WATER BUFFALO AND YAK PRODUCTION IN CHINA

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SUMMARY

This article introduces the water buffalo and yak populations of China and their production, it feels in the Chinese animal genetic resources pictures: two articles published in AGRI No. 9 on the Sheep Genetic Resources and the Wenling Humped and Red Cattle of China; the articles on goat breeds in this number of AGRI and the cattle production survey published in World Animal Review No. 3/1993. The authors discuss in this article the types, characteristics and distribution of the Chinese water buffalo population (2 220 000 animals); they also present the animals work, meat and milk performances and the crossbreeding experimentation to date with Murrah and Nili-Ravi bulls. The Chinese yak populations are described with an in depth presentation of adaptability and production performance information.

RESUME

Cet article présente les populations de buffles et de yaks en Chine et leurs productions. Deux articles ont été publiés dans AGRI No. 9 sur les ressources génétiques ovines et le Wenling zébus et la race Bovine Rouge en Chine; les articles sur les races caprines publiés dans ce No. d'AGRI et celui sur la production bovine publié dans le No. 3/1993 de World Animal Review. Les auteurs présentent dans cet article les types, les caractéristiques et la distribution des populations de buffle en Chine (2 220 000 animaux); ils présentent également les performances des animaux en viande, lait et travail, ainsi que les experiences actuelles de croisements avec des tauraux de race Murrah et NiliRavi. Les populations de yaks chinois sont décrites largement, avec des informations sur leur performances d'adaptabilité et de production.

1.0 INTRODUCTION

China is abundant in cattle breed resources including *Bos* taiffits, *Bos* Itidic-its, water Buffalo and Yak. The brief introduction of *Bos Taurus and Bos Indicils* production in China had been made in the name of "A Survey of Cattle Production in China" published in "Word Animal Review" (1993, No.3). This paper will mainly review the water buffalo and yak production in China at present.

2.0 WATER BUFFALO

2.1 The distribution, types and exterior characters of Chinese Water Buffalo

There were 2.22 million water buffaloes in China at the end of 1992 (excluding Taiwan) which is twice that of 1949 and only takes second place after India in the whole world. According to the geological distribution, water buffalo can be divided into swamp and river types. The Chinese water buffalo belongs to the swamp type which is distributed throughout 17 provinces, autonomous regions and municipalities directly under the Central Government between the south at 36 degrees north latitude and the east of 97 degrees east longitude. The survey of CWBA (Chinese Water Buffalo Breeding Association) indicates that China only has one breed, named Chinese Water Buffalo. But from its geological distribution, water buffaloes can be further classified into 4 types, such as littoral type, plain and lakeside type, plateau type and hilly and mountainous type. Because of the vast territory, Chinese water buffaloes show wide variation in size including three varieties of large, middle and small body size. Haizi and Shanghai water buffalo in the Jiangsu province are the typical large size buffaloes with an average height of 140 cm for the mate and 130 cm for the female buffalo: the average height of middle body size buffaloes such as the Binghu water buffalo of the Hunan province and the Dechang Water buffalo of the Sichuan province, is over 130 cm for males; the small body size water buffaloes including Xilin buffalo of the Guangxi province and Xinulung buffalo of the Guangdong province h;s an average height below 130 cm. The three kinds of Chinese water buffaloes mentioned above have the similar exterior features. Compared with the *Bos* faiirtis, buffalo shows a lower, strong and heavy frame, short body length and large belly. The head extends from almost parallel to the ground surface, with a level forehead, bulgy eyes, short face, wide nose mirror and a long neck. The rump of buffaloes is more sloping than in *Boy* taiirtis. The Chinese water buffalo mainly has a shining black coat, but also has other coat colour patterns of grey and dark yellow with only 0.25 % white etc. Horns are big and long with a crescent shape and square horn base (figures 1, 2, 3 and 4). The Chinese water buffalo has 48 chromosomes while the *Bos taun-is* has 60 chromosomes.

3.0 PRODUCTION PERFORMANCES OF CHINESE WATER BUFFALOES

3.1 Work Performonce as a Dmught Animal

Chinese water buffaloes have been used traditionally as working animals in the rice producing agricultural area and are famous for their great strength and endurance to hard work. They are also used for other heavy work such as draught vehicles, water wheels and turning millstones, as well as ploughing land and raking the soil.

Chinese water buffaloes are trained from two years old, and normally start working at 3 years old. Generally the annual working time is over 120 days which are concentrated in spring and fall with the daily ploughing time of at least 7 to 8 hours. The loading capacity of a large size Shanghai water buffalo draughting carriages on the cinder road can reach 800-1 000 kg and move 24 km a day; water bailed by a buffalo can irrigate 0.74 hectares of farmland within 4 hours. The average maximum draughting force is 350 kg which is 73% of body weight for water buffalo bulls; 240 kg and 46.3% for buffalo steers; 190 kg and 43.8% for buffalo cows,

3.2 Milking Perfomance

Very few water buffaloes in China are used as milking animals. But before the foundation of RR. China, some private and state-owned farms in the Zhejiang, Jiangsu, Guangdong and Cuangxi provinces raised water buffaloes specially for milking. The maximum number of milking buffaloes was kept in the Wenzhou region of the Zhejiang province with a hundred year-long history. About 10 000 heads of water buffalo cows were dual purpose (dairy and working).

The lactation period of the Chinese water buffalo varies from 8 to 10 months with large individual differences. Survey for the dairy buffaloes kept by village farmers of the Ruian county of the Zhejiang province showed that the average lactation period was 213.8 days for first calving and 239.9 days for second calving buffaloes. Statistics for 72 lactations of dairy buffaloes on the Xinzhou Farm Station of Guangzhou indicated that lactation periods less than 250 days accounted for 8.4 %; between 270-300 days, 25%; over 300 days, 66.6%.

The average milk yield for a lactation was from 500 to I 000 kg. The milk production of 32 lactations of 25 buffaloes in the Ruian county of the Zhejiang province averaged for 733.35 kg (437.37-1 509 kg). The statistical result of 72 water buffaloes on the Xinzhou Farm Station of Guangzhou showed that the number of buffalo cows whose 300 day milk yield was less than 500 kg accounted for 6.94%; between 500-1 000 kg, 88.87%; over I 000 kg, 19%.

The milk of water buffaloes has a higher consistency and large fat globule size and better smell with butter fat percent of 7.4-11.6 and protein percent of 4.5-5.9, which is a high quality milk for cattle breeds (Table 1).

TABLE 1.

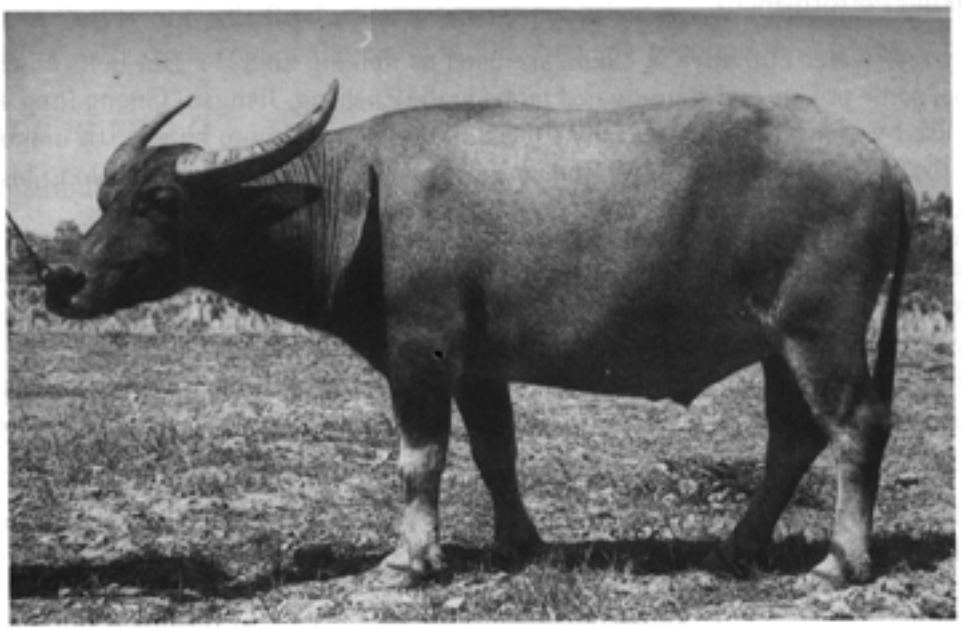
Milk composition of Chinese water buffalo cows (% in each area)

Sample place	Water	Fat	Protein matter	Lactose	Ash	Dry
Guangdong	78.56	11.62	5.18	3.69	0.84	21.33
Guangdong	79.65	9.14	5.49	4.77	0.94	20.35
Guangdong	78.24	10.80	5.26	4.83	0.83	21.76
Wenzhou	81.26	9.50	4.50	3.80	0.94	18.74
Shanghai	81.06	7.40	5.95	4.63	0.91	18.94
Guangxi	78.49	11.67	5.56	4.28	0.82	21.51

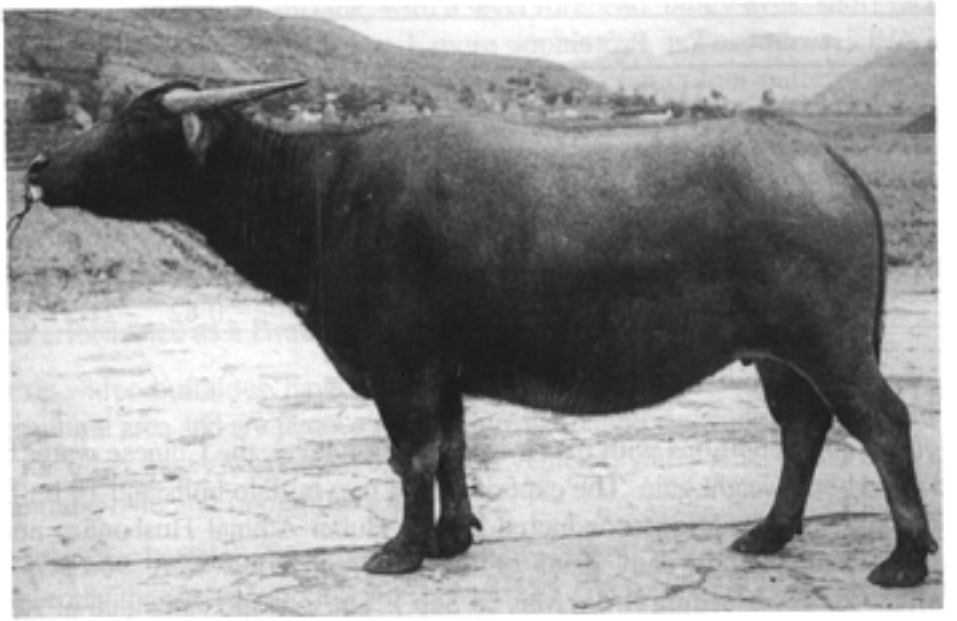
3.3 Meat Performance

Under grazing conditions with of a lower nutrition level, the Chinese water buffaloes still demonstrated good body weight gain. The experiment'of two buffalo bulls and IO buffalo 2-3 yearold cows under grazing conditions conducted by the Hubei Animal Husbandry and Veterinary Institute, showed that average daily gains of the bulls and cows were 960.5 g and 516.5 g respectively after 120 days' feeding (from May to Sep.). The average daily gain of steers castrated at 2 years old was 640 g in the experimental period. One kg weight gain needs 3.43 kg concentrates.

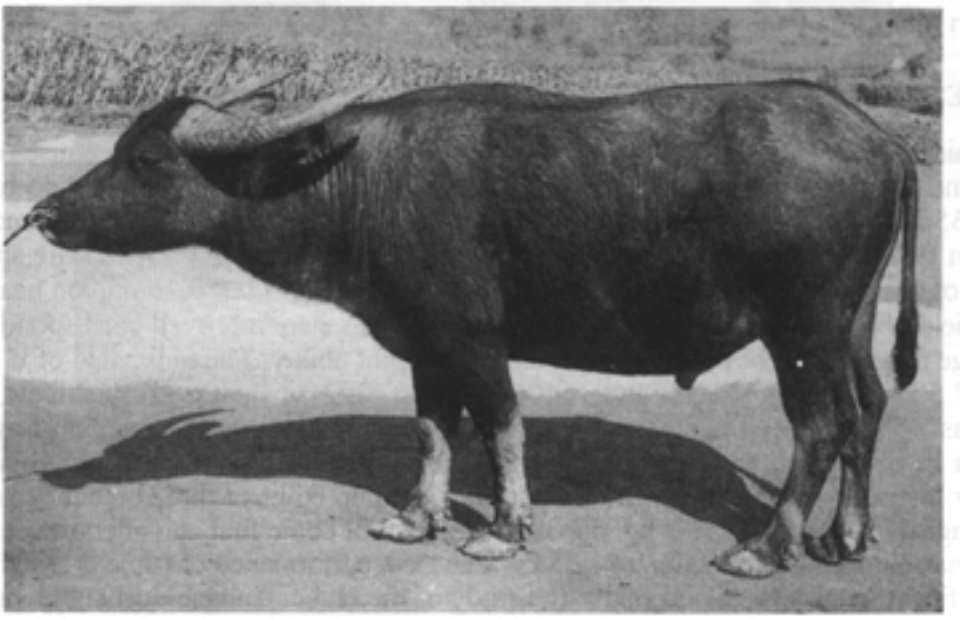
The dress percent, meat percent, fat percent and bone meat ratio of slaughtered steers were 48.5%, 36.9%, 5.41% and 1:3.8 respectively, Buffalo meat, is dark red in colour with white fat and a delicious taste, the muscle is coarser than that of *Bos* faitnis. The chemical composition of buffalo meat is as follows: water 75.57%; protein 22.01%.; fat 1.56%; ash 0.86%. The protein content is higher than that of *Bos* taitriis.



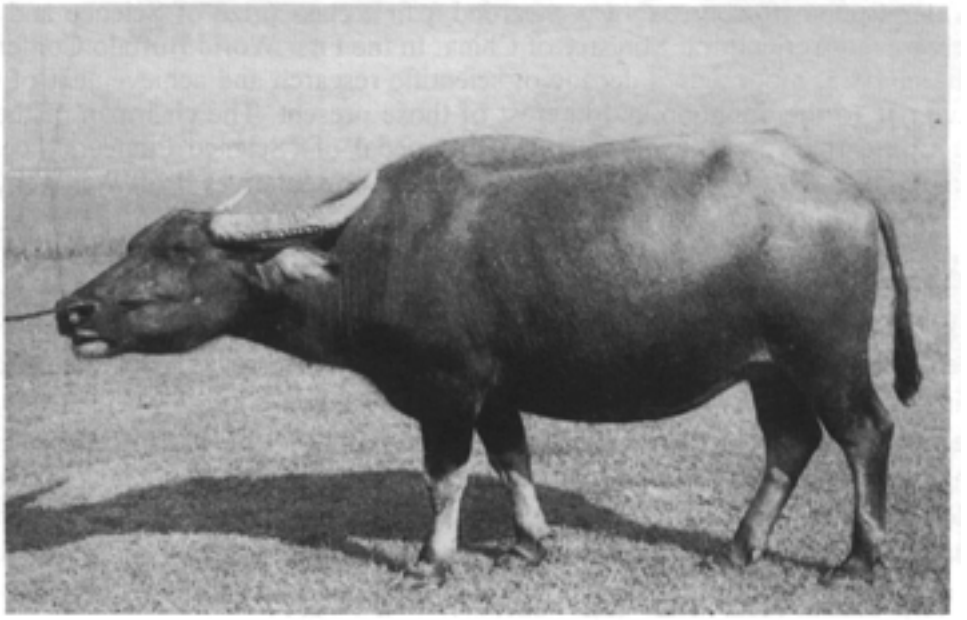
Chinese water buffalo bull in the Hunan province



Chinese water buffalo cow in the Sichuan province



Chinese water buffalo bull in the Hubai province



Chinese water buffalo cow of the Enshi type in the Hubai province

4.0 RESULTS OF IMPROVEMENT THROUGH CROSS-BREEDING

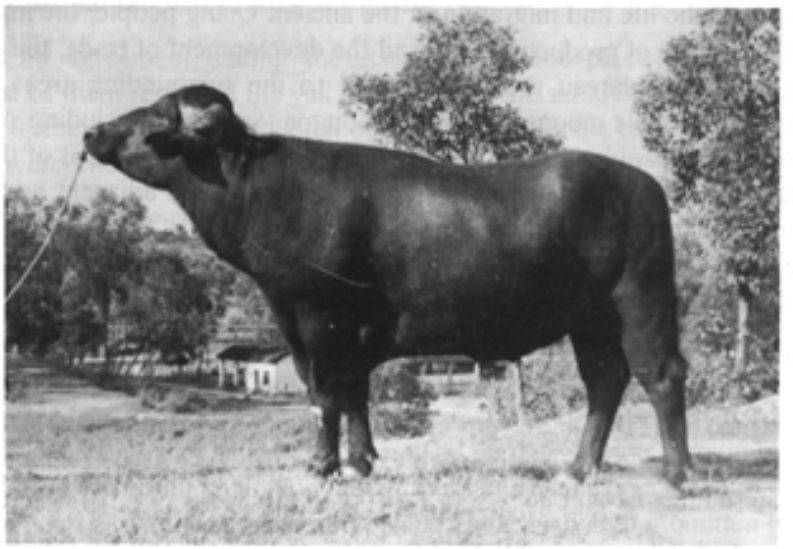
Chinese water buffaloes were used as working animals traditionally because of their lower milk and meat production and economic benefit. In order to improve local buffalo breeds, China imported 55 Murrah (Fig. 5 and 6) and 50 Nili-Ravi buffaloes (Fig. 7) from India and Pakistan in 1957 and in 1974 these two river buffalo breeds had a good adaptability to the climate and ecological conditions of China. The number of hybrid buffaloes (Fig. 8, 9) reaches 0. 15 million head at present. The milk yield of F, and F_2 buffaloes crossed with Murrah has also improved correspondingly as well as their large frame, heavy body weight and strong draught ability. The milk yield of F, and F_2 were 1 153+397.5 kg (270+82.7 days) and 1540+687.2 kg (292+66.1 days) respectively, average fat percent was 7.5%. Three-way crossing has been conducted since 1977 using Nili-Ravi buffalo, to cross with F, of Murrah and local buffaloes. According to the statistics of the Guangxi Animal Husbandry Institute, the average lactation period of buffalo cows of three breeds crossed was 3 11 days. Average milk yield was 2 662 kg, the 305 milk yield of some first calving cows.reach to 3 000 kg with a maximum daily production of 12.5 kg. The meat performance of triple crossed breeds have given significant increases. According to the study of the Hubei Animal Husbandry and Veterinary Institute, the measurement for 6 year-old hybrids after 100 days' fattening showed that the dressing percentage, meat percentage and bone meat ratio were 56.1%, 42.58% and 1:4.75 respectively, being 15.77%,15.39% and 25% higher than that of local buffalo breeds.

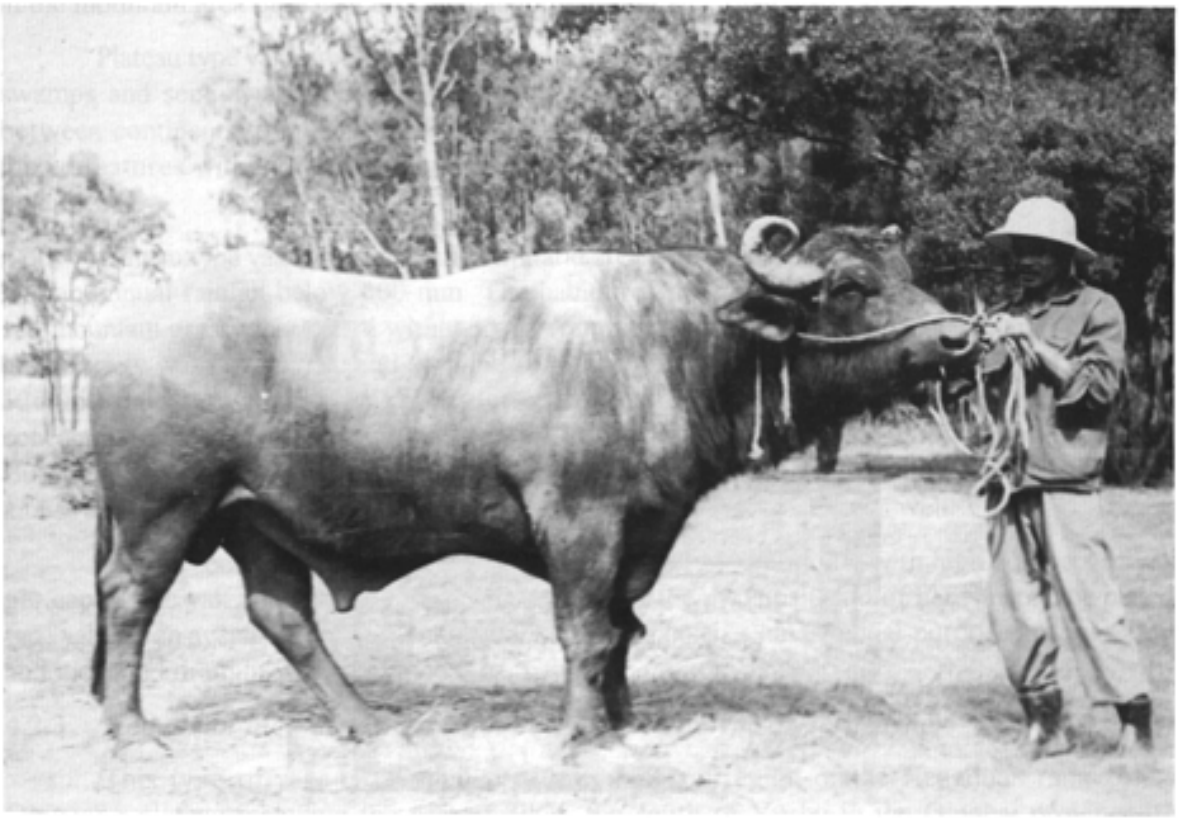
CWBA has done lots of research work with numerous and substantial achievements in pure buffalo breeding and hybridisation, which play an important role in improving quality and accelerating the breeding progress of Chinese water buffalo. The studies on frozen semen technology and oestrus synchronization of buffalo is foremost worldwide. The basic subject studies about the buffalo has filled the gap in the field of research for Chinese water buffalo. The project "Survey of Chinese Water Buffalo Resources" was awarded a first class prize of Science and Technology Achievement by the Agricultural Ministry of China. In the First World Buffalo Conference held at Cario, Italia in 1985, more than a decade of scientific research and achievement of China in the buffalo gave rise to the attention and interest of those present. The chairman of the conference Organizing Committee, Dr. Sularsh awarded the medal of "Science Pioneers", certificate and honourary diploma for Buffalo Association, to Chinese representatives Prof Wei Wenya and Wang Pijian.

4.1 Yak

Yak, the distinctive animal species, is necessary for the production and daily life of people living on the Qingzang plateau of China and adjacent high-cold region. There were about 13 million yaks in China in 1988 which was 90% of the total number of yaks in the world. The yaks of today were domesticated from wild yak captured by ancient peoples of the Qiang nationality distributed in the Qiangtang area of the north part of libel the autonomous region of China. After a very long history of domestication, during the late period of the Old Stone Age (about I 0 thousand years ago), the wild yak was domesticated by the ancient Qiang people and the yak husbandry was formed in the late period of the New Stone Age, i.e. the period of the Longshan culture (from 2800-2300 B.C.). There was a 4500 years history of yak husbandry in ancient China.

With the nomadic life and migration of the ancient Qiang people, the improvement of the means of work, the increase of production level and the development of trade, the domesticated yak existing on the Qingzang plateau gradually spread to the surrounding areas with appropriate conditions, from the Bayankala mountain range to Songpan grassland including Aba, Ruoergai and Hongyuan in the Sichuan province in the east; in the south, crossing the exit of the Himalayas into the high mountain grassland; in the west, entering Cashmere and adjacent area through the Ali grassland; in the north entoring the Pan-der area, the north and south of the Tianshan range





Murrah buffaloes

and Aertai area crossing the Kunlun range via the Cashmere area. The yak distribution of today was gradually formed in the following years.

At present, the yaks in China are distributed mainly in the Tibet autonomous region (3.86 million in 198 1), and the provinces of Qinghai (4.79 million), Sichuan (2.98 million), Gansu (0. 88 million of 18 counties), the Xinjiang Uygur autonomous region (0. 16 million in 1982) and Yunnan (about 50 000). In addition, a small number of yaks was also kept in the Beijing region, the Hebei province and western inner Mongolia.

The yaks outside China were scattered throughout Mongolia (0.71 million in 1978), former Soviet Union (0.13 million in 1981), Nepal (90 000) and India (25 000 in 1978). The estimated number of yaks (0.04-0.05 million) in Afghanistan, Pakistan, Sikkim and Bhutan approached the main yak production region of the Qingzang plateau of China. There are about I million yaks outside of China.

Nili-Ravi buffalo

4.2 The type distributions and breeds of Chinese yak

There is no agreement among the scientists for the place of the yak in the animal classification. Most of them regarded the yak and cattle as the same *Bo.5 genus.* Their chromosome numbers are all 60, they can mate with each other, obtain a fertile cow and infertile bull, but this situation can be overcome with an increase in crossing'over generations.

4.2.1 The types of Chinese yak

After domestication by the ancient Qiang people thousands of years ago, the Chinese yak maintained many characters of the wild breed because of the lesser effort of artificial selection than that of natural selection, but under household condition, yaks with considerable variation in confortnafion, coat colour and production performance etc. are distinguished from wild yak breeds. Simultaneously, owing to many different factors of the main yak production area, such as land form and terrain, water and heat conditions, types of grassland, variety of grass, economic structure, level of rearing and grazing, breeding technology and other natural and social ecological environments, two Chinese yak types, i.e. Qingzang plateau type and Hengduan high mountain type, were formed with obvious divergences in body conformation, exterior characters, production performance and purpose of utilisation.

4.2.2 Qingzang plateau type (Plateau type or Grassland type)

These types of yak were dispersed in the central area of the Qingzang plateau including the Qinghai province, most of Tibet and high-cold grassland in the northwestern Sichuan province. Yaks in the mountain area of Gansu and Xinjiang imported from Tibet also belonged to this type.

Plateau type yaks are distributed in areas of ligh physical features, hilly areas, broad valleys, swamps and semi-swamps, gentle slopes and more open terrain. Because of the transportation between continents, frequent migration and great interaction, the plateau yaks showed relatively mixed features with more varied colour, more hom shape of homed yaks and high percentage of polled yaks.

Plateau type yak subsisted in the semi-arid area with annual average temperatures below O'C and an annual rainfall below 600 mm. The habitat of the grassland type is mainly mountain and sub-mountain grassy marshland with part of swamp and semi-swamp grassy marshiand. The major grass variety was *Gramitieae and Cypenis rotiindus,* of a short height, great diversity of cover and 120-150 days' growth period. With the winter and spring being almost absent of grass and concentrate supplement, extensive management and low breeding intensity led to the small body size. But the differences of local climate and management conditions in the distribution area also led to a big variation in body size among the local breeds and sub-population as well.

For the economic structure, primarily the pure animal economy with high numbers of yaks per capita, the yak milk, milk products and meat, are the principal food of herdsmen. The plateau type yak has an average milk yield and higher fat percent and is a kind of dual-purpose animal of milk and meat and draught with fine bone quality.

4.2.3 Hengduan high mountain type (high mountain type or gorge type)

This type of yaks is distributed in the mountain region of the Hengduan range of the Qingzang plateau including the east of Tibet, the south of Yushu in the Qinghai province, the southeastern part of mountain and gorge grassland of the Sichuan province and the north-western part of the Diqing area in Yunnan. There are many high mountains and deep valleys in these areas because of the force of the river with an elevation over 4 000-5 000 meters and 1 000-2 500 meters altitude difference, showing a big variation of vertical heat energy, being relatively warm on the valley bottom with rice growth and buffalo distribution in some areas such as the river valley zone in the south of Sichuan; but the areas above the forest zone and grassy marshiand on the top of mountain are too cold to grow any cold resistant crops. The climate is semi-humid with an annual precipitation over 600 mm and a clear dry season.

The complex vertical climate zone provided various ecological environments for animals, the

inconvenient transportation from east to west caused environment separation, so the high mountain type yaks carried on rather more intrinsic yak characters. At the same time, the closed population was formed and received a relatively high extent of selection of influences by human beings.

The high mountain type yak is mainly distributed in the mountain shrub grassy marshland and some in the high mountain grassy marshland. The superior grass species are Rank grass and *Gramineae* with rich cover and 150-180 days'growth period. In winter and spring, there are some supplements for yaks with forest grass, crop stock and small amount of agricultural by-products from the valley area. This type of yak, which has a large body frame, enduring hard works, a strong and robust constitution, excellent meat performance and high production of cashmere, are recognised as a multi-purpose animal of milk, work and meat.

The high mountain type yaks are relatively pure with a single coat colour, mainly showing a black body with a greyish white mouth and some showing black alternating with white and mixed coat colour. Both bulls and cows have big and round horns (very few polled) curving backwards and outwards with little difference among the population. This kind of yak has a wide forehead with thick-curled hair on it and distinctive top of shoulder, and also shows a small exterior difference among the local breeds and population.

4.2.4 Chinese yak breeds

The local yak breeds initially listed in "Annals of bovine breeds in China" included the Jiulong yak of the Sichuan province and the high mountain yak of Tibet of the Hengduann high mountain type; Qinghai plateau yak, Tianzhu white yak of the Gansu province and the Maiwa yak of Sichuan of the Qingzang plateau type. In addition, there are still a number of high quality local yak populations, such as the Zhongdian yak of Yunnan, the Bazhou yak of Xinjiang and the Huanhu yak of Qinghai etc. Some of them are listed in "Annals of animal and poultry breeds" of each province, prefecture or autonomous prefecture.

The yak has a strong constitution and long coarse hair of 20-28 cm and cashmere in hair clusters. The Chinese yak has high withers, a small hollow in the back and loin, bulging at the hip cross, so its back line shows an undulatory shape. The yak tail resembles the liorse tail with long thick hair and is distinguished between male and female. The head is long wide, a little narrow at the lower end of the face: a small nose mirror with a thin and active upper lip to eat short grass. They can also be divided into homed and polled yaks, the former has long and sharp horns with an obvious horn fing. The thick coat hair clusters on the side of the body and belly like an "apron" can prevent freezing when it rests on the snow. The main coat colour is black, and secondly is dark brown, black and white, grey and white with big differences. The yak has a special hoof structure with a solid protruding edge like a horseshoe on the sole, so it can walk on hilly roads freely.

The body size of the Chinese yak varies with the ecological environment and feeding condition of each region. Generally, live weights of the adult yak bull and cow are about 300-450 kg and 200-300 kg respectively. The body weight and body size as well as the main production area of every yak breed in China is shown in table 2.

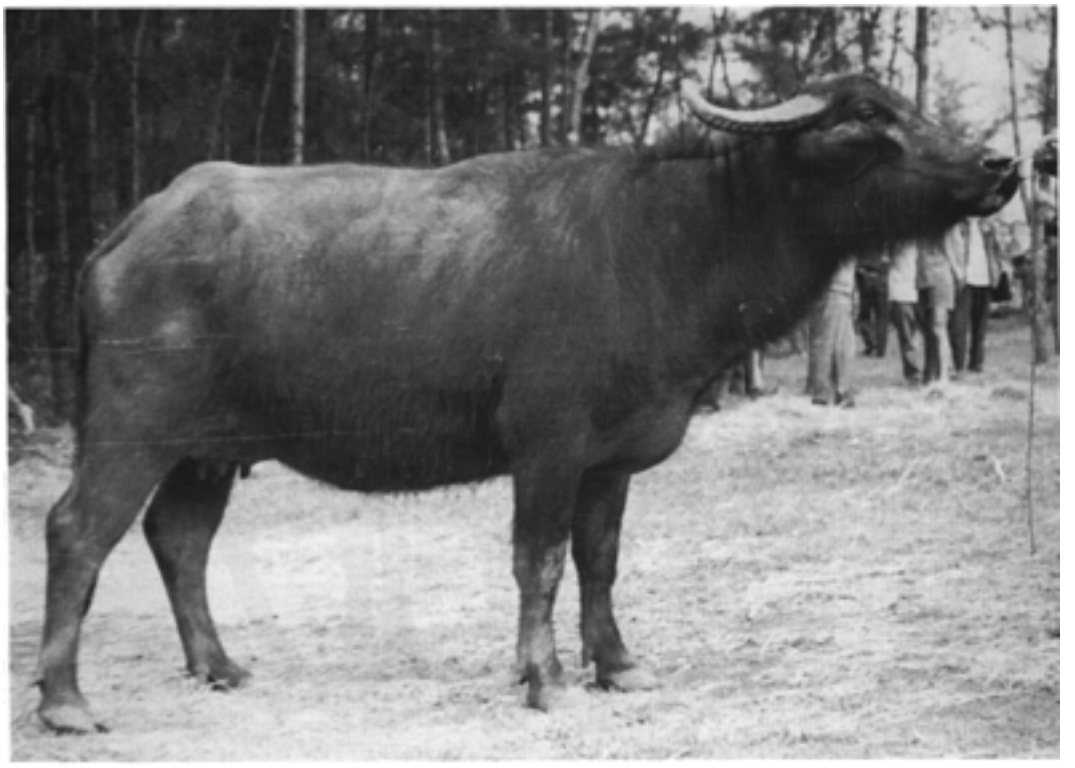
5.0 ADAPTABILITY OF THE CHINESE YAK

Yaks concentrated on the Qingzang plateau of China had formed a distinguishable conformation character and physiological functions from other cattle breeds in order to adapt to the particular ecological environment of their living area. So the yak and its outside environment hold a dynamic equilibrium, which is a so-called surprising adaptability of the yak to an ecological environment which is cold, with high elevation, lack of oxygen, strong solar radiation and long periods without grass.

5.1 Adaptability of the yak for the cold climate

The climatic features of areas where yaks are to be found are cold and semi-humid with an annual average temperature of -3 to 3'C, the average temperature of January is below O'C, the

absolute temperature can reach -40’C or lower; those of July were 13 0 C and 30’C respectively and lasted for a very short time. There is no absolute frost-free period or summer time. The cold season normally can last for half a year with a very short spring and fall. Plants grow only for 150 days, there is almost no planting system and tree growth. Yaks can live in this kind of cold climate due to their compact body frame, thick coat hair and undeveloped sweat glands etc. which prevent the loss of body heat and keep them warm.



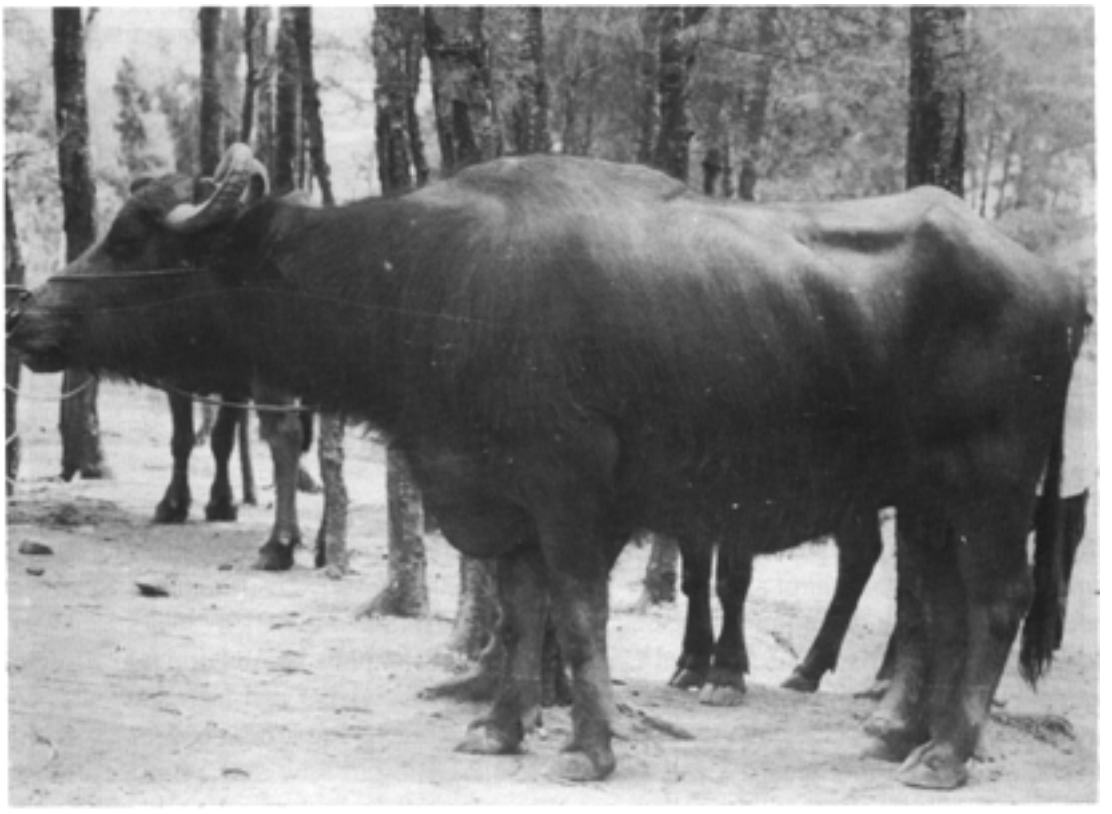
Murrah x Chinese buffalo cow

5.2 Adaptability of yaks to the plateau environment of less oxygen and strong solar radiation

Most of the Chinese yaks were dispersed in the high mountain grassland 3 000 meters above sea level, oxygen content in the atmosphere at this elevation is 35% less than that in the air at sea level; on the grassland of 5 000 meters' elevation, oxygen content is only 50% of that at sea level. In addition, the yak distribution area has too much sunlight and such strong solar radiation that the total radiation per year can reach 130-165 kcal/cm'. With the special function characters, such as a well-developed chest, fine heart and lung structure, strong breath and blood circulation, black or brown coat hair and skin pigmentation on yaks can subsist in such conditions.

5.2.1 Chest, lungs and heart

The yak has 14 thoracic vertebrae, 14 pairs of ribs which is one more than that of other cattle breeds, but lumbar vertebrae is one less than others, 12-16 coccygeal vertebrae of yak are 4-8 less than that of others. There are the same number of sacrum and cervical vertebrae for yak and other cattle breeds. The yak has long and narrow ribs with wide intervals and well developed rib muscle. The yak also has a large heart girth of chest with a well developed depth but poorly developed width which provides enough space for the development of heart and lungs whose weight is 1. I- 1. 7% of body weight and heart weight is 0. 5-0. 8% of body weight. The yak has a short and wide trachea with a narrow and long cartilage ring like the dog trachea and is very suitable for quick breathing.



Murrah x Chinese buffalo cow

5.2.2 Red blood cells and haemoglobin

The research results showed that the diameter of yak red blood cells is more than that of other cattle with high haemoglobin content which can increase the amount of oxygen in the blood, under normal breathing conditions, they can gain more oxygen in order to adapt to mountain grassland environment with high elevations, lower atmospheric pressure and less oxygen content.

5.2.3 Coat colour

The ground coat colour of the Chinese yak is black or blackish brown. Then, black alternating with white and a few grey, yellow and other light colours are seldom seen. The Tianzhu white yak of the Gansu province is white. According to the statistical analysis data, the different coat colours and distribution of yaks are related to the intensity of solar radiation. The total solar radiation per year is 160 kcal/cm' at the lower latitude area in the south of 31 degrees north latitude, yaks in those regions such as Yunnan and the east part of Tibet and the Sichuan province, are seldom of a light colour needless to say pure white colour, in the north of 31 degrees north latitude, with the increase of latitude and weakness of the solar radiation, the number of light coloured yaks increased gradually thus lessening the harm from solar radiation because of the lesser absorption ability of the light coat colour. This is the physiological and genetic adaptability of yak for strong radiation environment. The yak epidermis cells with much pigment can protect the deep layer tissue from the ultraviolet radiation in the high elevation areas.

5.3 Adaptability of yak for short grass and extensive management

The feeding behaviour of the yak is distinguishable from other cattle breeds because of the specificity of its digestive system. Yaks can make the best utilisation of short grass and graze through a year with such extreme conditions as no concentrate supplement or sheds or pens.

5.3.1 Digestion andfeeding behailiour

The yak has a wide mouth, small nose mirror, thin and active lips and more feed intakes. The incisors of the yak have very solid teeth quality with a wide and flat tooth surface. It has an obtuse and wide tip of tongue with developed silk-like papillae on its surface. It is also highly cutinized. The surface of the tongue is very coarse and thorn-like, which is helpful to take in feedstuff. Yaks can not only take in grass by tongue, similar to other cattle, but also eat very short grass and grass roots due to its hard and wide incisor tooth cooperating with active lips like sheep. In the winter and spring of the snow and ice-bound season, yak can still break ice and thick snow with face and mouth to eat grass with lips and teeth on mountain grassland. It is know that 10- 1 5 cm high grass will become 2.6-5.2 cm after yak grazing. At the end of spring, the grass turns green again but is only 2-3 cm high. Yaks can get enough food for their requirement after one day grazing on such short grassland. The yak has a very extensive eating ability. On the mountain shrub grassy marshland, yaks can take in all kinds of leaves and tender branches except for poisonous grass or plants with hard thorns; in the swamp, semi-swampy grassy marshland on high and sub mountain area, yaks can walk into the low-lying swamp grassland and eat all grass with hard and coarse leaves and stems of the *Cyprus rot-iindtis* family; grass varieties eaten by yaks in the mountain grassy marshland amounted to more than 60.

5.3.2 Limbs and hoofs

The yak has very robust limbs, small hard quality hoofs with sharp and narrow tips, a hard hoof edge and closed toes, a soft cut in the pad of the sole and strong force to stand on ground and rocks. Therefore, the yak is good at walking on the dangerous road and steep slope which sheep and horses can not walk on; yaks also eat grass in low-lying swamp grassland unsuitable for sheep, they can stamp snow and open paths for people and sheep in the snow. In the snow-ridden season in the mountains; swimming cross the rapids of rivers; steep snowed slopes and rivers can never stop its movements which undoubtedly enlarged the eating ability and improved the adaptability of yaks.

Table 2: *The body size and weight of Chinese yak breeds and population (adult yaks of over 7 year-old).*

						Body Size (cm)				
Region	Breeds	Distribution	Number	Sex	No. samples	Height	Lenght	Heat Girth	Circ. of cannon bone	Body weight[a]
Sichuan	Jiulong yak[b]	Ganzi Prefec. of Tibet	30 000	bull	15	137.5	177.6	218.6	23.6	593.5
				cow	708	116.6	140.3	178.5	18.2	314.4
	Meiwa Yak[b]	Aba Prefec. of Tibet	200 000	bull	17	126.0	157.3	193.4	19.8	413.8
				cow	219	106.2	130.7	154.6	15.6	221.8
Yunnan	Zhongdian yak	Zhongdian County of Yunnan Province		bull	23	119.1	126.9	162.2	17.6	234.6
				cow	186	105.2	117.1	153.7	16.1	192.5
Gansu	Tianzhu yak[b]	Tianzhu County of Gansu Province	30 000	bull	17	120.8	123.2	163.8	18.9	264.1
				cow	88	108.1	113.6	153.7	16.8	189.7

	Gannan yak	Gannan Prefec. of Gansu Province		bull	10	126.4	141.3	189.3	22.4	354.4
				cow	159	109.3	122.1	156.7	16.1	209.9
Qinghai	Gaoyuan yak[b]	South and north area of Qinghai	3 400 000	bull	21	129.2	150.6	194.4	20.1	398.4
				cow	208	110.9	131.9	157.2	15.8	228.2
	Huanhu yak	Mountain area around Qinghai lake		bull	14	113.9	143.7	169.0	18.3	287.3
				cow	138	103.0	123.8	147.0	15.4	187.3
Tibet	Gaoshan yak[b]	East part of Tibet	1 400 000	bull	8	130.0	154.2	197.4	22.4	420.6
				cow	197	107.0	132.8	161.6	16.1	242.8
	Yadong yak	Yadong County of Xizang		bull	7	119.6	137.0	173.3	19.0	288.0
				cow	70	111.1	125.2	157.4	15.2	217.1
Xingjiang	Bazhou yak	Central area of Tian mountain		bull	24	126.4	140.4	191.2	20.6	359.3
				cow	228	111.0	124.0	172.2	16.8	257.4

[a] Weight = (heart girth)^2 * (body length) * 70

[b] Listed in the "Annals of Cattle Breeds in China"

Source of literatures: Caili (1992), Chinese Yak, Agricultural Publisher.

6.0 PRODUCTION PERFORMANCE OF CHINESE YAK

The primary nreed of yak, has no specialized economic purpose. Owing to its peculiar adaptability to the high mountain climate, it can be used in many ways such as draughting, ploughing, milking and meat producing etc. Burden yak of 65-80 kg can still climb the steep slope and move 25-30 km per day, thus earning it's name "the desert vehicle". For main Chinese yak breeds and population, the nu'lk yield and fat percent in a 150 day lactation period averaged for 350 kg and 6.5% respectively, 1.0-2.5 kg per day. Daily milk production of Xingjiang Bazhou yak is the highest at 2.5 kg; that of the Tibet high mountain yak, the lowest (0.9 kg). The grass quality and yield of grassland are the principal factors causing differences. In the sub mountain area of the middle part of the Tian mountain of Xingjiang with 2 500 meter elevation, enough water resources, vast expanse of grassland, less number of yaks and relatively more carrying capacity, yaks can produce more milk with adequate nutrients but for the high mountain grassland of Tibet with 4 500 meters elevation, 120 days growth time of grass, 50-80% cover degree, short grass and lower grass yield of 2 250 kg per ha, the yak milk production is low.

The yak has the better meat performance with the trait of "fattening by less amount of grass" in the warm season, only eating grass of natural grassland can make the meat performance of Chinese yak gain varying with the difference of ecologic type, breeds, cage, sex, body size and slaughter season. The meat production of yaks of the Hengduan high mountain type is superior to that of the Qingzang plateau type, and the meat yield of Jiulong yak is the best. The dressing percentage of adult bulls, cows and steers with middle fat and grazing through a year without supplement was 57.57, 56.15 and 55.660/o; meat percentage, 47.88, 8.52 and 45.30%; meat bone ratio, 4.8, 6.0 and 4.2; eye muscle area, 83.7, 58.3 and 86.7 c@ respectively. Meat performance for adult yaks of different sexes is as follows: dressing percentage of the bull is the highest, secondly the cows and steers; the meat percentage and meat bone ratio of cows is the highest. Secondly the bulls and steers; eye muscle area of steers is the highest, but that of cows is the lowest.

7.0 THE IMPROVEMENT RESULT OF CROSS BREEDING

The first generation hybrids of Chinese yak crossed with *Bos* taunis showed an obvious heterosis in height at withers, body length and heart girth with 6.7-14.6% heterosis rate and in weight with 36. 1% heterosis rate, milk yield of hybrid cows is 50-1 00% more than that of yaks. Hybrids can well adapt to high and cold mountain grassland conditions and yearly grazing there. Hybrids of yaks crossing with bulls of *Bov* taiinis and breeding breeds have a better meat performance doubling that of local crosses, but because of the poor adaptability of improved breeds to the ecological environment of cold mountain grasslands, the further improving work was limited. With the extension of Al technology since 1970, the interspecific hybridization using frozen semen of *Bos tauni.v* by Al was conducted gradually in yak distribution area 3 500 meters above sea level including the Sichuan and Qinghai provinces. The result showed that average fertility rates reached 40% calving rate, 74% and the calf survival rate as high as 93%, i.e. 100 fertile adult cows can produce 28 hybrids of yak and *Bos tauriis* which created a good condition for improving their production performance. Local yak breeds in Sichuan mating with Holstein give birth to crosses whose coat colour is black and whose live weight at 6 months old is 123 kg which is 77. 1 % more than that of calves of yaks at the same age; live weight at 17 months old is 234.6 kg which is 87.5% more than that of yaks at the same age; whose average daily gain is 782 g which is 87.5% more than that of 417 g of yak. Black cow crosses can produce 690-909 kg milk for the first lactation with 5.15-5.3 1% fat percent and 36.6-41.8 kg fat yield, put into production one year earlier than the yak and get 2-2.5 times more milk and 1.2-1.5 times more fat. The income of keeping hybrid cows of yak and *Bo@ taui,us* equal to that of grazing 2 head of yaks.

Since the middle of 1970's, the basic research for utilization of yaks were conducted continuously in China. Researchers have completed the investigation of Chinese yak resources, proposed the criteria of Chinese yak classification at "Qingzang plateau type" and "Hengduan high mountain type" and initially studied the cold and heat enduring ability, physiological and biochemical characters, polymorphism of serum proteins and other ecological features. Research into the male sterility mechanism of interspecific hybridization for yaks crossed with other cattle showed that the direct reason is that the primary spermatoce crosses ceased to develop further into spermatozoon by cell division means that there is an absence of Sertoli cells as well as a lack of gonadotropin secretion cells in the anterior pituitary. Thess findings provided an important clue to study the male sterility of interspecific hybridization and find the way to solve the problem in this field.