The relationship between avian influenza disease vaccination and chicken mortality in Sukabumi District, West Java Province, Indonesia

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Abstract. Vaccination program is an important aspect in the development of chicken industry. This paper aims to analyse the relationship between vaccination program and local chicken mortality during Poverty Alleviation Program in Sukabumi District, West Java Province. Total of 3579 households in two subdistricts namely Lengkong and Cikembar were involved in this study, who received superior local chicken KUB (improved local chicken) followed by Newcastle and Avian Influenza vaccination program. Monitoring of chicken population were done during March-November 2019, while households’ characteristics data were obtained from the Ministry of Social Affairs in 2017. Descriptive and regression analysis were used to identify households’ characteristic, coverage rate and relationship between vaccination and chicken mortality. The results showed that the number of vaccinated chickens during the program significantly increased chicken mortality by 0.381 times. Even though, the coverage rate of chicken vaccination in Cikembar was higher compared to that number in Lengkong, chicken mortality in Cikembar was much greater than the other. Probably, chickens were stress or sick during vaccination program, exacerbated by poor management practices (such as lack of water and feed) notably during dry season. In conclusion, a better understanding of chicken vaccination as well as a good management practices was required to lessen chicken mortality.

1. Introduction
The population of local chicken in Indonesia has increased since 2014 which reached 275 million heads to 311 million heads in 2018. This population has spread around Indonesia particularly in Central Java, East Java, South Sulawesi, and West Java. While most of those areas have an increasing trend of the local chicken population in the last four years, the population of local chicken in West Java has decreased from 27.6 million heads in 2014 to 26.7 million heads in 2018 [1]. In fact, the demand for local chicken products in West Java continues rising due to the changes in people’s lifestyle and preferences. Particular segmentation for local chickens existed in Garut District, West Java leads to a higher price of local chicken compared to broiler [2].

To support the development of local chicken, the Indonesian government distributed local chicken through BEKERJA (Alleviate poverty, prosperous people) program to poor households in 10 provinces in 2018 and 20 provinces in 2019 including West Java Province. During the program, households received 50 tail of chicken aged one week, feed subsidy about 200 kg, pen subsidy (IDR 500 thousand)
and also obtained free vaccination for chickens namely New Castle Disease vaccine (ND) and Avian Influenza vaccine (AI).

Vaccination program is an important component during the program in order to ensure the chicken’s health and productivity. Some research revealed the importance of chicken vaccination in order to avert diseases outbreaks [3–6], as well as to improve the productivity [7–9]. This will impact on the contribution of income to farmers. The study by Ilham and Yusdja (2010) indicated that the contribution of farmers’ income from chicken business in Lampung, East Java and West Java has diminished from 83.5 percent to 68.7 percent after AI outbreaks [10]. Moreover, vaccination was also crucial to reduce the risk of mortality [11] due to ND and AI disease in particular. However, in some cases, the mortality of chicken still exists even after vaccination. Study by Annapragna et al (2019) mentioned that a high number of chickens being vaccinated (more than 90 percent) among the population will not stop the outbreaks unless followed by continued vaccination [12].

Therefore, this paper aims to analyze the relationship between vaccination program and local chicken mortality during Poverty Alleviation Program in Sukabumi District, West Java Province. This study is important to adjust the vaccination strategies in the future.

2. Method

2.1. Program and research location

The study has been conducted in West Java Province due to contributing the largest Indonesian population which has reached 46.7 million population in 2015 or about 18 percent of total Indonesian population [13]. Moreover, West Java Province has the third largest agricultural poor households which in 2003 has reached 14 percent of total agricultural poor households in Indonesia [14].

For this reason, West Java Province was also selected to be involved in Poverty Alleviation Program so-called BEKERJA Program in order to diminishing the poverty rate in Indonesia. One of several strategies in this program is by distributing improved local chicken (KUB=Kampung Unggul Balitbangtan), innovated by Indonesian Agency for Agricultural Research and Development (IAARD). The chicken were distributed to selected poor households with the criteria defined by Ministry of Social Affair in 2017 as mentioned in technical guidance of this program [15]. Each household received 50 tail of chicken, 200 kg feed subsidy, IDR 500 thousand pen subsidy; training and assistance in keeping chicken including free vaccination and vitamin.

Sukabumi District is one of several districts in West Java Province that received BEKERJA Program, where the study was done from February to November 2019 in two subdistricts namely Lengkong and Cikembar Subdistricts. These two subdistricts have differences in terms of height from sea level, where Lengkong Subdistrict is located in the area with height 500–800 m above sea level (upland), while Cikembar Subdistrict is located in the area with height 100–500 m above sea level (lowland). Lengkong Subdistrict includes five villages which are Lengkong, Neglasari, Tegallega, Cilangkap and Langkapjaya, while Cikembar Subdistrict covers 10 villages which are Sukamulya, Cikembar, Cimanggu, Bojongkembar, Parakanlima, Bojong, Bojongrahara, Kertaraharja, Cibatu and Sukamaju.

Chicken distribution were done gradually from the end of February to March in Lengkong Subdistricts, while the distribution in Cikembar Subdistrict were in the end of February (for several households, continued in the end of March to first week of July. Supervision and monitoring of chicken population were done for four months, which were until July 2019 in Lengkong Subdistrict and November in Cikembar Subdistrict. On the other hand, vaccination was done twice for Newcastle Disease Vaccine (ND) on day 56th and Avian Influenza disease vaccine (AI) on day 70th after chicken received. ND vaccination was done through eye drops while AI vaccination was done through injection.

2.2. Method

A total of 3,879 households consisted of 2,427 households in Lengkong Subdistrict and 1,152 households in Cikembar Subdistrict, Sukabumi District involved in this Poverty Alleviation Program and received 121,350 dan 57,600 bird respectively for Lengkong and Cikembar Subdistrict. Primary
data were gathered from monitoring chicken population kept by all households which was done every week and accumulated every month since March to November 2019. During vaccination program, recording was done for number of chickens vaccinated and those that were not vaccinated. In addition, secondary data was gained from Ministry of Social Affair (2017) associated with characteristic of households such as age, family members, land and asset owned by households.

2.3. Data analysis
Both primary and secondary data gathered were analysed descriptively and statistically. Regression analysis were used in this study to analyse the relationship between number of vaccinated chicken and variable weather factor against mortality of chicken with the model below:

\[ Y = a + bnX_n \]

- \( Y \) = Number of dead chickens (bird)
- \( a \) = Constant
- \( b \) = Coefficient of regression for \( X \)
- \( X_1 \) = Number of chickens vaccinated (bird)
- \( X_2 \) = Dummy “weather” whereas valued by 1 for the rainy season, and 0 for dry season

Moreover, mortality rate and coverage rate in percent was counted by:

- Mortality rate (%) = \( \frac{\text{Total dead chicken (bird)}}{\text{Total chicken population (tail)}} \)
- Coverage rate (%) = \( \frac{\text{Total vaccinated chicken (tail)}}{\text{Total chicken population (tail)}} \)

In addition, characteristic of households was analysed descriptively and the difference of those characteristic among two different areas (subdistricts) were tested using T-test.

3. Results and discussion

3.1. Characteristic of households
In general, there was a significant differences between characteristic of farmers in Lengkong and Cikembar Subdistrict in terms of households’ age, family member, size of dwelling and size of land asset as showed in table 1.

| Parameters                  | Total | Lengkong | Cikembar | P-Value |
|-----------------------------|-------|----------|----------|---------|
| Age of households (year)    | 50.0  | 49.4     | 51.5     | 0.000*  |
| Family members (people)     | 3.6   | 3.7      | 3.5      | 0.000*  |
| Size of dwelling (m²)       | 35.4  | 33.4     | 39.5     | 0.000*  |
| Size of land asset (m²)     | 887.1 | 1,126.4  | 384.4    | 0.000*  |

*number were significant (P<0.001)

Household were classified into productive age in both subdistricts, suggested that households have capability in keeping chickens. According to table 1, the average age of households in Lengkong were about 49 years’ old, significantly younger compared to those households in Cikembar Subdistrict (about 52 years’ old). This Siyaya and Masuku (2013) also a similar average age of farmers keeping indigenous chicken reported in Swaziland [16]. However, the majority of poultry farmers in Botswana were young farmers who aged 16–45 years’ old [17]. Moreover, family members was on average about 3–4 people
per households in this study. This indicated that households have a potential source of labour in order to support their chicken business. A larger households size was found in poultry farming in two wards namely Sanza Ward and Majiri Ward in Tanzania which was about five people [18].

Interestingly, according to size of land for dwelling, households in Lengkong had a smaller area compared to households in Cikembar Subdistrict, which were about 33 m² and 40 m² for Lengkong and Cikembar, respectively. However, households in Lengkong had a larger size of other land (asset) in the form of rice-field or other food crop area compared to households in Cikembar Subdistrict. It is likely that a large amount of other land owned by households in Lengkong due to this area was in rural area with mountain topography, while the lands in Cikembar Subdistrict were closed to urban area with smaller size. Most of those areas in both Lengkong and Cikembar Subdistricts belong to households themselves (96 percent). More land owned by farmers has potency to increase the number of chicken kept, as a result increase farmers’ income [19].

3.2. Coverage rate of chickens
Coverage rate of chicken vaccination in each location was high for ND vaccination which were about 92.31 and 97.15 percent, for Lengkong and Cikembar, respectively (table 2). In contrast, coverage rate of chicken vaccination for AI disease were lower compared to ND vaccination particularly in Lengkong Subdistrict which were about 66 percent and 92 percent for Lengkong and Cikembar. This was probably due to a simple technique used for ND vaccine through eye drops and gave less sensitive effect compared to AI vaccination which was done through injection. In injection technique, inappropriate position of needle caused problems such as swelling in the part of injection [20], and this leads to stressful condition to chickens. The same situation was also found in West Java and Bali that the participation of layer chicken farmers in ND vaccination was higher which was around 96 percent compared to AI vaccination which was about 60–73 percent [21]. This study only analyzed the relation of chicken vaccinated with AI toward chicken mortality due to a significant decrease of AI coverage rate was found.

Table 2. Coverage rate of chickens for ND and AI diseases vaccine in Lengkong and Cikembar Subdistrict, Sukabumi District during Poverty and Alleviation Program in 2019.

| Subdistricts | Coverage rate of ND (%) | Coverage rate of AI (%) |
|--------------|-------------------------|-------------------------|
| Lengkong     | 92.31%                  | 66.43%                  |
| Cikembar     | 97.15%                  | 91.76%                  |
| P-value      | 0.0195*                 | 0.0005**                |

**number were significant at level 99 percent (P<0.01); and *number were significant at level 95 percent (P<0.05)

Between two subdistricts, coverage rate of chicken vaccination for both ND and AI in Cikembar were significantly higher (P<0.001) compared to that percentage in Lengkong Subdistrict. This might be because the location of Cikembar Subdistrict was close to urban area and the Livestock Agency Services Sukabumi District Office, that ease access to information related to the importance of chicken’s vaccination. Study by Ochieng et al (2012) revealed that the adoption of technology intervention were influenced by the increase access to extension services [22]. Moreover, almost eight percent of households in Cikembar Subdistrict were engaged in animal production so that they understand more about vaccination programs. Only less than one percent of households in Lengkong Subdistrict were involved livestock business. In addition, chicken farming that was located close to urban area tend to be more crowded so then increased the risk of being exposed by disease, and this trigger the decision of farmers in vaccination program [21]. Details coverage rate of chicken vaccination per village in two locations can be seen in figures 1 and 2.
3.3. **Mortality rate of chicken**

The population of chicken has started declining in the first month of raising chicken in both subdistricts. The decrease number of chicken population during the program in Sukabumi were mainly due to chicken mortality, chicken slaughtering and selling. The percentage of chicken mortality was about 27 percent in Lengkong, lower than that percentage in Cikembar which reached about 36 percent (figure 3 and 4). This percentage contradicted with the coverage rate of chicken whereas Cikembar Subdistrict had a higher coverage rate compared to Lengkong (table 2). The study by Barman et al (2010) reported a different result in the district of Mymensingh, Bangladesh where mortality of chicken due to ND was 4.4 times significantly higher in unvaccinated chicken flocks compared to those in vaccinated flocks of chickens [23]. The result of this study indicated that, even though vaccination was implemented, it would not prevent the chicken mortality. Probably, there was another factor affecting the mortality such as weather where it was in dry season in that area were starting in August to November 2019. This can be seen by the significant increase of mortality percentage in Cikembar Subdistrict in August to November 2019. Moreover, chicken mortality in vaccinated flocks were probably due to failure in vaccination implementation such as improper cool chain handling and timing for vaccination as also reported by Barman et al [23].

According to figure 3 and 4 also showed that number of chicken selling was also higher in both subdistrict which reached 16 and 18 percent in Lengkong and Cikembar Subdistrict, respectively. Moreover, there were a small number of slaughtered chickens found which were less than five percent in research areas. Number of chickens slaughtered and sold indicated the income received by farmers.
3.4. The relationship between AI vaccination and weather towards chicken mortality

The result of linear regression model showed the effect of weather and number of chickens vaccinated toward chicken mortality in table 3.

Figure 3. Total decline of chicken population in Lengkong Subdistrict

Figure 4. Total decline of chicken population in Cikembar Subdistrict.
Table 3. Relationship of number of chicken vaccinated and weather against chicken mortality in Sukabumi District during Poverty and Alleviation Program in 2019.

| Parameters                  | B    | t    | Significance |
|-----------------------------|------|------|--------------|
| Constanta                   | 1121.424 | 0.246 | 0.810        |
| Number of chicken vaccinated | 0.381 | 2.371 | 0.035*       |
| Weather                     | -538.522 | -0.276 | 0.788        |

R square: 0.672; Adjusted R-square: 0.618; *number were significant at level 95% (P<0.05).

According to table 3, R-square was 0.618 represented number of chicken mortality was 62 percent developed by independent variables (weather and number of chicken vaccinated). Table Annova has also showed a significant result (P=0.001 or < 0.05) meaning that the model developed was significant explaining the relationship between the independent variables and the dependent variable.

Table 3 showed that an increased number of chicken vaccinated in Sukabumi District during BEKERJA program, rose the number of dead chicken by 0.381 tail, significant at P=0.035 (P<0.05). This result contradicted with the purpose of vaccination to increase the endurance of chickens against the outbreak of diseases, so that diminishing chicken mortality. This might be during vaccination implementation, the chickens were in poor condition such as stress, sick, etc. Vaccination in stressful condition of chicken increased the failure of vaccination [24]. Those condition were exacerbated by limited knowledge of vaccinators who were not only from Livestock Agency Services’ Staff but also from field staffs in the village that pointed during Poverty Alleviation Program. Moreover, the distant between pen was quite far especially in mountainous locations, as a result the implementation of vaccination might take more time until noon, which certainly made the chicken stressed due to heat. In addition, Barman et al (2010) discovered that inappropriate time of vaccination as well as failure in managing cool chain were also increased chicken mortality [23]. Therefore, before the vaccination, it was suggested that field staffs should be provided by technical guidance related to vaccination techniques and importantly, the condition of chicken required before the implementation of vaccination.

The second factor was the condition of weather where high temperature, generally in dry season, caused heat stress that impact negatively to performances and chicken health [25,26]. Table 3 denoted that raising chickens in the dry season increased the number of dead chickens. The review of Lara and Rostagono (2013) also reported that heat stress impacted immune system [27]. However, this factor was not significant at P=0.79 (P>0.05). Although mortality rate of chicken has started increasing during dry season in May (in Lengkong District) and in June-November (in Cikembar District), it was actually not because of the weather but probably due to a poor management practices of chicken, for example lack of water and feed during hot weather. Study by Barman et al (2010) revealed that heat stress on chicken will increase the frequency of panting and drink water also reduced feed consumption [23]. Therefore, farmers need to consider additional feed for chicken as well as water particularly during high temperature, even though it has been distributed subsidized feed up to 200 kg of concentrate per households.

4. Conclusion

Chicken vaccination program implemented during BEKERJA Program in Sukabumi District, West Java Province, found significantly increased the mortality rate of chicken about 0.381 times. High coverage rate did not necessarily reflect low mortality of chicken if it was not supported by good vaccination management practices. In addition, better understanding of chicken vaccination technique as well as knowledge in scheduling vaccination were needed in order to diminish chicken mortality.
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