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ORIGINAL PAPER

Current status of ticks in Asia

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Abstract Ticks and tick-borne diseases (TTBD) pose a major constraint for the development and improvement of the livestock industry. They cause economical losses by decreasing milk production, effecting weight loss, and increasing risk for bacterial, viral, and fungal infections. It has been reported that 80% of 1,200 million cattle are at risk for TTBDs causing a global annual loss of US$7,000 million. Ticks are currently considered to be second only to mosquitoes as vectors of human infectious diseases in the world. There are more than 850 species recognized with approximately 180 in the family *Argasidae* (soft ticks) and the others in the family *Ixodidae* (hard ticks). In Asia, the economical losses due to TTBDs is great; however, the knowledge on Asian ticks is scarce and needs intensive studies regarding their geographical distribution, ecology, and diseases transmission. To close this gap, the Asian component of the Integrated Consortium on Ticks and Tick-Borne Diseases (ICTTD-3) organized a meeting held from 26th–28th April 2006 in Pendik, Istanbul, Turkey on the characterization of Asian ticks. Besides the knowledge dissemination, this meeting resulted in a number of achievements such as the establishment of working groups for epidemiological studies and distribution of tick differentiation protocols and diagnostic tools.

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Introduction

The livestock sector represents a significant part of the global economy, particularly in the developing world. Thus, livestock provides energy, food, raw material, and manure for crops. It is therefore not surprising that the livestock sector, especially the dairy sector, has emerged as an important economic source for a vast majority of the rural population and a target for agribusiness in the dairy, meat, and various other products in the processed foods sector.

In Asian countries, three major groups of livestock diseases are present with different epidemiological, economic, and regulatory implications:

1. Epidemic diseases such as Blue tongue, FMD, PPR, which have regional and international security consequences,
2. Endemic diseases such as tick-borne diseases, which have considerable economic importance locally and regionally but are non-threatening internationally, and
3. Zoonotic diseases with impact on human health.

The impact of ticks and tick-borne diseases (TTBDs) on the livelihood of resource poor farming communities has been ranked high (Perry et al. 2002). Ticks are among the most important vectors of diseases affecting both humans and animals worldwide. They are currently considered to be second only to mosquitoes as vectors of human infectious diseases in the world. It has been reported that 80% of 1,200 million cattle are at risk for TTBDs causing a global annual loss of US$7,000 million (McCosker 1979). There are more than 850 species recognized with approximately 180 in the family *Argasidae* (soft ticks) and the others in the family *Ixodidae* (hard ticks). Ticks transmit a greater variety of protozoan, bacterial, rickettsial, and viral pathogens than any other arthropod vector group. They also cause direct damage due to paralyses and toxicoses, irritation, and allergy and contribute to a general loss of condition resulting in significant economic losses.

The Integrated Consortium on Ticks and Tick-Borne Diseases (ICTTD-3) has established an Asian component to extend its activities in this region focusing on:

1. Creation of national and regional networks for ticks and tick-borne diseases
2. Organization of technical workshops for molecular diagnostic tools, epidemiological tools, and attenuated vaccines
3. Establishment of working groups for the characterization of Asian ticks and for epidemiological studies

The Asian component organized a meeting held from 26th–28th April, 2006 in Pendik, Istanbul, Turkey on the characterization of Asian ticks. Besides the knowledge dissemination, this meeting resulted in a number of achievements such as the establishment of working groups for epidemiological studies and distribution of tick differentiation protocols and diagnostic tools. Participants from Turkey, Iraq, Iran, Uzbekistan, Kazakhstan, China, Pakistan, India, Bangladesh, Georgia, Germany, Spain, and South Africa attended this meeting and addressed issues regarding the characterization of the Asian ticks, their geographical distribution, ecology, socio-economic impact, and their capacity to transmit pathogens.

Status of ticks in Asia

A number of presentations described the tick species present in Asia, their geographical distribution, their hosts, and the pathogens they transmit.

More than a dozen tick species have so far been recorded from Bangladesh infesting cattle, goat, sheep, dog, wild mammals, birds, and lizards. The cattle tick, *Boophilus microplus* is predominant, followed by *Haemaphysalis bispinosa*, *Hyalomma truncatum*, and *H. anatolicum*. The other common species are *Amblyomma gervaisi*, *Haemaphysalis canestrini*, *H. kinneari*, *Rhipicephalus sanguineus*, *R. evertsi evertsi*, and *Amblyomma variegatum* among the hard ticks, and *Argas persicus*, the fowl tick, among the soft ticks infesting poultry. *B. microplus* has occasionally been found to infest human beings. *B. microplus* was found to infest 28.3% cattle, 6.3% goats, and 100% animal attendants. *H. bispinosa* was detected on 7.6% of examined cattle, 55.4% goats, and 13.2% pigs, and *R. sanguineus* on 59.4% dogs and 16.7% jackals. *H. kinneari* was recorded on 66.7% jackals (Ghosh et al. 2007).

A number of studies have been conducted in different geographical areas of Pakistan to investigate the prevalence of ticks on livestock. Eighteen thousand animals comprising of 4,500 each cattle, buffaloes, sheep, and goats were examined for tick infestation from three districts of Faisalabad division. The rate of tick prevalence was highest (28.2%) in cattle followed by sheep (18.8%), buffaloes (14.7%), and goats (12.3%) (Ghosh et al. 2007).

In India, seven genera of hard ticks and three genera of soft ticks have been identified. The authors found that the most importnant genera are *Boophilus*, *Hyalomma*, *Haemaphysalis*, *Rhipicephalus*, and *Argas*. However, they also identified that there is a great gap on the tick distribution pattern in many of the states like North Eastern States, Kerala, and Goa. In addition, they stated that the prevalence of *Babesia bovis* and *Boophilus annulatus* and *B. decoloratus* needs to be confirmed. In India, ticks transmit protozoa, Rickettsiae, bacteria, and viruses. The economic losses caused due to TTBDs is estimated to US$498.7 million per annum (Ghosh et al. 2007).

Aydin and Bakirci from the Department of Parasitology, Uladag University, Turkey gave a detailed information about Turkey's tick fauna. Thirty-two tick species have been identified in Turkey, which are integrated in two families and classified in ten genera infesting mammals, reptiles, and birds. The family *Ixodidae* is of veterinary significance and is composed of seven genera. In addition, these authors showed that (a) *Ixodes* spp. is mostly seen in Northern Turkey, most likely favored by the high rainfall and the intensive forest in this area; (b) *A. variegatum* is found in Hatay province near the border to Syria; (c) *Haemaphysalis*, *Hyalomma*, *Boophilus*, *Dermacentor*, and *Rhipicephalus* are widespread throughout Anatolia (Ayden and Bakirci 2007).

Neval Kaya presented results of a 2-year study conducted between April 2001 and March 2003 in different areas of Diyabakir province in Turkey. They found that 26.2% of 7,188 examined animals were infested by ticks, which were identified as *R. sanguineus*, *R. bursa*, *R. turanicus*, *Hyalomma anatolicum anatolicum*, *H. anatolicum excavatum*, *H. marginatum*, *Haemaphysalis parva*, *H. punctata*, and *H. sulcata*.

Anıl İça and his colleagues from the Erciyes University in Kayseri, Turkey investigated the status of tick infestation of cattle in the Kayseri region. They found that 21.70% of 866 examined cattle were infested with ticks. Moreover, they collected 1,585 ticks and could identify them to belong to *Rhipicephalus turanicus* (2.27%), *R. bursa* (2.14%), *R. sanguineus* (0.94%), *Hyalomma marginatum* (17.16%), *H. anatolicum excavatum* (24.73%), *H. anatolicum anatolicum* (19.62%), *Dermacentor niveus* (1%), *B. annulatus* (16.71%), *Ornithodorus lahorensis* (0.25%), *Hyalomma* sp. nymphs (7.31%), and *B. annulatus* nymphs (7.82%). Furthermore, the authors investigated the seasonal fluctuation of ticks and found that *Rhipicephalus* species were generally found in spring, other ticks like *Hyalomma* species in late spring, summer, and early autumn, *B. annulatus* in September, October, and December, *D. niveus* in December, January, and February, *O. lahorensis* in December. Nymphs of *Hyalomma* species were found in summer and autumn, while *B. annulatus* nymphs were observed in October, November, and December (İça et al. 2007).

Another focus of this meeting was the outbreaks of Crimean-Congo Hemorrhagic fever (CCHF). The disease is a zoonosis transmitted by ticks and causes severe outbreaks in humans but which is not pathogenic for ruminants. CCHF outbreaks constitute a threat to public health services because of its epidemic potential, its high case fatality ratio (10–40%), its potential for nosocomial outbreaks, and the difficulties in treatment and prevention. The participants of the meeting discussed previous outbreaks of CCHF, which have occurred in several countries including Albania, the former Yugoslavia, Iran, Iraq, Russia and South Africa. In a recent outbreak of CCHF in Turkey, 19 persons had suspected cases of Crimean-Congo hemorrhagic fever or a similar viral infection. Six serum samples were tested; all six had antibodies against the CCHF virus. Two of the samples yielded CCHF virus isolates. Genetic analysis of the virus isolates showed them to be closely related to isolates from former Yugoslavia and southwestern Russia. These cases are the first of CCHF reported from Turkey. Eighteen patients handled livestock, and one was a nurse with probable nosocomial infection. The case-fatality rate was 20% among confirmed CCHF case patients (1 of 5 patients), and the overall case-fatality rate was 11% (2 of 19 patients). In addition to previously reported symptoms and signs, hemophagocytosis in 50% of the patients was observed. A clear correlation between the occurrence of CCHF virus and ticks was observed. Vatansever and his colleagues from Ankara University presented data showing the distribution of *H. marginatum* ticks and their relation to the outbreak of CCHF. To further analyze this correlation, a working group was established in Turkey to coordinate research regarding the epidemiology of Crimean–Congo hemorrhagic fever. A similar working group has been established in Iran and is coordinated by Parviz Shayan. The aim of this working group is to collect data from the field regarding the distribution of the CCHF virus in areas neighboring Afghanistan where CCHF cases have been found.

Sadegh Rahbari and his colleagues from the Tehran University in Iran examined 1,500 sheep, 1,200 goats, and 500 cattle belonging to12 herds in different provinces for tick infestations. The infestation rate was 62, 55, and 57% for cattle, sheep, and goats, respectively. The mean number of ticks on each animal ranged between 10–20 ticks per animal. *Rhipicephalus*, *Haemaphysalis*, and *Dermacentor* ticks were recorded in the mountainous area, whereas *Boophilus* and *Ixodes* ticks were only present in the Caspian region, while *Hyalomma* was the most abundant in each zone especially in the mountainous areas (Rahbari et al. 2007).

Emad Changizi from Samnan University presented data regarding tick prevalence in Samnan province of Iran. Examination of the 9,511 ticks resulted in the identification of the following tick species: *Dermacentor marginatus*, *Hyalomma asiaticum asiaticum*, *H. marginatum marginatum*, *H. anatolicum anatolicum*, *H. anatolicum excavatum*, *H. detritum*, *H. dromedarii*, *Haemaphysalis punctata*, *H. sulcata*, *H. parva*, *R. bursa*, and *R. sanguineus*. In all areas under study, the most abundant ticks on the cattle were from genus of *Hyalomma* and *Rhipicephalus*. While *H. asiaticum asiaticum* was the most abundant tick on cattle in the northern and southern area of Samnan, *H. anatolicum excavatum* turned out to be the most dominant tick species in Garmsar. Moreover, three genus of *Haemaphyslis* and *Dermacentor marginatus* have just been recorded in Samnan, and *Hyalomma schulzei* was recorded to infest camel in Garmsar. The authors collected 3,252 and 6,259 ticks from sheep from North of Samnan and Garmsar, respectively. In Samnan, the most of these ticks (59.6%) were *D. marginatus*. In Garmsar, most ticks (71.93%) were identified as *R. bursa*. Regarding cattle, *D. marginatus* was the most dominant tick in the northern area of Samnan, while *Hyalomma* spp. and *Haemaphysalis* spp. were abundant in the southern area. In Garmsar, the most abundant tick was *R. bursa*.

The Asian panel of ICTTD-3 has provided aid to establish a working group in Iraq to investigate the epidemiological situation of TTBDs in the Northern part of the country. Luqman Omer from the Universityof Dohuk reported on results of a survey on hard ticks affecting cattle, sheep, and goats done in Dohuk Governorate from March 2005 until February 2006. The species collected from cattle were *Hyalomma anatolicum anatolicum*, *H. anatolicum marginatum*, while the species collected from sheep and goats were *R. bursa*, *R. turanicus*, *Haemaphysalis parva*, and *Hyalomma* spp. (Omer et al. 2007). As reported by Luqman Omar two CCHF cases have been recorded in North of Iraq.

Ilhan Rasulov from the Department of Protozoology, Academy of Sciences, Tashkent, Uzbekistan, reported on a study conducted on 30,000 ticks collected from different regions of Uzbekistan. It was found that cattle were parasitized by 11 species of *Ixodidae* ticks. They found that *H. anatolicum* (34.9%), *H. detritum detritum* (31.8%), and *B. kohlsi* (30.7%) were the most dominant ticks (Rasulov 2007).

Petney and his colleagues described the status of the Southeast Asian ticks. About 104 species of ticks from 12 genera are found in Southeast Asia. A number of them have been introduced, such as *R. sanguineus* from dogs, which is an important vector of canine diseases. The most species rich genus is *Haemaphysalis* with about 52 species or 31% of the world species, with 23 belonging to the subgenus *Kaiseriana*. Furthermore, they mentioned that for Cambodia, Laos, and Myanmar, there is very little information available on the ticks present and no national guide has ever been published (Petney et al. 2007).

Epidemiology of small ruminant theileriosis in China

Guo and her colleagues investigated the epidemiology of ovine theileriosis in the Gannan Tibet region of China. The seroprevalence of ovine theileriosis varied from 27.8 to 83.3% among different areas of this region. The seroprevalence rose from March reaching a peak value of 68.2 in May, declining in October, and reaching the lowest value of 36.4% in January. There is a clear correlation between the presence of the vector *Haemaphysalis qinghaiensis* and the infection (Guo et al. 2007).

More information on ovine theileriosis in China was presented in the paper of Yin et al. (2007). These authors described the biology, the vector tick, and the phylogenetic position of different *Theileria* species infecting small ruminants in China.

Ecological changes

Climatic conditions dictate the dynamics of tick-borne diseases by affecting the distribution of ticks and their seasonal occurrence. Reliable predictive models are required to measure the direct effect of climatic change on the abundance of TTBDs. The ecology of tick-borne diseases is complex, as is the influence of climate on spatial and temporal variations in TTBDs. The relative impact of climate is often difficult to discern from variations in other factors that are not directly climatic. Climate change may affect not only tick survival but also indirect effects on host ecology and abundance, causing emergence of tick-borne diseases in some regions and their disappearance in other areas.

Agustín Estrada-Peña from the Department of Parasitology, Veterinary Faculty, Zaragoza, Spain reported on the climate-matching models and their use to predict distributions of living organisms, using records of the known distribution of a species to map its expected range of habitat suitability. He mentioned that “predictive mapping is of particular importance in large, ecologically heterogeneous regions, like Asia, where ticks are a serious limiting factor of animal production.” Moreover, he stated that “data availability is a major constraint in building large-scale models of the distribution of ticks, as inductive modeling requires a large amount of optimally assessed information to be able to predict species occurrence.” During the meeting, the ICTTD-3 initiative for predictive mapping of ticks in Asia was discussed and the usefulness of remotely sensed climate variables in tracking the habitat suitability.

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