Household Animal Raising Behaviour in China's Developed Regions: The Case of Zhejiang Province [1]

Xi-An Liu [a], Hua-Yong Teng [b] and Qing-Fang Guo [b]

[a] *Asian Agribusiness Research Centre*
The University of Sydney
Orange NSW 2800
Emial: xliu@orange.usyd.edu.au

[b] *College of Economics and Management*
China Agricultural University
Beijing China 100094

Abstract

Due to the dominant role of household animal raising in China's animal production, an improved understanding of household animal raising practices is essential to study China's feedgrain markets. It is also noted that the level of local economic development affects animal raising practices and the development of feedgrain markets. This paper reports the findings from a rural household survey we conducted recently in a China's coastal and developed province. It was specially designed to examine issues related to household animal raising practices such as animal raising scale, sources of feed, feed processing and feeding efficiency in a developed area. Discussed also are implications of the findings on China's regional feedgrain markets.

1. Introduction

There are three kinds of animal raising practices in China: (1) very small-scale traditional household backyard animal raising; (2) specialised animal raising households; and (3) larger-scale animal feedlots. The former two occupy an important share. For example, in 1998, about 95% of China's pork was produced by the former two animal raising practices. Backyard animal raising alone produced some 80% of total pork production (Qi et al. 1999, p. 2). Although the share of animal production by backyard animal raising is declining in the past years, the share by specialised animal raising households is increasing (NORHS 1998; Qi et al. 1999, p. 2). Hence the total share of production by these two practices has remained at a similar level in the past years. This makes it extremely important to gain an improved understanding of household animal raising practice in order to better understand China's feedgrain issues.

[1] Paper to be presented to the 46th Annual Conference of the Australian Agricultural and Resource Economics Society, 13-15 February 2002, Canberra, Australia. This paper is part of the GRDC-funded project, 'China's Regional Feedgrains Markets: Development and Prospects'. GRDC's support is gratefully acknowledged. The authors wish to thank Dr Zhang-Yue Zhou of the University of Sydney and Professor Wei-Ming Tian of China Agricultural University for their assistance in this study.

Despite the need and importance of understanding household animal raising practice, studies conducted at the farm level are not extensive. Earlier attempts include Zhang and Lu (1997), NORHS (1998), Zhang (1998), and Wang et al. (1999). Using data collected by the National Office for Rural Household Surveys, Zhang and Lu (1997) examine changes in pig production scale and structure and feed conversion ratios between provinces. NORHS (1998), based on a survey of some 5000 households of seven provinces, discusses a number of issues related to animal production, e.g., composition and changes of animal feeding practices, feed source and conversion ratios. Zhang (1998), using the same set of data of NORHS (1998), but examines issues related to pig production only. Zhang provides an analysis and comparison of economic returns from pig production between the seven surveyed provinces. Wang et al. (1999), based on a survey of some 300 pig raising households in Sichuan province, also address issues such as feed use and conversion ratios and pig raising costs and returns.

Cao (1998) believes that China's animal production is still largely a sideline operation by many farm households as evidenced by the fact that on average each household raises only two pigs a year. However, due to the high homogeneity of Chinese farm household size and other economic similarities, Chinese farmers tend to respond to market signals simultaneously and similarly. Any small adjustment in animal production decision, e.g., raising one more or one less pig, by the many millions of Chinese farmers can generate a huge impact on the market. It is in this sense that Cao reinforces the importance of studying animal raising practice at the household level.

It is also important to examine household animal raising behaviour in different regions. Being such a vast country, China has regional variations in many aspects that affect feedgrain demand and supply. Previous studies on China's feedgrain market have dealt with the issues largely at the aggregate national level. Zhou et al. (2001), however, point out that regional characteristics need to be taken into consideration so to gain useful insights in understanding China's feedgrain issues. As part of a GRDC-funded three-year project on the development and prospects of China's feedgrain market, we conducted household surveys in four regions in China on household animal raising practices. The four regions were chosen with the following distinctions: a traditional pig-raising region, a feedgrain-surplus region, an economically developed region and a region that is economically less developed, lack of feedgrains and is dominated by small-scale traditional backyard animal raising.

This paper reports the findings from our rural household survey conducted in Zhejiang, a south-east coastal and developed province. Through the survey, we attempt to find out the reasons for farms to engage in animal husbandry, the composition and sources of feed, feed-meat conversion ratios, farmers' responses to input and output price changes, and their intention towards future animal husbandry. In the next section, we describe the administration of the surveys. In Section 3 we report and discuss major findings. We summarise the key findings from the survey and discuss their implications in the final section.

2. The Survey

The survey was conducted in May-June 2001. Two hundred and seventy households were surveyed, which were selected from six villages in Jiashan county, Zhejiang province.

Zhejiang province is situated in China's south-east corner, south to Fujian, west to Jiangxi, north to Jiangsu and Shanghai, and east to the China East Sea. By land area, Zhejiang is one of the smallest provinces in China (being 1.1% of China's total land area) yet it is one of the most economically developed regions – it produces 6.8 per cent of China's GDP. Its per capita income in 2000 (¥6700) was almost double of the national average (¥3711). Telephone possession is very high. In rural areas, per 100 households telephone possession in 2000 was 61 sets for fixed phones and 20 sets for mobile phones (compared to the national average 26 sets and 4 sets, respectively).

Due to rapid industrialisation and urbanisation, opportunity cost for agriculture is high. The share of agriculture in total GDP has declined rapidly from 38 per cent in 1978 to 11 per cent in 2000. Crop and animal husbandry is also on the decline. In 1987, per capita grain output and meat output in Zhejiang were 386kg and 20.9kb, respectively, being slightly higher than the national average that were 379kg and 20.7kg respectively. By 2000, however, both per capita grain output (271kg) and per capita meat output (26.2kg) were lower than the national average that were 374kg and 49.5kg, respectively. Hence, while per capita meat output was marginally increased, per capita grain output had significantly dropped.

Limited resources can be spared to produce feedgrains and feedgrain production is low. The percentage share of corn output – the major feedgrain item – out of total grain production in 2000 is less than 2 per cent (Table 1). Imports of feedgrains have to be used and corns are mainly sourced from China's north-east provinces. Traditionally, barley is used to feed pigs in order to produce a kind of special ham (Jin-Hua Ham). Some low quality of rice is also used for feed. At the provincial level, although the gross value of animal husbandry has increased, its share out of total agriculture has declined from 24% in 1990 to 17% in 2000. The number of pigs in stock also declined in 2000 compared to 1990. The number of pigs slaughtered, on the other hand, increased slightly (Table 1).

Table 1. Feedgrain Production and Meat Production in Zhejiang Province

	1990	2000
Total Population (000)	42349	45012
Area Sown to Grains (000 ha)	3266	2300
Area Sown to Corn (000 ha)	48	52
Corn out of Grains (%)	1.5	2.3
Grain Output (000 t)	15861	12177
Corn Output (000 t)	128	203
Corn out of Grains (%)	0.8	1.7
Gross Value of Agriculture (m ¥)	33677	106290
Gross Value of Animal Husbandry (m ¥)	7957	17730
Animal Husbandry out of Agriculture (%)	24	17
Head of Pigs in Stock (year end) (000)	13305	10430
Head of Pigs Slaughtered (000)	12879	13598
Total Meat Output (000 t)	961	1176
Per Capita Meat Output (kg)	22.7	26.2

Note: Agriculture includes farming, forestry, animal husbandry, fishery and other economic activities carried out by agricultural population.

Sources: Ministry of Agriculture, *Chinese Agricultural Statistics*, various issues.
Zhejiang Statistic Bureau, *Zhejiang Statistics Yearbook*, various issues.

Jiashan county is situated in the north-east plain of Zhejiang. It is close to three major cities, Suzhou, Shanghai and Hangzhou (capital of Zhejiang). This provides important market for animal husbandry products of this county. It is chosen for the survey due to its predominant meat production position in the province. It is a commercial pig production base of Zhejiang province. This county is also famous in piglet reproduction. Those pig feedlots in the nearby major urban centres are important buyers of piglets produced in this region.

Six villages, three from each *Xiang*, were selected. The gross value of animal husbandry out of total agricultural value in these villages ranged from 2% to 35% in 2000 (see Table 2). In the past few years, the share of animal husbandry gross value out of total agricultural value in three out of the six villages has declined with two remaining the same and only one experiencing an increase. Table 2 also reveals that the gross value generated by other activities other than farming and animal husbandry accounts for an important share in most of

the villages except in one village. All the villages have access to at least one major road and all have access to extension services.

Table 2. Basic Indicators of Surveyed Villages

Village and Sample Size	Total Arable Land (mu)	Industry Structure According to Gross Value (%)						Total Work Force (person)	Per Capita Net Annual Income (¥)	Any Exten-sion Station	Any Major Roads Passing the Village
		Farming		Animal Husbandry		Others					
		1995	2000	1995	2000	1995	2000				
1 (40)	5970	50	45	35	25	15	30	1445	5080	Yes	Yes
2 (48)	2812	50	50	20	20	30	30	1075	4767	Yes	Yes
3 (47)	3227	50	40	30	20	20	40	1293	4500	Yes	Yes
4 (48)	4418	65	60	30	35	5	5	1767	5882	Yes	Yes
5 (47)	4000	50	35	25	25	25	40	1187	4872	Yes	Yes
6 (40)	4680	38	5	19	2	43	93	1348	4403	Yes	Yes

Due to high labour opportunity cost and concerns of releasing family business and financial information, conducting surveys with rural households in such economically developed regions has become increasingly difficult. Strict random selection of households was not feasible – due to the likely high rate of rejection for being surveyed. The households chosen were largely according to local cadres' understanding of the village situation. Therefore, the sample is likely biased in favour of those that do raise animals, particularly those that raise pigs. This, however, should not pose any major problem for this study as it is mainly concerned about the animal raising behaviour. Nonetheless, it is noted that it would be most ideal if random selection could be used as that would give us a more accurate picture about the share of households that do not engage in raising animals.

In Jiashan county, pig production occupies an overwhelming position. Majority of feed is used for raising pigs (over 80%) with a small share used for poultry production. Cattle and sheep production is not significant. Therefore, in the rest of the paper, the discussion is focused on pig production.

3. Findings

Of the 270 surveyed households, 235 households (87%) raise pigs and 35 of them (13%) do not raise pigs. [2]

3.1 Reasons for Raising or not Raising Pigs

It is not only interesting but also very useful to find out why some households do not raise pigs. Of special interest is to know whether some households choose not to raise pigs is because their income has increased. If that is the case, then one would anticipate that fewer and fewer households would raise animals when their income level is increased. This would likely lead to larger-scale animal raising units which would have subsequent effects on feed sourcing and feed usage.

We obtained the following responses from our survey as to why some households do not raise pigs (see Table 3).

[2] As noted earlier, the sample is likely biased in favour of those that do raise animals, particularly those that raise pigs. The actual share of households that do not raise pigs is likely somewhat higher than this percentage.

Table 3. Reasons that Farmers Do not Raise Pigs

Reason	% of Respondents
1. Never raised pigs	23.1
2. Not profitable	46.2
3. Too troublesome	6.5
4. Too dirty	0.0
5. Too busy to do it	17.8
6. No need to do it because income has increased	1.8
7. Other	4.7

(35 respondents)

The results show that whether a farmer raises pigs or not has little to do with their income level. It is also not related to whether raising pigs is too troublesome or too dirty. This is somewhat surprising and needs to be verified from further investigations. Thus, the assertion cannot be confirmed that a farmer would give up pig raising after income increase because of the troubles and dirtiness associated with pig raising. In fact, except those that never bothered to raise pigs (23.1%), the reasons for those not to raise pigs are primarily based on economic considerations (64%): not profitable and opportunity cost is too high to do it.

Results in Table 4 clearly show that the most important motivation for farmers to raising pigs in this region is to increase family income. Home consumption is not a major consideration. Disposing of surplus grains and collecting manure are not important consideration either. Thus, whether farmers raise or not raise pigs is largely driven by economic considerations in this region.

Table 4. Reasons that Non-Specialised Households for Raising Pigs

Reason	% of Respondents
1. For home consumption	3.4
2. To increase family income	92.2
3. For disposing of surplus grains	1.0
4. For disposing of on-farm by-products	0.5
5. For disposing of tables scrapes	2.4
6. For manure	0.5
7. Other	0.0

(205 corespondents)

Among the 235 households that raise pigs, 159 (68%) were backyard animal raising (raising 15 hogs or less) and 76 (32%) were specialised. In our study, one sow is treated to be equivalent to two hogs and five piglets are equivalent to one hog. It is found that the age and education level of household head and farm size had little influence on whether a farm will follow traditional backyard animal raising practice or will become a specialised household (Table 5). However, a family with larger population size and more labour is more likely to become a specialised animal-raising household. According to our investigation, pig-raising expertise and the availability of funds seem to be the other two important reasons that affect a farm's pig-raising scale. It is interesting to note that the head of those households that do not raise pigs tend to be younger and have more years of education. These families are also relatively smaller and their farm size is also smaller (Table 5). This tends to suggest that, in this region, the smaller nuclear family with higher level of education may lead to reduced intention to raise pigs in the future, implying that the number of farms engaging in pig raising will reduce.

Table 5. Attributes of Surveyed Households

	Family Size (Person)	No. of Labour (Person)	Age of Household Head (Year)	Education Level of Household Head (No. of Years of Schooling)	Farm Size (mu)
Backyard animal raising	3.6	2.6	45.0	6.8	7.5
Specialised households	4.1	2.9	45.7	7.0	7.6
No animal raising	3.3	2.1	40.4	9.3	4.0

3.2 Feedgrain Production

The survey results tend to indicate that feedgrain production in this region has been declining and is unlikely to increase in the future. The respondents were asked, compared to five years ago, what changes had happened to their sown area to feedgrains (e.g., corn, barley) and forage crops. The responses obtained are given in Table 6.

Table 6. Changes in Sown Area to Feedgrains and Forage Crops

Change	%
1. A major increase	2.8
2. A slight increase	5.3
3. Almost the same	70.0
4. A slight decrease	10.9
5. A major decrease	10.9

(247 respondents)

It can be seen that, in balance, more farmers have chosen to reduce their area allocated to feedgrain and forage production. For the few who indicated that their sown area to feedgrain production and forage had increased, the major reasons they gave were for on-farm use (30%), for high yield (28%), and for a good price (28%).

When asked how they would plan their sown area to feedgrain and forage crops in the near future (2-3 years), the replies had suggested that the sown area is unlikely to increase but may decline (see Table 7).

Table 7. Future Changes in Sown Area to Feedgrains and Forage Crops

Change	%
1. A major increase	0.4
2. A slight increase	4.2
3. Almost the same	82.1
4. A slight decrease	10.4
5. A major decrease	2.9

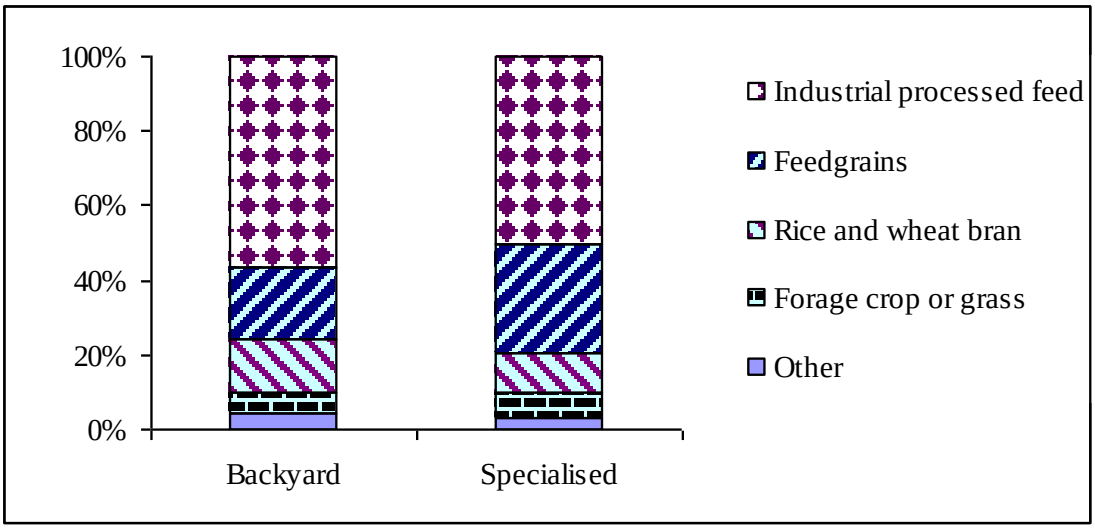
(240 respondents)

3.3 Composition and Sources of Feed

Figure 1 shows the composition of feed use by backyard animal raising and specialised households. It is clear that in this region, industrial processed feed was a major component of feed, accounting for over 50 per cent in both cases (56% and 51% for backyard animal raising

and specialised households, respectively). The next major component of feed is raw feedgrains, chiefly, corn, being 19 per cent and 29 per cent for backyard animal raising and specialised households, respectively. It is noted that the share of industrial processed feed used by specialised households was lower than that by backyard animal raising, but the former uses more raw feedgrains than the latter. According to our investigation, the reason for this is that for those large-scale specialised households, it is cheaper for them to buy raw feedgrains to process and mix meals for animals on site. Altogether, specialised households use more feedgrains and industrial processed feed (80%) than the backyard animal raising (75%). This is anticipated as the labour cost is lower for smaller-scale backyard animal raising to handle those feed components such as table scraps. The use of "other" feed (including table scraps, oil meals, tube crops, and distiller's by-products) by specialised households is minimal, being 3 per cent.

Figure 1. Composition of Feed Use by Backyard Animal Raising and Specialised Households



The share of feed from the on-farm source reduces as the feeding scale increases. For example, when the feeding scale is 1-5 head of pigs, this share is 37 per cent. When the scale is increased to 6-10, it reduces to 29 per cent. It tends to reduce further when the scale increases. This indicates that the purchased feed accounts for a significant portion of the total feed and the larger the feeding scale, the higher the share of the bought feed.

Both backyard and specialised animal raising buy feed from similar outlets. For feedgrains, rice and wheat barn, tube crops, soy meals and distillers' by products, backyard animal raising obtains 44 per cent of such feed from local fairs, 45 per cent from private merchant shops and 11 per cent from grains and oiling processing firms. The corresponding percentages for specialised households are 33 per cent, 40 per cent and 27 per cent. Specialised households buy relatively more from grain and oil processing firms but less from local fair markets, reflecting the fact that larger demand for feed enables them to have some deals with such processing firms other than engaging themselves in tedious bargains in the fair markets. None of them buy such feed from government-run outlets. For industrial processed feed, the major outlet is private feed companies in the local towns (92% for backyard and 98% for specialised).

According to the survey, only a very small portion of the respondents answered that they used additives in their animal feeding; being 6% and 20% for backyard and specialised, respectively. Two reasons are likely responsible for this. (1) This region raises a high portion of sows. Additives are less critical because sows do not need to gain weight as hogs. (2) In recent years in China, additives seem to have been abused and this has caused high level

residuals in final products. Increasingly health-conscious consumers have been very concerned and tried to avoid such products. Producers, being aware of such concerns, have tried to distance their products from the use of additives. During our survey, we noticed that many respondents avoided using the term "additives", instead, they chose to use the term "micro nutrients". Therefore some respondents might have significantly underestimated their use of additives.

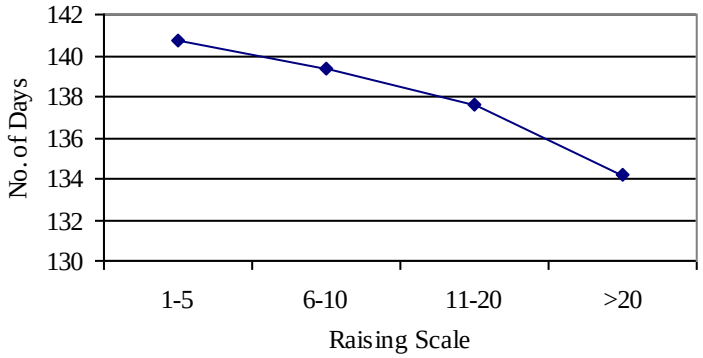
3.4 Feed-Meat Conversion Ratios

Feed-meat conversion ratios are a critical variable in feedgrain demand projections (feed here refers to fine feed only). To date, there are not many commonly accepted such ratios. This may be not surprising due to regional differences and different animal raising practices. NORHS (1998) believes that specialised households have a higher feeding efficiency than backyard animal raising and therefore the former has a lower feedgrain-meat conversion ratio while the latter has a higher conversion ratio. However, others argue that backyard raising has the smallest feedgrain-meat conversion ratio because this practice uses less feedgrains but more other feed components (Guo et al., re-cited from Zhang, X.H. 1998).

Our survey results show that, at the all-six village level, the difference in feedgrain-pork conversion ratios between the backyard and specialised is marginal, being 3.13 for the former and 3.08 for the latter. This is perhaps the composition of feed used in both cases is similar, as shown in Figure 1. Therefore, the conversion ratio is likely more affected by the composition of the feed and the kind of pig breeds but less by the scale of production.

Nonetheless, the results do show that the feedgrain-pork conversion ratio by specialised households is lower, though marginally, than those by backyard animal raising households, indicating the former has slightly higher efficiency compared to the latter. This is also confirmed by the number of days that pigs are kept in pigsty before slaughtering. Figure 2 clearly shows that the number of days that pigs are kept in pigsty reduces as the raising scale increases.

Figure 2. Relationship between Raising Scale and the Number of Days that Animals are Kept in Pigsty



3.5 Producers' Responses to Changes in Input and Output Prices

When the prices of feed, industrial processed feed, and animal products change, we would expect farmers accordingly adjust their decisions on the amount of feed to be used and the number of animals to be raised. In our surveys, we obtained farmers responses on their possible decision adjustments by asking them questions with various price change scenarios. These responses are reported in elasticity terms in Table 8.

Table 8. Elasticities of Feed Use and Production Scale in Response to Input and Output Price Changes

I. Changes in Favour of Producers

	Backyard Animal Raising	Specialised Households	Average of Both Groups
	Price Elasticities of Production Scale		
Fine feed price reduces by 10%	0.41	0.80	0.49
Coarse feed price reduces by 10%	0.18	0.42	0.22
Industrial feed prices reduces by 10%	0.48	0.90	0.56
Animal product prices increases by 10 %	0.62	1.47	0.84
	Price Elasticities of Feedgrain Use		
Fine feed price reduces by 10%	0.47	0.86	0.54
Coarse feed price reduces by 10%	0.22	0.46	0.26
Industrial feed price reduces by 10%	0.65	1.06	0.74

II. Changes not in Favour of Producers

	Backyard Animal Raising	Specialised Households	Average of Both Groups
	Price Elasticities of Production Scale		
Fine feed price increases by 10%	-0.15	-0.51	-0.27
Coarse feed price increases by 10%	-0.12	-0.31	-0.16
Industrial feed price increases by 10%	-0.23	-0.57	-0.33
Animal product price reduces by 10 %	-0.25	-0.92	-0.45
	Price Elasticities of Feedgrain Use		
Fine feed price increases by 10%	-0.17	-0.52	-0.28
Coarse feed price increases by 10%	-0.14	-0.27	-0.16
Industrial feed price increases by 10%	-0.21	-0.53	-0.31

Note: Fine feed in this study refers to feedgrains (mainly corn and barley), manufactured feed, rice and wheat bran, oil meals, and distiller's by-products. Coarse feed includes agricultural by-products such as crop stalks, forage and tube crops, grass and leaves.

Based on the results given in Table 8, the following can be drawn:

1) For both backyard and specialised animal raising, short-term and long-term price elasticities are only marginally different. [3] Conventionally, one would expect that the short-term elasticities would be smaller than the long-term counterparts. This is because once the commitments are made, e.g., the raising of a certain number of animals at a given time, then the inputs have to be resorted and the outputs have to be sold. However, the elasticities in both short-term and long-term in Zhejiang province are very similar. This may be due to the following facts. (1) Feedgrain supply is limited from local source but is primarily reliant upon imports from other provinces. This makes short-term adjustments relatively difficult; not like those farmers in feedgrain surplus regions who can change their feedgrain use more quickly in response to price changes. (2) Availability of suitable substitutes for feedgrains is also limited because of limited land resources in this region.

[3] Decision adjustments about feedgrain use can be made within a relatively short time span and thus changes in feedgrain use largely represent short-term price responses. On the other hand, Changes in production scale takes relatively longer time and thus represent long-term price responses.

2) Among all short- and long-term elasticities, the response to animal product price change tends to be the largest. This indicates that, *ceteris paribus*, output price delivers a stronger message to producers.
3) In both short- and long-run, the price elasticities for backyard animal raising are smaller than those for specialised household animal raising. This suggests that, in economically developed regions like Zhejiang, specialised animal raising seems to be more responsive to price changes than their backyard counterparts. It is possible for specialised households to be more responsive to market changes in developed regions because there are more other opportunities available in such regions.
4) Both groups of farmers are more responsive when price changes are in their favour. Thus, if input prices reduce, it is likely that they will use more of such inputs.

3.6 Producers' Intention towards Future Development of Animal Husbandry

Based on their current production cost and income, the majority of the respondents had chosen not to increase their production scale (Table 9). It is clear that backyard animal raising in this region will not expand, instead some farms may quit the pig-raising industry. Some 20 per cent of those specialised households are willing to expand. The possible future scenario is that fewer but larger scale pig-raising will be emerging in this region.

Table 9. Intention to Expand Animal Raising Scale

	Backyard Animal Raising	Specialised Households
Intend to expand	8.9%	19.3%
Intend to reduce	3.7%	8.1%
No change	87.4%	72.6%

Table 10. Major Difficulties Farmers Face in Expanding their Production Scale

Difficulty	%
1. Low prices for animal products	66.5
2. Difficult to sell animal products	1.9
3. Feed is too expensive	12.0
4. Lack of feedgrains	0.0
5. Lack of expertise	4.8
6. Lack of capital	1.0
7. Piglets are too expensive	1.0
8. Lack of labour	4.3
9. No space to expand	5.3
10. Other	3.3

(209 respondents)

Most farmers have related the difficulties in expanding their animal raising activity to the economic returns: they complain that the output prices are low (66.5%) but the input prices are high (12%) (Table 10). Most of those who gave these answers have relatively larger feeding scale. The next major difficulty is the limited space (5.3%). A few believed that they lack the expertise or labour. Very few believed that marketing was a problem (1.9%) – proximity to three major urban centres give this region a huge advantage in disposing of their

products. Low feedgrain production in this region is not thought to be a problem by any of the respondents. They can always import feedgrains if such imports are economically worthwhile.

Had they intended to expand their production scale, the way they would source their increased feed is overwhelmingly through purchasing feedgrains or processed industrial feed (78.8%). Some would expand feedgrain production (7.4%). Some others would choose to buy more rice or wheat barn (1.4%) or tube crops, distillers' by products, or soybean meals (3.2%); those who choose these options generally have smaller feeding scale. None would choose to buy table scraps from restaurants or others; perhaps too troublesome to do so. The other 9.2 per cent of the respondents choose to use various "other" ways to increase their feed.

4. Summary and Concluding Comments

This paper reports the findings from a survey that examines issues related to farm household animal raising practice in an economically developed region in China. The survey was conducted in May-June 2001 in Jiashan country of Zhejiang province. Of the 270 households surveyed, 87% raised pigs and 13% did not raise pigs. Except those that never raised pigs, whether farmers raise pigs or not is largely driven by economic considerations in the surveyed region.

Feedgrain production in this region has been declining and is unlikely to increase in the future. The composition of feed used by backyard animal raising and specialised households is very similar with raw feedgrains and industrial processed feed being the major component and accounting for over 75 per cent. Farms buy a significant portion of their feed from the market. This portion increases as the feeding scale increases.

At the village level, the feedgrain-pork conversion ratios by specialised households are marginally lower than those by backyard animal raising households. The number of days that pigs are kept in pigsty reduces as the raising scale increases. It seems specialised households have slightly higher efficiency compared to their backyard counterparts.

When the animal raising scale is small, a household relies less on the market for obtaining their feed inputs and for the disposal of their animal products, and thus is less responsive to price changes. When the scale increases, a household's reliance on the market increases and subsequently becomes more responsive to price signals in the market. In the surveyed regions in Zhejiang province, specialised animal raising is more responsive to price changes than backyard animal raising.

Not many farmers are willing to expand their production scale. Apart from concerns of economic returns, limited space in this highly populated area is another key constraint for the expansion of animal production.

Hence, according to our survey, feedgrain production in Zhejiang province will continue to decline and feedgrain imports will be necessary. The number of farm households that raise animals will decline. However, the remaining animal raising farms are likely to increase their production scale. Overall, the trends tend to indicate that the animal husbandry industry in Zhejiang province is unlikely to expand but may gradually shrink.

As far as feedgrains are concerned, in this economically developed region, farmers can afford to buy feed. They will buy more feed when their production scale increases. In addition, our survey results show that farmers are more responsive when price changes are in favour of them. Thus, if feed prices reduce, it is likely that they will use more of such inputs. Given that China is now a member of the WTO, it will gradually open its grain markets. Increased market opening up may lead to lower grain prices in China. Consequently, how this may affect the demand for feedgrains in this region deserves continued attention.

References

Cao, L.Q. (1998), 'Is animal production by households still a sideline operation?', *Reference Materials for Rural Economic Research* , No. 8, pp. 26-29.

Ministry of Agriculture, *Chinese Agricultural Statistics*, various issues, China Agricultural Press, Beijing.

NORHS (National Office for Rural Household Surveys) (1998), 'A comparative study of production efficiency and profitability of various animal raising practices', *Reference Materials for Rural Economic Research* , No. 8, pp. 20-25.

Qi, J.F. et al. (1999), *Yearbook of China Animal Husbandry Industry 1999*, China Agricultural Press, Beijing.

SSB (State Statistical Bureau), *China Statistical Yearbook*, various issues, China Statistical Press, Beijing.

Wang, J.M., Zhou, L., Liang, S.M. and Fan, C.H. (1999), 'Cost structure of pork production: A case study of Sichuan province', *Problems of Agricultural Economics*, No. 4, pp. 24-27.

Zhang, X.H. (1998), 'An analysis of household pig raising situation and economic return in China', *Chinese Rural Survey*, No. 1, pp. 53-61.

Zhang, X.H. and Lu, M. (1997), 'Pig production scale and feed conversion ratios', *Chinese Rural Economy*, No.10, pp.63-66.

Zhejiang Statistic Bureau, *Zhejiang Statistical Yearbook*, various issues, China Statistical Press, Beijing.

Zhou, Z.Y., Tian, W.M., Liu, X.A. and Wan, G.H. (2001), 'An issue of debate: China's feedgrain demand and supply', AARC working Paper Series, No. 15, Asian Agribusiness Research Centre, The University of Sydney.