“It's a habit. They've been doing it for decades and they feel good and safe.”: A qualitative study of barriers and opportunities to changing antimicrobial use in the Indonesian poultry sector

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Supplementary information

Appendix A: Example of interview guide

Purpose

The purpose of interviewing the stakeholder is to understand their needs for information and their capabilities in relation to data with regards to production management, disease surveillance, and AMU/AMR.

Preamble to interview

- Introduction to project and interview
    - Name of interviewer and go through the Participant Information Sheet (i.e., describe the project, explain what is expected from the participant and how his information will be used). Answer any question the participant might have.
    - Obtain consent for participation, pictures and recording.
    - Thank for participation in interview

Theme 1: Transversal topics

Primary question	***Examples/Prompts***	**Secondary questions***	**Comments**
Can you please tell us more about your job and your role in the poultry sector?	*a. Provide feed/drugs to farmers/companies* *b. Provide technical advice on farm management* *c. Perform lab diagnosis*		**Objectives of this question:** ● Understand the role of the interviewee in the poultry system ● Understand his interactions with the other components of the system
Who are the people, associations or institutions who you work with?	*For example:* *a. Farm advisors* *b. Farmers* *c. Traders* *d. Veterinary services (government or private)* *e. Community animal health workers* *f. Others*	● You indicated that you work with <XX>, can you tell me why? **TO BE ASKED TO ALL STAKEHOLDERS:** ● Can you please provide the contact details of the people you consider your most important collaborators?	The objective of this question is to identify the relationships of the interviewee with other actors of the poultry sector. To save interview time, it is recommended that follow-up questions are restricted to one or two key collaborators, and, if applicable, explore why veterinary services are not used.
What are the main challenges you find in	*For example (multiple options possible):* *a. Managing diseases in the flock*	● You mentioned that <XX> is a challenge, can you tell me why?	The objective of this question is to capture any major challenges stakeholders face when

Primary question	*Examples/Prompts*	Secondary questions*	Comments
your job in relation to poultry production?	*b. Sourcing healthy chicks* *c. Accessing medicines* *d. Transportation* *e. Government regulations (red tape)* *f. Input costs like feed, medications,* *g. Other*	● How do you manage this challenge now? **IF DISEASES ARE NOT MENTIONED** ● Are you facing or have you faced any specific challenges related to poultry health or performance? **IF DISEASES ARE MENTIONED** ● What are the most important poultry diseases or health issues you are facing? *For example:* *a. Newcastle disease* *b. Gumboro disease* *c. Avian influenza* *d. Pasteurellosis* *e. Colibacillosis*	performing their job and which ones they consider as priorities.

* Secondary questions are more specific and help direct the interviewee to the objectives, allowing them to expand on their answer to the primary question.

Theme 2: Disease prevention and control

Primary question	*Examples/Prompts*	Secondary questions*	Comments
Do you perform or support any action to improve the health of chickens and prevent diseases **AND/OR** are you involved in the development of policies related to poultry health?	*For example:* *a. Research on diseases* *b. Prescribing drugs* *c. Providing feed or products to improve performance* *d. Providing advice or technical support to farmers* *e. Provide vaccines*	**IF INVOLVED IN PREVENTION:** You mentioned doing <XX>. Do you work in collaboration, or seek technical support or advice to perform this action? **IF YES:** ● Who do you ask and why? **IF NO:** ● Why not? **IF INVOLVED IN POLICY MAKING:** ● Who else is responsible for developing and/or implementing this policy? ● How do you ensure that this policy is effectively implemented?	The objective of this question is to understand the role of the interviewee in disease prevention and how they decide on the measures to be taken.

Primary question	*Examples/Prompts*	Secondary questions*	Comments
Were you ever involved in the management of a disease outbreak in chickens? **If yes,** Can you tell me more about it?	*For example,* *a. Culling* *b. Support a farmer* *c. Provide drugs* *d. Provide advice on management*	You mentioned you did <XX> to manage the issue. Did you work in collaboration, or seek information and/or technical support to perform this action? **IF YES:** ● Who did you ask, why and what for? **IF NO:** ● Why not? **TO BE ASKED TO ALL STAKEHOLDERS:** **Did you tell anyone about it?** **IF TOLD SOMEONE** You mentioned you told<XX>. ● For what reason(s) did you decide to tell <XX>? ● What happened after you reported the issue? **IF DID NOT TELL ANYONE** ● Why did you decide not to report the problem? ● Were there any consequences for not reporting?	The objective of this question is to understand the role of the interviewee in the control of poultry diseases, and how they decide on the actions to be taken. We also want to identify if they are involved in the reporting of disease outbreaks, and if so how they make the decision of reporting the issue or not.

* Secondary questions are more specific and help direct the interviewee to the objectives, allowing them to expand on their answer to the primary question.

Theme 3: Antimicrobial use and antimicrobial stewardship

Primary question	*Examples/Prompts*	Secondary questions*	Comments
Please see some pictures of antibiotics and medicines. Do you prescribe, provide or use any of these?	*Will provide a printed document with pictures of antibiotics commonly used in poultry in ID and VN.* *E.g.: Put some in the feed he sells* *Provide AM to farmers*		The objective of this question is to rapidly verify that the answers given to the following questions concern antibiotics, rather than other products. We are checking the stakeholder's ability to differentiate antibiotics from other products, rather than identifying the specific antibiotics used. Not too much time should be spent on this question.
Can you explain to me how you decide to prescribe, sell, use or not use antibiotics	*Examples/prompts of reasons for AMU (multiple options possible):* *a. When chickens are sick (to treat disease in those chickens)*	**IF ANTIBIOTICS USED/SOLD:** ● What are the main reasons that you use/prescribe/sell antibiotics? ● Who do you sell/prescribe antibiotics to?	The objective of this question is to identify what information the stakeholder uses to decide if, how, and what kind of antimicrobials to use in poultry, where they get their

Primary question	*Examples/Prompts*	Secondary questions*	Comments
or other medicines in poultry?	*b. When chickens are sick (to prevent other chickens in the flock from getting sick)* *c. Before birds get sick to prevent disease from occurring* *d. To increase the growth of chickens* *Examples/prompts for not using AMU (multiple options possible):* *a. Unable to purchase (due to lack of pharmacy/vet/drug store, or too expensive)* *b. Do not think these are needed* *c. Did not work the last time these were used*	● How do you decide which antibiotics or medicines to use/prescribe? ● Do you seek/provide advice from anyone on which antibiotics or medicines to use/prescribe? ○ **If yes,** who and why? ○ **If no,** how do you (or the person using antibiotics) decide which antibiotics or medicines to use? ● Where do you buy antibiotics or medicines from and why? ● Do you find it difficult or convenient to buy antibiotics or other medicines? ● What do you think of the cost of antibiotics? **IF ANTIBIOTICS NOT USED/SOLD:** ● Why not?	information from, and to identify potential needs to be addressed.
In your opinion, is there anything that should be changed in the way you or other actors from the poultry sector are using antibiotics?		**IF WISH TO CHANGE ANTIBIOTIC USE:** ● Which changes and why? ● Do you take any actions to achieve this? ○ **If yes**, what are these? ○ If no**, why not? What are the barriers?** ● Would it be useful to have a tool that provides information on the amount of antibiotics or other medicines that you use/sell/prescribe? ○ Why/why not? **IF DO NOT WISH TO CHANGE ANTIBIOTIC USE:** ● Why not? ● Would it be useful to have a tool that provides information on the amount of antibiotics or other medicines that you use or provide? ○ Why/why not?	The objective is to identify if stakeholders are motivated to improve AMU stewardship and if there are any barriers to or opportunities for them to do so. If applicable, it also aims to identify if farmers consider it useful to have information on their AMU.

* Secondary questions are more specific and help direct the interviewee to the objectives, allowing them to expand on their answer to the primary question.

Theme 4: Health information and monitoring

Primary question	***Examples/Prompts***	**Secondary questions***	**Comments**
In general, where do you get information about poultry diseases and their management (including treatment with medicines)?	*For example:* *People* *a. Veterinarians* *b. Gov animal health workers* *c. Vet shops* *d. Other farmers* *e. Relatives* *f. Own experience* *g. Feed dealers* *h. Pharmacists/drug dealers* *i. Traders/middlemen* *j. Farmers association* *Tools* *a. iSIKHNAS* *b. InfoLab* *c. HPAI PDSR* *d. SIZE 2.0* *Other* *a. Media* *b. Internet* *c. Television* *d. Other*	● Do you find it easy to get information? Why/why not? ● Among all the sources you indicated, can you tell me which one(s) you prefer and why? ● You indicated getting information from <XX>. ○ What kind of information do you get from <XX>? ***Prompts:*** *a. Disease management information* *b. Information on potential disease outbreaks in the area* *c. Guidance on treatment when chickens are sick* *d. Other* ● How do you use this information?	The objective of this question is to identify the main sources of information about poultry health, the type of information they seek and why, and potential barriers to accessing this information.
Do you record information on production parameters and health in your or others' animals?	*For example:* *a. Mortality* *b. Disease outbreaks or suspicion* *c. Weight at slaughter* *d. Feed/drug consumption* *e. Vaccination* *f. Environmental conditions* *g. Other*	**IF YES:** ● Why? How do you use this information? ● Which tool(s) or method do you use to record this information? ***Prompt:*** *Have you heard of, and/or do you use any of the following tools?* *a. Paper record* *b. BroilerX* *c. CCF Recording* *d. Chickin Smart Farm* *e. Farm by Agrinis* *f. XL Smart Poultry*	The objective of this question is to understand which type of information is already being collected, the tool(s) or methods used for recording the information, and how the information is processed and analyzed.

Primary question	*Examples/Prompts*	Secondary questions*	Comments
		● Do you share this information with anyone? What for?/Why not? ***Prompt:*** *Have you heard of, and/or do you use any of the following systems?* *a. iSIKHNAS* *b. InfoLab* *c. HPAI PDSR* *d. SIZE 2.0* *e. Farmers association* ● What difficulties do you face in recording or sharing this information? **IF NO:** ● Why not? What are the main barriers preventing you from doing this?	
Do you record information on treatment with antibiotics in your or others' animals?	*For example:* *a. Dates of treatments* *b. Reasons for treatments* *c. Type of antibiotic/medicine used, etc.*	**IF YES** ● Why? How do you use this information? ● How do you record this information? (e.g., paper log, digital app…) ● Do you share this information with anyone? What for?/Why not? ● What are the main challenges you face in recording or sharing this information? **IF NO:** ● Why not? What are the main barriers preventing you from doing this?	The objective of this question is to understand if, how and why information about AMU is already being collected and/or shared, and identify potential barriers to recording and/or sharing information about AMU.

* Secondary questions are more specific and help direct the interviewee to the objectives, allowing them to expand on their answer to the primary question.

Summary transversal questions

The team member responsible for drawing the "mind map" showing the respondent's contact network during the interview will now present it to the farmer. They will review the information that has been collected so far, and amend or complement it if necessary. It will serve as a visual support to help

the respondent reflect on the main issues he/she is facing in his/her job, and what he/she thinks could be done to improve his/her current way of operating.

Primary question	**Secondary questions***	**Comments**
Please see the network map we have prepared showing the different interactions and sharing of information, based on what you have told us. Have we missed anyone?		The map of networks and communications prepared by one of the observers should be presented to the stakeholder at this point. The objective of this question is to capture any other actors with whom the stakeholder shares information that we may have missed, and to confirm the information in the map prepared by the observer.
Do you feel you have all the resources and information to perform your job in regards to diseases and AMU?	**IF YES:** ● What resources and information do you find most useful? ● What additional information could help you to better prevent or manage diseases? **IF NO:** ● What prevents you from getting the information you need? ● What could help you to better prevent or manage diseases?	The objective of this question is to capture any major resource or information gaps that have not been identified earlier in the interview.
Is there anyone you know who you think would be interested in participating in our study?	**IF YES** Can you please provide us with their contact details?	This question is to give us the opportunity to perform snowball sampling.

* Secondary questions are more specific and help direct the interviewee to the objectives, allowing them to expand on their answer to the primary question.

End of interview

Ask the interviewee if there is anything else they would like to discuss and if they have any questions e.g., “We have come to the end of the interview. Is there anything else you would like to say?”, “Do you have any questions?”

Appendix B: Detail of verbatims from transcripts

Supplementary Table S1: Interviewees' opinions on the impact on production and profitability of the 2018 ban on antibiotic growth promoters in livestock*

Type of impact	Excerpt	Interviewee
Reduced production and/or increased costs	"The most severe outbreak was around 3 years ago, when we are no longer allowed to use antibiotic growth promoters that actually really influenced performance in our, in industry."	ASSOCIATION_02
	"That [impact of the ban] can be up to 20% -30% down in production, very drastic." "Ok, yes, that's the problem. If you don't use AGP, production will drop."	OTHER_02
	"So the cost of production, then the results of production, that's what burdens the breeders when the majority are asked about the AGP ban."	OTHER_06
	"Yes, performance has decreased, mainly since the implementation of [the ban in] broiler farms."	OTHER_10
	"The mortality when we stop using the AGP, the mortality was quite increase at that time, I think the average about from, average four percent up to six or seven percent at the time […] And also the effect of banning the AGP, the length of production time is more time."	OTHER_17
Increased disease	"I think the challenge is higher. After not using it [antibiotics], the disease challenge is higher. Yes, even though the aim is good when it comes to eliminating antibiotics, but the maintenance is difficult."	OTHER_07
No impact overall	"In 2018, actually, we didn't use that [AGP] because it was government policy […] so the cost for production would actually increase, and with this increasing cost, it would reduce profitability. However, on the other hand with this, well actually [the chickens are] growing slower, so the meat producing would be also smaller, so we have two things in 2018. So because the supply becomes lower, then the price actually increases, the price skyrocketed, and at that time in terms of profit, the performance was bad, but profit is actually relatively unaffected."	ASSOCIATION_02
	"On the production impact, it [impact of the AGP ban] is not visible."	FARMER_07
	"It [impact of the AGP ban] doesn't look too different I feel. It looks like there's no problem."	FARMER_12
Improved production and/or reduced costs	"We didn't have problem since the change of year in 2018. I saw that we have best performance, in my opinion."	MANAGER_01
	"Only the health of the chicken is better. Secondly, it [impact of AGP ban] saves money. The cost savings are extraordinary.""	FARMER_07

* AGP = antibiotic growth promoters, AMU = antimicrobial use.

Supplementary Table S2: Interviewees' opinions on the impact on AMU and AMR of the 2018 ban on antibiotic growth promoters in livestock*

Type of impact	Excerpt	Interviewee
Reduced AMU	"It's a bit difficult for us because we are not required to give antibiotics, if possible, these things should not happen."	OTHER_007
	"I believe that right now, in my opinion, well in the beginning we used growth promoters in the past, antibiotic as growth promoters, but we are no longer using them."	ASSOCIATION_02
Antibiotics still being used for growth promotion	"The government start to ban antibiotic in 2018. But I believe that now, when I visit the farms […] I always ask, "do you request the antibiotic", "no, we still use", especially in the starter phase."	OTHER_09
	"To be honest, even we officially we banned the use of antibiotic in the feed since 2018, you know, some farmers still use it you know, and maybe secretly."	OTHER_16
	"After all, the government has started to ban AGP [antibiotic growth promoters], but it's still being used by breeders. Because what, cheap. Replacing AGP is expensive."	FARMER_09
Antibiotics not used for growth promotion even before ban	"Because by 2018 in Indonesia, the feed can't contain AGP, but in 2017 I was already non-AGP, I was already ahead of it."	FARMER_07
	"I haven't used AGP for about 10 years."	FARMER_09
Poorer AMU practices	"And the first time when the government make the policy, in 2018, for the antibiotic ban, the farmers buy antibiotics very easy and they put [administer antibiotics]. And they don't know about the dosage, how much you add the antibiotic so they just give and give and give."	OTHER_09
Reduced AMR	"Then what we feel the most is that by using a non-AGP, there is no resistance. If we use AGP, we have to do switching."	FARMER_07
	"However, in the long term, this regulation might be better. Thus, the bacteria will be more sensitive to antibiotics. Also, many resistant bacteria are now due to the uncontrolled use of antibiotics. In the past, antibiotics could be used up to three kinds at a time. Now you can't have two categories. You can only have one type."	OTHER_10

* AGP = antibiotic growth promoters, AMU = antimicrobial use, AMR = antimicrobial resistance.

Supplementary Table S3: Summary of interviewees' opinions on the price and efficacy of feed additives as compared to antibiotic growth promoters*

Purpose of use	**Opinion on price/efficacy**	**Excerpt**	**Interviewee**
In response to drop in production	Not specified	"So when we see a decline in production then we will give them vitamins."	FARMER_01
Improvement of feed quality Routine use as replacement for antibiotics	Effective	"Yes, there are some manufacturers whose feed quality is really bad. But I handle that by giving the chickens prebiotics, enzymes and amino acid, sometimes antibiotics if I feel like there is bacteria in the chickens." "In my place, the use of antibiotics is minimal. Because for maintenance, I use enzymes, prebiotics, vitamins, amino acids, and others." "It [herbs] is effective. It can be consumed by the chicken, it can be sprayed into the litter."	FARMER_02
When chickens are sick	Not specified	"Oh, we always provide vitamins. We mix vitamin C into the chicken feed."	FARMER_04
Replacement for antibiotics	Not specified	"I have been using herbs for several years. Don't use antibiotics." "As long as I use the herbs, I think I almost don't use antibiotics at all."	FARMER_05
Replacement for antibiotics	Not specified	"In principle for drugs, especially for antibiotics, we really try to minimize it. What we have on a regular basis are vitamins and additives such as amino acids and so on, that we use regularly. So we rarely prepare for antibiotics. We only use antibiotics if the chicken is really sick."	FARMER_06
Replacement for antibiotics	Effective	"We use local herbal products, instead [of AGP]. We use curcuma and turmeric […] Yes, it is very effective and the ingredients are easy to access locally."	FARMER_07
Improvement of feed quality	Not effective at preventing disease	"We switch from self-mixed feed to semi-finished feed. So we use concentrate. Of course, there are additional multivitamins and premixes which are added to increase the chicken's amino acid intake." "We have given drinking disinfectants, and the acidifier has also entered the chickens. But it can not help the chicken to survive against disease."	FARMER_08
Replacement for antibiotics	More expensive than antibiotics Similar efficacy	"Replacing AGP is expensive. There are organic acids, probiotics, it's so expensive." "Yes for the performance I think it's [feed additives are] almost the same [as AGP]. But for healthy food I think we don't use AGP."	FARMER_09
Drop in production Replacement for antibiotics	Effective	"However, if suddenly it [the production] drops slightly, firstly I will give multivitamin, anti-stress or electrolytes then do the re-evaluation of what other actions is needed." "I think farmer can focus more on giving probiotic. For digestive system, probiotic is very good. Traditional medicine herbal is also good, but it is a long process."	FARMER_10

Supportive treatment (but not replacement of antibiotics)	Less expensive than antibiotics	"For example, the chicken has CRD [chronic respiratory disease], so we won't necessarily treat it immediately […] it turns out that the chicken will improve, then we at least can support with vitamins. But when the chicken is sick, we will still treat it with antibiotics." "The cost [of antibiotics] is definitely higher, because usually [comparing] antibiotics with vitamins, antibiotics are more expensive."	MANAGER_04
Replacement for antibiotics	Cheaper than antibiotics	"We prefer to provide vitamins or amino acids that chickens need. While antibiotics are quite expensive and the price of chicken feed is also high, antibiotics will only add to the cost."	ASSOCIATION_04
Provided in feed to farmers upon request	More expensive than antibiotics Less effective than antibiotics	"Because these alternatives first are much more expensive than antibiotics, secondly they are not as effective as antibiotics in terms of the growth of the chicken right, because they, actually before 2018 people don't use the antibiotics only to cure the disease, they use that to boost up the performance, right? And now it's, I think until now they still cannot solve the problem. I mean, there are some products that can be similar, the mechanism is similar but the result still cannot reach the level of antibiotics."	OTHER_04
Replacement for antibiotics	More expensive than antibiotics Less effective than antibiotics	"As a comparison, actually before there was AGP, the production was indeed good, and the additional cost was small in economic calculation. Meanwhile, after the AGP is banned, the price of this AGP replacer can be up to 3 to 4 times the AGP, while the production is lacking." "If they get the ingredients locally, [the cost of herbs is] not as high as AGP. But if the ingredients are imported, it's [the cost is] definitely above AGP."	OTHER_06
Replacement for antibiotics	More expensive than antibiotics	"For the essential oils, sometimes there are those who use them, and those who don't, because the cost is pretty expensive."	OTHER_07
N/A (not using self)	Less effective than antibiotics More expensive than antibiotics	"If you want to change the antibiotic you have to add not only one, not only essential oil, or not only organic acid but also you have to combine […] When you use three kinds of the antibiotic replacer, the price is expensive."	OTHER_09
N/A (not using self)	More expensive than antibiotics More effective than antibiotics	"The function of the herbs is actually to substitute the antibiotic growth promoters." "But the price of the herbs, the extract is quite expensive if you compare to the price of the antibiotic growth promoters at this time." "Even in some cases we found the production and the feed conversion efficiency is better when you use the herbs, especially we combine, if we combine some herbs, you know."	OTHER_16

* AGP = antibiotic growth promoters, AMU = antimicrobial use, AMR = antimicrobial resistance, CRD = chronic respiratory disease.