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Interdisciplinary Collaboration Analysis of Agricultural Researcher's : Case Study on Indonesian Agency for Agricultural Research and Development

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ABSTRACT

Interdisciplinary collaboration analysis of agricultural researchers : case study on Indonesian Agency For Agricultural Research And Development (IAARD). The purpose of this research were (1) to determine Multidisciplinary and Interdisciplinary collaboration of agricultural researchers, and (2) to identify pattern of interdisciplinarity collaboration using moleculer graph. The research based on 525 IAARD research proposals (RPTP). Co-uthor analysis using bibliometrics approach were employed to measure interdisciplinary collaboration, while and data gathering using questionair have been used to measure publication productivity. Results showed that collaboration among IAARD researchers with different spesialization have been conducted. Collaboration among researchers with different research disciplines occurred in the agricultural researches. Graphic molecular showed that Biotechnology, Horticulture, Plantation, and Food Crops were dominant research disciplines had strong collaboration. The most dominant were belong to Plant Breeding and Agronomy. Both research disciplines have strong relationships. While, Agricultural Socio-Economic pertanian and Agricultural Mechanisation showed low multidisiplinaritas and interdisiplinaritas value. Visualization of molecular graphs in Animal Nutrition (AN) in the field of Livestock research is the most dominant research discipline. Furthermore, which also involves collaboration among Animal Biotechnology (ABI) and Animal Breeding (ABR) researchers. Molecular graph is known that Postharvest Technology (PT) is the research field of Postharvest Technology the most widely held by researchers, followed by Mechanization (MEC), Analytical Methods (AM), and Chemistry (CHE). The diameter of the sphere of molecules known that Soil Science (SS) is the most dominant skills on the Land Resources field, then followed by the Agronomy (AGR), Cartography (CAR), Climatology (CLI), Hydrology (HYD), Microbiology (MIC), Soil Conservation (SC), Geography (GEO), and Plant Breeding (PB).

Keyword: *research collaboration, interdiscipline, agricultural research, researcher*

Introduction

Researchers as creators and users of scientific knowledge play important roles in the knowledge creation through research or scientific studies. They were needed to have adequate knowledge and tools as well as other facilities are in order to achieve scientific results.

Indonesian Agency for Agricultural Research and Development director general under the Ministry of Agriculture with the duty is to conduct research and development in agriculture. Since its establishment in 1974, gradually IAARD have been supported by 2036 researcher. There are 11 Research and Development Centers in IAARD, each of them has main function to manage research and development on food crops, horticulture, estate crops, livestock, veterinary, soil and agro-climate, agro-socio economics, machinery development, post-harvest, biotechnology and agricultural technology assessment. Within these centers, IAARD manages 15 research institutions, 3-research station and 31 assessment institution located throughout provinces in the country.

Evaluation tool to study collaboration among researchers from different disciplines and to study the influence of interdisciplinary collaboration on the productivity of publications could be carried out to study on how research could stimulate collaboration among interdisciplinary

researchers. The research was expected to describe the characteristics, and interdisciplinary collaboration in research activities conducted by agricultural researchers.

Research with the collaboration would be possible among those who have the expertise needed in research. Katz and Martin (1997) states that the benefit of the collaboration were: (1) sharing of knowledge, expertise, and specific techniques in a science, (2) transferring knowledge and expertise, (3) encouraging crossbreed of ideas from various fields of science, (4) driving growth of creativity and opportunity from many different disciplines, (5) intellectual friendship opportunities, and (6) increasing productivity.

This study was aimed to (1) determine the level of interdisciplinary collaboration among IAARD researchers, and (2) analyze the pattern of collaboration among agricultural researchers using molecular graphs based on interdisciplinary index.

Method

IAARD Research Proposals from CARIS (Current Agricultural Research Information System) data base during 2004-2006 had been analyzed for determining (1) disciplinary categories (FAO, 1990); (2) Multidisciplinary index and Interdisciplinary index (Schummer, 2003). Measurement multidisciplinary Index is used to find the area of discipline that will be included in the calculations. Measured discipline is the discipline involved in the authorship with a total of at least 5% of the overall work of the existing denoted by M^{05}.

M^{05}: Index multidisciplinary is a number of disciplines involved in the authorship with a total of at least 5% of the overall work of the existing.

Thus is it calculated
M^{05} = count [c_i] if $c_i > 0.05$,
with
c_i: the relative size of disciplines i.
$c_i = n_i / N$,
with
n_i: number of papers with at least one author of the discipline I was involved
N: total number of papers.
In addition to providing a picture of the distribution, also used the relative size of the largest disciplines, c^{Max} as other indicators that are simple. the relative size of the largest disciplines are:
$c^{Max} = Max [c_i]$.

Common measurement is the amount of research co-author Interdisciplinary-works by authors from more than one discipline. In this study, limited to the interaction of two or more disciplines. The size of the index for the work that co-author by the author of two or more disciplines is I^2 or interdisciplinary index of two or more disciplines.

I^2 = number co-authors of papers by authors from two or more disciplines / N

Also be conducted to measure the coefficient of bi-disciplinary discipline specific
for each pair I and k, c_{ik}.
Calculate this coefficient is:

$c_{ik} = n_{ik} / N$, c_{ik} : the relative size of I and k

n_{ik} : the number of papers with co-author of at least one author of each discipline I and k

N: total number of papers

To obtain all important information about which discipline to collaborate with other disciplines and to what extent the level of collaboration, the coefficient obtained shoo be compiled into a binary combination of disciplines in interdisciplinary symmetric matrix. This matrix will also provide information about the level of collaboration among the authors who come from one discipline. Diagonal matrix elements with k = I, $c_{i.i}$, will indicate the relative amount of work that was composed by mono disciplinary authors from every discipline i. (3) visualization using molecular graph which is a topological representation of nodes and connecting rods. Discipline is the node from the graph and connected with connecting rods that describe interdisciplinary relationships. Measures were needed to make each graph of all research disciplines were: (a) c_k to the diameter of the circle and to represent the coefficient of bi-discipline, and (b) c_{ik} to show the connecting rods wide.

Results and Discussion

The Results indicate that collaboration among IAARD researchers with different research discipline have been occurred in the entire field of research. The average rating of Interdisciplinary index (I^2) was 78.38 %. The highest I^2 value was 100%, achieved by Land Resources and Livestock. While the lowest were socio-economic areas (25.81%) (see table 1).

Table 1. Value Index M^{05} Multidisciplinary and Interdisciplinary (I^2) researchers Agricultural Year 2004-2006

No.	Reseach Field	I^2 (%)	M^{05}
1	Agricultural Mechanization	31,71	3
2	Biotechnology and Plant Genetics	94,12	**21**
3	Food Crops	98,95	18
4	Horticulture	94,94	18
5	Land Resources	100,0	16
6	Livestock	100,0	11
7	Plantations	98,49	17
8	Postharvest Technology	92,31	9
9	Socio- economic	25,81	**2**
10	Veterinary	47,50	6

The calculation of index multidisciplinary values (M^{05}) and visualization of molecular graph showed that 58 research's discipline belong to IAARD researchers were obtained. The top 10 dominant research disciples were Agronomy, Economic Sociology, Plant Breeding, Biotechnology, Post harvest technology, Mycology, Entomology, Plant Physiology, Pests of Plant, Plant Physiology and Plant Diseases. Economic Sociology and Agronomy related to the other six research discipline namely Horticulture, Plantations, Land Resources, Food Crops, Socio-economic, and Biotechnology and Plant Genetics, while Plant Breeding and Postharvest Technology dominantly present in five areas of research disciplines. The five disciplines were Biotechnology and Plant Genetics, Food Crops, Horticulture, and Plantations. The other six research disciplines played important roles in the four areas of research, namely Agricultural Mechanization, Livestock, Postharvest Technology and Veterinary.

The molecular graph showed that Biotechnology, Horticulture, Plantations, and Food Crops were the research disciplines dominantly owned by Plant Breeding researchers followed by Agronomy (Figure 1, 2, 3,4).
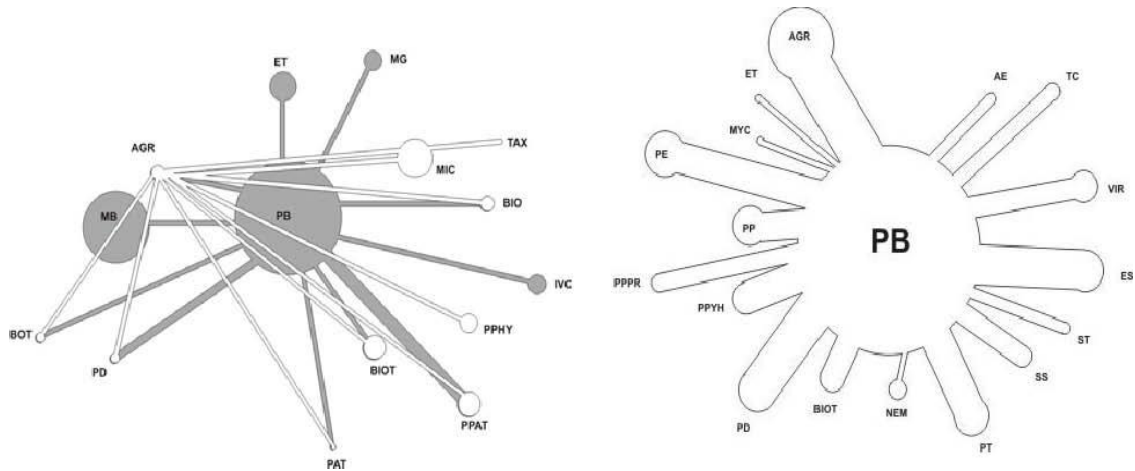
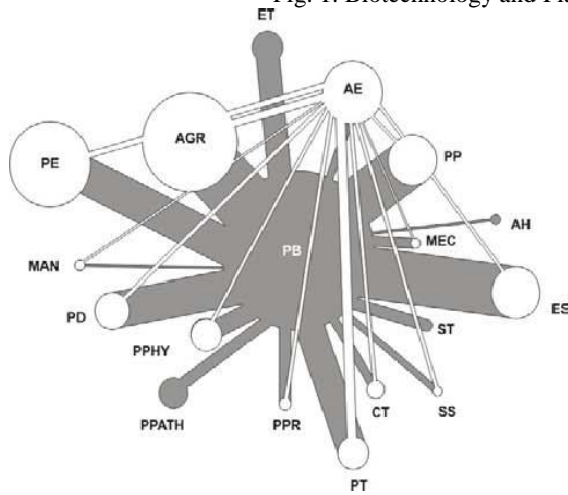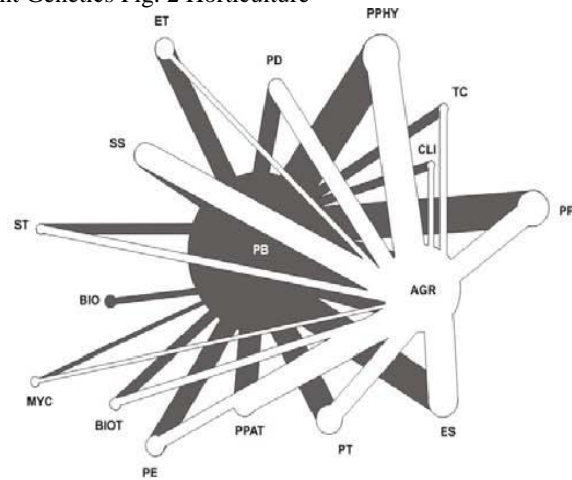Fig. 1. Biotechnology and Plant Genetics Fig. 2 Horticulture

Fig. 3. Food Crops   Fig. 4. Plantations

Both research disciplines have also had strong interaction. The dominance of PB researchers due to of the big number of researchers. This possibly PB researchers and other research field to collaborate in the similar activities more than other researchers from other research disciplines. Research task to produce new varieties is also made plant breeding become superior.

Multidisciplinary and Interdisciplinary collaboration of Socio-economic Agriculture and Agricultural Mechanization are low. This phenomenon indicated that the involvement of researchers in the two mentioned research disciplines also very low, even though, the collaboration is still presented due to the involvement of more than two researchers expertise (Figure 5 and 6).
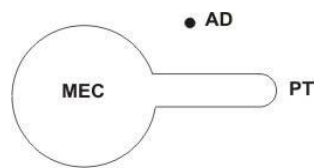

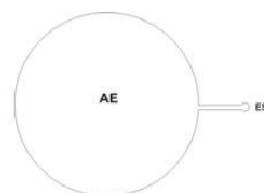Fig. 5. Agricultural Mechanization   Fig. 6. Socio-economic

Visualization of molecular graphs in Figure 7 shows that the expertise Animal Nutrition (AN) in the field of animal husbandry research is the most dominant expertise. Furthermore, which also involves collaboration among researchers expertise Animal Biotechnology (ABI) and Animal Breeding (ABR).

Based on the interaction relationship between the expertise of researchers described in a molecular graph is known that expertise postharvest Technology (PT) is the expertise of the most widely held by researchers Loading areas, this looks wide diameter of the molecule in Figure 8, followed by skill Mechanization (MEC), Analytical Methods (AM), and Chemistry (CHE). When viewed from the width of the stem that connects the researcher expertise, it is known that the PT's most lots of expertise to collaborate with researchers CHE, followed by the researcher and MEC FT
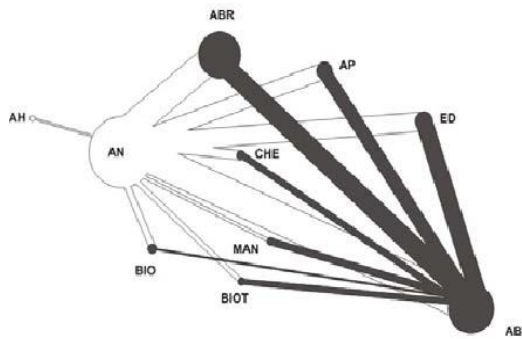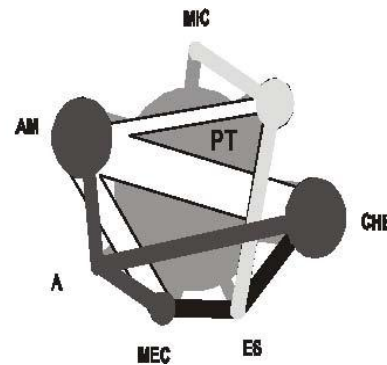

Fig. 7. Livestock

Fig. 8. Postharvest Technology

In Figure 9, the diameter of the sphere of molecules known that expertise Soil Science (SS) is the most dominant skills, then followed by the Agronomy (AGR), Cartography (CAR), Climatology (CLI), Hydrology (HYD), Microbiology (MIC), Soil Conservation (SC), Geography (GEO), and Plant Breeding (PB). Expertise of other researchers only reached a value of less than 10%.
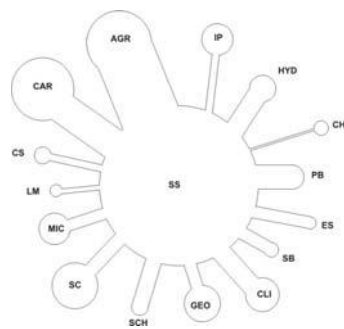

Fig. 9 Land Resources

CONCLUSION

Collaboration among researchers with different research disciplines occurred in the agricultural researches. Graphic molecular showed that Biotechnology, Horticulture, Plantation, and Food Crops were dominant research disciplines had strong collaboration. The most dominant were belong to Plant Breeding and Agronomy. Both research disciplines have strong relationships. While, Agricultural Socio-Economic pertanian and Agricultural Mechanisation showed low multidisiplinaritas and interdisiplinaritas value.

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Colaboration analysis is a complex process which can be part analyzed using bibliometrics approach. Hence, employing other methodology together other methodology which will enriched the analysis. This is needed to expose interaction process among the collaborated researchers. Other factore, nemely motivation and other specific reasons only can be obtain through interviews.

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