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ANALISIS TIPOLOGI DAN PEMETAAN PEMANGKU KEPENTINGAN STRATEGIS MENGGUNAKAN SISTEM JARINGAN PERTANIAN TERPADU-PETERNAKAN

TYPOLOGY ANALYSES AND STRATEGIC STAKEHOLDERS' MAPPING USING NETWORK ON INTEGRATED CROPS-LIVESTOCK FARMING SYSTEMS

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ABSTRAK

Pemangku kepentingan dan jaringannya memainkan peran penting dalam mengembangkan sektor pertanian. Misalnya, indikator ekonomi, sosial, dan lingkungan pertanian ditopang dengan keterlibatan pemangku kepentingan dan

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pihak terkait lainnya. Oleh karena itu, penggalian kepentingan dan peran para aktor menjadi strategis dan vital untuk dikenali. Penelitian ini bertujuan untuk menentukan tipologi dan pemetaan pemangku kepentingan strategis menggunakan analisis jaringan mereka pada sistem pertanian tanaman-ternak terintegrasi di West New Guinea. Penelitian dilakukan di Manokwari dengan menggunakan diskusi kelompok terfokus pada dua puluh perwakilan individu, kelompok, dan lembaga kemasyarakatan. Pertanyaan yang dibahas didasarkan pada latar belakang, penyampaian sumber daya, antar-konektivitas antar aktor, intervensi, dan inovasi. Hasil penelitian menunjukkan bahwa pemangku kepentingan pada tanaman campuran-ternak didominasi oleh individu-individu yang mengelola lahan pertanian secara resmi sesuai dengan peraturan perundang-undangan. Hasil penelitian juga menunjukkan bahwa sistem pertanian di West New Guinea mengalami ancaman nyata yang perlu diturunkan untuk mengurangi turn-back effect. Lima sumber daya bersama teratas adalah akses, kepuasan, kekuasaan, pengetahuan, dan alokasi waktu. Sumber daya ini cenderung bertahan lebih lama untuk menopang kebutuhan kuat pertanian, yang didominasi oleh kesamaan positif dengan rentang korelasi yang bervariasi mulai dari negatif, netral hingga positif. Hal ini dikarenakan para pemangku kepentingan enggan untuk melakukan intervensi dan inovasi, oleh karena itu bagi mereka yang memiliki kepentingan dan kekuasaan yang rendah perlu dipromosikan menjadi kepentingan dan kekuasaan yang tinggi dengan menggunakan bantuan, bimbingan, dan layanan dari masing-masing pelaku usaha campuran tanaman-peternakan.

ABSTRACT

Stakeholders and their networks play prominent roles in developing the agricultural sector. For instance, the economic, social, and environmental indicators of farms are sustained by the involvement of stakeholders and other relevant parties. Therefore, exploring the importance and roles of actors has become strategic and vital to recognize. This research aims to determine the strategic stakeholders' typology and mapping using their network analyses on integrated crops-livestock farming systems in West New Guinea. The study was carried out in Manokwari using the focus group discussion on twenty various represented individuals, groups, and mass institutions. The queries discussed were based on background, resources delivery, inter-connectivity amongst actors, intervention, and innovation. The result showed that the stakeholders in mixed crop-livestock are dominated by individuals' that privately manage the farms officially in accordance with the laws. The

result also showed that the farming systems in West New Guinea, experience real threats which need to be lowered to mitigate the turn-back effect. The top five shared resources are access, satisfaction, power, knowledge, and time allocation. These resources tend to stay longer to sustain the strong needs of the farms, which are dominated by positive similarity with varying ranges of correlation ranging from negative, neutral to positive. This is because the stakeholders are reluctant to deliver the intervention and innovation, therefore, those with low interest and power need to be promoted to high interest and power by using aids, guidance, and services from each actor in the mixed crop-livestock farms business.

INTRODUCTIONS

The crop-livestock sector is a mixed agricultural farming system recognized and run by many small-scale farmers worldwide. This type of farming is carried out by combining some commodities from crops and livestock. This system's trend is rapidly developed due to input efficiency, global climate changes, and consumer concerns, which are the goals of sustainable development. In line with consumers concern, people are now involved in determining products obtained from farms which are developed by involving relevant parties. Individuals, groups, and mass are involved in fulfilling and satisfying peoples' agricultural needs and consumers' preferences. In Europe and other Western countries, crops and livestock products are obtained from organic farms. This is due to the growing increase in consumers' concern about the production of healthy food without certain treatment. For instance, in some countries, caging animals in the compartment are forbidden by the animal welfare and right institution.

Similarly, the treatment of livestock with certain drugs and medicines is against some laws. This research question is based on the types of actors' involvement in crops-livestock farming, which qualifies them to play important rules to ensure the policy of right and welfare. It also aims to determine the ability of these institutions to represent consumers' interests and answer questions associated with people's and producers' concerns.

Policies ruled by the laws do not hamper consumers' interest by legalizing another, irrespective of the varying perceptions and constraints faced by mixed farming systems. According to Grimble & Wellard (1997), many stakeholders' publications are discussed without seeing and analyzing the background and back-bound of the actors. The analysis of actors and stakeholders' is qualitatively discussed by drawing diagrams, pictures, and connectivity lines. Furthermore, many analyses are carried out by quantitatively computing the pattern and relationship of the network. Muniesa (2015) stated that the shapes of actors in line with individual, group, and mass determine how actors have to be approached. Meanwhile, Hajjar *et al*. (2019) reported that law status and types of organization are the criteria of legality that play prominent roles, which also

provides certainty and respect for involvement, besides trustworthiness. The roles of stakeholders and shareholders affect how the contribution is delivered in determining crop-livestock business beneficiary and production. This is explained in Iyai *et al*. (2016) study carried out in Manokwari, West Papua-Indonesia.

Mayulu & Sutrisno (2014) stated that understanding the background and back-bound of the actors is of utmost importance. This is because the best fitted and appropriate actors play significant roles in promoting and sustaining cattle farming system particularly in Indonesia and specifically in West Papua. Iyai & Yaku (2015) reported several livestock farming systems in Manokwari, West Papua, where each is associated with a certain relationship and typical involvement of various interests. Therefore, it is urgently needed to deeply dig up the characteristics of the institutions and their performance in livestock development. Therefore, it is important to apply precise technical units of analyses to predict the relationships of related and relevant stakeholders in benefiting from the crop-livestock farming systems' economic and social objectives. Furthermore, stakeholders' or institutions' characteristics provide direction in executing and implementing programs that aid guidance and services in the near future.

One powerful social network analysis beside Gephi (Bastian *et al*., 2009), Netmap (Schiffer, 2007) and SmartPLS (Ringle *et al*., 2005), is Social Network Visualizer. Krupa *et al*. (2017) stated that the Social Network Analysis (SNA) is an adequate and appropriate software to compute network and relationship. Therefore, by mapping the stakeholders, institutions without power and interest, are identified, and they easily promote their roles, comprehensively. These multi-sectors of agriculture development need detailed positioning of the roles and responsibilities of the involved actors. Therefore, this study aims to portrait the typology of actors involved in the old traditional livelihood of crop-livestock farming systems in Manokwari, West Papua(Deny Anjelus Iyai et al., 2020).

METHOD

Location and involved actors

This research was carried out in Manokwari, West Papua, with several organizations, groups, and individuals representing institutions, mass, and households. Relevant data were collected on the existing mixed crop-livestock farming business by seeking their consent over the phone and with an invitation letter. The focus group discussions and desk study from qualitative research (Moleong, 1991) were used to collect relevant data from research reports, policy documents, articles, daily newspapers, and magazines. This study is concerned with stakeholders and shareholders' roles in shaping and determining the development pattern of mixed crop-livestock business in West Papua. Manokwari was set up and developed as one of the central developments of mixed crop-livestock farms in accordance with the Republic of Indonesia's national plans and by local livestock and veterinary provincial offices of West Papua province. All stakeholders were grouped into local citizens, government, finance institutions (banks), markets, private, and transportation.

Data collection

The collected data were related to organizational function and characteristics of the mixed crop-livestock business. These include shape, types, roles, effect, importance, and status of the organization. Data were also collected on the threats and turn-back effect towards mixed crop-livestock farming development. In determining the roles and presence of the stakeholders, the study also recorded the organization's resources, as well as the duration, continuity, power, and intervention.

Table 1. Stakeholders and roles and their responsibility under mixed crop-livestock development

No.	Institution	Role and Function
1.	Cattle farmers	Individuals or groups of farmers that keep cattle in their yards.
2.	Pig farmers	Individuals or groups of farmers that keep pigs in their yards.
3.	Crop farmers	Provide feed materials for men and animals.
4.	Veterinarian	Attends to the health needs of animals and farmers.
5.	Inseminators	Individuals that serve the animal reproductions.
6.	Regency livestock offices	Ruled policy and regulation related to cattle.
7.	Biogas users	Individuals that use gas as source of energy from livestock.
8.	Fertilizer user	Individuals that use fertilizer as source of organic soil materials from livestock.
9.	Market	Provide and distribute sale cuts.
10.	Banks	Provide a saving account and loans.
11.	Consumer	Individuals that buy and consume meat products.
12.	Slaughtering houses	Provide facilities for slaughtering livestock.
13.	Local government	Provide policy and regulations.
14.	Landowners	Provide the width of areas for land use function.
15.	Village cooperation	Provide and distribute farmers' needs.
16.	Butchers	Individuals that slaughter the meat of livestock
17.	Retailers	Individuals or groups of the community.
18.	Restaurants	Provide animal-based products for consumers.

Method of analyses

This research used the Social Network Visualizer (SocNetV) to analyze the power and flows of information amongst stakeholders. Kalamaras (2019) stated that SocNetV is a cross-platform, that is light and free of charged social-stakeholder related software in network analyses and visualization. The PCC matrix, similarity matrix (SM), power centrality (PC), and Hierarchical clustering (HCA) were used to visualize the graphs. The adjacency matrix of a social network, namely supplement no. 1 & 2, is a

matrix where each element a(i,j) is equal to the weight of the arc from actor (node) i to j. When the actors are not connected, then a(i,j)=0. This computes the Cocitation matrix, $C = A^T * A$. C, which is an *n* x *n* symmetric matrix where each element (i,j) is the number of actors that have outbound ties/links to both actors i and j. The diagonal elements, C_{ii}, of the Cocitation matrix are equal to the number of inbound edges of i (in Degree). A key notion in SNA with a structural equivalence.

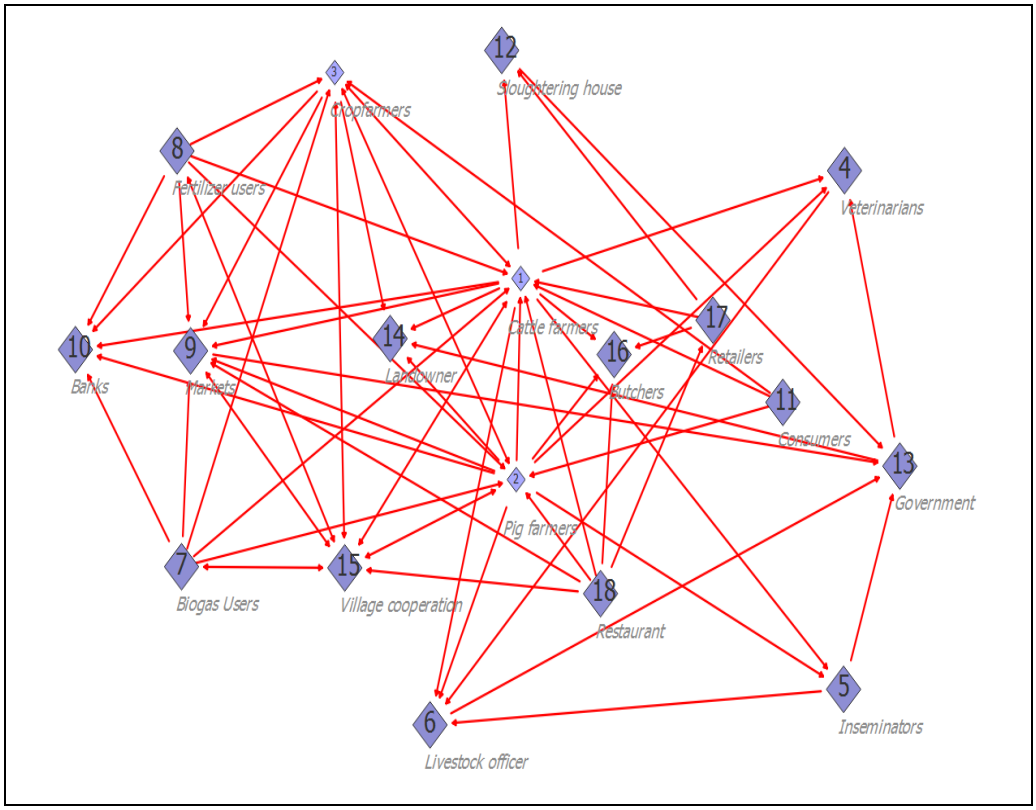

Figure 1. Mapping the involvement of actors amongst crop-livestock production systems

Mapping is used to map the relationships in a graph by creating classes or groups of actors with equivalent characteristics. One of the methods used to identify groups of structurally equivalent actors is to examine the relationships between them for similarity patterns. There are many methods used to measure the similarity or dissimilarity of actors in a network, with the Pearson Correlation Coefficient supported by SocNetV which enables it to create a pair-wise actor similarity/dissimilarity matrix. This method also actors to compute a pair-wise similarity matrix, where each element (i,j) is the ratio of tie (or distance) matches of i and j. In the case of Simple Matching, the similarity matrix depicts the ratios of exact matches of pairs of actors to others.

When the element (i,j) equals 0.5, it means that actors i and j have the same available or unavailable ties that are present to other actors 50% of the time. These measures of similarity are particularly useful when ties are binary (not valued) or when it computes a correlation matrix, where the elements are the Pearson correlation coefficients between pairs of actors in terms of their tie profiles or distances (in, out or both). The Pearson product-moment correlation coefficient (PPMCC or PCC or Pearson's r) is a measure of the linear dependence/association between two variables X and Y. This correlation measure of similarity is particularly useful when ties are valued/weighted, thereby denoting strength, cost, or probability. According to Gil and Schmidt (1996), the Power Centrality (PC) is a generalized degree of centrality used for measurement. For each node u, this index sums its degree (weight 1), with the size of the 2nd-order neighborhood (weight 2), and size of the kth order neighborhood (weight k). Therefore, node u is more important compared to its immediate neighbors. This is followed by the nodes of the 2nd-order neighborhood, 3rd-order neighborhood, etc. For each node, the sum obtained is normalized by the total number of nodes in the same component, minus 1. This index can be calculated in both graphs and digraphs, however, it is usually best suited for undirected graphs. It can also be calculated in weighted graphs, although the weight of each edge (u,v) in E is always considered to be 1. Hierarchical clustering, also known as hierarchical cluster analysis (HCA) is a method used to build a hierarchy of clusters, based on their elements dissimilarity. In the SNA context, these clusters usually consist of network actors. This method takes the social network distance matrix as input and uses the Agglomerative "bottom-up" approach, where each actor starts in their cluster (Level 0). In each subsequent Level, with an ascending order of clustering hierarchy, clusters are merged into larger pairs until all actors end up in the same cluster. A measure of dissimilarity between sets of observations is used to determine the clusters to be combined at each level. This measure consists of a metric for the distance between actors such as the Manhattan distance and a linkage criterion, namely single-linkage clustering. This linkage criterion is essentially a definition of distance between clusters and differentiates between the different HCA methods. The result of Hierarchical Cluster Analysis is the clusters per level and a dendrogram. The concept of a clique, which is defined as a group of people that regularly and intensely interact with each other compared to others, is simple. This means that a group of people form a clique when connected to each other. A clique is also defined as the largest subgroup of actors in the social network that is directly connected to each other. In terms of graph theory, this notion is equivalent to the maximal sub-graph of the social network. The word maximal means that for each clique, the group of members is expanded to include many actors to prevent others' addition. A clique in Social Network Analysis essentially consists of several overlapping closed triads.

SocNetV applies the Bron–Kerbosch algorithm to determine all maximal cliques in an undirected or directed graph. This produces a census of all MAXIMAL cliques in the network and reports some useful statistics. The clique census report includes disaggregation by vertex and co-membership information. Information Centrality (IC) is an index suggested by Stephenson and Zalen (1989), which focuses on how

information flows through many different paths. Unlike SC and BC, the IC metric uses all paths between actors weighted by the strength of tie and distance.

The IC' score is the standardized IC divided by the sumIC and can be seen as the proportion of total information flow controlled by each actor with the standard IC' values sum to unity, unlike most other centrality measures. This is because there is no known generalization of Stephenson & Zelen's theory for information centrality to directional relations. The index needs to be calculated only for undirected graphs and is more meaningful in weighted graphs/networks. Therefore, to compute this index, SocNetV drops all isolated nodes and symmetrizes the adjacency matrix even when the graph is a directed Algorithm (Wasserman & Khaterine, 1994). In order to calculate the IC index of each actor, a N x N matrix A from the symmetrized sociomatrix is created with: Aii=1+di, Aij=1 if (i,j)=0, and Aij=1−wij if (i,j)=wij. Furthermore, the inverse matrix of A is computed, for instance, C, using the LU decomposition. C can always be computed since the matrix A is always a diagonally strong, and invertible. Finally, IC is computed by the formula: ICi−1Cii+T−2·RN, where: T is the trace of matrix C (the sum of diagonal elements), and R is the sum of the elements of any row with a minimum value of IC.

The steps in running this SocNetV version 2.5 are shown in Figure 1. To analyze the intervention shared by organization, this study determined the intervention conducted by stakeholders. All data are collectively typed into a Microsoft Excel worksheet and tabled into the manuscript.

RESULT AND DISCUSSIONS

Table 2 showed that the typology of organizations such as shapes, law status, types, and roles tends to affect threat and turn-back in establishing and delivering relationships and actions in mixed crop-livestock farming business. This portrait that mixed crop-livestock actors' development in West New Guinea was on the local and grassroots organization stage. National and International involved stakeholders are lagging behind for stimulating development. According to UNDP, the experience shared is similar to the West Papua and CIP-project in Wamena and Pegunungan Arfak, with no bargaining position used to determine the shapes and rate of crop-livestock development. The law of institutions determines the legality and power in the sounding policy of development, therefore, having access and trust for establishing cooperation and resources tends to induce the accelerated development of mixed crop-livestock farming business. The distinguishing status of stakeholders and shareholders enables easy-made and clear-contribution of delivering packages of the aids and services. This tends to lower the negative effect in the short-run, which enables actors to act with insurance. Direct threats are faced by many actors in crop-livestock farming system development. Therefore, serious action is needed to reduce the direct impact. There are various sources of threat, from animal health, wastes including livestock emission (Mariantonietta *et al*., 2017; Cardoso *et al*., 2016), forage management (Zanten *et al*., 2016) and price uncertainty (Asmarantaka *et al*., 2019). Therefore, Internal and external warning need to be addressed to avoid turn back effect.

Table 3 shows the inventorying possibilities of offered resources needed as inputs to stimulate the development of the crop-livestock farming system and enhance farmer capacity, including its actors. Eleven components of resources are found, therefore, further policy and action are needed to arrange it for future establishment and prospects to achieve sustainable crop-livestock farming systems. Prolong period is used to show how serious stakeholders are in establishing livestock development, despite their sustainability with neutral and strong livestock development.

Table 4 grouped actors with similar typology and characteristic, while figures 2, 3, and 4 are used to draw rich pictures and interpretations of the actor-network. There are also rich relationships and interlinked connectivity amongst actors. In figure 2 various linking actors with phenomenal attributes were created, showing the degree of mutual connectivity and analyzing the interlinked actors. The relationship between tables 2 and 3, as well as figures 2 and 3 enable the developing actors to be more precise in delivering resources and capacities to share aids and guidance needed for this service.

Table 5 explores the computed relational actors and the network and interlinked actors, which consist of positive, neutral, and negative relationships. This means that a negative network needs the adaptation and adjustment of local conditions and targeted goals of crop-livestock development. Neutral relationship needs future intervention and innovation for driving the powers and interest in stimulating tangible roles and future actions.

Table 6 investigated and recorded resources of further action that can be conducted. Policy, skills, and feed materials are the three top interventions used by actors. However, according to Table 6, the policy, space, and skill are the top three innovation programs, which means that the actors bring and deliver intervention based on these priorities. In general, the actors and donors convinced the receptors in promoting the development of mixed crop-livestock farming businesses in West New Guinea, Indonesia.

CONCLUSIONS

This study highlights the stakeholders in mixed crop-livestock, which are dominated by individual actors that privately manage the farms in accordance with law. These actors commonly act as stakeholders that are positively important and those that ruled the farms. The threats are real and need to be lowered as much as possible to mitigate the turn-back effect. The top five shared resources are access, satisfaction, power, knowledge, and time allocation. Those resources tend to stay longer to sustain the farms' strong needs with the relationship of actors positively dominated by similar correlations, which varies between negative, neutral to positive. However, this variation is due to the actors reluctant to deliver the intervention and innovation. Actors with low interest and low power need to be promoted to high interest and power by using aids, guidance, and services from each mixed crop-livestock farm business.

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript.

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REFERENCE

Bastian, M., Heymann, S., & Jacomy, M. (2009). Gephi : An Open Source Software for Exploring and Manipulating Networks Visualization and Exploration of Large Graphs. *International AAAI Conference on Weblogs and Social Media*, 361–362. https://doi.org/10.13140/2.1.1341.1520

Cardoso, A. S., Berndt, A., Leytem, A., Alves, B. J. R., Carvalho, N. O. De, Henrique, L., Soares, D. B., Urquiaga, S., & Boddey, R. M. (2016). Impact of the intensi fi cation of beef production in Brazil on greenhouse gas emissions and land use. *AGSY*, *143*, 86–96. https://doi.org/10.1016/j.agsy.2015.12.007

Gil, J., & Schmidt, S. (1996). The origin of the Mexican network of power. *International Social Network Conference*, 22–25.

Iyai, D A, & Yaku, A. (2015). Identifikasi Sistim Peternakan di Manokwari, Papua Barat-Indonesia The Identification of Livestock Farming Systems in Manokwari, West Papua-Indonesia D. A. Iyai 1 dan A. Yaku 2 1. *Jurnal Peternakan Indonesia*, *17*(2), 94–104.

Iyai, Deny A, Saragih, D. T. R., & Rumbiak, F. P. (2016). *Effect of Traditional Cattle Farming Systems on Farmer Knowledge , Cattle Performances and Agribusiness Potential in West New Guinea-Papua Barat Province , Indonesia*. *4*(1), 5–10. https://doi.org/10.11648/j.avs.20160401.12

Komalawati, Asmarantaka, R. W., Nurmalina, R., & Hakim, D. B. (2019). Modeling Price Volatility and Supply Response of Beef in Indonesia. *Tropical Animal Science Journal*, *42*(2), 159–166.

Mariantonietta, F., Alessia, S., Giustina, P., & Alessia, S. (2017). *Accepted Manuscript*. https://doi.org/10.1016/j.jclepro.2017.07.167

Moleong, L. J. (1991). *Metode Penelitian Kualitatif* (3rd ed.). Remaja Rosdakarya Offset, Bandung.

Ringle, C. M., Wende, S., & Becker, J. M. (2005). *SmartPLS* (SmartPLS 3.2.8). SmartPLS GmbH.

Schiffer, E. (2007). *Net-Map*.

Stephenson K and Zalen M. (1989). Rethinking Centrality: Methods and Examples. *Social Networks*, *11*(1), 1–37.

Wasserman, S & Khaterine, F. (1994). *Social Network Analysis: methods and application*. Combridge University Press.

Zanten, H. H. E. Van, Meerburg, B. G., Bikker, P., Herrero, M., & Boer, I. J. M. De. (2016). *Opinion paper : The role of livestock in a sustainable diet : a land-use perspective*. 547–549. https://doi.org/10.1017/S1751731115002694