LAPORAN
HIBAH PENELITIAN STRATEGIS NASIONAL
TAHUN 2009

MODEL MATEMATIS
KOMPETISI ANTAR SPESIES DAN PREDATOR-MANGSA
HAMA TANAMAN KELAPA DAN KOPI-KAKAO

Oleh:
Agustina Pradjaningsih, S.Si., M.Si
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FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM

HALAMAN PENGESAHAN

1. Judul Penelitian: **Model Matematis Kompetisi antar Spesies dan Predator-Mangsa Hama Tanaman Kelapa dan Kopi-Kakao**

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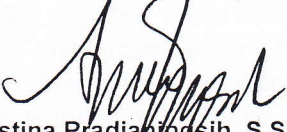   - **Total biaya**   **Rp 100.000.000,-**

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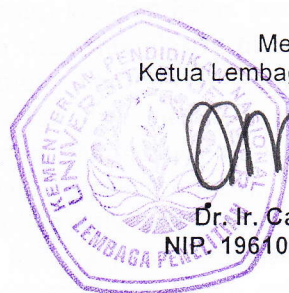
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RINGKASAN DAN SUMMARY

Beberapa komunitas/populasi fauna (misalnya jenis insekta) dapat mempengaruhi proses pertumbuhan maupun produktifitas tanaman perkebunan (misalnya pada kebun kelapa, kopi, kakau, jeruk, tembakau ataupun lainnya). Dalam komunitas tersebut interelasi (simbiosis) antar mereka ada yang saling kopetitif dalam memangsa makanan yang tersedia di alam dan ada pula yang sebagai predator dari yang satu terhadap yang lain (predator-mangsa). Demikian juga, dari kedua jenis simbiosis ini dapat bersifat menguntungkan atau bahkan merugikan (parasit) terhadap pertumbuhan tanaman dimaksud. **Tujuan dan target** dari hasil penelitian ini adalah untuk dapat: (a) mengenali parasit laten (hama) pada tanaman perkebunan kelapa dan kopi-kakao di beberapa daerah wilayah Jatim; (b) melakukan pengendalian hama tanaman dimaksud melalui studi model matematis siklus simbiosis perkembangbiakkan komunitas fauna tersebut; (c) mengurangi pencemaran lingkungan akibat penggunaan insektisida (zat kimia) dalam pembasmian hama tanaman. **Masalahnya** adalah, **pertama**, jenis simbiosis fauna apa yang laten menyerang tanaman kelapa dan kopi-kakao di beberapa area perkebunan di wilayah Jatim. **Kedua**, bagaimana dapat diformulasikan model matematis analitis siklus simbiosis fauna tersebut agar ke depan dapat dikenali dan dikendalikan perilakunya sehingga ekosistem perkebunan (khususnya dalam pertumbuhan tanaman) dapat seimbang dan berkelanjutan. Untuk mendapatkan solusi dari masalah-masalah ini, diperlukan beberapa **tahapan penelitian (metode)** berikut. *Pertama*, survey lapangan guna identifikasi pasangan binatang yang laten sebagai hama dan melakukan simbiosis kompetitif ataupun predator-mangsa pada tanaman kelapa dan kopi-kakao. *Kedua*, merumuskan hitung matematis analitis dan numerik untuk masing-masing model simbiosis dimaksud. *Terakhir*, evaluasi dan diskusi tentang hasil formulasi model guna mendapatkan nilai-nilai kritis ataupun parameter simbiosis yang dapat mengontrol mekanisme simbiosis antar dua jenis atau lebih populasi fauna dimaksud di alam. **Hasil dan kesimpulannya**, (a) model kompetisi dua spesies pada tanaman kakao berupa kutu putih dan helopeltis dengan buah kakao sebagai makanannya menunjukkan bahwa tingkat partisipasi helopeltis dalam menyerang tanaman kakao lebih dominan dibanding kutu putih. Pada tanaman kelapa, pemangsa tetratiscus dan laba-laba dalam menyerang hama brontispa hampir berimbang; (b) kompetisi dua spesies diantara kutu putih, helopeltis, tetratiscus, maupun laba-laba memiliki koefisien perkebamgbiakan positif, oleh karenanya ketersediaan makanan kakao (buah yang terserang) ataupun hama brontispa di alam sepenuhnya bergantung pada faktor keberadaan nilai interelasi γ masing-masing pasangan spesies dimaksud; (c) mangsa secara umum memiliki kemampuan berkembangbiak lebih tinggi daripada daya susut pemangsa dan interelasi keduanya menyebabkan kematian sejumlah mangsa ($-\gamma_1$) dan bertambahnya pemangsa ($+\gamma_2$); (d) contoh pasangan mangsa-predator (kutu hijau, kumbang merah), (kutu hijau, laba-laba), dan (kutu putih, laba-laba) akan lenyap bila dalam pertambahan waktu masing-masing pasangan mangsa-predator tersebut kondisi jumlahnya menuju (38,4), (52,15), dan (17,6); (e) ketiga pasangan predator-mangsa (d) dalam segmen waktu 30 hari, dapat dikatakan bahwa perkembangbiakan antara kutu hijau, kumbang merah, dan laba-laba relatif hampir saling paralel (ketiganya memiliki ritme reproduksi yang sama), namun untuk pasangan kutu hijau dan laba-laba perkembangannya berbeda (bentuk kecenderungan grafik antara keduanya berupa sinusida dan kurva normal).

SUMMARY

Some communities/fauna populations (eg species of insect) can affect the process of growth and productivity of plantation crops (eg coconut plantation, coffee, kakau, citrus, tobacco or other). In these communities interelation (symbiosis) between them is that each prey kopetitif the food available in nature and some are as a predator of the one against the other (predator-prey). Likewise, the two types of symbiosis can be beneficial or even harmful (parasitic) on the growth of plants in question. Objectives and targets of this research is to be: (a) identify latent parasites (pests) on the coconut plantation crops-cocoa and coffee in some areas of East Java region; (b) to control plant pests is through the study of mathematical models symbiotic cycle growthy community these fauna; (c) reduce environmental pollution due to the use of insecticides (chemicals) in plant pest control. The problem is, first, what kind of symbiotic fauna latent attacking coconut plantations and coffee-cocoa plantations in some areas in East Java region. Second, how can an analytical mathematical model is formulated symbiotic fauna of the cycle to the next can be recognized and controlled manner so that the plantation ecosystems (particularly in the growth of plants) can be balanced and sustainable. To get the solution of these problems, take several stages of research (method) follows. First, the field survey to identify the latent animal pairs as pests and conduct competitive symbiosis or predator-prey on coconut plantations and coffee-cocoa. Second, calculate the mathematical formulation of analytical and numerical for each model is symbiotic. Finally, evaluation and discussion of the results of the model formulations in order to obtain critical values or parameters that can control the symbiosis symbiotic mechanism between two or more populations of fauna referred to in nature. Results and conclusions, (a) model of competition of two species of plant lice cacao white and cocoa helopeltis with fruit as a food indicates that the level of participation in the attack helopeltis cocoa plant lice are more dominant than the white. In coconut, tetratiscus predators and spiders in pest attack brontispa nearly balanced; (b) competition between two species of white lice, helopeltis, tetratiscus, as well as the spider has a positive coefficient reproduction thus food availability cacao (fruit is attacked) or γinsects in nature brontispa entirely dependent on the presence of factors interelasi value of each pair of species referred to; (c) prey in general have the ability to multiply higher than the shrinkage interelation both predator and an increase in predators cause the death of the prey; (d) example of prey-predator pairs (green tick, red beetle), (green ticks, spiders), and (white ticks, spiders) will disappear when the increase of time each pair prey-predator is the condition number to (38.4), (52.15), and (17.6); (e) third predator-prey pairs (d) in the 30-day time segment, it can be said that the proliferation of green lice , red beetles, and spiders are relatively close parallel to each other (all three have the same rhythm reproduction), but for a couple of green ticks and spiders different development (graphic trend between the two of sinusida and the normal curve).

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