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# THE DEVELOPMENT AND EVALUATION OF A MODEL FOR ARTIFICIAL INSEMINATION BY BACKYARD PIG FARMERS

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A Thesis Submitted in Partial Fulfillment of the Requirements

for the Degree of Master of Science Program in Theriogenology

Department of Obstetrics Gynaecology and Reproduction

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วีร์ธิมา วิศาลเวทย์ : การพัฒนาและประเมินรูปแบบของการผสมเทียมโดยเกษตรกรที่เลี้ยงสุกรแบบหลังบ้าน (THE DEVELOPMENT AND EVALUATION OF A MODEL FOR ARTIFICIAL INSEMINATION BY BACKYARD PIG FARMERS) อ.ที่ปรึกษาวิทยานิพนธ์หลัก : ศ.น.สพ.ดร.มงคล เตชะกำพุ, อ.ที่ปรึกษาวิทยานิพนธ์ร่วม: รศ.น.สพ.ดร.วิชัย ทันตะศุภรักษ์ 81 หน้า

การศึกษานี้มีวัตถุประสงค์เพื่อพัฒนาและประเมินต้นแบบการถ่ายทอดเทคโนโลยีการผสมเทียมสุกรสู่เกษตรกรที่เลี้ยงสุกรแบบหลังบ้าน ซึ่งประกอบด้วยศูนย์ผลิตน้ำเชื้อสุกร การรีดน้ำเชื้อพ่อสุกร เจ้าหน้าที่ผสมเทียมและรีดน้ำเชื้อ ระบบการกระจายน้ำเชื้อ การอบรมเกษตรกรเกี่ยวกับการผสมเทียมสุกร การติดตามผลการผสมเทียม และการสร้างเครือข่ายเกษตรกร โดยวิเคราะห์อัตราเข้าคลอด จำนวนลูกแรกคลอดทั้งหมดและจำนวนลูกแรกเกิดมีชีวิต จากบันทึกการคลอดของสุกรจำนวน 531 บันทึกจาก 307 แม่สุกร ที่มีลำดับครอกระหว่าง 1 ถึง 8 ที่เลี้ยงในระบบฟาร์มหลังบ้านในจังหวัดน่าน พบว่าการผสมเทียมมีอัตราเข้าคลอดที่ดีกว่าการผสมพันธุ์ธรรมชาติอย่างมีนัยสำคัญ ($P<0.05$) เกษตรกรเพศชายและเกษตรกรอายุมากกว่า 60 ปี ผสมเทียมสุกรให้มีอัตราเข้าคลอดที่ดีกว่าเกษตรกรกลุ่มอื่นอย่างมีนัยสำคัญ ($P<0.05$) เกษตรกรที่มีระดับการศึกษาสูงและมีประสบการณ์ผสมเทียมสุกรเพิ่มขึ้นผสมเทียมสุกรให้มีจำนวนลูกแรกคลอดทั้งหมดดีกว่าเกษตรกรกลุ่มอื่นอย่างมีนัยสำคัญ($P<0.05$) ส่วนลักษณะการอบรม การขนส่งน้ำเชื้อ และอายุการเก็บรักษาน้ำเชื้อ ไม่มีผลต่ออัตราเข้าคลอด จำนวนลูกแรกคลอดทั้งหมดและจำนวนลูกแรกคลอดมีชีวิต($P>0.05$) จากความสำเร็จที่เกษตรกรสามารถทำการผสมเทียมได้ด้วยตนเองและให้ผลที่ดีเทียบเท่าการผสมเทียมจากเจ้าหน้าที่และดีกว่าการผสมจริงจากพ่อสุกรนั้นต้องอาศัยความเข้าใจและความร่วมมือกันระหว่างหน่วยงานความรับผิดชอบในตัวต้นแบบ โดยเกษตรกรที่ควรเป็นกลุ่มเป้าหมายของต้นแบบคือเกษตรกรเพศชาย เกษตรอายุมากกว่า 60 ปี และเกษตรกรที่มีระดับการศึกษาสูง กล่าวโดยสรุปคือ การถ่ายทอดเทคโนโลยีการผสมเทียมสุกรแก่เกษตรกรรายย่อยที่เลี้ยงสุกรแบบหลังบ้านประสบความสำเร็จ ซึ่งเป็นการนำเอาการผสมเทียมไปใช้อย่างยั่งยืนเพื่อให้เกษตรกรสามารถพึ่งพาตนเองในด้านการผสมพันธุ์สุกรในการประกอบอาชีพได้

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| ภาควิชาสูติศาสตร์ เธนุเวชวิทยา และวิทยาการสืบพันธุ์ | ลายมือชื่อนิสิต.......วีร์ธิมา วิศาลเวทย์....... |
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KEYWORDS : MODEL / AI / BACKYARD FARM / PIG


WEETHIMA VISALVETHAYA : THE DEVELOPMENT AND EVALUATION OF A MODEL FOR ARTIFICIAL INSEMINATION BY BACKYARD PIG FARMERS THESIS ADVISOR : PROF. MONGKOL TECHAKUMPHU, THESIS CO-ADVISOR ASSOC. PROF. WICHAI TANTASUPARUK, 81 pp.


The aim of this study was to develop and evaluate the model of artificial insemination (AI) technology transfer to backyard pig farmers in rural area. AI center, criteria and process for farmer selection, AI training program, AI practice in pigs and backyard farmer network were created as a model. Five hundred and thirty-one farrowing records from 307 sows at parity $1^{st}$ – $8^{th}$ from 231 backyard pig farms were studied. Farrowing rate (FR), number of total piglets born (TB) and number of piglets born alive (BA) were analyzed. Using this model, we found that AI had led to better results in FR, TB and BA than natural mating ($P<0.05$). Personal factors such as sex and age of farmers only had significant effects on FR ($P<0.05$), while educational level and farmers' AI experience had significant effects on TB and BA ($P<0.05$). Model factors such as type of training, semen delivery system and semen storage time did not have significant effects on FR, TB and BA. But joining training program more than 2 time affect on FR ($P<0.05$). The backyard farmers could be trained in AI technique in order to achieve equally good results as experienced technicians. Male farmer within working age group or older, with high school education or higher could be the recommended target group for implementing this model. A strong cooperation with clear responsibilities of all stakeholders could create a good network of backyard pig farmers. In conclusion, the implementation of AI technique in pig can be applied with an aim towards a sustainable, self-sufficiency community.


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# ABBREVIATIONS

| | |
|---|---|
| AI | Artificial Insemination |
| BTS | Beltsville Thawing Solution |
| TB | Number of total piglets born per litter |
| BA | Number of piglets born alive per litter |
| FR | Farrowing rate |
| TAO | Tambon Administrative Organization |
| P value | Probability value |

# CHAPTER I
# INTRODUCTION

## Important and Rationale

In present, the world population has dramatically increased. As of the second half of year 2009, the Earth's population is estimated by the United States Census Bureau to be 6.779 billion (Wikipedia, 2009). The world human population increased by 203,800 every day, then it is expected that the world's population is expected to reach about 9 billion by the year 2040. This increasing will mismatch with the meat production, the food shortage will be a hot issue of debating in the near future especially in underdeveloped countries or in rural areas. Thailand is known to be one of the leading countries of pig production in Southeast Asia. Thailand is one of an important pork production country in Southeast Asia by divided into two types of production which are the intensive farming systems and the small production systems or the backyard farms. Around 80% of pigs produced are from intensive farming systems and 56% of these are from farms with over 1000 pigs. The remainder are from small (50 – 200 pigs), to medium (201 – 1000 pigs) farms. Large intensive farms are either integrated company owned (8.5%) or private independent (47.5%) farms (Cameron, 2000). The backyard farm is the pigs rising with propose to be the supporting income of the family and to depend on themselves according to the sustainable economic philosophy. By the pigs will be raised for the family consumption or for the local along with other agricultural products. Other material left unused from other agricultural activities will bring to build the household or being the food materials for the animal. It was accepted that this kind of production lacked of proper breed, management, nutrition and housing including a proper reproductive performance. This form of pasturage can be found in the countryside provinces of the country especially, the provinces located far from the capital such as Nan. It was found out that most of the farmers conduct hog husbandry as a backyard farm by having not more than two sows in the farm, though, the need for consumption of the province population has double increased in 2007-2008 (Intrakumhang et al., 2007). Therefore, to bring the breeding technology to help enhance the production of pork in Nan province to apply with the backyard farmers shall be benefit to increase their incomes. To get a good reproductive performance, we need the good systems of heat detection, proper insemination and good care during pregnancy. It was found that natural mating is usually used while artificial insemination (AI) is not introduced properly. AI is the breeding technology that help increased the livestock production. This technique can be used to solve the problem in case of a failure of boar's insemination and its advantage of a greater genetic distribution and the venereal disease transmission control, AI-service was introduced to small scale pig farms in rural areas of Nan provinces since 2005 (Techakumphu et al., 2005). They reported that AI-service could be successfully implemented in backyard pig farms. About 700 piglets were born by AI in 2005 and increased to be more than 5,000 piglets in 2006- 2007. The numbers of sows with those artificially inseminated increased from 473 to 731 heads. It was found that AI achieved in higher reproductive performance in terms of farrowing rate (FR) and number of total piglets born (TB) compared to natural mating (Am-in, 2005). This showed a successful outcome of AI in pig in backyard farms. However, there were two major problems of poor farmer's heat detection and inadequate AI-services especially when the project finished while the insemination still be needed by the local farmers. So this made the model for backyard farmers to do AI by themselves is necessary in order to use it as a sustainable implementation. In the present, there is no model for the contribution of the AI knowledge for the backyard pig farmers to strengthen pig production in Thailand. Therefore, the objective of this research is to develop the model of AI by the backyard farmers in local that never been done it by themselves to be able to inseminate the pig for better productions and increase the incomes as well as being sustainable self sufficiency.

## Hypothesis

The trained farmers can successfully perform artificial insemination for their own pigs by themselves with a good farrowing performance and get the similar result as well trained staffs.

## Objectives

1. To develop a model for artificial insemination by well-trained farmers in rural areas.
2. To evaluate the success of the method of training the backyard farmers to perform AI by themselves.
3. To study the outcomes and problems of backyard farmers using AI technique.

## Definition of words

**Artificial Insemination (AI)**: a process which sperm is placed into the reproductive tract of a female for the purpose of impregnating in the female as a mean other than sexual intercourse. The fresh ejaculated sperm is placed in the cervix (intracervical insemination) (ICI)) or in the female's uterus (intrauterine insemination) (IUI) by artificial means.

**Backyard pig farm**: an outdoor small-scale system of pig farming which has few pigs provided year-round meat for the table. The pig pen was built by wood or metal (figure1). The farmer fed hogs by grains, fruit and vegetables that are inadequate for sale or family use.

**TAO**: a local administrative authority of Thailand, in accordance to the Tambon Council and Tambon Administration Authority Act 1994 and the Thai Constitution of 1997.

Figure1. Local small scale pig production in Nan province

a: Pig housing was made by wood or metal b: Pig pen was made by wood

Expected output

1. The model for AI in backyard pig farm by farmers is developed for the first time in Thailand.
2. The related organizations can used this AI- model as a standard model to improve pig reproductive performance and pig production in any small-scale farms in Thailand.
3. The educated farmers can perform artificial insemination in pig with good farrowing performance.
4. The reproductive technology like AI was transferred to rural areas in Thailand.

# CHAPTER II
# LITERATURE REVIEW

## Pig production in Thailand

Livestock production is growing faster than any other agricultural sectors, and it is predicted that by 2020, livestock will produce more than one- half of the total global agricultural output in value terms. There are approximately 7 million pigs on Thais' farms and exporting pigs are raised mostly in the central part of the country (Padungtod et al., 2008). The increasing of human population growth and increasing urbanization will significantly drive the demands for animal foods (Devendra, 2007).

There are 2 systems of pig production in Thailand. The majority are raised on industrialized farms with either in the open or closed housing system. The others are the small scale systems as backyard farm which cover 20% of the whole production while their goal is to increase the family incomes (Cameron, 2000; Paruksa, et al., 2008; Padungtod et al., 2008). Commercial farm refers to a group of farmers in the hogs raising business which had more than 50 pigs. Most farm owners had experienced with academic knowledge. The largest parcel was to control the production directly. This type of farming was 80% of all hog production (Paruksa, et al., 2008). Commercial farms with both open or closed housing system was found around the country. The closed houses were literally wrapped with plastic sheets with an evaporative cooling system to control temperature and humidity. Generally, breeder farms, which produce only piglets, supply weaned pigs to fattening farms that produced pigs destined for slaughterhouse. Piglets were weaned at 18–21 days of age, and the sows were moved to the mating unit on the same day. All-in-all-out system, in which all pigs entered and left from the facility together at the same time, was applied in mating, furrowing, and nursery units (Padungtod et al., 2008).

In rural areas, small scale pig production has remained as the main source of meat supply for local consumption. The major income sources come from agricultural crops, animal husbandry and off farm activities and the income from pig constitutes have high share of household incomes. Pigs, in small holder production system, contribute to the livelihood of the poor in many ways – incomes from products, insurance against drought, emergency cash requirements, household nutrition and manure for crops etc (Devendra, 2007; Kumaresan et al., 2008). The smallholders reared pig mainly on common property resources and free crop residues and used the available family labor for pig production activities. The smallholder resource driven pig production system is economically viable and sustainable at the household level as revealed by the input: output ratio. Majority of the farmers (60.9%) had their pigsties side by the house for to ease the management. It was observed that about 98 % of the pigsties were of the temporary type and made up of locally available materials (Kumaresan et al., 2008).

It has already been reported that smallholders typically owned one or two sows and less than 10 fatteners (Kumaresan et al., 2008). Generally, purchasing of pigs coincided with harvesting and marketing of crops. Pig feeding system is entirely different from the standard system. Some smallholders overcome the prohibitive costs of feeds by adding supplements to feed concentrates. Using cross exotic breeds and feeding the animals with a mixture of commercial feed and local cheap available by-products are also usual practices. Very few pigs were being fed with standard concentrate feed. Among the more common additives used are: cassava leaves (*Manihot esculenta*), sweet potatoes (*Ipomoea batatas*), water hyacinth (*Eichhornia crassipes*), water spinach (*Ipomoea reptans*), Kangkong (*water glorybind*), banana tree, soya bean, cotton seed, coconut oil, fish meal, rice meal, and sea shells (Kunavongkrit and Heard 2000; Vu et al., 2007). The average of crude protein content in the cooked pig- feed offered by the farmers was only 6.7±2.1%, which was less than the recommended level (12 – 18%) (Kumaresan et al., 2008). The management of smallholder systems and the resulted levels of production are often sub-optimal. Pig storing was not very attractive due to the high cost of feeding.

### Small scale farming

In Thailand, small scale farming was classified into 2 types (Paruksa, et al., 2008):

1. The folk-culture or backyard farming

This type of farming was not well-developed. Backyard farming refers to a group of pig farmers rearing careers outside the home accessories from the main occupation. Pig-pens were built from abundant agricultural materials. Husk, rice bran or banana stalk pith mixed with commercial pig feed were used as pig food. Pork was produced to enter the local market because of low quality. Moreover, most farmers are not well educated thus; they had less opportunity in gaining new technology in pig production to improve the quality of their products.

2. Cooperative system

This type was bred to improve effective trade. Housing was built by materials available locally. Majority reared to enter the market or sold to local cooperatives.

**Technology and knowledge transfer in rural areas**

Smallholder farmers are mainly located in rural areas. Because of their numbers and generally low standard of living, smallholders are importantly focused on poverty alleviation and development programs sponsored by Governments donor agencies (Jones, 2002). Production at the smallholder level is constrained by number of barriers, lack of competitiveness and risk factors such as financial and asset barriers, technical barriers, social and cultural barriers and production costs (Steinfeld, 2003; Devendra, 2007). Transformation of know-how from scientists to farmers shall be conducted at the grassroots level which the perceptions of the group of nucleus farmers should be elicited before such new applications are taught to the whole community. Finally, the system, once established, has to be monitored to maintain its sustainability. Undoubtedly, inappropriate technologies and the failure to deliver services to poor farmers have contributed greatly to the lack of success in many livestock development projects. However, even in cases where the technologies were appropriately targeted and the focus was distinctly pro-poor, technical projects in many cases have failed to deliver any significant sustainable improvements in the livelihoods of the poor (Steinfeld, 2003). But successful adoption of such pro-poor technologies will require partnership between the private sector, which the proven ability to bring technologies to farmers in the form of agricultural inputs, and the public sector, which has agricultural research capability and a firm to commit the smallholder farmers' needs. The continuum technology transfer from research to farmers' fields has many prerequisites that go beyond successful technology development. Serious attention shall be paid to the important requirements such as, intellectual property management, regulatory compliance and public awareness, which ultimately determine the success or failure of the efforts to commercialize the products of agricultural technology (Mignouna et al., 2008). Learning process of villagers was started from knowledge transferring to curious youth, learning through experiences, from the study team visit, opportunity to learn methods, learning process by combining the existing knowledge with the new one, learning with media culture, ceremonies, and motivating thoughts.

Knowledge management is a process associated with the pursuit of enhancing development and application of knowledge which started by the knowledge issues review, folk wisdom, managing of the adjustment to solve the problem, common activities, summary of obstacles and problems resolve (Techa-atik, 2006).

For rural development by knowledge transfer, the synopsis of policy recommendations was classified as;

1. The government should support budgets, structural, technique and technology to community organizations for lesson summarizing and increase the result of studies and self knowledge management.

2. Local government organizations, government, NGOs, technical institute should support and increase the result of studies and manage the knowledge on self Economics (Integrated Agriculture), small and micro community enterprise, foundation management for community welfare, poverty problem solving, youth problem protecting and solving.

One element in the learning process is learning through actual experiences in the midst of practice. Learning process could be operated by the combination of research and practice. The details are as follow: learning to practice, the pursuit of knowledge transfer, learn the best practice of the audit standard, using local research to provide information, using data and information resulting from changes in the media for learning, step-by-step training, using a learning-repeat, the exchange of results or products, monitoring, Implementing the research, recording and Learning from media.

## Artificial insemination

Artificial insemination (AI) is the conservative breeding technology which spermatozoa are injected into a female genital tract. AI remains as the most worldwide breeding technology applied under commercial condition in domestically farm species. The primary reason in introducing AI to the commercial industry is to speed up the rate of genetic improvement since the genetic potential of the best sires can be transferred to a large number of female.

AI in pigs has been used since the early 1930s but the wide commercial application in pig production did not take place until the 1980s. More than 80% of the female pigs are bred by AI in the Netherlands, Norway and Spain. But in North America (USA, Canada and Mexico) and Brazil the percentage was 75% in commercial farms. Over the last 25 years artificial insemination in pigs has developed enormously to increase animal production and improve genetic quality in herds (Weitze, 2000). The Asia-Pacific region maintains 44.1 million sows, only 28% are bred by AI (Knox, 2005).

The advantage of AI is that it can distribute the superior genetics ten times more than natural mating (Kunavongkrit, 2000), easily assess reproductive status of female within the breeding herd, breed in condition of size mismatch as older boars to very small young gilts or young boars to older sows (Kunavongkrit, 2002). Moreover, it can be the benefit for limiting disease transmission because of the routine monitoring of health status of boars The standardized insemination procedure is called intra-cervical insemination, 99% of these inseminations are made with semen extended in a liquid state and usually stored at 15–20$^{o}$C for up to 3 days (Paulenz et al., 2000). The current protocol involves the intra-cervical deposition of a large number of spermatozoa (generally more than 2,500 x10$^{6}$cells) in a dose of 80–100 ml, two to three times during the estrous period (Johnson et al. 2000). Over 85% of these artificial inseminations are performed on the day or the following day of sperm collection (Gadea, 2003). The fertility success is high with farrowing rates and litter sizes equivalent to or even better than those resulting from natural mating. Moreover, consistent fertility rates of 80–90% are common on many farms.

Factors affecting the success of artificial insemination

1. Semen

The fertility of stored boar semen depends mainly on initial semen quality, number of spermatozoa per insemination, semen storage temperature and semen storage time. Most of the AI was performed using two doses given 24 hrs. apart and containing 3 billion motile sperms in 80 ml. of a 3 to 5-day liquid extender (Alm et al., 2006) and stored at 15-18°C (Kunavongkrit, 2002). Some studies reported that number of total born decreased significantly with semen dose < $2.5 \times 10^9$ sperm but no effect to FR (Reick and Levis, 2008). In contrast, Alm et al. (2006) found non-return rate and litter size in primiparous sow and multiparous sow decreased with a dose of 2 billion spermatozoa compared with 3 billion spermatozoa.

The effect of storage time of boar semen in liquid state has been investigated in many studies. The aging of semen affected litter size before it affected FR (Hofmo, 1991) although higher FRs were reported if the semen was used within the first 2 days after collection, it has been reported to be as low as 50% with 5-days-old semen (Johnson et al., 2000). Alexopoulos et al. (1996) found that AI dose of $3 \times 10^9$ spermatozoa in BTS could be stored for 72 hrs. with no negative effect on fertility. Similar results were obtained by Hofmo (1991) who reported that the BTS gave rise to a significant reduction in fertility when, the diluents are stored for 48 hrs. While, the number of total born and number of piglets born alive are significantly decreased after 24 hrs. of storage. But it has no significant effect on FR and litter size that different from semen stored 4-5 days in X-cell™ (Haugan et al., 2007). Whereas using extension with BTS and increasing storage from 4-14 hrs. to an interval of 52-62 hrs. was associated with a 0.5 piglet reduction in litter size ($P<0.05$) for homospermic semen but, not for heterospermic semen (Haugan et al., 2005). Semen stored for 10 days has been reported to decrease fertility over than 6 days in sow but not in gilt in terms of total born per litter (Anil et al., 2004). The temperature also has a strong effect on sperm motility. For the fresh semen, the rate of motile spermatozoa was not lower than 70%. Zou and Yang (1999) studied on the effect of temperature on fresh sperm motility and found that boar spermatozoa were particularly susceptible to cold shock when cooled below 15°C. The 20°C and 15°C were better for maintaining sperm motility than 39°C and 4°C for 24 to 48 hrs. Althouse et al. (1998) studied on extended boar semen and found that a decrease in sperm motility occurred within the first 12 hrs. and sperm motility was below 70% within 12 hrs. in the 8°C and by 48 hrs. in the 10°C but >75% in the 12, 14 and 17°C and FR , total born and born alive were no difference between 60 hrs. 12°C and 60 hrs. 17°C. The temperature during transportation of semen for AI is at 15-22°C within 24 hrs. and it did not affect to semen quality for AI (Techakumphu et al., 2007).

2. Sows quality and sows management

Gilts attained puberty at about 6–7 months of age. Sows ought to return to estrus 4-7 days after weaning and have body condition score 3.0 (Kunavongkrit, 2002). The average litter size was smaller ($P<0.01$) for gilts than for sows (10.1±0.2 vs 11.4±0.1) (Steverink et al., 1999). The largest litters were from sows in parities 3$^{rd}$ through 10$^{th}$ (Dewey et al., 1995). Both gilts and sows should have no lame or any reproductive problems. Some studies reported that sows with cystic ovary would return to estrus after mating and had low FR but did not effect to litter size.

For general management, lower litter size and pregnancy rate in group housed compared to individually housed non-lactating sows has been observed in several on-farm studies. Considered whether stress and fear caused by social interactions are possible mediators of impaired reproduction in group of housed sows. Group-housing may lead to individual variation in feed intake, stress and fear, which may impair the reproduction performance. Sows group housed from weaning until two days after mating has significantly fewer total born piglets compared with sows individually housed in the same period (reviewed by Kongsted, 2004). While sows group housed from1-8 days after mating have significantly higher return to service rates compared with sows ungroup housed until 22-29 days after mating. Gestation housing system did not influence the number of piglets born alive or weaned. Gestating sows housed in groups had either similar or improved performance compared to sows gestated in stalls. Higher FR was reported in non-tethered individually housed sows (Bates et al., 2003). Moreover, sows should be moved from the service area to their gestation quarters either within the first 72 hrs. post-breeding or else at least 28 days after breeding. The stress of moving or mixing before implantation of the embryos has occurred, it can result in lower FR and lower litter size (Aherne, 2002). Moreover, Munsterhjelm et al. (2008) found that individual stalled sow showed behavioral sing of decrease welfare, but no corresponding reproductive effects. Sows with a lower daily bodyweight loss during first lactation had a larger second litter (Eissen et al., 2003). Thaker and Bilkei (2005) found that lactation weight loss of more than 10% had a negative (P<0.05) effect on subsequent farrowing rate to the first service. The difference was higher (P<0.01) in sows with lactation weight loss more than 20%. Lactation weight losses exerted a negative (P<0.001) effect on total-born litter sizes in parity $1^{st}$ versus parity $>5^{th}$ and parity $1^{st}$ versus parity $2^{nd}$–$5^{th}$ sows at lactation weight losses of more than 10%. The reduction of subsequent ovulation rate because of lactation weight loss was observed and the litter size may actually be reduced by feeding a very low energy level in the first four weeks of pregnancy (Kongsted, 2005). Minimizing weight loss during lactation is critical when, attempting to achieve a high litter size at the subsequent farrowing (Eissen et al., 2003; Thaker and Bilkei, 2005) but litter size was not affected by high fiber diet during gestation (Darroch et al., 2008). Subsequent litter size did not increase in $1^{st}$ and $2^{nd}$ parities as the lactation length increased but subsequent litter size in sows of parities $3^{rd}$-$6^{th}$ increased. In lactation-length groups 14-28 days, $1^{st}$ parity sows had lower subsequent litter sizes than parity $2^{nd}$ and 3-$6^{th}$ sows (P<0.022) (Koketsu and Dial, 1998). Lactation lengths of 27-32 days and 33-40 days resulted in progressively larger litter sizes in subsequent farrowings than shorter lactation lengths (Dewey et al., 1995).

Because the endometrial in the uterus is regenerated between14 and 21 days after farrowing, the involution, may not be complete in sows weaned at 21 days or less (especially with older sows). For this reason, sows weaned at 21 days or less are likely to have a reduction in litter size at the subsequent farrowing (Koketsu and Dial, 1998). The highest FR was found when sows were first inseminated at day 4 (88.3%) or 5 (87.5%) after weaning and decreased up to day 10. Thereafter, the litter size decreased ($P<0.05$) from 11.7 to 10.6 pigs when, WEI increased from day 4 to 7 (Steverink et al., 1999). Litter size was highest at weaning-to-conception intervals of up to 4 days, decreased daily from 5 to 7 days (Dewey et al., 1995).

3. Time of insemination

The interval between artificial insemination and ovulation influence the fertilization rate in pigs. During estrus, egg release occurs approximately 66-85% of standing estrus. After insemination, boar sperms can survive in the female reproductive tract about 24-36 hrs. However, eggs may be fertilized normally and develop into fetuses up to 8 hrs. after ovulation. Conception and litter size are mostly influenced by the time of insemination relative to ovulation. The optimal time to inseminate was from 24 to 0 hrs. before ovulation (Soede et al., 1995) or from 28 hrs. before to 4 hrs. after ovulation (Nissen et al., 1997). Insemination more than 4 hrs. after ovulation yielded no fertilization. While Soede et al. (1995) discovered that gilts inseminated 24 hrs. before ovulation and up to 8 hrs. after ovulation produced the highest conception rate and the greatest number of normal embryos. Similar to Bortolozzo, et al. (2005) who found that insemination performed <24hrs. before ovulation resulted in a higher embryos recovery rate and produced 2.1 more embryos than inseminations > 24hrs. before ovulation. However, the pregnancy rate was reduced when inseminations were performed > 16 hrs. before ovulation.

Generally, gilts showed a shorter ($P < .05$) duration of estrus than sows (40.8 ± 1.1 hrs. vs 48.5 ± 1.0 hrs.) (Steverink et al., 1999). More than 50% of gilts ovulate within 32 hrs. after onset of estrus, and 35% ovulate between 32 and 44 hrs. and 15% ovulate later than this time (Waberski et al., 1994) and duration of estrus is about 36-48 hrs. On the other hand, about 20% of sows ovulate within 24 hrs. after onset of estrus, 22% ovulate between 24-36 hrs., 35% ovulate 35-48 hrs. and 18% ovulate 48-60 hrs after onset of estrus (Knox et al., 1999) and standing heat for 60-70 hrs. The accuracy of detection of estrus is the most critical factor when using AI especially, in backyard farms which have no boar to detect estrus. Some studies reported that when back pressure test was applied, females would exhibit the standing response for approximately 46%. The standing response in presence of boar without back pressure test was 56%. When using back pressure test and boar stimulation, females exhibited standing response at 90% when, using back pressure test and in the presence of four boar, 97% females were detected (Langendijk et al., 2000).

4. AI technique

Some field studies have shown higher reproductive performance in sows after double insemination versus single dose of insemination. Female that received a double insemination had higher reproductive performance than female receiving a single dose (Anil et al., 2003; Haugan et al., 2005). Number of total born per litter in sows have significantly increased with numbers of insemination. Waller and Bilkei (2002) studied on single dose and double dose of insemination during estrus found that number of total piglets born and live-born piglets per litter were significantly lower in the group of sows and received only one mating compared with two mating but, the FR did not differ significantly.

Flower and Alhusen (1992) have studied the comparison between natural mating and artificial insemination. Gilts with double- natural mating had the forrowing rate significantly lower than natural mating in the first time and AI in the second. Sows with double AI had litter size significantly larger than single-natural mating. Other study found that litter size was smaller for sows bred by artificial insemination (10.2, SD = 3.2) than in sows bred naturally (11.3, SD = 3.1) ($P< 0.05$) (Dewey et al., 1995). While Steverink et al. (1999) found sows that were inseminated twice had 4.3% higher ($P < .001$) FR than sows inseminated once (80.8 vs 85.1%). The beneficial effect of the increasing number of inseminations in lowering farrowing failure among sows was pronounced when two inseminations were performed in comparison to one insemination. However, the third insemination was not found to be equally beneficial. Further, comparing two inseminations, performing three inseminations increased the farrowing failure in sows. A further slight advantage with third insemination is also reported (Tilton et al., 1982). Whereas Anil et al. (2004) found that a third insemination could be disadvantageous in sows, as farrowing failure increased when a third AI was performed in comparison with two inseminations.

5. Breed

Genetic or breed affects litter size for example, litter size of crossbred sows is on the average of 0.25 to 0.5 pigs greater than that of purebred sows (Aherne, 2002). Tantasuparuk et al. (2004) who studied about ovulation rate and number of total piglets born of gilt in Thailand found that Yorkshire gilts had significant higher ovulation rate compared to Landrace gilts. But no difference in the number of total piglets born per litter between the two breeds. Therefore, the total prenatal loss from ovulation to farrowing was significantly higher in Yorkshire than in Landrace gilts. Other study found that ovulation rate and number of embryo recovered per sows were higher ($P<0.001$) in Meishan than in domestic sows (Anderson et al., 1993).

6. Season and photoperiod

Seasonal effects on reproductive performance in pig have been studied for several years. Variations in ambient temperature and photoperiod were believed to be primary external factors influencing fertility such as FR and litter size (Love et al., 1993). A change in photoperiod may act on reproductive hormone via melatonin profile (Tast et al., 2002). The high temperature may contribute to seasonal infertility via decrease feed intake (Prunier et al., 1997). The ovulation rate in $2^{nd}$ to $4^{th}$ parity Landrace sows and Yorkshire sows in Thailand was also lower for corresponding breeds in temperate areas

(Tantasuparuk et al., 2001). The study in Finland, litter size was not affected by the season. There was no difference in the litter size between litters from winter–spring or summer–autumn inseminations (12.3±3.4 versus 11.9±3.2). The seasonally decreased FR was partly caused by early disruption of pregnancy. One EDP identified in the winter–spring, and nine such cases were found in the summer–autumn ($P< 0.05$) (Tast et al., 2002). While other reported the FR during the summer period was lower than those during winter and fall ($P<0.05$). Parity 1 sows had a lower FR than those in parities 2 and ≥ 7($P<0.05$) summer and spring had the lowest and second-lowest FRs among the four seasons ($P<0.05$) (Koketsu et al., 1997) and sows conceived during the spring produced smaller subsequent litter sizes than those during the winter and autumn months (Koketsu and Dial, 1998).

**Artificial insemination in pig in Thailand**

Pork represents about 40% of all red meat consumed worldwide and continues to be an important part of the human diet throughout the world. In the past 10 years, pork production has increased from 73 to 94 million metric tons according to FAO records. It is projected that the demand of pork will increase to 125 million metric tons by 2020. Most of the increase is projected for developing countries (Delgado et al., 1999).

In Thailand, AI in pig was firstly used in 1961. In 1999 AI in pig was very popular in Ratchaburi and Nakornpathom province. This technique was used more than 90% in replace of natural mating (DLD, 2008).The backyard pigs raised by farmers in rural areas are still lack of things such as good breed, proper management, adequate nutrition and good housing. Livestock was kept with low budgets, and simple keeping conditions of use of farm-own and unbalanced feeding rations, and poor health services. According to Intrakumhang et al. (2007), it was reported that in Nan province, backyard farmers kept crossbreed pigs of Large White or Landrace and mixed breed. The majority of breeding herds were in small scale with 1,2,3-10 and more than 10 female pigs as 22.7%, 14.6%, 16.7% and 1.9% respectively while 44.1% produced only fatteners. Most farmers did not keep breeding boar (89.6%) while 6.5% had only 1 boar. The backyard farmers raised up animals as the other source of income supporting their occupation such as rice farming or crop-farming. Farmers, who have rice mills, often use by-products such as rice bran, broken-milled rice or chaff in raising their animals. They also kept other livestock and grew cash and subsistence crops (Kunavongkrit, 2002; Wabacha et al., 2004). Most farms depended on family labors for pig production. Natural mating is widely used in rural areas. The farmers usually used natural mating by boars that have never been checked for infectious disease, semen quality or mating frequency. Thus, the production is fluctuate regular and it may cause diseases which result in high culling rate and repeat breeder in sows/gilts (Wabacha et al., 2004; Am-in, 2005) while artificial insemination (AI) is not introduced properly to solve the problem in case of boar lacking supplies.

### The adaptation of AI to backyard farms

Due to the advantage of AI such as the greater genetic distribution and the venereal disease transmission control, AI-service was introduced to small scale pig farms in rural areas. The use of AI in pig farms will be the other technique to get superior genetics. The research of "The implementation of pig artificial insemination services in small farms" which is the cooperation between Chulalongkorn University and Rajamangala University of Technology Lanna Nan (Techakumphu et al., 2005 and 2007), showed a successful AI-implementation in backyard pig farms in Nan province. In 2005, the research was conducted in three districts which are Mueang district, Wiang Sa district and Phu Phiang district which covered 106 farms and 473 pigs. Seven hundred and thirty eight piglets were born in year 2005 and farmers had more understanding on the benefit and needed AI service. In year 2006 the total number of inseminated pigs increased to 701 heads which FR was 68.9% and TB was increased tremendously to 5,083 piglets or 70% of increasing rate. The non return rate and FR were significantly better than natural mating while litter size was not significantly different. From these results, it indicated that AI-service by well trained staffs can be successfully implemented in backyard pig farms in Nan province as a national model and produce the better outcome than natural mating. However, there were still problems such as the inadequate AI-service and poor farmer’s heat detection.

CHAPTER III

MATERIALS AND METHODS

## Materials

1. Material for semen collection
2. Material for semen evaluation
3. Material for semen preparation and storage
4. Material for artificial insemination

### 3.1 Study areas

The study was conducted at the CU-Network for Academic Opportunities and Services (CU-NAOS), Chulalongkorn Unversity in Nan province, located in the northern part of Thailand. The data was based on 231 backyard pig farms in 7 districts in Nan province; Chiang Klang district (n=19), Tha Wang Pha (n=80), Mueang (n=25), Pua (n=37), Santisuk (n=1), Wiang Sa (n=40) and Phu Phiang districts (n=11), as shown in figure 2. The available data comprised of mating and farrowing records from April 2007 to May 2009.

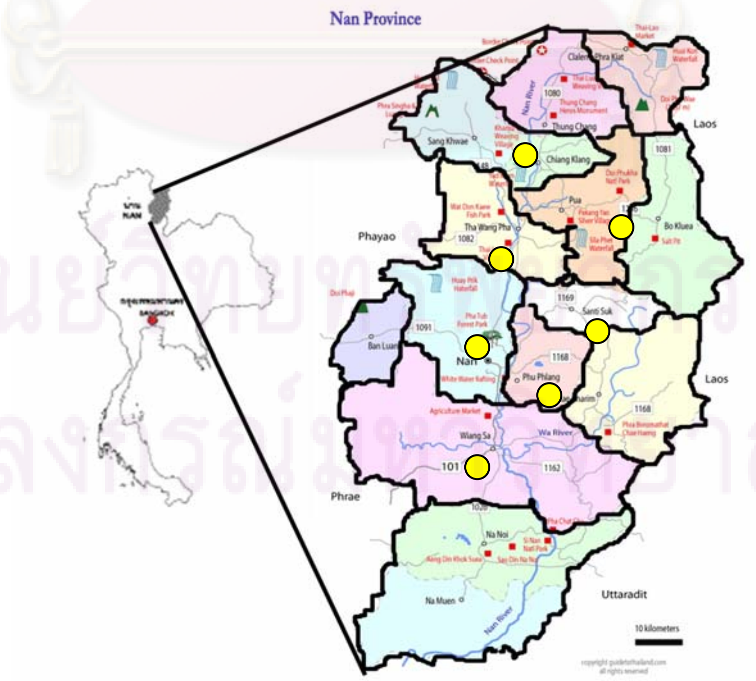



Figure 2. Study area of AI implementation in Nan Province (7 districts, ○) of Thailand

### 3.2. Animal and general management

Mixed-European breed multiparous sows were selected from backyard pig farms. The average body condition score ranged between 2.5 - 3.0. They were housed individually in conventional open-air stables and were fed by rice bran mixed with commercial feed. Only non-repeat breeding sows were added to the study group. No boar was presented in these herds. No clinical findings of foot-and-mouth disease or swine fever was found during the study period.

### 3.3 The model for AI Technology Transfer by backyard pig farmers

The model can be divided into seven-steps cyclical processes as shown in AI workflow model (figure 5) as followed;

**Step I: Set up the AI center**

Under this step, boar station, semen laboratory, two technicians, four stud boars (described in 3.3) and semen delivery (described in 3.5) were established.

Semen from four synthetic matured boars was collected and evaluated every week. Three boars were collected on Monday and the other two were collected on Thursday. The semen was produced at least 100 doses per week (5200 doses per year).

**Step II: Farm contact and selection.**

The backyard farms were selected through a direct contact or through contacting a local organization called "Tambon Administrative Organization (TAO)". TAO is a local administrative authority in Thailand, in accordance with the Tambon Council and Tambon Administration Authority Act 1994 and the Thai Constitution of 1997.

**Step III: Training and intensive education**

Farmer participants were educated in topics of artificial insemination in pigs and related subjects. Two types of training were carried out:

a) Group training: 5-50 farmers were educated in the topics of:

- Reproductive anatomy of female pigs
- Disease transmission and hygiene
- Heat detection  (describe in 2.6)

- Preparation of female before AI
- Procedure of semen transportation and handling
- Procedure of AI in pigs (describe in 2.6)

b) Individual training (figure 3): Farmers were trained and supervised by technicians at their own farms in the subjects of AI procedure (describe in 2.6). The so called “learning by doing” under supervision was conducted.

Figure 3. Individual training: technicians educated farmers in AI procedure on their farm by “learning by doing” method

### Step IV: AI and data recording

Reproductive data of the sows, that were AI by either farmers or technicians, were recorded in individual sow cards (figure 4). Beside, reproductive data of some sows from some backyard farms that were mated by rent-boar were also recorded and kept as a control group. Farmers’ background including educational level, gender, age and type of training were interviewed and were recorded.

Figure 4. Sow cards to record the reproductive performance

**Step V: Farm visiting and monitoring**

Technicians continued to visit farmers monthly in order to follow up the results of AI and gave advices concerning the pig management.

**Step VI: Data collection and analysis**

The data of sow reproductive performance i.e. FR, TB and BA in each type of mating were retrieved from the sow cards and then statistical analyses were performed.

**Step VII: Promotion and built backyard pig AI farmer network**

The outcomes of the present project was propagated by the researchers as well as spread widely among the farmers inside and outside the communities. Backyard pig AI farmers assembled the network under the concept of self sufficiency and sustainable backyard farming. This made more efficient in pig AI promotion and in development of animal health and welfare, including farmers' income.

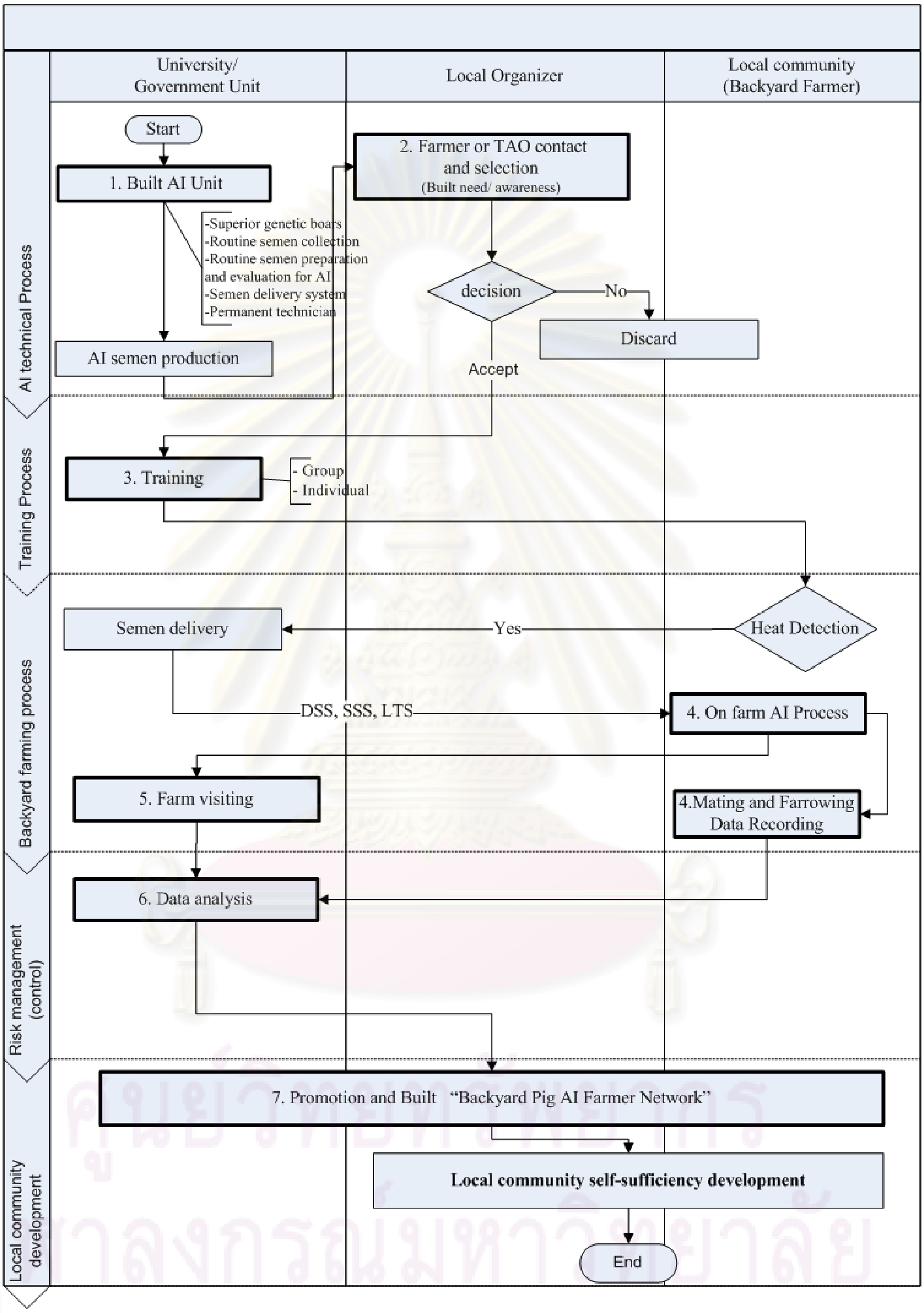



Figure 5. The workflow of a model for AI Technology Transfer by backyard pig farmers

### 3.3. Semen collection and diluted semen production

The four matured boars (composited breed) were kept in 2x3 m individual pen in evaporative cooling housing system at CU-NAOS center. Semen was collected by technicians every 3 days using glove-hand method. Semen was examined for quality before further processing as the standard of Department of Obstetrics Gynaecology and Reproduction Faculty of Veterinary Science, Chulalongkorn University i.e. color, pH, progressive motility, sperm concentration by hemocytometer and sperm morphology by William's stain and formal-saline solution. Qualified semen (normal color, pH 7-7.5, progressive motility >70%, concentration >100 spermatozoa/ml and normal sperm >80%) was diluted with Beltsville Thawing Solution (BTS, Minitub, USA). One dose of semen contained approximately 3 billion total spermatozoa in 100 ml. Approximately one hundred semen doses were produced weekly and stored at 18 $^{o}$ C for no longer than 48 hrs.

### 3.4 Estrus detection

Estrus detection was performed by the farmers by visual observation of the reddening and swelling vulva twice a day (am/pm) and by back pressure test. If the onset of standing heat was detected in the evening, the sows were inseminated in the next morning. The sows were inseminated two times per estrus in 12 hrs. interval.

### 3.5. Semen delivery systems

The semen delivery systems in the model were classified as follows;

1. Direct service system (DSS): two doses of semen were delivered by our technicians to backyard farmers.
2. Self service system (SSS): The two doses of semen were carried from the center to farm by farmers themselves and AI was performed by themselves.
3. Local transport system (LTS)

   The semen was delivered via public transport (bus) in the appointment. In this system, farmers received the semen at the bus stop and performed AI by themselves.

In all systems, two doses of semen and two disposable AI catheters were packed for insemination of one sow. During transportation, the semen was controlled at the temperature of 16-18º C in a foam box or insulating container. Normally, the first dose of semen will be used immediately since arrival, but the second dose will be kept another 12-24 hrs. in controlled temperature.

### Artificial insemination

Sows were inseminated 2 times at a 12 hrs. interval using a disposable Golden Pig® catheter (IMV, Maple Grove, MN, USA). Non-return rate was determined at 18-24 days after service.

### 3.7. Data collection

The record covered sow identity, breed, parity number, mating date, farrowing date, number of total piglets born per litter, number of piglets born alive per litter, number of stillborn piglets per litter, number of mummy, weaning date were collected individually. The FR, number of total piglets born per litter and number of piglets born alive per litter were used for the criteria to evaluating the successful of AI in pigs by backyard farmers. FR was calculated by dividing the number of animals that farrowed by the number of animal that were bred. The date of return to estrus after mating , date of abortion, date of farrowing, number of total piglets born, number of piglets born alive per litter, born dead were recorded for each animal that farrowed. The natural mating sows were record individually in the same information of AI sows.

Farmer background including educational level, gender, age, number of training, and type of training were recorded.

Sows with incomplete record or error of date including sow with gestation period longer than 117 days, weaning to first estrus interval longer than 30 days, lactation length less than 17 days and more than 30 days were excluded in all analyses.

After exclusion of records, the analysis comprised 531 farrowing records from 213 backyard pig farms.

### 3.8. Data analysis

Descriptive statistic was obtained using SPSS (Version 11.5, SPSS Inc., and Chicago, IL, USA). The variations between mean and relationships between farrowing rate, number of total piglets born per litter and number of piglets born alive per litter were assessed by Analysis of variance (General linear Model and Generalized liner Mixed Model) in 95% confidence level.

1. Analyze the reproductive performance of the sow (farrowing rate, number of total piglets born per litter and number of piglets born alive per litter) in group of service artificial insemination compare with farmer artificial insemination compare with natural mating. The sows in each group were selected to match a characteristic of managementand parity.

2. Analyze the factor which effect to the success of artificial insemination by backyard farmer. The personal factors such as age, gender, education level, AI experience, type of training and number of training were analyzed

2.1. The effect of farmer's education level on farrowing rate, number of total piglets born per litter and number of piglets born alive per litter

2.2. The effect of number of farmers' artificial insemination experience on farrowing rate, number of total piglets born per litter and number of born alive

2.3. The effect of farmer's gender on farrowing rate, number of total piglets born per litter and number of piglets born alive per litter

2.4. The effect of farmer's age on farrowing rate, number of total piglets born per litter and number of piglets born alive per litter

2.5. The effect of number of farmers training on farrowing rate, number of total piglets born per litter and number of piglets born alive per litter

2.6. The effect of type of farmer training on farrowing rate, number of total born per litter and number of piglets born alive per litter

### 3.9. Statistical analysis

Analysis of variance (General linear Model and Generalized liner Mixed Model) was used to determine differences in conception rate, farrowing rate, total-born pigs and live-born pigs in all groups.

1. Analyze the reproductive performance of sows that were received artificial insemination by farmer compare with natural mating and artificial insemination by well trained staff. Farrowing rate was analyzed by generalized liner mixed model. Number of total piglets born and number of live born per litter were analyze using general linear model.

2. Analyze the effect of farmer’s education level on sow reproductive performance. Farrowing rate was analyzed by generalized liner mixed model. Number of total piglets born and number of live born per litter were analyze using general linear model.

3. Analyze the effect number of farmer’s artificial insemination experience on sow reproductive performance. Farrowing rate was analyzed by generalized liner mixed model. Number of total piglets born and number of live born per litter were analyze using general linear model.

4. Analyze the effect of farmer’s gender on sow reproductive performance. Farrowing rate was analyzed by generalized liner mixed model. Number of total piglets born and number of live born per litter were analyze using general linear model.

5. Analyze the effect of farmer’s age on sow reproductive performance. Farrowing rate was analyzed by generalized liner mixed model. Number of total piglets born and number of live born per litter were analyze using general linear model.

6. Analyze the effect of number of farmers training on sow reproductive performance. Farrowing rate was analyzed by generalized liner mixed model. Number of total piglets born and number of live born per litter were analyze using general linear model.

7. Analyze the effect of type of farmer training on sow reproductive performance. Farrowing rate was analyzed by generalized liner mixed model. Number of total piglets born and number of live born per litter were analyze using general linear model.

# CHAPTER IV
# RESULTS

## 4.1. Model evaluation

Since April 2007, Technicians made contact to 9 TAO as TAO Pha Sing, Mueang district, TAO Bo, Muang district ,TAO Puea ,Chiang Klang district, TAO Rim District, Tha ,Wang Pha district, TAO Pa Kha, Tha Wang Pha district, TAO Sila Laeng, Pua district, TAO Chiang Khong, Na Noi district, TAO Pong, Santisuk district, TAO Du Pong, Santisuk district . But only 6 TAO were interested to join this model (TAO Pa Singha, Mueang district, TAO Puea ,Chiang Klang district, TAO Chiang Khong, Na Noi district, TAO Pa Kha, Tha Wang Pha district, TAO Pong, Santisuk district and TAO Du Pong, Santisuk district) However, because of transportation problems and farmers quit raising swine because economic conditions, TAO Chiang Khong could not participate in the study. Including the budget for management training problem, TAO Pa Kha could not join this project. From the TAO connection, there were 26 farmers from 4 TAOs. And because of local communication by backyard farmers in Chiang Khong district, Tha Wang Pha district, Pua district, Wiang Sa district, Phi Phiang district and Meuang district combined with the intensive connection from technicians, the number of individual farmers joining the model was increased to 193 people (75 people in the first year and 118 in the second year) (figure 6).

Farmer group training was created 3 times with the cooperation received from 4 President of Tambon Administrative Organization (Pau district, Pha Sing, Pong and Du Pong). The number of farmers participating in the training were 11 people from TAO Pha Sing, Mueang district, 11 farmers from TAO Puea ,Chiang Klang district and 12 farmers from TAO Pong, Santisuk district and TAO Du Pong, Santisuk district . Moreover, 19 farmers from Mueang district, Phu Phiang district and Weng Sa were joined the group training themselves without contact with TAO. As individual training, 160 farmers (40 from Tha Wang Pha, 35 from Muang, 40 from Pua, 9 from Phu Phiang and 36 from Wiang Sa) were trained by technicians on their farm.

The total numbers of farmer joining this model was increased by 135% from April 07 to May 09. Moreover, 84% of trained farmers could perform AI themselves. The incomplete data was found about 25% (144/575). Backyard farmers didn't used to record breeding data on sows card or breeding book, they used to record all about breeding and farrowing data on the hog pen.

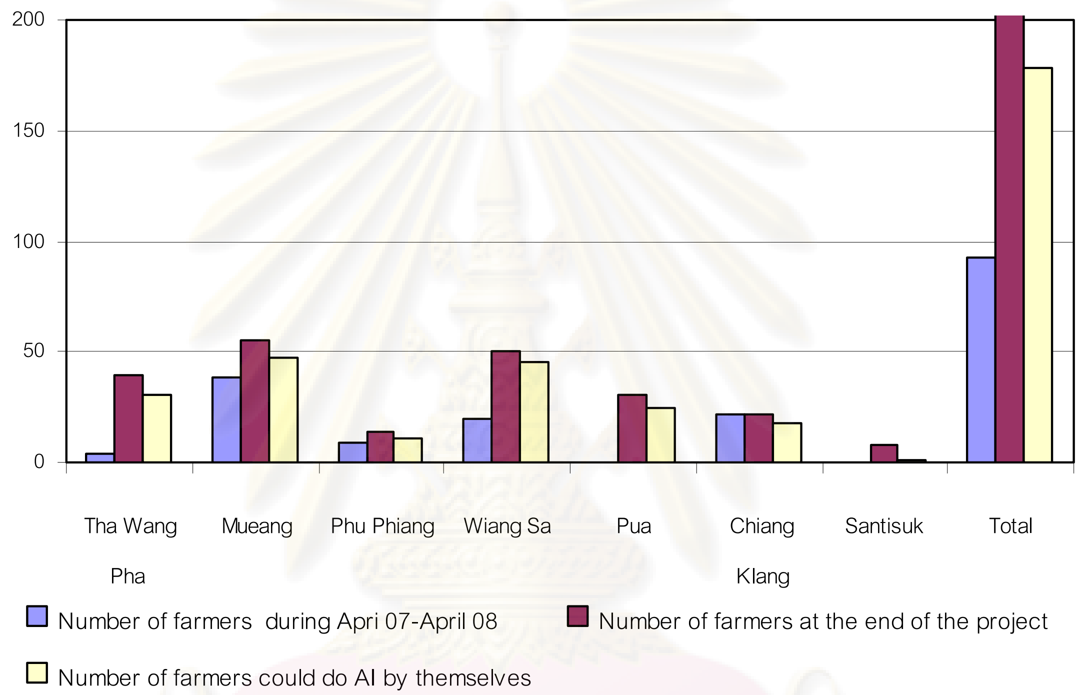



Figure 6. Number of backyard farmers during the study

*4.2. Factor affecting the success of farmers' AI*

Two hundred and thirteen farmer information (male=158, female=55) were recorded. Two hundred and six were farmers, three were teachers, two were policemen, one was postman and one was motor car mechanic. The education levels of farmers were 153 for elementary, 53 for secondary and 5 for bachelor degree.

Five hundred and thirty-one parity records were analyzed. The average herd size was 2.6 sows (1-10 range), average parity was 3.2 (1-7 range), average gestation length was 114.5 days (113-117 range), average lactation length was 29 days (28-30 range) and average weaning to estrus interval was 8 days ( 3-20 range) (Table 1).

Table 1. Descriptive statistics of the data

| | N (pigs) | N (records) | Mean | SD | Min | Max |
|---|---|---|---|---|---|---|
| Average herd size | 557 | - | 2.6 | 1.8 | 1 | 10 |
| Parity | 557 | - | 3.2 | 1.7 | 1 | 7 |
| Gestation length (days) | 307 | 531 | 114.5 | 1.1 | 113 | 117 |
| Lactation length (days) | 307 | 531 | 29.7 | 0.7 | 28 | 30 |
| Weaning to estrus interval (days) | 307 | 531 | 8.0 | 3.8 | 3 | 20 |

The data of farrowing performance was presented in Table 2.

*4.2.1. The effects of type of insemination on sows reproductive performance*

Natural mating type had significantly lower FR than both type of AI (P<0.05) but there was no statistical difference in terms of TB and BA. The reproductive performance of farmers' AI and RA's AI were similar (P>0.05).

*4.2.2. The effect of farmer's gender on sows reproductive performance*

The present study found that farmer's gender had effects on sow reproductive performance. FR from male farmers was higher than female's (P<0.05), while no difference was found in TB and BA.

*4.2.3. The effect of farmer's education level on sows reproductive performance*

The effects of farmer's educational level on sow reproductive performance are shown in table 2. There was no effect of farmer educational level for FR and BA (P>0.05), however, this was not the case with TB. TB was significantly higher when sows were inseminated by farmers whose educational level was higher than high school. However, FR of sows inseminated by farmers with elementary-school education seemed to be lowest FR, while TB and BA of sows AI by farmers whose education was high school or higher were the highest.

*4.2.4. The effect of farmer's age on sows reproductive performance*

FR was affected by farmers' age. FR was 12% higher from farmers who were older than 60 yrs compared to younger ($P<0.05$), but TB and BA were similar in all age groups ($P>0.05$).

*4.2.5. The effect of farmer's artificial insemination experience on sows reproductive performance*

Farmers' AI experience had significant effects on TB and BA but not on FR. TB of the farmers who experienced AI for the first time was the lowest ($P<0.05$), while BA of the farmers who experienced AI for the second time was the highest ($P<0.05$).In addition, FR of the fist time AI in pig was higher than more AI experience.

*4.2.6. The effect of training type on sows reproductive performance*

FR, TB and BA were not significantly effected by the training type ($P>0.05$) but if farmers were joined the group training more than 2 times, FR was the lowest ($P<0.05$).

*4.2.7. The effect of semen delivery system on sow reproductive performance*

FR, TB and BA were no different significantly among these three types of semen delivery system ($P>0.05$). But transport semen by bus seem to have the best result on FR .

*4.2.8. The effect of semen storage time on sows reproductive performance*

There was no effect of semen aging on FR, TB and BA. But long time storage seem to give lower FR ($P>0.05$).

Table 2. Factors affecting on sows reproductive performance

| Factor and category | Number of records | Farrowing rate (%) | Number of total piglets born (mean ± SD) | Number of born alive (mean ± SD) |
|---|---|---|---|---|
| Type of mating | | | | |
| Natural mating | 100 | 55.1[a] | 10.8 ± 3.4[a] | 10.1 ± 3.3[a] |
| Technician AI | 104 | 73.9[b] | 11.2 ± 2.8[a] | 10.7 ± 2.6[a] |
| Farmer AI | 327 | 73.4[b] | 11.5 ± 2.8[a] | 10.7 ± 2.8[a] |
| Farmer's gender | | | | |
| Male | 255 | 76.0[a] | 11.6 ± 2.8[a] | 10.7 ± 2.9[a] |
| Female | 72 | 64.1[b] | 11.3 ± 2.7[a] | 10.7 ± 3.0[a] |
| Farmer's education | | | | |
| Elementary | 180 | 70.3[a] | 11.2 ± 2.4[a] | 10.7 ±2.6[a] |
| High school | 85 | 78.0[a] | 11.4 ± 3.4[a] | 10.5 ± 3.3[a] |
| Above high school | 62 | 75.9[a] | 12.4 ± 2.6[b] | 10.9 ±3.1[a] |
| Farmer' age (years old) | | | | |
| 25-40 | 39 | 71.8[a] | 11.6 ± 2.6[a] | 10.6 ± 3.1[a] |
| 41-60 | 239 | 71.6[a] | 11.4 ± 2.8[a] | 10.6 ± 2.9[a] |
| 61 up | 49 | 83.5[b] | 11.1 ± 2.7[a] | 11.0 ± 2.7[a] |
| Farmer' AI experience | | | | |
| 1 time | 90 | 77.3[a] | 10.8 ± 3.0[a] | 10.0 ± 3.1[a] |
| 2 times | 56 | 71.4[a] | 12.1 ± 2.4[b] | 11.4 ± 2.4[b] |
| ≥ 3 times | 181 | 72.9[a] | 11.7 ± 2.8[b] | 10.8 ± 2.9[a] |
| Type of training | | | | |
| Individual training | 167 | 70.5[a] | 11.3 ± 2.4[a] | 10.7 ± 2.6[a] |
| Group training | 160 | 76.4[a] | 11.7 ± 3.1[a] | 10.6 ± 3.2[a] |
| 1 time | 130 | 78.4[a] | 11.7 ± 3.1[a] | 10.6 ± 3.2[a] |
| ≥ 2 times | 30 | 67.5[b] | 11.8 ± 2.8[a] | 11.1± 2.9[a] |
| Type of semen delivery system | | | | |
| DSS | 169 | 73.5[a] | 11.6 ± 2.8[a] | 10.9 ± 2.8[a] |
| SSS | 90 | 70.0[a] | 11.9 ± 3.0[a] | 10.7 ± 2.9[a] |
| LTS | 68 | 77.0[a] | 11.1 ± 2.6[a] | 10.1 ± 2.8[a] |
| Semen storage time | | | | |
| < 24 hrs. | 70 | 78.6[a] | 11.6 ± 2.9[a] | 10.6 ± 3.5[a] |
| 24-48 hrs. | 171 | 77.8[a] | 11.6 ± 3.2[a] | 10.5 ± 3.3[a] |
| 48-72 hrs. | 86 | 72.0[a] | 11.2 ± 2.3[a] | 10.7 ± 2.6[a] |

[a,b] : different superscript letters in the same column in the same topic indicate a significant difference at $p<0.05$.

# CHAPTER V
# DISCUSSION

The present study showed that the success of implementation of AI by backyard farmers model. The success of the model can be described in term of an increased number of farmers from 7 local districts in the second year of the project, a number of trained farmers who can perform AI by themselves after training and the good reproductive performance after AI. Our model comprises of at least 3 operational units including university/government unit, local organizer and backyard farmers (Simarak et al., 2006; Mignouna et al., 2008) as demonstrated in workflow. We found that among the 7 steps in the model, the need of local community toward AI combined with the local networks and the regular monthly follow-up are the key of success. The model could not be implementing if the community need of AI was low as found in TAO collaboration. Five of nine local authorities refused to join the project because no budget or not correspond to their policies and AI might not be a critical issue for local farming (Sanankong et al., 2000; Simarak et al., 2006; Techa-atic, 2006). Meanwhile the individual farmer contact was more effective than TAO's contact. It is remarked that the number of farmers in the project continuously increased and some farmers came from other areas. We noted that about 80% of trained farmers can do AI by themselves with a good result. Similar to previous study reported the most important components for local community self-sufficiency development were the clearly identify and understand of local needs and problems before activities implementation, the efficient people and the community network (Tongkow et al., 2002; Steinfeld, 2003; Simarak et al., 2006; Techa-atic, 2006; Mignouna et al., 2008). Furthermore, the regular visit can help to get the complete record for analysis.

This study showed the success of AI by well-trained backyard farmers in term of FR, TB and BA which were better than natural mating or similar to those by technicians. It was found in our previous studies that AI provided a higher FR than natural mating in backyard farmers which confirmed by this study even AIs were performed by farmers themselves (Am-in, 2005; Techakumphu et al., 2007, 2008). Because in case of AI, semen was regularly evaluated compared to non evaluated semen in natural mating (Am-in, 2005; Techakumphu et al., 2005).

The model factors such as the types of training programs, semen delivery systems and storage time did not significantly affect the success of AI in backyard farms. A success of AI can come from trained farmers in group or individually. Moreover, it was found that keeping semen at controlled temperature at 16-20 ºC during semen transport in short-term boar semen extender such as BTS help to deliver semen to different locations from AI station in Nan province within 48 hrs. Normally, boar semen should be stored between 12-17 º C for up to 48 hrs. which did not affect FR, TB and BA, compared to keeping below 8 ºC, reducing sperm quality (Althouse et al., 1998). Semen transportation using stryofoam box which controlled the temperature between 15-22ºC and transport to other locations within 1 hr. did not affect reproductive performance of AI sows (Am-in, 2005; Techakumphu et al., 2007). Increasing storage time of AI dose with BTS extender from 4-14 hrs. to an interval of 52-62 hrs. caused a 0.5 piglet reduction in litter size ($P<0.05$) for homospermic semen but not for heterospermic semen (Haugan et al., 2005). Similar to report of Hofmo (1991), it was found that there was a significant reduction in fertility when the diluent was stored for 48 hrs, while number of total piglets born and number of piglets born alive significantly decreased after 24 hrs of storage which was due to sperm motility and increasing of abnormal sperm (Dimitrov et al., 2009). Alexopoulos et al. (1996) reported that AI dose of $3 \times 10^9$ spermatozoa in BTS could be stored for 72 hrs with no negative effects on fertility. For adaptation of semen service AI to be used in other provinces, for which the semen has to be stored for more than 48 hrs, the long-term semen extender may be required. Moreover the local transportation of semen without any impact on semen quality and hence, the reproductive performance will enhance the implementation of AI in different location within or neighboring provinces of Nan.

On the other hand, inseminator factors such as working experiences in AI, educational background, sex and age affected on the success of AI in backyard sows. The farmers with high educated and having experiences in AI tended to perform it with more effectiveness. In the fact that the education and the practices are a process of knowledge transferring which can develop person capability. Person with high educated and having experiences can understand the new thing and better accept it faster, they can bring the knowledge to employ and process the knowledge with the analysis to implement or solve problem better (Simarak et al., 2006; Techa-atic, 2006). The farmer with low educated and little experience will have low skill to work. Insufficient experiences of the farmers, improper semen storage, improper semen warming process and semen backflow during AI hence low number of spermatozoa for AI. Besides, semen backflow during insemination had significantly affects on FR when the low dose semen was used (Steverink et al., 1998). Moreover, it was found that male farmers and senior farmers were more successful in AI in sows, with better productivity rates than others. Because male and senile people in rural area were mainly responsible for agriculture and backyard farming (Mata. 1998; Jitapunkul et al., 2001; Kumaresan et al., 2008), they will be able to notice the animal behavior in each day to monitor the vulva reddening and more familiar with back pressure test for heat detection and catheter insertion than others (Techakumphu et al., 2008). In addition, the old farmers will be clam when AI and this will cause more effective work. Since, the heat detection is the most important factor for successful AI because it marked the accurate period of insemination time which affects sows reproductive performance (Banbury, 1965; Sode et al., 1995; Kaeoket et al., 2005). In our study, we found that the heat detection is a major cause of a failure of insemination and conception in backyard farmers. More education on this subject is required. It is recommended that a fertilization rate correlated positively when the insemination took place between 0 and 24 hrs. before ovulation (Soede et al., 1995; Steverink et al., 1997). The early or late insemination caused a drop in FR particular in parity $1^{st}$ and $2^{nd}$ (Rozeboom et al., 1997). The insemination 15 hrs after ovulation resulted low embryo recovery rate on day 11 after standing heat (Kaeoket et al., 2005) and also no embryo were found at day 19 (Kaeoket et al., 2002). The reproductive performance obtained in the study was comparable to those obtained from our previous studies which AI was performed by our technicians

(Am-in, 2005) or the data in commercial farms as shown by (Suriyasomboon et al., 2006).

## Conclusion

Based on the reported data, a model of “AI technology Transfer for Strengthen Productivity in Backyard Pig Farming” has been created. The model composite of 7 components as;

1. AI center as a technical unit
2. Criteria for suitable farmer selection
3. AI farmer training program as knowledge management at local community
4. AI in pig as a AI processing and data recording after mating
5. AI Risk management
6. Adjust and Adapt
7. Promotion and built the network of backyard pig farmer AI

The relationship was showed in figure 7

A number of major findings must be stated;

1. The qualified farmer could be trained on AI technique for his own benefits.
2. The well trained farmer could perform in AI as well as a experienced RA.
3. A strong coordination with clearly responsibility of all stakeholders could create a good network of backyard pig farmer.
4. A advanced AI technique in pig meting could be applied with the local folk wisdom for a long-life self sufficiency community.
5. A well understanding in local need was one of major factors for any technical transfer to a rural area development.
6. Male farmers within working age group or older with high school education or higher and one experienced training in AI can be a recommended target group for implementing of the model

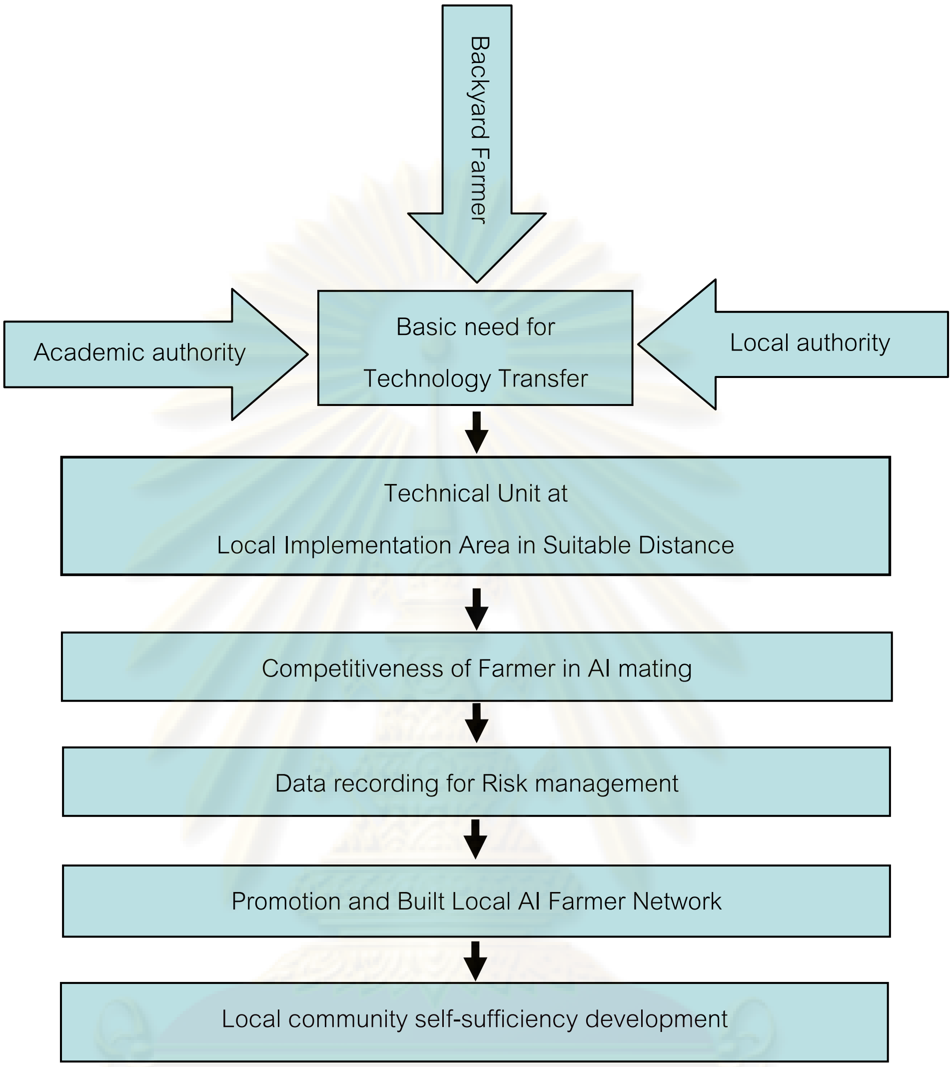



Figure 7. A model of AI technology transfer for strengthen productivity in backyard pig farming

The results of the study open the window of technology transfer for livestock production in rural area by educating the farmers to do AI by themselves. The outcome of this model will help the farmers to increase their income with an aim toward as sustainable self-sufficiency community. This model could be developed in other part of the country or could be implementing in other backyard farming system.

## REFERENCES


Aherne, F. 2002. Improving breeding herd efficiency: an industry perspective. In: Proceedings of the 29th Annual Symposium of the Pig Health Society. Pig Health Society, Dublin. 30-44.

Alexopoulos, C., Boscos, C., Saratsis, P., Saoulidis, C. and Kyriakis, S. 1996. The effect of storage time and number of spermatozoa per insemination dose on semen characteristics and fertilizing capacity of boar semen diluted with Beltsville thaw solution (BTS) extender. Anim. Sci. 62:599–604.

Alm, K., Peltoniemi, O.A.T., Koskinen, E. and Andersson, M. 2006. Porcine field fertility with two different insemination doses and the effect of sperm morphology. Reprod. Dom. Anim. 41:210–213.

Althouse, G.C., Wilson, M.E., Kuster, C. and Parsley, M. 1998. Characterization of lower temperature storage limitation of fresh-extened procine semen. Therogenology, 50:535-543.

Am-in, N. 2005. Sow reproductive performance before and after implementation of AI service in small holder farms. Master's Thesis. Department of Obstetrics Gynaecology and Reproduction, Faculty of Veterinary Science, Chulalongkorn University. 42 pp.

Anderson, L. H., Christenson, L. K., Christenson, R. K. and Ford, S. P. 1993. Investigations into the Control of Litter Size in Swine :II: Comparisons of morphological and functional embryonic diversity between Chinese and American breeds. J. Anim. Sci. 71:1566-1571.

Anil, S.S., Larriestraa, A., Deena, J., Morrisona, R.B. and Minionb, L. 2004. A retrospective study on the preserving capacity of a commercial boar semen extender. Theriogenology. 62 :425–436.

Banbury, L.J. 1965. Comments from practical experience with swine artificial insemination. Can. Vet. Jour. 6:237-240.

Bates, R.O., Edwards, D.B. and Korthals, R.L. 2003. Sow performance when housed either in groups with electronic sow feeders or stalls. Livest. Prod. Sci. 79: 29–35.

Bortolozzo, F. P., Uemoto, D.A., Bennemann, P.E., Pozzobon, M.C., Castagna, C.D., Peixoto, C.H., Barioni, Jr. W. and Wentz, I. 2005. Influence of time of insemination relative to ovulation and frequency of insemination on gilt fertility. Theriogenology. 64:1956–1962.

Cameron, R.D.A. 2000. A Review of the Industrialization of Pig Production worldwide with Particular Reference to the Asian Region. Animal Health and Area Wide Integration. FAO, Brisbane, Australia. 32pp.

Darroch, C.S., Dove, C.R., Maxwell, C.V., Jhonson, Z.B. and Southern, L.L. 2008. A regional evaluation of the effect of fiber type in gestation diets on sow reproductive performance. J. Anim. Sci. 86: 1573-1578.

Delgado C, Rosengrant M, Steinfeld H, Ehui S, Courbois C. 1999, Livestock to 2020: the next food revolution. Rome, Italy: UN FAO. 72 pp.

Department of livestock development. 2008. Livestock information in Thailand [Online].Available from : http://www.dld.go.th/ict/yearly/yearly50/stock50.html[2008, July 20]

Devendra, C. 2007. Perspectives on animal production systems in Asia. Livest Sci. 106:1 – 18.

Dewey, C.E., Martin, S.W., Friendship, R.M., Kennedy, B.W., Wilson. M.R. 1995. Associations between litter size and specific sow level management factors in Ontario swine. Prev. Vet. Med. 23 : 101-110

Dimitrov, S., Atanasov, V., Dichiyanova, E. and Petrova, R. 2009. Comparision of three commercial diluents for short-term storage of boar semen. Trakia J. Sci.. 7:58-62.

Eissen, J. J., Apeldoorn, E. J., Kanis, E., Verstegen, M. W. A. and de Greef, K. H. 2003. The importance of a high feed intake during lactation of primiparous sows nursing large litters. J. Anim. Sci. 81:594–603.

Flowers, W.L. and Alhusen, H.D. 1992. Reproductive performance and estimates of labor requirement associated with combinations of artificial insemination and natural service in swine. J. Anim. Sci. 70:615-621.

Gadea, J. 2003. Review: Semen extenders used in the artificial insemination of swine. Spanish J. Agri. Res. 1(2):17-27.

Haugan, T., Reksen, O., Grohn, Y.T., Gaustad, A.H. and Hofmo, P.O. 2005. A retrospective study on effects of storage time of liquid boar semen onreproductive performance in Norwegian swine. Theriogenology. 64:891–901.

Haugan, T., Gaustad, A.H., Reksen, O., Grohn, Y.T. and Hofmo, P.O. 2007. Fertility results of artificial inseminations performed with liquid boar semen stored in X-cell ™ vs BTS extender. Reprod. Dom. Anim. 42:94-99.

Hofmo, P.O. 1991. Commercial swine artificial insemination with liquid boar semen in Norway. Reprod. Dom. Anim;1 (Suppl):317–320.

Intrakumhang, M., Rawiyawong, P. and Asakit, H. 2007. The survey of pig production and the requirement of pig meat in Nan province. In: Research seminar of the cooperation between Chulalongkorn University and Rajamangala University of Technology Lanna Nan. Bangkok: Chulalongkorn university publisher. 121-130.

Jitapunkul, S., Chayowan, N., Yordpet, S., Chunsirikanchana, S., Intarasombat, P., Pananiramai, M., Suntornchawakan, N., Siribun, S., Wongsit, M. and Sombat, L. 2001. Senile in Thailand a review of knowledge, status and research and policy suggestion. Final report, Thailand Research Fund. 275 pp.

Johnson, L.A., Weitze, K.F., Fiser, P. and Maxwell, W.M.C. 2000. Storage of boar semen. Anim. Reprod. Sci. 62:143–172.

Jones, R. 2002. Priorities for pig research in Southeast Asia and the Pacifc to 2010. [Online].Available from: http://www.aciar.gov.au/sites/aciar/fles/node/472/wp53.pdf. ACIAR (Australian Centre for International Agricultural Research), Canberra, Australia. pp 5–13.

Kaeoket, K., Persson, E. and Dalin, A.-M. 2002. The influence of pre- and post – ovulatory insemination on sperm distribution in the oviduct, accessory sperm to the zona pellicida, fertilization rate and embryo development in sows. Anim. Reprod. Sci. 71:239-248.

Kaeoket, K., Tantasuparuk, W. and Kunavonghrit, A. 2005. The effect of post-ovulatory insemination on the subsequent embryonic loss, oestrus cycle length and vaginal discharge in sows. Anim. Reprod. Sci. 40:492-494.

Knox, R.V., Lamberson, W. R. and Robb, J. 1999. Factors influencing time of ovulation post-weaned sows determined by trans-rectal ultrasound. Theriogenology 51:435.

Knox, R.V. 2005. Artificial insemination of swine: Improving reproductive efficiency of the breeding Herd. Department of Animal Sciences, University of Illinois, Urbana-Champaign. 1-15.

Koketsu, Y., Dial, G. D. and King, V. L. 1997. Influence of various factors on farrowing rate on farms using early weaning. J. Anim. Sci. 75:2580-2587.

Koketsu, Y. and Dial, G.D. 1998. Interactions between the associations of parity, lactation length and weaning to conception interval with subsequent litter size in swine herds using early weaning. Prev. Vet. Med. 37:113-120.

Kongsted, A. G. 2004. Stress and Fear as Possible Mediators of Reproduction Problems in Group Housed Sows: A Review. Anim. Sci. 54: 58-66.

Kongsted, A.G. 2005. A review of the effect of energy intake on pregnancy rate and litter size discussed in relation to group-housed non-lactating sows. Livest. Prod. Sci. 97: 13-26.

Kumaresan, A., Bujarbaruah, K. M., Pathak, K. A., Anubrata, D and Bardoloi, R. K. 2008. Integrated resource-driven pig production systems in a mountainous area of Northeast India: production practices and pig performance. Trop Anim Health Prod.

Kunavongkrit, A. 2000. Artificial insemination research developments in the pig. Thai J. Vet. Med. 30(1): 13-17.

Kunavongkrit, A. and Heard, T. 2000. Pig reproduction in South East Asia. Anim. Reprod. Sci. 527-33.

Kunavongkrit, A. 2002. Artificial insemination in pig. Technology of pig reproduction. Bangkok: Chulalongkorn university. 256, 373-378.

Langendijk, P., Soede, N. M., Bouwman, E. G. and Kemp, B. 2000. Responsiveness to boar stimuli and change in vulvar reddening in relation to ovulation in weaned sows. J. Anim. Sci. 78:3019-3026.

Love, R.J., Evans, G. and Klupiec, C. 1993. Seasonal effect on fertility in gilts and sows. J. Reprod. Fertil. Suppl. 48:191-206.

Mata, N. 1998. A follow-up study of farmers in swine artificial insemination and improvement training course at the national swine research and training center. Master's Thesis. Department of Agricultural Extension and Communication, Faculty of Agriculture, Kasetsart University. 174 pp.

Mignouna, H.D., Abang, M.M., Omanya, G., Nang'ayo, F., Bokanga, M., Boadi, R., Muchiri, N and Terrr, E. 2008. Delivery of agricultural technology to resource-poor farmers in Africa. Ann. N.Y. Acad. Sci. 1136: 369–376.

Munsterhjelm, C., Valros, A., Heinonen, M., Halli, O. And Peltoniemi, O.A.T. 2008. Housing during early pregnancy affects fertility and behaviour of sows. Reprod. Dom. Anom. 43:584-591.

Nissen, A.K., Soede, N.M., Hyttel, P., Schmidt, M. and D'Hoore, L. 1997. The influence of time of insemination relative to time of ovulation on farrowing frequency and litter size in sows as investigated by ultrasonography. Theriogenology. 47:1571-1562.

Padungtod, P., Kadohira, M. and HILL, G. 2008. Livestock Production and Foodborne Diseases from Food Animals in Thailand. J. Vet. Med. Sci. 70(9):873–879.

Paruksa, N., Ungsurat, A., Mata, N. And Watana, J. 2008. Study of the contract farming for livestock production (swine) in Thailand. Final Report Thailand Research Fund. 179 pp.

Paulenz, H., Kommisrud, E. and Hofmo, P.O. 2000. Effect of long-term storage at different temperatures on the quality of liquid boar semen. Reprod. Dom. Anim. 35:83-85.

Prunier, A., Messias de Braganca, M. and Le Dividich, J. 1997. Influence of high ambient temperature on performance of reproductive sows. Livest. Prod. Sci. 52:123-133.

Reicks, D.L. and Levis, D.G. 2008. Fertility of semen used in commercial production and the impact of sperm numbers and bacterial counts. Theriogenology. 70:1377-1379.

Rozeboom, K.J., Troedsson, M.H., Shurson, G.C., Hawton, J.D. and Crabo, B.G. 1997. Late estrus or metestrus insemination after estrual inseminations decreases farrowing rate and litter size in swine. J. Anim. Sci. 75:2323-2327.

Sanankong, K., Tapcha, A., Kumphu, S., Intuman, P. and Tun-aud, S. 2000. Agricultural promotion models for Tambon Administrative Organization San Sai and Mae Pheag Mai, Ching Mai province. Final Report, Thailand Research Fund.183 pp.

Simarak, S., Leungmanee, W., Pongsri, M., Deerun, T. and Srila, S. 2006. Development of local knowledge management agents at sub-district and district level. Final report of the Thailand research fund. 164 pp.

Soede, N.M., Wetzels, C.C.H. and Zondag, W. 1995. Effects of time of insemination relative to ovulation, asdetermined by ultrasonography, on fertilization rate and accessory sperm count in sows. J. Reprod. Fertil. 104:99–106.

Steinfeld, H. 2003. Economic Constraints on Production and Consumption of Animal Source Foods for Nutrition in Developing Countries. J. Nutr. 133:4054S-4061S.

Steverink, D.W.B., Sode, N.M., Bouwman, E.G. and Kemp, B. 1997. Influence of insemination-ovulation interval and sperm cell dose on fertilization in sows. J. Reprod. Fertil. 111:165-171.

Steverink, D.W.B., Sode, N.M., Bouwman, E.G. and Kemp, B. 1998. Semen backflow after insemination and its effect on fertilization results in sow. Anim. Reprod. Sci. 54:109-119.

Steverink, D. W., Soede, N. M., Groenland, G. J., van Schie, F. W., Noordhuizen, J. P. and Kemp, B. 1999. Duration of estrus in relation to reproduction results in pigs on commercial farms. J. Anim. Sci. 77:801-809.

Suriyasomboon, A., Lundeheim, N., Kunavongkrit, A. and Einarsson, S. 2006. Effect of temperature and humidity on reproductive performance of crossbred sows in Thailand. Theriogenology. 65:606-628.

Tantasuparuk, W., Dalin, A-M., Lundeheim, N., Kunavongkrit, A. and Einarsson S. 2001. Body weight loss during lactation and its influence on weaning-to-service interval and ovulation rate in Landrace and Yorkshire sows in the tropical environment of Thailand. Anim. Reprod. Sci. 65:273–281.

Tantasuparuk, W., Techakumphu, M. and Dornin, S. 2004. Relationships between ovulation rate and litter size in purebred Landrace and Yorkshire gilts. Theriogenology. 63:1142–1148.

Tast, A., Peltoniemi, O.A.T., Virolainen, J.V., Love, R.J. 2002. Early disruption of pregnancy as a manifestation of seasonal infertility in pigs. Anim. Reprod. Sci. 74:75–86.

Techa–atik, S. 2006. Community learning process and knowledge management for community organization. Final report of the Thailand research fund. 126 pp.

Techakumphu, M., Tantasuparuk, W., Tummarak, P., Chanchai, W., Am-In, N. and Burana-Amnuay, K. 2005. The use of information technology to improve pig production. The research of the cooperation between Chulalongkorn University and Rajamangala University of Technology Lanna Nan: final report. 26 pp.

Techakumphu, M., Tantasuparuk, W., Suwimonteerabutr, J., Am-In, N, Manopek, S. and Tanu, N. 2007. Establishment of Artificial Insemination Center and Related Researches. A Final report. The research of the cooperation between Chulalongkorn University and Rajamangala University of Technology Lanna Nan: final report. 49 pp.

Techakumphu, M., Tantasuparuk, W., Suwimonteerabutr, J., Visalvethaya, W., Tanu, N and Nitiwararuk, K. 2008. The development of semen production and artificial insemination in small holder pig farms for self-sufficiency and sustainable implementation (year IV). The research of Chulalongkorn University: final report. 30 pp.

Thaker, M.Y.C. and Bilkei, G. 2005. Lactation weight loss influences subsequent reproductive performance of sows. Anim. Reprod. Sci.88:309–318.

Tilton, J.E. and Cole, D.J.A.1982. Effect of triple versus double mating on sow productivity. Anim. Prod. 34:279–82.

Tongkow, K., Sungsri, S. Limsuwan, T., Juito, S., Hutapeal, B. Ratioran, S., Nitikasetsoontorn, P. and Krongchon, P. 2002. A project of research and development of work skill in the aspect of social development for subdistric administration organizations. Final report of the Thailand research fund. 156 pp.

Wabacha, J.K., Maribei, J.M., Mulei, C.M., Kyule, M.N., Zessin, K.H. and Oluoch-Kosura, W. 2004. Health and production measures for smallholder pig production in Kikuyu Division, central Kenya. Prev. vet. Med. 63:197-210.

Waberski, D., Weitze, K.F., Lietman C., Lage, W.L.Z., Bortolozzo, F.P., Willmen, T. and Petzoldt, R. 1994. The initial fertilizing capacity of longterm-stored liquid boar semen following pre- and postovulatory insemination. Theriogenology. 41:1367-1377.

Waller, C.M. and Bilkei, G. 2002. Effect of mating frequency on sow reproductive performance under field conditions and natural mating in large outdoor production units. Reprod. Dom. Anim. 37:116–118.

Weitze, K.F. 2000. Update on the worldwide application of swine AI. Boar semen preservation IV. Lawrence, Kansas: Allen Press Inc. 141-146.

Wikipedia, the free encyclopedia. 2009. World population. [Online].Available from : http://en.wikipedia.org/wiki/World_population [2009, Aug 22]

Vu, T.K.V., Tran, M.T. and Dang, T.T.S. 2007. A survey of manure management on pig farms in Northern Vietnam. Livest. Sci. 112:288–297.

Zou, C.X. and Yang, Z.M. 1999. Evaluation on sperm quality of freshly ejaculated boar semen during in vitro storage under different temperature. Therogenology. 53:1477-1488.

APPENDICES

1. Lecture documents

1.1. Reproductive anatomy of female pigs

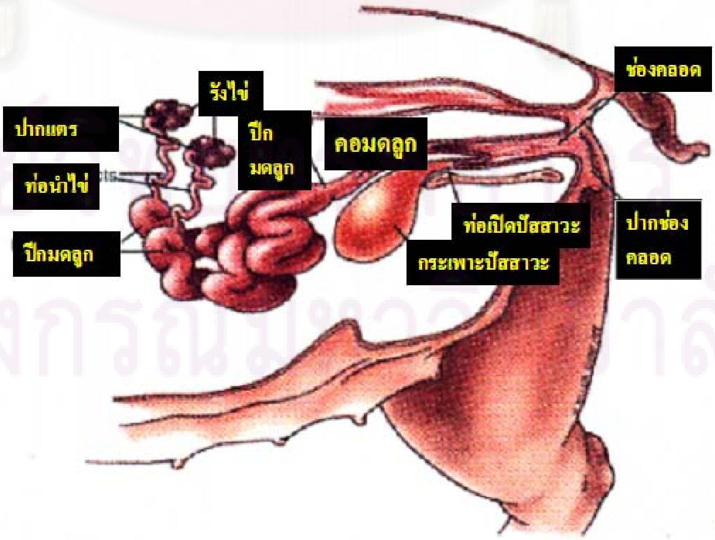
## กายวิภาคระบบสืบพันธุ์สุกร

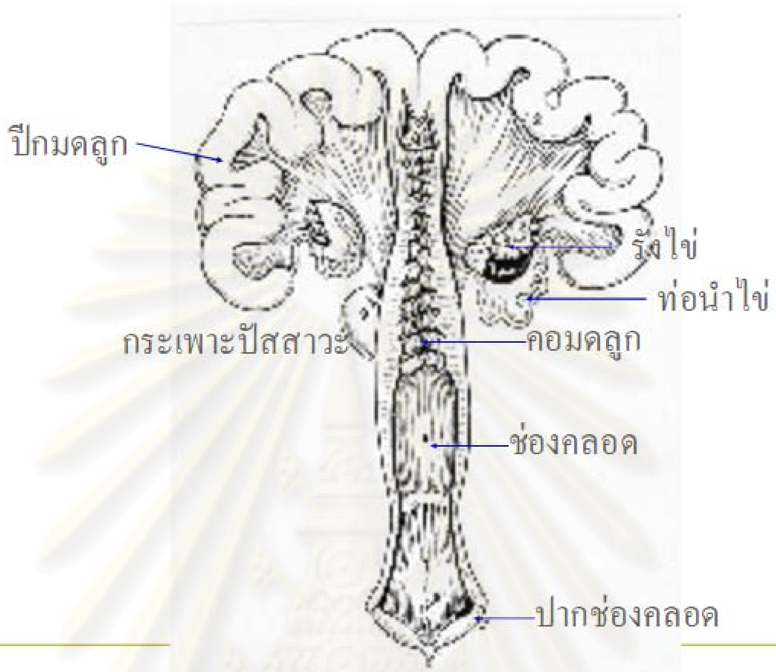
ศาสตราจารย์ น.สพ.ดร.มงคล เตชะกำพุ

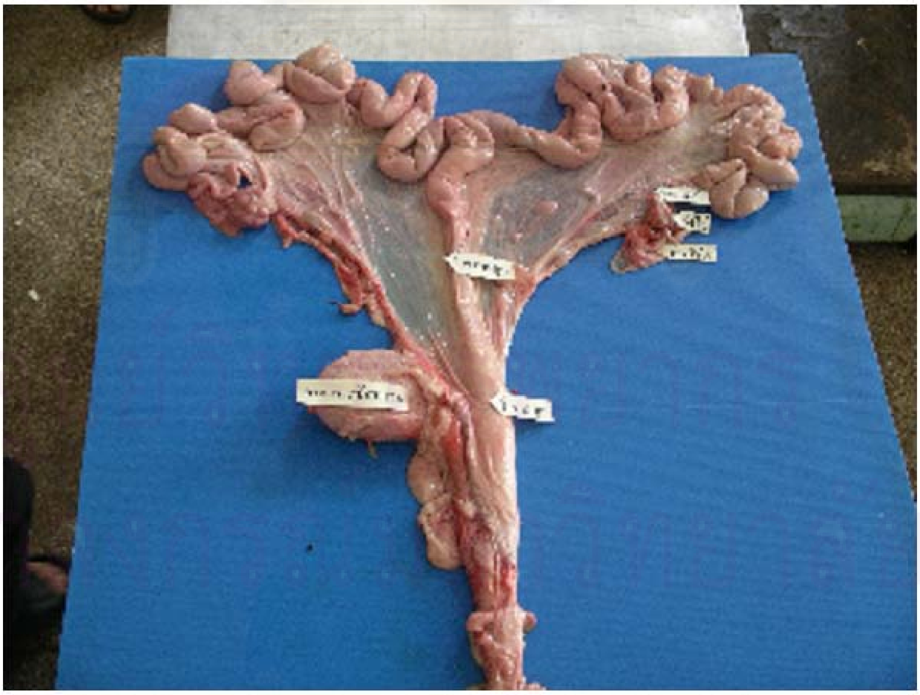
การฝึกอบรมเชิงปฏิบัติการด้านการผสมเทียมสุกร ครั้งที่ 2/2550

วันที่ 16 ตุลาคม 2550

ณ ศูนย์การเรียนรู้และบริการวิชาการเครือข่าย แห่งจุฬาลงกรณ์มหาวิทยาลัย จ.น่าน




ปีกมดลูก
รังไข่
ท่อนำไข่
กระเพาะปัสสาวะ
คอมดลูก
ช่องคลอด
ปากช่องคลอด



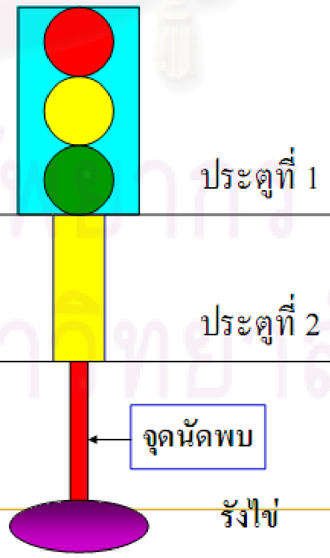

จุดตกไข่
รังไข่
ท่อนำไข่

## รังไข่แม่สุกร

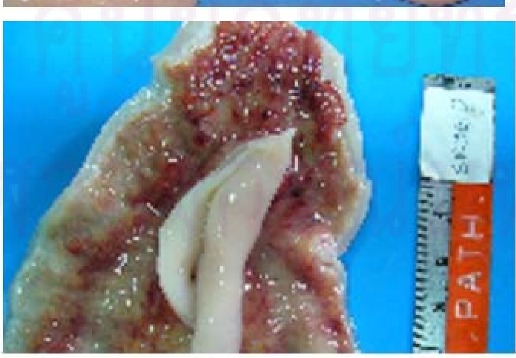
ตกไข่ครั้งละ 15-20 ใบ (ข้างละประมาณ 10 ใบ)

## ส่วนประกอบที่สำคัญของอวัยวะสืบพันธุ์แม่สุกร

- ปากช่องคลอด
- ช่องคลอด
- คอมดลูก
- มดลูก
- ปีกมดลูก
- ท่อนำไข่
- รังไข่




CU. VET. PATH.


PATH.


CU VET PATH

1.2. Disease transmission and hygiene

# โรคติดต่อทางน้ำเชื้อสุกร

สพ.ญ. วีร์ธิมา วิศาลเวทย์

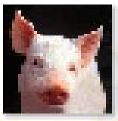
**การฝึกอบรมเชิงปฏิบัติการด้านการผสมเทียมสุกร ครั้งที่ 3/2551**

**วันที่ 4 ตุลาคม 2551**

**ณ ศูนย์การเรียนรู้และบริการวิชาการเครือข่าย แห่งจุฬาลงกรณ์มหาวิทยาลัย จ.น่าน**

โครงการความร่วมมือระหว่างอบจ.และจุฬาลงกรณ์มหาวิทยาลัย
ในเรื่องการผสมเทียมและสุขภาพสุกร จ.น่าน

สพ.ญ.วีร์ธิมา วิศาลเวทย์



## โรคติดต่อทางน้ำเชื้อสุกร

- ในปัจจุบัน การผสมเทียมสุกร เป็นที่ นิยมกันแพร่หลาย
- ง่ายต่อการ **กระจายพันธุกรรมที่ดี** ไปยังที่ต่างๆทั่วประเทศและทั่วโลก
- ดังนั้น ถ้ามีการ ปนเปื้อนของเชื้อโรคในน้ำเชื้อ จะทำให้โอกาสเสี่ยงที่จะติดโรคนั้นเพิ่มมากขึ้น ก่อให้เกิดปัญหาทางระบบสืบพันธุ์ในเพศเมีย และทำให้เกิดความสูญเสียทางเศรษฐกิจ
- น้ำเชื้อสุกรสามารถปนเปื้อนเชื้อไวรัสและแบคทีเรียที่ก่อให้เกิดโรคสำคัญในสุกรได้หลายชนิด

29 ก.ค.50

WEETHIMA VISALVETHAYA

# โรคที่ติดต่อได้ทางน้ำเชื้อสุกร

โรคอหิวาต์สุกร

โรคพีอาร์อาร์เอส

โรคปากและเท้าเปื่อย

โรคพิษสุนัขบ้าเทียม

โรคแท้งติดต่อ

โรคฉี่หนู (เลปโตสไปโรซีส)

โรคหนองไหล

29 ก.ค.50 WEETHIMA VISALVETHAYA

# โรคอหิวาต์สุกร

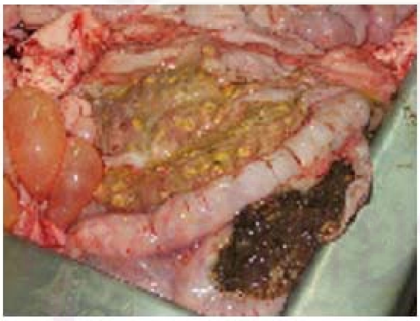
- โรคติดต่อตามพรบ.โรคระบาดสัตว์ พ.ศ. 2499
- โรคติดต่อร้ายแรง เกิดจากเชื้อไวรัส

29 ก.ค.50 WEETHIMA VISALVETHAYA

# โรคอหิวาต์สุกร



# โรคอหิวาต์สุกร



แผลหลุมที่ลำไส้


จุดเลือดออกที่ไต

ที่มา : น.สพ.เติมสิทธิ ปภาวสิทธิ์ ภาควิชาพยาธิวิทยา คณะสัตวแพทยศาสตร์ จุฬาฯ

# โรคอหิวาต์สุกร

มัมมี่ แท้ง

29 ก.ค.50

WEETHIMA VISALVETHAYA

# โรคพีอาร์อาร์เอส

- โรคระบาดรวดเร็ว
- แท้ง มัมมี่
- ลูกสุกรแรกคลอดอ่อนแอ
- สูญเสียลูกสุกรก่อนหย่านมสูง
- อัตราการเจริญเติบโตลด

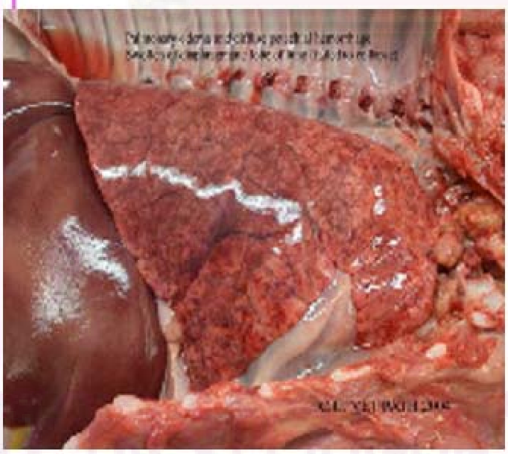
29 ก.ค.50

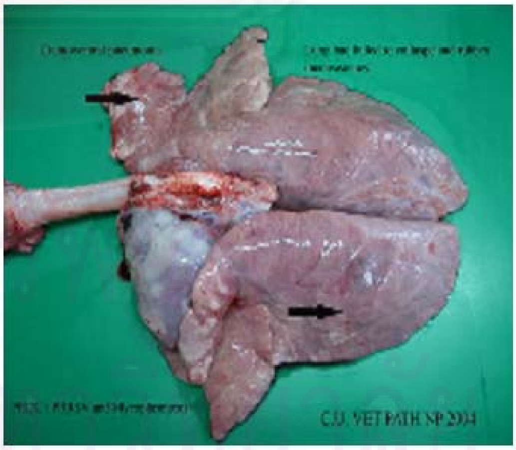
WEETHIMA VISALVETHAYA

# โรคพีอาร์อาร์เอส



# โรคพีอาร์อาร์เอส






ที่มา : น.สพ.เติมสิทธิ ปภาวสิทธิ์ ภาควิชาพยาธิวิทยา คณะสัตวแพทยศาสตร์ จุฬาฯ

## โรคปากและเท้าเปื่อย

- โรคติดต่อเชื้อไวรัส
- รอบต่อระหว่างกีบและผิวหนังรอบ ๆ อักเสบบวมแดง
- กีบหลุด พื้นเท้าเปื่อย

29 ก.ค.50

WEETHIMA VISALVETHAYA

## โรคปากและเท้าเปื่อย

ตุ่มใส หรือแผลหลุมที่ จมูก ปาก ลิ้น

29 ก.ค.50

WEETHIMA VISALVETHAYA

# โรคปากและเท้าเปื่อย

- ในแม่สุกรอาจพบตุ่มพองที่ราวนม หัวนม อวัยวะเพศ
- ลูกสุกรดูดนม ตายเกือบยกครอก(กล้ามเนื้อหัวใจอักเสบรุนแรง)
- สุกรท้อง มักแท้ง
- น้ำนมแม่สุกรลด
- ลูกสุกรน้ำหนักลด

29 ก.ค.50 WEETHIMA VISALVETHAYA

# โรคพิษสุนัขบ้าเทียม

- โรคติดเชื้อไวรัส
- ชักตะกาย อัมพาต หายใจลำบาก
- อัตราตายสูงมากในลูกสุกร
- แม่สุกรแท้ง มัมมี่ ตายแรกคลอด

29 ก.ค.50 WEETHIMA VISALVETHAYA

# โรคแท้งติดต่อ

- โรคติดเชื้อแบคทีเรีย
- เป็นโรคในพรบ.โรคระบาดสัตว์ พ.ศ. 2499
- ไม่แสดงอาการชัดเจน แต่ทำให้เกิดความผิดปกติทางระบบสืบพันธุ์
- แท้ง มัมมี่ ลูกแรกคลอดอ่อนแอ
- พ่อพันธุ์อัณฑะบวม
- ติดต่อถึงคน

29 ก.ค.50 WEETHIMA VISALVETHAYA

# โรคแท้งติดต่อ

29 ก.ค.50 WEETHIMA VISALVETHAYA

# โรคฉี่หนู (เลปโตสไปโรซีส)

- เสียหายชัดเจน
- แท้ง มัมมี่
- ลูกสุกรแรกคลอดอ่อนแอ อัตราตายแรกคลอดสูง



# โรคหนองไหล

- ติดเชื้อแบคทีเรียในมดลูก ช่องคลอด
- อัตราผสมติดต่ำ
- แท้ง
- ไข้ น้ำนมลด

# สรุป

- เชื้อโรคสามารถปนเปื้อนมากับน้ำเชื้อได้ พ่อสุกร ⟶ แม่สุกร
    - แท้ง ตายแรกคลอด ตายก่อนหย่านม

## ผสมเทียมสามารถช่วยแก้ได้

พ่อพันธุ์ปลอดโรค

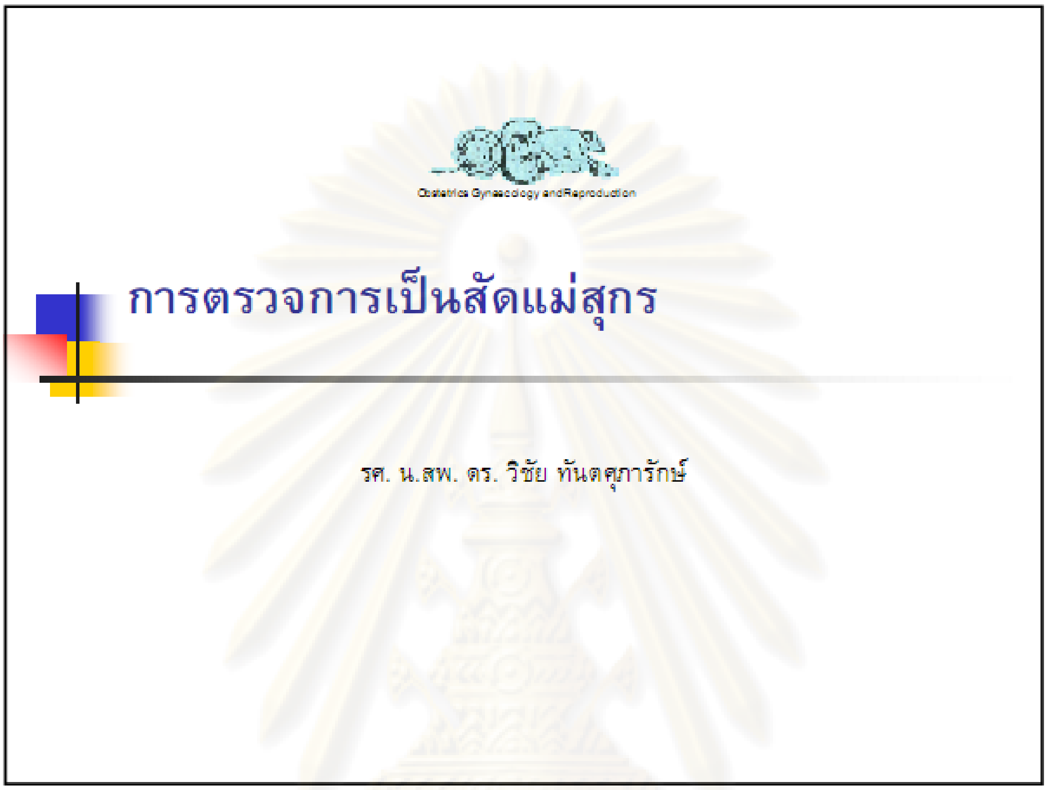
น้ำเชื้อสะอาด

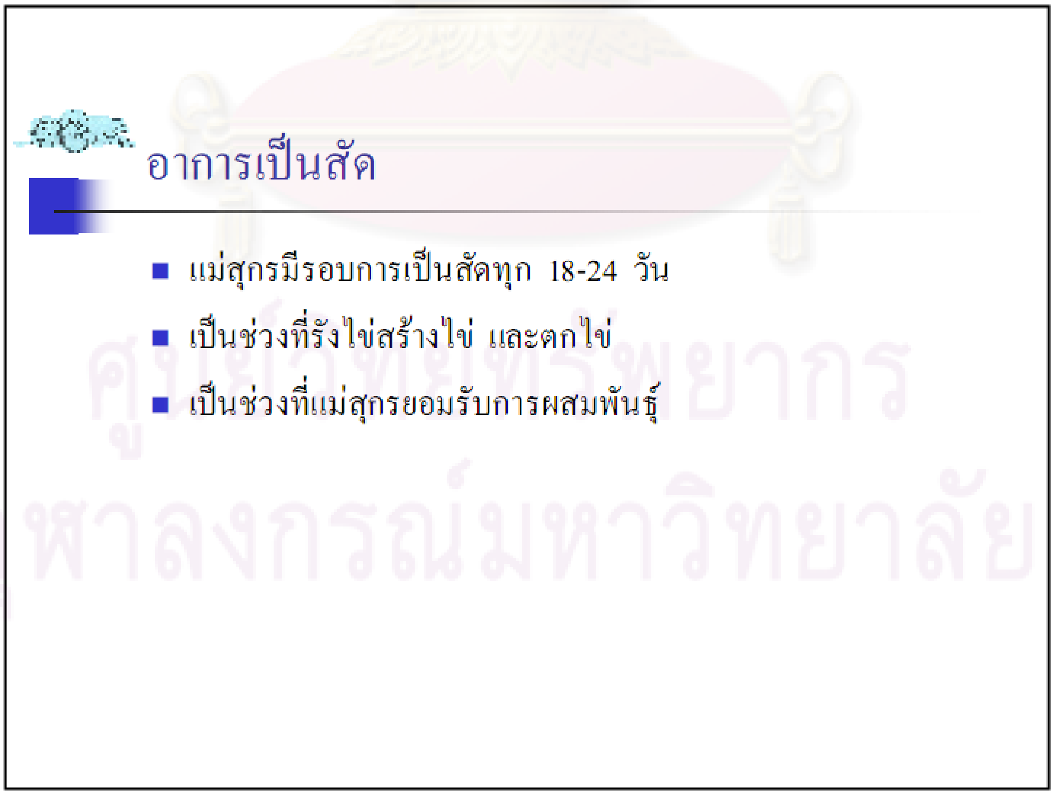


# การป้องกัน

- ตรวจสุขภาพพ่อสุกรเป็นประจำ
- มีโปรแกรมตรวจเฝ้าระวังโรคและฉีดวัคซีนป้องกันโรค
- กักโรค 1 เดือนก่อนเข้าฟาร์ม
- ตรวจประเมินคุณภาพน้ำเชื้อและกระบวนการเตรียมน้ำเชื้อก่อนนำไปใช้

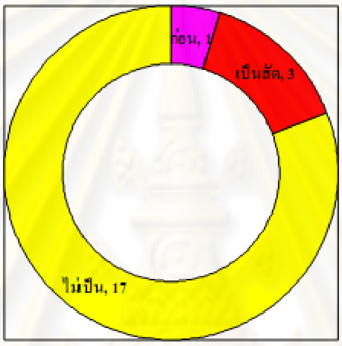
1.3 Heat detection



## ระยะของการเป็นสัด

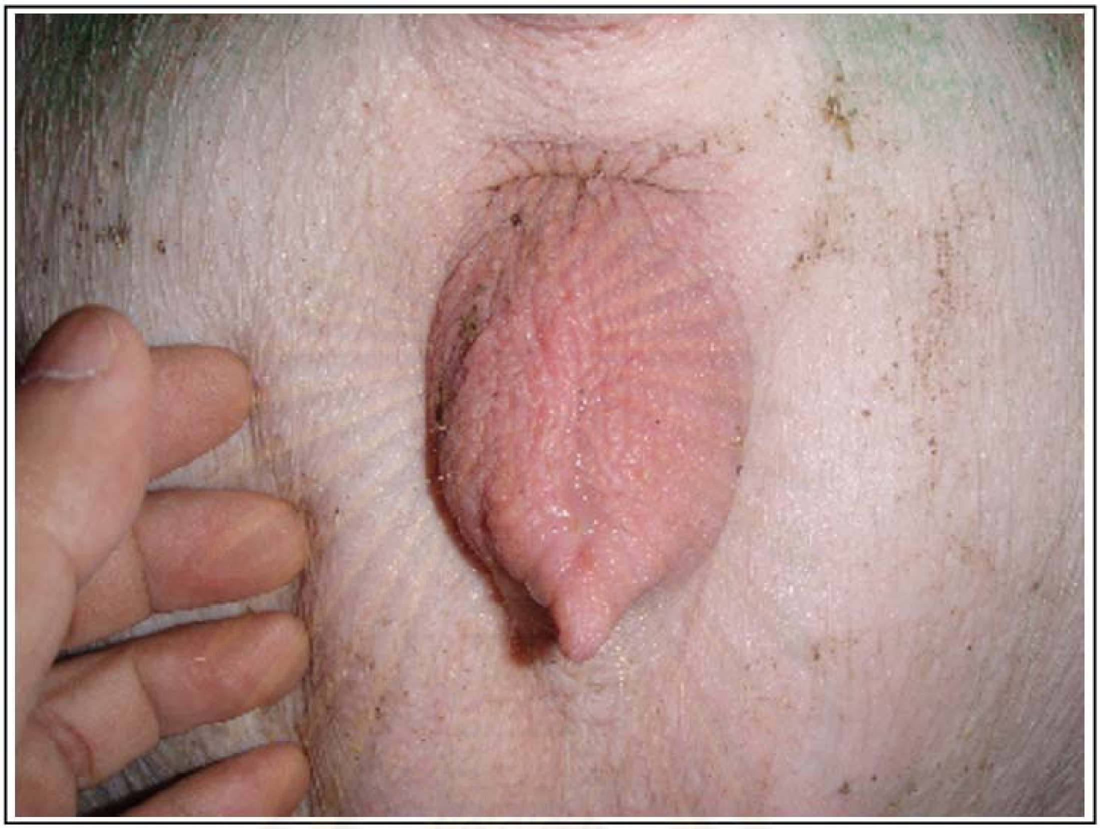
- ระยะก่อนเป็นสัด (Proestrus)
- ระยะเป็นสัด (Oestrus)

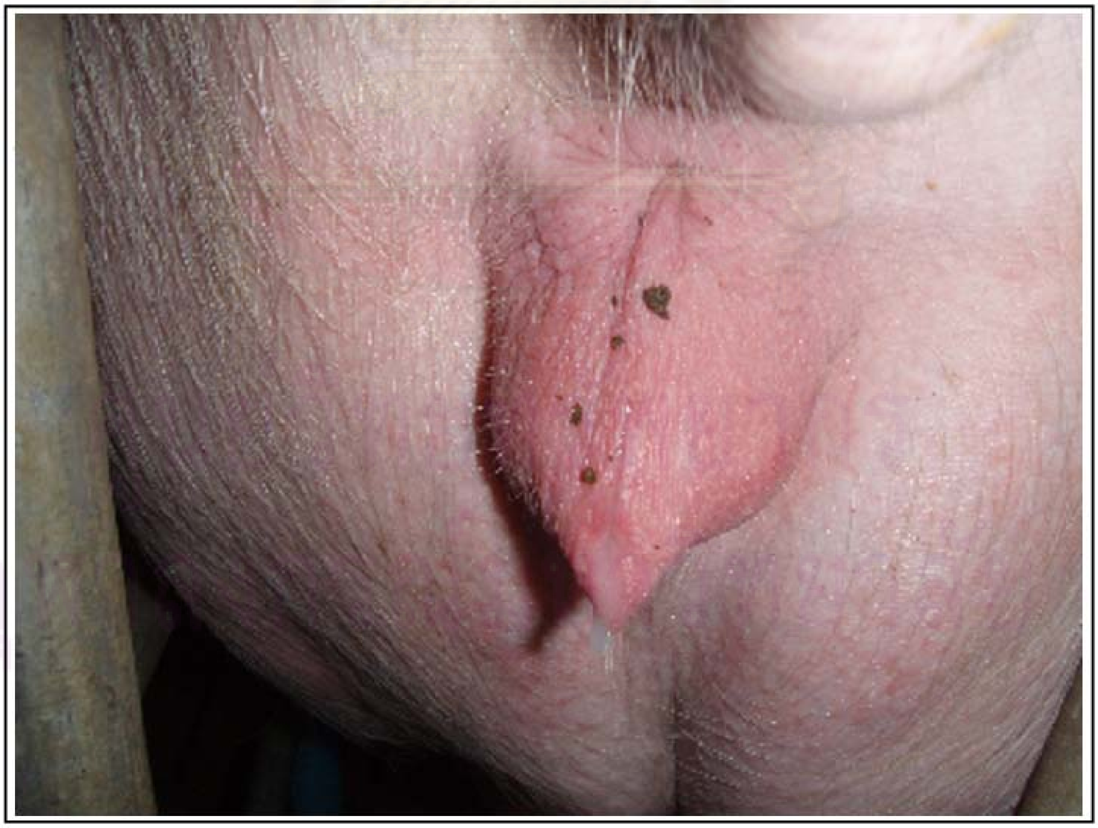



## ระยะก่อนเป็นสัด

คือช่วงก่อนเป็นสัด กินเวลาประมาณ 1 วัน

- อวัยวะเพศเมียภายนอก (ปากช่องคลอด/แคม) บวม แดง
- ยืนนานและบ่อยกว่าปกติ แทนที่จะนอน
- ตะกายปีนคอก ขึ้นขี่ตัวอื่น แต่ไม่ยอมถูกขี่
- มีน้ำเมือกเหลวใสจากปากช่องคลอด
- ส่งเสียงครางหาพ่อสุกร





## ระยะเป็นสัด

- อวัยวะเพศเมียภายนอก ลดขนาดลง อาจเกือบเท่าปกติ
- ร้องกรีดเรียกหาพ่อสุกร
- เบื่ออาหาร ชอบยืนนาน ๆ เวลายืนจะยกหาง และกระดกขึ้นลง หูเกร็งจนตั้งหรือยกขึ้น อาจสั่นพลิ้ว ช่วงหลังเกร็ง อาจโก่ง ตัวสั่น
- น้ำเมือกจากปากช่องคลอดเหนียวข้นขึ้น
- ตอบสนองการกดหลังด้วยการยืนนิ่ง เกร็งตัวรับน้ำหนักกดทับ

## การตรวจสัด

- ตรวจอย่างน้อยวันละ 2 ครั้ง อย่าให้ห่างเกิน 15 ชั่วโมง
- ตรวจก่อน/หลังมื้ออาหาร 2 ชม.
- พ่อสุกรอยู่ด้านหน้าอย่างใกล้ชิด
- ให้เวลากับการตรวจพอสมควร เฉลี่ยตัวละ 3-5 นาที
- มีการกระตุ้นอย่างเหมาะสม สังเกตความพร้อมของแม่สุกร ฉี่/ขี้เสร็จแล้ว ขาไม่เจ็บ ไม่ซึมไม่ป่วย
- วนกลับมาตรวจใหม่จนแน่ใจ
- เปลี่ยนพ่อสุกร มาเก็บตกพวกที่สงสัย
- บันทึกการเปลี่ยนแปลงเป็นรายตัว อาจใช้เป็นรหัส

## เวลาตกไข่

| % ของการยืนนิ่ง | พิสัย | จำนวนแม่สุกร | ผู้วิจัย |
|---|---|---|---|
| 71± 14 | - | 91 | Nissen et al.,1997 |
| 68± 8 | 54-78 | 20 | Mburu et al.,1995 |
| 67± 6 | 58-77 | 13 | Soede et al.,1992 |
| 72± 15 | 39-133 | 144 | Soede et al.,1995a |
| 69± 1 | - | 60 | Soede et al.,1995b |
| 68± 10 | - | 115 | Steverink et al.,1997 |

## ระยะเวลาเป็นสัด

| เป็นสัดนาน (ชม) | พิสัย | จำนวนแม่สุกร | ผู้วิจัย |
|---|---|---|---|
| 50±13 | 24-88 | 144 | Soede et al.,1995 |
| 56±7.9 | 46-73 | 15 | Mburu et al.,1995 |
| 47±12.4 | - | 6 | Dalin et al.,1995 |
| 48.4 ±1.0 | 31- 64 | 15,186 | Steverink et al.,1999 |

- จุดผสม จุดตรวจสัด อยู่คนละที่
- ตรวจพบว่าเป็นสัด กำหนดเวลาผสม ย้ายไปเรียงตามเวลาและประเภท
- พ่อสุกร 1 ต่อแม่ 3 ไม่เกิน 4 อยู่จนเสร็จทุกตัว
- อย่ากำหนดกลุ่มพ่อสุกร ใช้เช้า-ใช้เย็น ควรคละกัน
- เริ่มผสม โต๊สแรกก่อน - สุกรสาว แม่หย่านม ตกค้าง กลับสัด
- ตัวไหนยืนนิ่งตัวเกรง ต้องผสมภายใน 15 นาที ถ้าไม่ทัน พัก 2 ชม.
- น้ำเชื้อไหลกลับขณะผสมคาท่อ อาจต้องผสมใหม่

1.4. Semen transportation, handling and preparation of female before AI and procedure of AI in pigs


## ข้อดี การผสมเทียม : ง่าย ประหยัด สะดวก

- ลดปัญหาหนอง ลดปัญหาแท้ง
- ป้องกันโรคติดต่อที่มากับน้ำเชื้อ
- ได้ลูกดก
- ได้ลูกสุกรตัวโต เจริญเติบโตเร็ว
- ขายได้ราคาดีกว่า
- ประหยัดกว่า (เวลา+ค่าใช้จ่าย)

- ลดอันตรายจากความก้าวร้าวของพ่อสุกรต่อผู้เลี้ยงขณะผสมพันธุ์
- สามารถผสมได้แม้ในแม่พันธุ์ตัวเล็ก

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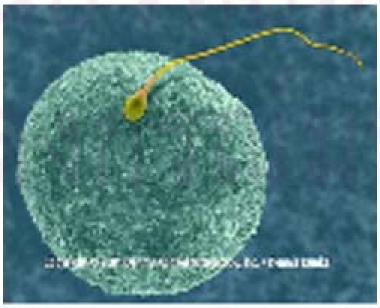
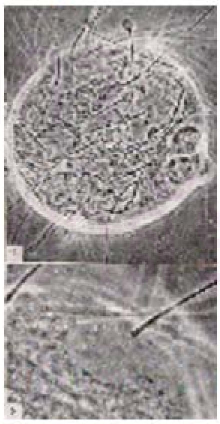
## เวลาผสมที่เหมาะสม

- เป้าหมายคือ

ไข่ที่ตกมา ต้องได้รับการ ผสมด้วยตัวอสุจิ

ให้ได้ มากที่สุด





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## เวลาผสมที่เหมาะสม

- สุกรสาว

  ผสมทันทีที่เป็นสัดยืนนิ่ง และซ้ำทุก 12-24 ชั่วโมง

- สุกรแม่พันธุ์ (แม่นาง)

  ผสมหลังยืนนิ่ง 12 ชั่วโมง และซ้ำอีกครั้ง ที่ 12-24 ชั่วโมง

เป็นสัดยืนนิ่ง เช้า ⟶ ผสมเย็นวันนั้น, เช้าวันถัดไป

เย็น ⟶ ผสมเช้า ,เย็นวันถัดไป

**ตรวจสัด สำคัญมาก!!!!!!!**

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## การเตรียม แม่สุกร เพื่อผสมเทียม

- อาบน้ำ และรอให้ตัวแห้ง
- ทำความสะอาดบริเวณอวัยวะเพศภายนอกด้วยยาฆ่าเชื้ออ่อนๆ หรือ สบู่ หรือน้ำสะอาด

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## การเตรียม สถานที่ ผสมเทียม

- ควรเป็นคอกแม่พันธุ์
- พื้นคอกควร แห้ง สะอาด
- เก็บกวาดมูลออกให้หมด

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## การขนส่งหลอดน้ำเชื้อจากศูนย์ฯ เพื่อไปผสมเทียม

1. จัดหากล่องโฟมที่สะอาดสำหรับใส่หลอดน้ำเชื้อ (ควบคุมอุณหภูมิและแสง)
2. ควบคุมอุณหภูมิขณะขนส่ง (น้ำแข็ง | แผ่นพลาสติก | หลอดน้ำเชื้อ)

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## การขนส่งหลอดน้ำเชื้อจากศูนย์ฯ เพื่อไปผสมเทียม

3. ก่อนผสมปรับอุณหภูมิหลอดน้ำเชื้อให้ใกล้เคียงอุณหภูมิร่างกาย
   - อุ่นในน้ำอุ่นที่อุณหภูมิประมาณ 37 องศาเซลเซียส
   - อุ่นประมาณ ไม่เกิน 5 นาที
   - ระวังแสงแดด !!!!

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## ขั้นตอน การผสมเทียม

1. ล้างมือผู้ผสมด้วยสบู่ให้สะอาด
2. เตรียมอุปกรณ์ผสมเทียม
   - เดือยผสมเทียม
   - หลอดน้ำเชื้อ

3. ทำความสะอาดอวัยวะเพศภายนอกให้สะอาด (อีกครั้ง ถ้าสกปรก)
4. จับท่อผสมเทียมให้แน่นพอเหมาะ กำส่วนด้าม ห้ามจับส่วนอื่น
5. ใช้สารหล่อลื่นที่ปลายเดือยผสม เช่น KY- Jelly ห้ามใช้สบู่ และผงซักฟอก
6. ใช้นิ้วมือแบะเปิดปากช่องคลอด
7. สอดท่อผสมเทียม ให้วิ่งขนานไปกับผนังด้านบนของช่องคลอด

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# **ขั้นตอน** การผสมเทียม

8. สอดท่อผสมเทียมถึง “คอมดลูก”

ถ้าปลายท่อเป็น**แบบเกลียว** ให้หมุนทวนเข็มนาฬิกา

ถ้าปลายท่อเป็น**ฟองน้ำนุ่ม** ให้ค่อยๆ

ดันเข้าไปตรงๆ

ดันจนสุดแล้วทดสอบดึงกลับเบาๆหากล็อก จะไม่หลุดง่าย

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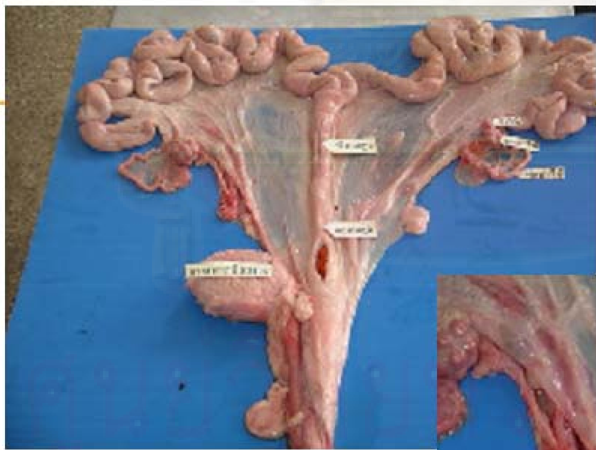


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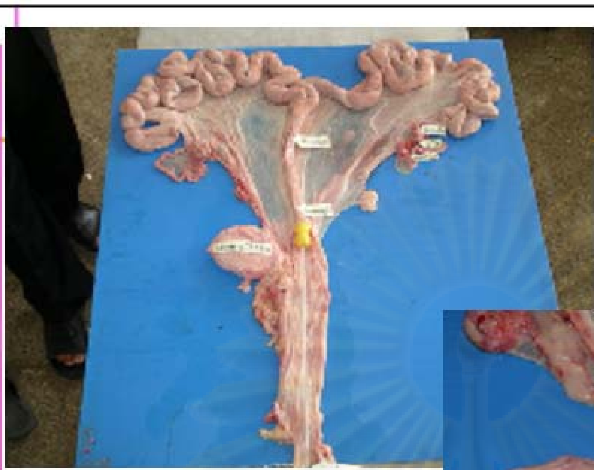

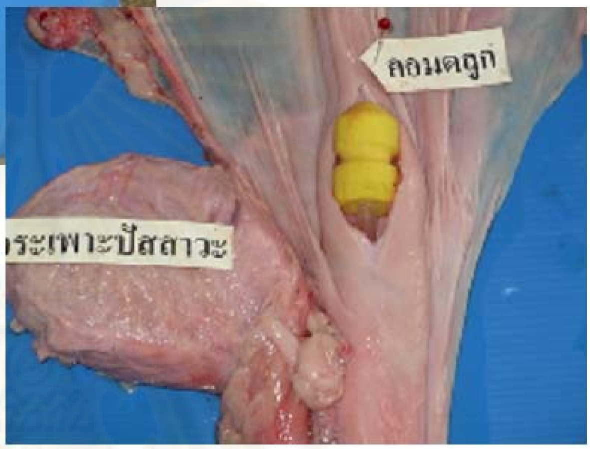


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## ขั้นตอน การผสมเทียม

9. บิดปลายหลอดน้ำเชื้อให้เปิดออก ใส่เข้าที่ปลายท่อผสมเทียม ค่อยปล่อยให้น้ำเชื้อไหลเข้าท่อ ช้า ๆ ป้องกันการไหลย้อนกลับ

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## ขั้นตอน การผสมเทียม



## ในขณะสอดท่อผสมเทียม........

ถ้ามีการไหลย้อนกลับ

- ท่อที่สอดไว้หลวม หรือ ล็อคไม่แน่นกับคอมดลูก
- ปล่อยน้ำเชื้อเร็วเกินไป (บีบ)
- เป็นสัดไม่ดี (ถ้าเป็นสัดดีจะดูดเข้าไปเอง)

## ในขณะสอดท่อผสมเทียม........

- ควรมีการกระตุ้นแม่สุกร เช่น
    - ขี่หลัง หรือมีกระสอบทรายทับหลัง เสมือนพ่อทับ
    - เล้าโลมโดยลูบกระตุ้นที่ราวนม หรืออวัยวะเพศภายนอก

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## ข้อปฏิบัติหลังผสมเทียม

- ปล่อยให้แม่สุกรอยู่เงียบ ๆ
- ให้อยู่ในคอกเดิมอย่างน้อย 3 สัปดาห์หลังผสม
- ไม่นำสุกรต่างกลุ่มมารวมกัน (กัดกัน)
- 18 – 24 วันตรวจการกลับสัด
- ตรวจการตั้งท้องที่ 25 วันหลังผสมขึ้นไป

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# สรุป

- การผสมเทียมช่วยเพิ่มผสมผลิต ประหยัด ป้องกันโรค

- ขั้นตอนการผสมเทียม ทุกขั้นตอน
    - ความสะอาด
    - ถูกต้อง ละเอียด เอาใจใส่

- ใช้ได้ดีในฟาร์มสุกรทั่วไป

WEETHIMA VISALVETHAYA

# BIOGRAPHY

## WEETHIMA VISALVETHAYA, D.V.M.

Date of birth: September $21^{st}$, 1983

Place of birth: Bangkok

Education:

2001-2006 Doctor of Veterinary Medicine (D.V.M.), Chulalongkorn University

1995-2000 Chulalongkorn University Demonstration Secondary School

1989-1994 Chulalongkorn University Demonstration Primary School

Work experience:

2007 Teaching assistant at Department of Obstetrics Gynaecology and Reproduction, Faculty of Veterinary Science, Chulalongkorn University

2007- 2009 Research assistant of the project “The Development of Semen Production and Artificial Insemination in Small Holder Farms for Self-Sufficiency and Sustainable Implementation”

2007- 2008 Research assistant of the project “The Application of Management and Quality Assurance for Biosecurity System Development in Swine Breeding herd”