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Recent production status, research results and development conditions of rabbit production in Vietnam - A review

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ABSTRACT

Rabbit production is well developed in different regions of Vietnam due to abundant feed resources, suitable climate, and good raising experiences with the total rabbit population of 5,844,000 in 2014.There are many production models created by producers, which show the technical and economic effectiveness for production contributing to the poor alleviation and prosperous income. Rabbit meat consumption is also increased in the cities and rural areas from year to year. In this paper, the current situation development, research results on breeds, nutrition, feed resources, rabbit performance of meat and reproduction, markets and development strategies are presented. The constraints of production development such as low breed quality, few intensive large farms, limited necessary studies, poor marketing, and less international co-operation are also discussed.

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1 INTRODUCTION

Vietnam is a tropical country located in Southeast Asia with a monsoon climate and the total land area of 33.1 million hectares in which there is 26.8 million hectares for agricultural production (81.0%). Total population is 90.7 million including 60.7 million in the rural areas (66.9%), and total labor population is 53.8 million with 69.3% working in the agricultural sector (GSO, 2014). The agriculture is based mainly on rice production with 7,814,000 hectares and 45.0 million tons in 2014. The other crops are maize, cassava, groundnut, soybean, sugarcane, fruit trees, coffee, tea, rubber, coconut, etc. The agriculture output value contributes around 25% of GDP and crop production takes around 77% and livestock production takes about 21% dealing mainly with pigs, cattle, poultry, goat and rabbit.

In Vietnam, rabbits have been recently raised in both small households and industries. After the bird flu happened in Vietnam from 2004 to 2006, rabbit has been paid more attention by farmers and government agencies, as a means to improve the meat production and income of the producer as well as to avoid the serious diseases of pigs and poultry. There have been studies on breeds and breeding, nutrition, feeds, nutrient supplements, improved houses and cages, health care of rabbit crossbreds and pure breeds aiming to improve their performances and income for farmers (Nguyen Thi Kim Dong *et al*., 2008). There are many rabbit husbandry models created by producers, which show the effectiveness for production contributing to the poor alleviation and prosperous income. Therefore, rabbit farming becomes popular for almost provinces in Vietnam, and as a result rabbit meat consumption is also increased in the cities and rural areas. In this review paper, the recent

production situations, research results, training and extensive activities, new highlights of production, advantages and disadvantages and future development strategies of rabbit production in Vietnam are presented.

2 CURRENT PRODUCTION STATUS AND MARKETING

The change of rabbit population in Vietnam from 2010-2014 is presented in Table 1.

Table 1: Rabbit population (thousand heads) in different regions of Vietnam from 2010 to 2014 (Nguyen Van Dat, 2016)

Region	2010	2011	2012	2013	2014	Annual change 2010- 2014 (%)
Whole Country	5,191	7,315	7,986	8,802	7,584	100
Red river Delta	3,026	2,843	2,973	3,379	3,250	42,9
Northern mountain areas	528	623	769	656	789	10,4
Central areas	576	632	727	717	874	11,5
Western mountain areas	723	746	1169	1950	675	8,90
Southeastern provinces	339	722	929	636	585	7,71
Mekong Delta	-	1,749	1,420	1,465	1,411	18,6

The total rabbit population in Vietnam in 2014 was 7,584,000 heads with the annual increase of 11.5% from 2010 to 2014 (Table 1). It also indicates that the technology and markets, trading for rabbit production is still modest. The distribution of rabbit population in provinces and cities of the Red river Delta (42.9%) and Mekong Delta (18.6%) was higher than other regions in Vietnam. This could be explained that Vietnamese consumers gradually adapt to the rabbit meat products. There is a Japan company available to buy the rabbits, while in the Mekong Delta feed resources for rabbit are abundant due to the fertile soils and available fresh water throughout a year. However, it is easy to recognize that in all the regions in Vietnam rabbit could be raised, and rabbit meat is popularly consumed. Rabbit breeds raised in Vietnam are White New Zealand, Californian, Hyla and crossbreds (New Zealand x local, Californian x local, and other improved breeds x local). The pure improved breeds are mainly raised in the intensive farms, while the crossbreds dominate at the small farms in rural areas. In both production systems, green forages are fed the rabbits, while feeding complete pellets rabbits is rare, due to availability and lower cost of green forages.

Rabbit meat and other products are still new for the Vietnamese; however, they are mainly consumed in the domestic markets. Although rabbits and their products could be exported to many countries, there is no preparation plan for this. There is a Japan pharmaceutical company (NipponZoki Ltd.) available to buy New Zealand rabbits for producing medicines with 1,000,000 heads per year (Dan Viet, 2015), but the increase of the herds needs more time. This also stimulates the rabbit production development in Vietnam. The price of meat rabbit sold to the middlemen has been recently varied from 2.3 to 2.75 USD/kg live weight; however, it has been around 7.0 USD/kg carcass weight when sold to the consumers. The price of reproductive rabbits has been much higher and depending on the breed quality. With the recent prices, producers could get some better profits as compared to commercial pigs and chicken. In general, the rabbit meat and other products processing and their marketing activities in Vietnam are poor, consequently there was a limitation of rabbit production development in Vietnam from 2011-2014 (Table 1), despite rabbit production products was not much. In practice, many family-scale rabbit production models have given high profits in provinces in the North (Bac Giang, Thai Nguyen, Ha Tinh) as well as in the South (Vinh Long, Tien Giang, Dong Thap and Long An) of Vietnam. The beneficial rabbit production in Vietnam is clearly recognized for better income and environment, due to low cost production of locally available feeds, housing and rabbit investments, and low waste pollution and greenhouse gas emissions from rabbits (Nguyen Van Thu and Nguyen Thi Kim Dong, 2011).

3 REVIEWED RESEARCH RESULTS

The main objectives of studies on rabbits in Vietnam are to improve their performance and health care for both industry and rural development. The recent research results are summarized as follows:

3.1 Dietary nutrients and metabolizable energy levels

The optimum dietary levels of crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and metabolizable energy (ME) for New Zealand, Californian and crossbred rabbits for meat production fed green forages and supplements are reported in Table 2. These have been useful for the training courses for rabbit husbandry in both intensive and extensive farms. The differences of concentration of nutrients and energy in diets are

recommended; they are probably explained due to the different quality of diets and rabbit growth performance. Nguyen Thi Vinh Chau (2015) stated that the optimum concentration of CP and ME for experimented rabbits were higher than those of the temperate rabbits; however, the CP and ME intakes of the experimental rabbit were lower.

Table 2: The optimum levels of dietary CP, fiber and ME of the growing crossbreds, New Zealand (NZL) and Californian in Vietnam

Criteria Rabbit breed	CP, % DM	NDF/ADF*, %	Dietary ME, kcal/kgDM	Daily weight gain, g	Sources
Crossbreds (NZL x local)	17.0 – 19.0	36.0 – 39.0	2500 – 2700	17.1 – 19.4	Nguyen Thi Vinh Chau, 2015
New Zealand	16.6	22.2*	2135 – 2350	17.4 – 19.0	Nguyen Van Dat, 2016

3.2 Feeds and supplementation

Many green forages including natural and planted grasses and legumes, vegetables, market wastes, vines of beans and potatoes, and other agro-byproducts in different regions of Vietnam were evaluated on chemical compositions*, in vitro* and *in vivo* digestion and nutritional values(Nguyen Thi Vinh Chau, 2015 and Nguyen Van Dat, 2016). The effects of association of among forages on rabbit nutrient digestibility, performance and economic returns were also investigated to recommend for local feed utilization (Nguyen Thi Kim Dong *et al*., 2008). Effects of CP and soluble carbohydrate feed supplements on rabbit nutrient intakes and digestibility were studied to improve rabbit meat production and reproduction (Nguyen Thi Duong Huyen *et al*., 2013 and Nguyen Van Thu, 2013) while these for minerals and vitamins were rarely implemented.

Table 3: Live weight (g), daily weight gain (g), feed conversion ratio and economic returns (VND/rabbit) of rabbit supplemented amino acid in different treatments (Nguyen Thi Vinh Chau, 2015)

	Treatment					SEM	P
	17CP	17CP-AA	16CP-AA	15CP-AA	14CP-AA		
Initial live weight, g/rabbit	631	618	619	628	626	9.42	0.834
Final live weight, g/rabbit	2,077^{ab}	2,137^{a}	2,056^{ab}	2,025^{ab}	1,977^{b}	23.3	0.012
Daily weight gain, g	18.8^{ab}	19.7^{a}	18.7^{ab}	18.1^{ab}	17.5^{b}	0.325	0.015
Feed conversion ratio	4.43	4.26	4.38	4.60	4.56	0,133	0,425

17CP, 16CP, 15CP, 14CP: crude protein level of 17, 16, 15 and 14 %; AA: amino acid supplemented (L-Lysine and DL-methionine).

Table 4: Feed and nutrient intakes of crossbred rabbits fed levels of Mulato II grass replacing sweet potato vines (Do Thi Khanh Linh and Nguyen Van Thu, 2017)

	Treatment					SEM	P
	M0	M25	M50	M75	M100		
DM, g/rabbit/day							
- Sweet potato vines	30.4^{a}	26.5^{b}	24.1^{c}	10.6^{d}	-	0.372	0.001
- Mulato II grass	-	7.69^{d}	15.3^{c}	22.9^{b}	30.8^{a}	0.260	0.001
- Soybean extraction meal	16.34	16.34	16.34	16.34	16.34	-	-
- Maize	13.14	13.14	13.14	13.14	13.14	-	-
Total, g/rabbit/day							
- DM	59.9^{c}	63.7^{b}	68.8^{a}	63.0^{b}	60.2^{c}	0.390	0.001
- OM	53.4^{c}	57.7^{b}	61.3^{a}	56.2^{b}	53.8^{c}	0.371	0.001
- CP	14.7^{ab}	15.7^{a}	15.0^{a}	13.0^{c}	11.7^{d}	0.082	0.001
- EE	3.46^{a}	3.36^{a}	3.37^{a}	2.54^{b}	1.93^{c}	0.031	0.001
- CF	10.1^{d}	11.4^{c}	13.0^{a}	12.0^{b}	11.7^{bc}	0.090	0.001
- NDF	19.2^{c}	22.6^{b}	26.5^{a}	25.9^{a}	26.6^{a}	0.190	0.001
- ADF	12.1^{d}	13.8^{c}	16.0^{a}	14.9^{b}	14.7^{b}	0.122	0.001
- Ash	5.13^{c}	5.57^{b}	6.16^{a}	5.52^{b}	5.23^{c}	0.043	0.001
- ME (MJ/head/day)	0.62^{c}	0.65^{b}	0.69^{a}	0.63^{c}	0.60^{d}	0.031	0.001

M0, M25, M50, M75 and M100: Mulato II grass replacing sweet potato vines at 0, 25, 50, 75 and 100%. $^{a, b, c}$*Means with different letters in the same row are statistically significant different at 5%.*

Table 5: Growth rate and feed conversion ratio of crossbred rabbit fed levels of Mulato II grass replacing sweet potato vines (Do Thi Khanh Linh and Nguyen Van Thu, 2017)

	Treatment					SEM	P
	M0	M25	M50	M75	M100		
Initial live weight, g	544	543	542	543	547	14.0	0.999
Final live weight, g	1,982^{bc}	2,055^{b}	2,205^{a}	1,981^{bc}	1,908^{c}	28.5	0.001
Daily weight gain, g	17.1^{b}	18.0^{ab}	19.8^{a}	17.1^{b}	16.2^{b}	0.41	0.001
FCR	3.50	3.54	3.48	3.68	3.73	0.082	0.205

FCR: Feed conversion ratio. $^{a, b, c}$ Means with different letters in the same row are statistically significant different at 5%

The supplements of soluble carbohydrate are paddy rice, maize, cassava, sweet potato, etc. as energy sources. While fresh legumes, soybean extract meal, coconut cake, cotton seed cake, soya waste, brewery waste, etc. are supplemented rabbits as protein sources (Nguyen Van Thu, 2013). Concentrate feeds in powder or pellet forms are also used as protein and energy sources for them. Several studies of amino acid supplementation in lower CP diets carried out gave promising strategies to increase the rabbit performance, but reduce the nitrogen excretion into the environment (Nguyen Thi Vinh Chau, 2015; Truong Thanh Trung, 2016).

DoThiKhanh Linh and Nguyen Van Thu (2017) reported that the crossbred rabbit fed 50% Mulato II grass (*Brachiariaruziziensis*) replacing sweet potato vines diet improved feed and nutrient intakes and increased growth rate and final live weight, carcass weight and profits (Table 4 and 5). Thus rabbits do need a suitable fiber requirement for their digestive functions and nutrients to grow. The author also suggested that study on Mulato II grass for the re productive rabbits should be considered for improving their performance.

3.3 Nutrient-response modeling for growing rabbits

Nguyen Xuan Trach *et al.* (in press) reported that there is a high need for research to determine optimal levels of nutrients in the diet for exotic rabbits fed on green forages available in Vietnam. Then a method of the mathematical modeling of nutrient-response curves to estimate optimal levels of energy, protein and fiber in the diet for New Zealand White growing rabbits in North Vietnam was done. The results indicated that the best diet for New Zealand White growing rabbits fed on available forages in the North of Vietnam contains 2106-2162 Kcal ME/kg DM, 16.52-16.75% CP, and 21.86-22.42% ADF. The regressions of average daily weight gain (ADG) and feed conversion ratio (FCR) of rabbits on ME, CP and ADF were presented in Table 6. However, there is still a need for further research to confirm these findings, especially, when the interactions among the diet components are taken into account.

Table 6: Regressions of ADG and FCR of rabbits on levels of ME, CP, and ADF in the diet (Nguyen Xuan Trach *et al.*, in press)

Regression equation	MPE	RPE	R^2	R^2adj
On level of ME, *Kcal/kg DM*				
(1) ADG = - 73.00 + 0.08648ME - 0.000020ME^2	1.44	7.10	77.10	76.50
(2) FCR = 33.24 - 0.02528 ME + 0.000006 ME^2	0.60	11.01	52.30	51.06
On level of CP,*% DM*				
(3) ADG = 2.538 + 2.153CP- 0.06518CP^2	2.80	13.82	69.90	69.20
(4) FCR = 11.78 - 0.7912CP+ 0.02361CP^2	0.67	12.38	50.80	49.90
On level of ADF,*% DM*				
(5) ADG = -23.99 + 4.12ADF- 0.0919ADF^2	1.30	6.43	83.00	82.60
(6) FCR = 16.58 - 1.076ADF+ 0.02461ADF^2	0.58	10.74	51.90	50.90

N.B.: MPE: Mean prediction error, RPE: Relative prediction error, R^2: Coefficient of determination, R^2adj: Adjusted coefficient of determination.

3.4 Rabbit performance

Because of green forages (low dry matter) used for feeding rabbit, the growth and meat production for both the pure improved breeds and crossbreds in Vietnam are lower than those of rabbits raised by the complete pellets in other countries. Similarly, the reproductivity of rabbits in Vietnam was lower than those for the developed countries. The performance of meat production and reproduction are presented in Table 7 and 8.

Table 7: Meat rabbit performance of crossbreds, New Zealand and Californian fed green forages and supplements in Vietnam

Rabbit breed	Daily weight gain, g	Feed conversion ratio	Carcass, %	Source
- Crossbred (New Zealand x local)	18.0 – 22.7	3.21 – 4.20	-	Nguyen Thi Kim Dong (2009)
- Crossbred (New Zealand x local)	16.7 – 20.9	4.20 – 4.83	48.1 – 55.9	Nguyen Thi Vinh Chau (2015)
- New Zealand	17.4 – 19.0	5.0 – 5.18	52.4 – 53.9	Nguyen Van Dat (2016)
- Californian	20.5 – 23.3	3.08 – 3.99	52.3 – 53.0	Truong Thanh Trung (2016)

Table 8: Several reproductive parameters of different rabbit breeds in Vietnam (Dinh Van Binh et al., 2008, *Nguyen Thi Kim Dong et al., 2008)

Reproductive parameters	New Zealand	Californian	Hipless	Crossbred (NZL x local)*
Litter size in average/year	6.57	6.45	6.66	6.70
Rabbit per litter	7.35	7.60	7.70	7.60
Live rabbit at weaning, %	87.5	87.4	87.5	90.5

3.5 Housing and cages

While in the large-scale farms the rabbit houses, cages and other facilities use the models introduced from the developed countries such as France, Bulgaria, Italy, etc., the researchers mainly study them by using the local materials such as bamboo, woods, trees, etc. for both the intensive and extensive farms to adapt to the environment and to reduce the cost (Nguyen Quang Lich and Dinh Vuong Hung, 2008). However, the use of these cages for the large-scale farms had limitations for automatic feeding systems.

Table 9: Size of rabbit's coop and the nest box (Nguyen Quang Lich and Dinh Vuong Hung, 2008)

Coop(cm)			Nest box (cm)		
Length	Width	Height	Length	Width	Height
90	60	45	60	35	35
	(big scale)			(deliver inside)	
70	50	35	40	35	30
	(small scale)			(deliver inside)	
			35	25	30
				(deliver outside)	

3.6 Breeds and artificial insemination

Studies on genetics, breeds and breeding in Vietnam seem to be ignored; however, there is a trend for improved breeds' importation from the developed countries. Due to some limitations of development of large-scale intensive farms, there is a lack of using artificial insemination in almost of the rabbit farms. Despite the above limits, there are also some studies on the rabbit semen. Do Van Thu and Nguyen Ba Mui (2008) concluded that rabbit semen was ejaculated in the cool months for better quality than the hot months, the interval between two ejaculations was three or four days for good quality of semen, and semen diluted at the rate 1:5 got better result than diluted rate of 1:10, and pregnant rate of conserving semen was 75.0, 71.4 and 50.0%for the first, second and fourth day, respectively. Some criteria of rabbit semen are showed in Table 10.

Table 10: Characteristics of semen of different rabbit breeds in Vietnam (Do Van Thu and Nguyen Ba Mui, 2008)

Genotypes	New Zealand	Californian	Panon	Grey local	Black local
Volume(ml/ejaculation)	$0.87^{a} \pm 0.02$	$0.91^{a} \pm 0.05$	$0.80^{a} \pm 0.03$	$0.65^{b} \pm 0.03$	$0.66^{ab} \pm 0.04$
Motility (%)	$65.0^{a} \pm 0.55$	$64.7^{a} \pm 1.64$	$62.1^{b} \pm 0.94$	$61.3^{b} \pm 1.26$	$61.8^{b} \pm 1.15$
Concentration (million/ml)	$264^{b} \pm 2.54$	$276^{a} \pm 5.47$	$291^{a} \pm 3.80$	$285^{a} \pm 2.98$	$282^{a} \pm 6.95$
Living proportion=LS (%)	71.8 ± 0.56	72.5 ± 1.60	70.9 ± 0.96	69.8 ± 1.18	70.9 ± 1.19
Abnormality proportion=K (%)	$18.5^{a} \pm 0.07$	$18.5^{a} \pm 0.17$	$18.6^{a} \pm 0.13$	$19.1^{b} \pm 0.13$	$19.07^{ab} \pm 0.32$

$^{a, b, c}$Means with different letters in the same row are statistically significant different at 5%

4 RECENT DEVELOPMENT CONDITIONS

In recent years, the local and central government of Vietnam have paid more attention to improvements of rabbit production such as producing the development policies, standards of rabbit farms, technical trainings and incentives for establishment of rabbit production co-operatives, lager intensive farms and extensive clubs, improved markets, etc. (Dan Viet, 2015). There have also been collaborations among the universities, companies and local institutions to

create chances of investments on technology, finance and human resources for improving the production and markets (BAFU, 2014). Many M.Sc. and doctoral students on rabbit nutrition, feeds and nutrient supplementation have been graduated at Can Tho University, Vietnam National University of Agriculture, and National Institute of Animal Sciences. This would give more capacities of sciences, techniques and trainings develop better rabbit production. The veterinary networks, vaccines of common diseases, parasite preventions and effective medicines have been also studied to protect the rabbit herds from diseases.

5 CONCLUSIONS

It is concluded that rabbit production in Vietnam is developing with promising conditions of abundant feed resources, good government policies, improved research results, applauded producers, and better development strategies. However, some constraints for production development such as low breed quality, few intensive farms, limited necessary studies, poor marketing and less international co-operation should be improved.

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