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Impact of Integrated Pest Control Field School Activities on Community Empowerment in Deli Serdang Regency (Case Control of Fusarium Wilt Disease on *Musa acuminata L.* Plants)

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ABSTRACT

Fusarium oxysporum f.sp cubense is bad disease for barangan banana plants specially in Sinemba Tanjung Muda Hilir district, North Sumatera (Indonesia) and its control was primarily carried out in 2003 by the agriculture department through Balai Besar Perbenihan Tanaman Perkebunan Hortikultura or BPTPH (Center for Food Crops and Horticulture Protection) to community of banana farmer in the district through integrated pest control field school or IPCFS (or in Bahasa Indonesia it is called Sekolah Lapangan Pengendalian Hama Terpadu (SLPHT)). The studies were conducted to know the impact of the IPCFS to banana's farmer in Deli Serdang (case of Panama wilt disease). The studies used the survey method by correlation of parametric Pearson product moment approach with statistical product and service solution (SPSS 13 version) to examine the rain climate and Panama wilt disease on 2001 until 2006 and tried to know the impact of social economic and cultural aspect using Leopold modified method. The result shows that the IPCFS can control Panama wilt disease at banana plant and contribute the positive impact in economic aspect.

Keywords: Impact, IPCFS, barangan banana plants, case control, fusarium wilt disease

INTRODUCTION

In the Indonesian Law No. 23 of 1997 concerning environmental management, it is stated that the environment is a unitary space with all objects, forces, conditions, living things including humans and their behaviors that affect the survival and welfare of humans and other living creatures. In this law, environmental management is defined as "an integrated effort to preserve environmental functions which includes policies for structuring, utilizing, developing, maintaining, recovering, monitoring and controlling the environment".

On the basis of the Law all environmental components, both abiotic and biotic, affect the survival of human life and welfare. Natural resources consist of two parts, namely biological resources including flora and fauna and non-biological ones including soil, water, air, climate, etc. According to the possibility of recovering natural resources, they are divided into three parts, namely: 1) renewable resources such as land, water, forests, grasslands, agricultural crops, plantations, wildlife, fish populations, etc., 2) natural resources that cannot be recovered (non-renewable resources) such as oil, natural gas, coal, metal ore, 3) natural resources that will not run out (continuous resources), namely solar energy, tidal energy, air and water in the hydrologic cycle.

Qualified human resources are primarily needed to manage natural resources, in order to create environmentally sustainable

development. Agricultural ecosystems (agro-ecosystems) are natural resources that can be recovered (renewable-resources), requiring special management from the government in order to increase development in the agricultural sector [1]. Indonesia, as one of the tropical countries in Southeast Asia, has a diversity of natural resources of which one of them is various varieties of bananas such as *barangan*. There has a great opportunity for the development and the increase in banana production with integrated development patterns across sectors [2].

Among the types of bananas, the *barangan* variety has superior quality and shelf life. The *barangan* bananas are produced by several regencies, such as, Deli Serdang, Langkat, Simalungun, South Tapanuli and Asahan. In the cultivation of *barangan* there are several obstacles, including the attack of plant destruction organisms (or in Indonesia, this is called Organisme Perusak Tanaman or OPT) referring to all organisms that can damage, interfere with life, or cause the death of plants.

These pests can be 1) microorganisms that infect plants, causing damage to plant parts, for example fungi, viruses, bacteria and nematodes, 2) organisms that interfere with the physiological functions of the host plant, for example nematodes, and 3) weeds that live in their place and cause harm to the main crop, for example reeds and sedge grass.

Fruit growth is normal if the growing conditions are met by plants, namely certain environmental factors such as climate, temperature, humidity and light, availability of sufficient nutrients and water. Factors affecting plant health are likely to also affect their growth and production, and reduce their usefulness to humans [3]. Plant pathogens, unfavorable weather, weeds and insects are very common causes of reduced plant growth and production. Plants become sick due to deviations from the normal state of the plant, especially by pathogens and environmental conditions. The main causes of disease are either pathogenic living organisms (parasites) or physical environmental factors (physiopaths) [3].

Various kinds of diseases can be transmitted, namely bacteria, fungi, viruses, microplasma and the peculiarity of infectious diseases is the continuous interaction by biotic (living) or abiotic factors (physical and chemical) [3]. Plant diseases occur because of the interaction among four components (human, environment, pathogen and plant).

Humans as individuals (social beings) have attitudes and behaviors that can change due to socio- economic and cultural factors. To meet economic needs, humans use biological natural resources (flora), namely plants as food producers. Plants, in terms of cultivation, experience sensitivity to plant pathogen attacks. The development and infection of pathogens into the plant body is influenced by environmental factors. The four components interact with each other and are related, therefore, to manage these natural and environmental resources, quality human resources are needed.

This disease causes plants to be unable to produce and the endemic spread of fusarium wilt occurred in Deli Serdang Regency (DSR), especially in Sinemba Tanjung Muda Hilir (STMH) district. This disease, known as Panama disease, is the worst disease in bananas worldwide and the most detrimental in the tropics [4]. In recent years, Panama disease control has been carried out by spraying chemical fungicides excessively and inappropriately. Fungicide residues contained in bananas can cause disease in humans. Fungicide residues exist that can last for years in the soil.

In Law No. 14/1992 disease control using trichoderma sp. fungi as a biofunction (a natural substance used as a substance to kill disease) is an environmentally friendly biological control (does not cause environmental/ecosystem degradation) so that chemical residues can be minimized to sustain the environment/ecosystem. The dependence of farming communities on chemical fungicides is already very high. This is due to the low human resources

(farmers), causing them to be unable to manage their agricultural land in a productive and professional manner. This situation is exacerbated by the very marginal ownership of working capital and arable land [5].

Yields, quality and prices of agricultural and smallholder plantation products are often lower so that they cannot provide sufficient income for farmers. For the welfare of farmers, the IPCFS was created, which is an informal school that aims to empower farmers. The IPCFS is based on the integrated pest management (IPM) oriented to the modification of technical and biological culture control.

The IPCFS of *barangan* banana varieties began in 2003 by the North Sumatra Agriculture Service and was carried out by the BPTPH. The participants were *barangan* banana farmers (BBFs) in five villages in STMH district. This IPCFS activity is useful in reducing the use of chemical fungicides (chemicals to grow plant diseases) in agricultural ecosystems, establishing environmentally friendly control principles so that the level of efficiency and productivity is high.

The orientation of IPCFS activities is directed to prioritize the use of biological agents of the fungus trichoderma sp to control fusarium wilt disease in the planting area. The use of the fungus aims to reduce the level of disease attacks to a level that is not harmful. The impact of IPCFS activities is thought to have an effect on the social, economic and cultural life of the BBFs. The increase in the results of the analysis of IPCFS activities is expected to make a positive contribution to the management of a sustainable and environmentally friendly agricultural environment, as well as changes in the social, economic and cultural life of the BBFs in STMH district and other areas in DSR.

Knowing the relationship of microclimate to fusarium wilt disease on *barangan* banan plants (BBPs), the impact of IPCFS activities on the social, economic and cultural life of BBF community and the benefits of IPCFS activities on the preservation of the agricultural environment and the welfare of farming communities.

MATERIALS AND METHODS

The research was carried out in five villages, namely, Talun Kenas, Siguci, Sumbul, Limau Mungkur and Gunung Rintih, in STMH district (± 500 meters above sea level); the research sites were selected purposively due to the endemic attack of fusarium wilt disease on BBPs. The research was quantitatively done from December 2006 to February 2007 to determine the relationship between microclimate and intensity of fusarium wilt disease on BBPs and the impact of FFS activities on socio-economic and cultural life of BBFs.

The collection of microclimate data and the intensity of fusarium wilt disease on BBPs in 2001-2006 was carried out using primary data collection methods and the impact of FFS activities on the social, economic and cultural life of BBFs involved primary data collection methods and active data collection with direct interviews with respondents. The research samples to determine the relationship of microclimate to the intensity of fusarium wilt disease was all BBPs in five villages in STMH district and to know the social, economic and cultural conditions of the community, eight informants (30%) were selected from 25 IPCFS participants as samples by random sampling.

The analysis to determine the relationship of microclimate to fusarium wilt disease becomes the parametric Pearson product moment correlation using SPSS 13 [6], and the social, economic and cultural impacts of the BBPs were measured by modified Leopold matrix method covering the following stages:

1. impact identification was carried out using a descriptive survey method through interviews with alumni of IPCFS participants in 2003;
2. simple matrix of environmental impacts on impact identification is marked with positive (+) and negative (-) marks;

3. environmental quality scale standards are made to identify the importance of impacts (as stated in the Decree of the Minister of Environment of the Republic of Indonesia No. 49/1997);
4. standard impact evaluation matrix table is based on the modified Leopold method and is created on the basis of primary data and active data collections through interviews. Impact forecasts in the form of scale values between 1-5 from the two data collections are included in the impact evaluation matrix in which the Leopold matrix table is made in five phases.

Phase I (RLA): determined initial environmental base

- in table S (quality value of environmental conditions), analysis of activities on the value of the environmental quality scale is obtained;
- in table K (importance of environmental components), the environmental component importance rating scale is also obtained.

Table 1. Environmental quality rating scale

Types	Scale	Percentage (%)	Interpretation
State of environmental components	1	1-20	very bad
	2	21-40	bad
	3	41-60	medium
	4	61-80	good
	5	81-100	good
Interest of environmental components	1	1-20	less important
	2	21-40	important enough
	3	41-60	important
	4	61-80	more important
	3	81-100	very important
State of environmental quality	1	1-20	very bad
	2	21-40	bad
	3	41-60	medium
	4	61-80	good
	5	81-100	very good
Impact of interpretation	1	1-20	least impact
	2	21-40	little impact
	3	41-60	medium impact
	4	61-80	big impact
	5	81-100	very big impact

Source: Fandelli (1992)[7]

Phase II (Activity): determined the scale for IPCFS pre-activity, during activity, and post-activity based on the results of interviews with respondents.

Phase III (evaluation): It is determined that the first table of evaluation is obtained from:

- Added up the scale values of the ICPFS pre-, activity and post-activities.
- For the 2nd table the evaluation is obtained from: Total maximum environmental quality scale total activity Σ (5x12). The method: multiplied the value of the quality of the scale (5) by the number of activities (activities) = (12) Σ (5 x 12) = 60
- For the 3rd table evaluation obtained from: 100 % x 1st table evaluation: 2nd table evaluation.
- For the 4th table the evaluation is obtained from: The value of the environmental quality of a parameter (scale) after completion of the activity. How: the estimated value of the scale of activities in 2007 (after post-ICPFS activities).
- For Table 5, the magnitude of the impact is obtained from Table 2 for evaluation minus.

Phase IV (amount of impact): determine the magnitude of the impact by referring to the calculation.

Note: length of scale class = 5 classes; formula: class length = max value – min value/class length; class length = 5 -1 / 5 = 0.8 (see table 2).

Table 2. Impact magnitude scale for five criteria

Impact magnitude	Level of impact
> 4.4 – 3.6	5
3.5 – 2.7	4
2.6 – 1.8	3
1.7 – 0.9	2
0.8 – 0	1

Source: Fandelli (1992) [7]

Phase V (degree of impact importance): determined the degree of impact importance by referring to: calculation: class length = 7 classes class length formula = max value – min value / class length class length = 7 – 1 / 7 = 0.85 (Bapedal Decree No. 56/1994) (See Table 3).

Table 3. Impact importance scale for seven criteria

Impact magnitude	Level of impact
> 6.55 – 5.7	7
5.6 – 4.75	6
4.65 – 3.8	5
3.7 – 2.85	4
2.75 – 1.9	3
1.8 – 0.95	2
0.85 – 0	1

Source: Fandelli (1992) [7]

RESULTS AND DISCUSSION

A. General condition of Deli Serdang Regency

i) Geographical locations and boundaries

Geographically, the DSR is located between latitudes 2o 57' to 3o 16' North Latitude and 93o 33' to 99o 27' East Longitude. The boundaries of DSR are described as follows [8]:
North: Langkat regency and Sumatra Strait;
East: Asahan regency and Sumatra Strait;
South: Karo and Simalungun regencies;
West: Karo and Langkat regencies.

ii) Physical state

The DSR has 33 districts covering an area of 4,397.94 km2 or 6.21% with population growth and density [8].

B. Sinembah Tanjung Muda Hilir District

i) Physical state

The STMH is bounded by four districts [8]:
North: Tanjung Morawa district;
East: Bangun Purba district;
South: Sibolangit district;
West: Patumbak district.

ii) Topography and soil

The STMH district is located at an altitude of 0-500 m above sea level. STMH district has a transitional climate between subtropical and tropical. The soil type is dominated by red yellow potsolik. The average temperature is 26.7o C and the relative humidity is 84%. The winds that blow through this area are sea and mountain breezes with a speed of 0.68 m/second [8].

iii) Climate

Climatic factors, namely rainfall, is one that affects plant growth. The climate data for 10 years is shown in the followings [2]:
rainfall ranges from 1500-3800 mm/year with six wet months;
air humidity is between 80-88% with sunlight intensity between 40-58 lux, and daily air temperature is 22.8o C – 32o C;
the average pH of the five measurement locations in STMH district ranges from 5.5-7.5;
sand textured soil, alluvial soil, and rich in humus.

iv) Education

The DSR government has made efforts to improve the education sector because it is one of the most important parts in increasing the quality of human resources. The local government has built public schools and helped private schools. In addition, since 2001, a program of effective study hours in the evening (or *jam belajar malam* (JBM)) has been launched (from 19.00 WIB - 21.00 local time). In the initial stage of the JBM program, three districts (Lubuk Pakam, Tanjung Morawa, Perbaungan) were designated as pilot projects and all districts are currently following such program. The DSR government's concern in the field of education was successful when, on May 2, 2000, the DSR received the highest award of *widya krama* from the Indonesian President, especially for the districts that succeeded the 9-year compulsory education program.

v) Potential data

v.a) The state of basic education institutions in 2002

Table 4. Number of primary and junior high school institutions

Level of education		Quantity		
	Schools	Rooms	Teachers	Pupils
State primary schools (SD)	1.049	8.059	10.153	227.972
Private SD	161	1.086	1.444	38.409
State madrasah ibtidaiyah (MI)	7	51	124	1.711
Private MI	56	236	349	7.942
State junior high schools (SLTP)	67	838	2.335	73.441
Private SLTP	186	1.025	2.701	45.074
State madrasah tsanawiyah (MTS)	4	20	113	1.292
Private MTS	149	642	2.055	23.185

Source: Data from the DSR's Education and Teaching Office

v.b) The state of secondary education institutions in 2002

Table 5. Number of senior high school institutions

Level of education		Quantity		
	Schools	Rooms	Teachers	Pupils
State senior high school (SMU)	16	206	727	9.316
Private SMU	74	396	676	17.042
State vocational school (SMK)	2	63	242	1.946
Private SMK	87	597	1.783	24.131
State madrasah aliyah (MA)	3	18	51	815
Private MA	50	156	867	4.625

Source: Data from the DSR's Education and Teaching Office

v.c) Investment opportunity

college development

development of higher education cooperation with private parties

development of skills with education institutions

bookstore and stationery establishment

vi) Human resources

The DSR population comprises of several ethnic groups, for instance, Karo (the majority tribe in STMH district), Malay, Simalungun, Toba, Mandailing, Javanese, Minangkabau and others who generally embrace Islam, Christianity, Catholicism, Hinduism and Buddhism. From 2001 economic census, the number of population is 2,047,488 people and is the second largest population in North Sumatra Province after Medan with a growth rate of 2.10% and an average density of 455 people/km2 [8]. The main livelihood composition of the population mentioned above are: farmers (60.22 %), civil servants/abri/employees (21.83%), traders (5.40 %), services (3.17%), fishermen (2.86%), craftsmen (0.40%) and others (6.12%).

vii) Food crops and horticulture

The agricultural sector including forestry, plantations, livestock and fisheries contributes significantly to the regional economy. The sub-sectors that play a greater role in the agricultural sector are plantations, followed by food crops, livestock, fisheries and forestry. The DSR becomes a rice self-sufficient area with rice production in 1998 was 511,126 tons and in 1999 increased to 521,322 tons, or an increase of 1.99%. The rice surplus of 213,712 tons in 1999 was the region's contribution to the preservation of rice self-sufficiency, both at the provincial and national levels. The STMH district has established farmer groups.

viii) Data of potentials

irrigated land area (technical, semi-technical and simple) comprises of 53,374 ha;

area of non-irrigated land (rainfed, tidal etc.) amounts to 33,021 ha;

rice production is achieved from 503.206 ha;

achievement of food and secondary crops are obtained from: 1) rice field of 92,261 Ha, 2) corn of 1,833 Ha, 3) soybean of

2,370 Ha, 4) cassava of 12,968 Ha, and 5) others of 7,033 Ha;
main commodities: rice, corn, guava or guava, star fruit, *barangan* banana, cassava, mango, orange [8].

ix) Investment opportunity
procurement of agricultural tools and machinery
procurement of dryer/harvest dryer
rice milling and packing
on-farm (post-harvest technology)
soybean oil industry
development/extensification of food crops and horticulture
marketing of food crops and horticulture [8].

C. Microclimate in relation to fusarium wilt disease in barangan banana plants

The STMH district has superior agricultural commodities, namely *barangan* bananas, in which during cultivation, environmental factors (humidity, temperature, light, nutrients and water) greatly affect normal fruit growth [3]. High intensity of rainfall causes changes in the microclimate, namely soil moisture around the BBPs area. Pathogen fusarium wilt can grow and thrive in moist soil conditions. The relationship between microclimate and the development of fusarium wilt on *barangan* bananas in 2001-2003 can be seen in Table 6 below. High rainfall causes the soil to become moist so that the number of BBPs affected by fusarium wilt increases. From the analysis of the correlation test (amounting to 0.534 with a significant level at the level of 0.01 and the value of r = 0.99), high rainfall intensity increases the number of BBPs affected by fusarium wilt disease.

Moist soil conditions cause BBPs to be susceptible (easy to disease) to the fungal pathogen fusarium oxysporum f.sp cubense (an important cause of disease in *barangan* bananas) [9]. Fusarium wilt is one of the worst diseases that can reduce the number of BBPs and decrease banana production in Indonesia. High rainfall also changes the microclimate (climate around plants) namely soil moisture [9], and the growth of fusarium wilt is influenced by environmental factors such as humidity, water, temperature, light and nutrients. To control fusarium wilt disease in STMH district, the IPCFS was carried out in 2003. The results of IPCFS activities have produced benefits for the sustainability of the BBPs. This is evidenced by the absence of a correlation between rainfall and the number of plants affected by fusarium wilt in the period 2004-2006, namely after the IPCFS activities were carried out (see Table 7). The attack of fusarium wilt disease decreases due to the application of the fungus trichoderma sp. This is evidenced by the results of the correlation test of 0.261.

Table 6. Intensity of fusarium wilt disease with rainfall conditions before ICPFS

Months	Years	Number of plants affected by wilt disease before SLPHT 2001-2003	Rainfall (mm) SLPHT 2001-2003
Jan	2001	6.200	19
Feb	2001	6.600	15
Mar	2001	8.200	11
Apr	2001	9.600	9
May	2001	10.200	12
Jun	2001	20.300	15
Jul	2001	23.500	17
Aug	2001	23.800	19
Sep	2001	22.200	21
Oct	2001	26.100	21
Nov	2001	29.700	23
Dec	2001	26.600	23
Jan	2002	5.100	16
Feb	2002	6.100	13
Mar	2002	11.100	9
Apr	2002	10.300	8
May	2002	11.300	13
Jun	2002	37.400	15
Jul	2002	25.300	14
Aug	2002	18.800	12

Table 6 To Be Continued…			
Sep	2002	22.600	11
Oct	2002	23.700	12
Nov	2002	31.300	14
Dec	2002	27.100	17
Jan	2003	3.300	6
Feb	2003	4.600	5
Mar	2003	5.100	4
Apr	2003	8.200	10
May	2003	1.500	4
Jun	2003	5.300	9
Jul	2003	2.700	9
Aug	2003	3.300	11
Sept	2003	5.600	12
Oct	2003	6.800	17
Nov	2003	7.800	18
Dec	2003	8.200	19

The IPCFS activity combines technical and biological culture control systems (using trichorderma sp. fungi biological agents). In the treatment of plant seeds and organic fertilization (compost, manure and biological agents of trichoderma sp. fungi) on BBPs, the resistance of plants increases. This is because the fungus trichoderma sp. can survive in the soil for about 18 months after application [10]. High rainfall does not affect the microclimate around the BBPs area; this is because biological control is able to modify environmental factors such as rainfall and soil moisture so that BBPs become healthy and free from fusarium wilt disease. The IPCFS activities have a positive impact on BBPs health, but bring a negative impact on socio-cultural aspects [11].

Table 7. Intensity of fusarium wilt disease with rainfall conditions after IPCFS

Months	Years	Number of plants affected by wilt disease after IPCFS 2004-2006	Rainfall (mm) IPCFS 2004- 2006
Jan	2004	8.600	96
Feb	2004	6.700	58
Mar	2004	5.200	28
Apr	2004	4.470	46
May	2004	5.000	28
Jun	2004	4.300	112
Jul	2004	4.300	98
Aug	2004	4.200	126
Sept	2004	3.500	148
Oct	2004	4.800	167
Nov	2004	6.000	288
Dec	2004	5.800	265
Jan	2005	3.600	66
Feb	2005	4.060	42
Mar	2005	11.060	69
Apr	2005	4.570	54
May	2005	3.160	112
Jun	2005	5.640	148
Jul	2005	4.900	136
Aug	2005	6.320	167
Sept	2005	5.400	288
Oct	2005	5.700	194
Nov	2005	5.900	218
Dec	2005	6.700	236
Jan	2006	4.100	112
Feb	2006	4.800	86
Mar	2006	6.000	62
Apr	2006	5.700	32
May	2006	5.300	164
Jun	2006	5.720	198
Jul	2006	5.400	148
Aug	2006	5.500	176
Sept	2006	5.800	248
Oct	2006	7.400	188
Nov	2006	11.000	236
Dec	2006	7.800	256

D. Impact of IPCFS activities on socio-economic and cultural aspects for BBFs in STMH district in DSR

Based on the Republic of Indonesia Law no. 23 of 1997, humans become the most important component in the environment development by using customary norms and cultural values. In between the natural environment and human activity, there is always an intermediary factor that connects them, namely a set of goals and values, knowledge and beliefs, and cultural patterns; then, humans are considered as biological, social, and cultural beings. In utilizing natural resources, humans make efforts through science and technology, for example, the IPCFS activities that has a positive impact on the health of the BBPs, but is expected to cause a negative reaction from the community. All this is influenced by several factors including the levels of education, socio-economy, community knowledge, and community vulnerability [12]. Evaluation of the environmental impact of socio-economic and cultural aspects is assessed on the basis of the results of interviews with respondents with the scale rating indicators.

To find out the impact of IPCFS activities on socio-economic and cultural aspects, a feasibility study was carried out using the environmental standard impact evaluation matrix of the modified Leopold method. Positive impacts from IPCFS activities were noted, namely, mutual cooperation activities (> 3 times a year) were agreed to clean the BBPs area to make the situation of the area safe. Alternative problem solving is done by conducting supervision to the development of IPCFS alumni cadres on the basis of Law No. 23 of 1997 stating "environmental management is an integrated effort to preserve environmental functions which includes policies for structuring, utilizing, developing, maintaining, recovering, monitoring and controlling the environment." Alumni cadres are involved as local leaders to reduce social conflicts in the BBFs' community and, in this case, local social norms play a role. Positive impacts of IPCFS activities really exist, for instance, the community in STMH district often participates in mutual aids (*gotong royong*) activities (> three times a year), i.e., to clean up the BBPs area and such condition makes the BBPs is healthy; people's mobility to other areas decreases and they have permanent and part-time livelihoods (total net income > two millions IDR per month). They exchange information on new technology and, as a result, interaction among them increases. In short, the IPCFS activities have a positive impact on the economic aspect but have a negative impact on the socio- cultural aspect [11].

Negative impacts of the IPCFS activities might refer to the lack of smooth communication among fellow BBFs in terms of exchanging information/new technology for the BBPs as well as major changes in social norms due to the lack of interaction between members of the BBFs' groups regarding how to solve problems related to banana cultivation goods. Communication among farmers is sometimes not smooth because of their bad attitude towards IPCFS activities.

CONCLUSIONS

Conclusions can be drawn that, concerning the relationship between microclimate and fusarium wilt disease on BBPs, the high rainfall intensity before IPCFS causes changes in the microclimate, namely soil moisture so that the number of plants affected by wilt disease fusarium increases in number, the intensity of high rainfall after IPCFS does not affect the microclimate because the biological control applied by IPCFS is able to modify environmental factors such as rainfall and soil moisture and FFS activities have a positive impact on the health of the BBPs. In case of social, economic and cultural aspects of the BBPs, the IPCFS activities have positive impacts, namely (1) the increasing participation in mutual cooperation activities among farmers to clean banana areas, (2) the state of the BBPs area becomes safe from theft, (3) the

BBFs' mobility from rural to urban areas decreases, and (4) the local BBFs have a permanent and/or extra finance as banana farmers. However, the IPCFS activities can bring negative impacts, such as, (1) lack of friendly communication in terms of exchanging information and/or new technology among BBFs' groups, (2) there has been a major change in social norms caused by the lack of interaction regarding the problem solving in BBPs cultivation.

Conflict of Interest: None

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