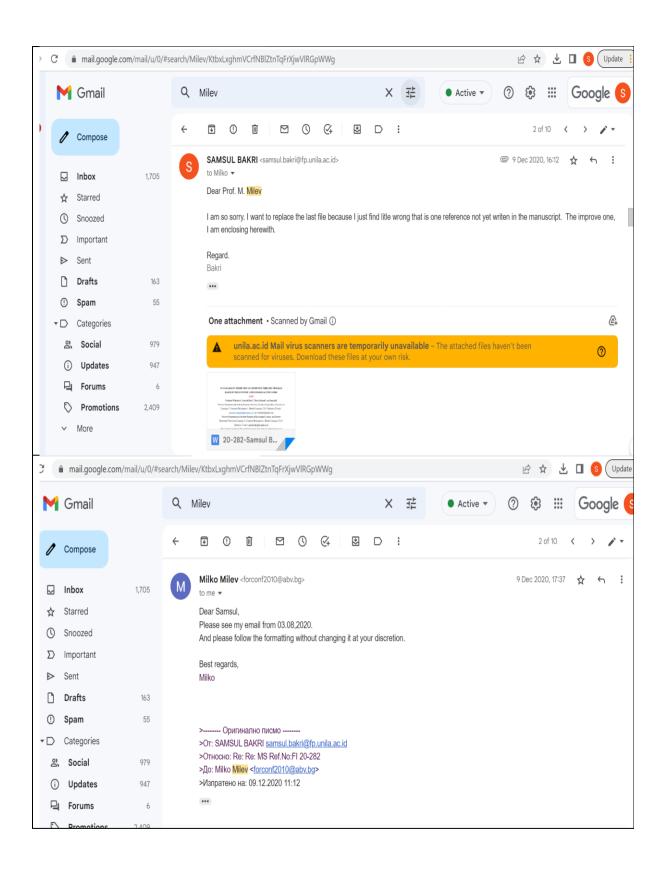


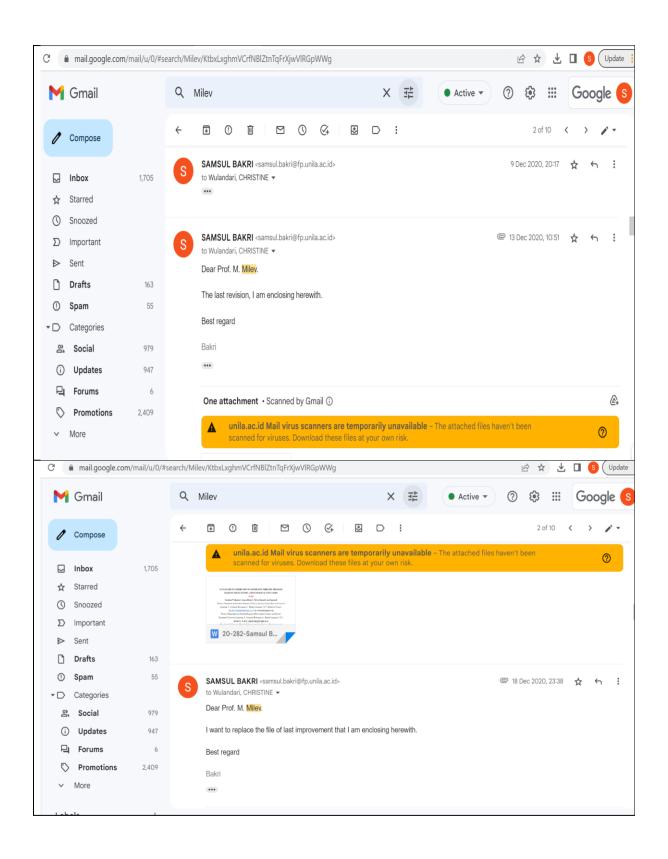


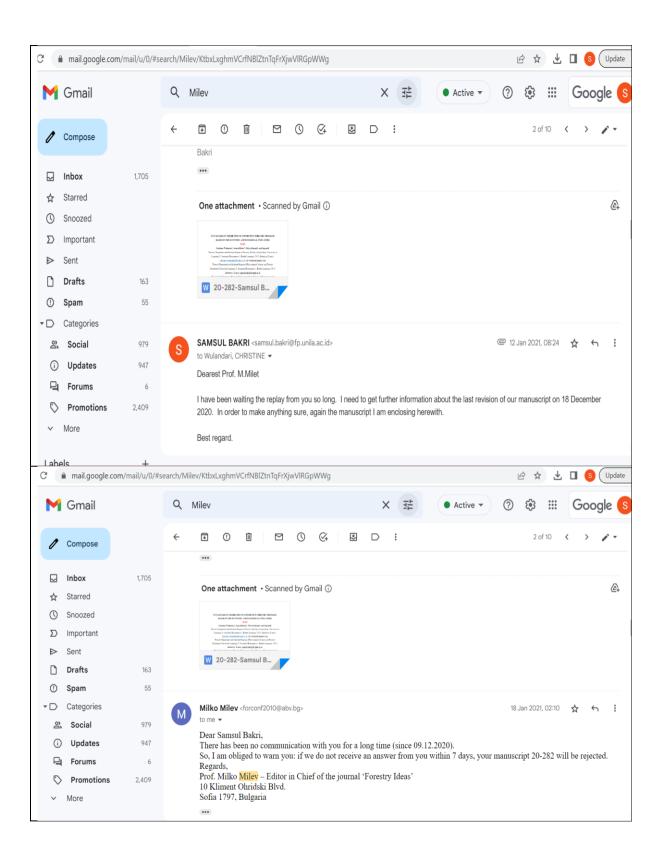


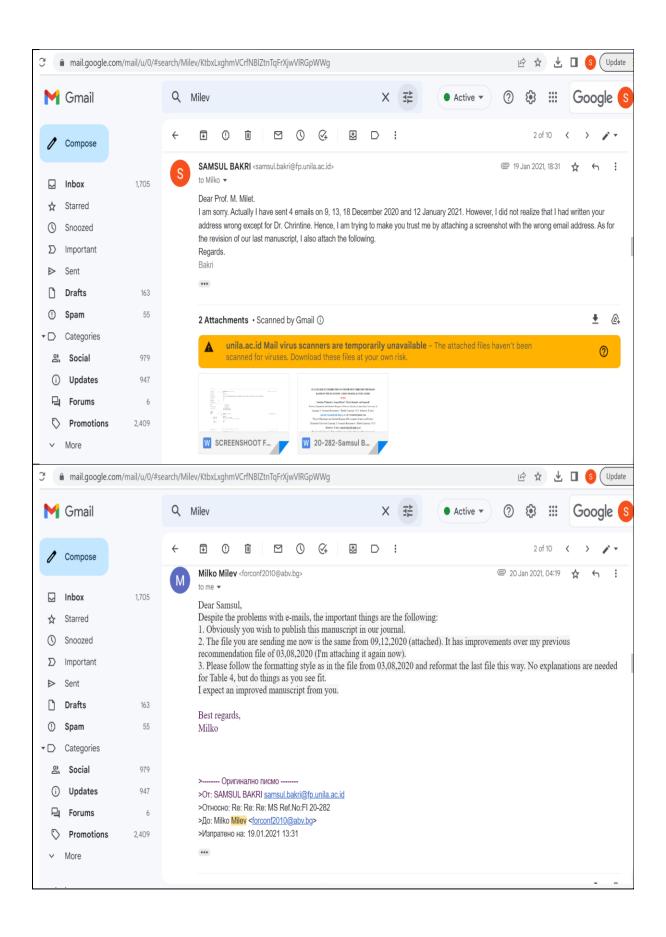


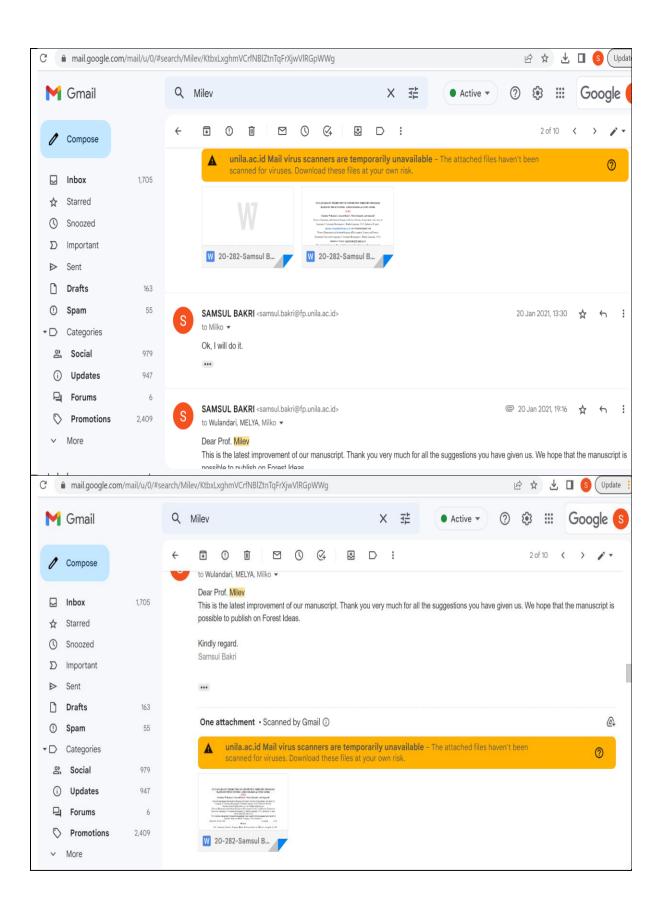


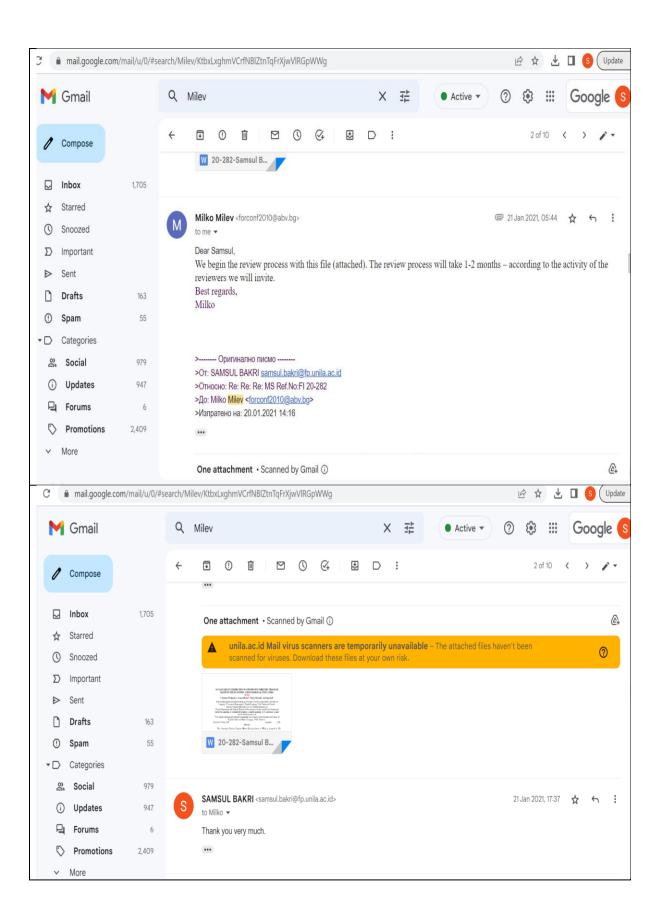


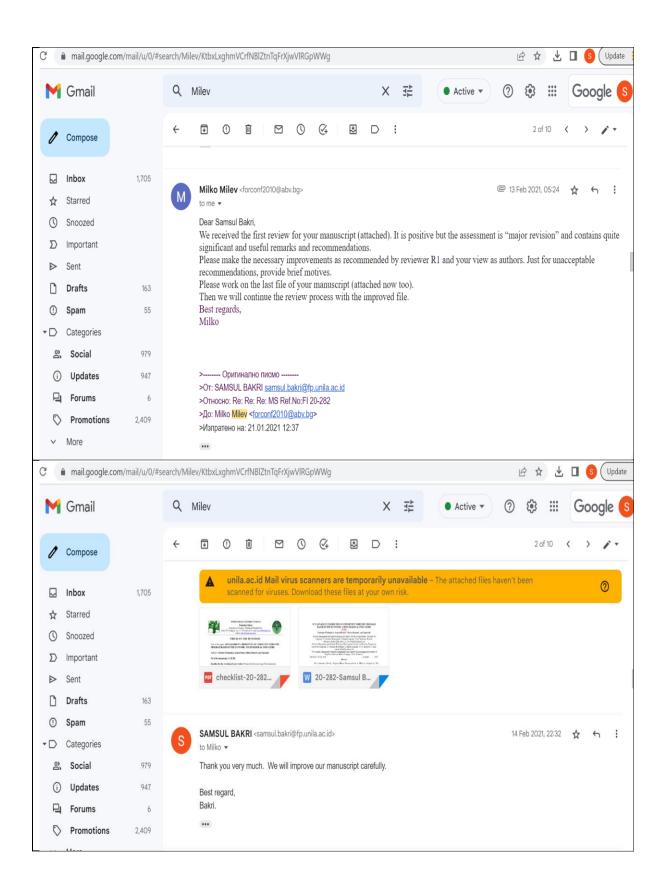


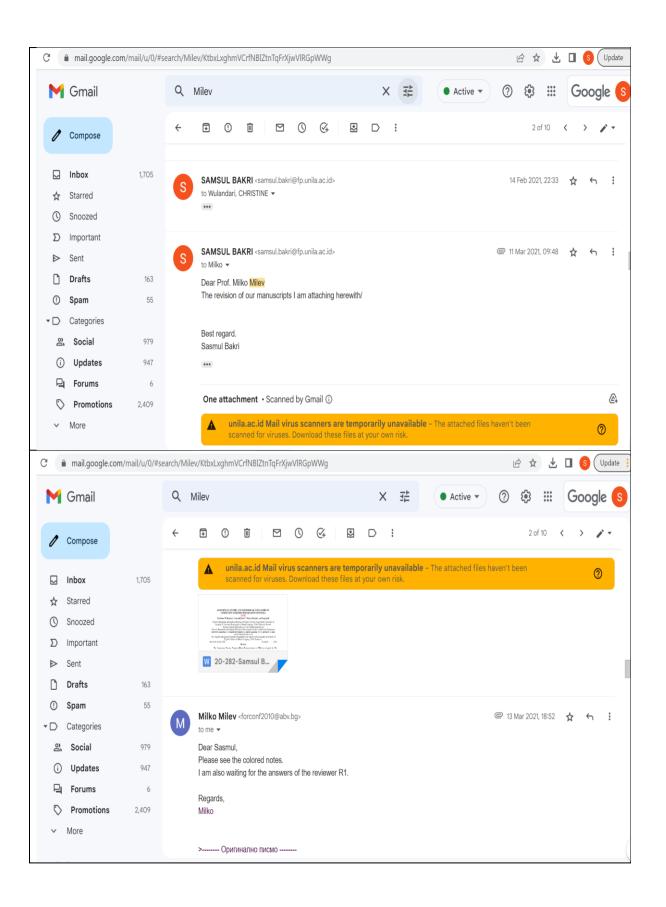


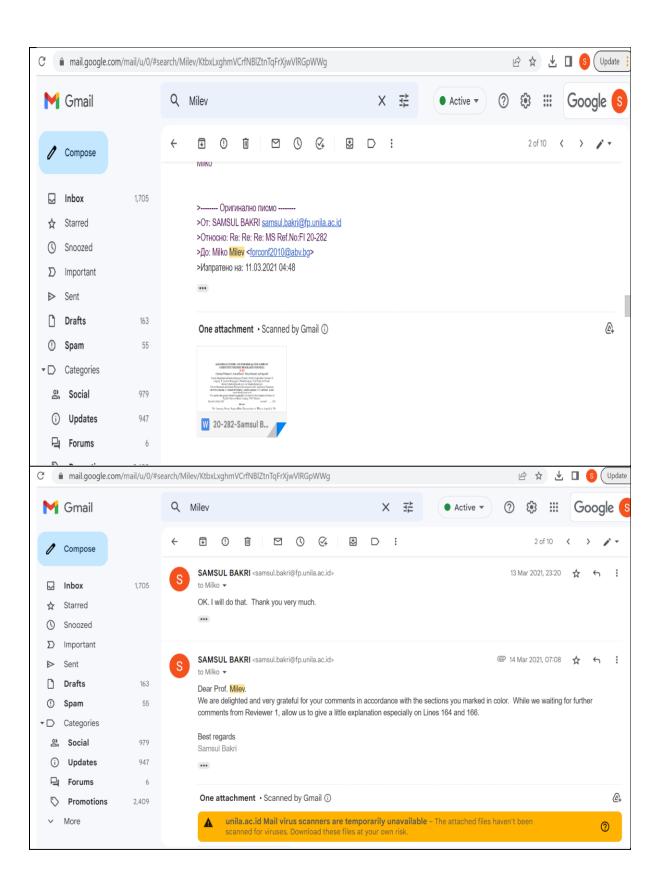


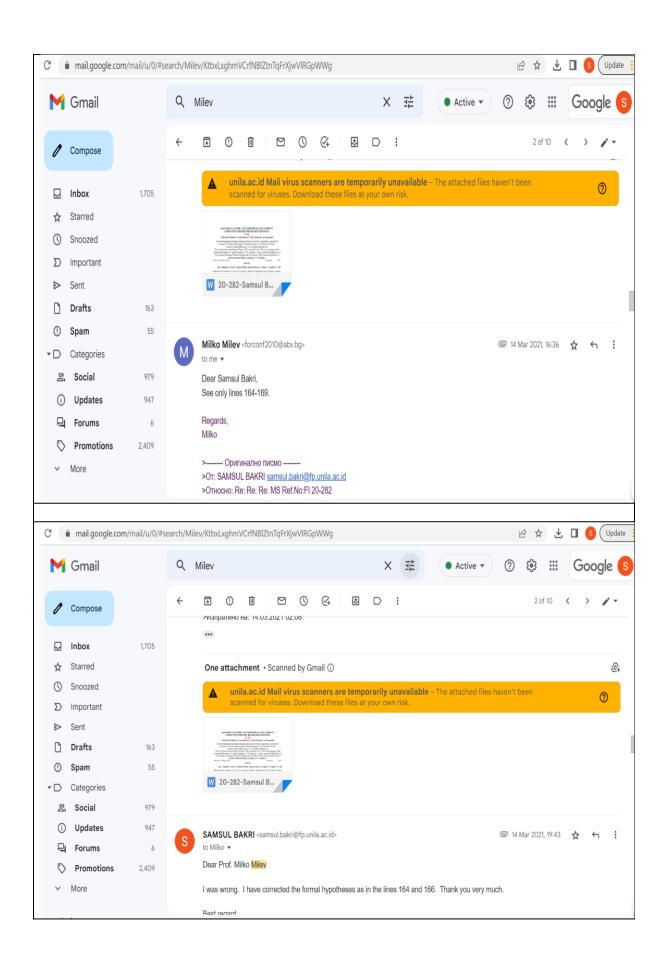


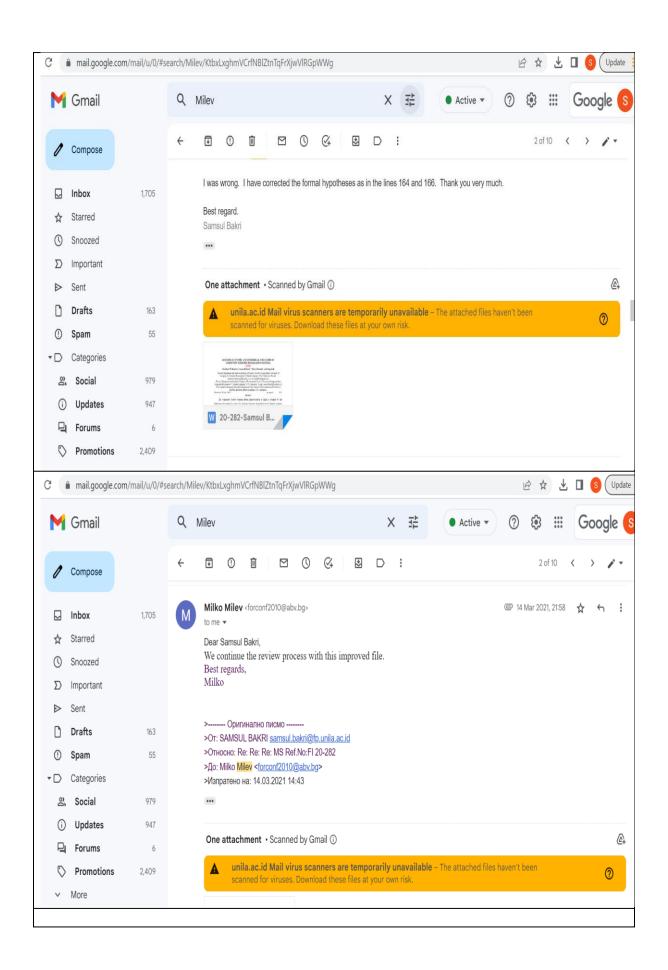


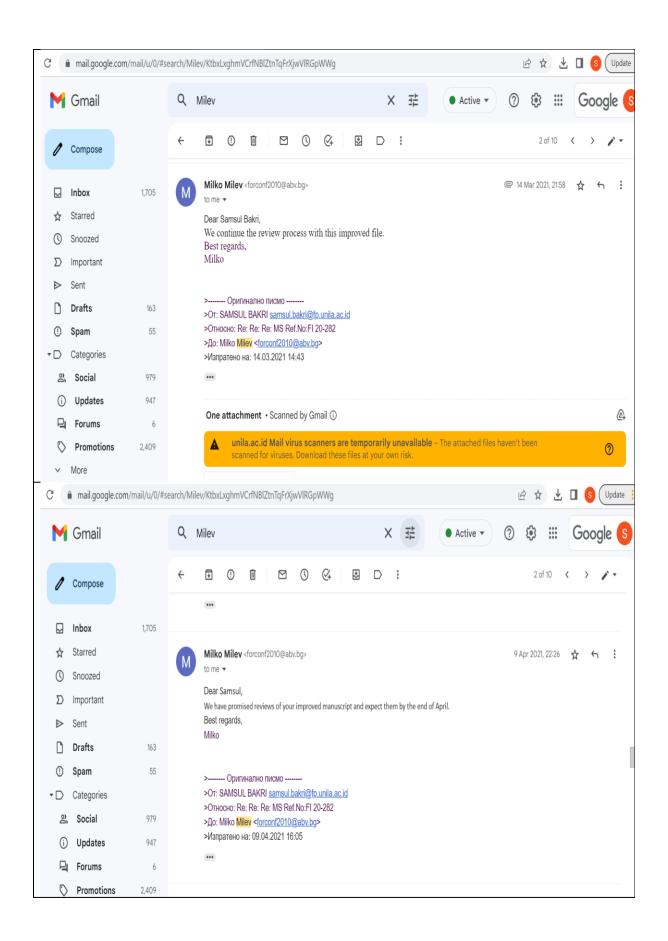


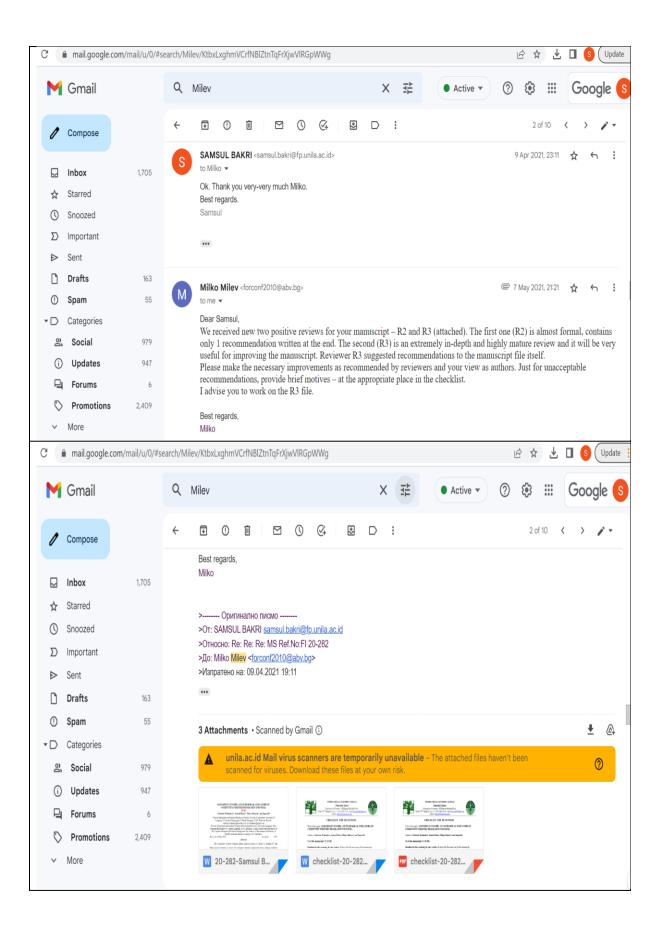


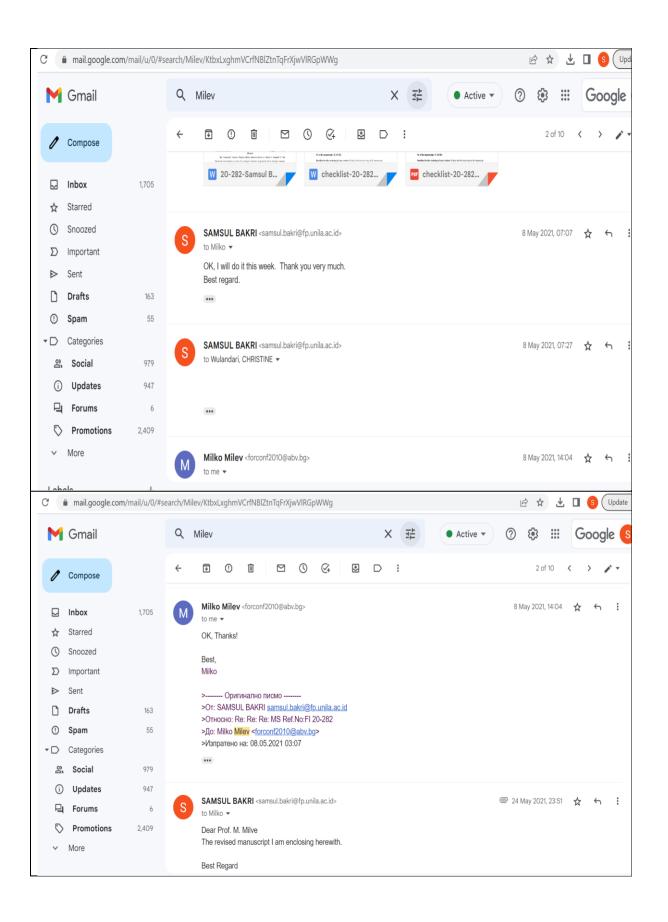


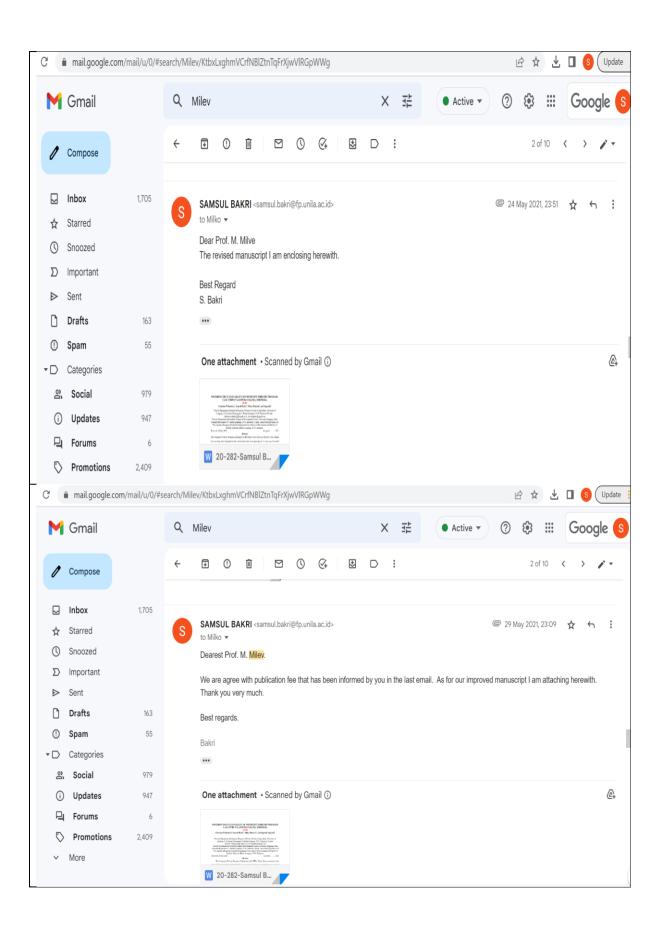


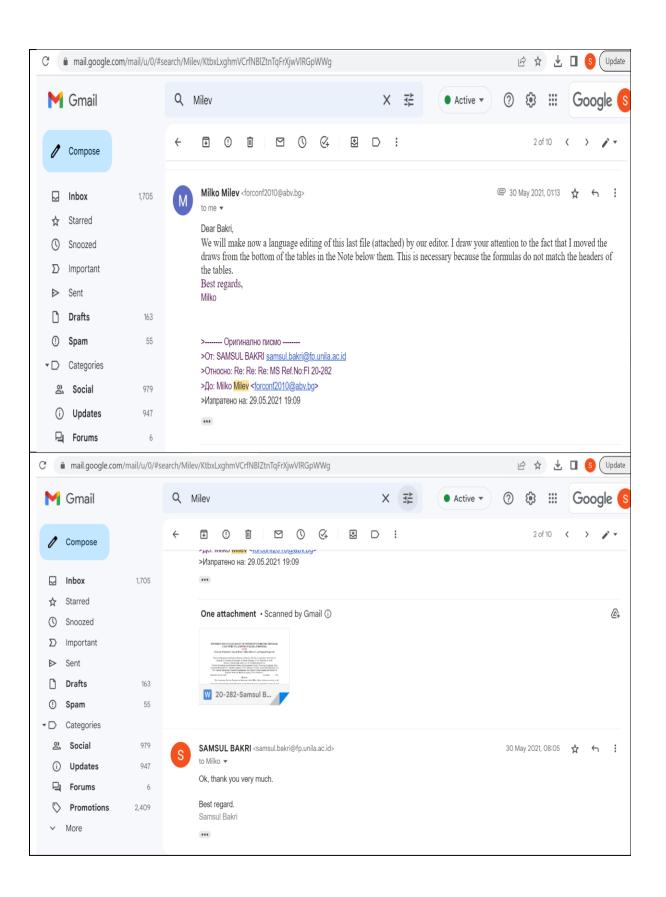


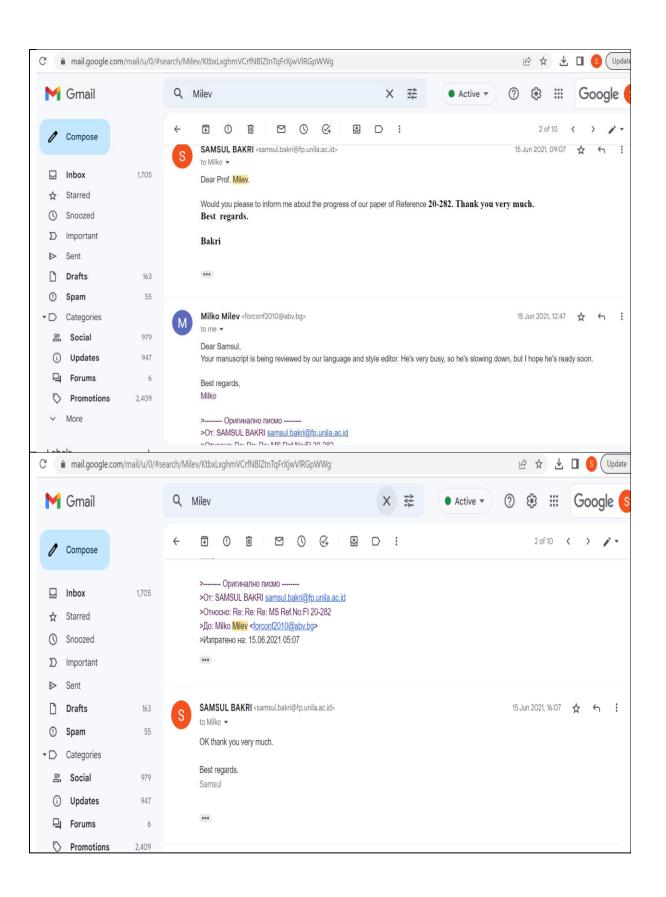


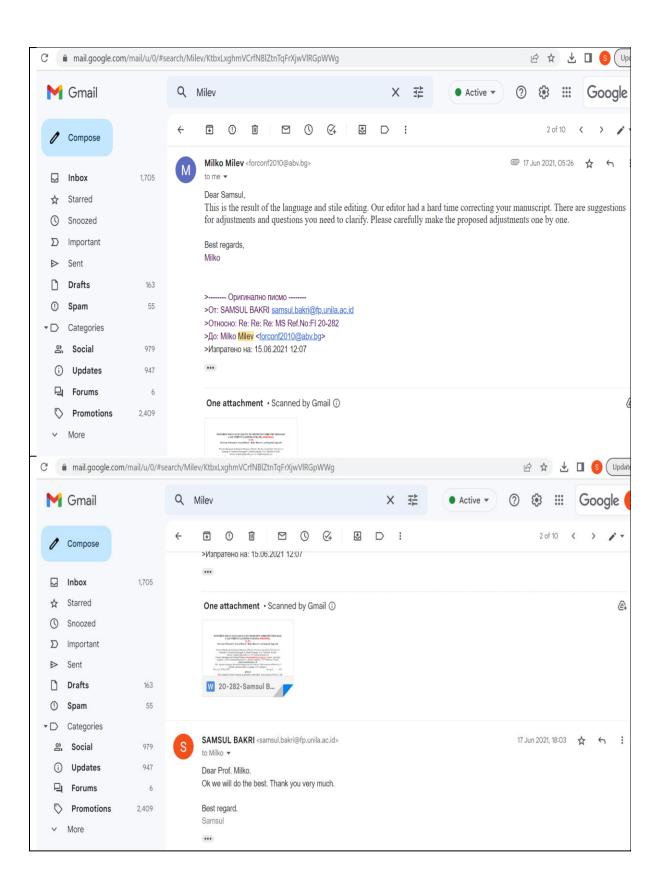


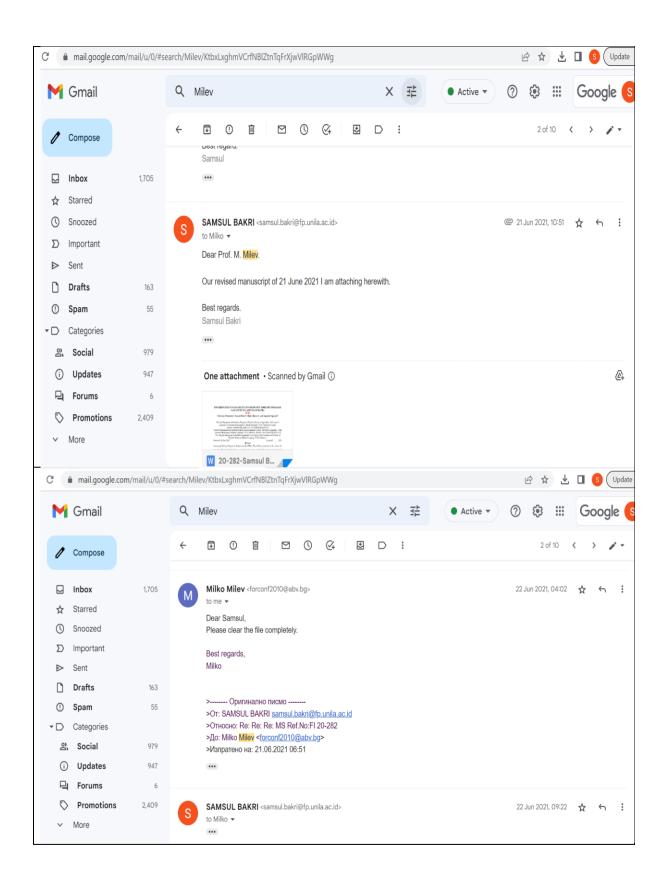


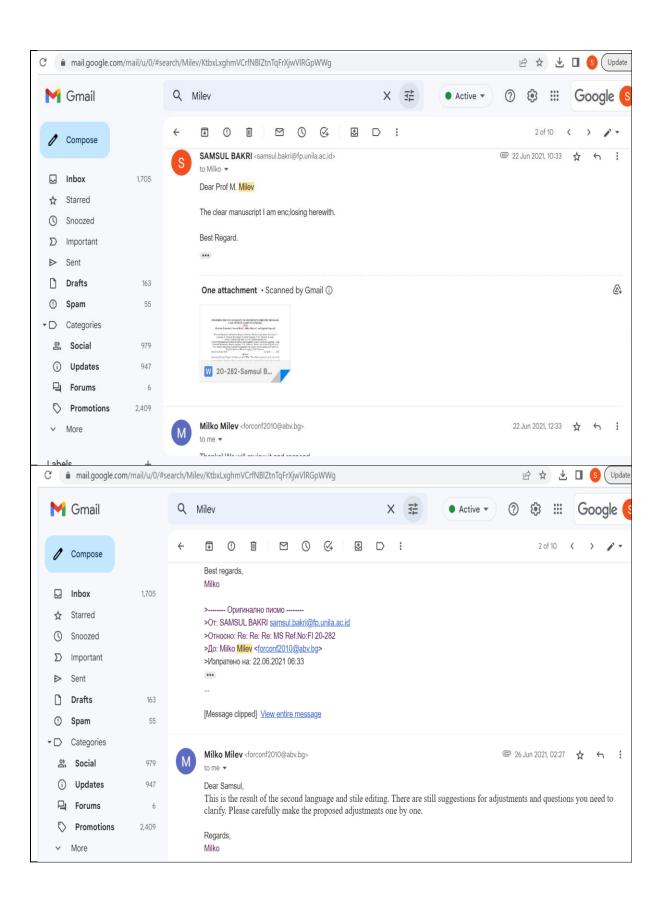


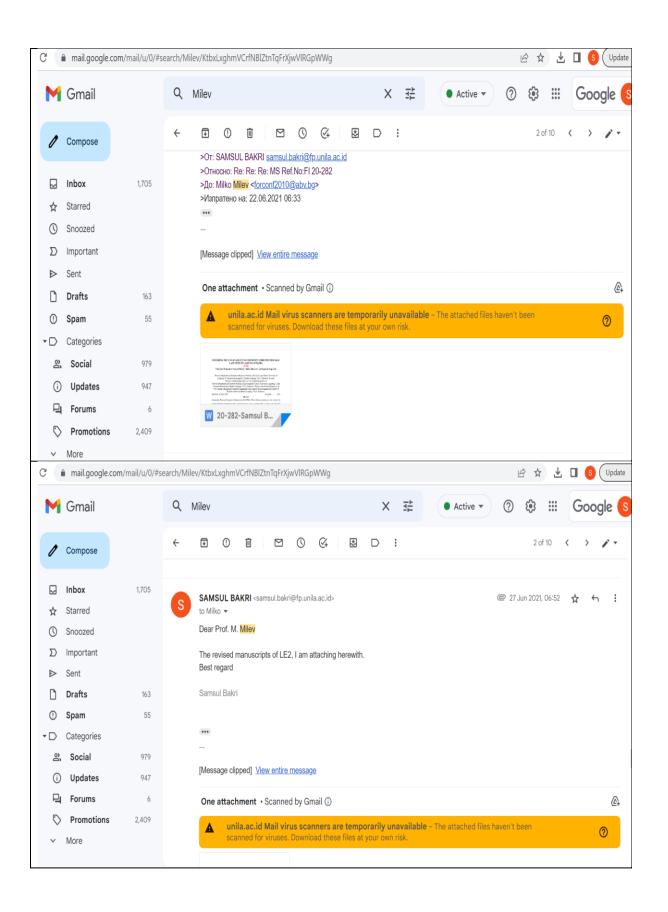


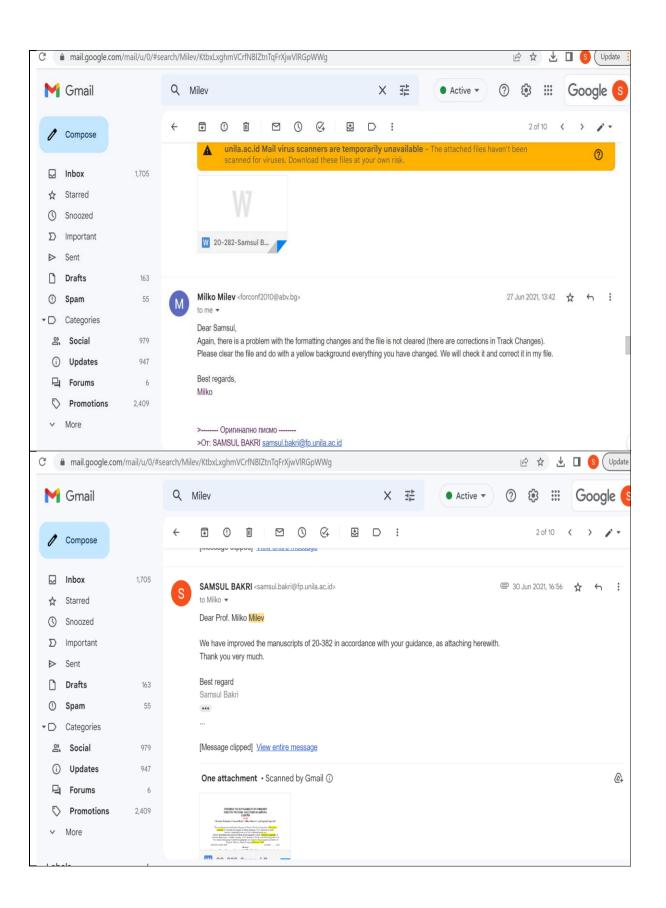


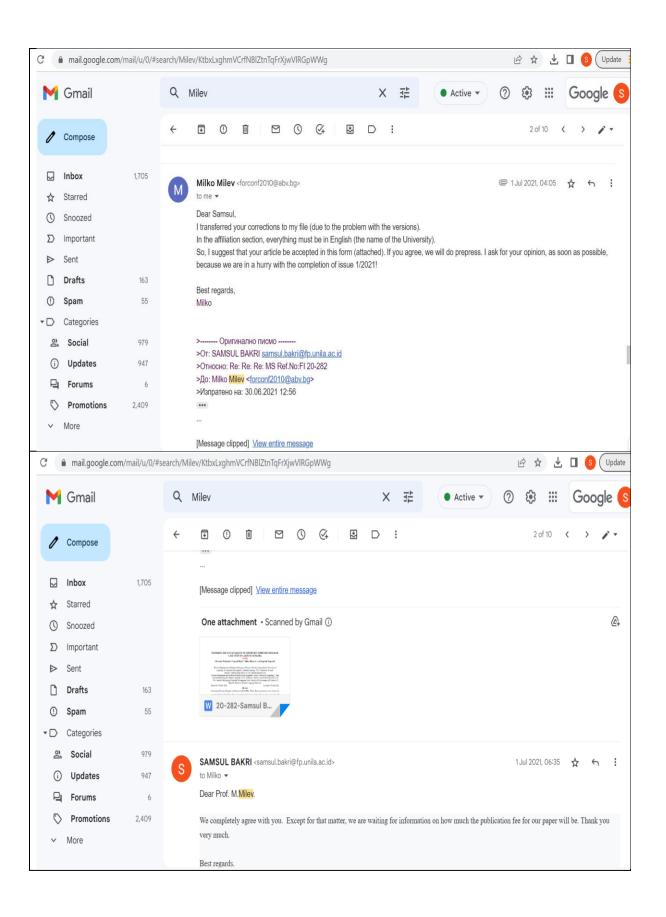


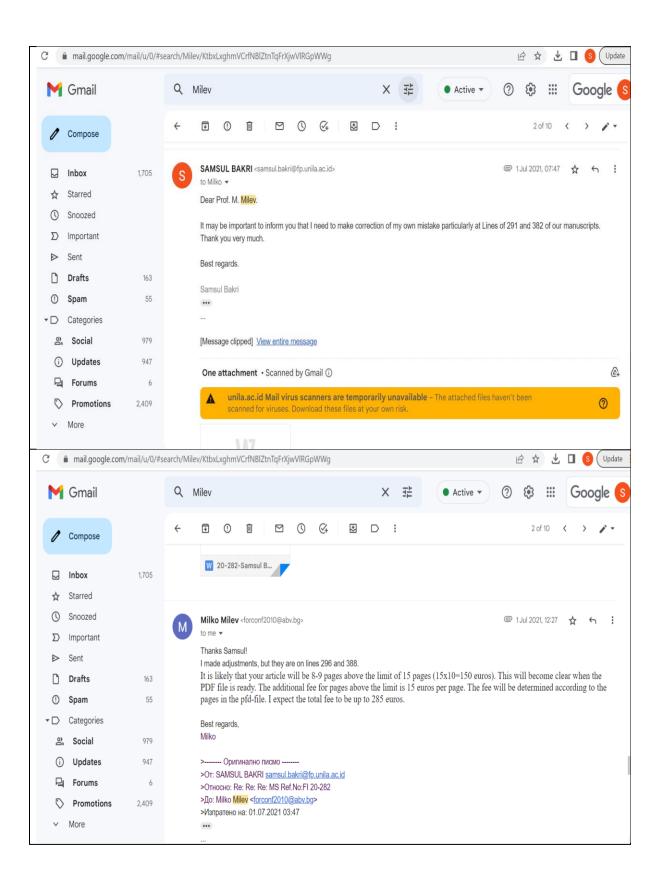


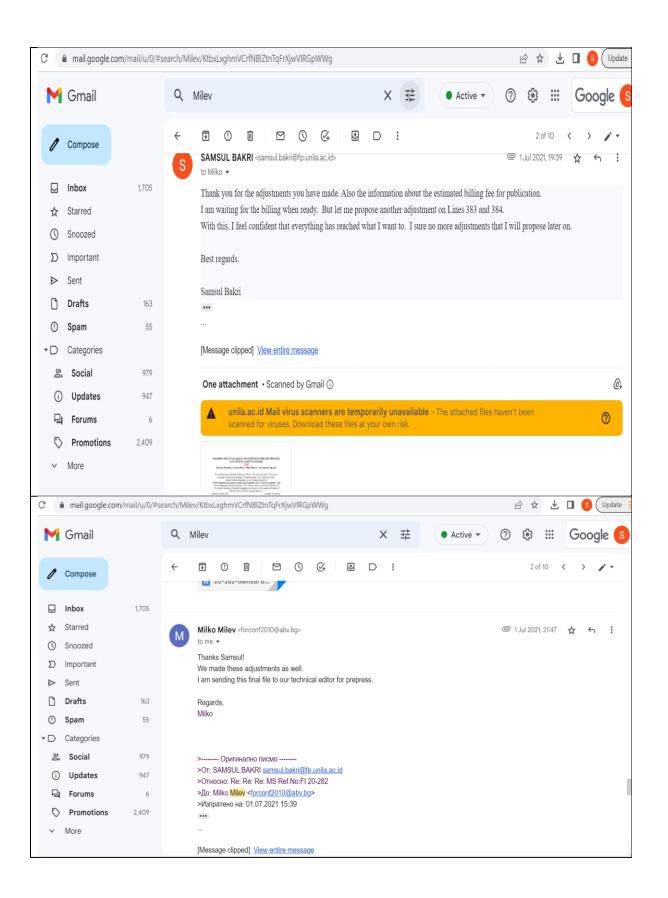


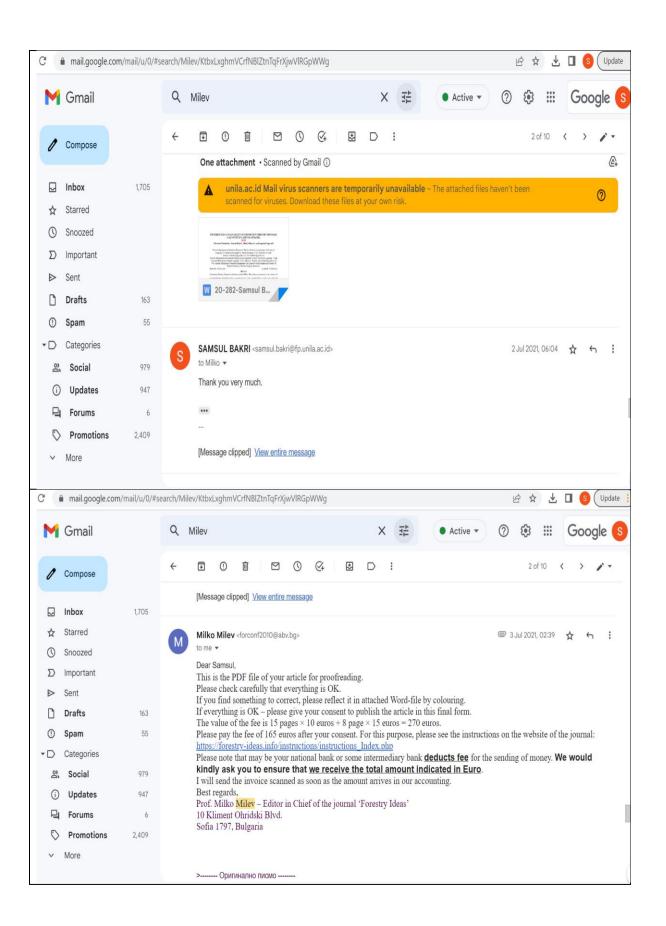


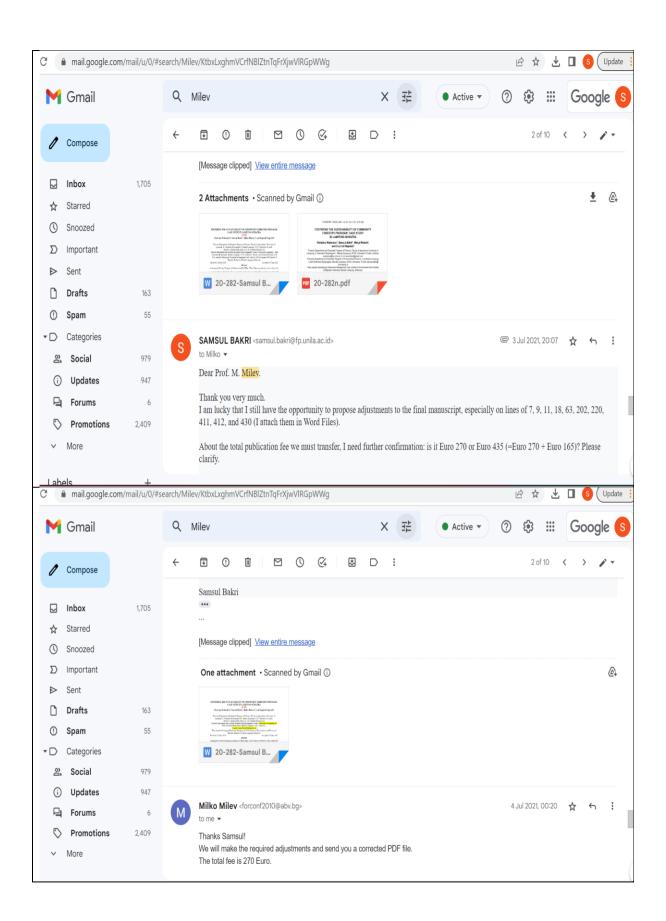


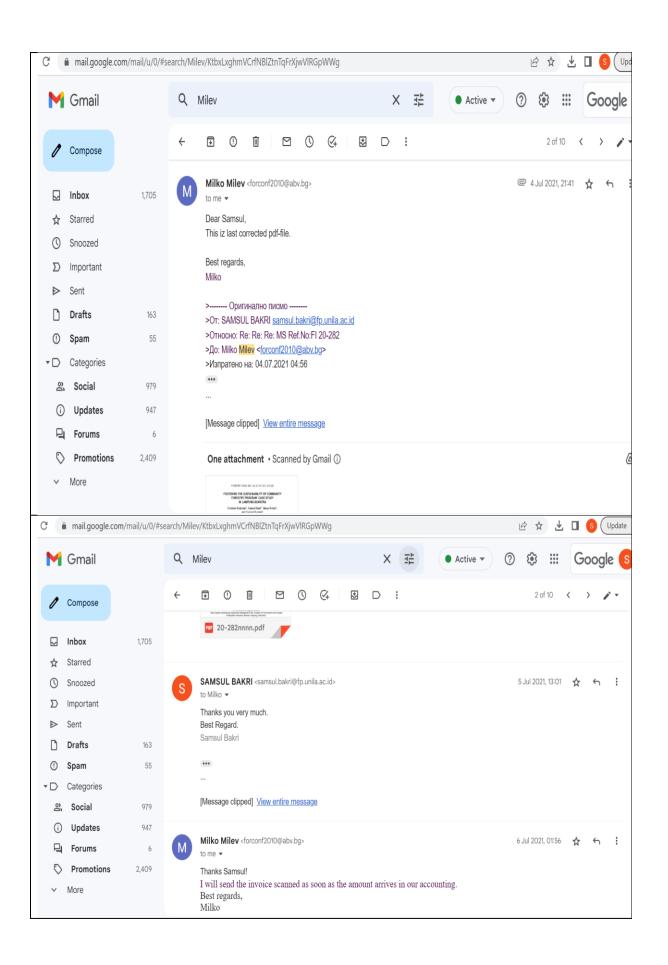


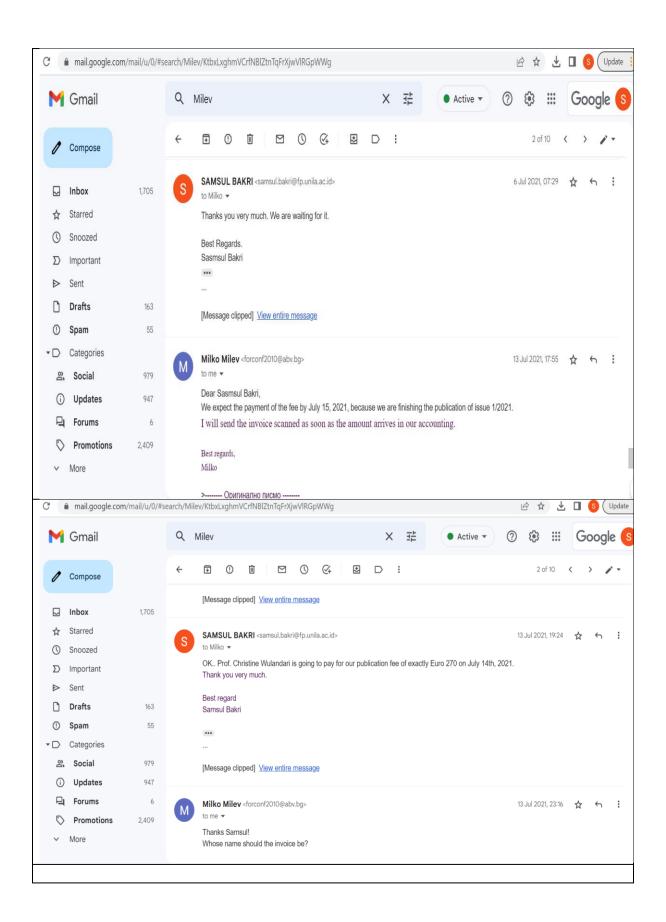












FOSTERING THE SUSTAINABILITY OF COMMUNITY FORESTRY PROGRAM: CASE STUDY IN LAMPUNG-SUMATRA, INDONESIA

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Abstract

Received: 26 May 2020

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Accepted:2021

The Community Forestry Program in Indonesia (called HKm: Hutan Kemasyarakatan) as the scheme for recovering forest degradation from encroachment has been operating for 13 years ago, but untill nowadays there is no available gridline for fostering its sustainability (SUST). The HKm Authority, however, still have 22-24 years remain to foster the program before the scheme due. It is in needing both economic and tree biodiversity indicators of every HKm's member land as the guidance for sustaining the program. The income as the economic indicator itself commonly affected by the endogenous and exogenous variables. This research aimed at determining the roles of: (i) the endogenous and exogenous variables on agroforestry income (INCM), (ii) the INCM on tree biodiversity performance (BIODV), and the BIODV on the HKm's program sustainability (SUST). Data collected by interviewing to 230 members of HKm Jaya Lestari located in Way Kanan Regency-Lampung, Indonesia in February-May 2018. We employed OLS regression postulate model to investigate the first purpose and Loglinear Regression to examine the second and the third purposes. Minitab Version 16 software applied for the models' goodness-fits test and parameter optimization at 90 and 95% confident level. The research suggest: (i) the endogenous variables with positively affect INCM were the family number size, participation in extension activities, land holding acreage, the tribes whose Sundanese and Semendonese were higher than Javanese, and with negatively effect was the land elevation; whereas the exogenous variable affected negatively namely the rural facility construction and nursery demonstration plot activities; (ii) the higher INCM the higher BIODV, but (iii) the more BIODV the less SUST will be. It recommend that continue in fostering the HKm members by managing the endogenous variables in order to rise up INCM, and then multiply BIODV as well as to broaden HKm members' awareness on voluntary planting some wooden trees as the prerequisite of pursuing SUST.

Key words: forest recovery, agroforestry, income, biodiversity, and sustainability.

Introduction

Sustainability is still remain a major theme in every development process since the Malthusian pessimism aroused in the early century, including in the agrarian sectors that commonly susceptible to the socio-demographical dynamic, market pricing commodity shock,

environmental disturbances, as well as macroeconomic or international policy changes. The phenomena is also experiencing by almost forest management programs in Indonesia including forest recovery from encroachment called HKm scheme (Wulandari and Inoue, 2018). The forest encroachment itself was rampant during Indonesia underwent governmental reformation from authoritarian to democratization regime followed by forest decentralization to local government in the period of 1998-2001. According to McCarthy (2006) during the period the desperate economic situation and disjointed political climate, many Indonesians saw that there would not likely be any punishment for unlawful actions in protected areas. Besides, the poverty, meanwhile, accompanied by lacking of land holding as well as the limited government apparatus for controlling state own forest region were the major triggering on the encroachment phenomenon.

According to Watala (2008) during the period forest cover loss at the protected forest, production forest, Way Kambas National Park and Bukit Barisan National Park were around 80%, 76%, 36% and 16% respectively. So that this province was the first established for the HKm scheme. Under the scheme forest encroachers recruited as the HKm member for 35 years, permitted to manage their claimed land by applying agroforestry gradually, forbidden in cutting tree woods instead of non wood products such as sap, latex, rattan, coffee fruit, vegetable, food crops etc. This HKm scheme can be considered as an incremental planning instead of radical planning due to limited resource or power. The HKm schemes contribution on forest recovery can be indicated by the improvement coverage forested area in Lampung Province.

According to Seno et al (2018) that in this province there has been forest cover improvement from 39,380 to 129,136 ha in between 2001 to 2014. This improvement occur particularly in the state own production forest and protected forest areas. Whereas in the conservation forests or national parks were almost free from encroachment due to very tightly guarding activities. The improvement of forest coverage areas, further, can contributes to the environmental services performance including microclimatic amenity, enhance ecological equilibrium, and at least to reduce infectious or zoonosis diseases incidence such dengue hemorrhagic fever (Seno et al, 2018), malaria (Wigaty et al, 2019), and avian influenza (Rohayati et al, 2018).

Those significant progress of the forest recovery that also maybe contributed by HKm scheme, however, has never been examined its sustainability ye. It is important to note that the sustainability indicator is something dynamic, always change from time to time, and even

sometime move down. Perhaps some years shows in highly performance, but the next year on maybe rise down. The sustainability HKm program, therefore, must be nurtured, managed, and pursued by fostering some of determined variables. The important and relevant variables commonly used are both economic and tree biodiversity performance of every parcels of forest land as the indicators (Wulandari et al., 2018a; Ruchyansyah et al. 2018). According some researchers both indicators commonly are trade off in a forest ecosystem. It was true for conventionally forest science in past, but not for agroforestry system currently.

Agroforestry system, actually can afford both economic and biodiversity all at once. The stratum of vegetations are stake, pole, and seedling can be growing bellow the wood stumpages in the agroforestry system. This stratified tree trunk system means to compose tree biodiversity on one hand and can afford economic benefit for the farmers (Puspasari et al., 2017). Among them that can afford a highly economic benefit for example cinnamon (*Cinnamomum verum*), coffee (*Coffea canephora*.) or cocoa (*Theobroma cacao*) for the stake and pole strata respectively. There are so many vegetation species of seedling stratum that can afford highly economic benefit as well as to contribute the biodiversity enhancement *i.e.* soybean, peanut, some vegetables, aromatic or medical herbs etc. (Bakri et al., 2018)

Applying agroforestry system for the HKm members, therefore, is an prominent way to meet their obligation for forest recovering beside to provide for their family income. But, the farmers' ability certainly will be constrained by some endogenous and exogenous variables. Their stock of knowledge and skill, their physical capital, or productive asset available are the endogenous variables that are possibly controlled internally by HKm management. The skill and knowledge level, however, are commonly affected by their socio-demographic variables including age, sex, family size, education, culture or ethnicity, group involvement, participation in extension, access to information, distance to market place (Idayanati et al., 2019). Besides, the skill and knowledge land acreage, the ownership of hand phone, grocery, fishpond, motor bike will be become productive capital that determine their productivity and will shed out in the form of their income later on. Additionally the exogenous variable including the availability of rural public investment as well as the social safety net maybe impact to their income.

Triggering by some incentive that possibly be generated by the economic benefits from miscellaneous agroforestry yields, it is normal to expect that the farmers will add various tree species voluntarily on their land, particularly whenever their income can be promoted by fostering the HKm authority. In line with this background, it is needing to build model

prediction of farmer income as the function of both the endogenous and exogenous variables and then the income need to predict to tree biodiversity performance as well as the control the sustainability of the HKm program. This research, therefore, was conducted with the aims of: (i) Modeling the HKm members' income from agroforestry yield (INCM) based on their endogenous and exogenous variables, (ii) Modeling tree biodiversity (BIODV) performance base on INCM, and (iii) Modeling the HKm sustainability program as the function of the BIODV. These three series model will become reliable tools in planning to foster the HKm Schemes sustainability endeavor in Indonesia.

M aterial and Methods

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This study consists of a field survey and data analyses, from February to May 2018. The field survey was conducted at Talang Mangga Village, Banjit District, Way Kanan Regency, Lampung Province, Indonesia (Fig. 1). Data were collected through interviews using questionnaires guidance to 230 HKm members. The cluster random sampling method on a population of HKm Mangga Jaya group members totaling 697 households and composed of 9 sub groups. The sub-grouping is formed based on block area that may consist of one or more village. Each sub group has about 73 to 76 households as members. Each sub group is treated as the cluster. We randomly drew samples of 25–26 households in each sub group as potential respondents so total our samples is 230 households, and we call this as 230 respondents. As to the decision about 25–26 respondents as the minimum size of sample per sub group is intended of having normal distribution of the data. According to the Central Limit Theorem (Johann Karl Gauss 1777-1855 as cited by Sang and Hae 2017; Lunsford et al. 2006; Dinov et al. 2008; Ghasemi and Zahediasl 2012) if the sample data size is large enough, it will follow a normal distribution regardless of the form of the population distribution. Sang and Hae (2017) and also Ghasemi and Zahedials (2012) have proven a sample size of >30 is the golden rule to meet normal distribution, while Lunsford et al. (2006) and Dinov et al. (2008) the golden number of minimum size is 25 members.

Commented [A1]: Using questionnaires?

Commented [A2]: Explain the distribution of samples: one village? Or more.

One block of areas of Community Forest?

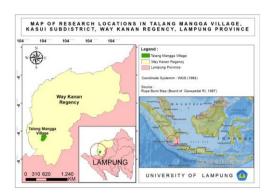


Fig. 1. Research location (Source: Redesigned based on Rupa Bumi Map, Board of Geospatial RI, Bogor, 1987)

Model Approach and Testing Hypotheses

In accordance with the aim of this research there are three measured response variables: 1) the farmers' income 2) the tree biodiversity indices (BIODV), and 3) the sustainability of HKm program indices (SUST). As for the surrogate of three are explianed in the following.

Model I: The Farmer Income

The farmer's income from agroforestry yields (INCM) is intended to depict their welfare under HKm program. In this research, ECNM is measured by using the total income per family per annum, the income from cultivation on HKm land only, such as latex (rubber sap), coffee bean, areca nut etc. The increasement INCM is expected to become an important variable in determining the improvement of tree biodiversity of every land parcel (BIODV) belong to HKm members. The BIODV itself is a good indicator of the forest ecosystem recovery process particularly agroforestry system instead of monoculture cropping pattern-.

According to Idayanti et al (2019), INCM is significantly influenced by age, sex, and number of dependents. While as reported by Puspasari et al (2017), there are no real differences between ethnicities in earning income. Setiawan et al. (2014), however, proved that in this study area Javanese ethnicity was more resilient in increasing their income than ethnic Lampung and others in making a living. Meanwhile, in the local forestry institution namely KPH Bukit Punggur (2014) Strategic Plan document, it is stated that the HKm members in this research area are composed of Javanese, Sundanese, Lampung, and Semendo ethnic groups. The first two ethnicities are immigrants while the others are native ethnicities who are very adaptive to agroforestry cultivation legacy from their ancestor. The ethnicity can be considered as the surrogate of a traditionally cultural bundle that have accumulated day by day along history. The

Commented [A3]: The logical flow of presenting the argumenst need to be revised.

Commented [A4]: I believe this is a new paragraph?

Commented [A5R4]: OK, thanks

different ethnicity can be utilized for contrasting skills and local knowledge in relation their productivity in agroforestry cultivation. This variable, therefore, should be counted on every community development plan included in the fostering to behave more efficiently in earning from agroforestry yields (INCM). The earning, in turn, will be the basic for stimulating HKm member to plant wooden tree crops other than rubber. The INCM modeling functioning as the endogenous and exogenous variables of household that in detailed summarized in Table 1.

Model I as the INCM prediction is expressed in Formula (1):

```
INCM_i = \alpha_0 + \alpha_1 AGE_i + \alpha_2 SEX_i + \alpha_3 FMLSZ_i + \alpha_4 VDAM_i + \alpha_5 GADM_i + \alpha_6 AJOB_i + \alpha_7 CLVTN_i
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$$\alpha_8D1$$
 ELS_i + α_9D1 JHS_i + $\alpha_{10}D2$ SND_i + $\alpha_{11}D2$ SMD_i + $\alpha_{12}D2$ LPG_i + $\alpha_{13}LHLD_i$ +

- α_{14} UPLN_i + α_{15} RICEF_i + α_{16} GOAT_i + α_{17} FPOND_i + α_{18} MBIKE_i + α_{19} GCERY_i + α_{20} TVOW_i
- 167 + α_{21} HPOW_i + α_{22} EXTN_i+ α_{23} ELVT + α_{24} DLND_i + α_{25} DVLM_i + α_{26} DDST_i + α_{27} RINVT_i +
- α_{28} SCNET_i + α_{29} NURSY + ϵ_{i} , (1)

where: INCM is income from agroforestry yield of respondents; α_0 is intercept; α_1 - α_{29} are

parameter Model I; \in is residual error Model I; i=1, 2, ..., 230 are respondent numbers; the

other symbols correspond to the symbols in Table 1.

The working hypothesis Model I as is expressed in the following:

Ho: $\alpha_1 = \alpha_2 = \alpha_3 = \dots = \alpha_{29} = 0$ (among the 29 variables enlisted in Table 1, there is no variable

that affect the family's income significantly);

 H_1 : $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq ... \neq \alpha_{29} \neq 0$ (among the 29 variables enlisted in Table 1, at least there would

be one variable that affects the family's income significantly).

The testing hypothesis and optimization parameters process for Model I was conducted by applying Minitab 16. The (*F*)isher Statistic employed to examine the goodness fits test for the Model I at confident level of 90 and 95%. Then to depict every parameter of predictor variables we employed the *T* statistic at confident level of 90 and 95% as well.

Model II: The Tree Biodiversity Prediction Model

As mentioned before that Model II is intended to predict the probability of tree biodiversity improvement of every land parcel belong to HKm members. The Model II is predicted by single variable of INCM. This model is expected can express that HKm members will add more tree species voluntarily at their land whenever their income from agroforestry yield (INCM) is risen up. In order to depict this objective, we employed the Loglinear Regression or Logistics regression that expressed in the Formula (2):

 Commented [A6]: Why education is not included in here?

Commented [A7R6]: Education is included in the sociodemographic factor that has mention in Table 1.

Commented [A8R6]: Education variable is defferentiated in 4 categorical level: have no schooling (as the reference), elementary school, Junior high school, and senior high school.

190	$Ln \frac{P(BIODVi)=1}{1-P(BIODVi)=1} = \beta_0 + \beta_1 INCM_i + \zeta_i$	(2)
	$1 = P(R(O)(V_1) = 1$	` '

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where: Ln is logarithm operator using the natural number (e=2,718281828459...) as the basis; 192 P(BIODV_i) = 1 are the probability of being succeeded in improving tree biodiversity of the 193 respondent i^{th} ; 1-P(BIODV_i) = 1 are probability of being fail in improving tree biodiversity of 194 195 respondent i^{th} ; β_0 is intercept; β_1 is parameter Model II; ξ_i is residual error Model II; i = 1, 2, ...230 are respondent numbers. The working hypothesis of Model II is expressed in the 196 following: 197 H_0 : $\beta_1 = 0$ (the family income do not affect the tree biodiversity performance significantly); 198

 H_l : $\beta_1 \neq 0$ (the family income affect the tree biodiversity performance significantly). 199

Commented [A9]: Seems this is not really biodiversity indicator of this only depends on trees diversity – just call this tree diversity (?)

Commented [A10R9]: Yes, we are agree with you Sir.

Commented [A11R9]: OK, thanks.

Table 1. The endogenous and exogenous variables of fami	v head and their data scoring in model em	ployed as well as the ex	spected sign in regression result

Group of variable and	Symbol	Unit or data	Scoring	Expected Sign in Regression: Brief explaination in relation to the
the variables	Symbol	scale measured	Scoring	income per family
Social demographic*				
1. Age	AGE	year	integer number	- : the older the lessen their productivity will be
2. Sex	SEX	catagorical	=1 if man; =0 if other	+ : man more powerfull in cultivation than woman
3. Family size number	FMLSZ	person	integer number	+ : the more person the more income
4. Role in village administration	VADM	-	=1 if village administrator	+ : will earn more access to information and power
Role in HKm group	GADM	-	=1 if administrator of HKm	+ : will earn more access to information and power
6. Additional job	AJOB	-	=1 if any	+ : will bring other source of income
7. Cultivation applied	CLTVN	-	=1 if agroforestry; =0 if monoculture	+ : who applied agroforestry have miscellaneous yield so that more secure from cropping failure as well as from pricing market shock
Education level* (0 = never schooling)				11 2
8. Dummy elementary school	D_1 _ELS	dummy	=1 if elementary; =0 if others	+ : graduate ELS more innovative then who never schl.
9. Dummy junior high school	D_1 _JHS	dummy	=1 if yunior high sch.; =0 if others	+ : graduate JHS more innovative then who ELS
Ethnicity* (0 = Javanese tribe)	_	•		
10. Sundanese	D_2 _SND	dummy	=1 if Sundanese; =0 if others	- : Sundanese less adaptive in agroforest than Javanese
11. Semendonese	D_2_SMD	dummy	=1 if Semendonese; =0 if others	+ : Semendonese more adaptive than Javanese
12. Lampungnese	D_2 _LPG	dummy	=1 if Lampungnese; =0 if others	+ : Lampungeses the most adaptive in agroforest
Productive assets*				
13. Total land holding acreage	LHLD	ha	rational number	+ : the more total land holding the more income
14. Up land acreage inside HKm area	UPLN	ha	rational number	+ : the more up land in HKm area the more income
Rice field inside HKm area	RICEF	ha	rational number	+ : the more rice field in HKm area the more income
Goat number ownership	GOAT	ha	integer number	+ : the more number goat the more income
17. Fish pond ownership	FPOND	categorical	=1 if own; =0 if other	+ : who owe fishpond will earn more income
18. Motorbike ownership	MBIKE	categorical	=1 if own; =0 if other	+ : who owe motor bike will earn more income
19. Small grocery shop ownership	GCERY	categorical	=1 if own; =0 if other	+ : who owe small grocery will earn more income
Information and physical accesibility *				
20. TV ownership	TVOW	categorical	=1 if own; =0 if other	+ : who own TV will have more productive information
21. HP ownership	HPOW	categorical	=1 if own; $=0$ if other	+ : who own HP will have more productive information
22. Extension participation	EXTN	-	=1 if active =0 if other	+ : who participate in extension have more productive
23. Elevation of land area	ELVT	m a.s.l.	rational number	- : the higher the more effort and the less income
24. Distance to land area	DLND	minutes by bike	rational number	- : the farther distance the more time or transportation cost needed
Distance to village market	DVLM	minutes by bike	rational number	- : the farther distance the more time or transportation cost needed
26. Distance to subdistrict centre	DDST	minutes by bike	rational number	- : the farther distance the more time or transportation cost needed
Beneficiary from rural facility investment				
27. Rural facility investment	RINVT	-	=1 if any; =0 if other	 : public investment activities project such as rural road improve will make trade off time and negatively impact to agroforestry activities
28. Social safety net	SCNET	-	=1 if any; =0 if other	+ : social safety net also will affect positively to income
29. Nursery demonstration plot	NURSY	-	=1 if any; =0 if other	+ : the plot will affect positively to the farmers skill & their income.
37 . d. 1 . 1.1. date.1			**	

²⁰⁰ Note:* endogenous variables, **the exogenous variables.

For the H_I above, a positive number of parameter β_1 was expected that would be produced later on through optimization process using statistical software of Minitab 16. The Gald statistic was employed to test the goodness fits of model. Whereas the significancy of parameter model was tested by employing the Wald statistic. Both Gald test and Wald test were employed at confident levels of 90 and 95%.

Model III: The HKm Program Sustainability Perdiction Model

Model III is intended to predict the sustainability of the HKm program (SUST) by using single predictor variable of BIODV. The model III is expressed in the Formula (3):

$$\operatorname{Ln} \frac{P(\operatorname{SUSTi})=1}{1-P(\operatorname{SUSTi})=1} = \pounds_0 + \pounds_1 \operatorname{BIODV}_i + \pi_i$$
(3)

where: Ln and i are as in formula (2); $P(SUST_i) = 1$ is the probability of respondents $-i^{th}$ succeeded to support HKm program sustainability; $1 - P(SUST_i) = 1$ is the probability of respondents $-i^{th}$ fail to support HKm program sustainability; \mathcal{L}_0 is intercept; \mathcal{L}_1 is a parameter Model III; π_i is residual error of Model III.

The working hypothesis Model III is expressed in the following:

 H_0 : $\pounds_1 = 0$ (the tree biodiversity performance do not affect the sustainability program significantly);

 H_I : $\mathcal{L}_1 \neq 0$ (the tree biodiversity performance affect the sustainability program significantly).

Also in the Model III, a positive number of parameter \pounds_1 was expected that would be produced by optimization process using statistical software of Minitab 16. The Gald statistic was employed to test the Goodness fits of the model. Whereas the significancy of parameter model was tested by employing the Wald statistic. Both Gald test and Wald test were employed at confident levels of 90 and 95%.

Results and Discussion

Result in Descriptive Statistic

Very firstly we need to describe three variables that used as the respond variables in the three models regression, namely [INCM], [BIODV], and [SUST]. Having displayed the descriptive statistic of the three variables respond, the three modeling results will be provided consecutively later on. It is important to note from data gathered of the field survey, that lowest [INCM] was IDR 0.15 and the highest was IDR 23 M per year. Briefly distribution of [INCM] is provided in Table 2. Based on this term, the dominant class [ICNM] was <2 M per year, with the

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Logical flow should be improved and to be well developed.

Better to present in two sub-headings: results and discussions.

Results section should be just discussing results. Literature review should be in the earlier section if the references support the choice of variables used. If the literature supports the findings, and these should be used in the discussion section.

Discussion section focusses on making the connection between results to the hypothesis and support the arguments with literature as necessary.

frequency of 91 family (39.4%). This fact can be treated as the bech mark in planning to enhance INCM from agroforestry earning that have to be fostered by HKm scheme.

Table 2. Proportion of family based on their income.

No.	Income Class (IDR M/annum)	Frequency	Proportion (%)
1.	<2.0	91	39.4
2.	2.1 - 5.0	60	26.1
3.	5.1 - 10.0	51	22.2
4.	>10.0	28	12.2

As for the tree biodiversity [BIODV] is defined by addition the wooden tree crop that have planted and successes to grow, The number addition of wooden tree then are grouped in three classes BIODV namely low, moderate, and high. The moderate class is defined in between 3 to 5 species added, while beyond both boundaries are low and high classes of BIODV respectively. The distribution BIODV is described in Table 3. From this table we can appraise for forestry workers, who have been striving their effort to recovery forest degradation (Bakri et al. 2018; Chamberlain et al., 2019). It is the fact that for 11 years HKm's program was operated only did 1.7% or 4 parcels of land covered by the high BIODV. The dominant is still 54.4% (125 parcel of land) low in tree biodiversity performance (BIODV). This fact can be treated as the bench mark in planning to speed up the forest recovery program under the HKm scheme as well.

Table 3. Proportion of the family based on tree biodiversity.

No.	Tree Biodiversity	Frequency	Proportion
	Class		(%)
1.	Low	125	54.4
2.	Moderate	101	43.9
3.	High	4	1.7

The third respond variable is classified as *yes* or *no* in supporting HKm's sustainability program (SUST). The distribution of this data of SUST is provided in Table 4. It is important to note that the criterium for separating between the two class (*yes versus not*) is the compliance of HKm's members to plant the additional wooden tree crops on their land even though without any financial assistant from HKm authority or from other sources except from themselves. In case a member comply is as "*Yes*" to support the probability of the HKm's sustainability

Commented [A13]: Tree diversities?

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program. The revers is as "*No*". This distribution between two is depicted in Table 4. The table displays that more than half of the families are still not support yet the probability of the HKm's sustainability program (SUST). This fact should be taken into account in developing programs to foster the SUST.

Table 4. Proportion of the family who support the probability of the HKm's sustainability program.

No.	Family who support	Frequency	Proportion (%)
1.	Yes	87	37.8
2.	No	143	62.2

For the sake of pursuing the guidelines to foster the SUST, we need to examine the relationship among the three variables consecutively in series models regression. Having known which ones of among both endogenous and exgenous variables (Tabel 1) that significantly affect on INCM, we then can estimate or predict BIODV performance. We, furthermore, use the predicted BIODV to examine the SUST. The three regressions model are presented in the following.

Result of the Regression Models

The Model I is to explain the role both the endogenous and exogenous variables (detail in Table 1) in determining family income from agroforestry in HKm land. The goodness of fits test result for the Model I applied is provided in Table 5. Meanwhile the optimization parameter of variables affecting family income (INCM) can be seen in Table 6.

Table 5. Analysis of variance of role independent variables on family income.

Source	Degree of Freedom	Sum Square	Mean Square	F	P
Regression	33	3746.76	113.54	13.36	0.000
Residual Error	195	1657.55	8.50		
Total	228	5404.31			

Note: S = 2.91552; $R^2 = 69.3$ %; R^2 -adj (adjusted to sample size) = 64.1 %;

F = Fisher Statistic value; P = Probability to miss prediction.

By referring to the P-value=0.000 (in Table 5), it means that we have had no enough fact to reject H_I (that also means there is no enough fact to accept H_0). In other word that the Model I is valid or robust predictor model of INCM that based on both endogenous and exogenous variables of every family at the study area. It is important to realize that there is no breaking any mathematical rules in case we write this P-value=0.0004 because this member is

approximately the same with the originate number. But the *P-value=0.0004* can help the interpretation about the robustness the Model I obtained. It tells us that if we applied the model for predicting INCM based on the 29 predictor (Table 1, the endogenous and exogenous) variables to predict 10.000 families, we will get very highly precision of predicted INCM *i.e.* there will be maximum 4 family miss predicted than the actual ones. Briefly speaking, the confident level of the Model I is more than 99%.

Table 6. The parameter optimization of socioeconomic variables that affected family income.

Predictor	Symbol	Coeff.	SE coeff.	T	P
Constant		4.7200	3.795	1.24	0.215
Social demography					
1.Age	AGE	-0.0059	0.0172	-0.34	0.731
2.Sex	SEX	0.3911	0.7872	0.50	0.620
3.Family size number	FMLSZ	0.4210	0.1386	3.04	0.003
4.Role in village administration	VADM	-0.0072	0.8622	-0.01	0.993
5.Role in HKm group	GADM	-1.2230	1.8350	-0.67	0.506
6.Additional job	ADJOB	-0.0627	0.6643	-0.09	0.925
7. Cultivation applied	CLTVN	1.2030	1.6220	0.74	0.459
Education level (0 =never school	ing)				
8.Dummy elementary school	D_1 _ELS	1.0231	0.7861	1.30	0.195
9.Dummy junior high school	D_1 JHS	0.1139	0.8287	0.14	0.891
Ethnicity (0 = Javanese tribe)					
10.Sundanese	D_2 _SND	1.6366	0.5892	2.78	0.006
11.Semendonese	D_2 SMD	1.8658	0.6891	2.71	0.007
12.Lampungese	D_2 _LPG	0.7410	1.5850	0.47	0.640
Productive assets					
13.Land holding acreage	LHLD	3.9783	0.2681	14.84	0.000
14.Land acreage	UPLN	0.1412	0.6829	0.21	0.836
15.Rice field inside HKm area	RICEF	-0.9278	0.8834	-1.05	0.295
16.Goat number ownership	GOAT	-0.0594	0.4735	-0.13	0.900
17.Fish pond ownership	FPOND	0.2654	0.4802	0.55	0.581
18.Motorbike ownership	MBIKE	-0.5104	0.5406	-0.94	0.346
19.Small grocery shop ownership	GCERY	-0.3521	0.5735	-0.61	0.540
Information and physical accessi	bility				
20.TV ownership	TVOW	-0.1725	0.5691	-0.30	0.762
21. HP ownership	HPOW	-0.4943	0.6455	-0.77	0.445
22. Participation in Extension	EXTN	2.3851	0.5094	4.68	0.000
23.Elevation of land area	ELVT	-0.0072	0.0025	-2.93	0.004
24.Distance to land area	DLND	-0.0229	0.07400	-0.31	0.758
25.Distance to village market	DVLM	-0.0229	0.0740	-0.31	0.758
26.Distance to district centre	DDIST	-0.0575	0.0543	-1.06	0.291
Beneficiary from rural facility in	vestment				
27. Rural facility investment	FIVST	-2.4571	0.6511	-3.77	0.000
28. Social safety net	SCNET	0.9818	0.9044	1.09	0.279
29. Nursery demonstration plot	NURSY	-2.8541	0.5818	-4.91	0.000

Note: the bold numbers are significant at level < 1.0 %.

As for which ones among the 29 variables that affect the ICNM significantly, we must examine their probability to miss (P) in Table 6. The table connoted that there are eight variables affect to INCM significantly with P < 1% (or confident level more than 99%) namely

the variables of the family number size (FMLSZ), the ethnicity where the Sundanese (D_1_SND) and Semendonese (D_1_SMD) compare to Javanese, land holding acreage (LHLD), participation in extension (EXTN), land elevation position (ELV), rural investment facility (FISVT) and nursery development plot project (NURSY). In other words, against to these eight variables, there is no enough fact to reject H_1 (all at to accept H_0). Additionally, that the last two variables mentioned happen to be are the exogenous variable where the others six are the endogenous variables. Fortunately the effect of the six endogenous variables are in the same direction with the INCM, the better quality of each variable the better INCM will be. On the contrary, for two remain of the exogenous variables, the INCM will reduce significantly if the activities of both FISVT and NURSY exists.

As for the 21 variables remain on the contrary, there is no enough fact to reject H_0 (or all at once to accept H_1). All these variables have any effect significantly to the INCM. As mention before, the Model II is intended to explain tree biodiversity (BIODV) based on the family income (INCM). The goodness fits test of the Model II as well as the significancy effect of INCM on the BIODV is provided in Table 7. This table depicts that there is no enough fact to reject H_1 (and all at once to accept H_0). In other word that the INCM affects significantly on the tree biodiversity (BIODV). In case the INCM at average rise up as much as IDR 1M per year, the BIODV will improve by 1.13 as indicated by its Odd Ratio and this improvement is very significant that indicated by its $P_{value} = 0.000$ or with confident level is more than 99%.

Table 7. The Wald Test of Model II: The logistic regression model of the effect of income to the tree biodiversity performance.

Predictor	Symbol	Coefficient	SE	Z	<i>P</i> -	Odd	95% Co	
	·	(Coeff.)	Coeff.		value	Ratio	Lower	Lower Upper
Constant	-	-0.330442	0.200843	-1.65	0.100	-	-	-
Income	INCM	0.122602	0.034123	3.59	0.000	1.13	1.06	1.21

Note: G = Gald statistic; Z = Coeff./SE Coeff.; Log-Likelihood = -149.873; Test that all slopes are zero result <math>G = 15.685; DF = 1; P-value = 0.000

Developing Model III is motivated by seeking some clues to compose a guideline for fostering every HKm member in order to contribute the probability increasement of the HKm's sustainability program (SUST). The goodness fits test of the Model III as well as the significancy effect of BIODV as the predictor of SUST is provided in Table 8.

Table 8. The Wald Test of Model III: Logistic regression of the effect of tree biodiversity performance to the sustainability of HKm.

Predictor	Symbol	Coefficient	SE	Z interva				
	•	(Coeff.)	Coeff.		value	Ratio	Lower	Upper
Constant	-	-0.138836	0.199487	-0.70	0.486	-	-	-
Tree biodiversity Performance	BIODV	-0.660920	0.275737	-2.40	0.017	0.52	0.30	0.89

Note: G = Gald statistic; Z = Coeff./SE Coeff.; Log-Likelihood = -149.637; test that all slopes are zero result G = 5.801; DF = 1; P-value = 0.016.

Table 8 indicates that there is no enough fact to reject H_1 (all at once to accept H_0). It means that the tree biodiversity performance (BIODV) is a reliable variable to perdict the HKm's sustainable program (SUST). But unfortunately, in case the BIODV improve from low to moderate or to high levels, the probability of the to become SUST will reduce by 0.52 as indicates by its Odd Ratio with confident level is more than more than 98.3% as indicated by its $P_{\text{-value}} = 0.017$.

Discussion

The role demographyc variables on income

Among the demographic variables, only the total family size number variable (FMLSZ) affects the INCM, if the other variables are constant, a family who has more than one family member will have an increase in income around IDR 0.4210 M per year. The effect of the addition of labor supply (family members) to the region is very significant (P = 0.003). This phenomenon means that the marginal labour productivity in the region is still positive in stimulating the INCM. Because the core business of HKm authority is to release this protected forest from human occupation, it is a must to employ a policy to enhance labor skill by extension or training program instead of mobilizing labor from outside area (Idayanti et al., 2019). Training silviculture cycle from seedling to post harvesting will make labor augmented by knowledge and technology, in turn will increase their work productivity and then lessen the excess demand of traditional labor (Supriadi et al., 2018). This finding is congruence with the effect of the landholding acreage variable (LHLD) that will be elaborated below.

The other variables of demographics, namely. age, sex, role in village administration, role in a HKm group, additional job, and cultivation applied do not affect significantly on the INCM. As depicted in Table 5, there is no significant effect of SEX, as the income of family (INCM) is relatively the same regardless the sex of the head of family. Similar to SEX is the variable of

Commented [A16]: This would be the common case whether community forestry program. What are the unique results that resulted from the analysis that you could say related to community forest program?

Commented [A17R16]: Because the main mission of HKm authory is to release this protected forest from human occupation, it is a must to employ a policy to enhance labor skill by extension or trainning program instead of mobilising from out area. Trainning silviculture cycle from seedling to post harvesting will make labor augmented by knowledge and technology, in turn will increase their work productivity and then lessen the excees demand of traditional labor.

CLTVN, a family applying an agroforstry pattern indeed has a higher INCM than that using monoculture, but the difference is not significant (P = 0.459).

Another AGE variable shows that the family income (INCM) will decrease with increasing age of the family heads each year, however, the effect is not significant (P=0.731). This reflects the agricultural work in the region is resilient enough to change in age of the farmers. So are the effects of the variables of VADM, GADM, and ADJOB. The INCM of the family heads involved in the village administration (VADM) are commonly lower than those free from that affair, but the difference is not significant (P=0.993). It is similar to GDAM, with P=0.506. Both cases suggest that voluntary work does not significantly disturb families in making a living. An interesting fact there is the effect of job addition (ADJOB) such as construction labour, pedicab drivers, etc. The families having the ADJOB tend to lose their opportunity to intensify their agricultural work and have lower income than those not having additional jobs.

In short, the FMLSZ is the only demographic variables that can enhance the INCM. In development practice, allocating more manpower to this region can be the only opportunity available for forest planners to increase economic performance as a necessary condition for enabling sustainable development besides the biodiversity of any landholding plots of. For the sake to find some opportunities in enhancing the economic performance, we need to examine other variables that give significant effects on the INCM as also depicted in Table 3.

Effect of education level on income

It is normal to expect an educational background on people's productivity in economic sectors, and so is it in the agroforestry sector in the study area. The higher people's education background the higher their innovativeness, that will be accompanied by their higher productivity reflected in their income. This expectation, unfortunately, cannot be achieved in this study. As referring to Table 5, the level of education of the family heads does not significantly affect the ICNM. Family heads with an Elementary School education level (D_{1} _ELS) have an income of IDR 1.0231M, compared to those who never attended school . The difference , however, is not significant (P = 0.195). The similar effect occurs with family heads categorized as junior high school diploma holders (D_{1} _SHSC). Although the family heads of the D_{1} _YHSC category have an extra of IDR 0.1139 M per year compared to those categorized as D_{1} _ELM, the difference is not significant (P = 0.891).

In brief the 3 levels of education background of the family heads have no significant impact on the ICNM. It can be concluded that the education background has not yet

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significantly stimulated innovativeness so that there are no significant effects on the ICNM as well. The phenomenon, however, will be very useful for forest planners eager to look for an INCM elevating strategy, at least that the forest planners will not need to separate the family heads based on the education level in conducting extension activities etc. The extension program itself gives a significant effect on the INCM, as discussed below.

Effect of ethnicity on income

Contrary to the educational level, the ethnicity affects the INCM significantly. The family heads in the study area belong to 4 ethnic groups: Javanese, Sundanese, Semendonese, and Lampungese. In order to make a comparison of the magnitude effect among the four ethnic groups on the INCM, the Javanese becomes the reference. The scoring applied for the Javanese is equal to θ in the ICNM modeling (Table 1). The results, in Table 5, show that the Lampungese (D₂_LGP) indeed have an average income (ICNM) of IDR 0.7410 M per year more than that of the Javanese do. But the difference is not significant (P = 0.640). On the contrary, the INCM of the Sundanese reaches IDR 1.6366 M per year more than that of the Javanese. The difference is s significant (P = 0.006 or <1 %). It seems that the Semendonese people are the most productive among the four ethnic groups in the study area. The family income of the Semendonese (D₂_SMD) is IDR 1.8658 M per annum more than that of the Javanese. The difference is also significant (P = 0.007 or <1 %).

It is interesting to discuss the differences in INCM based on the ethnicity analysis. Setiawan et al. (2014) revealed that the Lampungese and the Semenodenese in the study area could be regarded as the native ethnic groups whereas the Javanese and the Sundanese were the newcomers. The natives commonly cultivate cash crops, including coffee, cocoa, cinnamon, and rubber through the agroforestry system. Meanwhile, according to Nurhaida et al. (2007) both the Javanese and the Sundanese migrated from Java Island (or their offsprings) in between 1961 and 1965 under the of National Reconstruction Scheme. The newcomers do not do much cash crop cultivation through the agroforestry system. Instead, they do the perennial crops cultivation especially for rice cultivation culture. Many of them, in fact, have no background in any agricultural livelihood at all. From this background it is easily understood why the Javanese come last in the INCM from rubber agroforestry cultivation. Reversing the argument, we have proven why the Semendonese (D2_SMD) is the most productive ethnic group in the study area, shown by their INCM.

We would be trapped in a wrong argument if we insist on using the origin of the people to explain the Sundanese or the Lampungese productivities. Although the Sundanese people are

the newcomers, they commonly live side by side with the Semendonese. Like the Semendonese, the ancestors of Sundanese in West Java commonly lived in the upper area of a landscape, cultivated rice on terracing land combined with fish ponds and wood plants in their backyard. The agrocomplex system pattern in the Sundanese community in the study area was found during the field research. Except for cultivating rice and managing fish ponds, both the Sundanese and the Semendonese prefer to live in an area biophysically very similar so they commonly live side by side in the study area. Sundanese, however, is more intensive in adopting skills for the cultural technique of rubber agroforestry in daily work. This background can serve as an appropriate explanation why the Sundanese are more productive than the Javanese are in the Study area. A reverse argument perhap could explain better why the productivity of the Lampungese is not different from the Javanese as expressed by their average annual income. The implication in the developmental economic planning in relation to the four ethnic groups in the study area that planners should be taken into consideration whenever they convey the technical assistant in extension activities.

In line with this finding, we should take a valuable lesson learnt provided by Nurhaida et al (2007) that proved the use local languages in accordance with their ethnicity (Javanese, Semendonese, and Lampungese) in pictured story books had been break trough effectively against the literacy barrier in conveying messages and improved significantly the knowledge's of low literate community about soil and water conservation on recharge areas of West Lampung Regency. Nurhaida et al (2011) who also conducted on a research at buffer zone of Way Kambas National Park-Lampung Province reported the use three tribal languages (Javanese, Sundanese, Balinese) in cartoon media of fable were much more effective in conveying messages of wildlife conservation than that of in Indonesian language. Beside the language, the local knowledge about the matter (that had been inventoried before) also to be utilized in the extension media designed by Nurhaida et al (2007 and 2011). In Figure 2 describe that agroforestry pattern demonstrated by Semendonese or Sundanese should be introduce to Javanese or Lampungese by a subtle extension methods in order to be accepted without any cross culture barrier.

Commented [A21]: How? So the community forestry program should be designed for a particular ethnic? Not clear what are the implications from the analysis on ethnic to the recommendation for successful community forestry program.

Commented [A22R21]: Happen to be our research prove that the extension activities affect on increasing INCM significantly. So the descrimination planning based on the ethnic background important particullary in extention program, need miticoulus consideration upon all aspects including custome, habit, norm, local language, local wisdom etc. In ordert to support our argument we provide two researchs that is relevant reported by Nurhaida et al (2006 ansd 2015). Tank you verymuch anyhow.



Figure 2. Croping pattern in rubber silviculture: (a) Javanese, monoculture, seem deligent to clean weed as their ancessor who custome with annual crops in Java Island, (b) Semendonese almost an ideal agroforestry pattern, (c) Sundanese seems make adaptation to Semendonese, (d) Lampungese seem too litle cultivation.

Additionally, the relevant custome including norm, habit, satire, allusion, folklore and other cultural acceptabilities or heritage from their ancestor were used exhaustively in Nurhaida (2007 and 2011). Because the extension envolvement (EXT) is positively significant in enhancing INCM (Tabel 5), it is a rational way in using up the strategic program in order to become the strategy for fostering the HKm's sustainability program (SUST) through improving the BIODV. All of the culture heritage of every tribe such as hospitality, local norm, habit, local wisdom, should be taken as consideration in developing extension programs.

Effect of productive asset

Among the 8 variables of the productive assets (Table 3) only landholdings under the HKm scheme acreage have a significant effect on the family income (INCM). This claim is

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connoted by the *P*-value of 0.000 which means this variable significantly influences the income because it has an error below 5 %. The coefficient of this variable is 3.9783 which means that the family income will increase by IDR 3.9783per ha on landholding plots under the HKm scheme. This implies that in the study area a landholding is still limited to achieve the community's welfare such as in Tanggamus Regency of Lampung Province (Ruchyansyah et al. 2018). This constraint can naturally encourage further encroachment if the authority cannot make an incentive policy to slow this tendency down. Thus, the challenge for forestry planners is to look for another productive asset that is possible to leverage the INCM without presupposing any need to increase land allocation. In relation to this challenge, fish pond management, goat and poultry development are prospectively economic activities that are possible to improve the economic performance due to their better economic gains.

The effect of information and physical accessibility

 Among the 4 variables, only the land elevation gives a significant effect on the family income variable (INCM). Farmers whose land elevation lies above 100 m a.s.l, will reduce their income by IDR 0.7420 M per annum. Perhaps the farmers must spend more effort or a bigger budget to cultivate rubber on land with a higher elevation such as found by Zhafira et al. (2019). The rubber sap productivity will also decrease significantly if cultivated on a higher elevation due to the temperature suitability of the rubber crop growth (Andrian et al. 2014).

As for both television ownership (TVOW) and cell phone ownership (HPOW) variables, they do not significantly affect the family income (INCM). Farmer participation in extension programs, on the contrary, plays a significant role in the enhancement of the family income (INCM). This kind of condition is based on the results of Idayanti et al. (2019) and Supriadi et al. (2018). Both research results have also proven that HPOW and TVOW have no effect on the income.

It is only the variable of farmer's participation in extension activities (EXTN) among the 6 variables of the information and physical accessibility having a positively significant effect on the INCM. Farmers who are more active in the EXTN can get an income of IDR 2.3851 mper annum, or more than those who are not. This proves that the extension program is an important source of information for the villagers in the study area such as found by Wulandari and Inoue (2018) in West Lampung. The knowledge contained in the extension can be very valuable in rubber cultivation activities. It is also possible that the social atmospheric interaction among the villagers has been improved by the extension activities so that the social capital can be developed as well.

Commented [A25]: Need to be explained first in the beginning on how one block area under community forestry has been divided into the household members.

Commented [A26R25]: Land allocation was based on individual claim when they were enlisting to become as a HKm member. On behalf of The Minister of Environmental and Forestry Affairs, the HKm authority conducted on series procedures before issuing the legal right upon their claimed land result from encroachment.

Commented [A27]: Why would the Community Forestry Program be allocated on area with this elevation? Does this mean, the pre-condition survey was not appropriately conducted?

Commented [A28R27]: They are forest ancoachers during the periode of political transformation from authoritarian regim to democracy regims accompanied by decentalization to local government. During the process as if vacant of power, so the poor community freely encrhoacher the forest areas. The limitted number apparatuse also contribute too. The HKm program is kind of the moderate way to empower the enchraochers by giving concesionary forest areas for 35 years. It is because the government impossible to expllet the enchoachers radically that almost will end in bloodsheding. In other word tha HKm Scheme is an incremental planning instead of the radical planning that applied when the authority is in weak potision. (See the revised Introduction Section).

Effect of rural facility investment activities

These exogenous varibles are include the rural facility investment project (FIVST), nursurey demonstration plot activity (NURSY), and social safety net SCNET. The presence of FIVST has decreased the INCM, farmers joining the temporary work have an average income of IDR 2.4571 M, less than those who do not. Perhaps they spend too much time in the non farm work so that they miss the opportunity to cultivate rubber trees. A similar situation also occurs in the the NURSY. These jobs are more attractive because the villagers can take cash than taken money from selling rubber latex, coffee bean, cocoa and other agroferestry yields that commonly much depend upon some variable such the buyers with normal price. This condition is also proven by Idayanti et al. (2019) that the improvement of project facilities has a negative influence on the INCM.

As for the SCNET program has no any significant effect on the INCM. Perhaps the program has not made their morale spirite risen up. But based on his research among pine (*Pinus merkusii*) sap tappers community at forest plantation in Central Java-Indonesia, Cahyono (2010) reported that the SCNET in cash assistance had been lessen the farmers' morale on working, reduce their productivity and increase consumption spending. On the contrary was the research conducted on in the community of sap damar (*Shorea javanica*) farmers at West Lampung Regency reported by Setiawan et al (2014) that SCNET in cash had stimulated their spirit in working and had induced their INCM increasement. Both Cahyono (2010) and Setiawan et al (2014) recommend that enhance extension program in order to foster the farmer's spirit to be able to self empower gradually escaping from poverty trap.

The role income on tree biodivrsity performance

As seen in Table 7, the G statistic is big enough (G = 15.685) with P-value = 0.000. This can be equated with P-value = 0.0004 because the rounding of 3 digits will be the same as P-value = 0.000. So the meaning of P-value = 0.0004 (or P-value = 0.04%) is that 99.06% (100% subtracted by 0.04%) variations of the BIODV among the 230 respondents' land parcel can be explained by the sole INCM variable, whereas the remaining 0.004% can not, but should be explained by other variables that not applied in this model. In brief, the precision of this model is very high because the confident level at more than 99.04%.

As for how much the INCM variable can multiply the BIODV, we need to refer to the Odd Ratio obtained, namely 1.13 with the P = 0.000 that can also be equated to P = 0.0004 (Table 7). It connotes that every farmer's income increases by an average of IDR 1 M per year,

Commented [A29]: Is this part of the Community Forestry Program?

Commented [A30R29]: No. These are the exogenous varible, beyon tduties of HKm Authority. The village road improve, bridge contruction etc are conducted on out of the forest area and under responsibility of the regency government specifictly intended to improve rural service providing including access to healtcare centre, shooling, acces to market etc. The Social safety net conducted on accidently by the Central Government especially when general subsidiary must be pulled out. Nursery demonstration plot is inteded to provide reforestration program using watershed approach not specifict for HKm program.

accompanied by the increasing of the BIODV by 1.13 times. The increase is around 95 % CI (namely in between 1.01 and 1.26) with the missing probability of is only around 0.06 %. This very small probability tells us that the built model is strong. This fact also justifies that the improvement of the BIODV through farmers' income improvement in this research area is in line with the mission of the HKm Scheme. In other words, the HKm Authority has conducted an amendment program for rehabilitating the degradation of protected forests through farmers' income increasement effort. The program proves effective. The members of the HKm are commonly very responsive to the program of planting some annual and cash crops under rubber trees stumpage. It is logical that farmers depend on forest's biodiversity for their daily needs so they will manage their forest neatly and conserve the biodiversity (Wulandari et al. 2018a).

The role of tree biodiversity performance on HKm's Program Sustainability

The BIODV is strong enough to be the predictor variable of the sustainability of the HKm Program. As seen in Table 8, this claim is proven by the Gald statistic results at 5.801 with $P_{\text{value}} = 0.016$. It means that the sole predictor variable of BIODV is reliable as the indicator of the sustainability of HKm due to its small missing probability of only 0.016 (=1.6 % or less than 5 %). This number tells us that there will be 16 units missing if we use the BIODV variable to predict 1,000 sustainability of the HKm Program. Therefore we can rely on this model to predict the sustainability of HKm.

We, furthermore, are interested in knowing how big the change of sustainability of the HKm is in case the BIODV rises from low to medium or high. Unfortunately, the sustainability of HKm will drop to only 0.52 as the BIODV rises from low to medium or high. This clue is indicated by the Odd Ratio described in Table 5, namely 0.52 (CI = 0.30 to 0.89) with P = 0.017, indicating the model is strong enough.

The reduction in the HKm program sustainability as a result of the increase in the BIODV gives a signal of a critical phase. It implies that farmers, whose BIODV has been rising up, need more nurturing from the HKm authority to support a critical breakthrough of a biodiversity development phase especially for newly wooden planted crops other than rubber. During that phase the farmers must pay much more attention in order to promote the growth of the newly planted wooden tree other than rubber. Those plants must survive from weed disruption, pests and borne diseases, poor soil fertility, and even from rubber plant shading. The farmers need to allocate their resources more than when planting rubber in a monocultural way, such as controlling weeds and pests, applying soil fertilizer, pruning rubber canopies and using them for green manure. This certainly will reduce the farmers' opportunity to earn income from the

Commented [A31]: This means that training on silviculture techniques should be part of the implementation activities.

rubber sap production. This claim is also in line with the FMLSZ roles to the INCM as expressed in Table 6. The HKm authority, therefore, are strongly recommended to conduct activities, including technical assistance through intensifying extension activities beside financial aids in the form of chemical material and cropping facilities for farmers whose BIODV has been rising up; otherwise, the BIODV will possibly decrease.

Conclusion

 The hypotheses have to be accepted at confident level more than 95% namely: (i) the endogenous variables with positively affect on the income from agroforestry yield (INCM) were the family number size, participation in extension activities, land holding acreage, the tribes whose Sundanese and Semendonese were higher than Javanese, and with negatively effect was the land elevation; whereas the exogenous variable affected negatively namely the rural facility contruction and nursery demonstration plot activities; (ii) the INCM effect on tree biodiversity (BIODV) enhancement i.e the BIODV performance will rise up by 1.13 for every if the ENCM rise up by IDR 1M per annum; and (iii) the effect of BIODV on the HKm's program sustainability (SUST) that will reduce by 0.53. It is clue that the nurturing phase on HKm member at critical stage. It recommend that continue in fostering the HKm members by managing the endogenous variables in order to rise up INCM, and then multiply BIODV as well as to broaden HKm members' awareness on voluntary planting some wooden trees as the prerequisite of pursuing the SUST.

Recommendations

The three consecutive models have been achieved from this research certainly are very meaningful tool for developing the next programs, particularly the strategies in fostering every HKm member in order to be able to contribute in pursuing the HKm's program sustainability (SUST). The Model III is the final point and flash back to the use Model II and Model I. At the ultimate objective that the enhancement of tree biodiversity performance (BIODV) has to be able to stimulate the awareness of HKm's member to add wood tree at every vacant space of their lands. The extension activities, including in silviculture techniques, are certainly a strategic way to broaden their knowledge if planting some wooden tree species will get some benefits of improvement in: shading coffee or cocoa crops, litter basalt and mulch of organic matter, soil fertility, and the opportunity to make earning from miscellaneous vegetable yields. Planting wooden tree, therefore, can generated these economic incentive for the farmers. On the other side, planting many species of wooden tree for the HKm authority is the main indicator of succussing duties in forest recovery program from the encroachment phenomenon.

As proved by the Model II, this scenario in fostering SUST through corner stones of improving tree biodiversity (BIODV) will be possible as the prerequisite if and only if the

Commented [A32]: Clear conclusion related to the hypothesis should be described here.

Commented [A33]: Should be added: comprehensive and clear recommendations to improve the design and the strategy for community forestry program.

There are a lot interesting and useful findings and need to be formulated in a more meaningful way in fostering the sustainability of community forestry program.

farmer's income (INCM) can be risen up. The flash back, therefore, we have to exploit the Model I as the basis for enhancing INCM strategy. It is clear that we have to use the endogenous variables which has characteristic of enabling to and being possible to induce INCM. From the six of endogenous variables (Table 4), only does the extension variable (EXTN) that meet the two characteristics, whereas the three variables remain are not, namely the family number size, land holding acreage, and land elevation.

Family size number is the endogenous variable that does not have meaning for fostering the SUST. This variable is not possible to be added or reduced for the sake of enhancing INCM. And so does the elevation of land parcel position, there is no real act can be conducted on changing the land elevation position across the landscape in whole HKm location. Additionally, although the land holding variable is possible to be expanded in order to enhance the INCM but this policy will contrary to the other mission of HKm Authority to free the protected forest from the occupation problem. So that the only strategic way in fostering the SUST through INCM enhancement (that later on inducing BIODV) is the promoting extension.

In order to achieve SUST, therefore, the extension promotion is a very important strategy in fostering of every HKm member. Therefore, even though the extension materials are focused on silviculture techniques, as exemplified by Nurhaida et al (2007 and 2011), the implementation of the activities of each extension program must also consider the ethnicity variables, which in this HKm the Ethnicity of Sundanese and Semendonese need to be distinguished from Javanese or Lampungese.

Acknowledgment

We would like to offer acknowledgement for single sponsorship for the research grant Badan Layanan Umum (BLU) of Lampung University, under The Scheme of Graduate Research Grant, fiscal year 2018.

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