Breeding Improvement of Swamp Buffalo

Charan Chantalakhana
Kasetsart University

Follow this and additional works at: http://digitalcommons.unl.edu/wcgalp
Part of the Animal Sciences Commons

http://digitalcommons.unl.edu/wcgalp/5

This Article is brought to you for free and open access by the Animal Science Department at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in 3rd World Congress on Genetics Applied to Livestock Production by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.
BREEDING IMPROVEMENT OF SWAMP BUFFALO

CHARAN CHANTALAKHANA
Department of Animal Science, Kasetsart University
Bangkok 10900, Thailand

SUMMARY

A review of performance of the swamp buffalo concerning reproductive traits, growth and carcass, milk production, and work capacities was presented. The potential for breeding improvement of certain traits was discussed. Breeding objectives and goals to suit the need of Asian smallfarmers were emphasized. Breeding of swamp buffalo for draft and for multi-purpose was discussed. Genetic selection and crossbreeding of the swamp buffalo were reviewed. It was proposed that genetic selection for weight and gain should improve meat production as well as draft ability of the swamp buffalo, while crossbreeding should be limited to experimental scale until crossbred buffaloes have been well tested for farmers' acceptance under prevailing smallfarm conditions. The aspect of germplasm conservation was also emphasized.

INTRODUCTION

According to the FAO statistics, in 1981 there were approximately 36 million swamp buffaloes in the Asian countries where sizeable populations of the swamp type existed (see Table 1). This number can be regarded as a minimum estimate of the world swamp buffalo population since additional numbers of these animals are also being raised in many other countries such as Australia, Sri Lanka, Taiwan, Brunei, etc. Mahadevan (1983) indicated that the swamp-type buffalo shared about 29.7 percent of the total world buffalo population, while the riverine type accounted for 66.7 percent and the rest (3.6%) were the Mediterranean buffaloes.

Table 1. Numbers of buffaloes in countries with sizeable populations of the swamp type

<table>
<thead>
<tr>
<th>Country</th>
<th>Thousand head</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burma</td>
<td>1,950</td>
</tr>
<tr>
<td>China</td>
<td>18,520</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2,488</td>
</tr>
<tr>
<td>Kampuchea</td>
<td>404</td>
</tr>
<tr>
<td>Laos</td>
<td>880</td>
</tr>
<tr>
<td>Malaysia</td>
<td>293</td>
</tr>
<tr>
<td>Philippines</td>
<td>2,782</td>
</tr>
<tr>
<td>Thailand</td>
<td>6,124</td>
</tr>
<tr>
<td>Vietnam</td>
<td>2,378</td>
</tr>
</tbody>
</table>

Source: FAO Production Year-book, 1981
While the riverine type is raised primarily for milk the swamp buffaloes are raised mainly for work, with manure as the most important by-product for rural small farmers in Asia whose livelihood depends on traditional integrated-rainfed farming systems in which crops are the major commodity. Culled or old draft animals are sold for slaughter to supply beef for town and city consumption.

Most of the Asian farmers are rural smallholders, they have traditionally integrated their livestock and crop production. Most buffaloes are mainly raised for work in crop production. The use of buffaloes or cattle for draft is quite suitable economically and sociologically since most farmers live in remote areas and own only small parcels of land, while, family labor is available whenever needed. Buffalo production is not regarded as a distinct enterprise; rather, it is an integral part of a crop production system and many characteristics of these systems are reflected in the husbandry practices and use of the buffaloes.

The general characteristics of buffalo production on small farms under village conditions are the followings (Chantalakhana, 1980b and 1983a).

- As a complement to crop production.
- Utilization of non-marketable farm products and marginal land.
- Utilization of surplus family labor.
- Required minimal cash inputs and simple and traditional technology.
- Non-market oriented production.
- Very low degree of risk.

As stated by McDowell and Hilderbrand (1980), the usual reasons for keeping animals on small farms are mainly reduction of risks from cropping, accumulation of capital, render services, e.g. traction, fertilizer, fuel. In general, attention is not given to obtaining high rate of output of meat from buffalo because other products and services are more important in the smallfarm system. Hence, buffalo production system under village conditions especially in Southeast Asia is commonly referred to as 'subsistence production' or 'traditional buffalo production' system.

The purpose of this paper is to review genetic information available on some important traits of swamp buffaloes and to discuss certain aspects of their breeding improvement with special reference to Asian farming backgrounds.

GENETIC POTENTIAL

Research in the swamp buffalo has been very scarce, especially studies in genetics. Most genetic information available up to present time has been the results from the studies in the riverine or dairy buffaloes, which cannot be directly applicable to the swamp buffalo, both from environmental and genetic standpoints. However, there have been various field observations or feeding trials in the swamp buffaloes, from which phenotypic characteristics can be obtained. Most of these informations have been reviewed by Chantalakhana (1981b, 1982a, 1980a), which are summarized in Tables 2, 3, 4 and 5.

The characteristics related to meat production such as weights and gains are presented in Table 2, while dressing percentage, loin-eye, and other carcass characteristics in Table 3. The detail figures concerning these traits was presented in the report by Chantalakhana (1981b). The variation of the reported averages of most traits were substantial, this variation is of course due to both
genetic and environmental influences, but it should partly reflect the possibility of genetic selection in the swamp buffaloes.

It was reported that the heritability estimates for birth and eight-month weights of the swamp buffaloes were 0.63 and 0.37, respectively (Chantalakhana et al., 1981). Bhat (1979) reported the heritability estimates for various weights of Indian buffaloes to be from medium to high, as shown in details below:

<table>
<thead>
<tr>
<th>Weight/Gain</th>
<th>$h^2$ Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Birth</td>
<td>0.74 ± 0.10</td>
</tr>
<tr>
<td>2. At 3 months</td>
<td>0.49 ± 0.08</td>
</tr>
<tr>
<td>3. At 6 months</td>
<td>0.43 ± 0.08</td>
</tr>
<tr>
<td>4. At 9 months</td>
<td>0.33 ± 0.07</td>
</tr>
<tr>
<td>5. At 1 year</td>
<td>0.74 ± 0.11</td>
</tr>
<tr>
<td>6. At 2 years</td>
<td>0.43 ± 0.08</td>
</tr>
<tr>
<td>7. At 1st calving</td>
<td>0.23 ± 0.06</td>
</tr>
<tr>
<td>8. 1st year gain</td>
<td>0.56 ± 0.10</td>
</tr>
</tbody>
</table>

The corresponding heritability estimates for the swamp buffaloes can be expected to be lower than these estimates since the variation due to management and feeding as well as other environmental factors should be greater for draft or meat animals as compared to dairy. From these evidences, there is sufficient indication that genetic improvement for growth and size in the swamp buffaloes is possible, and medium genetic response to the improvement could be expected.

Table 2. Ranges of means for swamp buffalo growth characteristics (7)

<table>
<thead>
<tr>
<th>Traits</th>
<th>Unit</th>
<th>Range of $\bar{X}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Birth Weight</td>
<td>kg</td>
<td>26-38</td>
</tr>
<tr>
<td>2. 8-mos. Weight</td>
<td>kg</td>
<td>125-150</td>
</tr>
<tr>
<td>3. Preweaning Gain</td>
<td>kg</td>
<td>0.34-0.75</td>
</tr>
<tr>
<td>4. Yearling Weight</td>
<td>kg</td>
<td>135-205</td>
</tr>
<tr>
<td>5. Post-weaning Gain</td>
<td>kg</td>
<td>0.34-0.75</td>
</tr>
<tr>
<td>6. Mature Weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>kg</td>
<td>450-650</td>
</tr>
<tr>
<td>Female</td>
<td>kg</td>
<td>350-450</td>
</tr>
<tr>
<td>7. Height</td>
<td>cm</td>
<td>120-137</td>
</tr>
<tr>
<td>8. Girth</td>
<td>cm</td>
<td>180-209</td>
</tr>
<tr>
<td>9. Length</td>
<td>cm</td>
<td>121-157</td>
</tr>
</tbody>
</table>

1/ Reference number

Table 3. Ranges of means for carcass traits in swamp buffaloes (7)

<table>
<thead>
<tr>
<th>Traits</th>
<th>Unit</th>
<th>Range of $\bar{X}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dressing Percentage</td>
<td>%</td>
<td>43-51</td>
</tr>
<tr>
<td>2. Slaughter Weight</td>
<td>kg</td>
<td>300-600</td>
</tr>
<tr>
<td>3. Loin-Eye Area</td>
<td>cm</td>
<td>33-50</td>
</tr>
<tr>
<td>4. Carcass Length</td>
<td>cm</td>
<td>111-118</td>
</tr>
<tr>
<td>5. Boneless Meat</td>
<td>% of carcass</td>
<td>73-75</td>
</tr>
<tr>
<td>6. Hide</td>
<td>% of body wt.</td>
<td>11-13</td>
</tr>
<tr>
<td>7. Cold Shrinkage</td>
<td>%</td>
<td>3.1-4.5</td>
</tr>
</tbody>
</table>
As far as carcass traits are concerned, there has been no genetic reports in buffaloes. It is reasonable to expect similar nature of inheritance in the swamp buffaloes for the corresponding carcass traits to those observed in beef cattle. From Table 3, the phenotypic variation appeared to be high in most traits. Genetic selection for the carcass traits in buffaloes, however, may not receive the same degree of importance as that for growth and size, especially under present Asian socio-economic situations.

For reproductive traits, the ranges of means are shown in Table 4. Genetic studies on the reproductive traits in buffaloes have been confined to Indian dairy buffaloes. For the swamp buffaloes, there was only a report on the repeatability estimate of calving interval to be 0.39 (Chantalakhana et al, 1982). The repeatability can be used as the upper limit or high estimate for the heritability. Some estimates of heritability of the reproductive traits of Indian buffaloes were as follow.

<table>
<thead>
<tr>
<th>Reproductive Traits</th>
<th>$h^2$ estimates</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age at first calving</td>
<td>0.78</td>
<td>(11)</td>
</tr>
<tr>
<td>2. Calving interval</td>
<td>0.01</td>
<td>(3)</td>
</tr>
<tr>
<td>First</td>
<td>0.64</td>
<td>(6)</td>
</tr>
<tr>
<td>Second</td>
<td>0.11</td>
<td>(6)</td>
</tr>
<tr>
<td>3. Breeding efficiency</td>
<td>0.20</td>
<td>(18)</td>
</tr>
</tbody>
</table>

The estimates of heritability appeared to range from low to high. From various studies in beef cattle (Preston and Willis, 1970) this phenomenon also appeared to be similar, however, in general the estimates tended to be low. The genetic study of various reproductive traits in the swamp buffaloes deserves more attention from research workers, The figures in Table 4 show some reproductive traits in the swamp buffaloes.

Table 4. Ranges of means for reproductive traits in swamp buffaloes (7)

<table>
<thead>
<tr>
<th>Traits</th>
<th>unit</th>
<th>Range of $\bar{X}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age at Puberty</td>
<td>yr</td>
<td>1.6 - 3.0</td>
</tr>
<tr>
<td>2. Age at First Calving</td>
<td>yr</td>
<td>3.5 - 4.7</td>
</tr>
<tr>
<td>3. Estrous Cycle</td>
<td>d</td>
<td>20 - 34</td>
</tr>
<tr>
<td>4. Estrous Period</td>
<td>hr</td>
<td>24 - 36</td>
</tr>
<tr>
<td>5. Gestation Period</td>
<td>d</td>
<td>308 - 332</td>
</tr>
<tr>
<td>6. Calving Rate</td>
<td>%</td>
<td>23 - 82</td>
</tr>
<tr>
<td>7. Calving Interval</td>
<td>d</td>
<td>370 - 670</td>
</tr>
<tr>
<td>8. Twinning</td>
<td>%</td>
<td>0.001 - 0.015</td>
</tr>
</tbody>
</table>

Most estimates of milk production and other related traits as appeared in Table 5 were obtained from the animals not specially raised for dairy purpose. Generally, milk yield in the swamp buffaloes appeared to be low, but butterfat percentage was very high (8 to 10%) as compared to that of cow's milk.

Crossbreeding between the swamp and the Indian buffaloes produced fertile offspring with improved milk producing ability (Tumwasorn, 1981; Cüong 1983).
Table 5. Ranges of means for milk production and other related traits in swamp buffaloes (7)

<table>
<thead>
<tr>
<th>Traits</th>
<th>Unit</th>
<th>Range of $\bar{x}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Milk Yield</td>
<td>kg/d</td>
<td>1 - 2</td>
</tr>
<tr>
<td>2. Length of Lactation</td>
<td>d</td>
<td>121 - 330</td>
</tr>
<tr>
<td>3. Butterfat</td>
<td>%</td>
<td>8 - 10</td>
</tr>
<tr>
<td>4. Protein</td>
<td>%</td>
<td>4.2 - 5.3</td>
</tr>
<tr>
<td>5. Total Solid</td>
<td>%</td>
<td>18.1 - 21.3</td>
</tr>
</tbody>
</table>

There were very few studies in the past dealing with draft power of buffaloes. The term "draft" as used in agriculture refers to the force required to pull an object for a given distance (Gow and McDowell, 1980). Most reports available, on working ability of the swamp buffaloes, usually gave general working abilities of the animals, as shown in Table 6. The measurement of draft power in a definite term is usually lacking. In addition, there are many factors known to influence the draft ability of an animal. The draft of tillage implements, like a plow, is dependent upon such factors as weight of the plow, its shape, sharpness and scouring properties of the plow, angle of draft, character of the soil, skill of the plowman, presence of different attachments, speed of travel, and size of the furrow (Ellis and Rumley, 1911). These factors complicate the measurement of accurate and comparable working capacities of the animals.

Table 6. Working ability of swamp buffaloes (7)

<table>
<thead>
<tr>
<th>Traits</th>
<th>Unit</th>
<th>Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Maximum Burden Capacity</td>
<td>kg</td>
<td>869 (F)</td>
</tr>
<tr>
<td>2. Draft Power</td>
<td>kg</td>
<td>287 (F&lt;sup&gt;*&lt;/sup&gt;)</td>
</tr>
<tr>
<td>3. Cart Speed</td>
<td>m/min</td>
<td>50 - 57</td>
</tr>
<tr>
<td>4. Plow</td>
<td>ac/hr</td>
<td>0.05 - 0.08</td>
</tr>
<tr>
<td>5. Puddle</td>
<td>ac/pair</td>
<td>0.12 - 0.25</td>
</tr>
<tr>
<td>6. Work</td>
<td>d/yr</td>
<td>20 - 146</td>
</tr>
</tbody>
</table>

F<sup>*</sup> = female

It was reported that, under normal working conditions, a mature buffalo can develop a tractive effort of 10 to 14% its weight. A buffalo weighing 452 kg produced a tractive pull of 55 kg at a speed of 3.5 km per hr, generating 0.73 hp (Stout, 1966). A similar estimate of 0.75 hp was also reported by Hopfen (1969). Garner (1957) studied three different types of harness: yoke, collar, and breast strap, with the swamp buffaloes in Thailand. The hp developed for each pull was 0.53 for the yoke, 0.79 for the collar, and 0.89 for the breast strap.

Traditionally Asian farmers select work animals on body size and height at about 3 to 3.5 years of age. It was pointed out earlier that working ability of an animal is a function of its body weight. Farmers know that larger and taller animal is more efficient for work in crop production. Most farmers castrate male buffaloes before training them for work. This practice automatically results in negative selection against larger animals. Genetic selection for

*Image of a table with columns for Traits, Unit, and Range of $\bar{x}$.*

*Image of a table with columns for Traits, Unit, and Estimates.*
size and height should improve draft ability of the buffaloes. However, it is questionable whether selection for growth rates or milk production will improve animal's draft ability. This aspect deserves more investigation. Further discussion on direct selection for draft ability in buffaloes will be presented in the later section.

**BREEDING IMPROVEMENT**

The use of buffaloes as draft animals, especially in rainfed agricultural area in Asia, will continue in spite of increasing farm mechanization in irrigated area. For a long-run, fuel price will continue to be high due to increasing world demand and limited energy resources. Small farmers will have to depend more and more on animal draft power or other cheaper source of power. In Thailand, where there are more work buffaloes than cattle, the demand for work buffaloes has been increasing. This is evident from the fact that the price of work buffaloes had doubled or tripled during the recent years.

At the same time, during the last decade, the demand for beef including buffalo meat had been increasing in many countries such as Indonesia, Philippines, Thailand, Malaysia, etc. This clearly indicates the economic importance of the swamp buffaloes in beef production, not only for Asian region but also for other regions as well. Hence, breeding improvement of the swamp buffaloes for meat production definitely deserve high priority.

Raising buffaloes for milk has been traditional in many countries such as India, Pakistan, Sri Lanka, Bangladesh, Egypt, etc. But, the swamp buffaloes have not traditionally been used for milk production due to various reasons. First, they are not very good milk producers; second, the swamp buffaloes exist mainly in the regions where the people are not real milk consumers. However, recently some countries such as China, the Philippines, and Thailand show their interest in improving these animals for milk, in addition to meat and draft, because a large number of these buffaloes already exists in these countries. Since these animals have already been raised for draft by rural farmers, improving animal milking ability would improve the nutrition and health of rural people, because milk will be available at the farm household level. Besides, many countries in Southeast Asia such as Indonesia, Malaysia, Philippines, and Thailand produce only 5% of milk they consume, the need to increase milk production in each country certainly receives high economic importance.

*Breeding for draft*

A. Breeding Goals. From socio-economic standpoints of the existing agricultural production systems in Asia, breeding goal for the improvement of buffalo on small farms should be dual-purpose ones, either for draft-and-beef or for draft-and-milk, depends on farmer's needs. Breeding improvement which is aimed purely at draft ability might not yield maximum benefits to the farmers (Chantalakhana. 1985). When a dual-purpose goal is considered in genetic improvement of buffalo, then the relationships between draft traits with beef or milk characteristics have to be taken into consideration in order to insure maximum overall breeding improvement. At the same time, as far as farmers are concerned, it is very important to know whether the resulted improved animals were suitable and acceptable under village smallfarm conditions. This calls for the research approach of the farming system research.
Choice and suitability of various breeding goals including breeding for draft, draft-and-milk, as well as for draft-beef-milk, were discussed by Chantalakhana (1983b).

B. Genetic Selection. Although conclusive information on genetic variation of important traits concerning draft or beef in the indigenous buffalo is lacking, but available evidences and experiences indicated that within-breed or within strain selection for draft-and-beef could yield considerable progress. It is highly recommended that national breeding herds should be organized in order to identify and multiply superior genetic stocks. Performance testing of buffalo bulls under the same specified environmental, feeding, and management conditions such as that going on in Thailand (Chantalakhana, 1983b) should be implemented in whichever country possible.

C. Crossbreeding. During the past two decades there had been various attempts in different countries to cross the swamp buffaloes with the riverine breeds such as the Murrah in order to produce the crossbreds for milk, draft and meat. Reports on crossbreeding works in West Malaysia and the Philippines, although sample size was small, indicated satisfactory work performance of the crossbreds (Chantalakhana, 1975). According to Liu (1978), about 45,000 crossbreds of swamp buffalo and Murrah had been produced in Southern China with the intention to produce more milk and meat, besides draft power. It was reported that the crossbreds were at least equal in heat tolerance to the local swamp buffaloes, and were superior in draft power, both in terms of speed and area per unit of time at plowing (Table 7).

Table 7. A comparison of the plowed area and plowing speed by the 1/2 Murrah and local buffaloes (21)

<table>
<thead>
<tr>
<th></th>
<th>Plowed Area (mu)*</th>
<th>Plowing Speed (m/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Area</td>
<td>Time Used (hour)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2 Murrah</td>
<td>1.59</td>
<td>2.30</td>
</tr>
<tr>
<td>Local</td>
<td>0.96</td>
<td>2.03</td>
</tr>
</tbody>
</table>

* mu = 1/6 Acre.

Many reports indicated clearly the superiority of the crossbreds in milk production but information on their draft ability and acceptance by farmers has yet to be evaluated. De Guzman (1982) reported that, concerning buffalo draft performance, 39 percent of the farmers in certain region of the Philippines rated the crossbreds poorer, 24 percent better, and 14 percent equal, as compared with the swamp buffaloes.

Recently, in China and the Philippines, three-breed cross in buffalo, involving swamp, Murrah, and Nili-Rave, have been conducted in order to produce superior offspring for draft, meat, and milk. Preliminary results obtained so far were favorable.

However, the performance of the crossbreds under village farm conditions needs to be evaluated. When work buffaloes are used also for milk what additional feed requirement is needed, and whether village farmers could provide the addi-
At present it is advisable to limit crossbreeding of the swamp buffaloes to only experimental scale, until the above questions have been thoroughly investigated. Another caution on crossbreeding of the swamp buffaloes arises from the aspect of germ plasm conservation, since little has been known about genetics of the swamp buffalo.

REFERENCES

6. __________. 1981a. A scope on buffalo breeding for draft. In "Recent advances in buffalo research and development", published by the FFTC/ASPAC, Taiwan, ROC. pp. 131-151.


