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Development of Digital Smart Community in Sustainable Agriculture Practice in Indonesia

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Abstract – Smart community development is a strategic step in anticipating the development of Society 5.0 in Indonesia. The transition process of an information society into a smart society requires appropriate policies, especially amidst the ongoing demographic bonus challenges from 2015 to 2035. The agricultural sector in Indonesia is a strategic sector that has contributed to 13% of the national GDP. In the context of sustainable agriculture which produces healthy food by environmentally on-farm practices and encourages community welfare, digital technology plays a crucial role in driving innovation adoption for sustainable agriculture practices. One of the goals is to promote knowledge-sharing processes and network strengthening through smart community development. In a case study of a poultry farming community in East Java and Central Java, sustainable on-farm practices by multi-nutrient and additive supplement implementation are facilitated by developing a smart community using digital media. This study aims to analyze how the digital smart community formed and to what extent the development of agribusiness networks can create a social entrepreneurship model. The results of this case study can serve as a recommendation for developing sustainable agriculture practice policies in Indonesia and other developing countries.

Keywords: Smart community, digital technology, sustainable agriculture

1 Introduction

From 2006 and 2016, Indonesia's sustainability index for biodiversity, organic farming, employment, and safe sanitation was lower than the world average, this effected agricultural production and sustainable development. This trend is similar in developing countries, where agricultural production contributes to 35% of Greenhouse Gas (GHG) emissions, compared to only 12% in developed countries [1]. Developed countries have more effectively adopted sustainable agricultural practices than developing countries. However, implementing sustainable agriculture, such as organic farming in Indonesia, has shown promising growth potential. There is increasing market demand for organic agricultural products, as evidenced by the rise in trade volume from 491.4 tons in 2019 to 7,795.9 tons in 2022 [2] This growth reflects the increasing adoption of organic farming for various crop types in Indonesia. However, research and available data evaluating sustainable livestock production, especially poultry farming, are still limited. Therefore, research into implementing sustainable livestock farming needs to be explored, especially in Indonesia.

In the context of digital technology development, its use in Indonesian agribusinesses presents both opportunities and challenges. Digital technology has the potential to enhance production efficiency, as well as drive socio-economic and environmental benefits. Indonesia boasts a high level

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of internet access, with 66.48% of the population reported to have accessed the internet in 2022, according to data from the Indonesia Statistical Bureau. This indicates significant potential for leveraging digital technology in various productive sectors, including agriculture. Considerable research in many countries has explored the intersection of communication technology and the empowerment of farming communities in many aspects. Aspects of farmer empowerment are seen from the aspect of information access [3][4][5][6], increasing decision-making capacity and aspects of farmer psychology [7][8], increasing supply chain efficiency and rural business development [9], and other socio-economic impacts [6][7][8][10].

The advancement of broadband internet, sensor technology, and data analysis drives the increased use of precise information in precision agriculture. The sensors, drones, weather satellites, intelligent software, and robot implementation have led to the emergence of "smart" farming [11]. Smart farming not only enhances efficiency and productivity but also supports sustainable agricultural development [12]. The utilization of sensor technology in detecting mineral content in the soil will be extremely beneficial in accurately managing fertilizer application, thereby reducing waste and environmental pollution. The advancement of digital technology has led to improvements in the economy, society, and the environment simultaneously.

However, digital technology is simply a tool and not a solution to socio-economic problems in rural communities [13]. Socio-economic conditions significantly influence the ability to access and use technology [14], There is a challenge in bridging the digital divide in rural areas and agricultural communities in Indonesia. The gap in household internet usage in urban areas in 2021 reached 88.53 percent, while in rural areas it was only 73.57 percent (Indonesia Statistical Bureau, 2022). Additionally, for the agriculture sector, i.e. there is a high entry barrier for smallholder farmers in the laying hen farming business in Indonesia due to the existing business and trade structure (Kristiansen, 2007). Given the constraints of sustainable agricultural practices, particularly in the livestock sector, and the potential for utilizing digital technology with limited access and adoption by farming communities, it is crucial to promote smart communities through digital media. Digital technology will serve as a means of communication, facilitating the sharing of knowledge and experience related to sustainable agricultural practices in the livestock sector, focusing on laying hen farming in Indonesia.

2 Materials and methods

This research is a case study utilizing a multi-stakeholder analysis approach. It involves identifying the actors involved, analyzing their respective roles, categorizing them, and exploring the interactions between the actors. This study took the object of analysis from the online community of laying hen farmers. This community is involved in the pattern of utilizing multi-nutritious and additive supplements. The community began with exposure to content about the experiences of farmers on a YouTube channel in 2014. It further evolved through a WhatsApp Group in 2019 and established a community with 109 members across multiple regions. The majority of community members are located in East Java, with 45 members, and in Central Java, with 23 members. This community initially started by sharing experiences with multi-nutrients and additive supplements. Over time, it has evolved into a forum for sharing good practices in livestock farming and promoting the use of environmentally friendly and non-polluting management practices, while prioritizing sanitation and the production of healthy products.

How the community becomes a smart digital community is answered through descriptive analysis and content analysis, while to find out how far the community has become a social entrepreneurship, we use a stakeholder analysis approach. Descriptive analysis is like zooming into

the details of data. It focuses on summarizing and describing the main feature without making any inferences. Content analysis involves examining texts from a chat or discussion forum and identifying patterns, themes, or meanings. Multi-stakeholder analysis is used to understand how different stakeholders (individuals, groups, organizations) interact and affect a particular issue. This analysis helps identify the needs, power dynamics, and potential interactions or conflicts among stakeholders.

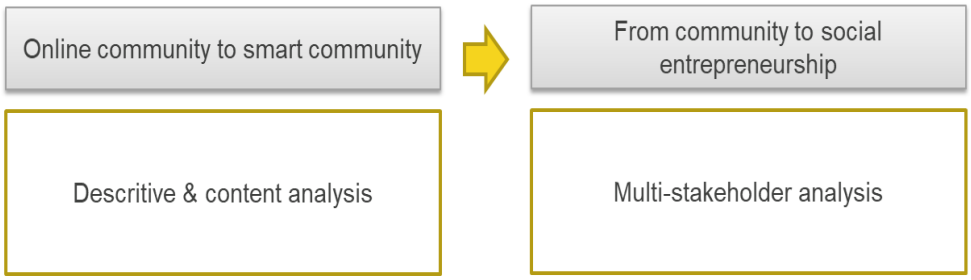

Fig 1. Methods of Analysis

3 Results and discussion

This online community became an ideal community and was evaluated based on the Community-on-Practice (CoP) approach introduced by Wenger et al. (2002). Daily active users averaged 9.9% out of 109 users, with a maximum of 27.5% active users. This indicates that the online farmer community is at an optimal level, with active users ranging from 15% to 20%. The level of interaction within online groups can be observed through the frequency of posts in the WhatsApp Group. The average number of posts per week reached 381, indicating that information and knowledge sharing activities are quite intense within the online group of the laying hen farming community.

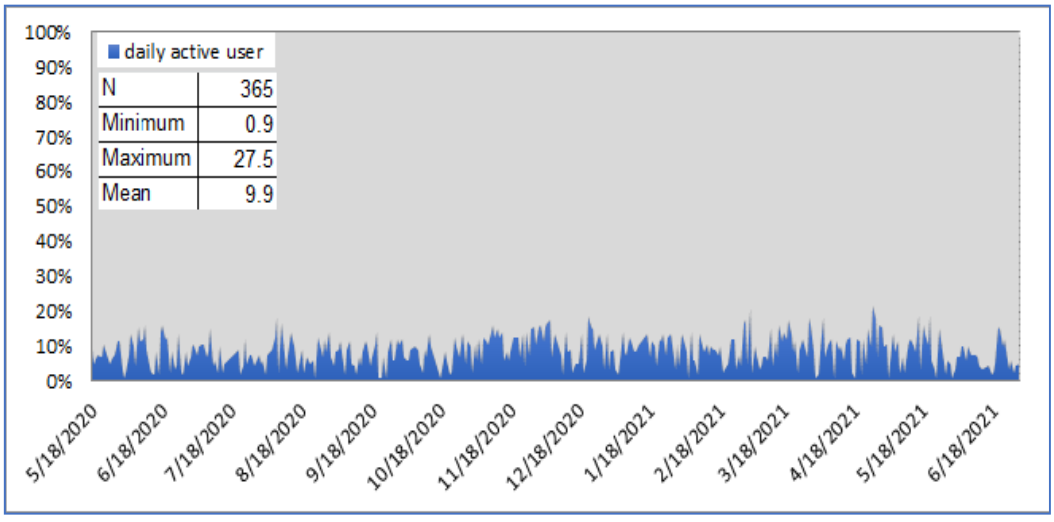

Fig 2. Frequency of posts in the WhatsApp Group

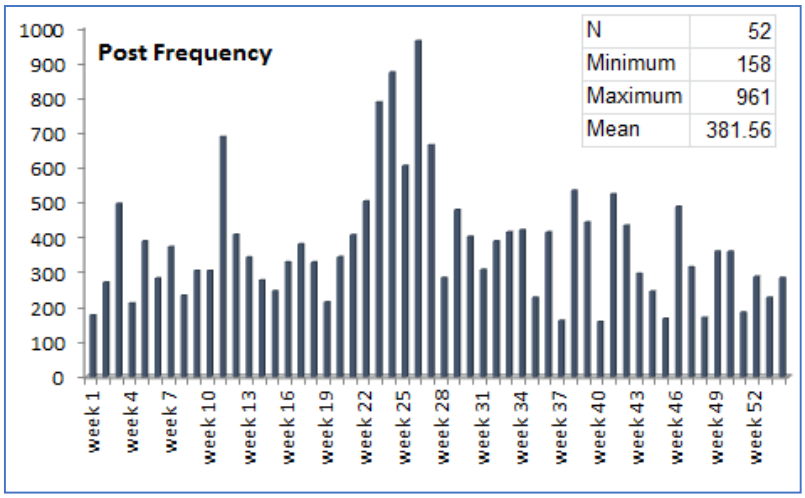

Fig 3. The average number of posts per week

In a community, there are different levels of participation. The first level is the core group, consisting of members who are most actively engaged in discussions and debates within the online community forum. These individuals have made significant investments in the community. The second level is the active group, which includes members who regularly participate online and contribute to discussions and knowledge sharing. The largest segment of the community is the peripheral group, which consists of members who are rarely active but still pay attention to the interactions and activities of the core and active members. Although they may seem passive, they are not entirely disengaged and possess the potential to influence their surrounding environment. This potential is a valuable strength of the community, as it can help attract outsiders to join and become active participants. The online community currently has 109 members. Among them, 5 individuals (4.6%) form the core group. This group includes 1 facilitator who serves as an agent for multi-nutrient supplement additive products and also provides technical consulting; 1 farmer who is a pullet supplier; 2 farmers who are early adopters of the product; and 1 off-taker. The active group within this community comprises 16.5% of the total membership, while the peripheral group makes up 78.8%.

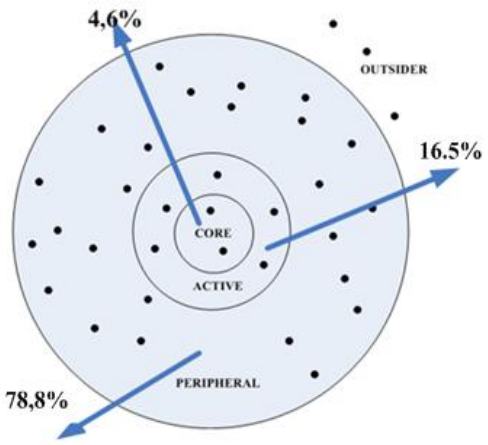

Fig 4. Participation level on online community members

3.1. Development of Digital Smart Commnity

The process of developing an online community into a digital smart community can be seen from the aspect of increasing the capacity of individuals within it, which has an impact on strengthening business and value chain networks. How online communities form business networks can be seen in Figure 5.

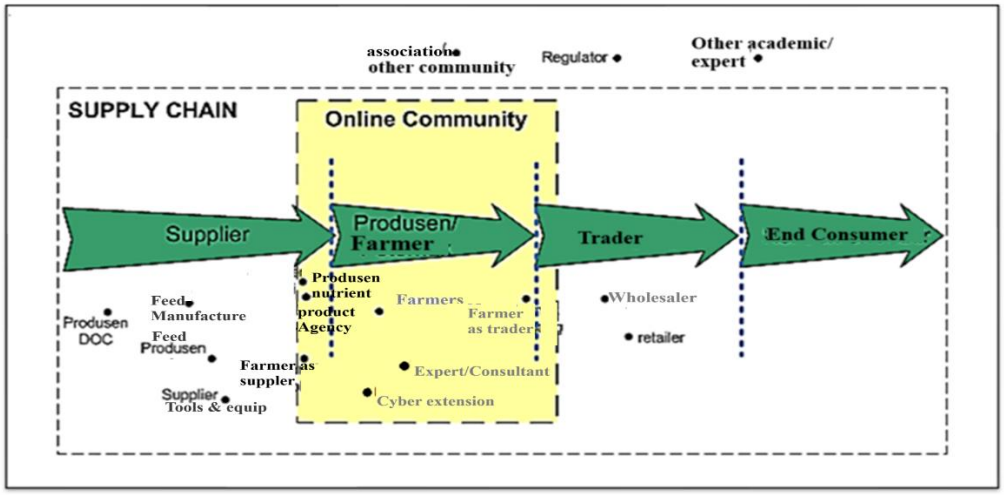

Fig 5. Actors mapping in supply chain and online community members

Figure 5 demonstrates that the members of the online community are still limited, which affects the community's ability to promote the development of agribusiness supply chain. There are still key actors and strategic roles that exist outside of the community. However, the advancement of agribusiness network is achieved by enhancing the capacity of farmers, who are not only engaged as farmers but also as traders and suppliers of various products, such as tools, equipment, and pullet producers (pre-production chickens).

Table 1. Roles of actors in Online Community

No	Actor	Role	Description
1.	Multi-nutrient and additive supplement agent	Online branding/Marketer	Provoke outside to active participants and community
		Inisiator online community	Drive active discussion in online community
		Agriculture extension	Consultancy and practical advice
2.	Laying hens farmer	Eggs production	Produce quality eggs, efficient and environmently poultry management
3.	Farmer as also trader	Eggs production	Produce quality eggs, efficient and environmently poultry management
		Marketing agent	Create niche market
		Trader	Trading activities
4.	Farmer as also supplier	Eggs production	Produce quality eggs, efficient and environmently poultry management
		Tool and equipment trader	Tool and equipment trading

No	Actor	Role	Description
		Pullet trader	Pullet trading
5.	Multinutrient and additive supplemen produsen	Produsen	- Multinutrient and additive supplemen produsen - R&D - Consultancy service

The online community has enhanced the supply chain network by strengthening the farmer's capacity. That means the empowerment effect has happened. A major advantage of this online community is the development of a value network among its members, which could significantly impact the entire supply chain of laying hen farms. However, the network is currently limited and needs to be strengthened through the right strategy. It's important to kickstart community development by creating value together through online communities and to continue efforts to form and grow shared value. The value co-creation process is outlined in the Value Creation Framework (VCF) by [15], which encompasses immediate value, potential value, applied value, realized value, and reframing value. Figure 6 illustrates the value co-creation process, which is ongoing and has further development potential.

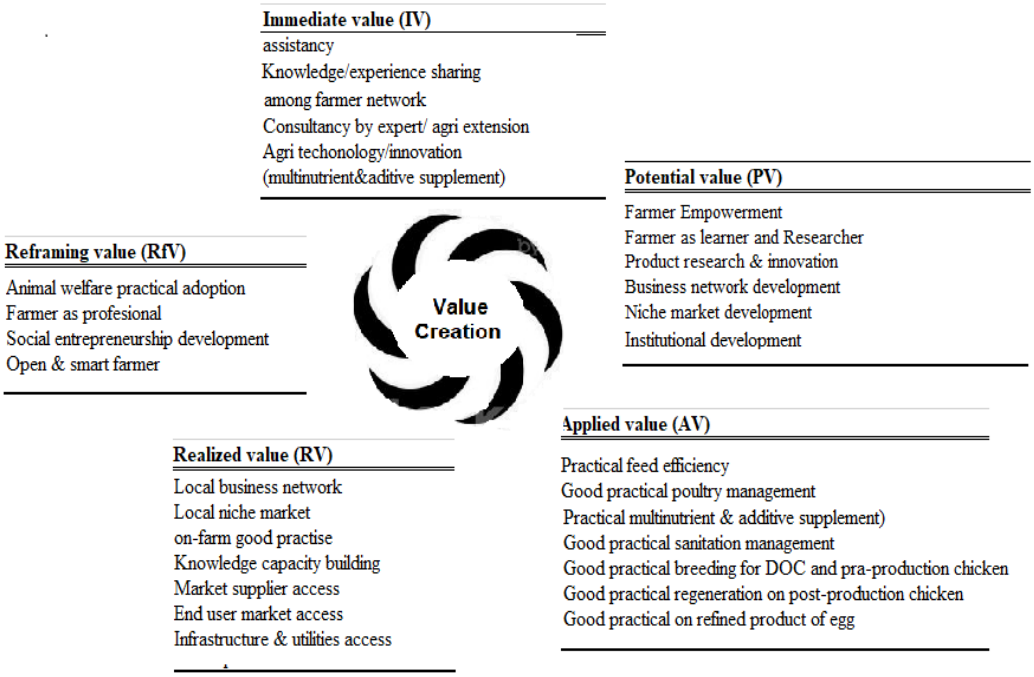

Fig 6. Value creation process in community

The online community of laying hen farmers was formed and started with the practice of product innovation (multi-nutrient and additive supplements) that provide benefits in the joint practice of raising laying hens. The existence of interaction in sharing experiences and mentoring from extension workers and expert consultations makes the online community stronger, plus the benefits of connections between farmers and relationships with several partners who are members of the community. In addition to the direct value felt in the community (immediate value), there are also potential values to be developed, such as farmer empowerment, business networks, development of research and product innovation, development of smart farmers, formation of special markets (niche

markets) and institutional development. These potential values are then partly seen in the practice of shared values in the community (applied value), which then produces various values that are realized and felt by community members. These realized values also directly reflect the benefits of empowerment for farmers, such as ease of access, business networks, increasing farmer capacity, and formation of special markets (niche markets).

The strategy for developing value networks in online communities needs to be directed at efforts to realize the potential values. Subsequent developments must also look at new values that enable changes in the way of thinking and farming practices that have been carried out so far. Reframing values such as making farmers smart, open, and professional, developing animal welfare practices, and also institutions to encourage communities to become business institutions as well as social entrepreneurship. These values can be developed to make the community that is built not only able to increase competitive value in the supply chain network as mentioned by [16] but also able to form a sustainable value chain network, which combines social and environmental issues. Reframing value is a bonding value that can be developed from a farming community to further become a form of social entrepreneurship.

3.2. Development Phase of Social Entrepreneur

While there is a profit-driven motivation behind the development of this online community of farmers, the values of empowerment foster complementary relationships among members, creating a social network as discussed by [17]. The transformation of the agribusiness supply chain within this community into a social entrepreneurship network takes place through several stages: incubation phase, growth phase and developed phase.

In this incubation phase, the value of farmer empowerment becomes the basis of social values that underlie the formation of online communities. The economic benefits of the practice of product innovation (multi-nutrient and additive supplements) become stronger with the bonds of empowerment values in them. The synergy of economic and social benefits is an important capital in the development of social entrepreneurship [17][18] and is a form of sustainable agribusiness development. Mentoring and consulting play an important role in the incubation or as a supporting resource and the main role of empowerment actors [19].

In the growth phase, environmentally friendly practices have been introduced on farms. Sustainable practices include implementing biosecurity measures, non-antibiotic methods, and processing chicken manure into organic fertilizer. In this phase, farmers feel new added value in their livestock business and a niche market has also formed for healthy and organic eggs. In the developed phase, a significant market for healthy and organic eggs has widely emerged, featuring agribusiness integration while still upholding social values and environmental sustainability.

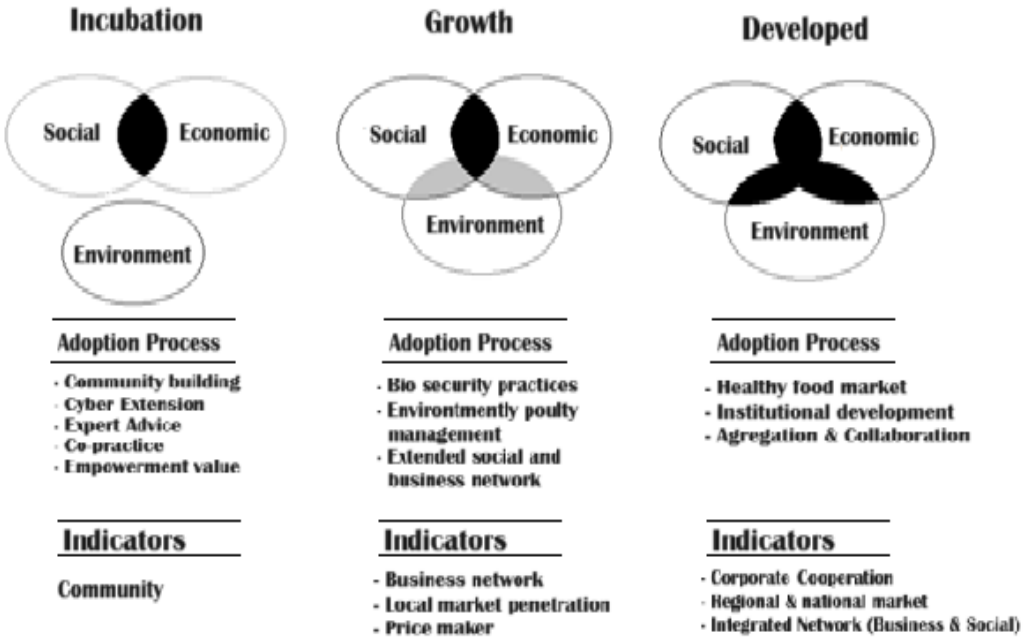

Fig 7. Development phase of sustainable agribusiness

The concept of social entrepreneurship, particularly in digital smart community development, serves as an alternative approach to achieving sustainable agricultural development. The impacts of sustainable agriculture can be observed in every role of social entrepreneurship. Table 2 illustrates the sustainability benefits and role of social entrepreneurship in digital smart communities.

Table 2. Sustainable impacts and digital smart community roles

Sustainable agriculture impacts	Digital smart community roles
Knowledge development based on Good Practices	- Compiling good practices cookbook - Assistance and expert counselling - Developing knowledge management system
Building farmer capacity	- Marketing facilitation - Scale-up assistancy - Training and development - market off-taker - Expanding value-based network.
Driving awareness of social and environmental value	- Social campaign healthy food - Assistance of bio-security and sustainable production practices - Increasing supporting system i.e facilities, supplier, policy and regulation support.

There are sustainable agricultural values resulting from the development of a digital smart community. The first: is knowledge development based on good practices, the second: building farmer capacity, and the third: driving awareness of social and environmental value. Good practices are developed through a variety of activities that involve sharing practical experiences alongside consultants and experts. This compilation of good practices serves as a cookbook, providing a shared

guide for community members. The continued growth of a digital smart community relies on the establishment of knowledge management system. And then, increasing the capacity of farmers in the community is reflected in the existence of market facilitation, training and education and the role of off-takers for quality egg products. The next role of sustainability is how online communities can promote social values and environmental sustainability in agricultural practices. Actions such as social campaigns about healthy and environmentally friendly products, biosecurity, and animal welfare practices and also the fulfillment of various support systems needed in increasing business and values networks

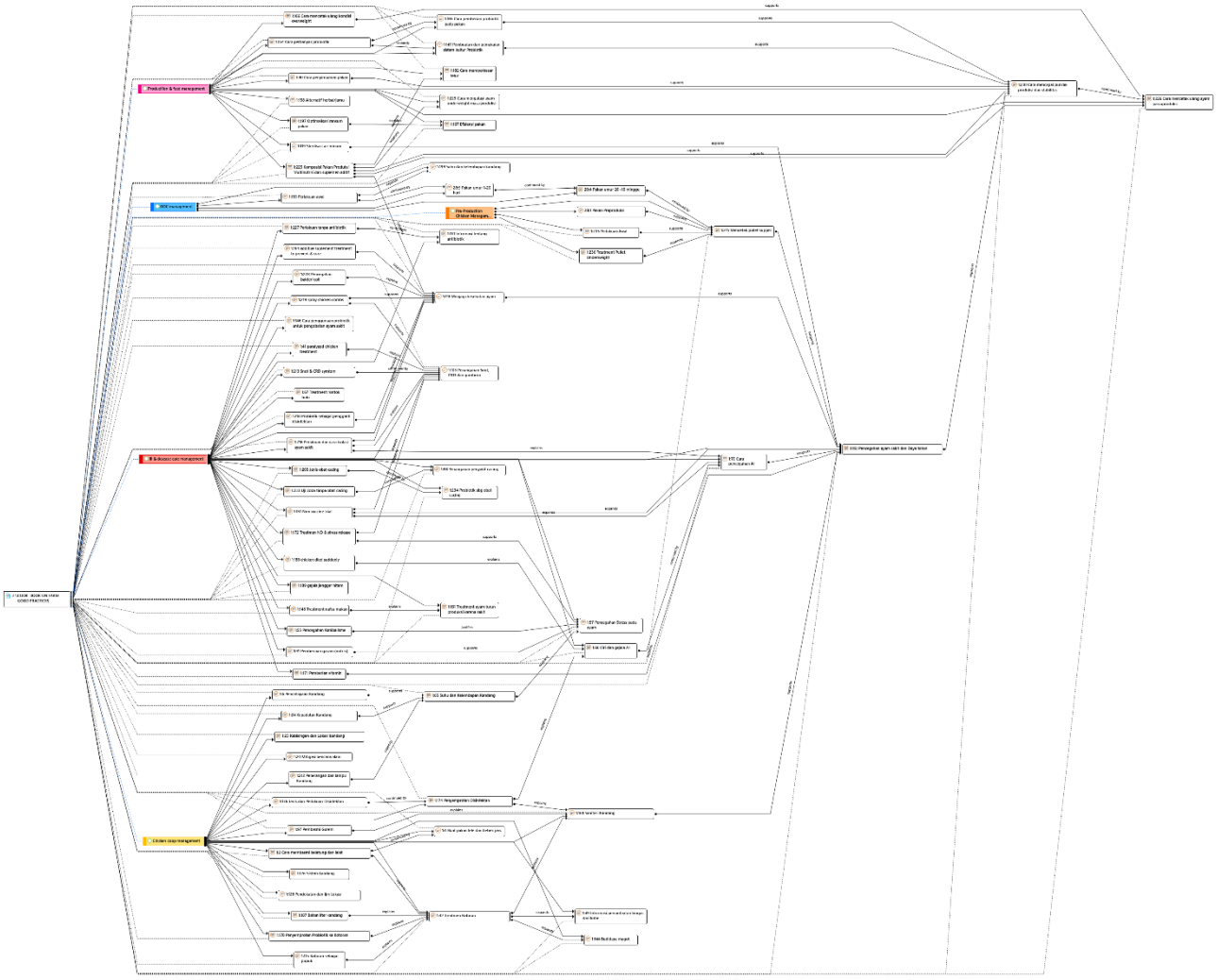

Fig 8. Cook book good practices on-farm management

From Figure 8, we can see that the digital smart community was developed through practical knowledge sharing about on-farm management. It becomes cookbook that contain good practices about chicken coop management, illness, and disease management, Daily Old Chicken (DOC) management, pre-production chicken management, and production and feed management. Each cookbook includes many activities and practical knowledge shared in this community. Through expert mentoring and consultation, these cookbooks create a smart community. In the long term, it becomes a community based on a shared knowledge system.

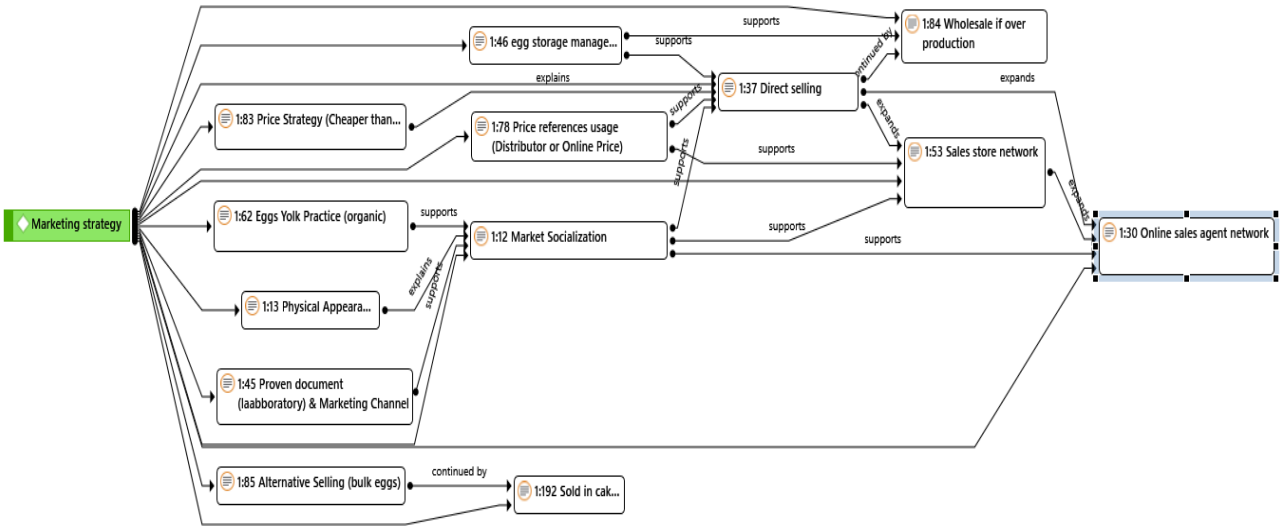

Fig 9. Cook book good practices off-farm management (marketing strategy)

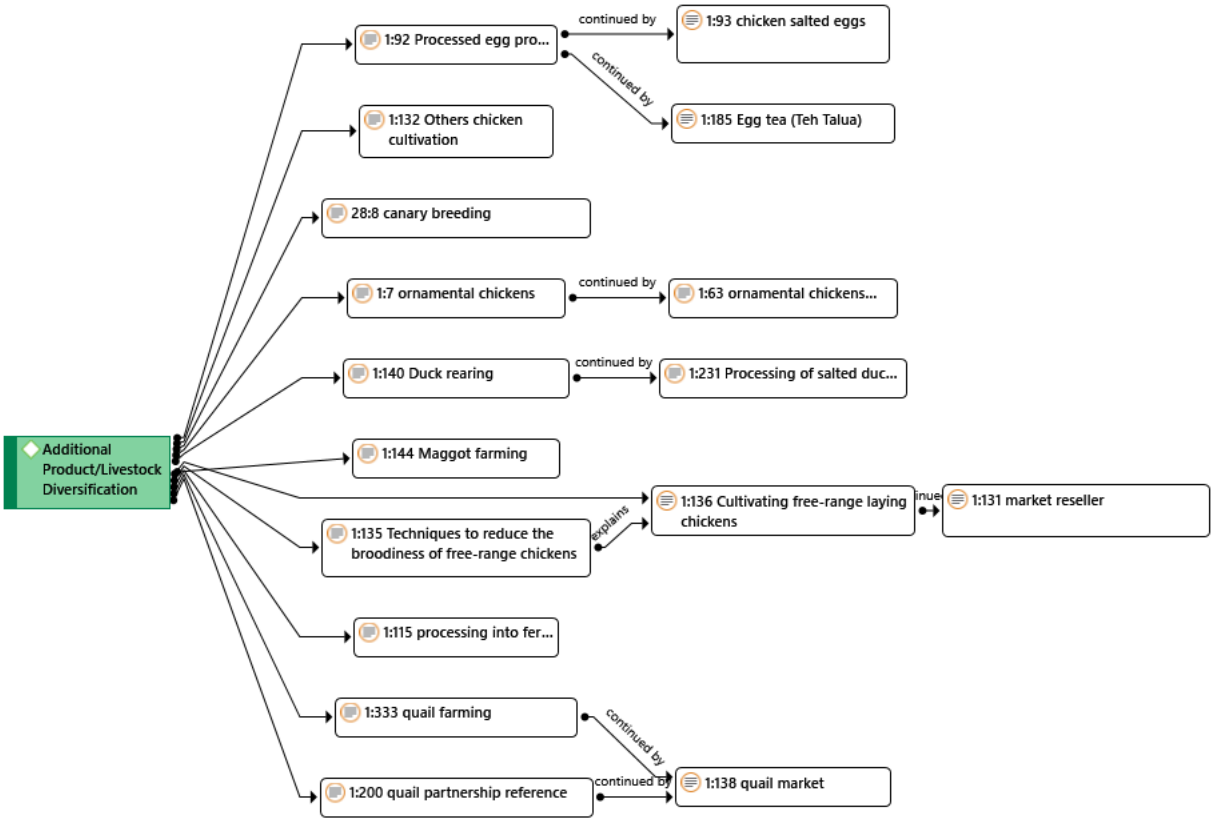

Fig 10. Cook book good practices off-farm management (product diversification)

From Figures 9 and 10, it can be seen that the development of digital communities has encouraged increased livestock farmer capacity. Through interactions between actors in the community, new skills have developed for livestock farmers, both in terms of marketing strategies and even product diversification. Market strategies include pricing strategies, sales channels, product appearance, egg yolk techniques to increase sales value, and various other strategies. Product

diversification includes the development of processed egg products to other poultry farming techniques (ducks, quails, etc.) as well as managing manure into fertilizer and developing other products. With the increasing capacity of farmers through smart digital communities, the process of developing shared values in terms of more sustainable farming practices, ensuring product quality and paying attention to animal welfare can be done more easily. Of course, with the increasing role of actors in it supported by a more equal policy ecosystem and economic ecosystem.

4 Conclusion

The development of a digital smart community is a pattern that integrates the use of digital technology in sustainable agricultural practices. This research shows that the online community that is formed can become a smart community if there is a value co-creation process between the actors so that the benefits of business and value networks can be formed. An online community becomes a smart community if there is a process of sharing knowledge and practices accompanied by extension agent and expert's facilitation. This study proves that online communities have provided an alternative to strengthening supply chain and business networks based on value networks and are not only competitive This value network strengthens sustainable agricultural practices and this potentially can be facilitated in the social entrepreneurship model. Although this research is a case study, the potential for generalization can be proven in further research.

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