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Adoption and Impact of Gaps in Pig Value Chains: Implications for Institutional Policy and Practice Change

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Abstract

This paper investigates the adoption of VietGAHP, a set of guidelines for best practices in pig production, and evaluates impacts using quantitative and qualitative indicators. It tackles the following specific research questions: 1) What is the extent of adoption of VietGAHP among smallholder pig producers? 2) Is there a difference in performance between VietGAHP adopters and non-adopters? Outcomes from adoption and compliance with VietGAHP are assessed using reduction in mortality as a metric for efficacy. Cost-benefit comparisons are also made to illustrate economic outcomes as a measure of effectiveness. We employ statistical t-tests for mean comparison of outcomes between VietGAHP adopters and non-adopters and across exposed and control sites. Our study shows productivity gains from practice and behavioral changes elicited from adoption and compliance with VietGAHP outweigh the costs of doing so, at least at the household level. The observed economic and market incentives could boost the adoption of VietGAHP if these incentives are sustained with appropriate institutions in place. Scalability could be facilitated by exposure via demonstration effects. Peer-to-peer learning is an effective strategy in enhancing capacity for uptake. With exposure being strongly linked to uptake, regardless of gender of respondents, training opportunities for non-exposed groups are worthwhile to pursue.

Keywords: Good agricultural practices, adoption and impact, smallholder pig value chain

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Introduction

Good Agricultural Practices (GAPs) are historically a private-sector strategic response to increasing demand for food safety and quality. GAP certification with quality labels as signals has become a central component of modern consumer policy in developed agri-food market systems, and increasingly in developing country settings in recent years. Being GAP-certified could secure market share and capture price premium by providing competitive advantage to a supplier of a product with credible quality and food safety attributes (Reardon and Farina 2002). In developing country settings where informal markets are still the dominant and generally preferred outlets for food, establishing a credible GAP certification scheme poses institutional and policy challenges. Consequently, the preponderance of standards with dubious credibility erodes public confidence and lead to market failure and sub-optimal supply of safe food being sold at higher prices. Since certification systems mainly depend on trust, the certification and audit procedures need to improve to engender trust in the system and avoid opportunistic behavior. The underlying institutional structure can considerably influence the effectiveness and reliability of the whole certification system (Jahn et al. 2005).

There are two types of GAP certification system: public and private. Government certification systems serve consumer protection purposes by providing quality labels to improve market transparency. Some disadvantages of public standards include loss of flexibility and innovation, lock-in-effects, and few incentives for over-compliance (McCluskey 2000). Private certification schemes tend to be significantly different depending on whether the certification is to be used for consumer marketing purposes or should meet the demands of institutional buyers. Many existing schemes in developed countries focus on the suppliers (EUROGAP, ISO); recently introduced schemes have shifted focus of labels on the consumers. There are also meat industry approaches comprising the whole value chain (e.g., the Dutch IKB-system or the German QS-system). Private certification schemes are likely to emerge in settings where there are weak or non-existent public certification systems (Lapar and Tiongco 2011). The main focus of private certification systems is management of food safety risk along the value chain in order to achieve a higher level of assurance in terms of regulatory compliance, and to capture price premiums and market share of the ‘certified’ product.

Increased concerns about foodborne illness from fresh produce and the attendant economic loss from foodborne illness have motivated many growers to voluntarily adopt good agricultural practices (GAPs). Evidence from available empirical work on horticulture products, for example, show that GAPs help reduce microbial contamination on farms and improve food safety systems (Unnevehr 2015). However, GAPs won’t necessarily increase consumer demand for fresh produce if buyers do not know that farmers adopted practices to improve food safety on farms. Consumers usually have no way to know whether or not fresh produce is grown with GAP practices. This is particularly true in developing country settings where certification systems are still in a nascent stage and third party certification a costly process.

In the context of livestock value chains, there are potentially two important benefits from adoption and compliance with GAP. First is economic risk reduction, including the potential reduction in risk that an outbreak could be traced to the farm and thus avoiding large economic losses, and ‘positive externality’ from reduced risk of spreading foodborne illness from the farm and consequently lowering risk of an outbreak that affects the entire value chain. Second are the improved market access opportunities by enabling GAP-certified producers to sell to a more diverse range of market outlets for their products. On the other hand, the cost of adoption of GAP could include large capital investments or more moderate expenditures such as training workers to improve hygiene and upgrading record keeping technologies. These costs could potentially pose critical barriers to some potential adopters.

Rationale and Objectives of the Study

The experience in the implementation of GAPs in developing country settings like Vietnam has shown mixed results, mainly in horticulture (Ha et al. 2014; UNCTAD 2007). For livestock, VietGAHP (Good Animal Husbandry Practices) was promulgated through Decision 1506 /QĐ-BNN-KHCN dated 15 May 2008. A revised set of guidelines based on the original VietGAHP but targeting household-based pig production was issued in 2011 (MARD 2011) and had been rolled out through a development project (LIFSAP). VietGAHP includes 29 practices on which compliance for VietGAHP certification is being evaluated. The list of 29 practices and requirements for compliance is presented in Annex --. The 29 practices are classified into eight categories as follows: Group 1: Pig housing, tools and equipment (6 practices); Group 2: Pig stock and management (3 practices); Group 3: Feeds and feed use (4 practices); Group 4: Water use (2 practices); Group 5: Veterinary hygiene (8 practices); Group 6: Marketing (3 practices); Group 7: Environment (2 practices); Group 8: Recording (1 practice). (Table 1).

Are GAPs such as VietGAHP effective? Are there sufficient incentives to engender adoption and compliance? Are these transferable and scalable? These are important policy questions. This paper investigates the adoption of VietGAHP and evaluates impacts using quantitative and qualitative indicators. It tackles the following specific research questions: 1) What is the extent of adoption of VietGAHP among smallholder pig producers? 2) Is there a difference in performance between VietGAHP adopters and non-adopters? The findings could provide empirical evidence to guide appropriate strategies for uptake and scaling of best practices.

Methodology

We designed our study within an ongoing development project, LIFSAP (Livestock Competitiveness and Food Safety Project), which provided a natural setting to study adoption and compliance with VietGAHP and compare the outcomes of adoption and compliance across a number of performance indicators. We identified three groups of survey participants to



recruit, namely, the VietGAHP adopters, the VietGAHP non-adopters, and a control. The VietGAHP adopters and non-adopters were recruited from the exposed sites, or where VietGAHP had been rolled out. The control group members were recruited from a non-exposed site, or where VietGAHP has not been introduced and where LIFSAP has not had nor any ongoing field activities. A total of 112 respondents were selected of which 42 are VietGAHP adopters, 40 non-adopters and 30 are control.

A structured survey was implemented in Nghe An province, one of the project sites of LIFSAP. For purposes of this study, Dien Chau district was selected as the exposed site, for its proximity to Vinh City, the urban center of the province and thus enabling the capture of rural to urban patterns of pig and pork trade that may influence uptake of best practices for pig production. Hung Nguyen district, not having been exposed to VietGAHP, was identified as the control site. Focused group discussions (FGDs) of men and women pig raisers were undertaken to capture qualitative information about knowledge, attitudes, perceptions, and gender issues.

Outcomes from adoption and compliance with VietGAHP are assessed using reduction in mortality as a metric for efficacy. Cost-benefit comparisons are also made to illustrate economic outcomes as a measure of effectiveness. We employ statistical t-tests for mean comparison of outcomes between VietGAHP adopters and non-adopters and across exposed and control sites.

Survey data was processed in Excel and data analysis was done using Stata. Descriptive statistical analysis was applied on a total sample size of 112 observation points from 37 VietGAHP adopters, 40 non-adopters, and 30 control respondents.

Results and Discussions

Profile of Adopters and Non-Adopters

Table 2 reports on the profile of respondents. The majority of respondents across the three groups are heads of households, and mainly responsible for pig raising. Gender balance is slightly tilted towards more women than men among respondents in the exposed site; a relatively higher proportion of men than women comprise the respondents in the control group. Income from pig production accounts for about a fifth to a fourth of total household income; VietGAHP adopters exhibit a higher proportion of household income from pigs vis-à-vis those in the other two groups.

Incidence and Extent of Compliance

Compliance was evaluated among adopters at two levels, e.g., high compliance (at >65% compliance) and low compliance (at <50% compliance) for each practice. Level of compliance is measured as the proportion of criteria met/practices adopted to total number of criteria/practices. A household is classified as having high level of compliance if that

household has met/adopted greater than 65% of criteria/practices. Otherwise, that household is classified as having low-level of compliance.

Overall, there is relatively low level of compliance in 17 of the 29 VietGAHP practices, while a relatively high level of compliance was documented for 12 out of 29 practices among the identified adopters of VietGAHP. (Table 3)

Outcomes from Adoption and Compliance

Mortality and Morbidity

The extent of mortality during the period of reference used in the survey, i.e., the last pig production cycle, is relatively low as reported by respondents; i.e., three pigs on average died among adopters and non-adopters of VietGAHP (see Table 4). The incidence of mortality is higher among non-adopters (10 out of 45 respondents reported with dead pigs) than among adopters (2 out of 27 respondents reported with dead pigs). The incidence of morbidity or having sick pigs is also relatively lower among adopters (17 out of 37 households) than among non-adopters (26 out of 45 households). Non-adopters also reported as having more sick pigs than adopters, on average (see Table 4)

Within exposed sites, we find that high compliance with the practice of feed hygiene ($p=0.06$) (Group 3, 3.2-high, in Table 3) and keeping pig pens clean on a daily basis ($p=0.03$) (Group 5, 5.2-high, in Table 3) are strongly indicative of improved pig health with lower numbers of pigs dying among adopters vis-à-vis non-adopters. High compliance with keeping the pig pens free from leaking roofs and walls and secured from wind drafts is also making a difference in pig mortality outcomes between adopters and non-adopters, albeit the relatively weak statistical significance ($p=0.10$) (Group 1, 1.4-high, in Table 3).

Strong statistical significance in mortality rates between adopters and non-adopters is also exhibited from low compliance with making complete records of pigs available during pig sales ($p=0.05$) (Group 6, 6.2-low, in Table 3), as well as in proper use of veterinary drugs and antibiotics including keeping records of veterinary drug use (Group 5, 5.6-low, in Table 3). Other practices where low levels of compliance appear to have influenced mortality outcomes include practices related to maintaining hygiene and sanitation of pig pens, tools and equipment; maintaining feed quality and safety; proper use of veterinary drugs; record keeping; and ensuring traceability.

Does exposure make a difference? Comparing outcomes between non-VietGAHP adopter in exposed sites and the respondents in the control or non-exposed site could inform whether exposure to new practices could bring about improvements in performance. Statistically significant differences are observed between the mortality rates of pig producers who are not VietGAHP adopters but exposed to the practices and those who have not been exposed to VietGAHP (see Table 3). Specifically, higher mortality rates are observed among non-exposed pig producers when evaluated in terms of practices such as proper application of



veterinary medicine (Group 5, 5.6-high, in Table 3) and keeping records of sale of pigs (Group 6, 6.2-high, in Table 3). It appears that exposure to best practices may likely engender improvements in the way pigs are raised by non-adopters when compared to those who have not been exposed at all. This could be facilitated by the demonstration effect; that is, seeing the effects of applying best practices first hand is likely to engender behavioral changes among those who have been exposed by taking up specific practices that are deemed relevant and feasible in their own particular case.

Production Performance and Economics

Cost-benefit comparisons between adopters and non-adopter show some glaring differences in production parameters, input use, output levels, and sales (see Table 5). VietGAHP adoption and compliance appear to engender shorter production cycle (7% longer for non-adopters), higher productivity (13% higher liveweight per head among adopters), more pigs sold (89% higher per household among adopters), and heavier pigs sold (10% heavier/head pigs sold among adopters). These production metrics are consistent with the documented lower mortality rate (by half) among adopters vis-à-vis non-adopters. VietGAHP adopters also appear to receive higher selling price, e.g., 4% higher per unit liveweight compared to prices received by non-adopters on average. Estimates of total production costs show no significant difference between adopters and non-adopters, although there are differences in the cost share of inputs, notably different types of feed and use of veterinary and other services. Among adopters of VietGAHP, feeding has shifted to more nutrient-dense feed that translates to higher cost of concentrate feed use, at the same time cost of other types of feed such as raw feed and crop by-products and residues declined. Cost of veterinary and other services are also slightly higher among adopters as compared to non-adopters. It does appear however that the value of productivity gains outweigh the cost of achieving these gains, thus resulting in net positive profits, on average (see Table 5).

Conclusion and Recommendations

Our study findings suggest that adoption of best practices such as VietGAHP do engender positive economic benefits and thus promotion of wider uptake could potentially redound to broader and positive economic outcomes. Productivity gains from practice and behavioral changes elicited from adoption and compliance with VietGAHP outweigh the costs of doing so, at least at the household level. It is also noted that the cost of investment in VietGAHP include other costs not reflected in the farm level cost-benefit analysis. Nonetheless, the reduced mortality from healthier pigs that appear to have been rewarded with better prices in the market are generating productivity gains that translate to better profits from pig production. The observed economic and market incentives could boost the adoption of VietGAHP if these incentives are sustained with appropriate institutions in place. Scalability could be facilitated by exposure via demonstration effects. Peer-to-peer learning is an effective strategy in enhancing capacity for uptake. With exposure being strongly linked to uptake,

regardless of gender of respondents, training opportunities for non-exposed groups are worthwhile to pursue.

Uptake could potentially be facilitated by continued investments in capacity development of target users who could transition as trainers to other potential adopters in the scaling out process. While full compliance with all practices is the desired target of the LIFSAP project for VietGAHP certification, the health and safety outcomes from full vis-à-vis partial compliance is not strongly supported in the empirical evidence from our study. Validation of this finding in other settings and with a relatively larger sample size would be useful to pursue as a future research enquiry.

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Table 1 VietGAHP criteria, sub-criteria, guidelines on practices.

Criteria/Guideline/Practices
1. Pig housing, tools and equipment used in the pigsty
1.1. Location
Be isolated from residential areas and from drinking water source
1.2. Boundary/separation
Have fence to separate the pigsty site from living house and other animal housing systems
Have the entrance to pigsty with lockable doors
Have an antiseptic system (footbath) in front of the entrance
1.3. Floor
Have no standing water
1.4. Roof, walls, blinds
Do not leak and avoid draft
1.5. Waste management
Have systems to collect and treat solid and liquid waste
1.6. Tools and equipment
2. Breeds
2.1. Sources
Have clear origin and be fully recorded
2.2. Animal health
Pig herds are fully vaccinated
2.3. Livestock management
Keep newly purchased pigs in quarantine and record information
Do not keep pigs with other animals
Keep different litters of pigs separate
3. Feed
3.1. Sources
3.2. Hygiene requirements
Feedstuff must be hygiene, not moldy
Kitchen waste like leftover food must be cooked before feeding
3.3. Technical requirements
Concentrate feed must be mixed in accordance with instructions for pig species, ages
Complete feed mixture must be marked with stamp
3.4. Feed preservation
Feed must be stored on shelves to avoid mold
To be packed in sealed bags to avoid spillage
Have separate storing place, protect from insects, rodents ...
4. Water
4.1. Water for pig production
Have enough water for pig production
Use drinking water/treated water
4.2. Waste water
5. Hygiene
5.1. Disinfection of pigsty
Disinfect the entire pigsty 07 days before and after the sale
Criteria/Guideline/Practices

Periodically spray disinfectant around the pigsty
5.2. Sanitary of pigsty
Daily clean, collect solid and liquid waste
5.3. Labor protection
Change labor protection equipment (clothes, boots, masks...) at the entrance before entering the pig housing
Periodically disinfect labor protection equipment
5.4. Control of access to pigsty
Disinfect footwear at entrance and exit of the pigsty
Tools and equipment must be disinfected before and after entering the pigsty
5.5. Vaccination
Full vaccination for compulsory vaccination diseases
Keep records on vaccination
5.6. Veterinary medicine
All veterinary medicine, including antibiotics when purchased and used, must follow instructions of veterinarians and fully recorded
Have preservation place for veterinary medicine
5.7. Prohibited substances
Do not use prohibited substances (banned antibiotics, weight gain, lean meat creating) in pig production
5.8. Diseases
Immediately notify the authorized agency or veterinary when diseases or epidemic occur
Keep records on all diseases
6. Marketing
6.1. Selling time
After the withdrawal period as prescribed on the label of medicine
Pigs are healthy, not sick
6.2. Records of sale
Adequate records must be provided
6.3. Identification
7. Environment
Fattening pigs for sale must have ear tags
7.1. Handling of dead pigs
Dead pigs must be collected and handled in accordance with the stipulations of the veterinary authority
Keep records on dead pigs
7.2. Inorganic waste
Needles, plastic bags, plastic containers must be collected for separate treatment
8. Recording
Record correctly and fully according to recording book of LIFSAP project

Source: VietGAHP Manual.



Table 2 Profile of survey respondents.

Item	Unit	VietGAHP exposed		Non-exposed
		Adopter	Non-adopter	Control
Household head	%	66.7	57.5	66.7
Gender				
Male	%	45.2	40.0	56.7
Female	%	54.8	60.0	43.3
Age	year	47.6	52.0	50.8
Mainly responsible for pig production	%	83.3	80.0	73.3
Income from crop production	Million VND	13.9	12.6	16.6
Income from livestock excluding pig	Million VND	17	18.5	37.6
Income from pig production	Million VND	31.4	16.8	32.2
Percentage of income from pig production	%	24.98	18.12	21.34
Off-farm income	Million VND	63.3	44.8	64.4

Source of data: ILRI-VNUA VietGAHP adoption survey, 2015.

Table 3 Level of compliance, comparison within and between sites

Group/Practice	VietGAHP exposed				Non-exposed		Comparison within sites (p values)	Comparison across sites (p values)
	Adopter		Non-adopter		Control			
	No.	%	No.	%	No.	%		
Group 1								
1.1-high	0	0.00%	2	4.44%	7	23.33%	ns	ns
1.1-low	37	100.00%	43	95.56%	23	76.67%	0.08*	ns
1.2-high	8	21.62%	16	35.56%	2	6.67%	ns	ns
1.2=low	29	78.38%	29	64.44%	28	93.33%	ns	ns
1.3-high	37	100.00%	44	97.78%	30	100.00%	0.08*	ns
1.3-low	0	0.00%	1	2.22%	0	0.00%	ns	ns
1.4-high	22	59.46%	18	40.00%	3	10.00%	0.10*	ns
1.4-low	15	40.54%	27	60.00%	27	90.00%	ns	ns
1.5-high	13	35.14%	22	48.89%	17	56.67%	ns	ns
1.5-low	24	64.86%	23	51.11%	13	43.33%	0.09*	ns
1.6-high	4	10.81%	8	17.78%	1	3.33%	ns	ns
1.6-low	33	89.19%	37	82.22%	29	96.67%	0.07*	ns
Group 2								
2.1-high	0	0.00%	0	0.00%	0	0.00%	ns	ns
2.1-low	37	100.00%	45	100.00%	30	100.00%	0.09*	ns
2.2-high	19	51.35%	27	60.00%	7	23.33%	ns	ns
2.2-low	18	48.65%	18	40.00%	23	76.67%	ns	ns
2.3-high	6	16.22%	15	33.33%	2	6.67%	ns	ns
2.3-low	31	83.78%	30	66.67%	28	93.33%	0.08*	ns
Group 3								
3.1-high	27	72.97%	39	86.67%	24	80.00%	ns	ns
3.1-low	10	27.03%	6	13.33%	6	20.00%	ns	ns
3.2-high	25	67.57%	37	82.22%	18	60.00%	0.06**	ns
3.2=low	12	32.43%	8	17.78%	12	40.00%	ns	ns
3.3-high	21	56.76%	35	77.78%	24	80.00%	ns	ns
3.3-low	16	43.24%	10	22.22%	6	20.00%	ns	ns
3.4-high	3	8.11%	18	40.00%	10	33.33%	ns	ns
3.4-low	34	91.89%	27	60.00%	20	66.67%	0.09*	ns
Group 4								
4.1-high	33	89.19%	44	97.78%	21	70.00%	ns	ns
4.1-low	4	10.81%	1	2.22%	9	30.00%	ns	ns
4.2-high	23	62.16%	23	51.11%	10	33.33%	ns	ns
4.2=low	14	37.84%	22	48.89%	20	66.67%	0.10*	ns
Group 5								
5.1-high	13	35.14%	14	31.11%	5	16.67%	0.07*	ns
5.1-low	24	64.86%	31	68.89%	25	83.33%	ns	ns
5.2-high	35	94.59%	44	97.78%	30	100.00%	0.03**	ns
5.2=low	2	5.41%	1	2.22%	0	0.00%	ns	ns
5.3-high	11	29.73%	19	42.22%	10	33.33%	ns	ns

Group/Practice	VietGAHP exposed				Non-exposed		Comparison within sites (p values)	Comparison across sites (p values)
	Adopter		Non-adopter		Control			
	No.	%	No.	%	No.	%		
5.3-low	26	70.27%	26	57.78%	20	66.67%	ns	ns
5.4-high	4	10.81%	5	11.11%	2	6.67%	ns	ns
5.4-low	33	89.19%	40	88.89%	28	93.33%	ns	ns
5.5-high	20	54.05%	24	53.33%	12	40.00%	ns	ns
5.5-low	17	45.95%	21	46.67%	18	60.00%	ns	ns
5.6-high	11	29.73%	18	40.00%	11	36.67%	ns	0.02**
5.6-low	26	70.27%	27	60.00%	19	63.33%	0.04**	ns
5.7-high	20	54.05%	30	66.67%	12	40.00%	ns	ns
5.7-low	17	45.95%	15	33.33%	18	60.00%	ns	ns
5.8-high	10	27.03%	20	44.44%	5	16.67%	ns	ns
5.8-low	27	72.97%	25	55.56%	25	83.33%	0.09*	ns
Group 6								
6.1-high	37	100.00%	45	100.00%	30	100.00%	ns	ns
6.1-low	0	0.00%	0	0.00%	0	0.00%	ns	ns
6.2-high	6	16.22%	22	48.89%	8	26.67%	ns	0.08*
6.2-low	31	83.78%	23	51.11%	22	73.33%	0.05**	ns
6.3-high	1	2.70%	2	4.44%	0	0.00%	ns	ns
6.3-low	36	97.30%	43	95.56%	30	100.00%	0.08*	ns
Group 7								
7.1-high	11	29.73%	23	51.11%	17	56.67%	ns	ns
7.1-low	26	70.27%	22	48.89%	13	43.33%	0.06*	ns
7.2-high	0	0.00%	1	2.22%	0	0.00%	ns	ns
7.2-low	37	100.00%	44	97.78%	30	100.00%	0.08*	ns
Group 8								
8.1-high	4	10.81%	8	17.78%	0	0.00%	ns	ns
8.1-low	33	89.19%	37	82.22%	30	100.00%	0.07*	ns

Notes:

1. "Group" pertains to the criteria and numbered according to the order of criteria shown in Table --.
 2. "Practice" refers to the sub-criteria or specific requirement/practice, numbered according to the order shown in Table --.
 3. Statistical significance: ***1 percent; **5 percent; *10 percent
- Source of data: ILRI-VNUA VietGAHP adoption survey, 2015.

Table 4 Mortality and morbidity rates

Indicators	VietGAHP exposed		Non-exposed
	Adopter (n=37)	Non-adopter (n=45)	Control (n=30)
Total number of pigs per household	22.5 (20.4)	52 (52.8)	59.3 (44.1)
No. of households reporting dead pigs	2	10	7
No. of dead pigs reported	3 (1.41)	3 (2.40)	3.6 (2.82)
% dead pigs/total pigs	17.5 (10.61)	10.5 (8.75)	8.5 (10.48)
No. of households reporting sick pigs	17	26	23
No. of sick pigs reported	11.1 (11.11)	16.5 (16.95)	16.2 (15.05)
% sick pigs/total pigs	69.4 (69.97)	40 (44.75)	28.9 (28.37)

Source of data: ILRI-VNUA VietGAHP adoption survey, 2015.

Table 5 Production cost, revenues, and profit (calculated for 100kg gained weight)

	Unit	VietGAHP exposed		Non-exposed	All
		Adopter	Non-adopter	Non-adopter	
Length of a cycle	days	95.00	102.55	97.13	98.27
Breeds	000đ	489.94	554.22	596.25	541.37
Concentrate feed	000đ	195.20	375.80	110.74	237.08
Complete feed	000đ	1268.43	575.92	2135.70	1253.41
Rice bran	000đ	606.79	778.28	313.98	589.61
Maize bran	000đ	241.02	521.75	181.58	325.36
Other raw feed	000đ	33.63	63.67	61.00	51.69
Veterinary	000đ	43.30	29.55	26.27	33.83
Others	000đ	22.11	16.64	10.51	17.05
Total	000đ	2900.4	2915.8	3436.0	3049.4
Revenue	000đ	4554.7	4486.3	4804.8	4597.3
Profit	000đ	1654.3	1570.4	1368.8	1547.9

Notes:

- 1) Exchange rate: 1USD = 22,000 VND at the time of survey.
- 2) Production cost is calculated based on the latest production cycle.

Source of data: ILRI-VNUA VietGAHP adoption survey, 2015.