CURRENT STATUS OF THE USE OF REPRODUCTIVE BIOTECHNOLOGIES IN LIVESTOCK PRODUCTION IN CAMBODIA

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ABSTRACT

Cambodia is an agricultural country in which agriculture contributes 28.7% of the national GDP in 2014. Sharing 3.3% of this, livestock production is a strategically developing subsector in poverty reduction for rural farmers. However, the number of livestock population has been decreasing significantly over the past years because most of the livestock production systems are yet in the form of subsistent and backyard farming which provides low yields, low reproductive performance, and self-consumption. Meanwhile, dairy farming is also still in small scale where a few farmers keep only a few local breeds and milk production is insignificant. Although the use of reproductive technologies such as artificial insemination in cattle production has long been introduced into the country, both beef and dairy cattle productions are usually traditional with no involvements of advanced technologies. In fact, their practical application has not much progressed due to the limitation of human resources, inadequate research and development, farmers’ unawareness of them, and lacking of livestock policies and strategies. In addition, genetic improvements of livestock through other technologies such as embryo transfer and cloning have never existed in this country. Thus, the improvement and promotion of superior breeds by effective application of the available reproductive biotechnologies are very important to increase the productivities and population of livestock.

Keywords: Artificial Insemination, Embryo Transfer, Cloning, Estrus Synchronization

INTRODUCTION

Cambodia is located between latitude No. 10 and 15 and between longitude No. 102 and 108 which shares the border with Vietnam 1,158 km, Laos 555 km and Thailand 817 km of land boundary, and 443 km of sea boundary. The country has an area of 181,035 Km² divided into 25 provinces and 1 capital city, Phnom Penh. The terrain of the country is mostly low, flat plains, and mountains in southwest and north, where are attractive for agriculture.

Cambodia is a country with hot and humidity because of Monsoon winds. The maximum temperature is 34.8-40 °C in April and the minimum temperature is 10.5-13.3 °C. The rain is determined by the Monsoon winds resulting in two seasons: dry season starting from November to April, and the rainy season begins from May to October. There are not many severe natural hazards in the country except for occasional flooding and droughts. However, this country is now facing a lot of environmental issues such as deforestation, electric hydro dam constructions, soil erosion and degradation, sand dredging, and strip mining for gems, etc.

According to Cambodia Inter-censal Population Survey 2013 (CIPS 2013), the total population of Cambodia as of March 2013 was 14.68 million and the census count was 13.40 million in 2008. In absolute terms, Cambodia’s population has increased by 1.28 million during the half-decade 2008-2013. The population growth rate of 1.63% was estimated in 2014 (CIA - World Fact Book).
THE STATE OF LIVESTOCK PRODUCTION IN CAMBODIA

Cambodia is dependent upon agriculture production to supply the local needs such as food, family income and national economy. The main purpose of cattle and buffalo raising is to use these animals for draft power (plowing and harrowing), agricultural activities and mean of transport. These animals are sold for slaughter for human consumption only when they are old or when they could not work. Other animal species such as pig, poultry, goat etc. are raised for self-consumption, saving income or exploitation according to purpose as well as types of production system.

a) Livestock Statistics 2013-2014

Table 1 Livestock Statistics Comparison 2013-2014

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>3,430,895</td>
<td>3,059,927</td>
<td>-10.81</td>
</tr>
<tr>
<td>Buffalo</td>
<td>619,114</td>
<td>541,859</td>
<td>-12.48</td>
</tr>
<tr>
<td>Pig</td>
<td>2,436,699</td>
<td>2,735,177</td>
<td>12.27</td>
</tr>
<tr>
<td>Poultry</td>
<td>27,473,443</td>
<td>31,583,657</td>
<td>14.96</td>
</tr>
<tr>
<td>Horse</td>
<td>10,897</td>
<td>9,161</td>
<td>-15.93</td>
</tr>
<tr>
<td>Sheep</td>
<td>150</td>
<td>238</td>
<td>138.00</td>
</tr>
<tr>
<td>Goat</td>
<td>15,831</td>
<td>18,256</td>
<td>15.32</td>
</tr>
</tbody>
</table>

Table 1 shows Livestock statistics comparison in 2013-2014. According to the DAHP report 2014, beef cattle production is sufficient for local consumptions while roughly around 12,000 heads of the surplus cattle and buffalos were exported to Vietnam last year. However, Cambodia imported a lot of live pigs and poultry approximately 450,000 heads and 3,000,000 chicken (including day-old-chicks), respectively, from Thailand and Vietnam.

b) Animal Production System in Cambodia

There are two types of animal production in Cambodia that are subsistent production system and commercial production system. The first type, cattle and buffalo of subsistent production system, represents almost 100 percent of the total cattle and buffaloes population in the country. The research found that animal raising has not made much progress both in quantity and productivity as animal production technology. Cattle and buffalo in year 2014 reached 3,601,786 heads almost belonged to the people in rural areas who do paddy cultivation. The main purpose of cattle and buffalo raising is to use these animals as draft animals for plowing and harrowing, pulling carts, transportation as well as to provide fertilizers to paddy fields and crops. However, this production type has been decreasing in number significantly over the years due to the replacement of machineries, lacking of grazing areas, labor forces, market instabilities, and so on.

Based on a research done by one local non-government organization (CelAgrid, 2013) the number of small holders who have raised the livestock and the average number of livestock in family farms are as follows;

- 89.9% keep in range of 5-23 chickens
- 66.9% keep in range of 1-5 cattle
- 46.1% keep in range of 1-5 pigs,
- 23.5% keep 1-40 in range of ducks, and
- 15% keep 1-3 in range of buffaloes
- Cattle is the second most important animals in small holder farms

In the other type of commercial production system, there are few small private cattle farms raising less than 100 heads of cattle in each farm in the country. There have not been any big investments made for cattle raising either beef or dairy farming by the year 2014. And there are only 40 farms raising 6,478 heads of cattle reported in the annual report 2014 of DAHP. There is no large scale buffalo production in Cambodia up to this date. According to
its production, size is classified into small holder, small scale-commercial, medium scale commercial and large scale-commercial production systems.

- Small holder keeps less than 50 pigs and 500 chickens
- Small scale commercial keeps in range of 50-100 pigs and 500-1,000 chickens
- Medium scale-commercial keeps in range of 100-500 pigs and 1,000-5,000 chickens
- Large scale farm keeps over 500 pigs and 5,000 chickens.

c) Livestock Markets in Cambodia

Generally, meat price has been going up every year when the population grows and the protein consuming demands also increase. In the same way, the value of live cattle has been increasing to no less than 4,000,000 Riel (USD 1,000) per 1-1.5 year old cattle per head. Table 2 shows market price of livestock animals and their products in Cambodia.

Table 2 Livestock and Meat Price Comparison 2013-2014

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2014</th>
<th>Incr. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live Cattle</td>
<td>17,600</td>
<td>23,050</td>
<td>30.97</td>
</tr>
<tr>
<td>Buffalo</td>
<td>29,800</td>
<td>35,150</td>
<td>17.95</td>
</tr>
<tr>
<td>Meat</td>
<td>7,950</td>
<td>9,260</td>
<td>16.48</td>
</tr>
<tr>
<td>Live Pig</td>
<td>14,500</td>
<td>16,900</td>
<td>16.55</td>
</tr>
<tr>
<td>Pork</td>
<td>12,100</td>
<td>14,000</td>
<td>15.70</td>
</tr>
<tr>
<td>Poultry</td>
<td>16,000</td>
<td>17,900</td>
<td>11.88</td>
</tr>
<tr>
<td>Poultry Meat</td>
<td>480</td>
<td>530</td>
<td>10.42</td>
</tr>
<tr>
<td>Chicken</td>
<td>520</td>
<td>540</td>
<td>3.85</td>
</tr>
<tr>
<td>Egg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duck Egg</td>
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</tbody>
</table>

*Unit price: Riel/Kg; Riel/egg for chicken and duck egg

**Currency: USD 1 = Riel 4,000

A recent study on meat consumption per capita by Cambodian people has not been conducted; however, it is concluded that the amount of meat consumed has been increasing rapidly until nowadays. According to MAFF report, the total meat consumption per capita in 2008 was 32.85 kg/capita/year; 10.95 kg beef meat, 14.60 kg pork, and 7.30 kg poultry meat (data of milk and egg consumption are not available in 2008). Figure 1 was extracted from Food and Agriculture Organization (FAO) livestock information 2005 showing the increase of annual consumption of livestock products per capita from 1980 to 2008.

Figure 1 Trend of Annual Per Capita Consumption 1980-2008 of meat, milk, and egg
BEF CATTLE BREEDS PRODUCTION

In Cambodia, there are three well known breeds of beef cattle: Khmer cattle (Kor Khmer), Haryana and Brahman. The breeds of Haryana and Brahman are actually imported from overseas and crossbred with Cambodian cattle to ensure that their progeny can be adapted to the local conditions and demands. The average body weight of these breeds is around 300-350 kg. In addition, Kampaing Saen breed imported from Thailand many years ago is also available at Phnom Tamao cattle experiment station of the Department of Animal Health and Production; however, this breed is not yet accepted by most farmers due to its appearances.

In fact, the beef production is mostly in the form of small holders in which farmers keep their livestock backyards; however, there are increasing number of commercial farms and more interests of investments. Just over a few years, crossbred artificial insemination (AI) of Santa and Simbra (Bos Taurus) has been introduced in some target areas in Takeo, Kampong Speu and Pursat province funded by European Union (EU). Nowadays, more and more farmers begin to realize and like the technologies of the crossbred AI when they start to see better performance of the offspring in term of meat production and market demands.

DAIRY CATTLE BREEDS PRODUCTION

Cambodia is a hot and humid country, and the dried season is slightly longer than that of rainy season. Normally, dried season is from November to April and its temperature is 32-37°C. That higher temperature is not favor of dairy production as it needs to be invested in large-scale enterprise. There is only one association of Dairy Breeds in the country. First, it was funded and supported by European aids, and now it becomes an association governed by the farmer or farmer association, in Koh Krabei nearby Phnom Penh city. The breed is a combination of imported bull semen of Jersey, Haryana and Brahman with local cows. Totally both local and hybrid dairy cows are around 60 heads, and milk yield is in range from 6-8 liters per cow/day. This means that almost 100% of local milk consumptions are imported from neighboring countries arising a very good potentials and opportunities in this industry.

At the moment, Royal University of Agriculture is now conducting a research on dairy production in cooperation with Nagoya University, Japan. At the first step, local breeds have been used for a couple of heads, and milking system has been already installed. New exotic dairy breed like Holstein will be probably imported from Thailand in near future for this research. In addition, the dairy production is also in the agenda of DAHP, and research on it will be conducted at Phnom Tamao cattle experiment station in the next coming year.

SEmen PRODUCTION AND AI

Previously, Haryana and Brahman have been imported to Cambodia since 1950 (Maclean, 1998), and widely spreaded in 1980 through the AI technique (Maclean, 1998; Soun, 2003). Nowadays, however, semen production and AI are rarely to be applied in ruminant, and they become a preferable practice in commercial pig farms. The animal breeds are improved according to the national policy and strategy of animal health and production, and they are promoted by import of genetic materials, selections of local breeds with high productivity in order to extend animal breeds to farmers and private farmers within countryside as well. According to MAFF (2013), main animal breeds in Cambodia are as follows;

- Kampaing Saen and Brahman in Phnom Tamao cattle experiment station.
- Imported cattle semen of Simbra and Santa for AI in some provinces that bred 556 heads of local cows and produced 425 calves.
- Other private sectors have enhanced these activities as well.
In 2013, 1,000 frozen semen straws were donated by the government of Republic of Indonesia. The imported breeds from Singosari National Artificial Insemination Centre are Brahman, Ongole, Limousin, Simental, and Friesian Holstein. So far, around 100 straws of Brahman, the most preferred breed, have been already distributed to AI unit located at the Office of Animal Health and Production (OAHP) in Takeo province. The remaining are stored and kept at Animal Production Research Institute (APRI), Department of Animal Health and Production for further promotions of AI in targets provinces.

Concerning to the use of AI technologies, there are no formal reports on the number of cow inseminated by official technicians. However, it is assumed that only very small numbers of cows were accepted the AI technologies according to the number of imported frozen semen straws used and the available straws comparing with the number of cattle population. Most of cattle breeding is done by natural mating only which is generally expensive and time consuming (varies from 100,000 -150,000 Riels per conception, and the farmers have to bring their heated cows to the house of bull’s owners). On the other hand, AI services are usually unavailable and not cheap because of limited frozen semen straws, inseminators, high cost of liquid nitrogen (20,000 Riels per litre), etc. Consequently, farmers have to pay similar price or more per service compared to natural mating.

In addition, under the supports from the on-going EU program, more 2,000 semen straws are expected to be purchased from outside of Cambodia in late 2015. The program is also funding the laboratory of cattle frozen semen processing at APRI and other AI activities at the 4 existing AI units. Until recently, there are almost complete laboratory equipments supported by International Atomic Energy Agency (IAEA) for the production of frozen semen although some of them are manual and semi-automatic machines, and some other consumable such as hormone for estrus synchronization has also been received. The APRI, by all means of supports from the department and development partners, will produce and distribute unsexed frozen semen with good quality by the end of year 2015.

**EMBRYO TRANSFER AND OTHER REPRODUCTIVE BIOTECHNOLOGY**

Cambodia is developing country and the reproductive biotechnologies such as embryo transfer and cloning have never existed. We don’t have national policy, human resources and proper equipment and environment needed for us to be able to use them to improve productivity of livestock.

Regarding to ET techniques, there were a few officers from DAHP participated in training in Japan many years ago. But because of lacking in laboratory equipment and not having sufficient budgets, it has never been practical in this country. Hopefully, this second generation of reproductive biotechnologies will be put into a plan and applied in the near future when dairy production will be promoted. Table 3 shows livestock raising constraints and governmental actions to solve them.

<table>
<thead>
<tr>
<th>Livestock raising constraint</th>
<th>Government action to be taken</th>
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<tbody>
<tr>
<td>Limited techniques of livestock raising, and the decreasing number of livestock population</td>
<td>Urgent change from subsistent livestock raising to one with appropriate technique through good animal husbandry practices (GAHP), and encourage commercial farming.</td>
</tr>
<tr>
<td>Poor quality and quantity of livestock feed</td>
<td>Promote the forage plantation, feed processing based on local resources (agricultural product residues), and improve feeding management.</td>
</tr>
<tr>
<td>Livestock breed: low yield</td>
<td>Selection of breed which meets market demand (high productivity and resistance to environment and diseases), promotion of AI</td>
</tr>
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**CONSTRAINTS IN LIVESTOCK PRODUCTION IN CAMBODIA**

Table 3 Livestock Constraints and Actions
Limited research capacity for livestock genetic performance to improve production and health

Enhance research capacities on improving livestock genetics, breeds, reproduction, and feed analysis through capacity building. Establish laboratory for producing frozen semen and embryos and vaccine. Establishment of National AI Centre.

Instability of livestock market

Subsidizes from government, law enforcement, etc.

No policy/strategies for developing industry in place, especially, cattle

Develop policy/strategies/roadmap for improvement of livestock industry.

**CONCLUSION**

The use of reproductive biotechnologies such as AI and embryo transfer will be a key factor and intended efforts for herd improvements in livestock genetic quality and productivities in any types of livestock production systems in Cambodia. The decreasing number of cattle is one indicator affected by the absence of involvements of advanced technologies in livestock raising. Not only beef but also dairy production have to use AI and embryo transfer techniques to improve their cattle performances. Although AI technologies have already applied in some areas, more promotion and extension campaigns need to be done effectively throughout the country while beef and milk demands are increasing. Additionally, clear livestock policies and strategies must be in place while research and development and technicians’ capacity in this field of reproduction have to be fostered and built in order to maintain livestock production sustainability.

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