

## 14. PRESENT STATE AND FUTURE PROBLEMS OF RESEARCH WORKS ON ANIMAL REPRODUCTION IN JAPAN

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Animal reproduction is one of the most active research fields in the study of animal husbandry in Japan. Experimental animals used for the study are primarily cattle, horse, pigs, goats, sheep and fowls, but laboratory animals such as rabbits, rats and mice are also used in a fairly large number of experiments. Subjects of research works also spread over various areas; physiology, endocrinology, immunology and pathology of reproduction, artificial insemination, transplanation of fertilized ova, physiology of milk secretion and so on.

The present status of research works on animal reproduction will be outlined here. However, available time and space allotted are limited to review all round of the works in the field of animal reproduction in Japan and it would not be so much significant to review all of them in view point of the main purpose of the present symposium. Contents of my description is divided into three parts.

### Activity of Research Works on Animal Reproduction

#### 1. Institution in the Field of Animal Reproduction

##### *A. Laboratories in universities.*

Japanese universities are under the control of Ministry of Education of the Japanese government. As shown in Table 1, there are 27 universities instituted with laboratory of animal reproduction.

##### *B. Institutions of Ministry of Agriculture and Forestry*

The are following two national institutes where the most active research works on animal reproduction have been performed.

##### (1) National Institute of Animal Industry

Chiba-shi, Chiba-ken (mainly works on the reproductive physiology and A.I.)

##### (2) National Institute of Animal Health

Kodaira-shi, Tokyo-to (mainly works on the reproductive pathology)

Beside these, there are laboratories of animal production in National Grassland Research Institute, Nishinasuno, Tochigi-ken, several Regional National Institutes of Agriculture, several National Animal Breeding Stations and many Prefectural Experiment Stations. Experiments on animal reproduction and A.I. have been also performed at the institutions occasionally.

#### 2. Scientific Societies and Their Activities

Main scientific societies where the research achievements on animal reproduction and A.I. are published, are as follows.

##### *A. Japanese Society of Zootechnical Science*

Office: c/o College of Agriculture, University of Tokyo

Member: 2,100

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\* Department of Animal Science, Kyoto University, Kyoto, Japan.

**Table 1. List of Japanese universities where Laboratory of Animal reproduction is instituted**

University	Address
1. Department of Veterinary Science, Obihiro Zootechnical University†	Obihiro-shi, Hokkaido
2. College of Agriculture & College of Veterinary Science, Hokkaido University†*	Sapporo-shi Hokkaido
3. College of Agriculture, Iwate University†	Morioka-shi, Iwate-ken
4. College of Agriculture, Tohoku University†*	Sendai-shi, Miyagi-ken
5. College of Agriculture, Ibaragi University†	Ami-machi, Ibaragi-ken
6. College of Agriculture, University of Tokyo†*	Bunkyo-ku, Tokyo-to
7. Tokyo University of Agriculture & Technology†	Fuchu-shi, Tokyo-to
8. College of Agriculture, Niigata University	Niigata-shi, Niigata-ken
9. College of Agriculture, Shinshu University†	Ina-shi, Nagano-ken
10. College of Agriculture, Shizuoka University	Shizuoka-shi, Shizuoka-ken
11. College of Agriculture, Nagoya University†*	Nagoya-shi, Aichi-ken
12. College of Agriculture, Gifu University†	Kagamihara-shi, Gifu-ken
13. College of Agriculture, Kyoto University†*	Sakyo-ku, Kyoto-shi
14. College of Agriculture, Kobe University†	Kobe-shi, Hyogo-ken
15. College of Agriculture, Okayama University†	Okayama-shi, Okayama-ken
16. College of Agriculture Tottori University†	Tottori-shi, Tottori-ken
17. College of Agriculture & Fisheries, Hiroshima University†	Fukuyama-shi, Hiroshima-ken
18. College of Agriculture, Yamaguchi University†	Yamaguchi-shi, Yamaguchi-ken
19. College of Agriculture, Kyushu University†*	Fukuoka-shi, Fukuoka-ken
20. College of Agriculture, Miyazaki University†	Miyazakishi, Miyazaki-ken
21. College of Agriculture, Kagoshima University†	Kagoshima-shi, Kagoshima-ken
22. College of Agriculture, Osaka Prefecture University†*	Sakai-shi, Osaka-fu
23. College of Agriculture & Veterinary Science, Nippon University†*	Setagaya-ku, Tokyo-to
24. Azabu Veterinary University†*	Sagamihara-shi, Kanagawa-ken
25. Nippon Veterinary & Zootechnical College†*	Musashino-shi, Tokyo-to
26. College of Dairy Agriculture	Ebetsu-shi, Hokkaido
27. College of Zootechnical Science, University†*	Towada-shi, Aomori-ken

Note: † Master course is offered.

\* Doctor course is offered.

No. 1 ~22 are governmental universities.

No. 23~27 are private universities.

Research papers are read at the annual meetings of the society once a year in spring or twice a year in spring and autumn. The number of papers on animal reproduction read at the annual meetings of the the society during past five years are shown in Table 2. As can be seen in the table, the average annual number of papers are 343 and 75 of them, about 22% are papers on animal reproduction. In addition to the papers read at the annual meetings, reviews and original papers are published monthly on the official journal of the soicity.

There are also seven sub-societies of the Japanese Society of Zootechnical Science and several papers on animal reproduction are presented at the annual meeting of each sub-society.

**Table 2. Number of papers presented at the annual meetings of the Japanese Society of Zootechnical Science during past five years**

Year	Total No. of papers presented	No. of papers on animal reproduction
1969*	433	81
1970	218	51
1971	298	71
1972	280	60
1973*	486	111
Average	343	75

\* Meetings were held twice a year

*B. Japanese Society of Veterinary Science*

Office: c/o College of Agriculture, University of Tokyo

Member: 3,000

Office: c/o College of Agricultu

Research papers are read at the annual meetings of the society twice a year in spring and autumn. Papers read at the meetings are mainly on pathology of reproduction. As shown in Table 3, 26 of 542 papers in total presented at the annual meetings are on the pathology of reproduction.

**Table 3. Number of papers presented at the annual meetings of the Japanese Society of Veterinary Science during past five years**

Year	Total No. of papers presented	No. of papers on pathology of reproduction
1968	505	33
1969	496	23
1970	507	29
1971	579	20
1972	623	25
Average	542	26

*C. Japanese Society of Animal Reproduction*

Office: c/o National Institute of Animal Health

Member: 550

This society was established exclusively for the study of animal reproduction. Annual meetings of the society are held twice a year in spring and autumn, and a symposium is held in spring on a special subject and general papers are read at the meeting in autumn. Subjects of the symposia presented during past five years are shown in Table 4, and the number of general papers read at the autumn meeting are shown in Table 5.

Official journal of the society is Japanese Journal of Animal Reproduction and the number of papers on animal reproduction appeared in the journal during past five years are also shown in Table 5.

**Table 4. Subjects of symposia of the Japanese Society of Animal Reproduction during past five years**

Year	Subjects
1969	Physiology of spermatozoa Physiology of mammalian ova Reproductive problems on large scale breeding of cattle Reproductive problems on large scale breeding of swine
1970	Gonadotrophin in animal clinics
1971	Immuno-reproduction in farm animals
1972	Synchronization of estrous cycle in farm animals
1973	Fertilized eggs and artificial pregnancy

**Table 5. The number of papers read at the annual meetings and original papers published in the official journal of the Japanese Society of Animal Reproduction during past five years**

Year	No. of papers read at the annual meeting	No. of original papers published in the journal
1968	8	22
1969	15	22
1970	19	23
1971	20	20
1972	11	24
Average	15	22

*D. Japanese Society of Frozen Semen Research*

Office: c/o College of Agriculture, Kyoto University

Member: 450

This society was established in 1960 exclusively for the study on frozen semen taking into consideration of the importance of extensive use of frozen semen in cattle A.I. in Japan. As will be referred later, most of Japanese cattle are bred by A.I. with from frozen semen at present, and the society has greatly contributed to the extension and

**Table 6. The numbers of papers read at the annual meetings and original papers appeared in the Journal of the Japanese Society of Frozen Semen Research during past five years**

Year	No. of papers read at the annual meetings	No. of original papers appeared in the journal
1968	28	24
1969	19	23
1970	25	16
1971	28	25
1972	22	22
Average	24	22

development of the techniques of frozen semen.

Research papers on frozen semen are read at the annual meeting of the society once a year and original papers are published in the official journal which is issued thrice a year. The number of original papers appeared in the journal during past five years is shown in Table 6.

In addition to the above mentioned scientific societies, several papers on animal reproduction are presented at the annual meeting of Japanese Society on Fertility and Sterility.

Furthermore many research achievements on animal reproduction appeared in the memories of college of agriculture of each university and in the bulletin of animal industry experiment station of each prefecture.

Several papers on reproduction in the fowl are presented at the annual meetings of the Japanese Society of Poultry Science (Office: c/o National Institute of Animal Industry) twice a year and original papers are published in the official journal of the society.

In reviewing the subjects 1 and 2 mentioned above, activities of research works on animal reproduction in Japan would be easily recognized. Of course estimation of the research achievements should be made by their contents and not by the numbers and volumes of papers. Contents of the most papers are highly estimated and some of them were presented at the International Congress on Animal Reproduction and A.I., World Conference on Animal Production, International Symposium on Zootechny, World Congress on Fertility and Sterility and so on. Some of the Japanese workers were nominated to be invited speakers and chairman at the above mentioned international congress, conference and symposium. These facts would also indicate the aspects of research activities in the field of animal reproduction in Japan.

## Topics of Research Works

### 1. Artificial Insemination

Study on A.I. of farm animals is one of the subjects of studies which have been actively performed in the field of animal husbandry of Japan. Tremendous number of studies on the practical techniques of A.I. such as collection, preservation and injection of semen, and of fundamental studies on reproductive physiology of various species of farm animals have been conducted since long past and many achievements obtained from the studies have greatly contributed to the development of A.I. in Japan.

The author is going to outline the status of extension of A.I. in various species of domestic animals and discussions will be made on the urgent problems of A.I. The participants of this symposium could find the details of A.I. in Japan in my booklet "Sixty Years of A.I. in Japan" which have already been in your hand.

#### A. *A.I. in Cattle*

##### (1) Extension of the use of A.I.

Table 7. Extension of the use of A. I. in cattle

Year	Dairy cattle		Beef cattle		Total	
	No. of A. I. cows	Rate of A. I. cows	No. of A. I. cows	Rate of A. I. cows	No. of A. I. cows	Rate of A. I. cows
1955	261	91.8%	486	74.1%	747	79.5%
1960	574	96.5	590	86.7	1,164	91.3
1965	906	98.2	470	90.7	1,376	94.5
1970	1,228	98.7	593	94.9	1,821	97.4
1971	1,274	99.3	544	93.7	1,818	97.6

Note: Unit number of cows is expressed as 1,000

Extension of artificial insemination in cattle started actively throughout the country in 1950 when "Livestock Improvement and Reproduction Law" was enacted. As shown in Table 7, the number of A.I. cows was about 1.82 million, and the rates of A.I. cows was about 98% in 1971; most of cattle were bred by A.I. with a few exceptional cases of natural mating in Japan. The rate of A.I. cows has already reached above 90% in dairy cattle in 1954 and in beef cattle in 1965, and the extension rate of A.I. in total of beef and dairy cows was above 90% in 1960. These figures indicate well the rapid extension of the use of A.I. in cattle. Total number of A.I. cows are 25 million during 21 years from 1951 to 1971.

(2) Merits resulted from A.I. in cattle

It has elapsed considerably long years since A.I. in cattle extended in Japan. The extensive use of A.I. resulted in the following merits.

a) Infectious diseases such as trichomoniasis, once expanded throughout the country, was completely disappeared in Japan.

b) The process of improving cattle has been greatly shortened and the successful effects have been obtained. For example, average annual milk yield of a dairy cow was about 2,700 kg prior to the extension of A.I. (most of the dairy cows in Japan are Holstein). However, the milk yield has increased to more than 5,300 kg as a result of the extensive use of A.I. This means the effective use of the excellent bulls for breeding. It should not be also overlooked as a cause of levelling up in cattle performance that the physical conformation has been uniformly improved both in dairy cattle and beef cattle (most of the beef cattle in Japan are Japanese Black Breed, "Wagyu").

c) Semen of the excellent bulls has been available inexpensively by the extension of A.I., and keeping of bulls in each farm or cooperative has not been necessary. These financial merits resulted from the extension of A.I. should not also be overlooked.

(3) Techniques of A.I.

Technique of semen collection and the methods of semen examination are almost similar to those adopted in American and European countries. Frozen semen has being rapidly extended throughout the country in place of liquid semen since several years ago. As shown in Table 8, most of dairy cattle are inseminated artificially with frozen semen.

Table 8. Rate of the use of frozen semen in 1971

Dairy cattle		Beef cattle		Total	
No. of A. I. cows with frozen semen	Rate of extension (%)	No. of A. I. cows with frozen semen	Rate of extension (%)	No. of A. I. cows with frozen semen	Rate of extension (%)
1, 136, 000	89. 2	247, 000	45. 4	1, 383, 000	76. 0

Vinyl straw has been used as the semen vial either for liquid semen or frozen semen. The pellet method for preparation of frozen semen was devised by Dr. Nagase of Japan and many workers were much interested in the method throughout the world. However, straw method has been exclusively used in Japan, owing to the advantage of this method in the practical use. Both forceps method and recto-vaginal method have been adopted for semen injection.

Import of frozen semen from foreign countries is legally prohibited with some exceptional cases for experimental use.

(4) Problems in A.I. administration

There are following problems in the administration of A.I. of farm animals in Japan.

a) Training of A.I. technician

Training of A.I. technician is performed on the basis of the above mentioned law which was enacted in 1950, however, 20 years have already elapsed since establishment of the law. Accordingly some modification of the law for the license of A.I. technician has become necessary to meet the newly developed A.I. techniques and discussions on an improved training course are now in progress.

b) Establishment of an effective system for administration of A.I.

Following to the rapid extension of the use of frozen semen, a plan of consolidating the present A.I. centers to about 10 large scale centers has been actively progressed. Furthermore progeny testing of bulls for A.I. included in the plan has been also practiced. We are expecting the success of this enterprise.

*B. A.I. in Farm Animals Other than Cattle*

(1) Extension of A.I.

Extension of A.I. in cattle is followed by pig A.I. About 100 thousand pigs have been bred by A.I. every year during recent several years. The extension rate of A.I. in pigs is about 15%.

In the beginning of research works on A.I. of farm animals, studies were performed exclusively in horses and the first conception test by A.I. was conducted by Dr. Ishikawa et al. in 1913. Artificial insemination in horses was actively practiced throughout the country since 1937 and the highest extension rate of A.I. was above 15%, the number of A.I. mares was above 22,000 annually. However, recently the number of horses raised in Japan was much decreased and the annual number of A.I. mares is less than 1,000. Considerable number of goats were also inseminated artificially in the past, the largest annual number of A.I. goats was 35,000 in 1960. Recently, however, the annual number of A.I. goats was only about 5,000 with the decreased number of them raised in Japan. There has not been wide application of sheep A.I. in Japan and only several conception tests have been performed experimentally. The annual number of A.I. hens was about 600 thousand in the past, but it also rather decreased recently.

(2) Techniques of A.I. and problem to be solved

Techniques of A.I. in each species, pigs, horses and goats could be seen in the booklet "Sixty Years of A.I. in Japan".

Establishment of a systematic organization of A.I. administration should be necessary for the future extension of the use of A.I. in pigs. There are several technical problems to be solved for the fulfilment of this problem; one subject is the development of a practical technique of freezing boar semen which could be safely applicable to A.I. Another subject is the development of a technique which makes it possible for sows to be conceived with insemination of less number of spermatozoa than that inseminated in the past.

Future problems in horse A.I. are as follows; effective use of the decreased number of stallions should be necessary because farmers tend to give up keeping own stallions, consequently the development of a technique of deep freezing of horse semen is urgently expected. Fortunately a successful technique of freezing horse semen was developed from research works performed for several years. Further experiments have been continued for the wide application of frozen horse semen.

It may be well recognized that A.I. in fowls is much effective for obtaining breeding eggs in either cases of buttry or cage feeding. However, there are also some problems to be solved for further development of fowl A.I.; it is generally said that fertility and hatchability trend to decrease when A.I. is practiced continually for long periods, and the development of a technique free from the defects mentioned above is in urgent need.

*C. Exchange of A.I. Technique among Countries*

Long-term training courses of A.I. under the leadership of Japanese workers had

been held in the past in Taiwan, Burma and so on.

Workers of several South East Asian countries have visited Japanese institutions for the purpose of training and learning of A.I. technique. Training courses, "Group Training Course in A.I. for Cattle", for workers of South East Asian countries have been held at Fukushima National Animal Breeding Station every year since 1970 under the auspices of Overseas Technical Cooperation Agency. Further systematic exchange of A.I. technique among countries would become necessary as the practical application of A.I. is extended in South East Asian countries.

## 2. Studies on Transplantation of Fertilized Ova in Cattle

One of the important objects of studies on transplantation of fertilized ova, artificial pregnancy, is to develop a technique by which makes it possible to produce a large number of fertilized ova carrying genetically superior characteristics at one time from donor animals, and transfer them into uterus of many other recipient animals and effectively many excellent offsprings of the donor. Pioneer works of this series of experiments in Japan were performed in the goats for several years from 1955 by Dr. Nishikawa et al. (reprints of paper of the research works are distributed here). Afterwards active studies on artificial pregnancy have been accumulated in the goats and cattle by Dr. Sugie et al. up to date. Many valuable achievements on the subject in laboratory animals such as rabbits and rats were also obtained in the past. Recently successful results were obtained in the experiments of transfer of fertilized ova in horses and pigs.

I intend to review here a series of noteworthy research works by Dr. Sugie et al. on the transfer of fertilized ova in cattle. Especially their techniques of collection and transfer of fertilized ova by non-surgical method should be highly estimated. Their excellent works on artificial pregnancy provided a possible application of the technique to the practical cattle breeding. Two publications by Dr. Sugie et al. "Studies on the ovum transfer in cattle. Bull. Nat. Inst. Anim. Indust. No. 25" in your hand would be referable to see the details of the technique. Outline of their technique of artificial pregnancy in cattle will be reviewed by movie later. Each technique of the process of artificial pregnancy developed up to date and future problems to be solved before its practical application will be discussed here.

### A. *Technique of Artificial Pregnancy*

#### (1) Induction of superovulation

For the induction of superovulation 3,000 to 4,000 IU of PMS is injected subcutaneously once on 16th day of estrous cycle and 100 to 150 thousand IU of natural follicular hormone is injected intramuscularly twice on three to four days after the injection of PMS. Cows are inseminated artificially on the day of the occurrence of estrus and simultaneously 2,000 MU of HCG is injected intravenously. The average number of fertilized ova collected from a donor cow was about 15 from the experimental results obtained in the past. A certain period of days should be elapsed for the hormonal treatment to induce superovulation repeatedly in the same cow; the second treatment for the induction of superovulation should be made 40 to 60 days after the previous treatment and the the third treatment is allowed 100 days after the previous treatment to expect a satisfactory superovulation.

#### (2) Collection of fertilized ova

Good recovery rates of fertilized ova are obtained non-surgically by the use of a specially devised instruments. The collector is inserted into uterus through cervix and and the ova are collected by flushing uteri. Composition of the flushing medium is as follows; 30 v/v% of cow serum is included in physiological saline and 500 U/ml of penicillin is added to the solution. Collection of ova is performed five to six days after



occurrence of first ovulation. The experimental results show that the recovery rate of ova is usually 40 to 50%.

(3) Handling of collected ova

The collected ova is kept in the medium until transfer. Culture medium is composed of equal volume of cow serum and Ringer's solution including 800 to 1,000 U/ml of penicillin. Sudden change in the temperature should be carefully avoided throughout the handling of ova. Fertilized ova is able to withstand in vitro culture for 24 to 48 hours in vitro.

(4) Transfer of fertilized ova

The most noteworthy characteristics of the technique of egg transfer in cattle in Japan is to transfer the fertilized ova into uterus non-surgically by the use of specially devised transplanter of eggs. Injection needle equipped at the top of the transplanter is inserted into abdominal cavity through vaginal wall, then eggs are transferred by introducing needle into uterine cavity which is kept by hand through rectum. Estrus of both recipient and donor animals must be synchronized at the time when eggs are transferred by introducing needle into uterine cavity which is kept by hand through rectum. Estrus of both recipient and donor animals must be synchronized at the time when eggs are transferred. Transplantation of eggs could not be successful when estrus is differed more than two days between recipient and donor animals.

(5) Successful cases of transplantation of ova in cattle

From the experiments by Dr. Sugie et al. at the National Institute of Animal Industry in Chiba, following results were obtained; 21 cases of 83 trials (25.3%) were pregnant, and 15 of 21 cases were terminated pregnancy (one case was twin pregnancy), one case is in pregnant and the other five cases were aborted. The rate of success was 18.3% (15/83) on the basis of successful parturition.

Three cases of 30 trials in total were pregnant and terminated pregnancy from the experiments performed at two National Animal Breeding Stations, and the rate of success was 10% (3/30).

The rate of successful artificial pregnancy is still fairly low. However, the significance of egg transfer in cattle by non-surgical method should be highly estimated.

*B. Future Problems in the Technique of Artificial Pregnancy*

Wide application of the technique of artificial pregnancy would greatly contribute to the cattle production and their genetical improvement. However, the technique for application has not been established yet, as compared with the level of A.I. technique which has been widely applied to the effective use of excellent bulls.

Device of the instruments for collection and transfer of fertilized ova by non-surgical method really provided an hopeful possibility of its practical application to cattle breeding. However, the following problems have remained unsolved.

(1) Levelling up of the recovery rate of fertilized ova

Efforts should be paid to collect as many eggs as possible which are superovulated and migrating in uteri for the effective use of excellent eggs. It is expected that the average recovery rate of 45-50%, generally obtained at present should be raised to 70-80% constantly.

(2) Increasing of the rate of successful artificial pregnancy

Egg transfer in the goats and rabbits is generally performed under laparotomy. The rate of success has been increased to 70-80% recently in both species. Such a high rate is required in cattle for the extensive application of this technique, and further experiments on the related subjects should be done.

(3) Establishment of a routine technique of estrus synchronization

One of the most important factor for the successful egg transfer is to synchronize estrus accurately between recipient and donor animals. In addition, studies on the method

of long-term conservation in vitro of fertilized ova should be also performed.

### **Development of Techniques in the Field of Animal Reproduction Expected in Future**

Development of several new techniques of animal reproduction is expected in future to obtain higher fertility and to find the effective conditions for the reproduction in large scale feeding and management of farm animals. Some of the important techniques which are expected to be solved in future in Japan are listed below. Studies on these subjects are going on.

*A. Practical Application of Artificial Pregnancy in Cattle (previously described)*

*B. Twin Pregnancy in Beef Cattle*

About 1.9 million of dairy cattle and 1.6 million of beef cattle are raised in Japan at present. Anyhow the number of cattle, especially of beef cattle is too small to supply the demand for meat. An artificial technique, twin pregnancy in beef cattle would be really effective for the rapid increase in the number of beef cattle.

*C. Prevention of Repeat Breeders and Reproductive Diseases in Cattle*

Comparatively large number of cows especially in dairy cattle have been suffered from non-contagious low fertility and reproductive disturbances in Japan due to the shortage in pasture land and to the unbalanced nutrition, excessive feeding of concentrates. Efforts should be paid to prevent these reproductive disturbances by the improvement in the conditions of feeding and management of farm animals under circumstances of a fairly large scale animal industry.

*D. Synchronization of Estrus in Farm Animals*

With a rapid increase in the number of farm animals raised in a farm, recently unit scale of animal industry has been coming larger. Accordingly, development of a system of management of farm animals which is reasonable and effective for the reproduction of a large number of animals is in urgent need. Estrus synchronization is estimated to be one of the effective tools to attain the object.

*E. Deep Freezing of Boar Semen*

Establishment of a practical technique of deep freezing of pig spermatozoa would contribute greatly to the systematic management of pig A.I., consequently to its extensive use.

The present status and future problems of research works on animal reproduction in Japan were outlined here. As referred in the beginning of the present lecture, both fundamental and applied studies on animal reproduction have been performed actively. However, considerable number of technical problems have remained unsolved yet. Great efforts should be paid to the solution of these problems.

Of course, international exchange of information in the field of research works on animal reproduction is in urgent need. Nowadays, we are given this opportunity through the meetings such as International Congress on Animal Reproduction and A.I., World Conference on Animal Production and so on. However, it is generally noticeable that only a small number of scientists have participated to the international meetings from Asian countries and scientific cooperation among Asian countries themselves are also inactive.

In my opinion, these scientific activities, particularly among Asian countries, should be promoted in future in every field of zootechnical science. I hope much progress will come out through the cooperative research works on common subjects among Asian countries.