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# **Final report**

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### 2 Executive summary

This project developed through discussions between Werner Stur of ACIAR and ILRI staff regarding joint interest in advancing the extensive work that ILRI has conducted in feed and fodder markets in South Asia and Africa, which particularly addressed market price and feed quality relationships (Jarial, et al., 2016; Ayuntunde et al., 2014; Gebremedhin et al., 2009; Samireddypalle et al., 2017; Blummel and Rao 2006). In this case, it was proposed to additionally address behavioural issues, particularly why and in what circumstances producers bought or sold fodder and feed, to better understand buyer needs. Since prices can also be influenced by market actor knowledge, location and other factors, there was an interesting possibility of exploring those relationships as well. East Java, an area of strong ACIAR interest, seemed to be a particularly suitable location to carry out the work, given that the province has the largest numbers of cattle in Indonesia, and so feed and fodder markets are likely to play an important role. The project objectives and terms of reference were then jointly agreed, and the project officially began by holding an inception meeting on 26-27 August 2015 in Malang. Indonesia, on the campus of the Balai Pengkajian Teknologi Pertanian (BPTP) Jawa Timur (Indonesian Agency for Agricultural Research and Development), Ministry of Agriculture. The BPTP was a key national partner implementing the project and its staff were exposed through the project to new approaches and methods. Additionally, students from Brawijaya and Malang Universities were engaged with the project in data collection exercises to collect a variety of scientific and technical data associated with feed sampling and household feed and fodder marketing.

The project was implemented over 16 months in three districts, Batu, Malang and Situbondo, which have contrasting and relevant settings in East Java, characterized by differing concentrations of cattle populations and on expected dependence on feed and fodder markets. Batu and Malang have higher cattle population, including dairy, and are elevated, while Situbondo is lower elevation and lower cattle density, mainly for beef. A survey, comprised of a participatory rapid appraisal (PRA) and quantitative in-depth household (farmers) and market actor surveys, were conducted during the second half of 2015 and early 2016. The participatory rapid appraisal served to assess ruminant producer feed and forage options and incentives. The in-depth survey of representative ruminant producers was conducted to identify practices, attitudes, incentives, and market access. Additionally a market actor survey was conducted to identify practices, suppliers and buyers, value addition and costs, and quality/price relationships.

The study provides an analysis of the determining factors that influence East Java's smallholder livestock farmers feed and fodder market participation and explain household level feed purchase prices, price formation and relationship with quality.

Econometric analysis was conducted using logit and OLS methods to determine factors that affect feed and fodder purchase market participation and the purchase prices. To capture seasonal differences, the analysis was conducted separately for dry and wet season.

The survey of the representative ruminant producers showed that about 80% the household interviewed participated in buying feed and fodder, and many of the households (about 78%) purchased feeds during both dry and wet seasons.

Generally, market access was restricted primarily by transaction costs (represented by distance to markets), but availability of operating capital (represented by cash inflow interms of farm and non-farm activities) supported market access and the purchase of feed and fodder by farm households. Being a net buyer in the feed and fodder markets required cash income from other sources such as from live animals, dairy products sale or crop sales, off-farm or non-farm income, or remittances.

The analysis found statistically significant relationships between feed and fodder prices and their quality in terms of animal nutrition. Feed and fodder prices were also influenced by access to market and price information and collective actions, such as cooperatives. The correlation analysis of price-quality relationships in feeds, feed ingredients, roughages and forages, sold by fodder shops and farmers during the rainy and dry season, found a strong relationship between prices and all quality traits. The traits most frequently closest correlated with feed prices were levels of protein and the fibre constituents NDF and ADF.

The full econometric analysis of participation and prices originally intended was not fully feasible due to data constraints, but some key messages nevertheless emerged from the analysis:

### Market participation:

- The cattle systems in East Java are clearly heavily dependent on feed and fodder markets, even in Situbondo where grazing predominates. Most of these are unregulated informal markets which may not fully comply with local rules and regulations.
- Herd and land size only marginally affected feed and fodder market participation. This suggests that all farmers, large or small, are similarly dependent on markets for feed, further underlining their importance.
- Distance to markets was found to affect feed market participation. This suggests that infrastructure and access to transport continue to be constraints to market performance.
- Access to working capital (proxied by access to income) was also found to play a role in market participation, suggesting that some producers face financing constraints

### Feed quality and prices:

- Feed quality was generally reflected strongly in prices, even thought traders said they did not evaluate or price feed quality. This is seen in individual feeds, but in particular feed diet prices, which can increase by 11% in the case of a 1% increase in quality, and by 5% in the case of some individual feeds. This is an important result which demonstrates that markets are generally effective in capturing and pricing differences in feed quality. Moreover, this is occurring in a largely informal or unregulated setting, so that it is unlikely to be the result of government feed standards regulation, but rather reflects the ability of buyers and traders to accurately assess feed quality.
- Producers with relatively low human capital paid the same feed prices as others, indicating that there may be few limitations to market participation and bargaining associated with lack of producer capacity
- Access to market information affected both the feed prices received by producers and their level of feed purchases. In the case of feed diet prices, market information can reduce prices by 50%, although this result is confounded with coop membership. Similar and statistically significant results were found in the case of individual feeds.
- Fresh maize stover and Napier grass (*Pennisetum purpureum*) were found in some zones and seasons to play an important role in fodder markets. Since the survey did not find any livestock producers who sell fodder, this indicates the presence of significant numbers of specialized fodder producers that supply the market, who may be livestock producers. During the stakeholder workshop,

participants reported the existence of specialized traders who bought young maize from farmers to make into silage for local sale and export.

Although the analysis shows that the markets in East Java in general are able to accurately price feed quality, it also reveals the existence of very clear constraints in terms of market information and infrastructure that impede market performance, and that cause some cattle producers to experience reduced access to feed and fodder markets and higher prices. Further, the scale and importance of the fodder markets in particular point to potential opportunities for new enterprises around specialized fodder production, including the introduction of higher quality forages. However, specific interventions may require further research beyond what this limited and short term scoping study was able to reveal.

The results suggest that some mechanism for improved market information would benefit the performance of the feed and fodder markets. There may be opportunities to apply online agricultural commodities trading platforms technology for such a system, as is now increasingly being used in many forms in agriculture. There may be existing opportunities for local officials to take action to incorporate feed and fodder market information into existing public information systems, but this is unclear, as the project did not investigate those systems. Crucially the apparent presence of non-livestock keeping fodder producers suggests there may be new and growing opportunities for new types of specialised fodder production. This would however require more investigation and piloting

Further research and piloting studies that would be of value to follow up on the project's findings include:

#### Markets and services:

- More detailed analysis into the feed and fodder market information needs of livestock producers. The limited variables obtained in this study may be confounded with cooperative membership. Which types of market information in particular would be of most value to producers?
- In addition, what agricultural market information systems currently exist, including ICT based systems, that could be adapted to include feed and fodder market information?
- Active engagement with feed and fodder market actors, to explore models for joint, collective activity, and also to reveal what policy, infrastructure or regulatory constraints might affect them. Would some types of publically supported infrastructure (e.g. designated feed market locations) improve their performance?
- Examine existing finance systems available to small scale livestock producers and market actors, and explore means to improve access.
- Examine the potential for adapting/replicating an innovative approach to beef fattening financing that ILRI and partners have piloted in Swaziland, with support from IFAD. The mechanism works with local banks to allow small scale producer without collateral to obtain access to financing. See below:

https://clippings.ilri.org/2017/02/25/beef-fattening-ready-for-take-off-in-southernafrica-with-new-financing-made-available-to-smallholders/

https://news.ilri.org/2017/03/03/beef-value-chain-actors-reap-big-gains-from-new-financing-in-southern-africa/

Conduct a more detailed spatial analysis of feed prices formation, using GIS derived market and distance variables, together with feed quality variables, using a large number of sites and samples. This would significantly reveal constraints to

the markets' ability to accurately price feed quality and to deliver that feed in an efficient manner.

### Feeds:

- Explore opportunities for specialized fodder production, including the introduction of improved varieties of forages. This would need to look carefully at geographical zones where appropriate land was available, and where market infrastructure was adequate. Forage seed systems would also need to be examined. Local land use policies advocating production of rice and other staples would need to be addressed in case they create constraints to such specialized production.
- Create a link between crop producers and livestock producers, traders and processors for efficient utilization of leguminous feeds. The current feed price trend in east Java shows leguminous feeds (protein rich feeds) are undervalued and sold on average three times lower in value than less nutritious Napier grass. That relationship could be further studied, including perceptions of sellers and buyers.
- Conduct more detailed analysis of farm-level feed use efficiency and the economic returns to specific feed choices. Although markets do reflect feed quality, is that relationship reflected accurately in the economic returns to feed use? This would guide the choice of which types of forages in particular to emphasize for specialized forage production.
- Develop and test least cost diet/rations according to sites, seasons and livestock productivity level and validate it through research trials. Linked to this, explore the possibilities for decentralized small-medium scale feed processing.



### 3 Background

Scarcity of feed and fodder is one of the key constraints to sustainable livestock development, and can be critical during dry seasons. This is particularly acute in East Java where 60% of all cattle in Indonesia are located, including most of the dairy animals. There being little or no remaining grazing land in much of the province - three quarters of all land is used for cropping – small-scale livestock production depends on the abundant supply of crop residues and by-products, mainly rice straw (27%) and maize stover (43%) (Privanti et al., 2012). This is in the context of steadily increasing demand for beef nationally, most of which is supplied by imports. Previous studies in East Java have found that fodder markets are increasing in importance as livestock and crop systems intensify in the context of limited land areas and unequal access to crop land (Ibid). In East Java, there are also many landless livestock keepers who depend on purchased feeds or forest land resources. Many livestock producers cannot obtain sufficient feed supplies from their own farm or communal resources and so have turned to an emerging market for crop residues and forages. This mirrors similar trends in intensifying crop-livestock systems in other parts of Asia (Singh et al, 2011), and in places where crop straw was traditionally burned or used for other purposes, markets now transport them to centers of livestock production. In East Java the dry season shortages of fodder are critically important to sustained production, challenges that fodder markets may be able help address (Waldron et al., 2015).

However, although local markets for crop residues and forages can be found in many areas, little is known about their levels of performance, even while livestock producers are increasingly reliant on markets for feed. Such markets are typically informally operated by small scale traders, outside of regulatory oversight, and in some cases local market concentration may lead to undue control by a few market actors. There is also generally little information about the quality of feed materials being supplied by the market and, of critical importance, whether market prices reflect those differences in quality. Consistent and transparent price/quality relationships in fodder markets will not only allow buyers to have better information as to the livestock performance outcomes they can expect, but will also provide incentives for crop and forage producers to provide better materials. The ability of fodder markets to accurately price quality will have growing importance as crop breeders increasingly include straw/stover digestibility within their breeding objectives, responding in part to the increasing importance to crop producers of sales of crop residues for feed, or for their own animals.

Fodder market surveys that include price – quality relationships provide essential information for business plans targeting Small and Medium Enterprises (SMEs) around feed, forage and fodder production, transaction, processing and densification. In addition, least cost diets and feed substitution options can be developed based on such fodder market information.

## 4 Objectives

In order to evaluate the performance of these markets in the context of East Java, and to identify the types of interventions that may be implemented to improve them, the project will examine the following key issues:

- a) The factors that determine producer use and purchases of local feed and forage materials.
- b) The performance and functioning of feed/fodder markets, including price/quality relationships, and actor roles and incentives.
- c) Provide input information for SMEs around feed/fodder production, transaction and processing
- d) Explore alternative least cost diets and feed substitution options
- e) Potential interventions to improve functioning of feed/fodder markets and further research that may be needed to more thoroughly understand opportunities and constraints.

The approach will be to use a set of interconnected analytical exercises, including 1)) participatory assessment of producer and market behaviour and networks, 2)) targeted surveys of ruminant producers and market actors, and 3) feed sampling and quality analysis. Based on this learning, potential interventions to improve fodder market performance will be identified for future implementation or research, including those related to breeding for residue digestibility.

## 5 Methodology

### 5.1 Project sites

The project sites were the districts of Batu, Malang and Situbondo. These districts were identified as project sites through discussions with partners and a review of secondary data. The sites have contrasting and relevant settings in East Java with respect to concentrations of cattle populations, land availability, and level of dependence on feed and fodder markets.

Kota Batu is situated about 20 km to the northwest of Malang city. With a population of about 190,000 people, it lies on the southern slopes of Gunung Welirang and relatively elevated providing a suitable climate for dairy cattle. Kota Batu has a fertile mountainous area surrounded by agricultural land and the livestock production system in the area is dominated by dairy farming.



Figure 1. Map of East Java (Jawa Timur)

Malang is the second largest district in East Java after Banyuwangi and is the district with the largest population in East Java. Malang is also the third largest district in the island of Java after Banyuwangi regency and Sukabumi district in the province of West Java . Most of the area is mountainous and relatively cooler compared to neighbouring areas and livestock keeping is predominantly in the form of dairy farming.

Situbondo district is located in the north coast of the island of Java, surrounded by sugar cane, tobacco, protected forest reserves and fisheries enterprises. With its strategic location along the main land transportation route of Java-Bali, there is significant economic activity. The population in Situbondo is estimated at some 670,000 and its climate is relatively dry and hot, lowland crops with some irrigation and the livestock production system is predominantly beef production based on grazing.

### 5.2. Sampling

As part of the project a survey was conducted in Batu, Malang and Situbondo districts during the second half of 2015. The survey comprised two phases: a participatory rapid appraisal (PRA) and the actual household (farmers) and market actor survey, including processors, importers and retailers. Both surveys were followed by collection of feed samples from among the respondents.

Given the limited resources to conduct the survey, it was decided to focus specifically on livestock-keeping households and to target those areas where livestock production was most important, rather than to attempt to generate a broadly representative sample. Towards that end, one sub-district was chosen in each district based on livestock extension staff guidance on where representative livestock keepers were located. Two villages were selected on the same basis in each sub-district.

The participatory rapid appraisal, which comprised of Focus Group Discussions and Key Informant Interviews, served to assess ruminant producer feed and forage options and incentives, confirm the relevance of the sites selected based on secondary data and to establish contact with authorities of the study area and with personnel from the livestock services (key informants). Partly based on the information obtained in the PRA, questionnaires for the household and market actors' survey were developed, pre-tested and, where required, revised.

The survey of representative ruminant producers was conducted to identify practices, attitudes, incentives, and market access. The total number of respondents were 111 livestock farmers, 37 farmers each from Batu, Malang and Situbondo, and were split equally between small, medium and large herd sizes, based on local norms. The questionnaire was developed based on the PRA and includes sections on land and farming basic information, household income, price trend of main feeds in local market, overall trends in the quantity in the market of main feed (since start of 2013), seasonal feed purchases in an average month during past year, number of livestock and feeding patterns, milk production, use & marketing, storage, preservation and processing of feeds and access to market information.

Likewise, the market actor survey was conducted to identify practices, suppliers and buyers, value addition and costs, and quality/price relationships. This short survey interviewed 45 market actors, 15 respondents per district, based on lists of registered feed enterprises, including dairy cooperatives. The questionnaire developed includes sections on the profile of the feed market actor, price trend of main feeds in the enterprise, overall three-year trends of the main feeds in the enterprise, seasonal feed purchases by month, seasonal feed/fodder sells by the enterprise, reasons for selection of main feeds in the enterprise, feed supply and demand, feed storage, preservation and processing and market information. Multiple feed samples were collected from each respondent, reflecting the range of feeds in the enterprise.

The survey instruments are attached in Appendix 1.

### 5.3. Econometric analysis

The analysis of determinant factors that affect feed and fodder market participation and purchased feed prices was initially conducted in a joint estimation using Heckman two step regression model (the first stage is a probit or logit regression followed by Ordinary Least Square (OLS) regression, following the example in Staal et al, 2000). However, the estimates of the correlation coefficient, rho ( $\rho$ ), were not adequately significant to guarantee our ability to conduct joint estimation of feed purchase market participation and purchase price paid. This means the joint estimation of feed and fodder purchase market

participation and purchase prices could not yield unbiased estimates and it, therefore, required separate estimations of feed and fodder purchase market participation and purchase prices using probit or logit and OLS regressions models, respectively.

### 5.3.1. Determinants of Feed and fodder market participation

The feed and fodder market position of a livestock keeping household could be that of a net seller (a household that sells more feed than it buys), net buyer (a household that buys more feed than it sells), or autarkic (a household that neither sells nor buys feed). In this study, the fodder market position of the surveyed households, in three regions, is either a net buyer or autarkic. None of the surveyed households participated in feed and fodder markets as a seller. Hence, the dependent variable of the logit regression has a binary outcome, buyer or not. Further, to explore the temporal differences in market participation, the regression model was estimated separately for dry and wet season market participation.

Similar to agricultural output market participation, agricultural input market participation is considered to be restricted primarily by higher transaction costs, human capital which influences bargaining and searching ability, and lack of access to physical and financial capital. The explanatory variables used reflect the constraints to feed and fodder market participation and include household characteristics (age, gender, education), transaction costs (distance to markets, price and market information), financial capital (non-farm income, income from agricultural activities) and physical capital that reflects the production system and affects demand for feeds (owned land size and herd sizes)(as demonstrated in Alene et al., 2007). Jari et al., (2009) demonstrated that availability of market information boosts confidence of household that are willing to participate in the market.

### 5.3.2. Determinates of feed and fodder purchase prices

Similar to the work done by Jarial, et al., 2016; Ayuntunde et al., 2014 an Ordinary Least Square (OLS) model was used to analyse the determinant factors that affect household level feed and fodder purchase prices. The dependent variable, feed and fodder purchase prices (Rupiah/Kg) were constructed based on individual and aggregated feed and fodder purchases.

The survey database show that farmers purchase different types of feed and fodder. An individual regression based on each feed price is not applicable since the degrees of freedom is very small. Instead, the price (Rupiah/Kg) of most commonly purchased feeds (wheat bran, maize stover and concentrates) are used as the dependent variable in the regression model.

Additionally a price for aggregated purchased feed that comprises the diet (Rupiah/Kg dry matter) is used as a dependent variable to analyse factors that affect purchased feed diet prices at the household level. The feed diet prices is calculated based on the total feed dry matter purchased by each household, by dividing the total cost with total quantity purchased (measured as dry matter feed).

The explanatory variables included in estimating the factors that affect the feed and fodder purchase price paid at a household level include household characteristics (age, gender and education of the household head), transaction cost (distance to market), asset endowment and production system (owned land size and herd size), quality (crude protein and energy content of the specific feed), quantity of specific feed purchased (kg and kg dry matter for individual and aggregated price analysis, respectively). The large degrees of freedom when analysing aggregate prices allowed for separate regression analysis based on temporal differences (dry and wet seasons).

## 5.4. Price-quality relationships in feeds, feed ingredients, roughages and forages and feed data analysis

A wide range of feed quality traits were chosen to adequately describe concentrates, feed ingredients, forages and roughages. Feed quality<sup>1</sup> traits analysed were dry matter (DM), organic matter (OM), nitrogen (Crude protein equals N\*6.25), crude fat (CF), neutral (NDF) and acid (ADF) detergent fiber, acid detergent lignin (ADL), in vitro organic matter digestibility (IVOMD) and metabolizable energy content (ME). The feed quality traits were determined using Near Infrared Spectroscopy (NIRS) at the ILRI animal nutrition laboratory in Patancheru in India within the framework of a training given to Dr Dinie Hardinie, the Indonesian animal nutritionist in the project from Malang who stayed at the ILRI laboratory in India for 2 weeks. It is the intention to make the NIRS equations available to Indonesian institutes with compatible NIRS hardware to facilitate follow up on similar work in the country and region. Samples in Indonesia were collected as fresh matter, dried, ground to pass through a 1 mm mesh and shipped to India. Liquid samples were shipped in small sealed containers. All fresh and dry samples were weighted to determine dry matter content. Where feed was not sold in kg units but bundles, basket weights etc. average kg weight of these units was determined. The statistical SAS software package was used to analyse correlations between feed costs and feed quality traits.

<sup>&</sup>lt;sup>1</sup> Feed samples were dried, ground and packaged, and then sent by courier to the ILRI NIRS lab in Hyderabad for analysis. Also, local feed units such as bundles, sacks, etc. were weighed and converted into kilograms to harmonize the analysis. Fresh and dry weights were also measured.

## *Objective 1: To identify the factors leading to the use or non-use of local feed and forage materials by ruminant producers*

no.	activity	outputs/ milestones	completion date	comments
1.1	Participatory assessment of ruminant producer feed and forage options and incentives among target communities.	Producer survey instrument redesigned based on knowledge gains, and sampling approach refined	Sept 2015	A precondition for survey instrument design. Small group assessment was conducted to investigate the available ruminant producer feed and forage practices. This information was used to finalize the survey instrument.
1.2	Survey of representative ruminant producers to identify practices, attitudes, incentives, and market access.	Data base on attributes of ruminant producers in target areas Producer feed samples, with price information	February 2016	<ul><li>111 farm households (45 households from each district) were interviewed to understand production systems and identify practices, attitudes, incentives, and market access.</li><li>Representative feed samples were collected for each feed type available in each district.</li></ul>

*PC* = *partner country*, *A* = *Australia* 

## Objective 2: To determine the ability of markets and producers to differentiate and reward feed/forage quality, and the barriers to that

no.	activity	outputs/ milestones	completion date	comments
2.1	Participatory and secondary data analysis of markets and other exchange mechanisms for feeds and fodder.	Trader survey instrument redesigned based on knowledge gains, and sampling approach refined	Sept 2015	45 traders (15 from each district) were surveyed to identify practices, suppliers and buyers, value addition and costs, and quality/price relationships.
2.2	Survey of representative feed market actors, to identify practices, suppliers and buyers, value addition and costs, and quality/price relationships	Data base on attributes of feed market actors in target areas Trader feed samples, with price information	February 2016	A second collection of feed samples was carried out in April 2016 to capture dry season variation in price and quality

PC = partner country, A = Australia

## *Objective 3: To assess the performance of feed/forage markets in terms of linking supply with demand, and sources of market failures,*

no.	activity	outputs/ milestones	completion date	comments
		milleotoneo		

3.1	Preparation and analysis of feed samples to quantify multiple quality attributes using NIRs technology.	Database of feed quality attributes included crude protein, energy and dry matter, among others	April 2016	The analysis was carried out in ILRI feed lab in Hyderabad. Dr Dini Hardini travelled to participate in and be trained in the analysis. This capacity development activity was an additional output for the project.
3.2	Statistical analysis of producer feed practices to identify determining factors for buying/not buying feeds	Analytical results compiled, using econometric techniques	Sept 2016	Preliminary results were presented at the stakeholder meeting at Indonesian Beef Cattle Research Institute in Pasuruan. Final report is completed – see publications.
3.3	Statistical analysis of market feed prices and quality attributes differentiated by market actor and channel.	Analytical results compiled, using both econometric and other statistical methods	Sept 2016	Preliminary results were presented at the stakeholder meeting at Indonesian Beef Cattle Research Institute in Pasuruan.

# Objective 4: Identify and make public through several channels potential interventions for improved market performance, and improved utilization of quality feeds/forage, as well as needs for additional research.

no.	activity	outputs/ milestones	completion date	comments
4.1	Synthesis of results presented to stakeholders.	Stakeholder meeting to present results and discuss implications	August 2016	Feedback was incorporated into this report and influenced the final recommendations

Publication of results in multiple	Feed industry	Nov, 2016	See publications at end of the report
target audiences	Bonort on market	0 1 00 17	
	actors survey descriptive statistics	Sept, 2017	See publications at end of the report
	Report on analysis of determinant factors affecting household feed market participation and purchase prices	On-going	Being reviewed as ILRI Working Paper.
	Article on fodder market participation related to feed quality and price	Sept. 2017	Article presented as contributed paper at the XV European Association of Agricultural Economists (EAAE) Congress, held in Parma, Italy from 28 <sup>th</sup> August to 1 <sup>st</sup> September, 2017. The article is further to be submitted to an academic journal.
	Analysis of determinant factors affecting household level temporal feed and fodder purchase prices in East Java, Indonesia (article).	Drafted	Aim to completed during 2018, to be submitted to a journal
	Analysis of feed efficiency and diet among small holder dairy and beef farms and the effect of fodder markets in East Java Indonesia (article)	At analysis stage	Aim to complete by end 2018
	Publication of results in multiple forms for key target audiences	Publication of results in multiple forms for key target audiencesFeed industry overview reportReport on market actors survey descriptive statisticsReport on analysis of determinant factors affecting household feed market participation and purchase pricesArticle on fodder market participation related to feed quality and priceAnalysis of determinant factors affecting household level temporal feed and fodder purchase prices in East Java, Indonesia (article).Analysis of feed efficiency and diet among small holder dairy and beef farms and the effect of fodder markets in East Java Indonesia (article).	Publication of results in multiple forms for key target audiencesFeed industry overview reportNov, 2016Report on market actors survey descriptive statisticsSept, 2017Report on analysis of determinant factors affecting household feed market participation and purchase pricesOn-goingArticle on fodder market 

### 6 Key results and discussion

## 6.1 Descriptive statistics of survey respondents and feed markets

### 6.1.1 Livestock Producers

Table 1 shows the descriptive summary of survey respondents, who were all smallholder livestock farmers. About 80% of the household interviewed participated in feed and fodder markets as buyers and many of the households (about 78%) purchased feeds during both dry and wet seasons while 22% and 2% purchased feeds only during dry and wet seasons, respectively.

Overall, about 59 per cent of farmers who purchased feed and fodder were male farmers with an average age of 45 years and 7 years of schooling. The proportion of male farmers and education level of the feed buyers was relatively lower than the feed non-buyers, who were more often male and with more years of education.

Some 80% and 42% of the surveyed farmers overall derived income from agricultural and non-agricultural activities, respectively. Non-buyers of feed and fodder reported lower incidence of those income sources than buyers.

Farmers who have purchased feed and fodder are located nearer to the livestock markets, about 6.5 kilometres away, as compared to non-buyers, who are located about 13 kilometres away from livestock markets on average. While more than half, 56%, of the feed buyers had prior information about feed prices and markets, only a third, 36%, of the feed non-buyers had such prior information.

Farmers who purchased feed and fodder on average owned 0.67 ha of land and 6 head of cattle. Feed non-buyers on average owned 0.58 hectares of land and 4 cattle, only slightly less. While about 63% of the feed buyers were engaged in dairy farming, of which 58% were milk selling farm households, none of the feed non-buyers were dairy farmers, instead kept cattle for sale.

	Buyers	Non Buyers	All
Variables			
Male farmers (%)	57%	64%	59%
Age (years)	45.1	45.4	45.2
Education (Years)	6.46	8.67	6.78
Agricultural (Livestock) income (%)	83%	68%	80%
Non Agricultural Income (%)	46%	27%	42%
Distance to livestock market (Kms)	5.11	12.91	6.65
Access to market information (%)	56%	36%	52%
Total owned land size (ha)	0.67	0.58	0.65
Herd size (number)	6.36	4.09	5.91
Dairy farmer (%)	63%	0%	50%
Milk Seller (%)	58%	0%	47%
Dry season purchases	20%	0	16.2

#### Table 1. Characteristics of feed and fodder buyers and non-buyers

Wet Season Purchases	2%	0	1.8
Both dry and wet season purchases	78%	0	62.1

Figure 2 shows the frequency of seasonal purchase of different feed categories by households in the three surveyed districts (Batu, Malang and Situbondo) of East Java. The frequency of feed purchase, during both dry and wet seasons, is higher for grain by products, by products or natural fodders and commercial ready feeds and supplements.



#### Figure 2: Frequency of seasonal feed and fodder purchases by feed category

The types of feed and fodder mostly purchased by the farm households slightly vary across the districts, and agricultural seasons. The major type of feed and fodder purchased in Batu and Malang are more or less the same and includes grain by products, mostly wheat bran, commercial ready feeds or supplements and natural fodders such as maize fodder. However, Batu farmers, predominantly dairy farmers, mostly purchase grain by products and commercial ready feeds and supplements. While in Malang, where farmers' are mostly engaged in both dairy and beef farming, the frequency of feed and fodder purchase is higher for natural fodder such as maize fodder and sugar cane tops followed by feed concentrates and supplements.

In Situbondo, where livestock farming is predominantly beef farming, the surveyed farmers mostly purchased natural and planted fodder such as fresh rice straw, fresh and dry maize stover and Napier grass.

Figure 3 shows the market outlets used by farmers when they purchase feed and fodder. Most of the farmers in Batu and Malang preferred to buy feed and fodder from dairy cooperatives. This could be due to the affordable prices cooperatives offer to particularly to their members or milk selling farmers. The milk selling behaviour of farmers show that, about 89% and 100% of the milk selling farmers in Batu and Malang, respectively, sell almost all of their surplus to cooperatives. The next major feed market outlets used by



farmers in Batu and Malang are retailers, followed by vendors, (in Batu) and other farmers or informal markets (in Malang).

## Figure 3: Market outlets (channel) used by farmers in purchasing feed during dry and wet season (by regions)

In Situbondo farmers mostly bought feed and fodder from retailers and informal markets such as other farmers. Apparently very few farmers bought animal feed from cooperatives and none of them relied on vendors and wholesalers.

Overall a significant number of farmers bought feed and fodder from retailers, cooperatives, other farmers and vendors. Only a few farmers used wholesalers and other market outlets to purchase feed and fodder.

In Batu and Malang the market outlets mostly used were the same during dry and wet seasons except that the intensity was higher during dry season. In Situbondo, where grazing predominates, purchases from retailers and other farmers were mostly during the dry season and no feed purchases were made during the wet season from other farmers.

### 6.1.2 An overview of market actors

In order to evaluate the performance of feed and fodder markets in the context of East Java, the project also examined the performance and functioning of feed/fodder markets, including price/quality relationships, and actor roles and incentives. The project surveyed the profile of the feed market actors, enquired as to price trend of main feeds, overall three-year trends of the main feeds handled by the enterprise, seasonal feed purchases in an average month, seasonal feed and fodder sales by the enterprise, reasons for selection of the main feeds handled by the enterprise, feed supply and demand, feed storage, preservation and processing and market information.

A typical feed and fodder trader surveyed in Batu, Malang, and Situbondo was a 42-45 years old man. Most the interviewed traders in the three districts had a history of formal

education that ranged between 7-10 years of schooling which is equal to middle to high school level in Indonesia.

The distance traders travelled to markets ranged from 2.2 km in Malang district to 3.27 kilometers in Situbondo district, relatively short distances in both cases. Most of the interviewed traders were retailers and collectors. Out of the 15 interviewed traders in Batu, there were 8 retailers, 3 local traders, 2 cooperatives, 1 feed processor and 1 farmer/trader. The feed enterprise was the main source of income for 62% of the respondents. Similarly in Malang, the respondents included 9 retailers, 2 collectors, 2 vendors, 1 cooperative and 1/trader farmer and about 43% of the respondents relied on feed trading as their main source of income. In Situbondo, where beef production predominates, the type of traders interviewed include 5 retailers, 5 collectors, 2 local traders, 1 inter regional trader, 1 cooperative and 1 feed processor. Feed trading was the main source of income for about 55% of the respondents in Situbondo.

Farmers as major buyers of feed and fodder and other traders such as collectors and retailers as suppliers as well as buyers of feed were the main contacts the traders have in the three districts.

The type of fodder sold in Batu included up to 14 types of feed and fresh maize and compounded dairy feed were the main feed types sold by the Batu district feed traders (Figure 4). Batu district is predominantly a dairy farming region and farmers mostly buy fresh maize fodder and compounded complete dairy feed to maximize their milk production.



Figure 4: Business connections of traders in Batu and main feed types sold

Figure 5 shows the business connections of a trader and major feeds sold in Malang. Malang, like Batu district, it is a predominantly dairy production area thus it is expected that the major feed buyers who are dairy farmers to buy mostly feeds that contribute to high milk production, such as wheat pollard, Onggok (cassava processing residue) and other concentrates.





The business connections of a typical trader and major feed traded in the district of Situbondo are shown in Figure 6. Traders in Situbondo were well connected with collectors, regional traders as well as others who are in animal feed business.

In Situbondo, where beef production is the main cattle system, the main types of feed traded were fresh and dry rice straw, maize stover, peanut stover and fresh maize. Many farmers in Situbondo grow maize, so as a result maize stover was widely available in feed markets.





The majority of customers who bought feed from a typical feed trader in Batu, Malang and Situbondo live in the nearby places or the same village where the trader lives (Figure 7). In Situbondo about 31% of the buyers live in the same sub district but outside the village where the trader lives. However, the feed suppliers who sold feed to the traders live with in the same village or sub- district and in some cases even outside the same sub-district

or district. This is particularly true in Batu where dairy farmers commonly bought mostly concentrate feed which was supplied from distant markets, including imports.





The interviewed traders were asked to indicate the numbers of other businesses or market actors that do sell feed in their area. As shown in Figure 8 below, most of other traders who sell feed in Malang and Situbondo were based in the nearby village as the respondent. In Batu the majority of other traders who sell feed live outside the village but within sub-district or district which to some extent indicates the existence less competition among traders.



Figure 8: location of market actors who do the same business as a typical feed trader in Batu, Malang and Situbondo

Figure 9 shows the places where the respondents or feed traders operated from. Most of the respondents in all the three districts operated their feed trading business from home while some (20-33% of the respondents) who are likely based in Urban areas operated from their business shops. About 20% of the traders interviewed in Situbondo as well as 13% of the traders in Batu and Malang operated from roadside fodder markets.



Figure 9: Places of feed business operation

The provision of additional services to consumers could be an added value in running the feed market business. In the three study sites traders were also engaged in other additional services. In Malang, some traders reported also providing transportation services, such as taking telephone orders and offering farm delivery services. Similarly, traders in Batu reported providing milk collection and credit services to their customers. In Situbondo very few traders engaged in additional services, including transportation and extension.

Most of the respondents interviewed in Batu, Malang as well as Situbondo districts were self-started feed traders, primarily used their own capital, and were not members of any trading organization. Only fa ew (6-13%) have accessed formal credits to start up their businesses. Most small traders claimed that they can't take loans from banks because they do not have assets that can be used as collateral. And those who have assets that can be used as collateral. And those who have assets that can be used as collateral were discouraged by the high interest rates imposed on the loans. Almost all of the respondents claimed that they have never received any assistance from the government at any stage of their feed business operation.

Respondents were asked to report the minimum and maximum feed prices during 2013 to 2015. Figure 10 shows the three year (2013-2015) average prices of commonly traded feeds in Batu, Malang and Situbondo. The figure shows prices were relatively higher for industrial by products, mineral supplements and concentrates.



Figure 10: Three year (2013-2015) average prices of commonly traded feeds in Batu, Malang and Situbondo

In addition, traders were asked to indicate the trends of the major feed prices from 2013 to 2015. In Batu, the traders noted that the prices of mineral supplement had increased whereas prices of most other feeds were fluctuating and for some feeds such as soya bean husk, soya bean stover and Napier grass remained constant.

Similarly feed price trends in Malang and Situbondo were mostly fluctuating the traders in Malang noted that most of the feed prices were fluctuating with some price decrease were noted for Napier grass.

The main reason stated for the fluctuation of the prices of the major feeds in Batu, Malang and Situbondo include increase or decrease in demand, increasing preferences among buyers and lower supplies of feeds. There did not appear to be a strong trend in any direction for most feeds during this period.

In Batu, the supply of both rice bran and pollard increased during the 2013 to 2015 period due to an increase in demand from buyers. The quantities of palm oil cake and fresh maize in markets were increasing reportedly due to increased production. The quantities of compounded complete feed for dairy (concentrate), mineral supplement, and other concentrate feeds in the markets were increasing as the result of increasing preferences and high demand from buyers, whereas the quantity of maize stover (dry) was decreasing due to less demand from buyers. The quantities of soybean husk and soybean stover were constant.

In Malang, there was an increasing trend toward wheat pollard and compounded complete dairy feed quantities due to high demand from buyers. Similarly, there was an increasing trend in the supplies of rice bran and Napier grass apparently due to an increase in production of those feeds during 2013 to 2015. Due to less demand from buyers, the supplies of dry maize stover remained more or less constant.

In Situbondo due to an increasing demand from buyers, there was an increasing supply of fresh maize, rice straw (fresh), peanut stover and other concentrates, while the supplies of pollard and peanut stover remained constant.

In Batu, most farmers use concentrate feeds because the majority of cattle in Batu are dairy cows. Many merchants sell mixed diet for dairy cows because these products were highly demanded by breeders.

In Malang, the most widely sold feed is cassava pulp. Dregs of cassava are commonly sold in Malang because there are traders who stock cassava pulp from the several flour mills locally operating. In addition the use of cassava dregs in Malang is believed to increase the production of milk from dairy cattle.

In Situbondo, rice straw (fresh) is the most widely sold animal feed. Most farmers in Situbondo commonly use rice straw as forage, obtained from the large rice farms. Agricultural land is relatively available in Situbondo, where farm sizes are larger.

Traders have several ways to connect with consumers. Based on the data obtained from the traders, most buyers buy feed by directly coming to the business location. Sometimes, additional selling services such as taking orders by phone are provided.

The most commonly used method of payments were cash payments. But there were also vendors that provide additional services such as credit. Payments on credit are mostly practiced in cooperatives where farmers can buy fodder and pay later, commonly through deductions of payments for their milk sales.

Figure 11 shows the main feeds sold by traders in Batu, Malang and Situbondo. In the districts Batu and Malang traders mostly prefer to sell maize stover (tebon), wheat pollard, rice bran and compounded complete dairy feeds. Additionally in Malang fresh maize and elephant grass are also rated by traders as the most preferable feeds to sell. In Situbondo, traders rate rice bran, dry maize stover, soybean stover and fresh maize as most preferable feed to sell.



Figure 11: Priority feeds sold by traders in Batu, Malang and Situbondo

As shown in figure 10, the respondents in Batu and Malang highlighted that the main reason of preference of selling the feeds shown in figure 11 was mostly due to demand from buyers. In Situbondo, trader's choice of feed was mostly determined by profitability.



Figure 12: Reasons for selecting priority feeds

Figure 13 shows the trader's responses with regard to feed availability during 2013 to 2015. In Batu and Malang feed was scarce during the dry seasons of the years 2013, 2014 and 2015. Whereas in Malang feed was adequate both during dry and rainy seasons of the years 2013 to 2015. This could be due to the fact traders in Malang used to stock feeds right after end of rainy seasons. Additionally, processed feed by products are relatively abundant in the region.





According to figure 14, in Batu and Malang most traders do not differentiate feed and forages based on quality or price forages based on quality. Most vendors sell feed at the same price and quality. While in Situbondo, most traded feed and forages vary in quality and prices. In other words, quality of the feed is reflected in the prices farmers pay.

The main reasons behind selling different forage qualities at different prices were the humidity, purity and freshness of the feed. Although there is no record on basic factors for price-quality differences in Batu and Malang, in Situbondo, the main factor underlying the differences in price and quality of feed include freshness of the feed. Similarly better prices were the motive behind selling sorted or graded feeds in Situbondo.



Figure 14: Price quality differences within the same type of feed (percentage)

Traders were asked if selling high quality feed has benefited them. In Situbondo, 73% of Situbondo traders agreed that they have benefited from selling quality feeds. However, only 33% and 20% of the respondents in Batu and Malang, respectively, have said that they have benefited from selling high quality feeds.

As shown in Figure 15, the majority of the traders do not store animal feed. This is due to the type of feed they sell which can in most cases easily sold out.



Figure 15: feed storage and preservation

Figure 15 also shows that the majority of the traders in Batu and Malang districts maintain the quality of they sell by means of feed preservation<sup>2</sup> such as making hay or silage However, only few practice feed preservation in the district of Situbondo. Such differences across districts may be influenced by the livestock systems, type of feeds commonly used in the regions as well as the level of knowledge in feed preservation.

<sup>&</sup>lt;sup>2</sup> For the questions related to feed storage methods, feed preservation methods and number of traders engaged in feed preservation, there was no adequate response from traders.

Most traders do feed processing to add value and potentially gain more profits. Most of the traders located in Batu are engaged more in direct selling of products acquired either from the factory, or from the farmers.

The reason for animal feed processing by the traders in Malang was to add value to the products to be sold. Traders commonly mix several ingredients that will become a special mixture of feed for dairy cows. Animal feed processing by traders in Situbondo were for reasons of storage and value addition.

Figure 16 shows the sources of market information used by the feed traders in Batu, Malang and Situbondo. The majority of the respondents in the three districts indicated self or personal observation and speaking with regular customers and brokers as their main source of market information. Market information obtained included such things as demand and supply levels of animal feed and information about the price of feed. According to some of the traders, there are not many trader associations or other organizations that provide comprehensive information about feed markets.



#### Figure 16: Sources of market information

About 47% of the respondents in Batu had taken credit, on average Rp 484 million (over 30,000 US\$), mostly from commercial banks and cooperatives. Only 13-20% of the respondents in Malang and Situbondo have taken credit from formal or informal creditors.

Overall the majority of the traders didn't take credit either from formal credit institutions or informal creditors. The main reasons why Batu and Malang traders didn't take credit include the difficulty in accessing credit and the risks associated with taking credit. In Situbondo, about 59% of the respondents indicated that they don't need credit for their feed business while others mentioned the risks and the difficulty in accessing credit as their main reason for not taking credit.

## 6.2 Results of analysis of determinants of feed and fodder market participation

The main objective of this analysis was to determine the factors influencing the spatial and temporal feed and fodder market participation.

An econometric approach was used to understand and determine the factors that affect feed and fodder purchase market participation. The market participation analysis was done for both seasonal and overall market participation. Generally, market access is

assumed to be is restricted primarily by higher transaction costs as well as lack of access to physical and financial capital. However, it is also known that attributes of the actors, such as their abilities or gender, and their access to assets, can also influence the level of participation. The explanatory variables used in the estimations are those that influence transaction costs (distance to markets and price and market information) and are associated with human capital (age, gender and education), physical capital (herd size, owned land size), and financial capital (agricultural and non-agricultural income). In market participation, the household structure or human capital captures the household behaviour and, hence, may reflect the attitude of farmers towards risk. Risk associated with market participation is caused by price and quantity fluctuations. The attributes of the household structure allowing for risk-taking are related to creating the possibilities of lowering transaction costs.

Transaction costs that determine market participation include information costs and negotiation costs. Information costs are incurred primarily due to information asymmetries that exist among farmers or market actors. Access to information tends to improve decision-making skills. This affect the probability of market participation since information service never lowers the expected utility. Negotiation costs include transport cost (proxied by distance to markets) and bargaining power that could emanate from differences in marketing experience and social status and networks. Access to assets (physical and financial capital) provides households with leverage to invest in market participation. Access to assets is an indication of endowment and wealth, and land and herd size also influence demand for feeds. Generally, the more endowed households tend to experience lower transaction costs and have more flexibility in allocating resources to market activities.

The results showed that agricultural and non-agricultural income, distance to livestock markets, market information and herd size significantly influenced the overall feed and fodder purchase market participation.

Five factors were found to be significant in influencing the feed and fodder purchase market participation during dry season and wet season. Out of this, the three significant variables (agricultural and non-agricultural income, and distance to livestock markets) are the same for both dry and wet season feed and fodder purchase market participation. Herd size and farmer age influenced only dry and wet season market participation, respectively.

Overall, farmers who have income from agricultural activities (sales of milk, cattle etc.) are 15% more likely to participate in the feed and fodder market as feed and fodder buyers than those farmers who doesn't have any income from agricultural activity, during the survey year of 2015. Similarly, income from non-agricultural activity (non-farm income) increases feed purchase market participation. Farmers with access to non-farm income are 18% more likely to participate in the market than farmers who doesn't have any income from non-agricultural activity, which indicates the importance of farm and non-farm income in complementing farm investments and maintaining viable farm, that requires purchase of inputs (machinery, fertilizer, feeds, etc.) and operating capital.

Distance to livestock markets, which is used as a proxy for distance to feed and fodder markets, were found to have a negative impact on feed purchase market participation both during seasonal (dry and wet seasons) and overall market participation. An increase in distance to a market by 1 km decreased the probability of participating in feed and fodder markets by 2.3 % and 3.5% during dry season and wet season, respectively. When the seasonal variation is not included in the model, an increase of 1km in livestock market distance reduced the likelihood of a farmer to participation (non-purchase of feed and fodder markets by 2.2%. The likelihood of non-participation (non-purchase of feed and fodder) as a result of distant markets was lower during the dry season than in the wet season. This could be due to the fact that in the dry season, regardless of the distance to the markets, farmers have to supplement own grown and communal sources of feeds with purchased feeds.

Access to price and market information significantly and positively influenced feed market purchase participation. Farmers who had access to market information were 12.5 % more likely to participate in the markets. This can be interpreted that access to more accurate information about prices and markets would create farmer confidence about marketing conditions that incentivized individuals to participate in the market.

The econometric analysis also found that an increase of herd size by one animal increases the probability of the farmer to participate in feed markets as a feed buyer by 1.2%. This was more pronounced, although still a small effect, during the dry season where an additional animal to the herd increases the likelihood of the farmer to purchase feed and fodder by 1.5%. There is no any specific effect of herd size on market participation during the wet season.

Finally, the age of the household head was found to significantly and positively influence feed purchase market participation during the wet season. The analysis showed that an increase in the age of the household head by one year increased the probability of participating in the feed and fodder markets during the wet season by 3.1%, all other factors held constant. This implies that older farmers are more likely to participate in the feed and fodder markets than the younger people, even during the wet season where natural feed sources are relatively easily available from own and communal lands. This could be attributed to the possibility that young farmers are energetic and can collect crop residues from their own plots as well as and forest, or growing their own forage, instead of purchasing.

## 6.3 Results of analysis of determinates of feed and fodder purchase prices

The analysis that explores determinant factors that affect feed and fodder purchase prices was conducted based on the prices of most purchased feed and fodder as well as calculated feed diet (aggregated) prices, from purchased feed and fodder by a household.

The main objective of the analysis is to investigate the determinant factors that affect household level temporal feed and fodder purchase prices.

Wheat bran, maize fodder and concentrate were the main feed types purchased by most farmers and, hence, the individual prices of these three feed types were used to determine factors that affect feed and fodder prices.

The explanatory variables included in estimating the factors that affect the feed and fodder purchase price paid at a household level include household characteristics (age, gender and education of the household head), transaction cost (distance to market), asset endowment (owned land size and herd size), quality (crude protein and energy content of the specific feed), quantity of specific feed purchased and a variable that explains seasonal purchases (season: dry or wet season).

The results of the descriptive analysis of the explanatory variables show that the average prices are higher for the commercial feeds and supplements and wheat brans. This is, obviously, due to higher nutritional content of those feeds and the costs (labour, machinery etc.) that are involved in making those feeds readily available for consumption by the animals. The average feed quantity (kilograms) (1424 kg of wheat bran; 3053 kg of Maize fodder and about 3900 kg of concentrates) purchased by the farm households varies and is higher for the commercial feed. There are slight differences in the ages of the household heads that purchased the three types of feeds (ranges from 43 to 47 years), however more than 60% of the buyers in all the three categories are male headed households. Similarly, there is little variation on the average education level (average 7 years of education) among the three samples.

The average distance to livestock markets (used as a proxy for distance to feed markets) ranges from 3.64 kilometres, for maize fodder buyers, to 4.46 kilometres, for wheat bran

buyers. The total land size owned by average household is about 0.85 hectare for those farmers who purchased wheat bran and maize stover, and much lower, about 0.7 hectare, for buyers of commercial feeds and supplements.

The descriptive analysis results also show that the average herd size owned are higher, about 7.78, for wheat bran buyer households. There is slight differences in the average herd sizes between the households who purchase maize stover (about 6.41 animals) and commercial feeds and supplements (about 6.5 animals).

Most of the feed purchases, particularly for wheat bran and commercial feeds and supplements were during both dry and wet season, while for maize stover the demand was more during dry season. And most of the buyers, for the three feed types, were from the district Batu with some are from Malang, where the livestock farming systems are predominantly dairy farming. There were few farmers from the district Situbondo who purchased maize stover and concentrates, as the production system there is more dependent on grazing. However, due to the presence of some missing values on some of the explanatory variables considered for the analysis, the observations were automatically dropped during regression analysis. Hence, there was no spatial or location variable included in the regression model.

The econometric analysis used three separate ordinary least square (OLS) regressions to determine the factors that affect the prices of wheat bran, maize stover and concentrates, expressed in Indonesian Rupiah (rupiah/kg) and transformed to logarithmic form.

In general, the explanatory variables used in analysing the determinants of the feed and fodder purchase prices are household and farm characteristics, transaction cost and feed quality related variables. It was hypothesized that human capital (gender, education and age), transaction costs (distance and market information), experience in marketing (selling milk), feed and fodder quality (protein and metabolized energy content of the feed) and quantity of feed and fodder purchased to affect the feed and fodder purchase prices. The introduction of human capital related variables in the price equation was to capture a number of possible concepts of household behaviour which may influence the fodder and feed purchase prices received by households, related to ability to bargain, search, and access to social networks.

The result of the regression analysis on individual feed and fodder prices showed that farmers can possibly secure relatively cheaper prices through bulk purchases of wheat bran, maize stover and concentrates. This means as the amount of purchased wheat bran and maize stover increases by a 1kg, the purchase prices are reduced by 0.008% and 0.005 %, respectively, while all other variable in the model are held constant. Similarly, for any additional 1kg purchase of feed concentrates, farmers could receive the price decreased by 0.0016%. This is line with expectations of lower price with volume.

The analysis also found a strong positive relationship between the quality of the feed (protein content of the feed) and price of concentrate feeds. For any additional 1% increase in the protein content of the feed concentrate, the purchase price is expected to increase by 5%, holding other variables constant. The regression analysis didn't find any seasonal variation impact when single feed prices are taken into account.

Additionally, a purchased feed diet price ((Rupiah/Kg) is used as a dependent variable for aggregate price. The feed diet prices is calculated based on the total feed dry matter purchased by each household for all feed types, by dividing the total cost with total quantity purchased (dry matter feed). The purchased feed diet price or aggregate price is calculated separately for dry season and wet season.

The explanatory variables used in the analysis are the same as those used in analysing individual feed and fodder prices, except the variable for spatial variation and milk selling behaviour of the households (proxy for experience in marketing). In the analysis based on individual feed purchase prices there were few observations and very little spatial variation hence there was no spatial variable included in the regression. Similarly variables related

to whether the household sells milk or not was not included in the regression model since such variable was almost unitary in a small number of observation which has very little spatial differences.

The quantity of different feed and fodder were aggregated using dry matter (DM) content of each feed purchased by the household. The variable that are used to represent the quality of the aggregated feed and fodder include total purchased crude protein (percent in a Kg of DM) and total metabolized energy (mega joules per kilogram of DM).

In comparison to the analysis of individual feed prices, the analysis based on purchased feed diet prices significantly improved the fitness of the regression model, as shown in the results Table 1.

The results show, like the analysis based on individual prices, there was no any indication of the impact of household characteristics (household head's age, gender and education) on the purchased feed diet prices, suggesting that producers' own capacity did not affect their access to these markets or their ability to bargain prices.

	Dry Season (N=85)	Wet Season (N=70)	Total (N=85)
Explanatory Variables	· · · ·	· · ·	. ,
Age (years)	-0.004 (0.011)	-0.013 (0.015)	0.002 (0.011)
Education (years)	0.045	-0.036	0.056
	(0.054)	(0.073)	(0.056)
Gender (1=male, 0 =female)	-0.022	0.217	-0.052
	(0.260)	(0.349)	(0.272)
Distance to market (kms)	-0.006	0.083	0.018
	(0.040)	(0.062)	(0.042)
Market Information (yes=1, No=0)	-0.383*	-0.563*	-0.500*
	(0.245)	(0.330)	(0.253)
Milk seller (yes=1, No=0)	-0.505*	-0.166	-0.551*
	(0.285)	(0.377)	(0.296)
Quantity purchased in DM (log)	-0.282***	-0.118	-0.149
	(0.114)	(0.132)	(0.120)
Diet Energy (log)	1.395	-0.169	0.396
	(1.805)	(2.474)	(2.077)
Diet Crude protein	0.114*	0.188**	0.163**
	(0.060)	(0.074)	(6.467)
Malang	0.127	-0.189	-0.052
	(0.308)	(0.385)	(0.315)
Situbondo	-1.934**	-0.915	-2.446***
	(0.654)	(1.536)	(0.703)
Constant	5.10	6.82	6.34
	(3.586)	(4.812)	(4.159)
Adjusted R-square	36%	27%	43%

Table 2. OLS regression results of factors	s influencing feed diet prices
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Significant at 10% level; \*\*: significant at 5% level; \*\*\*: significant at 1% level.

Farmers who have access to price or market information on average received about 50 % reduction in feed diet purchase prices (aggregated) than those who doesn't have any information on feed prices and markets. The rate of reduction that farmers received as the result of having prior market and price information was 38% and 56 % for dry and wet season, respectively. Similarly, milk sellers approximately received about 55% reduction in feed diet price than non-sellers of milk. This could be due to the negotiation skills that they have developed from being often in markets or favoured treatment they receive from feed sellers such as dairy cooperatives which are out there to primarily serve their members who deliver milk to their plants on frequent basis. This is further confirmed by the fact that about 89% and 100% of the milk selling farmers in Batu and Malang, respectively, sell almost all of their milk surplus to cooperatives and about 65% of milk sellers meet more than 50% of their feed demand from formal markets, including cooperatives.

The regression results further show that the purchased feed diet prices significantly increased with the quality (protein content) of the whole feed diet purchased during both seasons.

The findings show that a 1 % increase in protein content of a kilogram DM of the purchased feed diet increased the purchase feed diet price by 11% and 19% during dry and wet seasons, respectively. This is a particularly interesting result in context of the fact that traders reported that they did not differentiate quality when pricing feeds, although they did so for factors such as freshness, which affects quality (see above)

The increase of purchased feed diet price due to increase in protein content is about 16% when there is no seasonal variation considered in the regression model. The results also show an increase in quantity of feed purchased by 1kg of DM feed, on average reduced the purchase feed diet price by about 0.28% during dry season.



## Figure 4: The protein and metabolized energy content of purchased feed diet across districts

To explore the impact of the spatial variation on feed prices two dummy variables that reflect for Malang and Situbondo districts (with district Batu district is considered as base scenario) were included in the model. The result shows farmers in Situbondo have received a reduction in prices of purchased feed diet during dry season. However, the magnitude of such reduction is entirely dependent on the specific feeds that make up the feed diet in Situbondo. For example, many farmers in Malang purchase sugar cane tops and none in other districts. Similarly, the purchased feed diet for farms in Situbondo, predominantly beef farms, is quite different from Batu and Malang; at least in the nutritional content of the feeds purchased. This is confirmed by the above figure which shows that the average Protein (%) and metabolized energy (MJME/kg DM) content of a 1kg purchased DM feed diet is lower in Situbondo than in Batu and Malang. As aforementioned, section 6.1, farmers in Situbondo mainly purchased natural and planted fodder, such as fresh rice straw, fresh and dry maize stover and Napier grass.

## 6.4 Price-quality relationships in feeds, feed ingredients, roughages and forages

Price-quality relationships were analysed in feeds, feed ingredients, roughages and forages that is sold by fodder shops and farmers during the rainy and dry season of the year 2015 in Malang, Batu and Situbondo. Feed quality traits analysed were dry matter (DM), organic matter (OM), nitrogen (Crude protein equals N\*6.25), crude fat (CF), neutral (NDF) and acid (ADF) detergent fiber, acid detergent lignin (ADL), in vitro organic matter digestibility (IVOMD) and metabolizable energy content (ME).

Relationships between costs per kg fresh and dry feed and feed quality traits were analysed using linear regressions for each site and each season. In all, laboratory traits were identified that were significantly (P< 0.05) correlated with prices and in all but one case, single traits were identified that accounted for 50% (P < 0.0001) and more of the variations feed costs. Traits most frequently closest correlated with feed costs were protein and one of the fiber constituents NDF and ADF. Interestingly feed cost expressed on a fresh matter basis (i.e. costs per kg as purchased) were much closer related to feed quality traits than feed costs per kg dry feed even though feed quality traits were expressed on a dry matter basis.

The closer relationship between fresh feed prices and (dry matter) feed quality traits can perhaps be explained by two factors. The conversion of fresh to dry matter entails conversion of a range of varying and sometimes only loosely defined units (bundles, baskets, cart load etc.) into kg, and second water content in forages and roughages might have a palatability value on in its own right. This advantage however would partially collide with transport worthiness, with water rather nutrients being a major constituent to be transported.

When feed price – quality relationships were analysed across sites but separately for dry and rainy season the single trait ADF accounted for 23 (P < 0.0001) and 49 % (P< 0.0001) of the variation in fresh feed prices in the dry and rainy season, respectively. Across sites and seasons ADF accounted for 34% of (P < 0.0001) the variation in fresh feed prices. Thus while sites and season can exert a significant effect on feed price, feed price – quality relationships show considerable stability across sites and seasons.

A correlation matrix for price quality relationships within sites and season is presented in the following Table.

Table 2. Correlations between nitrogen (N), crude fat (CF), neutral (NDF) and acid (ADF) detergent fiber, acid detergent lignin (ADL), in vitro organic
matter digestibility (IVOMD) and metabolizable energy content (ME) and fresh feed prices according to site (Malang, Batu and Situbondo) and season
(values in square brackets are probability values)

Season	N	CF	NDF	ADF	ADL	ME	IVOMD
	Malang						
Rainy	0.64	0.52	-0.70	-0.67	-0. 17	0.54	0.55
	[0.0002]	[0.004]	[0.0001]	[0.0001]	[0.39]	[0.003]	[0.002]
Dry	0.76	0.69	-0.76	-0.54	0.15	0.25	0.40
	[0.0002]	[0.001]	[0.001]	[0.06]	[0.59]	[0.30]	[0.09]
	Batu						
Rainy	0.31	0.42	-0.52	-0.69	-0.28	0.13	0.20
	[0.06]	[0.01]	[ 0.002]	[0.0001]	[0.11]	[0.45]	[0.24]
Dry	0.20	0.21	-0.39	-0.43	0.06	0.27	0.31
	[0.21]	[0.22]	[0.02]	[0.009]	[0.73]	[0.10]	[0.07]
	Situbondo						
Rainy	0.84	0.81	-0.76	-0.92	-0.42	0.11	0.24
	[0.0001]	[0.0001]	[0.001]	[0.0001]	[0.11]	[0.65]	[0.33]
Dry	0.53	0.75	-0.65	-0.84	-0.44	0.36	0.40
	[0.002]	[0.0001]	[0.0003]	[0.0001]	[0.01]	[ 0.05]	[0.03]

Given the diverse types of feed and fodder traded, compound feeds, feed ingredients, forage and roughages, significant correlations between price and quality traits should be expected. When separating the different feeds into the three groups, compound feeds, feed ingredients and roughages the following picture emerged. Compound feeds were generally true to their description. For example, retailers sold 5 grades of compound feed from one cooperative and the correlations between grade and feed quality traits were  $\geq R^2 = 0.92$ . Similarly, the mostly traded concentrate feed ingredients were wheat bran, rice bran and maize bran and in this order of pricing and feed quality traits.

The situation is a bit more complex in forage and roughage trading, as illustrated in the figure below. Very clearly groundnut haulms having the highest average nitrogen content and in vitro digestibility of all forages and roughages are clearly drastically under-priced and under-valued. Ignoring groundnut haulms from the relationships below resulted in  $R^2$  of 0.84 (P =0.03) between nitrogen content and *in vitro* digestibility and prices.

Napier grass was the most widely traded forage and had on average only moderate nitrogen content and in vitro digestibility. The comparison with the price of fresh maize stover shows how much value could be added to Napier grass if the digestibility could be raised to about 55% of how much demand would exist for a replacement forage of Napier with higher fodder quality.

In general, prices reflect feed quality quite consistently, although there are exceptions, such as the case of ground-nut haulms.



Relationships between nitrogen content and prices of forages and roughages traded across season and sites Relationships between *in vitro* organic matter digestibility and prices of forages and roughages traded across season and sites

Figure 5: Relationships between feed quality and price

### 7 Impacts

### 7.1 Scientific impacts – now and in 5 years

With the intention of making the NIRS equations available to Indonesian institutes with compatible NIRS hardware, Dr Dinie Hardinie, Indonesian animal nutritionist in the project, trained for two weeks at the ILRI animal nutrition laboratory in India, and helped in determining the feed quality traits, using Near Infrared Spectroscopy (NIRS). It is the intention to make the NIRS equations available to Indonesian institutes with compatible NIRS hardware to facilitate follow up on similar work in the country and region.

Three scientific journal papers from the project will be submitted to scientific journals. An ILRI working paper with all the project results is also forthcoming.

Perhaps most importantly, this is the first study that we are aware of that econometrically examines feed prices not just in terms of relationship to feed quality, but also in terms of other behavioral, market and contextual factors. ILRI will continue to build on this methodology, and it is expected that through the project publications and wider recognition and use of this approach will follow.

### 7.2 Capacity impacts – now and in 5 years

Although not initially planned, the project although short in duration and scale, had significant impact in capacity development. The Indonesian Agency for Agricultural Research and Development (BPTP) was the primary partner, and its staff were exposed through the project to new approaches and methods. No study of feed market and quality had previously been conducted in East Java. Importantly, 11 students from Brawijaya and Malang Universities were engaged with the project in data collection exercises to collect a variety of scientific and technical data associated with feed sampling and household feed and fodder marketing. As shown in the list of publications, most used this opportunity to write internship reports required for completion of their Bachelors' degrees. They uniformly expressed great satisfaction with the experience which has motivated them to continue their careers in agriculture.



### 7.3 Community impacts – now and in 5 years

There are not generally expected to be any community impacts from this small scoping study. Our hope is that through the participatory process with producers, market actors and officials, and the greater attention that the work gave to feed and fodder quality, and to the markets that supply those materials, that there will be increased awareness and potentially new activity.

### 7.3.1 Economic impacts

There are not expected to be any economic impacts from this small scoping study, unless the increased awareness through the participatory process leads to new investment in feed and fodder enterprises.

### 7.3.2 Social impacts

There are not expected to be any social impacts from this small scoping study.

### 7.3.3 Environmental impacts

No environmental impacts are anticipated from this scoping study. Further research into uptake of new forages, particularly legumes, could lead to improvement of soil quality.

### 7.4 Communication and dissemination activities

A well-attended result dissemination workshop was conducted on 23<sup>rd</sup> August, 2016, at Indonesian Beef Cattle Research Institute in Pasuruan. The workshop featured all the key research findings from the project. Discussions and feedback from a wide range of participants including producers, market actors, private sector and government research and extension officials. The presentations and list of participants are available in the Appendix.

Two blogs were produced and posted on the ILRI Asia site. The first descried the project when it was launched:

https://asia.ilri.org/2015/09/15/indonesia-fodder-markets/

Another blog described the final workshop https://asia.ilri.org/2016/11/02/indonesia-fodder-markets-workshop/

## 8 Conclusions and recommendations

### 8.1 Conclusions

The econometric analysis examined factors affecting the temporal feed and fodder market participation and feed and fodder purchase prices using econometric approaches with data gathered from three regions of East Java (Batu, Malang and Situbondo), Indonesia. The descriptive results show that about 80% of the smallholder livestock farm households interviewed participate in feed and fodder markets and most of the households (about 78%) purchase feeds both during dry and wet seasons, with slightly more participation during dry season (about 87%). This demonstrates the strong reliance on feed and fodder markets in an area characterized by small land holdings and so limited ability to producer feed. On average about 54% of the wet season feed and fodder buyers purchased their feed and fodder from formal market (cooperative, wholesalers, traders etc.) outlets, while only 50% of those who buy feed and fodder during the dry season use formal market outlets.

The major type of feed and fodder purchased in Batu and Malang are the same and includes grain by products, mostly wheat bran, commercial ready feeds or supplements and natural fodders such as maize fodder. However, Batu farmers, predominantly dairy farmers, mostly purchased grain by products and commercial ready feeds and supplements. While in Malang, where farmers mostly engaged in both dairy and beef farming, the frequency of feed and fodder purchase is higher for natural fodder such as maize fodder and sugar cane tops followed by feed concentrates and supplements. In Situbondo, where livestock farming is predominantly beef farming, the surveyed farmers mostly purchased natural and planted fodder such as fresh rice straw, fresh and dry maize stover and Napier grass.

The result of the econometric analysis showed that agricultural and non-agricultural income, distance to livestock markets, market information significantly influenced the overall feed and fodder purchase market participation. Access to income, and access to market information increased participation, while distance to market had a negative effect.

The analysis found statistically significant and positive relationships between feed and fodder prices and their quality in terms of animal nutrition. Feed and fodder prices were also influenced by access to market and price information and collective actions, such as cooperatives. The correlation analysis of price-quality relationships in feeds, feed ingredients, roughages and forages, sold by fodder shops and farmers during the rainy and dry season, found a strong relationship between prices and all quality traits. The traits most frequently closest correlated with feed prices were levels of protein and the fibre constituents NDF and ADF.

The full econometric analysis of participation and prices originally intended was not fully feasible due to data constraints, but some key messages nevertheless emerged from the analysis:

### Market participation:

The cattle systems in East Java are clearly heavily dependent on feed and fodder markets, even in Situbondo where grazing predominates. Informal markets are very important and are those made up of individual and mostly small-scale actors who are generally not licensed and may not comply with municipal or other market and tax regulations. Such markets were found to play an important role in feed and fodder supply. These markets may be less amenable to interventions to support market performance, but may benefit from infrastructure development.

- Herd and land size only marginally affected feed and fodder market participation. This suggests that all farmers, large or small, are similarly dependent on markets for feed, further underlining their importance.
- Distance to markets was found to affect feed market participation. This suggests that infrastructure and access to transport continue to be constraints to market performance.
- Access to working capital (proxied by access to income, either from farm or nonfarm) was also found to play a role in market participation, suggesting that some producers face financing constraints

### Feed quality and prices:

- Feed quality was generally reflected strongly in prices, with a few exceptions (eg groundnut haulms), even though traders generally reported they did not price feeds by quality. This is seen in individual feeds, but in particular the feed diet prices, which can increase by 11% in the case of a 1% increase in quality, and by 5% in the case of some individual feeds. This is an important result which demonstrates that markets are generally effective in capturing and pricing differences in feed quality. Moreover, this is occurring in a largely informal or unregulated setting, so that it is unlikely to be the result of government feed standards regulation, but rather reflects the ability of buyers and traders to accurately assess feed quality.
- Producers with relatively low human capital (eg education) paid the same feed prices as others, indicating that there may be few limitations to market participation and bargaining associated with producers' individual abilities
- Access to market information affected both the feed prices received by producers and their level of feed purchases. In the case of feed diet prices, market information can reduce prices by 50%, although this result is confounded with coop membership. Similar and statistically significant results were found in the case of individual feeds.
- Fresh maize stover and Napier grass (*Pennisetum purpureum*) were found in some zones and seasons to play an important role in fodder markets. Since the survey did not find any livestock producers who sell fodder, this indicates the presence of significant numbers of specialized fodder producers that supply the market, who may be livestock producers. During the stakeholder workshop, participants reported the existence of specialized traders who bought young maize from farmers to make into silage for local sale and export.

Overall, the picture is one of large and important feed and fodder markets which generally perform well in terms of delivering quality, across districts and seasons, with a few exceptions. Access to market information emerges as a key constraint to improved performance and participation, along with access to working capital. With continued growth in the livestock industry, which is struggling to meet national demand for meat and milk, the results show that there appear to be important opportunities for specialized forage production.

### 8.2 **Recommendations**

Although the analysis shows that the markets in East Java in general are able to accurately price feed quality, it also reveals the existence of very clear constraints in terms of market information and infrastructure that impede market performance, and cause some cattle producers to experience reduced access to feed and fodder markets and higher prices. Further, the scale and importance of the fodder markets in particular point

to potential opportunities for new enterprises around specialized fodder production, including the introduction of higher quality forages. There is also evidence that access to short term finance may limit producer purchases of feed and forage. However, specific interventions may require further research beyond what this limited and short-term scoping study was able to reveal.

Clearly, some mechanism for improved market information would benefit the performance of the feed and fodder markets. There may be opportunities to apply online agricultural commodities trading platforms technology for such a system, as is now increasingly being used in many forms in agriculture. There may be existing opportunities for local officials and the private sector to incorporate feed and fodder market information into existing public/private information systems, but this is unclear, as the project did not investigate those systems.

Further research and piloting studies that would be of value to follow up on the project's findings include:

### Markets:

- More detailed analysis into the feed and fodder market information needs of livestock producers. The limited variables obtained in this study may be confounded with cooperative membership. Which types of market information in particular would be of most value to producers? That may include prices, but also supplier location, volumes, quality, etc. This would guide any interventions for improved market information.
- In addition, what agricultural market information systems currently exist, including ICT based systems, that could be adapted to include feed and fodder market information?
- Active engagement with feed and fodder market actors, to explore models for joint, collective activity, and also to reveal what policy, infrastructure or regulatory constraints might affect them. Would some types of publicly supported infrastructure (e.g. designated feed market locations) improve their performance? Is there room for new entrepreneurs to participate to grow such markets? Explore incentives and disincentives of various actors in the feed related activities in making investment to improve feed supply in terms of quantity and quality
- Examine existing finance systems available to small scale livestock producers and market actors, and explore means to improve access.
- Examine the potential for adapting/replicating an innovative approach to beef fattening financing that ILRI and partners have piloted in Swaziland, with support from IFAD. The mechanism works with local banks to allow small scale producer without collateral to obtain access to financing. See below:

https://clippings.ilri.org/2017/02/25/beef-fattening-ready-for-take-off-in-southernafrica-with-new-financing-made-available-to-smallholders/

https://news.ilri.org/2017/03/03/beef-value-chain-actors-reap-big-gains-from-newfinancing-in-southern-africa/

Conduct a more detailed spatial analysis of feed prices formation, using GIS derived market and distance variables, together with feed quality variables, using a large number of sites and samples. This would significantly reveal constraints to the markets' ability to accurately price feed quality and to deliver that feed in an efficient manner.

#### Feeds:

- Explore opportunities for specialized fodder production, including the introduction of improved varieties of forages. This would need to look carefully at geographical zones where appropriate land and labor were available, and where market infrastructure was adequate. Forage seed systems would also need to be examined. Local land use policies advocating production of rice and other staples would need to be addressed in case they create constraints to such specialized production. At its simplest, growing forage-as-cash crop requires comparatively little investment and experience from India and Ethiopia show that small holders often women can make more money with lower labour requirement when selling forages than when feeding to their few own often non-descript livestock. See this example from Kenya of women's groups commercializing forage production: <a href="https://avcdkenya.net/2018/02/21/cash-crop-women-farmers-in-kenya-beat-drought-with-native-grass/">https://avcdkenya.net/2018/02/21/cash-crop-women-farmers-in-kenya-beat-drought-with-native-grass/</a>
- Whenever high bulk low density basal diets are used as in the case of rice straw and maize stover in Indonesia, decentralized feed processing options may be more viable than centralized ones. Two general business models are possible here: a) producing complete diets involving transport of basal diet and concentrate ingredients; and b) producing only the supplement component fed to on-farm originating basal diets. Development, pilot testing and scaling of context-specific business models round forage, forage and feed production will be a highly relevant and timely project activity to increase livestock productivity and to provide income and employment opportunities for rural populations to facilitate transition out of small holdings.
- Create a link between crop producers and livestock producers, traders and processors for efficient utilization of leguminous feeds. The current feed price trend in east Java shows leguminous feeds (protein rich feeds) are undervalued and sold on average three times lower in value than less nutritious Napier grass. That relationship could be further studied, including perceptions of sellers and buyers.
- Conduct more detailed analysis of farm-level feed use efficiency and the economic returns to specific feed choices. Although markets do reflect feed quality, is that relationship reflected accurately in the economic returns to feed use? This would guide the choice of which types of forages in particular to emphasize for specialized forage production.
- Develop and test least cost diet/rations according to sites, seasons and livestock productivity level and validate it through research trials.

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### **9.2** List of publications produced by the project

**Project reports and articles** 

1. Overview of Livestock, Feed and Fodder Industries in East Java.



2. Market actors survey descriptive statistics report



3. Report on analysis of determinant factors affecting household feed market participation and purchase prices (includes producer survey descriptive statistics)



4. Determinants of household feed and fodder market participation in East Java, Indonesia

Paper presented at the XV European Association of Agricultural Economists (EAAE) Congress, held in Parma, Italy, from 28<sup>th</sup> August to 1<sup>st</sup> September 2017. (Conference paper to be submitted to a journal)

See also list under Objective 4 other planned publications.

### **Student internship reports** (Some titles are in Bahasa Indonesia)

Name	University	Title of thesis/internship report	Year of completion
1. Gilang Rama Pradita Subroto	Brawijaya University (Agribusiness)	<ol> <li>Tipe dan jumlah pemberian pakan sapi potong dan sapi perah (Types, giving, technology feed Beef and dairy cattle in Indonesia) (literature review for Boga's paper)</li> <li>model komunikasi dalam kegiatan proyek penelitian pemasaran pakan ternak sapi hijauan dan non-hijauan di Jabung, Malang (model communication in project activities marketing research animal feed cattle forage and non-green in Jabung, Malang (internship report)</li> </ol>	2015
2. Gita Rhosa Dini	Brawijaya University (Agribusiness)	<ol> <li>Kondisi sosial ekonomi peternak sapi potong di beberapa daerah di Indonesia Socio – Economic Conditions Of Cattle Breeder From Several Regions In Indonesia (literature review for Boga's paper)</li> <li>Hubungan Kerja antara Petani Jagung dengan Koperasi 'KPM Baru' di Kecamatan Batu, Malang Working Relationship between the corn farmer cooperative 'KPM Baru' in the district of Batu, Malang (internship report)</li> </ol>	2015
3. Intan Nurrafika	Brawijaya University (Agribusiness)	<ol> <li>Internship report: Manajemen Pemasaran Hijauan Pakan Ternak dalam Program Pemasaran Pakan Ternak di Kecamatan Batu oleh BPTP Jawa Timur (Forage Marketing Management in Marketing Feed Program at Batu District by BPTP East Java)</li> <li>Literature review for Boga's paper: Manajemen Rantai Pasok dan Manajemen Pemasaran Pakan Ternak (Supply Chain Management and Marketing Management of Feed)</li> </ol>	2015
4. Mashadi Dwi Milayanto	Brawijaya University (Statistics)	Pengaruh jenis pakan yang dijual terhadap pendapatan pedagang (internship report)	(in process; 2016 [expected])
5. Agil Syofian Hidayat	Brawijaya University (Agribusiness)	Pemodelan partisipasi peternak dalam pasar pakan ternak dengan menggunakan model logit di jawa timur (Identifying affecting factors producers participant in the feed and fodder market using Logit Regression) (internship report)	2016
6. Fitria Ramadlani	Brawijaya University (Animal science and nutrition)	Addition of mug sprouted bean (phaseolus radiates) feed additive on performance reproduction crossbreeding between local male and female ISA – BROWN (internship report; published on their university journal)	2015

7. Jhonatan Hari Setyawan	Brawijaya University (Animal science and nutrition)	The quality of silage made of varying proportion of maize stover and calliandra calothyrsus by addition of molasses (internship report)	2015
8. Herdwilia Ramadanti	Brawijaya University (Agribusiness)	Kemitraan peternak dengan produsen hijauan pakan ternak dalam rangka peningkatan kualitas pasar hijauan pakan ternak local di dusun busu, kec jabung, kab malang (internship report)	2015
9. Murning	Brawijaya University (Animal science and nutrition)	Pemanfaatan limbah cair biogas sebagai starter dalam fermentasi sekam padi sebagai bahan pakan alternative terhadap komponen serat (internship report)	2015
10. Fatra Hadi Kurniawan	State University of Malang (MSc in education technology)	Pengaruh hasil laporan data pedagang di Situbondo terhadap Mahasiswa pada survey ILRI (survey data; no report)	2016
Andi Irawan	State University of Malang (MSc in education technology)	Hubungan antara berfikir kritis terhadap kegiatan survey lapangan (survey data; no report)	2016

## **10 Appendixes**

### **10.1 Appendix 1: Survey Instruments**

Livestock Producer Questionnaire



### Trader Questionnaire



### 10.2 Appendix 2: Final Workshop attendance and presentations

Final workshop economics presentation, August 2016



### Final workshop feed quality presentation, August 2016



#### List of participants in final workshop, August 2016

Day / Date : Tuesday / 23 August 2016

Time : 09.00 WIB

Location : Grati - Pasuruan

No.	Name	Institution	Email
1.	Nurul Humaidah	Unisma (One of University Islamic In Malang)	nurul.humaidah@yahoo.co.id
2.	Tri Agus Sulistio	Lolitsapi (Place of Husbandary Research)	bapakkutag@gmail.com

No.	Name	Institution	Email	
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6.	Noor hudhix laruti	Lolitsapi (Place of Husbandary Research)	briohnapdaba@yahoo.com	
7.	Hendra	BPTP Jatim (agricultural technology assessment center)	hendriariantodo@yahoo.com	
8.	Yudha sukandi	BPTP Jatim (agricultural technology assessment center)	-	
9.	Yenny nur A.	Lolitsapi (Place of Husbandary Research)	<u>yennysahim@gmail.com</u>	
10.	M. Fakhrudin	SPR Sumber Sekar (Husbandary School)	ayrafakhrudin@gmail.com	
11.	Dara Melisa	SPR Sumber Sekar (Husbandary School)	Daradara927@gmail.com	
12.	Sulistiyanto	GKSI Jatim (The combination of dairy cooperation in Indonesia)	-	
13.	Farhan	KPSP Setia Kawan (dairy farm cooperative in East Java)	-	
14.	Zainul A	KPSP Setia Kawan (dairy farm cooperative in East Java)	-	
15.	Bagur W. K	Jaffa Comfeed (one company that is engaged in the largest agri-food and ter-integrity in Indonesia)	baguswisnuk@gmail.com	
16.	Rudi B	BBPP Batu (Husbandary Training Center)		
17.	Pantjo	BBPP Batu (Husbandary Training Center)		
18.	Lutviah H. M	BBPP Batu (Husbandary Training Center)		
19.	M. Aris W	Disnakkeswan MLG (animal health and husbandary department)		
20.	Nur Zulaicah	Disnakkeswan MLG (animal health and husbandary department)		

No.	Name	Institution	Email
21.	Galu	Disnakkeswan MLG (animal health and husbandary department)	
22.	Rosepta	Dinas Pertanian Kota Pasuruan (Agriculture Department Pasuruan City)	
23.	Dian F	Dinas Pertanian Kota Pasuruan (Agriculture Department Pasuruan City)	
24.	Koko Wisnu P	BBIB Singosasi (Center of Artificial Insemination)	
25.	Andi Hasan	BBIB Singosasi (Center of Artificial Insemination)	
26.	Titik Krisna Wati	BBIB Singosasi (Center of Artificial Insemination)	
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