

Buffalo Development in Thailand

Jintana Indramangala

1. Introduction

The buffalo mostly found in Thailand has been classified as the swamp type. Traditionally, they were raised by small farm holders for multipurpose roles as complementary with their crop production. The role of buffalo farming essentially takes the form of three functions:

1. the farm integration function
2. the insurance, capital formation and income function
3. the food production function.

These 3 functions interact with the sustainability of small farm holders in Thailand. Thus, in the first instance, environmental factors determine the status of buffalo production in farming systems and influence what type of farming is carried out. It is evident that human influence and socioeconomic location factors also have a decisive impact on the goals of livestock production, There are various factors influencing a change in buffalo production as a result of population growth, local economic development and with increasing urbanization gearing to demand for buffalo products. Hence the number of buffalo in Thailand is sharply decreasing. This paper, looks at buffalo development system in Thailand with particular an attention to sustainable buffalo production systems.

2. Population and distribution

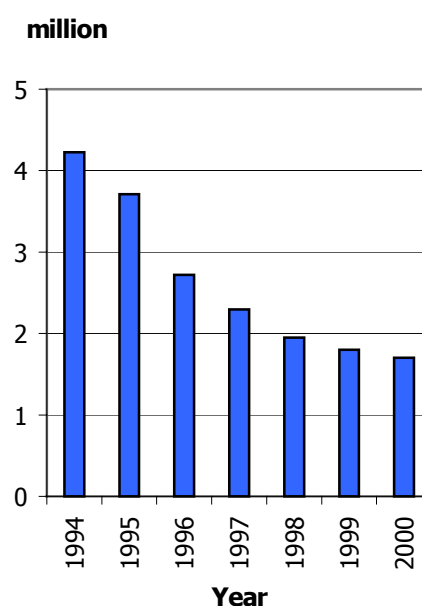
According to FAO statistics (1996), Thailand had the fourth largest buffalo population after India, China and Pakistan. Although the world buffalo number are increasing at about 1.3 percent annually, Thailand, has had a sharp decline in numbers (Table 1)

From 1994 to 2000, numbers decreased from 4.2 million to 1.7 million head which equates to an annual percentage change of -13.8%. The distribution of buffaloes is predominantly in the Northeastern a part of Thailand which accounts for about 83 percent of the total buffalo, particularly in the south of Northeastern namely Ubonratchathani, Surin, Buriram, Roi-et and Yasothon provinces. (Figure 2). There were 517,941 families farming buffaloes and 88 percent of their were living in the Northeast (DLD, 2000),

-
1. This paper is Genetic Evaluation for Beef Production in Developing Country” 23 -25 July 2001, Khon Kaen Province, Thailand.” Presented at the International Workshop on Development Strategies for
 2. Senior Animal Scientist, Animal Husbandry Division, Department of Livestock Development, Phayathai road, Bangkok 10400.

Table 1. Number of buffalo in Thailand by year (1994 - 2000)

year	Total	annual change	
		+head	%
1994	4,224,791	-579,355	-12.1
1995	3,710,061	-514,730	-12.2
1996	2,719,674	-990,387	-26.7
1997	2,293,938	-425,736	-15.7
1998	1,951,068	-342,870	-14.9
1999	1,799,606	-151,462	-7.8
2000	1,702,223	-97,383	-5.4
Total Change			-13.8

**Figure 2.** Buffalo and householder distribution by region in 2000

Region	No.			Total	Number of	head per
	Female/male Ratio	male	female	head	Householder	Householder
Total	2.55	479,220	1,223,003	1,702,223	517,941	3.29
Central	2.52	28,100	70,868	98,968	13,893	7.12
Nth east	2.57	393,797	1,012,645	1,406,442	457,590	3.07
North	2.25	46,280	103,976	151,829	36,554	4.16
South	4.88	11,043	53,941	44,984	9,904	4.54

3. Production System

Most of Thailand's buffalo production could be referred to as backyard, subsistence production involving smallholders in remote areas. There is a great variety in forms of husbandry and management techniques from region to region and even from farm to farm. These variations in husbandry and management are a result of natural condition of the grazing area, the crop production system, and the lifestyle and economic framework of the farmers. Knowledge in assessing the suitability for animal species of different environments has been passed down through the generations of farmers. In the Central region, where the land is generally flat with good soil fertility, there is a higher population density and a high level of mechanization in the irrigated paddy fields. Even still, the number of buffaloes is quite large. The buffaloes do not graze on specific pasture nor are feed supplements given, rather a more traditional "cut and carry" or tethered grazing system is used. Buffalo production is for generating income and building up saving. Animal are sold when the family needs cash.

The Northeast region of Thailand has the most Buffalo. This region is generally characterized by poorer soils, less rainfall and only small amounts of irrigation for rice growing. A DLD survey of stockholders in the Surin area revealed that the average farmer was of low income carrying their living farm with rain-fed rice production and the owning of 3 buffalo. The farmers priority for keeping buffalo were draught power, manure as fertilizer for the rice fields and as a savings bank against hard times. Hence meat production per se was not the primary focus of these

farmers. From the farmers perspective, sustainable systems are those that have supported their families over many generations. Traditional farming practices are used extensively and generally include daytime grazing (edge of fields, roadsides marginal land, communal grazing areas, etc.) supplemented with rice straw in night corrals. Note that animals are usually supervised while grazing (for confinement and protection reasons) and this has traditionally been the role of children. However, this now conflicts with parents desire to send their children to school and improve their education.

4. Contribution and Utilisation

While, buffalo production is now of less economic importance in terms per capita GDP and economic development prospects, it's economic importance to individual smallholders is generally underestimated especially by their multipurpose contributions which ensure food security for the growing population and to increase income of the poor in these subsistence farming systems.

The roles of buffaloes in contributing to human needs were discussed by Sansoucy et.al. (1993); Peters (1999) and Chantalakhana (2001) and can be grouped into 3 functions plus an additional function: -

4.1. Food security: Food security can be defined by a combination of balance between availability and need, avoidance of temporary food shortage and nutritional deficiencies and adequate food quality. Buffaloes are living manufacturers who transform non-edible human food (such as crop residue, rice straw, and weeds) into high protein food for human consumption. Thus, increased buffalo production may add to food security in several ways. First, many poor farmers will have direct access to more food with lower cost. Second, increased domestic production will reduce imports and save foreign currency.

4.2. Insurance, capital formation and income: This function is most relevant to securing the socio- economic status of the farmers. It can serve as long term capital reserve by using local natural resource as long as fodder resources are freely accessible at no charge. However, variable annual rainfall, especially in rain-fed area, reduces income stability from cropping. Rearing buffalo as a means of “**Saving bank**” gives some financial security for the household. In addition, sales of progeny or unproductive buffalo and their dung provide direct cash income to the farmers. So buffalo represent buffer assets (with some security against inflation) which can be realized at any time, adding further stability to the self-sufficiency crop-livestock system.

4.3. Farm integration: Farm mechanization is suitable in some locations and some socio-economic framework. However, for the smallholder, especially in the Northeast region, buffalo are still used as draught power for preparing paddy fields. The integration of cropping and livestock production makes efficient use of farm waste and crop by-products such as rice straw and weeds, and enables a transfer of such nutrients to cultivated soils through the use of manure. Manure not only provides direct supply of fertilizer but also improves soil structure, and pH value of the soil especially in areas, which use higher quantities of chemical fertilizer as in today's rice paddy fields.

4.4. Recreation: The buffalo is also considered a friend of family who is a loveable family member, which has many legends about them. Moreover, buffalo are part of many festivals, e.g. "buffalo racing festival " at Chonburi Province and "fighting bull" at Samui Island and agrotourism as "Ban Kwai Thai" at Chaing Mai. International tourists also expect to see buffalo at work in Thailand.

These four functions mentioned above are complementary to each other so that all aspects of sustainability are accounted for, consequently buffaloes should be available for utilization by the next generations.

5. Breeding buffalo for subsistence farming systems

One of the important considerations in developing livestock enterprises is obtaining as high a level of efficiency as possible from the animals used. In addition, scientists point out inappropriate comparisons of buffalo productivity with exotic cattle breeds from developed countries, e.g. low growth rate, late maturity and long calving interval, but studies have indicated that their productivity is remarkable high, when compared with exotic breeds under the same harsh conditions. Buffalo infertility has been noted as a major concern. Moreover its is usually caused by mismanagement e.g. lack of bulls or neglect of farmer to give productive females a chance to mate. Moreover, feeding strategies and behavior is important in assessing the suitability of animal species to different environments due to differences in morphology and physiology characteristics associated with diet selection and the rate of passage of fodder through the digestive system.

5.1. The most efficient use of low quality roughage. McDowell (1993) and Ligda (2001) have reported that buffaloes digest feed more efficiently than cattle, particularly when feed is of poor quality and high in cellulose. No single reason alone explains the buffalo' success in using poor quality forages, rather, it is a combination of reasons that include:

5.1.1 Higher dry matter intake -: Buffalo have wide muzzles for rapid intake of feed combined with less selective grazing even on short native grasses. Buffalo generally have a wider range of grazing preferences.

5.1.2 Large gut capacities and a greater degree of fermentation in the rumen, result in slow passage of foods from the rumen and therefore higher production of microbial protein

5.1.3 Rumen bacteria: Poondusit (2001) reported that the numbers of rumen bacteria and fungal zoospores in buffalo were significantly higher than in dairy and beef cattle, while protozoa was significantly less. In addition, the values for ammonium nitrogen in buffalo were higher as a consequence of higher production of microbial protein. This mean a higher efficiency to utilize high cellulose forage such as crop residue.

5.2. Superior ability to handle stressful environments. Some exotic cattle have less tolerance to heat and humidity and as the consequence eat less, where as buffaloes in the same field maintain appetite as long as some shading is provided.

5.3. Poned forage. Buffaloes are able to eat under water forage such as in a flooded area or in the pond.

5.4. Working capacity -: The buffalo is a sturdy draft animal. It's body structure, especially the distribution of body weight over the feet and legs is an important advantage. It's large boxy hooves allow it to move in the soft mud of rice field, Moreover, the buffalo has very flexible pastern and fetlock joints in the lower leg so that it can bend back it's hooves and step over obstacles more easily than cattle. Buffalo have a high capacity for hard work in marshy and flood prone environments where small tractors can not work as well. In the Northeast region, buffalo are worked about 5 hours a day. Hence, for small pieces of land of about 3 hectares, they may take 10-20 days to plow, harrow and grade the rice paddy field.

5.5 Lean meat :- Buffaloes have leaner meat, 3-5% less fat and less intramuscular fat than cattle (Ligda, 2001). Due to their lower fat, buffalo meat is preferable to beef for meatball manufacturer and traditional Thai style recipes.

6. Current situation, constraints and problems.

Since buffaloes are not just a farm animal or meat producer, breed development has emphasized their suitability for subsistence production systems of smallholders who raise only a small number of animals. Generally, this has not taken into consideration the demand of meat for human consumption and its consequence on animal type.

In Thailand, there is a sharp decrease in the number of buffaloes and possible genetic erosion due to heavy slaughtering and exploitation. There were various lessons to be learned from Government policies, which have changed focus from subsistence farming systems to industrialized systems. The focus has been toward introducing new technology for development to rapidly improve socioeconomic levels and attitude of the farmers to the technology. Combined with the Green Revolution, agricultural patterns have dramatically changed and significantly contributed to an increased productivity through the transfer of high yielding plant varieties and livestock breeds to the farmers. Hence, buffalo become a symbol of obsolete farming methods. Effects of Government policy can be grouped into 4 categories:-

6.1 Institutional problem. Government policies have affected the utilization of buffaloes and forced their sale by the farmers e.g.

6.1.1. Less consideration of buffaloes compared to cattle in the livestock development plan. There were no clear extension programs and less research support for buffalo production, hence, production systems are backward within Thai agricultural development.

6.1.2 The promotion of mechanization using two-wheel tractors through subsidies and credits to farmers over the last two decades. This has promoted mechanization at the expense of the farmer production.

6.1.3 The benefits of stock raising are not easily seen by the farmers and planners in the short term.

6.1.4 Law and regulations are ineffective to restrict the slaughtering of productive females.

6.2. Demand side.

6.2.1 The demand for buffalo meat is growing fast due to population growth, urbanization and rising income. The FAO predicts that the demand for red meat (both from cattle and buffalo) will rise from the estimated 6 - 7.4 kg /h/y in 2000 to 10.1 -14.8 kg/h/y by 2001. However, Thailand can currently produce 5.3 - 6.3 kg/h/y. This predictions are in line with Thailand's current decreasing number of buffalo.

6.2.2 Non sustainable exploitation, consumer demand for red meat has meant that there is heavy harvesting both young male and female buffalo and even productive females which has meant that there are not enough productive females to sustain future demand.

6.2.3 Price distortion of buffalo over cattle. Buffalo contribute more red meat than cattle to the Thai market, but their liveweight price is lower than cattle, so that butcher tends to prefer buffalo as he sells buffalo meat and beef at the same meat price.

6.3 The supply side. Smallholders generally do not threat buffalo production as a farm enterprise like the developed world, where they are part of an integrated farming system. Conventional Thai production systems tend to exhibit :

6.3.1. **Low productivity** - especially low calving rate of about 30% because the owners did not realize that increasing frequency of calving would have the largest effect on income. The reasons for low calving rate include lack of a bull due to most of the big males are sold before sexual maturity, or even they have a loan bull the productive females are unable to have access to the bull due to separate grazing areas.

6.3.2 **Lack of breeding improvement program** - which Chantalakhana (1994) pointed out that this was due to both a lack of interest among farmers as well as among extension personnel within the loan bull project.

6.3.3 Forced sale of buffaloes due to socioeconomic change, reduced areas of land for grazing, use of mechanization, off farm job opportunity and seasonal migration to work (Sukharomana, 1991)

So, it has now been generally agreed that people, wanting to study and develop buffalo production systems, should identify and diagnosis farmer's needs. Problems at the village level need to be defined and should cover the land, the farmer, the animal and the crops in sufficient depth to define constraints in the farming system. However, once the problems and constraints are identified, it is another to train the people concerned to overcome such complicated problems.

7. Swamp buffalo development in the past

Buffalo development in Thailand has been under consideration since 1975. The Department of Livestock Development (DLD), Kasetsart University, Khon Kaen University and Rocky Feller Foundation signed a memorandum of agreement to conduct a joint research program for improvement of a swamp buffalo named "The National Buffalo Research and Development Center Project". The aims at organizing resources already existing in the DLD and to have a breeding center for establishing a swamp buffalo nucleus herd at the National Buffalo Breeding Center (NBBC) at the Surin Livestock Breeding Station.

There have been various activities in relation to buffalo development which have been carried out both at both a national and international level. These activities include (Chantalakhana, 1994):- research, education and training, seminar and workshop for information exchange, establishment of an information center called the "International Buffalo Information Center" (IBIC) under IDRC supported and the formation of Asian Buffalo Association (ABA).

In addition, there were routine extension programs at farm level such as the loan bull program, AI service, buffalo health service, buffalo bank and buffalo contest and fair. Up to the late eighties, external agricultural assistance by various agencies decreased markedly while government policies in large ruminants were revised particularly in relation to cattle enterprise (both beef and dairy). However, the buffalo sector has been largely neglected.

Breeding Improvement : the performance testing program

Breeding improvement has been established since 1979, through the "performance testing program". A closed nucleus breeding herd was kept at Surin Livestock Breeding Station and a central testing station was located at Lamphayaklang Breeding Station. The breeding objective established since 1981 was to increase the growth rate and then to increase the mature size of buffalo. The breeding herd bulls and cows have been selected through the performance-testing program with close association of improving management, nutrition and health programs. This center has capacity to run 300 breeding cows per year. The performance-testing program has a 1-year testing period for each lot. There are 3 lots a year of weaned calves to be selected for this testing and each lot consists of 60 -70 weaned calves. The candidate animals were selected by ranking their 240 days weaning weight with good general appearance. At the end of the test period, animal were ranked for average daily gain (ADG) during test, 2 year adjusted weigh wither height and general appearance. The higher ranked animals were selected and an independent culling level was also based on ADG where the selected male and female should be above 400 and 350 gm/head/day respectively.

The testing procedures have been planned so that they are applicable to small holder by having similar feeding regime. The pastures were provided at 1 acre per head and each lot of candidate animals were managed in the same pasture and

management condition. The concentrated feed supplied to animals was at the rate of 1% of body weight each day. The concentrate feed had 12% protein and 75% TDN. The top bulls were assigned for collecting semen (distributed to the whole country) and for replacement at the NBBC, the rest were used in farmer's herds. The females that passed the test were used for replacement at the NBBC.

8. Promising project for buffalo development

Buffalo development has been neglected for a long period, until the sudden downfall of our tiger economy in 1996, when Thailand was faced with a financial crisis. One way to cope with these economic problems is to save foreign currency and promote a self-sufficient economy. Hence, buffalo production gave a good opportunity for this by using buffalo for preparing land and using manure instead of chemical fertilizer. This change in attitude has meant reduced expenditure of the farmer to pay for hiring small tractors and buying fertilizer both of which we need to import. Moreover, using buffalo for draught animal power may be bring back considerable cultural and social links within the community.

Nowadays, the concept of organic farming has grown in importance and become fashionable. Buffalo as draught animal power and for manure is appropriate for this way of thinking. Farmers sometime express their wish to make use of these already more environmentally friendly production methods and convert to organic agriculture. Organic rice farming methods as demonstrated at sites such as in Kalasin and Surin Province, can gain a higher price to the farmer, by using appropriate product labeling and selling to niche markets.

The new development policy of the government is directed towards participation and the King encourages this. Emphasis towards a new theory and self-sufficiency economy incorporating natural resource conservation and the change in paradigm for excessive range management has led to a rethinking in the design and implementation of development cooperation. Important instruments to this end are reforms of institutional framework, support, joint management of resource use, participation by all stake-holders, resource use, decentralization of management decisions and use of appropriate technologies.

Following the new concept, farmers participatory system is practiced by the DLD projects concerning buffalo production. To date, this approach has seen the transition from traditional top-down projects, (based on the provision of experts), to people's participation in programs with decentralization of management decision to the local community. So buffalo projects now come from the needs of the grass root community with Rapid Rural Appraisal methods at the site of the project itself.

Buffalo are deserving of conservation and sustainable utilization. Various outstanding projects have developed with this mind. Unfortunately, achieving results in such a complexity of problems in animal enterprises and rural development does not produce quick results. Nowadays, buffalo production emphasizes not only the socio-economic and cultural aspects, but also accounts for the high price of buffalo offered to the farmer hence buffalo production includes non-draught aspects with more emphasis on profitable sale. The outstanding projects are as following :

8.1. Breeding improvement : An Open Nucleus Breeding Scheme.

Breeding improvement is long term and needs to look at a 20-25 year period. So the design for the right breeding program is critical. It is likely that draught animal power will become less important, but buffalo for meat consumption might be more important for the next generation. From lessons learned, closed nucleus breeding schemes do not provide enough buffalo bulls to meet the demand of the industry due to limitation of resources and financial support. So, **"the open nucleus breeding scheme"** has been established since 2000 with 3 tiers including:

1. the first top of pyramid is the "nucleus herd" in the station farm
2. the second tier is "multiplier herds in the model buffalo breeding village"

3. the third tier is “village herds” around the whole country.

The genetics flow from the nucleus herd through the multiplier herd and then to the village herds by selected bulls and culling females. Upward selection of females from multiplier herds to the nucleus is allowed. Assortive mating with proven bulls in the nucleus herd is practiced.

There are three key decision areas to be considered to make the ONBS beneficial : **breeding objectives, genetic evaluation and breeding program design.** Buffalo production has traditionally been a subsistence farming system on a smallholders basis. However, breeding objectives are most commonly defined in terms of profit or economic efficiency with no explicit consideration of sustainability and have usually been practiced by livestock production systems in developed countries. However, a breeding objective for sustainability will involve strategic decisions to optimize selection of adaptive and productivity traits. Adaptive traits include fertility in the production environment, survival, which is influenced by disease and parasite tolerance, and efficient use of locally available feeds. As buffalo usually suit to these environments selection has traditionally been done only for production traits (such as growth rate) in the particular environment and to allow **natural selection** to look after adaptation. However, the relationship between body size and production efficiency in particular environments, especially regarding nutrition where feed quality is poor and sometime seasonal is important. The disadvantage of larger animals requiring higher maintenance may indicate that intermediate body size will produce the greatest return. Hence, the farmers have their indigenous knowledge to select moderate body size of females which can produce a calf every year, while selection of big bulls for draught purposes.

BREEDPLAN, is a genetic evaluation system by using BLUP techniques using animal mixed model analysis that allows both fixed and random effects to be fitted at the same time in the model and estimated simultaneously in the same analysis. BREEDPLAN was introduced in 1995 (under ACIAR supported) to predict genetic merit of the buffalo (call “ Estimated Breeding Values” or EBV) and are expressed as the difference between an individual animal genetics and the genetic base to which the animal is compared. With this technologies, measurements in the nucleus herd need to include pedigree and performance information.

8.2 Demonstration villages for buffalo conservation and development are established at the Northeast region since 1999. There are 19 pilot villages in the 19 provinces of the Northeast. There is no blue print for development of the production system. Rather, each site develops its own based on the local environment, natural resource, socio-economic and cultural practice, and traditional farming system of the site. The guideline for these villages are :

- group the stakeholders together and create strong civil society with the concept of farmer participation, encourage this by holding regular meetings and elect their own leaders.
- closer link among researchers, extension workers and farmers to analyze and diagnose the results together and discuss the potential of development and allow decision making to come from the community.
- define the efficiency of buffalo production in terms of high output per productive female. Increasing numbers of live calves per female through reducing calving interval will mean the largest income effect. The main challenge to the extension worker who adopts this technology will be to consult with the farmer on how to increase the exposure of the cow to the bull within the constraints that suit to the traditional practice of the framers in the village.
- advise farmers of other extension work to give incentive to the farmer to utilize buffalo to help alleviate poverty.

- increase knowledge transfer by using techniques that farmers at the village level will relate to e.g. demonstration site peer discussion.

Role model villages can be established in any reasonably sized village that has the support of the majority of the community in the village. From the results to date, the number of buffalo in the 19 demonstration villages has increased 22 percent and number of participating householders has also increased 22 percent in the first year.

8.3. Cattle and Buffalo Bank Project has been established under the initiative of The King Bhumipol since 1979. The aim of this project is to donate buffalo to the poor who do not have animals for draught power and as a consequence increase the number of progeny from these animal and pass them on the other people. The fund was established from donations and administered under DLD management.

8.4 Organized extension to persuade people of the value of buffalo and the need to conserve them for sustainable utilization on the production system :

8.4.1 Organize the National Buffalo Day annually. The main activities are Buffalo Contest - organized in order to select best bulls for donating as loan bulls or semen collection for A.I. service; conduct academic seminar and indigenous knowledge seminar; technology transfer through poster and demonstration.

8.4.2 Propaganda through the mass media.

8.4.3 Establish “ The Association of Buffalo Conservation and Development” ABCD with the aim to emphasize buffalo conservation and development.

9. Future buffalo development

Buffaloes are a large ruminant which requires time to implement structural change. It therefore has to be recognized, that buffalo projects do not produce quick results for either the donor or the farmer. The following are the aspects to ensure buffalo development:-

9.1. The focus of development should be on the potential and constraints of the target groups. That means ensuring that it addresses their problems, meets their needs and does not overtax the resources available. The best way of making sure of that is by developing the new practices and solutions in conjunction with the users. Target group participation programs and decentralized programs is the preferred approach.

9.2. The most incentive for farmers to continue raising buffalo is **the sale price**. As long as buffalo rearing is profitable, then the total numbers should stabilize and hopefully increase and consequently be available for use in the paddy field. If so, the farmers will seek to improve their productivity e.g. reducing calving interval, maintaining adaptation and increasing mature weight of sale animals.

9.3. The research and development program should be created for “ Farming System Research relating to buffalo production”. This needs to be a multidiscipline research program to identify, diagnose and design programs which make the greatest impact on farmers net income while maintaining and utilizing natural resources. This needs to be supported by an extension program conducted in a suitable manner to implement the strategies at the village level.

9.4. Government reforms that discourage slaughter of the female herd and reducing the price differential of live buffaloes and cattle.

9.5. Biotechnology approach with EBV's calculated might be useful for increasing the rate of genetic progress.

References

Chantalakhana, C. 1994. Swamp buffalo development in past three decades and sustainable production beyond 2000. In Proceedings 1st Asian Buffalo Association Congress, Khon Kean, Thailand.

Chantalakhana, C. 2001. Contribution of water buffaloes in rural development. Regional workshop on water buffalo for food security and sustainable rural development. Surin, Thailand.

Department of Livestock Development. 2000. Statistical Yearbook, Bangkok, Thailand.

FAO, 1996. FAO Yearbook Production, Vol. 50. Food and Agriculture Organisation of the United Nations. Rome.

Ligda, D.J, . 2001. <http://www.netnitco.net/users/djidda/wblinks2html>.

McDowell, R.E. 1993. Who speaks for the animals. Policies and strategies for livestock development. Proceedings of the Regional Seminar, Manila, Philippines.

Peters, J.K. 1999. Livestock production and food security consequences for the environment ?. Agriculture & Rural Development. Vol. 6 No. 1. , Frankfurt.

Poondusit, Taweeporn. 2001. Comparison of rumen ecology and fattening performance of male dairy, beef cattle and buffalo. M.S. Thesis, Kasetsart University, Bangkok, Thailand.

Sansoucy, R. , M.A. Jabbar, S. Ehui and H. Fitzhugh. 1994. Keynote paper: The contribution off livestock to food security and sustainable development. Roundtable on Livestock Development Strategies for low income countries. ILRI, Ethiopia.

Sukharomana, S. 1991. Attitude of Thai farmers toward buffalo holding. In Draught Power for Swamp Buffalo in Asia. Proceedings, Buffalo and Beef Production, Research and Development Center, Kasetsart University, Bangkok, Thailand.