

# IMPORTANT PROTOZOAN DISEASES OF ANIMALS IN INDONESIA (A REVIEW)

*Soeprapto Soekardono\**

## ABSTRACT

An account on important protozoan diseases mostly with obvious clinical symptoms are emphasized and their current status reviewed.

Those diseases are surra, trichomonosis in cattle, babesiosis, anaplasmosis, theileriosis, leucocytozoonosis in chicken, and coccidiosis.

Toxoplasmosis, histomonosis, chicken malaria, balantidiosis and diseases caused by *Giardia*, *Haemoproteus* and *Sarcocystis* are not reviewed because significant problems caused by these parasites considered important economically do not appear in Indonesia.

## INTRODUCTION

The Republic of Indonesia is a big country consisting of approximately 3600 islands and is divided into 27 provinces. The total population is approximately 165 million. Agriculture is the most important activity and most common farmers are smallholders or landless farmers. According to the book on livestock statistics<sup>1</sup> from the Directorate General of Livestock Services, in 1985 the livestock population in Indonesia consisted of approximately 186,000 dairy cattle, 7,081,000 beef cattle, 2,706,000 buffaloes, 8,235,000 goats, 4,416,000 sheep, 3,956,000 pigs and 686,000 horses. In 1985 the poultry population in Indonesia consists of approximately 174,505,000 indigenous chicken, 31,090,000 layers, 143,657,000 broilers and 25,642,000 ducks.

The most important constraints in livestock production include human overpopula-

tion leading to land pressure (in Java), climate leading to poor nutrition in dry areas (Eastern Islands), poor soil conditions (Kalimantan) or to optimum development of certain diseases (surra) and less than optimal management, disease surveillance due to a shortage of funds and no efficient marketing system in some areas.

The most important animal production in Indonesia are poultry (both indigenous and commercial) for meat and eggs, large ruminants and horses for draught and some meat, small ruminants for meat and fish for protein. Pigs and dogs are important protein sources in some areas.

Parasitic diseases, including important protozoan diseases which may cause death and infertility, decrease production of meat, milk, egg and animal power, inhibition of growth and decrease the quality of products.

---

\* Faculty of Veterinary Medicine, Bogor, Indonesia

Parasitic diseases are thought to be economically the most important in Indonesia<sup>2</sup>. Many of these diseases are widespread, making the control program very difficult.

## ANIMAL PROTOZOAN DISEASES

A checklist of important protozoan diseases and some other important diseases, which occur in important livestock in Indonesia, has been published. The diseases are divided into those having some significance and those whose significance is still unknown.

Very important protozoan diseases are trypanosomosis of cattle and horses, dogs and cats, anaplasmosis and theileriosis of cattle and buffaloes, trichomonosis of cattle, and coccidiosis of cattle, goat, sheep and chicken. Toxoplasmosis which is an important zoonosis is also included.

The significance of some protozoan diseases is still unknown, for example the trichomonosis and haemoproteosis in birds, giardiasis in domestic animals, trypanosomosis in birds, histomonosis in chicken, entamoebiasis in monkeys.

## HISTORY ON THE STUDY OF PROTOZOAN DISEASES

The first report on protozoan diseases in animals in Indonesia which the author was able to trace was a report in 1899 by B. Vrijburg<sup>3</sup> on "Sakit Mubeng", surra in cattle caused by *Trypanosoma evansi*.

But de Does<sup>4</sup> reported the presence of piroplasmosis and anaplasmosis in Indonesia in cattle and buffaloes in 1896.

The most current report on protozoan diseases was that by Astyawati<sup>5</sup> on "A tissue

culture technique for the cultivation of *Theileria* sp. and *Babesia* spp., a blood protozoa of dairy cattle, in an effort to be able to eradicate, treat or control those diseases".

The Bulletin LPPH<sup>6</sup> is a bibliography of research work which has been carried out since 1912 until 1987, containing protozoan and other diseases in animals.

Only the most important protozoan diseases in animals will be high-lighted in this paper.

Work that was done before 1912 has been published in journals like Veeartsenijkundige Bladen v. Nederlandsch Indie, Medical Journals and possibly in other Dutch journals that the author was not able to trace.

## IMPORTANT PROTOZOAN DISEASES IN ANIMALS

### 1. Surra

Surra in Indonesia is caused by *Trypanosoma evansi* and is found in horses, cattle, buffaloes, goats, dogs and cats.

The parasite is thought to occur in the main islands of Indonesia with the exception of Irian Jaya<sup>7</sup>. Few definitive studies have been conducted.

*T. evansi* is spread mechanically by biting insects and at least 26 species can harbour the parasite in their mouthparts<sup>8</sup>. *Tabanus*, *Stomoxys*, *Chrysops*, *Haematopota*, *Lyperosia* and *Haematobia* appeared to be important vectors of the disease. But mosquitoes, house flies, and ticks are also capable to transmit the disease.

Animals which harbour the parasite without showing disease symptoms are important reservoir hosts.

Buffaloes are more commonly infected than cattle<sup>9,10</sup> based on serology and on

detection of circulating parasites. Using the ELISA test, around 60% of buffaloes in sentinel herds in Java were serologically positive compared to 35% of cattle<sup>11</sup>.

Surra can be acute (mainly in horses) or chronic (mainly in large ruminants) with anaemia and loss of weight being the main symptoms<sup>10</sup>. But diarrhea, loss of hair and oedema are also often observed. Keratitis and conjunctivitis are observed in horses and dogs.

The economic losses caused by surra was estimated at US\$ 22,400,000 per year.

## 2. Trichomonosis in cattle

*Tritrichomonas foetus* was found in 1967 in dairy cattle in Lembang (near Bandung) by Mansjoer and isolated by Balitvet (Veterinary Research Institute) in 1977 in Pasuruan<sup>12</sup> and Lembang. In 1976 the parasite was found by Sidik Muljo and identified by Bouters in Grati (Pasuruan)<sup>13</sup>.

No studies on the distribution of the parasite has been done.

The parasite is usually transmitted sexually but can also be transmitted by artificial insemination or by dirty hands or equipment soiled with infected material. Infected bulls are usually difficult to treat and are in fact usually not treated but brought to the slaughter house. Especially in cases where the disease is in an advanced stage, infected cows recover without treatment if they are kept in clean pastures for approximately 3 months and not allowed to mate during this period. The economic loss due to this disease is still unknown.

## 3. Babesiosis

Babesiosis in cattle in Indonesia is caused by *Babesia bigemina*, *Babesia argentina* (*Babesia bovis*) and *Babesia divergens*

(*Microbabesia divergens*). Babesiosis in the horse reported from West Sumatra is likely caused by *Babesia caballi*. *Babesia* in the dog is caused by *Babesia canis*.

*Babesia bigemina* was first found in Tegal, in a buffalo in 1896 and afterwards in Sumatra in cattle in 1906<sup>14</sup>. Ressay<sup>15</sup> claimed that piroplasmosis was first found in 1896 by de Does in cattle. He also claimed that the distribution of *B. bigemina* was not as extensive as *B. bovis* (*B. argentina*)

The ticks which transmit *B. bigemina* are *Boophilus*, *Rhipicephalus*, and *Haemaphysalis*. In Indonesia *B. bigemina* causes an acute disease and haemoglobinuria. Sometimes it may cause death<sup>15</sup>. *B. bovis* is often found in cattle buffalo in Indonesia, but this parasite is generally not very pathogenic and usually causes a chronic disease. But in Australia *B. argentina* is more pathogenic than *B. bigemina* and may cause a mortality of 70- 80%<sup>16</sup>.

*Ixodes* and *Haemaphysalis* are the ticks that can transmit this parasite. But others claim that *Boophilus* can also transmit the disease.

In 1918 *B. divergens* was reported in cattle imported from Australia, but the author was able to find the parasite in a blood smear from cattle from Cilacap in 1960. The parasites were located on the margin of erythrocytes.

*B. argentina* which is now considered a synonym of *B. bovis* can be transmitted by *Boophilus*<sup>15</sup>.

Areas which are infected or suspected to be infected by *Babesia* are Aceh, North Sumatra, West Sumatra, Jambi, Riau, Lampung, West Kalimantan, South Kalimantan, South Sulawesi, Central Sulawesi, Hal-mahera, Irian Jaya, Lombok, Bali and Java. Babesiosis has not been reported from other areas of Indonesia<sup>14</sup>.

*Bos taurus* is more susceptible for babesiosis than *Bos indicus* (zebu). Young animals are more resistant against babesiosis than older animals. The infection rate in modern breeds of cattle may reach 90%. The mortality rate in cattle is between 5-50 %<sup>15</sup>. The Directorate General of Livestock Services stated that the mortality rate in adult cattle may reach 80-90 % if not treated and 10-15 % in young cattle (1-2 years old)<sup>14</sup>. Epizootics or acute infections followed by death may sometimes occur in newly imported cattle or in transported cattle from non infected areas to infected areas in Indonesia.

The most important tick which can transmit babesiosis in Indonesian cattle is *Boophilus microplus*<sup>15</sup>. *B. canis* is transmitted by *Rhipicephalus sanguineus*. Soiled equipment with infected material may also cause the transmission of babesiosis. The economic losses due to this disease has not yet been estimated in Indonesia.

#### 4. Anaplasmosis (Call sickness)

Anaplasmosis in Indonesia is caused by *Anaplasma marginale*, and *Anaplasma centrale*. The first species is pathogenic, while the second is not. Formerly *Anaplasma* belongs to the protozoa, but now it belongs to the *Rickettsia*.

*Anaplasma* can attack almost all warm blooded animals such as cattle, buffaloes, goats, sheep, deer, camels, pigs, horses, asses, dogs and many other animals. *Anaplasma* does not affect man.

In Indonesia anaplasmosis was first found in 1987 in cattle and buffalo. In 1912 *Anaplasma* attacked buffaloes from the Cileungsi area in the Bogor Regency, West Java. In 1918 this disease attacked cattle from North Sumatra and in 1934 it attacked cattle in Bojonegoro and Madiun in East Java. It is believed that *Anaplasma* has spread almost all over Indonesia<sup>14</sup>.

Table 1. Diseases of large ruminants

##### A. Diseases known to have some significance (suggested order of economic importance)

Disease	Pathogen	Distribution	Significance
Fascioliasis	Parasite	Widespread; end	++++
Trypanosomiasis	"	" ; "	++ to +++
Foot and Mouth	Virus	Localised ; epi.	++ to +++
Haemorrhagic			
Septicaemia	Bacteriae	Widespread; end.	++ to +++
Haemonchosis	Parasite	" ; "	+ to ++
Neoascariasis	"	" ; "	+ to ++
Babesiosis	"	Localised ; end.	+ to ++
Coccidiosis	"	Widespread; end.	+ to ++
Theileriosis	"	" ; "	+ to ++

##### B. Diseases known to occur (significance: low)

Sarcocystis	Parasitic	Localised ; end. ?	+
-------------	-----------	--------------------	---

*Bos taurus* is more susceptible than *Bos indicus*. Older animals (older than 6 months) are more susceptible than young animals, which may at an older age become carriers of this disease. Ticks are the natural hosts for *Anaplasma* and may transmit this disease transovarially to their offspring. Ticks are the intermediate hosts in the transmission of *Anaplasma* to cattle and buffaloes (*Boophilus*, *Ixodes*, etc.). *Tabanus*, *Stomoxys*, *Aedes* and *Psorophora* mosquitoes act as mechanical vectors. Even a bird, the jalak (*Sturnupostor jalla*) can transmit the disease mechanically. Soiled medical equipment with infective material can also transmit the disease. Transmission in utero sometimes occurs.

## 5. Theileriosis

Theileriosis in Sukabumi, West Java is caused by *Theileria orientalis*<sup>17</sup>. According to Callow<sup>18</sup> the name *Theileria buffeli* has priority if the benign cattle and buffalo theilerias are the same. The Australian *Theileria* is transmissible from buffalo (*Bubalus bubalis*) to cattle and for that reason is called *Theileria buffeli* until otherwise advised by taxonomists. These two names are formerly synonyms of *Theileria mutans*, but it appears that *T. mutans* and *T. orientalis* are serologically different<sup>19</sup>.

Theileriosis in Indonesia was first reported as "pseudokustkoorts" by de Blicck and Kaligis in 1912<sup>20</sup>. Later Soekardono<sup>21</sup> reported *T. mutans* in Sukabumi from dairy cattle. According to Astyawati<sup>19</sup>, sera from cattle with theileriosis from Sukabumi and other areas of Indonesia were identified as sera from cattle affected with *T. orientalis* by G. Uilenberg. So it appears that *T. orientalis* is widespread in Indonesia. The main vectors of *T. buffeli* in Australia are *Haemaphysalis longicornis* and *H. bancrofti* and not *Boophilus microplus*<sup>18</sup>. *Boophilus microplus* ac-

ording to Astyawati<sup>5</sup> is also not a vector of *T. orientalis*. Mortality due to *T. mutans* is less than 1 per cent<sup>16</sup> and losses due to *T. buffeli* are most unusual in Australia. But one parasite, very similar to *T. buffeli* (*T. orientalis* ?) has been reported to cause sickness and death, particularly in imported cattle, in several eastern Asian countries<sup>18</sup>. In Sukabumi, Indonesia the mortality rate due to *T. orientalis* was higher than 1 % in imported cattle. The economic losses due to *T. orientalis* has not yet been estimated in Indonesia.

## 6. Leucocytozoonosis in Chickens

Leucocytozoonosis in chicken in Indonesia is caused by *Leucocytozoon caulleryi* and *Leucocytozoon sabrazesi*, both formerly known as *L. schueffneri* and found by Prowazek in 1912 in Sumatra<sup>22</sup>. Akiba *et al*<sup>23</sup> reported the presence of *L. caulleryi* in Sumatra, Java, and Bali in 1976. Levine<sup>16</sup> reported that besides *L. caulleryi* chicken in Indonesia were also affected by *L. sabrazesi*. *L. caulleryi* occurred in Sumatra, Java, Bali, and Sulawesi and *L. sabrazesi* occurred in Sumatra, Java and Bali<sup>22</sup>. In Bali the mortality rate in young imported/modern bred chickens (approximately one month old) is approximately 50 % and the morbidity rate 80-100 %. In West Java the mortality rate may reach 80 %. In Parung Kuda (West Java) the mortality rate in adult imported/modern bred chicken is 15-20 % and the morbidity rate approximately 40 %. Indigenous chicken (village or kampong chicken) showed no morbidity or mortality due to infection with *L. caulleryi*. This case has been observed in Bali<sup>22</sup>. In epizootics (enzootics) those chickens are suspected as reservoir hosts or carriers. *L. sabrazesi* usually does not cause mortality in indigenous and imported/modern bred chickens, but a heavy parasitaemia may cause morbidity especially in young chicken.

**Table 2. Diseases of small ruminants****A. Diseases known to have some significance (suggested order of economic importance)**

Disease	Pathogen	Distribution	Significance
Gastrointestinal nematodes (Haemonchus most important)	Parasite	Widespread/end.	+++
Fascioliasis	"	" "	++
Mange (Sarcoptes most important)	"	" "	++
Coccidiosis	"	" "	+ to ++
Trypanosomosis	"	Localised / end	+

**B. Diseases known to occur (significance: unknown)**

Toxoplasma	Parasite	Localised / end.	+
------------	----------	------------------	---

**Table 3. Diseases of chicken****A. Diseases known to have some significance (suggested order of economic importance)**

Disease	Pathogen	Distribution	Significance
New Castle Disease	Virus	Widespread / end. and Localised/epi.	++ to +++
Marek's Disease	"	Widespread / end. and Localised/epi.	++ to +++
Coccidiosis	Parasite	Widespread / end.	+ to ++
Leucocytozoonosis	"	Localised / epi.	+ to ++
Ascariosis	"	Widespread / end.	+ to ++
Plasmodium	"	Localised / end.	+ to ++

**B. Diseases known to occur (significance low)**

Histomonosis	Parasite	Localised / end. ?	?
--------------	----------	--------------------	---

*L. caulleryi* in Indonesia is transmitted by *Culicoides arakawai* and *L. sabrazesi* in Taiwan by *Simulium geneculare*. Leucocytozoonosis due to *L. caulleryi* in Java and Bali may occur all year round if the vector (*C. arakawai*) and a reservoir host/carrier is present. But epizootics (usually endemics) due to this parasite are likely to occur in the rainy season. The economic losses due to *L. caulleryi* has not yet been estimated properly in Indonesia, but could be substantial in big poultry farms.

## 7. Coccidiosis

Coccidia found in chicken are *Eimeria tenella*, *E. necatrix*, *E. brunetti*, *E. maxima*, *E. acervulina*, *E. hagani*, *E. mivati*, *E. mitis* and *E. praecox*. The most pathogenic species *E. tenella*, *E. necatrix*, *E. brunetti*, and *E. maxima* have been found in Indonesia. Also *E. acervulina*, a less pathogenic species, has been reported.

Approximately 21 species of coccidia are found in cattle. Species found in Indonesia are *E. bovis*, *E. zuerni*, *E. ellipsoidalis*, *E. braziliensis*, *E. alabamensis*, *E. canadensis*, *E. subspherica*, *E. auburnensis* and *E. bukidnonensis*<sup>24</sup>. In coccidiosis of cattle *E. bovis*, *E. zuerni*, *E. ellipsoidalis*, *E. auburnensis* and *E. bukidnonensis* are the species most often found in the faeces<sup>25</sup>.

The following species which infect sheep in Britain and New Zealand<sup>18</sup> are *Eimeria ahsata*, *E. arloingi* (*E. ovina*), *E. cranadallis*, *E. faurei*, *E. granulosa*, *E. ninakohlyakimovae* (*E. ovinoidalis*), *E. intricata*, *E. parva*, *E. pallida* and *E. punctata*. *E. arlongi* (*E. ovina*), *E. ninakohlyakimovae* (*E. ovinoidalis*), *E. faurei*, *E. parva* and *E. ahsata* are found in Bogor and its surroundings in sheep. South Australian workers found nine species in goats. These are *E. arloingi*, *E. parva*, *E. ninakohlyakimovae*,

*E. granulosa*, *E. ahsata*, *E. cranadallis*, *E. faurei*, *E. pallida* and *E. christensen*<sup>18</sup>. *E. arloingi*, *E. parva*, *E. ninakohlyakimovae*, *E. ahsata* and *E. faurei* are found in goat in Bogor and its surroundings<sup>25</sup>. *E. deblickei* has been found in pigs and *E. stiedai* in rabbits<sup>25</sup>.

Many coccidia species are widespread.

Coccidiosis is mainly a disease of young animals. Those animals which recover, develop an immunity to the particular species which infects them. However this is not an absolute immunity, and recovered adult animals are often continuously reinfected, so that they carry light infections which do not harm them, but makes them a source of infection for the young. In addition under conditions of stress their immunity may be broken down and they may suffer from the disease again. Coccidiosis is considered to be a selflimiting disease. If no reinfection occurs, the animal recovers without treatment.

Proper management supported by the use of effective coccidiostats will usually prevent the occurrence of the disease. Some believe that the application of vaccins supported by the application of coccidiostats will give a good prophylaxis. A vaccine consisting of irradiated oocysts is made by Badan Tenaga Atom Nasional (BATAN) in Pasar Jum'at, Jakarta.

Many coccidia species are widespread worldwide and pathogenic species may harm farms where no proper management and hygienic conditions occur. The infective stage is the sporulated oocyst which will remain alive for approximately one year if stored at 4-5°C in K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> (potassium dichromate) 2.5% solution.

Niilo in Soekardono<sup>26</sup> stated that the annual loss per calf under one year of age is US\$ 1.00. In Soekardono<sup>26</sup>, Foster stated that bovine coccidiosis was responsible for the

loss of US\$ 10,000,000.- annually in the USA.

The population of Indonesia cattle is approximately 7,081,000, the population of the Indonesian water buffalo is 2,706,000 and that of the dairy cattle is approximately 186,000. The total amount of big ruminants is 9,973,000<sup>1</sup>. If one third of the animals are less than one year old, the loss due to coccidiosis in cattle in Indonesia could be estimated at  $1/3 \times 9,973,000 \times \text{US\$ } 1,- = \text{US\$ } 3,324,333.-$  per year.

## 8. Other protozoan diseases

Toxoplasmosis, histomonosis, chicken malaria, balantidiosis and diseases caused by

*Giardia*, *Haemoproteus*, *Sarcocystis*, and trichomonosis and trypanosomosis in birds are considered economically not important diseases.

Toxoplasmosis is considered an important zoonosis and may cause abortion in sheep. The presence of toxoplasmosis in sheep and goats has been reported from Surabaya and Malang by Hartono<sup>27</sup> and in pigs and goats from Surabaya by Sasmita<sup>28</sup>. But people appear not to be aware of the dangers of the disease, which can be dangerous to workers in this field especially in laboratories with unqualified personnel and supplied with inadequate facilities, equipment, chemicals/disinfectants and supported with a very inadequate (very low) budget.

Table 4. Diseases of pigs

### A. Diseases known to have some significance

Disease	Pathogen	Distribution	Significance
Ascariosis	Parasite	Widespread / end.	++
Strongyloidosis	"	Localised / end.	+ to ++
Coccidiosis	"	" "	+ to ++
Balantidiosis	"	Widespread	?
Toxoplasmosis	"	Localised / end.	+
Trypanosomosis	"	" "	+ ?



## REFERENCES

1. Direktorat Jenderal Peternakan, Direktorat Bina Program. (1986). Buku Statistik Peternakan.
2. Skaggs, J.W., M. Mansjoer and P. Soeratio. (1970). Veterinary medicine in Indonesia. *Adv. Vet. Sci. & Comp. Med.* 14: 355-364.
3. Vrijburg, B. (1899). Sakit moebeng. *Veearts. Bl. v. N. I.* 12: 219.
4. Does, de. (1905). Piroplasmosen in Ned. Indie. *Geneesk. Tijdschr.* 45: 515.
5. Astyawati, T. (1988). Teknik biakan jaringan hewan untuk pengembangbiakan Protozoa darah *Theileria* sp. dan *Babesia* spp. dalam usaha melakukan pengobatan, pemberantasan dan pengendaliannya pada sapi perah. Seminar hasil-hasil penelitian IPB. Maret, 1988.
6. Lembaga Penelitian Penyakit Hewan (Animal Disease Research Institute). (1975-1988). *Bull LPPH* 7 (10). Bibliography Penelitian Lembaga Penelitian Penyakit Hewan, Bogor. (dengan Appendixnya).
7. Adiwinata, T. and A. Dachlan. (1972). A brief note on Surra in Indonesia. *ELVEKA Folio Veterinaire* (3).
8. Nieschultz, O. (1930). Surra uebertragungsversuche auf Java und Sumatra. *Mededeel. v.h. Dept. v. Landb., Nijv. en Handel no. 75, Utrecht. (Mededeel. Dept. v. E.Z., 1930).*
9. Wilson A.J., S. Partoutomo, Suhardono and P. Stevenson. 1983. Observations on the epidemiology of *Trypanosoma evansi* infection in cattle and buffalo in Java. *Proceed. WAAP, 10th Conf. Perth, W.A.*
10. Partoutomo, S., A.J. Wilson, P. Stevenson, M. Soleh and A. Day. (1984). The value of Sentinel populations to monitor production and disease in small holder herds in cattle and buffalo in Java with special reference to Surra., *Proc. 8th Ann. Conf. Malay. Parasit. Soc. Kuala Lumpur, March, 1984.*
11. Luckins, A.C. (1983). Development of serological assays for studies on trypanosomiasis of livestock in Indonesia. *Consultants Report No. 13. RIAD, Bogor, Indonesia.*
12. Partoutomo, S. and Soetedjo (1977). Trichomoniasis pada seekor sapi F.H. pejantan di Pasuruan. *Bull. LPPH* 14: 38.
13. Direktorat Jenderal Peternakan. (1978). Pedoman pengendalian penyakit hewan menular Jilid I.
14. Direktorat Jenderal Peternakan. (1980). Pedoman Pengendalian Penyakit Hewan Menular Jilid II.
15. Ressang, A.A. (1984). *Patologi Khusus Veteriner. N.V. Percetakan Bali.* 667 hal.
16. Levine N.D. (1973). *Protozoan Parasites of Domestic Animals and of Man.* Burgess Publ. Comp., Minneapolis 15, Minnesota.
17. Astyawati, T. (1987). Diagnosis Piroplasmosis pada Sapi Perah dengan Metode Fluoresein Antibodi Tak Langsung Dibandingkan dengan Giemsa May Gruenwald. *Dok. Fak. Pasca Sarjana, IPB.*
18. Callow, L.L. (1984). *Animal Health in Australia Vol. 5. Protozoal and Rickettsial Diseases.* 246 pp.
19. Astyawati, T. (1989). Personal communication.
20. Blicck, L. de en J.A. Kaligis. (1912). Pseudokustkoorts en anaplasmosis bij buffels op Java. *Veearts. Bladen.* 24: 253.
21. Soekardono, S. (1978). *Theileria mutans* di Sukabumi. *Media Vet.* 1 (2).
22. Soekardono, S. (1986). Leucocytozoonosis pada Ayam di Jawa dan Bali. *Disertasi Doktor Fak. Kedokteran Hewan-IPB.*
23. Akiba, K., K. Iwatsuki, Y. Sasaki, Y. Furuya and Y. Ando. (1976). Report on the Investigation of Poultry Diseases in Indonesia. *Japan International Cooperation Agency.* 47 pp.
24. Soekardono, S. (1982). Coccidia pada Sapi di Bogor. in *Proceed. Pertemuan Ilmiah Ruminansia Besar, 1983 in Cisarua (Bogor).*
25. Soekardono, S. (1989). Unpublished material.
26. Soekardono, S. (1972). Redescription of the Life-cycle of the Bovine Coccidium, *Eimeria alabamensis* Christensen, 1941. *M.S. Thesis. Auburn University.*
27. Hartono, T. (1988). Survei kista *Toxoplasma gondii* pada kambing/domba di Surabaya dan Malang. *Makalah pada Seminar Parasitologi Nasional V di Bogor, 20-22 Agustus 1988.*
28. Sasmita R. *et al.* (1988). Insiden toxoplasmosis pada babi dan kambing di Rumah Potong Hewan Surabaya. *Makalah Seminar Parasitologi Nasional V di Bogor, 20-22 Agustus 1988.*

## QUESTIONS AND ANSWERS :

1. Question: 1. Could you explain, why older animals are more susceptible than the younger to Babesia infection ?
2. What kind of vaccine can be used to control coccidiosis in chicken ?
3. Has the vaccine already released in the market in Indonesia ?

- Answer : 1. A possibility is that younger animals may still have maternal immunity. Older animals may already have lost their immunity and may be exposed to another strain.
2. In the U.S. coccivac (measured vaccination) supported with coccidiostats has been applied, apparently succesfully, but improvement in the application and effectivity is needed.
3. There are that "coccivac" or a similar product has been used in certain farms.