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ORIGINAL RESEARCH

A review of pig and poultry diseases in the Eastern Cape Province of South Africa, 2000–2020

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The informal poultry and pig sector in the Eastern Cape Province (ECP) of South Africa is of significant socio-economic importance as it sustains livelihoods and ensures food security; yet little is known about the distribution and prevalence of infectious and zoonotic diseases in this region. This paper reviews data published for pig and poultry diseases in the province during the last 20 years (2000–2020). The review included relevant published papers identified by a computerised literature search from Web of Science; provincial animal health reports; the national database from the Department of Agriculture, Land Reform and Rural Development (DALRRD); animal health reports submitted by DALRRD to the World Organisation for Animal Health (OIE) via the World Animal Health Information Database (WAHID) interface and laboratory records. A publication was considered eligible if it included qualitative or quantitative information on any disease affecting pigs and poultry including zoonosis. The search retrieved 174 publications, of which 26 were relevant. The review found that Newcastle disease (ND), coccidiosis and fowl pox (FP) were the most reported avian diseases in the national database, whereas avian infectious bronchitis (AIB), ND and highly pathogenic avian influenza (HPAI) were the most reported diseases in the OIE database. Classical swine fever (CSF) was the most reported pig disease in both databases. The retrieved literature on pig and poultry diseases was scarce and no longer up to date, providing decision makers with little information. The review identified important zoonotic diseases that require further studies yet failed to find information on important neglected diseases like leptospirosis.

Keywords: pig, poultry, diseases, zoonotic, Eastern Cape Province, review

Introduction

Transboundary animal diseases are highly contagious epidemic diseases that can spread extremely rapidly, irrespective of national borders. They cause mortality and morbidity in animals, thereby having serious socio-economic and sometimes public health consequences (FAO, 2020). The Eastern Cape is the second largest province in South Africa after Northern Cape (Figure 1). It is divided into two metropolitan municipalities and six district municipalities. The district municipalities are in turn divided into 27 local municipalities. The human population is estimated to be 6 734 001 (STATS, 2020) with the density of 39/km^2. The main industries include agriculture and mining (primary sector), which contribute 2% to the provincial GDP; manufacturing, electricity and construction (secondary sector) contributing 18.5% to the GDP; trade, transport, finance, personal services and government services (tertiary sector) contributing 79.5% to the GDP (ECSECC, 2018). Overall the province only contributes 8% to the national GDP (STATS, 2018). The Eastern Cape Province (ECP) is economically the poorest province in South Africa where subsistence agriculture predominates in the former homelands.

Livestock plays a major role in the social, cultural and economic environment in the province. The Eastern Cape is among the lowest pork and poultry producing provinces with 6% and 6.5% of total production countrywide respectively (DAFF, 2018, SAPA, 2017). These production statistics are mainly commercial and do not include backyard chickens (indigenous chickens) and free roaming pigs owned by many households in the province. The informal pig and poultry sector in the ECP is estimated to have 3 841 174 birds and 536 108 pigs (STATS, 2016). Apart from being a source of income for many households, pigs and poultry constitute a cheap source of protein for rural communities and ensures food security.

However, little has been published on what diseases are present in these animals within the province. Due to financial constraints, animal disease detection in the province is mainly dependent on passive surveillance in village communities (Fisher 2018, personal communication). This constitutes a major challenge since some diseases are being underreported or are not reported. Also, the province does not have animal health information systems which could help for the collection and analysis of animal health data. Such animal health information is recognised as necessary for the setting of animal health priorities (Morris, 1991). Therefore, a systematic review of peer-reviewed articles, animal health reports and laboratory records compiling information on pig and poultry diseases in the province is presented with the view of identifying diseases of pigs and poultry kept within these rural communities. This will help decision makers to prioritise resources for animal disease surveillance and control in these communities once animal health information is available.

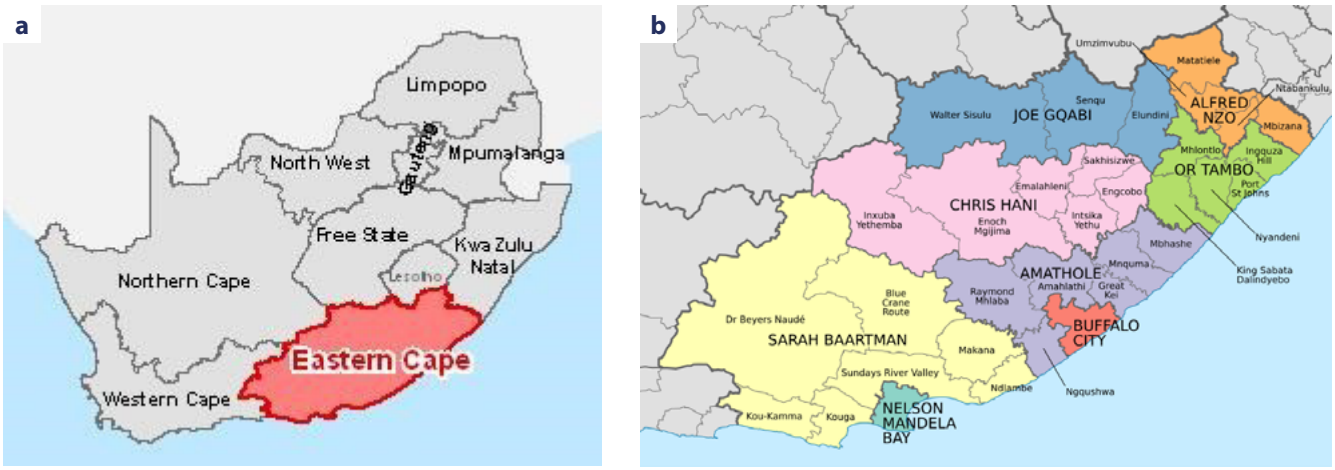

Figure 1: (a) Map of Eastern Cape Province; (b) Eastern Cape Province with its municipalities

Methods

A review was carried out on what has been published on diseases of pigs and poultry in the ECP over the last 20 years (2000–2020). The review included relevant published papers identified by a computerised literature search of all databases (WOS, BCI, CABI, CCC, DRCI, DIIDW, FSTA, KJD, MEDLINE, RSCI, SciELO and ZOOREC) from Web of Science (Appendix 7), which is the global standard for finding and connecting scholarly content across multiple disciplines around the world; monthly reports on the animal health situation submitted by the Directorate of Veterinary Services in the province to the Department of Agriculture, Land Reform and Rural Development (DALRRD); the national database from DALRRD; official animal health reports submitted by DALRRD to the World Organisation for Animal Health (OIE) and laboratory records from three provincial laboratories (Grahamstown, Middleburg and Queenstown).

Search strategy

All databases from Web of Science

All databases mentioned above were searched for published articles on pig diseases in the province from 2000 to 2020 using the following key words: Pigs OR Pig OR Swine OR Porcine (Search 1); Diseases (Search 2) and "Eastern Cape" OR (east* AND cape*) (Search 3).

Search 1, search 2 and search 3 were combined and all the published papers relevant to pig diseases in the ECP were selected.

The same search strategy was used for poultry and all databases were searched for published articles on poultry diseases in the province from 2000 to 2020 using the following key words: Chickens OR Chicken OR Poultry (Search 1); Diseases (Search 2) and "Eastern Cape" OR (east* AND cape*) (Search 3).

National database from DALRRD

The national database from DALRRD comprises all the disease reports from each province in South Africa. Each province consolidates different disease reports from the state veterinarians on a monthly basis. The Animal Diseases Act (35 of 1984) requires that all occurrences of controlled and notifiable diseases be reported to the national directorate. For other diseases and vaccinations, the national directorate requests provinces to include them in monthly reports for OIE reporting purposes and to serve as indication of the presence and prevalence of these diseases. Some diseases that are not controlled can still have trade implications (DAFF, 2016). The final report from each province is then submitted to the epidemiology section of DALRRD, which in turn, compiles and updates its national database. All disease reports from the ECP were reviewed from 1999 to 2019. The national database comprises diseases that were reported from 1993 to 2019.

WAHID interface

All official animal health reports submitted by DALRRD to the World Organisation for Animal Health (OIE) were reviewed via the World Animal Health Information Database (WAHID) interface (OIE, 2020b) from 2005 to 2020.

Laboratory records at three provincial laboratories

Laboratory records were used to select pig and poultry diseases that were diagnosed at each of the three provincial laboratories in the province (Queenstown, Middleburg and Grahamstown).

Eligibility criteria

Inclusion criteria

A publication was considered eligible for this review if it included qualitative or quantitative information on any disease (bacterial, viral, parasitic and fungal) affecting pigs or poultry in the ECP. To have a wide range of reported diseases in the province, diseases affecting pigs or poultry from commercial farms were also included. Diseases affecting "poultry" other than chickens were also included. Finally, zoonotic diseases were also included in this review.

Exclusion criteria

Duplicate articles were excluded. Different references from the same study were counted as one reference irrespective of the format in which they were published (article, proceedings, workshop, etc.). The inclusion and exclusion criteria were applied to the title and abstract of all retrieved references.

Data collection process

The data collection process was undertaken in two steps. First, basic information was collected from all retrieved articles to assess which diseases have been reported in the province. For this basic analysis, the following information was systematically recorded: the publication date, the district, the species, the disease, the type of causative agent (bacteria, virus, parasite, alga, toxins, tumour, fungi, etc.), whether or not the reference focus was of a zoonotic disease, and the type of study (case report, case series, review or survey). In a second step, considering that the objective of this review was to obtain a better understanding of the current pig and poultry disease situation in the ECP, only documents published or written in the last 20 years were selected to focus on the most recent information. A more detailed analysis of the key findings from these references was then performed. The number of reported outbreaks for each disease was used to determine which disease was more frequently reported than others.

Results

Selected references and characteristics

The search strategy retrieved 174 publications, of which 26 were relevant based on the inclusion and exclusion criteria (Table I and Table II). Eighteen references were surveys (69.2%), four were case reports (15.4%), one was a conference paper (3.8%) and three were general papers describing a particular disease nationally with little data provided for the ECP (11.5%). The majority of references provided data on diseases for pigs (84.6%), whereas references for poultry represented 15.4%. A paper on both chicken and pig disease was represented by three references (11.5%). Seventy-seven per cent of the references referred to zoonotic diseases. The following zoonotic diseases (or agents) were found in this review: Hepatitis E virus; *Enterococcus*, *Salmonella*, *E. coli*, cysticercosis, chlamydiosis, campylobacteriosis, norovirus, avian influenza, Newcastle and nocardiosis (Appendix 1).

Selected diseases from national database, OIE and laboratories records

A total of 14 diseases (10 poultry diseases and four pig diseases) were retrieved from the national database (Table III). Poultry diseases were subdivided into three categories: viral, bacterial and protozoal diseases (Figure 3). Viral diseases were most often reported (135 reported outbreaks representing 73% of all the outbreaks) followed by protozoal diseases (37 outbreaks; 20%) and bacterial diseases (13 outbreaks; 7%) (Figure 3). Among viral diseases, Newcastle disease (ND) was the most reported disease in the ECP with 103 outbreaks in the past 20 years followed by fowl pox (FP) with 18 outbreaks; avian leukosis (AL) with nine outbreaks; Gumboro and avian infectious bronchitis (AIB) with two outbreaks each and avian infectious laryngotracheitis (AIL) with one outbreak (Figure 2).

Table I: Pig diseases identified in the Eastern Cape Province between 2000 and 2020 from all databases from Web of Science

Disease	District	Year	Reference
Campylobacteriosis*	OR Tambo	2020	Ngobese et al. 2020
Campylobacteriosis*	Chris Hani and Amathole	2020	Igwaran & Okoh 2020
Classical swine fever	Eastern Cape**	2010	Akol & Lubisi 2010
E. coli	Amathole	2016	Iwu et al. 2016b
E. coli	Amathole	2017	Iwu et al. 2017
Enterococcus	Amathole	2015	Iweriebor et al. 2015
Hepatitis E virus	Chris Hani and Amathole	2017	Adelabu et al. 2017
Norovirus	Amathole and OR Tambo	2017	Taku et al. 2017
Porcine circovirus type 2	Chris Hani Amathole and OR Tambo	2017	Afolabi et al. 2017
Porcine circovirus type 2	Chris Hani Amathole and OR Tambo	2019	Afolabi et al. 2019
Salmonella	Amathole	2016	Iwu et al. 2016a
Salmonella	_	2017	Mathole et al. 2017
*Salmonella**	OR Tambo	2019	Mthembu et al. 2019
Swine Fever	Eastern Cape**	2013	Penrith 2013
Taenia solium	OR Tambo and Alfred Nzo	2008	Krecek et al. 2008
Taenia solium	OR Tambo and Alfred Nzo	2012	Krecek et al. 2012
Taenia solium	OR Tambo and Alfred Nzo	2013	Krecek et al. 2013a
Taenia solium	OR Tambo and Alfred Nzo	2013	Krecek et al. 2013b
Taenia solium	Eastern Cape**	2016	Syakalime et al. 2016
Taenia solium	OR Tambo and Alfred Nzo	2019	Sithole et al. 2019b
Taenia solium	OR Tambo and Alfred Nzo	2020	Sithole et al. 2020
Taenia solium	OR Tambo and Alfred Nzo	2019	Sithole et al. 2019a

* – Disease found in both pigs and poultry
** – The article referred to the whole province

Table II: Poultry diseases identified in the Eastern Cape Province between 2000 and 2020 from all databases from Web of Science

Disease	Species	District	Year	Reference
Avian influenza	Ostriches	Sarah Baartman	2005	Manvell et al. 2005
Avian Influenza (H5N2)	Ostriches	Eastern Cape	2009	Abolnik et al. 2009
Avian Influenza (H5N8)	Wild birds and poultry	South Africa including Eastern Cape	2019	Abolnik 2019
Salmonella	Swine and chickens	OR Tambo	2019	Mthembu et al. 2019

* – Disease found in both pigs and poultry

Table III: List of pig and poultry diseases found in the Eastern Cape Province in the national database (DALRRD) from 1999 to 2019

Disease	Species	Number of reported outbreaks*
Mycoplasma gallisepticum	Avian	10
Newcastle disease	Avian	103
Gumboro	Avian	2
Fowl cholera	Avian	2
Avian infectious bronchitis	Avian	2
Fowl pox	Avian	18
Coccidiosis	Avian	37
Salmonella enteritidis	Avian	1
Avian infectious laryngotracheitis	Avian	1
Avian leukosis	Avian	9
Classical swine fever	Swine	99
Swine erysipelas	Swine	2
Cysticercosis	Swine	4
Coccidiosis	Swine	1

* – Source of data is given in Appendix 2

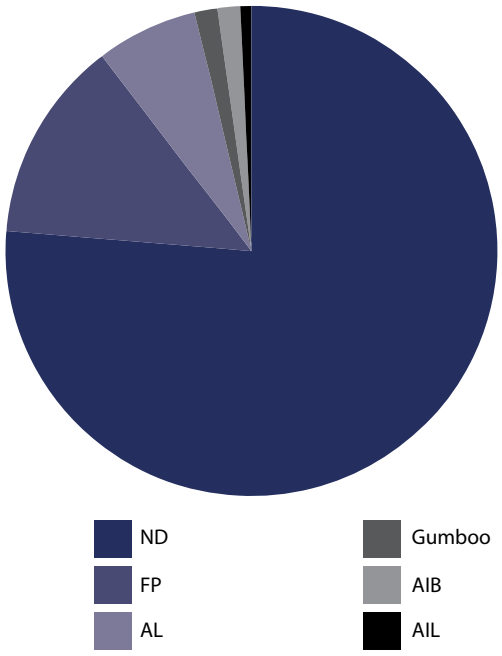

Figure 2: Frequency of poultry viral diseases reported in the Eastern Cape Province from 1999 to 2019 in the national database (DALRRD): ND – Newcastle disease: 103 outbreaks, FP – fowl pox: 18 outbreaks, AL – avian leukosis: 9 outbreaks, Gumboro and AIB – avian infectious bronchitis: 2 outbreaks, AIL – avian infectious laryngotracheitis: 1 outbreak

For pig diseases, classical swine fever (CSF) had the most reported outbreaks among pig diseases (99 outbreaks representing

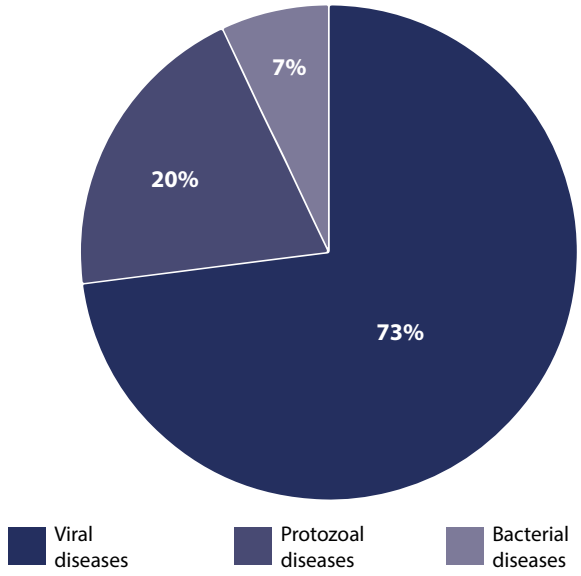

Figure 3: Frequency of reported poultry diseases per category

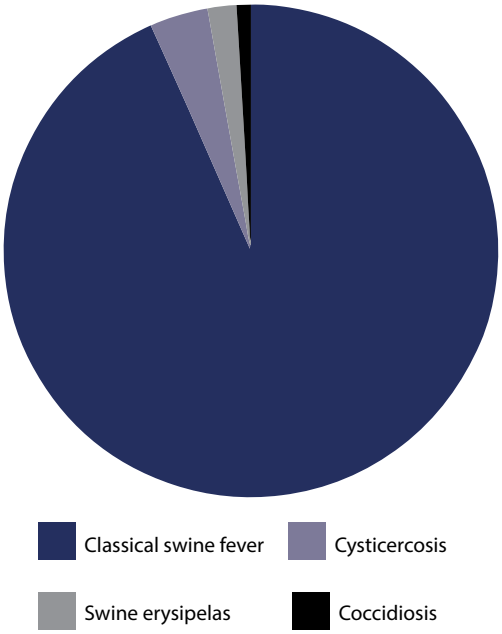

Figure 4: Frequency of reported pig diseases in the national database (DALRRD) from 1999 to 2019: classical swine fever (99 outbreaks); cysticercosis (4 outbreaks); swine erysipelas (2 outbreaks) and coccidiosis (1 outbreak).

93.4%), followed by cysticercosis (four outbreaks representing 3.8%), swine erysipelas (two outbreaks representing 1.9%) and coccidiosis (one outbreak representing 0.9%) (Figure 4).

A total number of nine diseases were retrieved from the OIE database (Table IV). The most reported poultry diseases from 2005 to 2020 were AIB and ND (reported seven times) (Table IV)

Table IV: List of pig and poultry diseases found in the OIE database (WAHID interface) from 2005 to 2020 (OIE, 2020a)

Disease	Species	Number of reported outbreaks*
Fowl pox	Avian	1
Avian infectious bronchitis	Avian	7
Newcastle disease	Avian	7
LPAI (poultry)	Avian	5
HPAI	Avian	6
Gumboro	Avian	2
Mycoplasmosis	Avian	1
Fowl cholera	Avian	2
Classical swine fever	Swine	3
African swine fever	Swine	1

* – The reported outbreaks are given in detail in Appendix 3

followed by highly pathogenic avian influenza (HPAI) (reported six times). For pig diseases, the most reported disease was CSF (Table IV). Additional information on diseases prevalent in the province was obtained from the provincial laboratories despite the fact that these laboratories did not have much information on pigs and poultry diseases over the past twenty years (Appendices 4, 5 and 6).

Discussion

Data limitations

Despite the economic importance of the pig and poultry sectors in the ECP, this study found very little published information on pig and poultry diseases in the province over the past 20 years, which made it difficult to conduct a meta-analysis, as was our first intention. Also, the available published information lacked quantitative data which could help to estimate the apparent prevalence of any reported disease in the province. The national database could provide different categories of qualitative data (the status of a particular animal disease being present or absent; the species, the year in which the disease was detected, the affected area and the number of the reported cases), whereas the WAHID interface could only provide the status of the animal disease being present or absent, the species and the period (year and month) in which the disease was detected. Hence, this paper gathered information on diseases from ECP using both the national and the WAHID databases and assessed the validity of the information by comparing the findings from both.

The lack of census data in the province prevented the calculation of disease rates and comparison of years or any predictive modelling of the diseases of economic importance like ND as was performed in Zambia (Mubamba et al. 2016). These constraints limited the work presented in this paper to a descriptive review of the data available on pig and poultry diseases in the ECP but served to highlight the major deficiency in disease reporting of pig and poultry diseases in this province that has long been present.

Reporting system and the role of provincial laboratories

In the Eastern Cape, animal disease detection in village communities depends largely on the passive surveillance of pigs and poultry due to lack of human and financial resources from veterinary services. Some surveillance occurs commercially using the private laboratories outside the province, but this targets primarily the commercial sector. It is therefore likely that non-controlled diseases are not reported, especially when there is poor communication between the private sector (private veterinarians and private laboratories) and the provincial veterinary services. Active surveillance is compulsory only for export purposes (commercial farms) and is mainly for avian influenza and ND (ostriches), CSF and African swine fever (ASF) for pigs. The surveillance in the communal area (rural sector) depends on the availability of the budget and it is not done on a regular basis. The province is only equipped with three state veterinary laboratories which assist veterinary services in animal disease diagnostics and advise on the control and prevention. Unfortunately, these laboratories did not have a proper database which could be used extensively in this study. Only one laboratory could provide an electronic record of a few cases seen from 2012. It is important to mention that these provincial laboratories rely on the national laboratories for advanced diagnostic technologies, which sometimes cause a delay in finalising results and a delay in databases being updated. Private veterinarians can also send diagnostic samples directly to the national laboratory and receive results back without informing the local state veterinarians whose responsibility is to compile a comprehensive monthly report on controlled and notifiable diseases for their area. For controlled diseases, however, the accredited diagnostic veterinary laboratory is obligated by a directive to inform the state veterinarian and DALRRD directly about the results at the same time the submitter receives them.

By reviewing the references from all databases of Web of Science, it was found that the number of references reporting on diseases on the communal farms was higher (42.3%) than the number of references reporting on diseases on the commercial farms (38.5%). The references reporting on diseases on both communal and commercial farms during the same study were 11.5%, whereas three references representing 7.7% were reporting on a disease found in an abattoir. However, from the national database, it was impossible to establish whether the reported diseases were coming from the commercial or the communal farms.

By analysing the national database, the review found that ND, coccidiosis and FP were the most reported avian diseases, whereas AIB, ND and HPAI were the most reported diseases from the OIE database. For pig diseases, CSF was the most reported disease in both databases. It is suspected that these diseases were the most reported due to their outbreaks across the province in the previous years rather than active surveillance. The 2020 ASF outbreak was not found in the national database but was found on the WAHID interface database, probably because there was no update of the national database during this review, which covers the period 1993 to 2019. The review highlights the fact that the national database is less accurate in recording non-

controlled disease incidence, like Gumboro and AIB, which are known to be endemic in the province (Simbizi, 2021), because it is not mandatory to report these diseases.

The limited published data, particularly on non-controlled diseases in the ECP, emphasises the need to encourage researchers to investigate animal diseases in the province.

Zoonotic diseases found in the review

A number of zoonotic diseases have been reported in the ECP. For avian influenza, a few studies identified the circulating strains (HPAI H5N2) in ostriches (Abolnik et al. 2009) and in chickens and wild birds (HPAI H5N8) (OIE 2020a). The significance of this finding in terms of human health in the province is unknown.

Despite the high number of reported cases of ND found in this study, there was no recent study investigating this disease and the circulating strains in the local poultry population. Such a study would help to understand the epidemiology of this disease for better prevention and control.

A few studies on cysticercosis (*Taenia solium*) in animals were done in the province, but they seemed to be limited to two districts (Alfred Nzo & OR Tambo) (Krecek et al. 2008; Krecek et al. 2012). This is surprising considering in 2004, an estimated 34 662 neurocysticercosis-associated cases of epilepsy were found in the ECP. The overall monetary burden (in million of US$) was estimated to vary from US$ 18.6 to US$ 34.2 depending on the method used to estimate productivity losses (Carabin et al. 2006). Currently, this cost is likely to have increased given the fact that this study was done sixteen years ago. Another study on neurocysticercosis in the ECP had found that the Xhosa-speaking people of ECP had the highest prevalence of cysticercosis in South Africa probably due to the common practice of free-range pig farming and the lack of sanitation in these areas (Mafojane et al. 2003) as well as illegal slaughtering and selling of pig meats without prior meat inspection. The latter finding has been confirmed in a recent survey on trading practices of rural pig farmers in the province (Simbizi et al. 2021).

The poor sanitation in the province and the use of swine waste as manure to improve the farm yields have been mentioned as risk factors for emerging pathogens like Hepatitis E (Adelabu et al. 2017) and Norovirus (Taku et al. 2017) found in this review. Such practices will also contribute to the propagation of diseases such as *Salmonella*, *Escherichia coli*, *Campylobacter* and *Enterococcus* infections found in this review and contribute to the risk of food poisoning in rural communities of ECP. These diseases become more significant when one considers that the rate of HIV/AIDS infections in the province is among the highest in the country (Abong'o & Momba 2008).

An interesting finding was the lack of reports on diseases that one would expect to be present. Diseases like leptospirosis would have been expected to be found given the large rural pig population in the province (STATS 2016) and the fact that some serovars are maintained in pigs (Ellis 2015). With the Eastern Cape being, economically, one of the poorest provinces of South Africa, the public health impact of these neglected diseases requires further investigation.

Conclusion

This paper reviews the current knowledge on pig and poultry diseases in the rural ECP with emphasis on data from 2000 to 2020. The study found that the retrieved literature was very scarce, and little has been published on pig and poultry diseases in the ECP. Hence decision makers do not currently have reliable prior knowledge upon which to direct animal health interventions or implement public health programmes aimed at reducing the incidence of zoonotic diseases. Important neglected diseases appear not to have been studied. An improved animal health information system and further targeted research based on this study are required to fill this gap in knowledge.

Poor communication between important disease reporting stakeholders in the province was reflected in the review through disparities in data sources and it is recommended that this be improved. Improved communication between the national department (DALRRD) and the National Institute of Communicable Diseases will increase awareness about the zoonotic diseases found in this review and help to minimise their impact on the livelihoods of the rural communities. It is recommended, therefore, that a disease reporting system in the province involving all the stakeholders be considered to provide current relevant information on pig and poultry diseases. This will provide a foundation for sound decision making around disease control and international trade in live animals and animal products.

Author contributions

V Simbizi conducted the literature review, analysed and interpreted the data under the supervision of B Gummow. V Simbizi wrote the article under the supervision of B Gummow. All authors assisted in the editing and critiquing of the manuscript.

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Conflict of interest

The authors declare that no conflict of interest.

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Data availability statement

A list of figures and tables that have associated raw data are included as appendices.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

Ethical approval

This article followed all ethical standards for carrying out research without direct contact with human or animal subjects.

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Appendix 1: List of zoonotic diseases found in this study

Disease	Source
Avian influenza	Web of Science, DALRRD Database, OIE database
Hepatitis E virus	Web of Science
Newcastle disease	Web of Science, DALRRD database, OIE database, All Eastern Cape veterinary laboratory records
Enterococcus	Web of Science
Salmonella	Web of Science
Colibacillosis	Web of Science, All Eastern Cape veterinary laboratory records
Cysticercosis	Web of Science, DALRRD database
Chlamydiosis	OIE database
Norovirus	Web of Science
Nocardiosis	Grahamstown laboratory records
Campylobacteriosis	Web of Science

Appendix 2: Pig and poultry diseases reported in the National Database (DALRRD) from 1999 to 2019 (DAFF 2020)

Disease	Species	District	Date	Number of reported outbreaks
Mycoplasma gallisepticum	Avian	Harry Gwala*	1999	2
	Avian	Harry Gwala*	2000	4
	Avian	Alfred Nzo	2000	1
	Avian	O.R Tambo	2001	1
	Avian	Harry Gwala*	2001	2
Newcastle disease	Avian	Harry Gwala*	1999	4
	Avian	Harry Gwala*	2001	1
	Avian	Amathole	2002	2
	Avian	Buffalo City	2003	2
	Avian	Harry Gwala*	2004	1
	Avian	Alfred Nzo	2004	1
	Avian	Nelson Mandela Bay	2005	4
	Avian	Buffalo City	2005	5
	Avian	Chris Hani	2005	3
	Avian	Harry Gwala*	2005	3
	Avian	Sarah Baartman	2005	1
	Avian	Amathole	2005	1
	Avian	Amathole	2005	1
	Avian	Amathole	2005	1
	Avian	Sarah Baartman	2006	4
	Avian	Nelson Mandela Bay	2006	5
	Avian	Buffalo City	2006	2
	Avian	Sarah Baartman	2006	1
	Avian	Chris Hani	2006	1
	Avian	Chris Hani	2006	1
	Avian	Chris Hani	2007	1
	Avian	Buffalo City	2008	1
	Avian	Alfred Nzo	2008	4
	Avian	Chris Hani	2008	2
	Avian	O.R Tambo	2008	2
	Avian	Amathole	2008	1
	Avian	Alfred Nzo	2009	11
	Avian	Nelson Mandela Bay	2009	1
	Avian	Buffalo City	2009	2
	Avian	Buffalo City	2010	5
	Avian	Nelson Mandela Bay	2010	1
	Avian	Sarah Baartman	2010	2
	Avian	Buffalo City	2011	1
	Avian	Amathole	2012	1
	Avian	O.R Tambo	2013	2
	Avian	Chris Hani	2013	1
	Avian	Amathole	2014	2
	Avian	Sarah Baartman	2014	1
	Avian	Amathole	2014	2
	Avian	Chris Hani	2015	1
	Avian	Chris Hani	2015	1
	Avian	Alfred Nzo	2015	2
	Avian	Amathole	2015	1
	Avian	O.R Tambo	2015	1
	Avian	Amathole	2015	1
	Avian	Amathole	2016	4
	Avian	Joe Gqabi	2016	1

	Avian	Sarah Baartman	2016	3
	Avian	O.R Tambo	2017	1
Gumboro	Avian	Sarah Baartman	2002	1
	Avian	Amathole	2009	1
Fowl cholera	Avian	Amathole	2010	1
	Avian	Joe Gqabi	2010	1
Avian infectious bronchitis	Avian	Nelson Mandela Bay	2005	1
	Avian	Amathole	2011	1
Fowl pox	Avian	Harry Gwala*	1999	2
	Avian	Harry Gwala*	2000	1
	Avian	Joe Gqabi	2000	1
	Avian	Harry Gwala*	2002	4
	Avian	Amathole	2002	3
	Avian	Joe Gqabi	2003	1
	Avian	Amathole	2003	1
	Avian	Alfred Nzo	2003	1
	Avian	Joe Gqabi	2009	2
	Avian	O.R Tambo	2010	1
	Avian	Amathole	2016	1
Coccidiosis	Avian	Harry Gwala*	1999	4
	Avian	Joe Gqabi	1999	1
	Avian	O.R Tambo	1999	1
	Avian	O.R Tambo	1999	1
	Avian	O.R Tambo	2000	3
	Avian	Alfred Nzo	2000	2
	Avian	Harry Gwala*	2000	1
	Avian	Harry Gwala*	2001	3
	Avian	Buffalo City	2001	1
	Avian	Harry Gwala*	2002	2
	Avian	Alfred Nzo	2002	1
	Avian	Amathole	2002	1
	Avian	Amathole	2003	2
	Avian	O.R Tambo	2004	1
	Avian	Harry Gwala*	2004	1
	Avian	Amathole	2006	2
	Avian	Amathole	2007	1
	Avian	Sarah Baartman	2007	1
	Avian	O.R Tambo	2007	1
	Avian	Amathole	2010	1
	Avian	Amathole	2011	3
	Avian	Amathole	2011	1
	Avian	Buffalo City	2011	1
	Avian	Amathole	2018	1
Salmonella enteritidis	Avian	Sarah Baartman	2017	1
Avian infectious laryngotracheitis	Avian	O.R Tambo	2008	1
Avian leukosis	Avian	Harry Gwala*	1999	4
	Avian	Harry Gwala*	2000	3
	Avian	Harry Gwala*	2001	1
	Avian	Alfred Nzo	2002	1
Classical swine fever	Swine	Chris Hani	2005	4
	Swine	Amathole	2005	2
	Swine	Joe Gqabi	2005	2
	Swine	Buffalo City	2005	30
	Swine	Sarah Baartman	2005	3
	Swine	Chris Hani	2005	10
	Swine	Nelson Mandela Bay	2005	6
	Swine	Chris Hani	2005	9
	Swine	Amathole	2005	2
	Swine	Amathole	2005	3
	Swine	Chris Hani	2006	5
	Swine	Buffalo City	2006	12
	Swine	Sarah Baartman	2006	1
	Swine	Nelson Mandela Bay	2006	6
	Swine	Amathole	2006	1
	Swine	Chris Hani	2006	3
Swine erysipelas	Swine	Chris Hani	2008	1
	Swine	Alfred Nzo	2013	1
Cysticercosis (*Cysticercus cellulosae*)	Swine	Buffalo City	2002	1
	Swine	Alfred Nzo	2003	2
	Swine	Harry Gwala*	2003	1
Coccidiosis	Swine	Amathole	2012	1

* – Umzimkhulu found in the national database is a town in Harry Gwala District Municipality (KwaZulu-Natal). Until 1 March 2006, the town was part of an exclave of the Eastern Cape Province.

Appendix 3: Pig and poultry diseases reported in the WAHID interface from 2005 to 2020 (OIE 2020a)

Disease	Species	Year	Month
Fowl pox	Avian	2005	Jan–June
Avian infectious bronchitis	Avian	2005	Jan–June
	Avian	2007	Jul–Dec
	Avian	2010	Jan–July
	Avian	2011	Jan–Dec
	Avian	2013	Jan–Jun
	Avian	2014	Jul–Dec
	Avian	2016	Jan–Dec
Newcastle disease	Avian	2005–2009	Jan–Dec
	Avian	2010	Jan–Jun
	Avian	2018	Jan–Jun
LPAI (poultry)	Avian	2007	Jan–Jun
	Avian	2013	Jul–Dec
	Avian	2014	Jan–Jun
	Avian	2016	Jan–Jun
	Avian	2017	Jan–Jun
	Avian	2018	Jan–Dec
HPAI	Avian	2006	Jan–Dec
	Avian	2011	Jan–Dec
	Avian	2012	Jan–Dec
	Avian	2013	Jan–Jun
	Avian	2017–2018	Jan–Dec
Gumboro	Avian	2009	Jul–Dec
	Avian	2016	Jul–Dec
Mycoplasmosis	Avian	2005	Jul–Dec
Fowl cholera	Avian	2006	Jan–Jun
	Avian	2010	Jul–Dec
Classical swine fever	Swine	2005	Jul–Dec
	Swine	2006	Jan–Dec
	Swine	2007	Jul–Dec
African swine fever*	Swine	2020	Jan–Jun

* – Disease reported to OIE but not found in the national database

Appendix 4: Pig and poultry diseases retrieved from Grahamstown veterinary laboratory records

Disease	Species	Year	Month
Aspergillosis	Avian	2012	Sep
Nocardiosis	Avian	2012	Nov
Roundworms	Avian	2012	Nov–Dec
E. coli	Swine	2012	Nov
Chicken pox	Avian	2013	Jan
Bacterial septicaemia	Avian	2013	Feb–Sep
Colisepticaemia	Avian	2013	Feb
Stunted growth syndrome	Avian	2013	Mar
Colibacillosis	Avian	2013	May–Nov
Staphylococcus epidermidis	Avian	2013	May
Bacterial pneumonia	Avian	2013	Jul
Klebsiellosis	Avian	2013	Sep
Newcastle disease	Avian	2013	Dec
Colibacillosis	Avian	2014	Jan–Dec
Colibacillosis	Swine	2014	Jan–Oct
Mycoplasma	Avian	2014	Mar
Roundworms	Avian	2014	Mar–Aug
Roundworms	Avian	2014	Apr–Sep
Hypothermia	Avian	2014	Apr
Pasteurellosis	Swine	2014	Apr
Roundworms	Swine	2014	Apr
Bacterial septicaemia	Avian	2014	Jul
Newcastle disease	Avian	2014	Aug–Nov
Perforating ulcer and peritonitis	Swine	2014	Sep
E. coli	Avian	2014	Sep
Aspergillosis	Avian	2014	Jan
Gastric ulcer	Swine	2014	Nov
Newcastle disease	Avian	2015	Mar
Bacterial pneumonia	Avian	2015	May
E. coli	Avian	2015	May
Pneumonia	Swine	2015	Sep
Colibacillosis	Avian	2016	Jan
Coccidiosis	Avian	2016	Jan
Pneumonia	Swine	2016	Sep
Roundworms	Swine	2016	Sep
Ascites	Avian	2016	Oct
Colibacillosis	Swine	2016	Oct
E. coli	Swine	2016	Oct
Anaemia and babesiosis	Swine	2016	Oct
Coccidiosis	Swine	2017	Jan
Asphyxiation	Swine	2017	Mar
Pneumonia and necrotic enteropathy	Swine	2017	May
Colibacillosis	Avian	2017	Jul
Coccidiosis	Avian	2017	Jun
E. coli	Avian	2017	Jul
Internal parasite infestation	Avian	2018	Jun

Appendix 5: Pig and poultry diseases retrieved from Queenstown veterinary laboratory records

Disease	Species	Year	Month
E. coli	Avian	2018	March
E. coli	Porcine	2018	March
Pulmonary hypertension syndrome	Avian	2018	March
Avirulent ND	Avian	2018	April
Coccidiosis	Avian	2018	April
Infectious coryza	Avian	2018	April

Appendix 6: Pig and poultry diseases retrieved from Middelburg veterinary laboratory records

Disease	Species	Year	Month
Newcastle disease	Avian	2007	Aug
	Avian	2014	Sep
	Avian	2015	Jun–Aug
E. coli	Avian	2009	-
Enterobacteria	Avian	2009	-
Chicken pox	Avian	2017	June
Chron. Resp. disease	Avian	2017	June
Colibacillosis	Avian	2018	Aug
Peritonitis	Avian	2019	Apr
Parvovirus	Porcine	2007	Jul
Erysipelothrix	Porcine	2007	Aug
Klebsiella pneumonia	Porcine	2009	Oct–Nov
Colibacillosis	Porcine	2009	Sep
Skin condition	Porcine	2009	Sep
Pneumonia	Porcine	2010	Oct
Thymus Lymphoma	Porcine	2014	May
C. perfringens. type A	Porcine	2016	Dec
SMEDI[1]	Porcine	2018	Feb

Appendix 7: List of databases from Web of Science used in the study:

WOS: Web of Science Core Collection

BCI: Biosis Citation Index

CABI: CAB Abstracts® & Global Health®

CCC: Current Contents Connect

DRCI: Data Citation Index

DIIDW: Derwent Innovations Index

FSTA: Food Science and Technology Abstract

KJD: Korean Journal Database

MEDLINE

RSCI: Russian Science Citation Index

SciELO: SciELO Citation Index