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# Final report

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# List of Abbreviations

| | |
|---|---|
| ACIAR | Australian Centre for International Agricultural Research |
| AFE | Action for Enterprise |
| AIAT | Assessment Institutes for Agricultural Technology |
| AIPD-Rural | Australia Indonesia Partnership for Decentralisation – Rural Economic Program |
| AusAID | Australian Agency for International Development |
| BPS | Badan Pusat Statistik |
| BLBU | Bantuan Langsung Benih |
| BPTP | Assessment Institute for Agricultural Technology (Extension/Research Office) |
| BULOG | Indonesian State Board of Logistics |
| CBN | Cadangan Benih Nasional (National Seeds Reserve) |
| CGIAR | Consultative Group on International Agricultural Research |
| CRP DINAS | Indonesian State Agriculture Office |
| DM | Downy mildew |
| EI-ADO | Analysing Agribusiness Development Opportunities in Eastern Indonesia |
| EJ | Eastern Java |
| GoI | Government of Indonesia |
| GDP | Gross domestic product |
| IAARD | Indonesian Agency for Agricultural Research and Development |
| ICERI | Indonesian Cereals Research Institute |
| ICFORD | Indonesian Center for Food Crops Research and Development |
| LF | Lead Firm |
| MBS | Market-based solution |
| MoA | Ministry of Agriculture |
| MSME | Micro, Small, and Medium Enterprise |
| MT | Million tonne (1,000 kg) |
| M4P | Making markets work for the poor |
| NGO | Non-government organisation |
| NTB | West Nusa Tenggara |
| NTT | East Nusa Tenggara |
| OPV | Open-pollinated varieties |
| QPM | Quality Protein Maize |
| SLPHT | Sekolah Lapang - Field School for Integrated Pest Management |
| t/ha | tonne (1,000 kg) per hectare |
| TTU | Timor Tengah Utara |
| US | United States |
| YMTM | Yayasan Mitra Tani Mandiri |

# Glossary of Technical Terms Used

| No | Term | Definition |
|---|---|---|
| 1. | Aflatoxin and Mycotoxin | Also known as mycotoxins, aflatoxins are toxins produced by certain fungi. Via infection of foods and feeds, particularly grains, they are associated with critical diseases of animals and humans. |
| 2. | Downy Mildew | Fungi (family *Peronosporaceae*) that produce whitish masses on the leaves of the host plant. |
| 3. | Lead Firms | Small, medium, and large firms that have forward/backward commercial linkages with targeted micro, small, and medium scale enterprises (MSMEs). Dynamic market actors that can promote greater integration of MSMEs into value chains and provide important goods and services. |
| 4. | Market-based solution | A market-based solution addresses business constraints in a sustainable manner. Market-based means commercially oriented and provided by the private sector. |
| 5. | Value Chain | The range of activities required to bring a product or service from conception, through phases of production (involving a combination of physical transformation and the input of various producer services), delivery to consumers, and disposal after use. |

# Preface

This report entitled *Eastern Indonesia Agribusiness Development Opportunities (EI-ADO)-Analysis of Maize Value Chains,*[1] was prepared by the Collins Higgins Consulting Group Pty Ltd as commissioned by the Australian Centre for International Agricultural Research (ACIAR). The information and recommendations from this study will inform AusAID in the design of the Australia Indonesia Partnership for Decentralisation – Rural Economic Development Program (AIPD-Rural).

Field work was conducted for 23 days during October 2012. The report involved the analysis of background data, field trips and interviews with actors involved in all sectors of the value chain.

The author of this study is Jaclyn Flewelling (Action for Enterprise), with contributions from Paul Fox, Ketut Puspadi of BPTP in Mataram, and Damianus Adar (Undana Kupang). Additional support was provided by the Action for Enterprise head office in Arlington, VA (USA), and local field team members in Eastern Java, West Nusa Tenggara, and East Nusa Tenggara. Environment and gender inputs were overseen by Emmanuel Santoyo Rio.

Thanks must go William Ruscoe, Abu Zaenal Zakariya (Yaya) of BPTP in Malang and Teddy Kristedi of ACIAR, and to Kuntoro Andri Boga for providing supporting data. Special appreciation is due to all the value chain actors - input suppliers, farmers, collectors, processors, and traders - who provided time and valuable information to the team.

The views expressed in this report are those of the consultants and do not necessarily reflect the views of the Collins Higgins Consulting Group, ACIAR or the Governments of Australia or Indonesia.

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July 2013

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# Executive Summary

### *Background on AIPD-Rural / EI-ADO*

The goal of AIPD-Rural is to increase incomes by 30% for more than 1,000,000 male and female smallholder farmers by 2022.

The objective is achieved by increasing competitiveness of poor male and female farmers, realised through:

- Increased productivity;
- Improved business performance;
- A growing share of an expanding market; and
- The continuous adoption of innovations that contribute to productivity, performance, and market growth.

The expected outcomes are:

- Improved farmer practices;
- Increased access to input and output markets; and
- Improved business enabling environment at the sub national level.

The strategy to be used is to address the systemic growth constraints in rural agricultural sectors that are most relevant to small farmers in the districts in which the Program operates.

The Program is to take a market-led approach of working with on- and off-farm market stakeholders (public and private sector) to stimulate both increased access to and the sustained delivery of public and private inputs and services that are likely to increase the incomes of poor farmers.

### *The Maize Study*

From October 3 to 25, 2012, on behalf of the AIPD-Rural program, Action for Enterprise (AFE) conducted a value chain analysis on maize in the Eastern Indonesian provinces of West Nusa Tenggara (NTB), East Java (EJ) and East Nusa Tenggara (NTT).This report presents AFE's findings as well as recommendations for further program development within AIPD-Rural.

AFE used the value chain analytical framework, interviewing market actors as well as other key informants such as relevant government agencies and local non-government organizations. Information from these actors was solicited to evaluate the relationship between buyers and suppliers, end markets and competitiveness, value chain dynamics, and the major constraints faced by each value chain actor. In addition to value chain analysis, the potential for selected value chain market actors to provide market-based solutions (MBS) to address value chain constraints in a sustainable manner was assessed.

The study team interviewed value chain market actors in NTB from October 3-8, 2012, including the target districts of East and West Lombok, Dompu and Bima. Interviews were then conducted in EJ from October 10-16 and in NTT from October 18-23.

A broad picture of the dynamics and key constraints within the value chain, as well as the role of key market actors, was established. Each of the three targeted provinces presented both unique characteristics and commonalities in terms of market channels and competitiveness.

The constraints facing targeted producers in the value chain as well as prospective MBS to address those constraints are presented below. It is important to note that a more detailed assessment of each of the targeted MBS will be required as part of project start-up and implementation.

**Table 1 Key opportunities and market-based solutions identified during the study**

| Constraints | Market-Based Solution | Existing/ Potential MBS Providers |
|---|---|---|
| Farmers lack technical knowledge, from planting to effective use of agro-chemicals and post-harvest handling, thereby limiting their yields and income. | 1. Provision of technical information to farmers on production and post-harvest handling to increase yields and income. | *Input supply manufacturers, wholesalers, and retailers* |
| The majority of farmers in the target areas, especially in more remote areas, lack access to or are not well informed about improved maize seed varieties | 2. Access to improved seed varieties for farmers, such as varieties with resistance to downy mildew. | *Seed companies* |
| Farmers lack input credit for seed, fertilizer, herbicide, etc. As a result, the economic returns per hectare are not optimized and income from maize is limited. | 3. Access to input credit for maize farmers. | *Wholesalers, feed mills, financial institutions* |
| Most farmers, collectors and traders lack equipment and facilities to effectively dry maize grain. They also lack effective tools and methods for testing the moisture content of their maize. | 4. Access to: a) appropriate and affordable crop drying technologies, and; b) tools and methods for maize moisture measurement. | *Agricultural equipment suppliers* |
| Farmers lack access to and training in storage methods and appropriate technologies for maize. Subsistence level farmers in NTT face losses of up to 50% due to poor post-harvest storage conditions. | 5. Access to and training in storage methods and appropriate technologies for maize. | *Input suppliers, agricultural equipment suppliers* |

A summary of additional constraints identified include:

- Feed mills have difficulty ensuring consistent quality of maize they purchase;
- Farmers often face labour shortages at maize harvesting time;
- Diluted or ‘fake’ agro-chemicals and seed sold on the market;
- The distribution of subsidized inputs from the government creates disincentives for private sector investment;
- Poor road conditions in all provinces (particularly during the rainy season); and

- Lack of irrigation in many areas prevents the growing of off-season maize.

The study team held discussions with targeted MBS providers (see column three in Table 1) to solicit their suggestions for AIPD-Rural activities that could build their capacity, and provide them the incentives they need to invest in the provision of the targeted products, and services to farmers. Examples of suggested potential project facilitation activities are presented below:

### *Illustrative Facilitation Activities to Promote Targeted MBS*

- Assist input supply companies, maize wholesalers, retailers, and feed mills to improve and expand the dissemination of production and post-harvest handling technical information to farmers.
- Promote activities of private sector seed and input supply companies to develop new products adapted to small-scale growers, introduce new varieties, build staff expertise, expand distribution networks, and promote their products and services.
- Support learning/exposure visits for traders, agricultural equipment suppliers, and/or mills in EJ and NTB to identify appropriate drying and moisture testing technologies (such as flatbed dryers). Support these market actors to carry out demonstration/information sessions for farmers and collectors.
- Support buyers such as traders, wholesalers and feed mills to establish procurement operations through which they may provide inputs on credit to qualified producers. Work with financial institutions to develop tripartite arrangements with maize buyers to offer loans to farmers participating in outgrowing operations.
- Support agricultural equipment and input supply companies to identify improved and commercially viable maize storage technologies, and to carry out demonstrations/information sessions for farmers.

It is important to note that the ultimate feasibility of these proposed activities, and the details of how they will be implemented can only be determined closer to project implementation, after in-depth discussions are held with targeted market actors.

### *Gender and Environment Issues in Maize*

During the field work the follow gender observations were made:

- In the three provinces visited there is a tendency for males to dominate land preparation: men plough and till the soil, clear the field, prepare irrigation channels, etc. There are instances, however where large teams of females participate in planting and fertilizing.
- Harvests are usually undertaken by both genders and household labour is shared between men and women within the family unit. Women are involved in multiple aspects of farm-level labour, including planting, fertilizing, weeding, harvesting, post-harvest handling, transportation and marketing.
- When large groups participate in harvesting, women typically comprise more than half of the teams. The larger the production unit or farm, the more likely that a male makes the management decisions.

- In agro-chemical kiosks, women tend to be able to supply more information about the use of the products than men. This is related to another observation: women tend to be more diligent in reading product instructions and company hand-outs than men.
- In some of the target areas there are differential wage rates based on gender. This was justified by being a traditional practice. For example, the study team found that certain farmers paid women between 5,000 to 10,000 IDR less than men per day. Those that were interviewed attributed this difference to 'tradition.' The working conditions for men and women are similar at farm level, particularly when small family groups are involved (e.g. family labour for cutting and burning or slashing and burning). Several of the wives of the men interviewed (at farm level) were just as knowledgeable (if not more so) about the 'business' of farming.

As for environmental issues, the study identified an opportunity to educate farmers about relative toxicities, active ingredients, and biochemical action of agro-chemicals. According to some of those interviewed the misuse of maize agrochemicals is widespread. The concept of active ingredients in agro-chemicals was in general foreign to farmers. There was often confusion between herbicides, insecticides and pesticides. Atrazine is widely applied without any recognition of its potential residual risks to subsequent crops.

### *Future Research Questions*

There are several issues that require further research to support the ongoing intervention design process for maize.

- The grain drying and storage interventions proposed would benefit from strong learning and adaptation elements.
- It will be important to understand why farmers reject appropriate storage technologies (such as jerry cans and plastic barrels) when these could lead to obvious benefits in higher yields and increased food security. Only once this issue is better understood can potential private sector solution providers be identified. This could potentially involve private seed companies 'piggybacking' the introduction of airtight storage alongside seed demos/field trials pertaining to the modern open-pollenated varieties to the companies are attempting to introduce.
- Productivity losses and human health risks associated with high levels of aflatoxin in maize has been studied extensively. As far back as 1991, Lubulwa et al estimated the total social cost of aflatoxin in Indonesia (from maize only) to be in the order of AUD $200 million annually. There is a need for the proposed pre- and post-harvest interventions in maize to link with the Aflatoxin Forum in Indonesia to better understand how market signals and government policies can better incentivise farmers to adopt on-farm practices that reduce the incidence of aflatoxin.

# 1 Introduction

## 1.1 Project Background

In 2011, AusAID invested in a program called Analysing Agribusiness Development Opportunities in Eastern Indonesia (EI-ADO) aimed at identifying agricultural value chains (value chains) and private sector development opportunities with potential to decrease poverty in East Nusa Tenggara (NTT), West Nusa Tenggara (NTB) and East Java (EJ). The outcomes of this work will be the focus of a new AusAID program: Australia Indonesia Partnership for Decentralisation – Rural Economic Program (AIPD-Rural).

AIPD-Rural has the goal of increasing the income of more than one million poor farmers in Eastern Indonesia by 30%. In particular, AIPD-Rural supports efforts to increase value chain competitiveness through better farm practices, improved access to input and output markets, and an enhanced business-enabling environment for agribusiness.

The EI-ADO project is being delivered through ACIAR and comprises a number of brief research activities undertaken in 2012 and early 2013 to inform the AIPD-Rural program. These studies will provide understanding of the rural sector, market actors, potential lead commodities, ease of doing business (including local regulation/policy), infrastructure that supports the agricultural sector, access to finance and district profile.

In Phase 1 of the EI-ADO project, the project Reference Group identified five commodities to be studied in a detailed value chain analysis during a second phase. Maize was one of these identified lead commodities. Action for Enterprise (AFE) was contracted by the Collins Higgins Consulting Group to lead the maize value chain study. International and Indonesian commodity specialists worked in the field as part of the study team to collect the information required for the value chain assessments.

## 1.2 Study Objectives

The objectives for the maize value chain study were:

1. Complete detailed mapping, characterisation and market description of maize value chains.
2. Document and analyse the governance structures and linkages, costs and margins and estimate income and employment distribution in maize value chains.
3. Document and analyse technology, knowledge and upgrading opportunities with potential to increase net income of farmers and other stakeholders in maize value chains.
4. Analyse and document social issues likely to influence adoption of value chain management innovations aimed at improving market access and income.
5. Analyse the gender roles and important environmental impacts in maize value chains and potential implications of changes to value chain management or other innovations, as well as specific opportunities for women to benefit from future program interventions.

6. On the basis of the above analysis, identify the most promising maize value chain development opportunities for the individual provinces and districts covered in this study.
7. Identify researchable issues within the maize value chain and formulate a list of priority research questions for future investigation.

## 1.3 Analytical Framework

The value chain/market development approach (also referred to as 'making markets work for the poor' or M4P) was used for collecting both quantitative and qualitative data. This framework involved interviews with representative market actors (and supporting networks) along the maize value chain: input suppliers (retailers, distributors, and field agents), farmers/farmer groups, village-level collectors, large-scale wholesale distributors, processors, importers/exporters, market retailers, financial institutions, and state agricultural support bodies (extension agents and local agricultural officials from DINAS and BPTP). Through these interviews, information was solicited on end markets and demand, relations between value chain actors, value chain constraints, and strategies that value chain actors are taking to mitigate constraints.

The study team provided a descriptive maize value chain analysis and identified potential market-based solutions (MBS) linked to market actors (lead firms (LFs) or inclusive businesses) with incentives in providing these MBS to strengthen commercial relationships with producers. Given the limited scope and timeframe for the study, more detailed assessments of the MBS should be conducted as a next step.

### *Study Methodology*

The maize study team consisted of a Team Leader with value chain experience, an International Commodity (maize) Specialist, a Commodity Specialist with expertise in Indonesian maize issues, a representative from ACIAR (for EJ and NTT), local field coordinators with maize experience and/or industry connections (these varied by province) and interpreters (when necessary). Interviews and itineraries were arranged in advance of the field work by the relevant field coordinators with input from the study team and ACIAR representative.

Interviews with key informants were based on value chain analysis question guides tailored to each identifiable market actor (see Annex 2 for the detailed question guides used). Where possible, quantitative data was collected (especially at farm level), to assess costs, margins, prices and market trends. Some of this data complemented secondary data provided to the study team.

In each province, information gathering focused on the specific target districts of AIPD-Rural. Table 2 below shows the summary of interviews conducted in the maize value chain and the types of actors interviewed in each province and district.

**Table 2 Summary of interviews conducted in the maize value chain**

| | Input Supplier | Seed Producer | FGD | Farmers | Retailers | Traders | Feed mills | Processors | Poultry Farm | Finance | Research | Govt. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NTB | | | | | | | | | | | | | |
| Mataram | | | | | | | | | | | | 1 | **1** |
| E. Lombok | 2 | | | | | 2 | 1 | | | | | | **5** |
| Bima | | | 1 | 5 | | 1 | | | | | | | **7** |
| Dompu | 4 | | | 1 | | 4 | | | | | | | **9** |
| EJ | | | | | | | | | | | | | |
| Surabaya | | | | | | | | | | | | 1 | **1** |
| Sidoarjo | | | | | | | 2 | | | | | | **2** |
| Mojokerto | | 1 | | 2 | | | | | | | | | **3** |
| Kediri | | 2 | | 2 | | 2 | | | | | | 1 | **7** |
| Trenggalek | | | | 2 | | 1 | 2 | | | | | 1 | **6** |
| Malang | 1 | 1 | | 1 | | 1 | | 2 | | | 1 | | **7** |
| NTT | | | | | | | | | | | | | |
| Kupang | 2 | 3 | 1 | 2 | 2 | 1 | | 1 | 1 | | | 1 | **14** |
| E. Flores | 1 | | | 2 | 1 | 1 | | | 1 | 1 | | 1 | **8** |
| TTS | 1 | | | | 1 | 1 | | | | | | 1 | **4** |
| TTU | 2 | | 2 | 5 | | | | | | | | 1 | **10** |
| Belu | | 2 | | | 2 | 1 | | | | | | | **5** |
| International Maize Conference, Gorontalo | | | | | | | | | | | | | |
| | | 2 | | | | 2 | 1 | | | | 11 | 2 | 18 |
| **Total** | **13** | **11** | **4** | **22** | **6** | **17** | **6** | **3** | **2** | **1** | **12** | **10** | **107** |

## 1.4 Report Structure

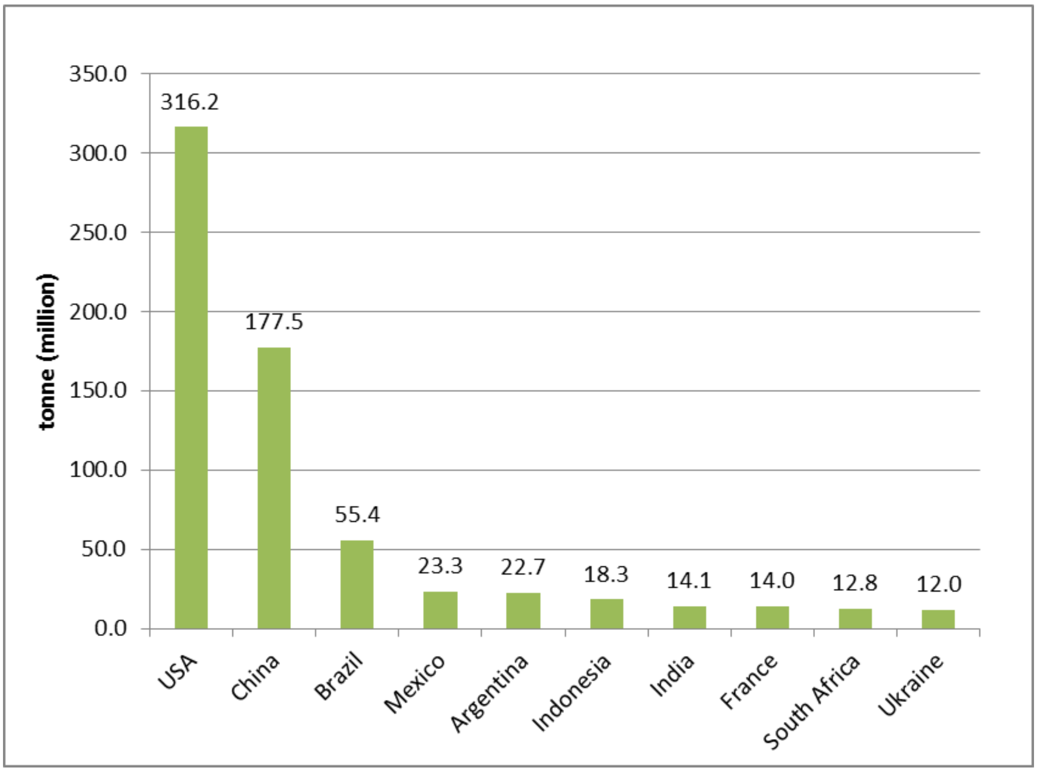
This report begins with a description of the background, study objectives, analytical framework, and methodology applied. Section 2 provides background information on maize in Indonesia, including the country's position in global production and trade, the socio-economic importance of maize, production, the demand situation, prices, policies and regulations and other value chain development programs. The third section describes the maize value chain and includes value chain maps with descriptions of the various functions of the market actors. Section 4 discusses the assessments of MBS and illustrative project facilitation activities while Section 5 covers cross cutting issues such as gender and the environment. The report concludes with areas requiring further research and analysis and recommended next steps (Section 6).

# 2 The Maize Sub-Sector in Indonesia

## 2.1 Indonesia's Position in Global Production and Trade

Maize is a dynamically expanding crop both in Indonesia and internationally. In terms of world production, it is predicted to outstrip both current leaders – rice and wheat by 2025. Between now and 2050, the demand for maize in the developing world will double (CIMMYT, 2010). In 2012 maize was grown on more than 174 million hectares (ha) across 163 countries globally, and 839.7 million tonnes of maize was produced (as at November 2012) (Lyddon, C, 2013).

World production of maize is dominated by the United States (US). In 2010 it produced 316.2 million tonnes, almost double that of the second largest producer, China, which produced 177.5 million tonnes (see Figure 1 below). Approximately 37% of the maize produced in the US in 2011 was used for animal feed and 38% was used for corn ethanol, a bio-fuel (USDA, 2012a).




*Source: FAOSTAT 2010*

**Figure 1 Top maize producing countries, 2010**

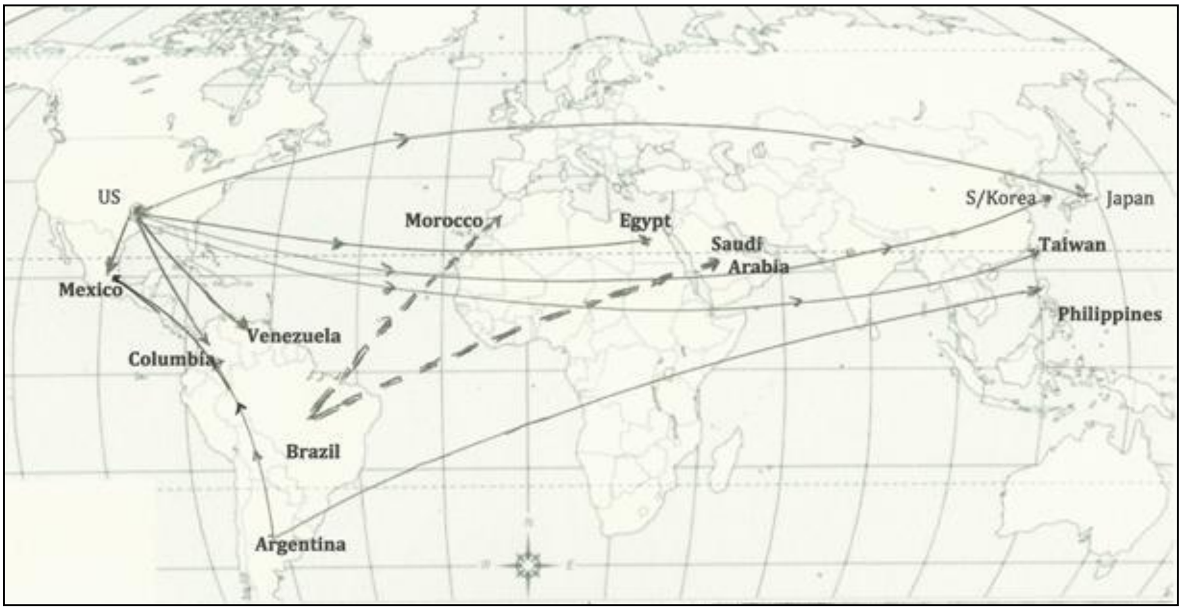
The top exporters of maize in the world are the US, Argentina and Brazil, respectively. In 2010, the US exported approximately 16% of its production; Argentina and Brazil exported 74% and 16% respectively. Despite China's status as the second largest global producer of maize, it is a net importer (UNCTAD, 2012). A list of top exporting countries, and the volumes they export, can be observed below in Table 3.

**Table 3 Top exporters of maize, 2010**

| Country | Maize Exports (tonnes) |
|---|---|
| United States | 49,887,000 |
| Argentina | 16,771,000 |
| Brazil | 8,623,000 |
| Ukraine | 5,072,000 |
| South Africa | 1,586,000 |
| European Union (27) | 1,500,000 |
| India | 1,500,000 |
| Paraguay | 1,388,000 |
| Serbia | 1,343,000 |
| Thailand | 1,000,000 |
| Canada | 184,000 |
| Rest of the world | 3,843,000 |
| Total | 92,697,000 |

*Source: USDA Grains, World Market and Trade November 2010*

The US exported 49.9 million tonnes in 2010, roughly three times the volume of Argentina, the next largest exporter. The US is a key supplier to Japan, Mexico, South Korea, Taiwan, Egypt, Colombia and Venezuela; Argentina is a key supplier to Mexico and the Philippines, and Brazil is the major supplier to Morocco and Saudi Arabia (UNCTAD, 2012). The major commodity flows for the top three exporting countries of the US, Argentina and Brazil, are shown below in Figure 2.




*Source: UNCTAD, 2012*

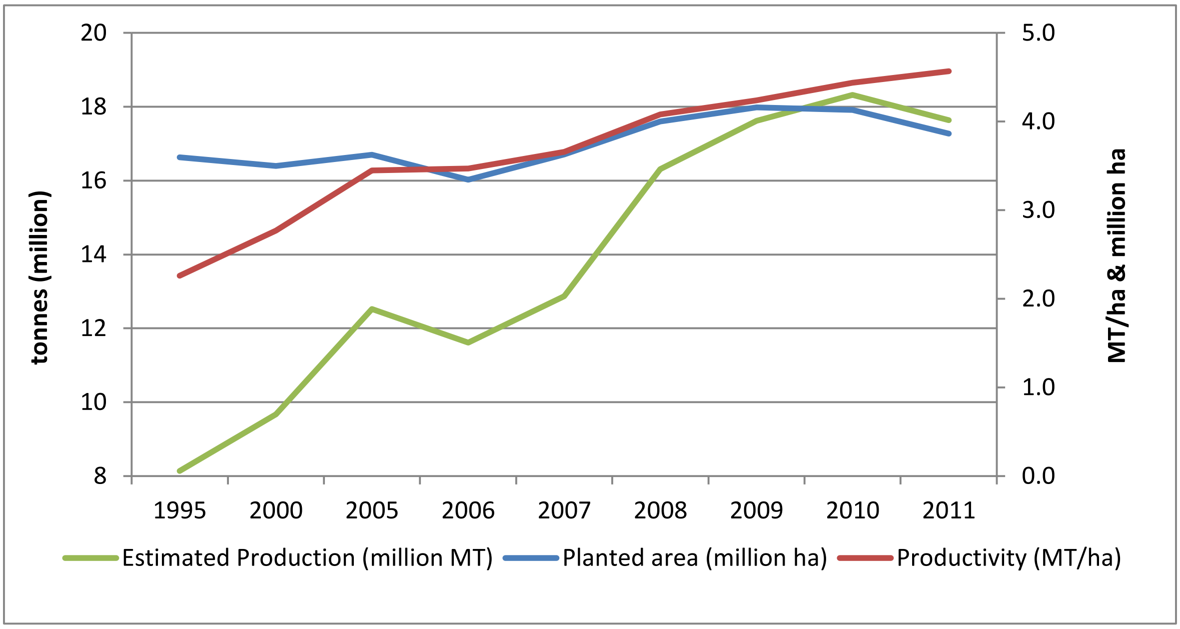
**Figure 2 Major worldwide commodity trade flows of maize**

## *Production in Indonesia*

Indonesia is the sixth largest producer of maize in the world, contributing nearly 2% to global production with 18.3 million tonnes in 2010 (refer Figure 1) (FAOSTAT, 2012).

A trend of increasing production in Indonesia is highlighted in Figure 3. Much of the growth is being fuelled by the rapidly expanding poultry industry (human consumption of maize remains relatively low). Indonesia remains, however, a net importer of maize having imported 2.89 million tonnes in 2011/12 (Indonesian Ministry of Agriculture 2012).

Figure 3 below illustrate the changes over time in maize harvested area (million ha), productivity (t/ha) and production (million tonnes). From 1995 to 2011, productivity and production of maize in Indonesia has roughly doubled, while the harvested area has fluctuated between 3.2 to 4.2 million ha for the same period. It is important to note that national statistics do not necessarily reflect what is taking place at the provincial level. In NTB, for example, the maize harvested area increased by 44% in the period between 2007 and 2011 (BPS, 2011). This is discussed in more detail in Section 2.3.1.




*Source: BPS, 2011*

**Figure 3 Production, harvested area and yield of maize in Indonesia, 2002-2011**

## 2.2 Socio-Economic Importance

### 2.2.1 Value

Disaggregated data on the role of maize in economic development and employment is unavailable. However, data is available for the food crops sector more broadly. At current prices, the food crop sector accounted for 8% of Indonesia's Gross Domestic Product (GDP) and 67% of agricultural GDP in 2012. This represents a 6% increase from 2011 figures (Ministry of Agriculture, 2013).

The demand for maize in Indonesia is increasing at an annual rate of 10-15% (Herry, 2012). Roughly 20% of maize is used for direct human consumption and the remainder is used for animal feeds – mostly poultry (USDA, 2012b). This is particularly relevant for NTB and EJ where most of the grain goes to feed milling operations. Farmers in these districts are intensive farmers and most of them use certified seeds. By contrast, maize produced in NTT is mainly for human consumption, where local (and not certified) maize is popular because of its taste, cooking characteristics and resistance to pests in storage.

Indonesia is striving to be self-sufficient in maize, with the Indonesian government (GoI) having an ambitious target of self-sufficiency for the crop by 2014. The total budget allocated for the maize self-sufficiency program per annum in the period from 2010 to 2014 is between 8.5 and 10.3 billion IDR. These funds are being distributed nationally in the form of water supply/pumps, dryers, shellers, seeds, fertilizers, pesticide and extension services. Fertilizer constitutes the largest component of the budget, accounting for approximately 50% of the funds.

### 2.2.2 Employment

Limited data is available on the number of farmers engaged in maize farming. Table 4 provides an estimate of maize farmers in various districts of EJ, NTB and NTT based on harvested maize area in 2011 divided by an average land ownership per farmer. An average land ownership area of 0.3 ha is used for EJ and 0.5 ha for NTT and NTB. Based on these assumptions, 18% of maize farmers in the three provinces are located in AIPD-Rural districts.

**Table 4 Estimated number of maize farmers & area harvested EJ, NTB and NTT, 2011**

| District | Maize area harvested (ha) | Average land ownership area (ha) | Number of farmers |
|---|---|---|---|
| **East Java (total)** | 1,257,721 | 0.3 | **2,096,202** |
| Trenggalek | 13,823 | 0.3 | 23,038 |
| Malang | 57,678 | 0.3 | 96,130 |
| Situbondo | 47,451 | 0.3 | 79,085 |
| Sampang | 75,696 | 0.3 | 126,160 |
| **NTB (total)** | 61,593 | 0.5 | **61,593** |
| Lombok Barat | 2,613 | 0.5 | 2,613 |
| Lombok Timur | 16,602 | 0.5 | 16,602 |
| Dompu | 5,821 | 0.5 | 5,821 |
| Bima | 9,686 | 0.5 | 9,686 |
| **NTT (total)** | 244,583 | 0.5 | **244,583** |
| Timor Tengah Utara | 19,858 | 0.5 | 19,858 |
| Flores Timur | 16,172 | 0.5 | 16,172 |
| Ngada | 5,211 | 0.5 | 5,211 |
| Sumba Barat Daya | 3,978 | 0.5 | 3,978 |

*Source: Author's calculations*

## 2.3 Production

### 2.3.1 Geographical distribution

The provinces of NTB, NTT and EJ provide stark contrasts in terms of maize production. Table 5 highlights the reasonably static area harvested nationally noting the doubling of the area in NTB from 2007 to 2011. In the same period, production in NTB increased by more than 350%, albeit from a low base. EJ, the province with the highest level of maize production, increased its production by 30% in this period, in keeping with the longer term yield triplication shown by DINAS for maize between 1970 and 2012 (IFC, 2011 and BPS, 2012).

**Table 5 Provincial maize production trends, 2007-2012**

| Harvested maize area (million ha) 2007-2012 | | | | | | |
|---|---|---|---|---|---|---|
| Region | 2007 | 2008 | 2009 | 2010 | 2011 | 2012* |
| Indonesia | 3.63 | 4.00 | 4.16 | 4.13 | 3.86 | 4.00 |
| EJ | 1.15 | 1.24 | 1.30 | 1.26 | 1.20 | 1.27 |
| NTB | 0.04 | 0.06 | 0.08 | 0.06 | 0.09 | 0.12 |
| NTT | 0.22 | 0.27 | 0.25 | 0.24 | 0.25 | 0.24 |
| Productivity (tonne/ha) 2007-2012 | | | | | | |
| Region | 2007 | 2008 | 2009 | 2010 | 2011 | 2012* |
| Indonesia | 3.7 | 4.1 | 4.2 | 4.4 | 4.6 | 4.7 |
| EJ | 3.7 | 4.1 | 4.1 | 4.4 | 4.5 | 4.7 |
| NTB | 2.8 | 3.3 | 3.8 | 4.0 | 5.1 | 5.4 |
| NTT | 2.4 | 2.5 | 2.6 | 2.7 | 2.1 | 2.6 |
| Productivity (million tonne) 2007-2012 | | | | | | |
| Region | 2007 | 2008 | 2009 | 2010 | 2011 | 2012* |
| Indonesia | 13.29 | 16.32 | 17.63 | 18.33 | 17.64 | 18.94 |
| EJ | 4.25 | 5.05 | 5.25 | 5.59 | 5.44 | 5.95 |
| NTB | 0.12 | 0.19 | 0.31 | 0.25 | 0.46 | 0.63 |
| NTT | 0.51 | 0.67 | 0.64 | 0.65 | 0.52 | 0.62 |

*Source: IFC, 2011 and *BPS,2012*

Production in EJ is constrained by long term population pressure on land availability. By contrast, the maize production in NTT and NTB is not land-limited. Despite this, EJ produces more maize than any other Indonesian province, accounting for 30% of national production in 2011 (Ministry of Agriculture, 2012). Java dominates Indonesian maize production, supplying 53% of the 2011 harvest. Javanese production is characterized by high levels of inputs and irrigation and high levels of adoption of hybrid varieties.

The NTB provincial government has given its highest priority to increasing maize production. There is considerable potential to increase total production through intensification in the rainy season without displacing other cropping activities and without irrigation, especially in Sumbawa (the largest island in NTB). Nevertheless, NTT remains dominated by subsistence maize production and accounts for little of the total Indonesian harvest: only 3% in 2011 (Ministry of Agriculture, 2012).

New maize production areas on the island of Sumbawa are a positive example of modern inputs (in particular herbicides) changing a traditional system productively. The application of fertilizer and the use of modern hybrids are widespread practices in NTB and EJ. White maize is traditional but not a staple here as it is on the islands of Madura (EJ) and Timor (NTT). The modern maize production system is strictly for feed and not stored on-farm for very long periods. In Sumbawa there has been a rapid increase in the use of pre-emergent herbicides to kill local grasses and weeds before planting instead of using tillage for land preparation.

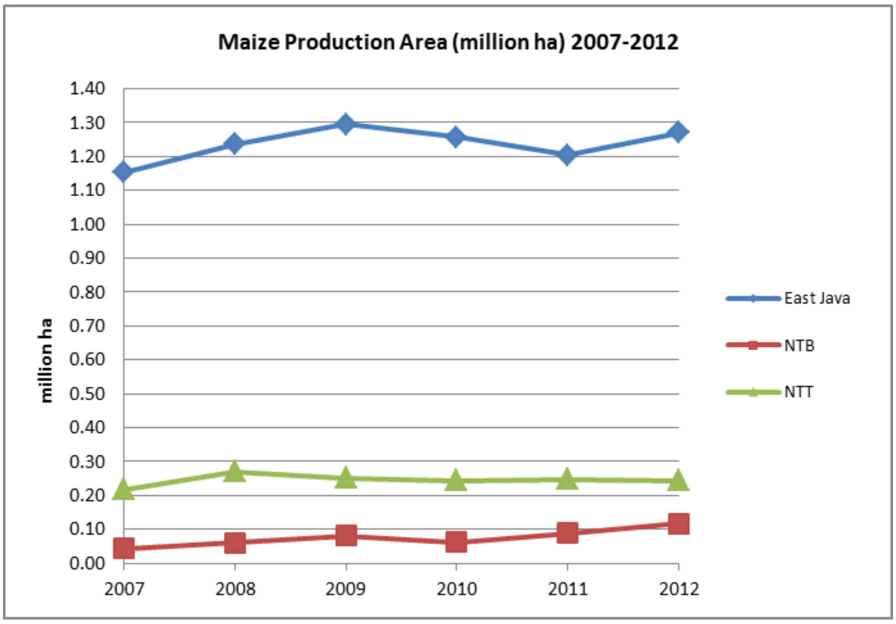
### 2.3.2 Trends

Based on provincial data from Badan Pusat Statistik (BPS) for 2007 to 2012 (presented in Table 5 above), several maize production trends are summarized below.

#### *Harvested maize area*

EJ continues to have the largest total harvested maize area in Indonesia with over 1.27 million ha, with an average annual growth rate of 2% from 2007-2012. This is in line with average growth rates for the country but, as noted in Section 2.3.1, there are land use constraints which limit further expansion. This could be influenced however if maize prices (or yields) increase, which could encourage farmers to replace other crops with maize.

The harvested maize production area in NTT province also grew by an annual average of 2% over the same period, to approximately 247,000 ha in 2012. In NTB, however, the harvested area for maize has grown by 25% annually over the past five years and in 2012 reached 116,817 ha. See Figure 4 below.

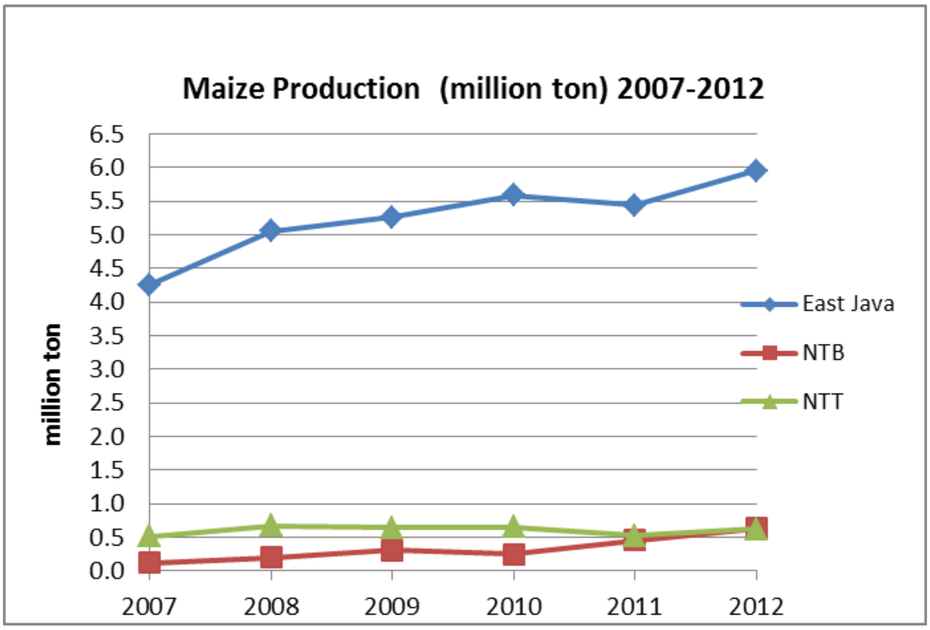



*Source: BPS,2012*

**Figure 4 Harvested maize area (million ha), 2007 - 2012**

#### *Maize production (volume)*

EJ produced 5.9 million tonnes in 2012, with an average annual increase of 7% over the past six years. Maize production in NTT also increased an average of 5% per year to approximately 626,000 million tonnes by 2012. But NTB had the sharpest growth in production during this period, from 121,000 million tonne in 2007 to over 634,000 million tonne in 2012 (a 45% average annual increase). Figure 5 outlines this growth.

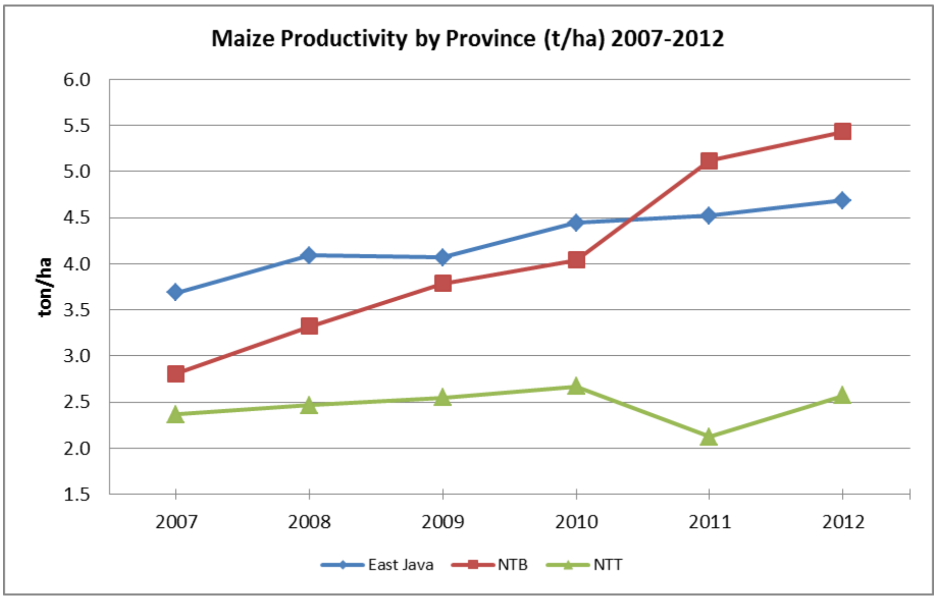



*Source: BPS, 2012*

**Figure 5 Maize production volume (million tonne), 2007 - 2012**

### *Maize productivity*

All three provinces experienced increases in maize productivity (t/ha) from 2007 to 2012. EJ increased productivity at an average annual rate of 5% and NTT experienced a 3% annual improvement in yield. NTB experienced the largest jump in productivity with a 14% average annual growth in yields over the five year period, from 2.5 t/ha in 2007 to 5.4 t/ha in 2012. Figure 6 below depicts this growth in productivity.




*Source: BPS, 2012*

**Figure 6 Maize productivity (t/ha), 2007-2012**

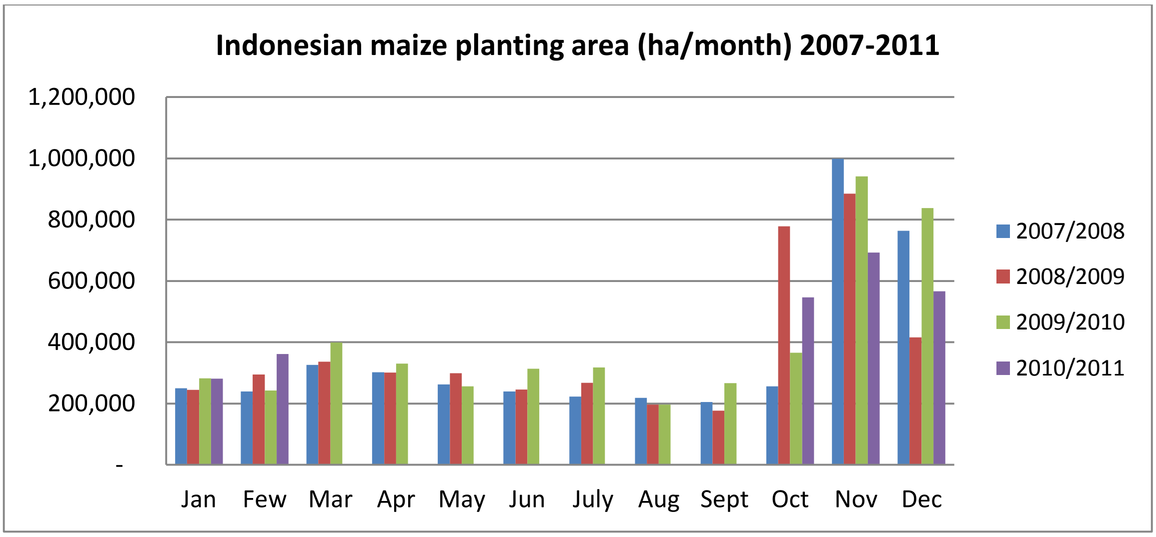
## 2.3.4 Seasonality and production systems

Although maize production in Indonesia is affected agronomic, climatic, edaphic, and social factors, no single factor is dominant. Agronomic and climatic factors affecting maize production include seed quality, weed infestation, available water and rainfall, plant population, pre- and post-harvest pest destruction, and soil quality. (Benu et al, 2011). The correct (or incorrect) use of fertilizers, herbicides and pesticides also has a major impact.

Much of the non-irrigated wet season maize is harvested in conditions of decreasing rainfall. Despite this, there is a general tendency to harvest as early as possible, the lack of on-farm cash flow may be a key driver for this. The practice of leaving cut maize plants in the field to dry, which is common in other developing agricultural contexts such as Latin America, is rare in Indonesia. The risk of rodents and other opportunistic animals is a likely disincentive for adopting this practice.

Maize is predominantly planted in Indonesia from late October to late December, peaking in November to take advantage of wet season rains. The maize planted during this time is dependent on rainfall and therefore can vary significantly from year to year (see Figure 7). During the remaining months of the year, maize planting is restricted to irrigated areas where, while less area is planted, greater consistency in planted area is recorded from year to year.

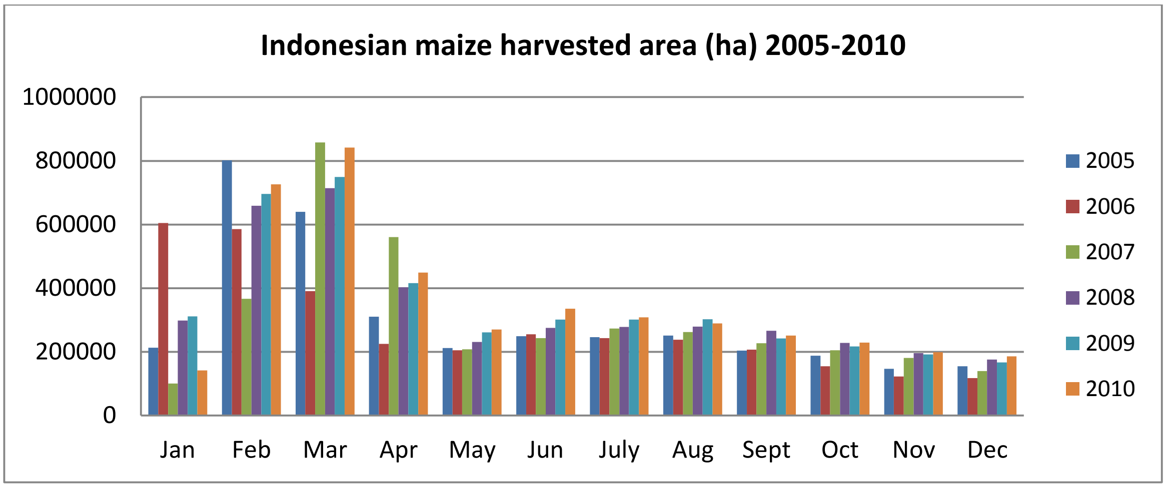
In Indonesia, 65% of maize is harvested in the rainy season months from January to April, and 35% during the dry season months. Wet season maize harvesting commences in late January, peaks in March and finishes by late April.




*Source: Desianto B. Utomo, Secretary General-Indonesian Feedmills Association, Presentation to the International Maize Conference 2012, Gorontalo.*

**Figure 7 Indonesian maize planting area (ha/month), 2007-2011**

Irrigated maize is harvested predominantly between the months of June to December (see Figure 8). Therefore, the supply of maize is highly seasonal and concentrated within roughly three months of the year. Since feed mills require continuity of supply year round, maize imports and storage are required in Indonesia.



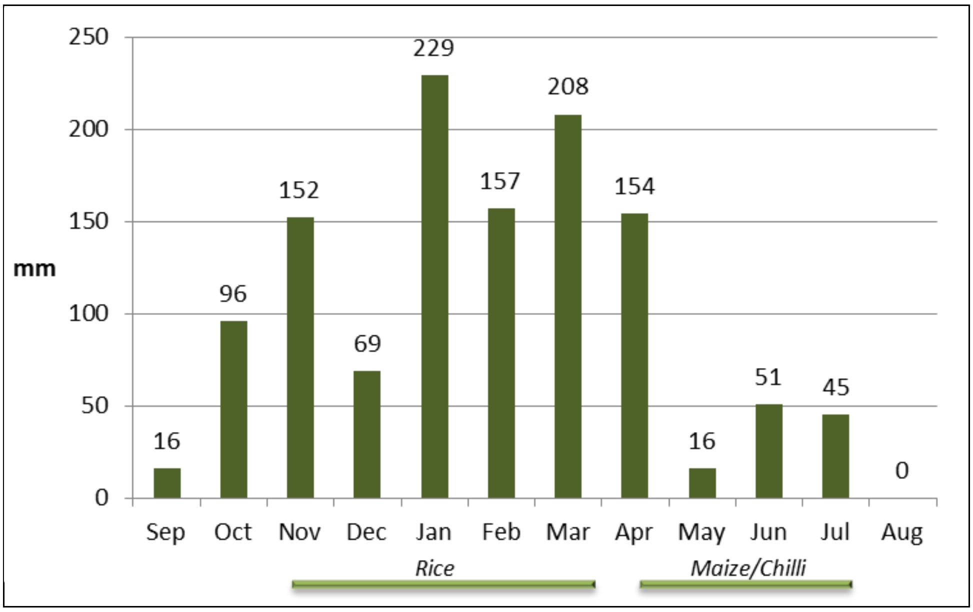

*Source: Desianto B. Utomo, Secretary General-Indonesian Feedmills Association, Presentation International Maize Conference 2012, Gorontalo.*

**Figure 8 Indonesian maize harvested area (ha), 2005-2010**

## *Cropping and production - East Java*

Cropping patterns in EJ vary across different agro-ecosystems. In both the irrigated and rain fed lowlands, rice is the most important crop and is grown as long as there is sufficient water. Farmers with irrigation in EJ prefer maize to soybeans as a second or third crop after rice, as maize offers greater profitability. In these areas, availability of irrigation influences the crop choice. If water is limited, there is no second rice crop and a rice/soybean/maize or a rice/maize/maize rotation is typically chosen.

After harvesting rice in irrigated and rain fed lowlands, maize is planted in late March or early April and harvested in July as shown in Figure 9. Only in the dry-land areas is maize the first priority crop during the wet season (Swastika et al., 2004).




*Source: Maize in Indonesia: Production Systems, Constraints and Research Priorities*

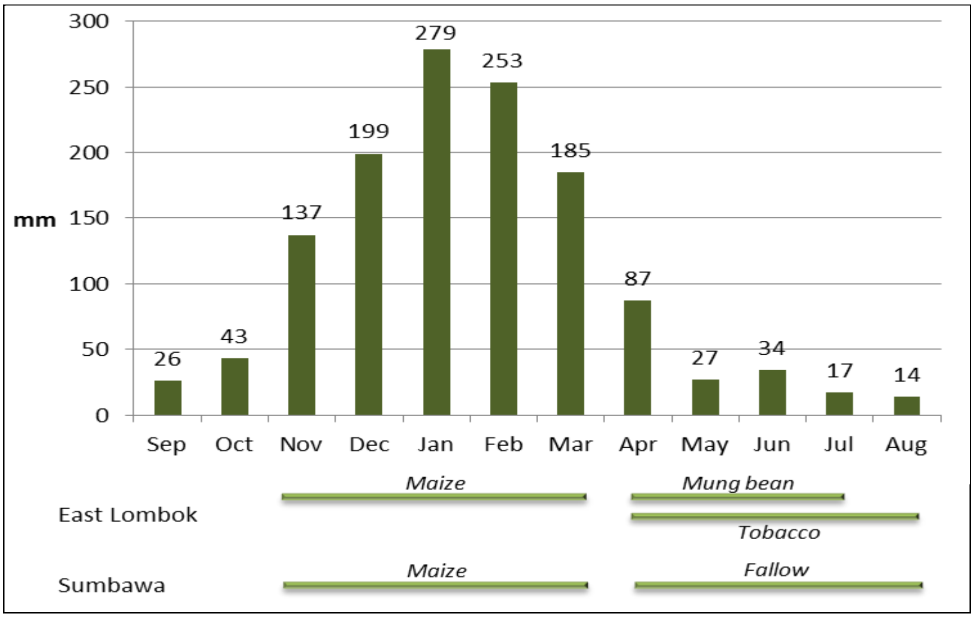
**Figure 9 Monthly rainfall and cropping patterns, EJ (irrigated and rain fed lowlands)**

### *Cropping and production – NTB*

Cropping patterns in NTB vary according to district. Maize in Sumbawa is largely rain-fed with one maize planting season around November or December, depending on the onset of the rains. The introduction of herbicide for weed control has enabled farmers to plant without tillage, and an initial herbicide application to suppress weeds appears to be the sole land preparation activity undertaken prior to planting. This 'no tillage' system has facilitated great expansion of the maize area, largely into former cattle pasture, and has been mostly taught by private company technicians. Aside from the ever-present problem of drought, the expansion of maize production in Sumbawa will be limited by peak labour demands and transportation problems for Sumbawa.

Lombok has more irrigation than Sumbawa, thus the maize production pattern is more characteristic of rain-fed irrigated areas. This means that farmers have more flexibility regarding when to plant, especially for crops after rice. In rain-fed East Lombok, the main cropping pattern is maize and mungbean. Maize is typically planted in November and harvested in March, and mungbean is planted in April and harvested in July. Tobacco is a very capital-intensive crop and, for poor farmers, represents an unaffordable alternative to mungbean.

In dryland Sumbawa, the main cropping pattern identified by the study team is maize-fallow. See Figure 10 for maize cropping patterns in NTB (Swastika et al., 2004).




*Source: Maize in Indonesia: Production Systems, Constraints and Research Priorities*

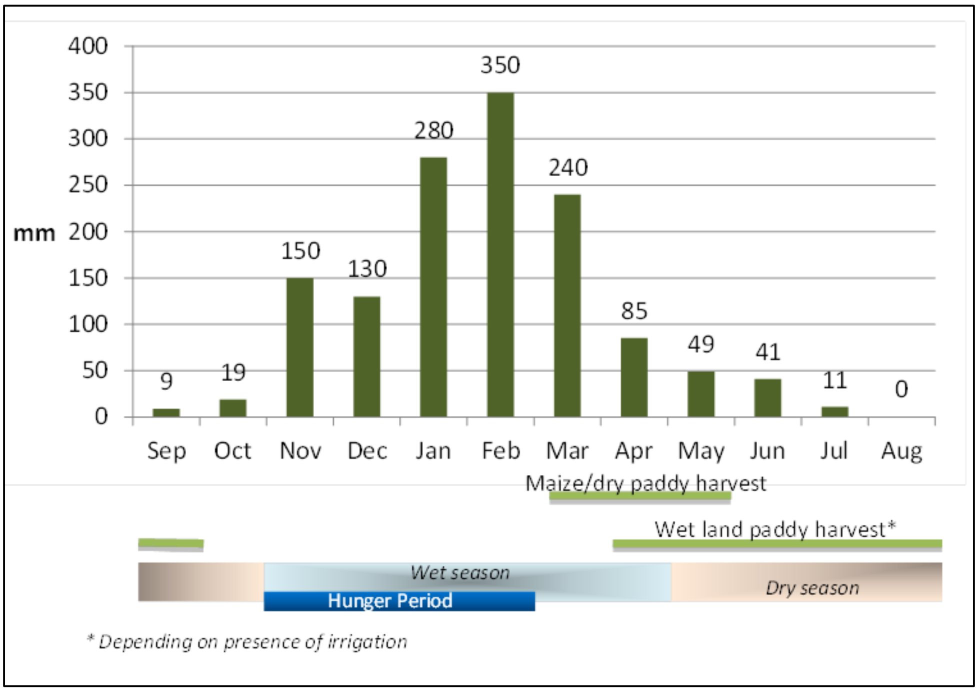
**Figure 10 Monthly rainfall and cropping patterns, NTB**

### *Cropping and production – NTT (Kupang)*

The cropping pattern for maize on the dryland agro-ecosystems of NTT is one crop per year, often grown as a monoculture or intercropped with cassava and rice fields. Maize planting commences during the early rainy season which is usually from late October to early December. Harvest commences from March to May, as the wet season subsides.
Farmers in NTT normally utilize seeds secured from previous harvests and rarely use high quality certified seed, unless it is provided by government offices or non-government organisations (NGOs). Stress tolerant local maize varieties are predominantly planted.

Major factors that limit the expansion of maize production in NTT include low quality seeds, weed infestation, and late weeding.

Yields in NTT are affected by the variable timing and inconsistent amounts of rain. High rainfall and flooding in NTT have resulted in farmers not planting maize and not being able to use slash and burn methods for land preparation. Another contributing factor to the low maize yields is the presence of stones in the soil, resulting in irregular planting distances (Benu et al., 2011). Farmers in NTT prefer to produce maize for home consumption using traditional methods, and seem less interested in investing in high yield production packages for commercial sale.




*Source: Benu 2010 and author's calculations*

**Figure 11 Monthly rainfall and cropping patterns - NTT (irrigated and rain fed lowlands)**

## 2.4 End Markets / Demand

The primary end markets for maize in Indonesia are livestock producers (mostly for poultry feed) and the general population (for human consumption). Maize is a key component of industrially-produced animal feed and is also used by smaller-scale farmers to feed their livestock. Maize is a staple food crop in certain areas, including NTT and certain parts of Java. A small percentage of maize is used for snack processing which, with a few exceptions, consists of small-scale 'home industry' processors using small quantities of maize to produce deep-fried kernels or flakes that are sold locally.

Demand for maize for animal feed production continues to increase approximately 10% per year, while the demand for maize for human consumption has remained relatively static (USDA, 2012b). As highlighted in section 2.1, Indonesia imports maize from a number of suppliers to satisfy total domestic demand.

### 2.4.1 Product uses

#### *Animal feed*

A 2012 study on maize prices states that ‘as they grow wealthier, consumers in less developed countries adjust their diets away from simple grain and toward meat. As a result, the demand for grain for animal feed increases’ (Carter et al., 2012). In Indonesia, animal feed has surpassed human consumption as the main use for maize in Indonesia. According to a study by the IFC, maize is mainly used for animal feed although there are some alternative uses in the biochemical industry. The share of maize used for human consumption is estimated at 10% (IFC, 2011).

Domestically produced maize contributes 90-95% of all maize required for feed rations with maize contributing 50% of the ingredients. Table 6 below outlines standard feed ingredients, highlighting percentage of locally sourced versus imported maize

**Table 6 Standard animal feed ingredients and source**

| No. | Feed Ingredient | Local sources (%) | Imported (%) |
|---|---|---|---|
| 1 | Maize | 90 - 95 | 5 - 10 |
| 2 | Fish Meal | 5 - 10 | 90 - 95 |
| 3 | Meat and Bone Meal | 0 | 100 |
| 4 | Soybean Meal | 0 | 100 |
| 5 | Rapeseed Meal | 0 | 100 |
| 6 | Corn Gluten Meal | 0 | 100 |
| 7 | Feed Additive | 0 | 100 |
| 8 | Rice Bran | 100 | 0 |
| 9 | Copra Meal | 100 | 0 |
| 10 | Palm Kernel Meal | 100 | 0 |
| 11 | Concentrated Palm Oil | 100 | 0 |

*Source: Indonesian Feed Millers Association (GPMT)*

The Indonesian poultry industry consumes about 83% of animal feed, aquaculture 11%, and cattle and swine 6%. The feed industry uses yellow maize, much of which is produced using hybrid varieties (USDA, 2012b).

#### *Human consumption*

As noted above, in certain areas maize is consumed as a staple food crop, such as the island of Madura in EJ and the province of NTT. Benu et al (2011) estimates 75% of maize produced in NTT is used for human consumption. This is typically a white variety of maize grown from local seed, but in NTT yellow varieties of maize are also consumed due to relatively low production of white maize. Maize is sometimes boiled into a stew with legumes and vegetables. As previously described, the snack industry consumes less than 5% of the end market for maize and, over the course of the study, only two larger-scale processors (with equipment for pressing kernels into flakes, for example) were identified in EJ and NTT.

### 2.4.2 Demand structure and trends

Indonesian maize milling for animal feed is dominated by large-scale Javanese millers. See Table 7 below. According to the Indonesia Feed Millers' Association, the total installed capacity of feed millers reached 18.5 million tonnes in 2012. Existing feed mills are estimated to run at 77 – 80% of total installed capacity and continue to rely on imports of maize to supplement production.

**Table 7 Estimate of total installed capacity of feed millers in Indonesia**

| | Province | Number of Feed mills | Capacity (000 tonne/year) |
|---|---|---|---|
| 1. | N. Sumatera | 8 | 2,250 |
| 2. | S. Sumatera | 4 | 1,500 |
| 3. | W. Sumatera | 1 | 250 |
| 4. | Banten | 11 | 3.500 |
| 5. | DKI Jakarta | 4 | 750 |
| 6. | W. Java | 8 | 2,000 |
| 7. | C. Java | 6 | 1.500 |
| 8. | E. Java | 20 | 5.250 |
| 9. | S. Sulawesi | 5 | 1,250 |
| 10. | S. Kalimantan | 1 | 250 |
| | **Total** | **68** | **18,500** |

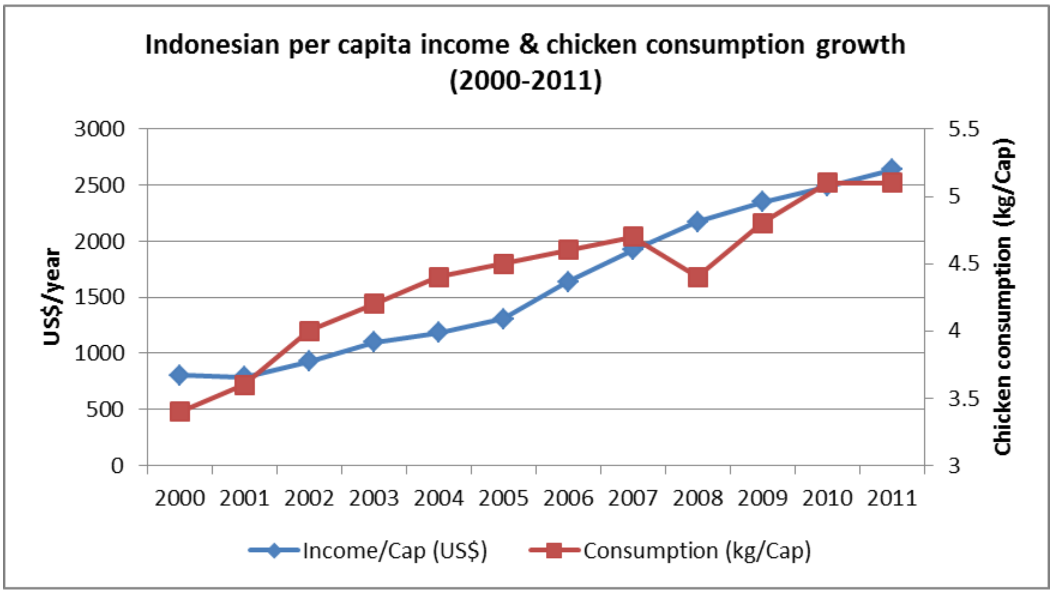
*Source: Indonesian Feed Millers' Association, International Maize Conference, 2012*

### 2.4.3 Demand trends

There is a correlation between increased per capita income in Indonesia and growth in per capita consumption of chicken. Since 2000, per capita consumption of chicken has increased 50% while per capita income has increased 300% (see Figure 12). Demand for eggs has also increased 12.5% over the past 10 years; Indonesia is now the 7$^{th}$ largest egg producer in the world, up from 14$^{th}$ in 2000[2].

As income increases in Indonesia, consumers seek to diversify their diets and sources of protein. Compared to other sources of protein, poultry products (meat and eggs) are the most affordable animal protein source in Indonesia (See Table 8).

[2] *Based on "Feed & Poultry Business Outlooks" data from BPS and other sources*




*Source: BPS & FAO 2012*

**Figure 12 Indonesian per capita income and chicken consumption growth**

**Table 8 Indonesian protein price/kg comparison (Jaobtabek, FMPI)**

| Protein Source | Price/kg (IDR) | Protein Content | Protein Price/gram (IDR) |
|---|---|---|---|
| Tofu | 7,500 | 7.5% | 100 |
| Egg | 11,000 | 12.5% | 90 |
| Chicken (broiler) meat | 18,500 | 18.5% | 100 |
| Fish | 21,000 | 17.5% | 120 |
| Fresh milk | 6,500 | 3.5% | 180 |
| Beef | 55,000 | 20.0% | 275 |

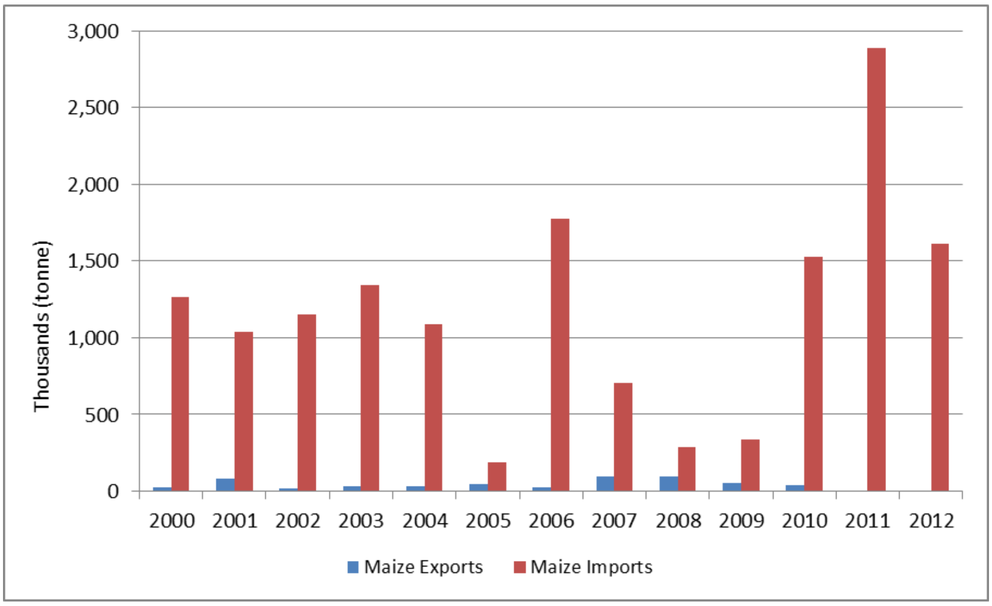
*Source: Paul Aho (Aviagen), PT Charoen Pokphand Indonesia Tbk (field work presentation, 2011)*

Steady increases in per capita income will continue to drive poultry meat and egg consumption. By 2015, it is expected that Indonesian per capita income will exceed US$ 3,000 and chicken consumption will reach 8kg per capita (Desianto B. Utomo, Secretary General-Indonesian Feed Millers' Association, International Maize Conference 2012).

Chickens raised for meat (broilers) and eggs (layers) account for approximately 90% of the total poultry sector. Therefore, with demand for broilers projected to grow at 10-12% per annum, corresponding demand for poultry feed and maize is also expected to remain strong (USDA, 2012b).

### 2.4.4 International trade

Indonesia is a net importer of maize. Exports of maize are minimal and have varied widely over the past ten years – from a low of 16,306 MT in 2002 to over 107,000 MT in 2008. Maize imports, on the other hand, are significantly higher and continue to be an important source of raw materials for Indonesia's feed mills (see Figure 13).




*Source: FAOSTAT and MoA export data combined*

**Figure 13 Indonesian maize imports and exports, 2000-2012**

Indonesia is the largest importer of maize in South East Asia (2.9 million tonnes in 2011), while Japan is the largest importer in Asia (at 16 million tonnes). China has recently become a net maize importer and by 2015 is expected to import 15 million tonnes from the US alone. In 2011, Indonesia imported maize primarily from India 37%, Argentina 34%, the US 11% and Brazil 9% (Ministry of Agriculture, 2012).

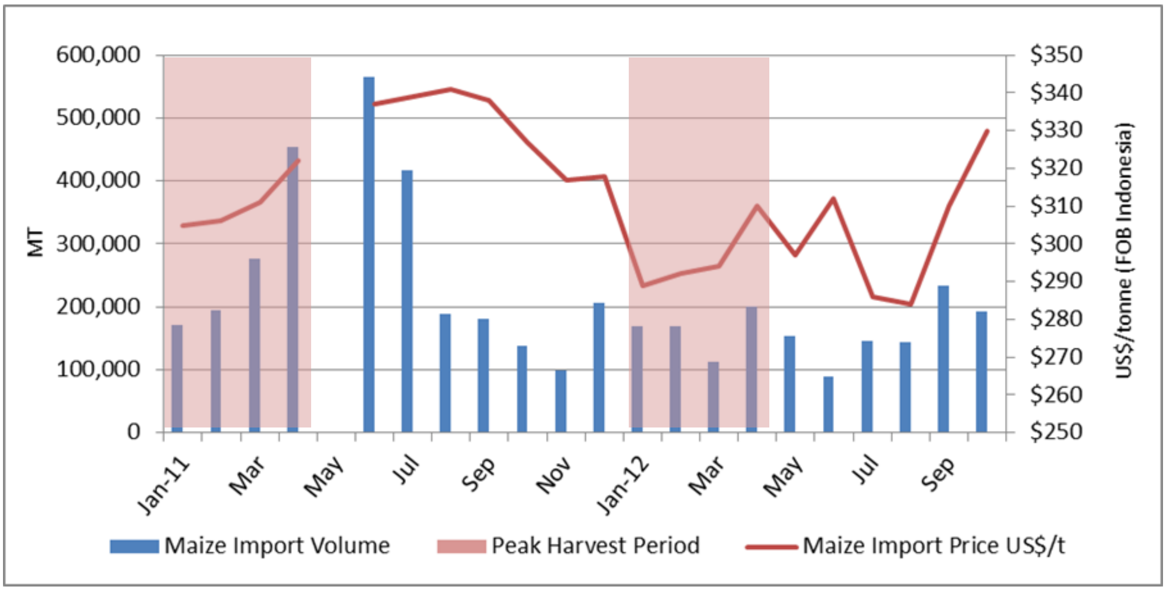
As discussed earlier, maize imports are driven by unmet demand from feed mills attempting to supplement seasonal domestic supply. As stated by the head of the Indonesian Feed Millers' Association, "there will always be a requirement for imports due to the seasonal concentration of production in Indonesia. This could only be overcome with either improved storage ability or investment in irrigation" (Desianto, 2012).

Indonesia's imported maize demand is positively affected by Indonesian GDP and declines in domestic production. It is negatively affected by the international maize price, along with imported soybean and imported rice prices (Suryantini, 2011).

The domestic supply of maize in Indonesia peaks following the wet season during the harvest months of February to April (see Figure 8 page 18). The volume of maize imports into Indonesia per month have a consistent base of between 100,000 to 200,000 tonne per month with large spikes up to 400,000 to 500,000 tonne per month triggered primarily by seasons of lower domestic production (see Figure 14 below). Even during the peak harvest period in April 2012, Indonesia imported 200,000 tonne of maize.

The data presented below in Figure 14 suggests there is an inconsistent negative correlation between the international maize price and the volume of imported maize. This is most evident for the period April to July in 2011. During this period both the imported maize price and volume peaked. The reason for such a large increase in imports may be explained by the 6.5% decline in domestic maize production in 2011 compared to 2010 (See Figure 14). Three new large feed mills were brought into production during the same period.

It appears the Indonesian feed mill industry is unable to buy and store maize during periods of lower international prices to even out fluctuations in domestic supply. This appears to be due to the inability of the industry to respond quickly, due to the requirement for import permits, etc.




*Source: Indonesian Department of Agriculture, Data Center and Agricultural Information*

**Figure 14 Maize import price, volume and peak harvest period, 2011-2012**

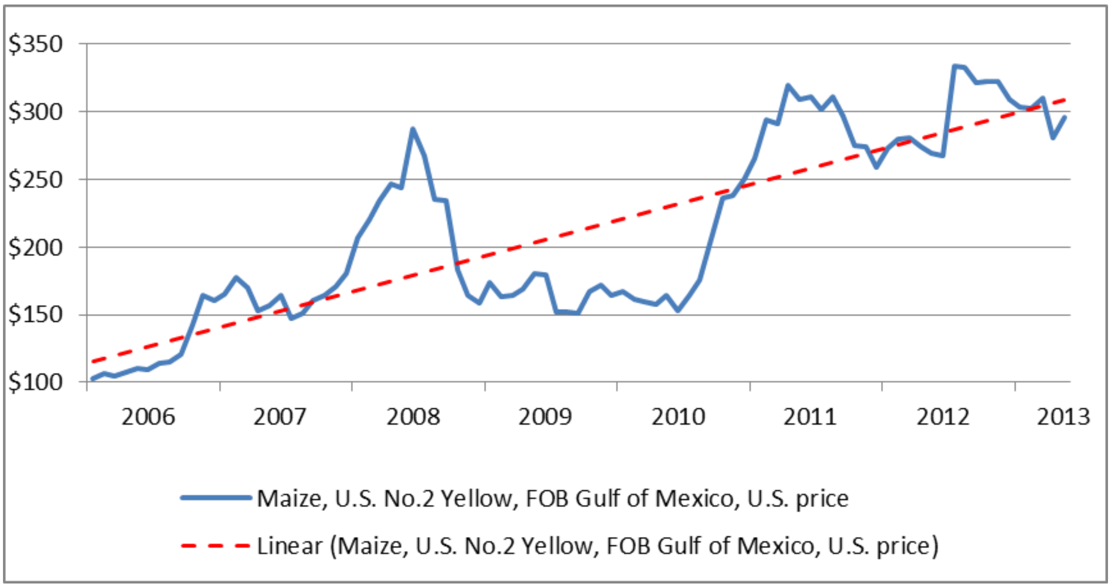
## 2.5 Prices

As presented above, the demand for maize in Indonesia has increasingly shifted from domestic human consumption to demand for animal feed, especially in the poultry industry. Maize in Indonesia is traded on a relatively undifferentiated market compared to wheat and rice. In this context, farmers are predominantly price takers from a base level of prevailing world market prices overlayed with local seasonal peaks and troughs. In Indonesia, the volatility of global commodity markets can affect maize prices, but local supply and demand conditions ultimately have greater influence on domestic maize prices. It should be noted, however, that human consumption markets for maize are relatively small and local so their impact on maize trading is not significant. Moreover, with the domination of maize for the poultry industry, the influence of a number of major maize markets in Indonesia is decreasing.

### 2.5.1 Price trends

The real price of internationally traded maize fluctuates considerably. Maize prices have been increasing over the past seven years (see Figure 15). The rapid increase in the use of maize for ethanol production in the US, combined with extreme weather conditions, has been the greatest influence on prices during this period.

The world maize price peaked in July 2012, following an unprecedented summer of high temperatures and lack of rain in both the US and Eastern Europe. Prices also peaked (albeit to a lower level) in 2008 due to the world food shock.




*Source: Index Mundi World Bank Data, 2013*

**Figure 15 World maize price US$/MT, FOB Gulf of Mexico, 2008-2013**

Africa and Asia's domestic food prices are less likely than those of other parts of the world to move parallel to (or be ‘co-integrated’ with) international maize prices and are more likely to have local and regional factors shaping, to a large extent, immediate changes in domestic prices (Greb et al., 2012).

In Indonesia, price transmission of agricultural commodities is neither uniform nor immediate. On average, three-quarters of a change in the prices of internationally traded cereals will be transmitted to domestic markets and it can take approximately six to seven months for half of a cereal international price hike to be transmitted to domestic markets (Suryantini, 2011).

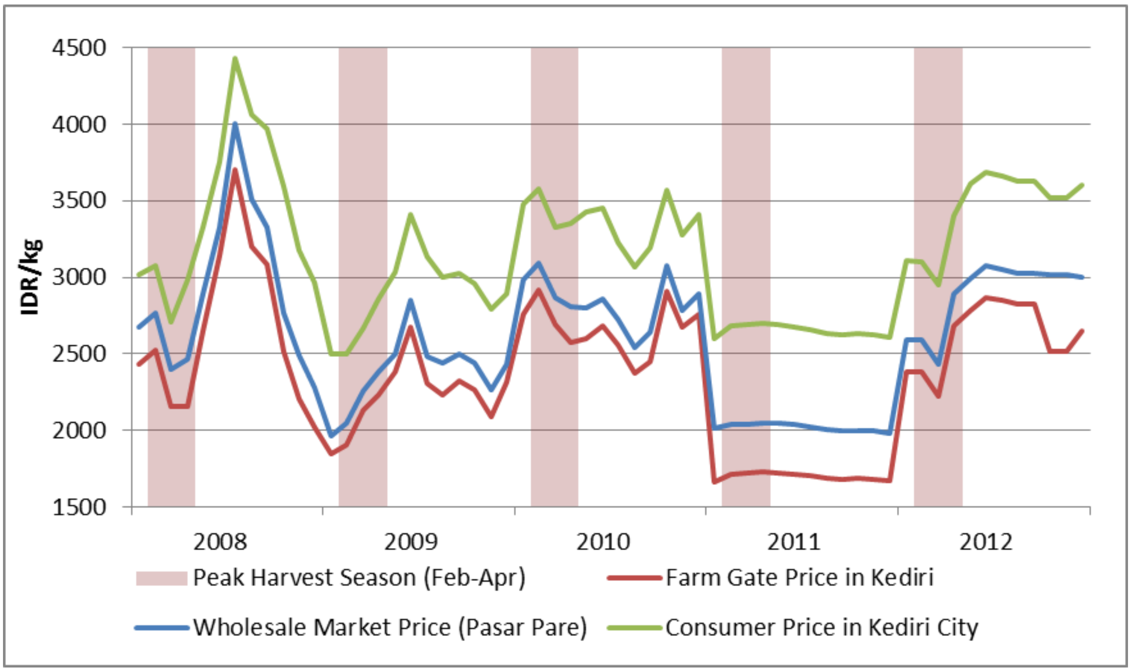
A summary of major price trends in the target provinces is presented below.

## East Java maize prices

The average monthly prices for maize for various chain actors from 2008 to 2012 in EJ (Kediri) are shown in Figure 16. In most years there is a predictable decline in price leading up to the peak wet season harvest period in April. Maize prices generally increasing after harvest, however the price remains quite volatile during the growing period.

Maize prices were the most volatile in 2008 and spiked by the middle of that year, most likely due to the overall global economic slowdown and corresponding food price crises around the world. It is unclear why prices remained consistently low for the 2011 year. It is believed it might be an error in the data sampling.

In nearly all years, the margin between the farm gate price and the wholesalers buying price declines when there is a rapid change (rise or fall) in the maize price. Retailer margins appear to be less impacted by fluctuations in the maize price.

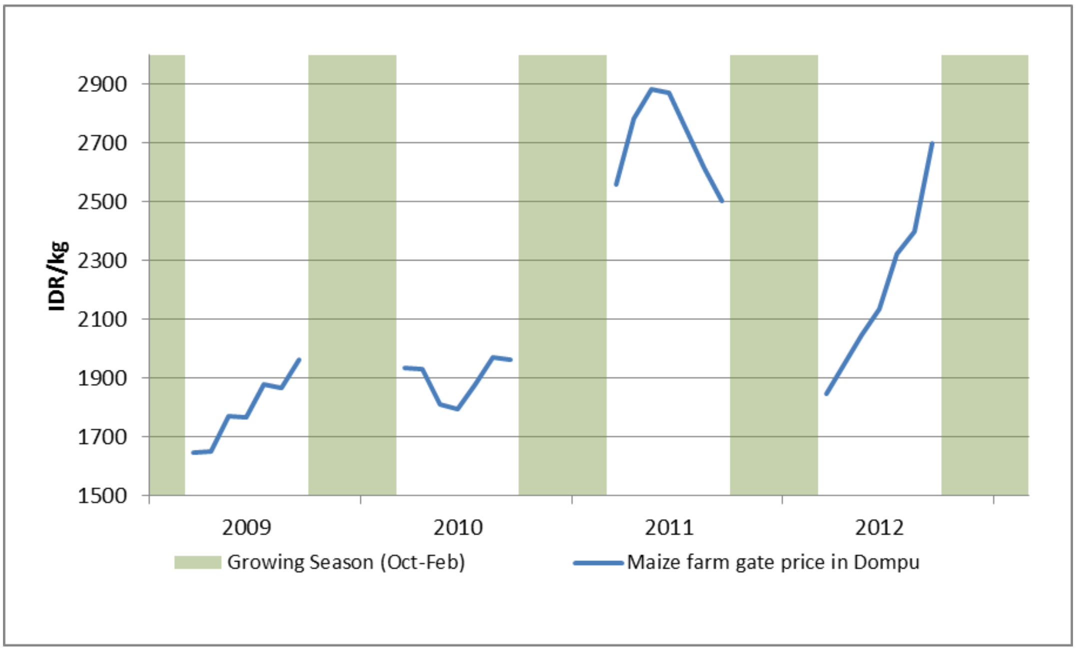



*Source: Kuntoro Boga Andri, BPTP Jawa Timur, Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture Republic of Indonesia, 2012.*

**Figure 16 Average real monthly farm gate maize price, Kediri (EJ), 2008-2012**

## NTB maize prices

Figure 17 below shows the real maize monthly farm gate price for the harvest period (March to September) in Dompu from 2009 to 2012 using data collected by Dinas Pertanian in NTB. Unfortunately maize price data is not collected during the growing months, with Dinas staff citing the reason for this being “nearly all maize is sold in the weeks/month following harvest, with none being held over for sale during the growing season”.




*Source: DINAS Pertanian 2012*

**Figure 17 Farm gate real maize price, Dompu NTB, harvest period, 2009-2012**

Whilst the data set is incomplete- it would be preferable to understand farm gate maize prices during the growing season- the following observations can be made.

Firstly, it appears storing grain for extended periods after harvest may not be a failsafe strategy leading to higher prices for farmers. While this was true for grain stored post-harvest during 2009 and 2012, the price actually decreased post-harvest for the years 2010 and 2011. Storing grain post-harvest can provide farmers with greater control of grain sales. This greater flexibility reduces their reliance on the Surabaya market immediately post-harvest and provides them more options of supplying the local market with the benefit of lower transportation costs.

Secondly, as previously observed, the sharp rise in the maize price post the 2012 harvest was most likely influenced by the peak international maize price caused by unprecedented droughts in the US and Europe. In this instance, world maize prices appear to have strongly influenced domestic prices. The increase and then sharp decline in the post-harvest maize price in 2011 was most likely caused by the fact it was a historically low domestic production year, leading to a spike immediately post-harvest and then a decline due to the large influx of imported grain later in the season.

### NTT maize prices

Maize prices in NTT were studied extensively in 2011 by Benu et al and by Da Silva et al in 2012. The following data and conclusions regarding maize prices in NTT are summarized from these two studies and confirm the observations of the study team in the field.

With up to 75% of maize produced in NTT being consumed by the local household (Benu et al 2011), prices are generally higher and are far more dependent on quality than maize produced for animal feed in other provinces.

Table 9 (below) shows the retail market price in January 2011 for various maize grades. The month of January is often the period of highest prices in NTT with new season maize due for harvest in March (See Figure 18).

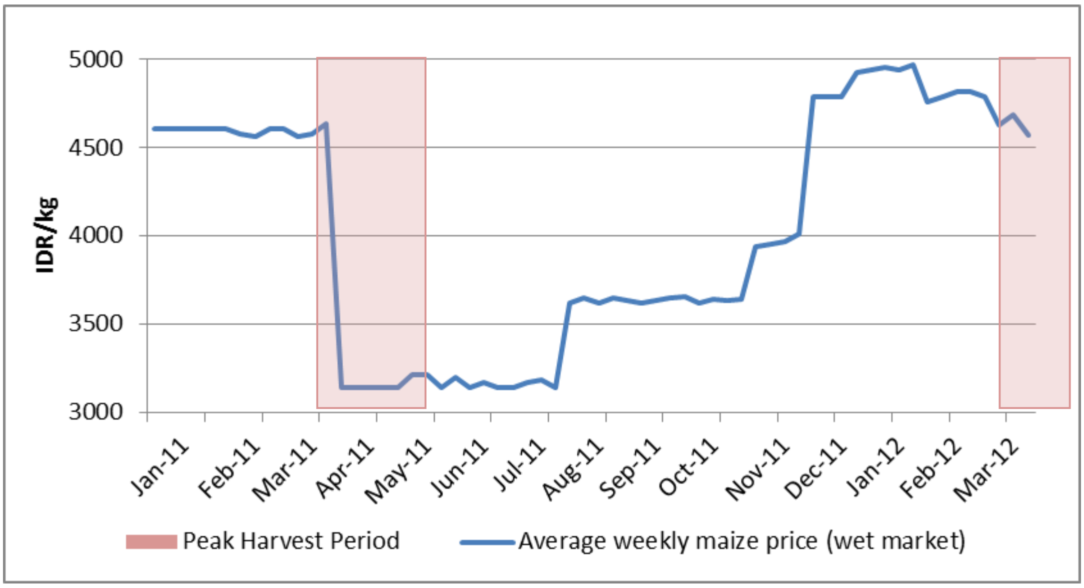
**Table 9 Maize price by grade[1] in TTS and Kupang districts, NTT 2011**

| Maize Types | Price (Rp/Kg)* | Description |
|---|---|---|
| Yellow local maize | 4,000 | kernel |
| White maize | 5,000 | kernel |
| Glutinous maize | 8,000 | kernel |
| White dehulled maize (white) | 9,000 | Half way processed |
| Maize grits (yellow) | 10,000 | Clean & ready to use/cook |
| Very fine maize grits (yellow) | 4,000 | Rough flower |
| Yellow maize grits | 4,000 | Size ¼ of whole kernel |
| Yellow maize grits | 4,000 | Size ½ of whole kernel |
| Introduced maize (bisma) yellow | 5,000 | kernel |
| Weevil infested maize | 3,000 | Feed for chicken and pig |
| Smoked maize | 3,000 | kernel |
| Maize bran | 1,000 | Feeding pig |

[1] *Average price at retailer markets in SoE and Kupang in the second week of January 2011.*
** Price (Rp/Kg) in SoE (TTS) and Kupang is the same at retailer market level in the second week of January 2011*

*Source: Benu et al, 2012*

Retail prices range from 1,000/kg for maize bran (by-product from milling for pig feed) up to 10,000 IDR/kg for yellow maize grits (ground and ready for cooking). Maize from NTT that is comparable in quality to NTB and EJ production retails for approximately 4,000-5,000 IDR/kg in local retail markets. The margin between retail price and farm gate price is in the order of 650 IDR/kg (Benu et al, 2011). This equates to an approximate farm gate price range from 2,600-4,000 IDR per kg during the season of 2011.




*Source: Modified by author. Based on data from Maize Farming Analysis and Determinant Factors of Maize Price in the Upland of Timor Island, East Nusa Tenggara.(da Silva and Murdolelono, 2011)*

**Figure 18 Average weekly retail maize price, Timor Island NTT, 2011/2012**

Figure 18 indicates rising prices over the year from harvest time through to the next season (approximately 50% increase at farm gate) and could indicate economic benefits of storing maize in NTT, assuming the costs and losses involved with storage are not greater than the net gain from higher prices.

### 2.5.2 Quality premiums

The Indonesian maize industry is dominated by yellow maize for the poultry industry and, as mentioned above, there is minimal product differentiation unlike maize for human consumption in NTT. Although parameters for various maize grades exist for feed maize (see Table 10), the feed milling industry does not pay quality premiums, but rather discounts for excessive moisture on a sliding scale. This will be discussed in greater detail in section 3.1.2.

Buyers of poultry rations appear to place minimal or no importance on metabolizable energy or nutritional value of feeds. Such lack of discrimination and the absence of premiums reduces the impetus towards adoption of Quality Protein Maize (QPM), although this product could increase the efficiency of the poultry industry.

**Table 10 Illustrative parameters for different grades of maize**

| Parameters | Grade A | Grade B | Grade C |
|---|---|---|---|
| Insect | None | | |
| Moisture | Max 15% | Max 28% | Max 28% |
| Foreign Material | Max 1% | Max 2% | Max 2% |
| Broken Kernel | Max 2% | Max 3% | Max 4% |
| Moldy Kernel | Max 2% | Max 5% | Max 7% |
| Dead Kernel | Max 3% | Max 5% | Max 7% |
| Aflatoxin | Max 50 ppb | Max 100 ppb | Max 150 ppb |

*Source: Based on data presented by QC Feed Technology CPI Surabaya; similar to PT. Agrico International East Java (July 2012)*

### 2.5.3 Price seasonality

On a national basis, seasonal maize prices vary by approximately 25% during the year, reflecting the high risks of quality deterioration in storage and the skewed pattern of supply throughout the year with the lowest prices received immediately post-harvest, driven to a degree by limited drying and storage capacity. In general, marginalized areas such as NTT experience larger seasonal price variation.

The World Food Program (WFP) Indonesia, in collaboration with the local government, monitors the retail price of food commodities such as rice and maize on a quarterly basis. In November 2010 the average national retail price of maize was 3,531 IDR/kg. Monitoring results showed prices of both maize and rice increasing in NTT throughout the year, peaking from November to February.

## 2.6 Policies and Regulations

After rice, maize is the second most important cereal crop in Indonesia. As such, maize plays a role in Indonesia's food security policies (Jakarta Food Security Summit, 2012), and is a priority crop according to government officials interviewed in all three target provinces.

### 2.6.1 Seed and input subsidies

The government has several subsidy programs for maize production (including the distribution of seed and fertilizer), described below. These programs are centrally funded, however they are managed and implemented at the provincial and district government levels, including in some AIPD-Rural target districts/provinces.

1. Direct Support for High-Yielding Seeds of Maize and Rice (Bantuan Langsung Benih Unggul, (BLBU)): a Ministry of Agriculture (MoA) program that provides free seeds to farmers for planting. The government has allocated 3 million tonnes of hybrid maize for 2012 under BLBU (USDA, 2012b).

2. National Seeds Reserve (Cadangan Benih Nasional, CBN): MoA program providing free seed to farmers to be used for post-disaster recovery. The seed is intended for use in replanting during harvest failure due to flood, extreme drought, or extreme pest and disease outbreaks.

3. Field School for Integrated Pest Management (Sekolah Lapang, SLPHT): This MoA program's objective is to promote the use of hybrid seed for increased productivity of maize. Farmer field schools were developed for this, to promote integrated pest management practices and build farmer knowledge and innovation in rural communities. The program provides field training and demonstrations annually (using hybrid seed), with multiple farmers visits per season to a demonstration area. Each group receives 15 ha worth of hybrid seed, distributed across the group. Demonstration plots are conducted on one hectare of the farmers' land[3]. In TTS (an AIPD-Rural district in NTT) the program works with 80 farmer groups (between 15-30 farmers per group) and covers 1,200 ha of land.
4. Seed Subsidy Program: This MoA/Dinas program provides subsidies for seeds that are commercially distributed by state-run seed companies such as PT. PERTANI and others.

Several of those interviewed during the value chain assessment expressed concern over the impact of these subsidies. At the farmer level, subsidized seeds are often distributed to farmers too late — i.e. after planting season - potentially attributable to an overly bureaucratic distribution process. A number of farmers interviewed also stated that the type of seed they receive from these programs, whether hybrid or composite (OPVs), is neither quality seed nor what they would choose to plant. In some cases, farmers sell the subsidized seed to other farmers that do not have access to the subsidy (because they are not members of a farmer group, which is a requirement for receiving the subsidy, or they are in a remote geographic area). They then either use their own retained seed or purchase the type of composite or hybrid seed they prefer. Furthermore, in NTT, for example, certain composite seed varieties such as 'Lamuru' are distributed, but farmers expressed concern that such varieties are more susceptible to weevils, which represents a widespread problem for farmers in NTT in particular (Hosang et al, 2010 and fieldwork, October 2012). This rejection by farmers of certain subsidized varieties, even after several years of program implementation, renders questionable the ongoing government investment in producing and distributing seed that farmers do not want.

For input suppliers, reaction to the subsidies is mixed. On the one hand, some seed companies (such as BISI, for example) are benefiting by receiving government contracts to purchase their seed (which is then used for the subsidy programs Indeed, there is a widespread sectoral suspicion that the quality of the composite seed produced by seed companies for government subsidy programs in NTT (especially by smaller-scale seed contractors) has little to no bearing on the companies' ability to win continued government contracts to produce seed.

On the other hand, several seed companies and retailers interviewed complained that they have been forced to 'compete' with the subsidized seed, with a decrease in their overall seed sales volume since the advent of the seed subsidy programs. In these cases the subsidy programs are creating disincentives for the companies to invest in new product development, marketing and demonstrations for farmers, and expansion of their distribution networks. Some traders also mentioned a concern that subsidy programs create dependency for farmers who seek subsidized seed year after year.

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[3] *This information was provided in an interview with the Agricultural division of Dinas in the NTT district of TTS and may be specific to the district rather than a national norm.*

### 2.6.2 Genetically modified (GM) maize

It is possible that genetically modified (GM) maize seed will be commercially available in Indonesia within the next year or two. Monsanto appears to be positioned ahead of the rest of the seed companies in Indonesia to receive approval to market GM maize seed.[4] Monsanto is seeking to market 'double-stacked'[5] Roundup Ready maize and Bt-maize, but ultimately the specific type of GM seed introduced will depend on regulators. Monsanto claims that trials have shown herbicide resistance in maize leads to a 12% increase in yield, and that Bt maize leads to a 10% increase in yield. Double stacked maize therefore creates up to a 22% increase in yield.

There is a three-step process to satisfy regulation. Monsanto has already satisfied the food safety requirements and 90% of the environmental requirements. They are currently awaiting approval for use of GM for animal feed. During the International Maize Conference held in November 2012 in Gorontalo, Monsanto stated that GM maize will lead to reduced Aflatoxin levels in maize due to cobs being undamaged by insects, therefore reducing moisture access to the grain.[6] Monsanto did not disclose the projected cost of GM hybrids seed (the current cost of OPVs on the market is approximately 1,000 to 2,000 IDR per kg, and hybrids are approximately 50,000 to 60,000 IDR per kg).

### 2.6.3 Aflatoxin

Aflatoxin (AF) is a toxic chemical, or 'mycotoxin,' that is produced by the fungus *Aspergillus flavus*. In maize, AF can start to develop as early as grain filling and flowering. Poor post-harvest handling (including storage) and weevils can render the grain even more susceptible to AF. For humans, AF has been linked with liver cancer, paralysis and death, and for poultry it can cause stunted growth. During this assessment, it was rare to find a market actor with any knowledge of AF. Those with some knowledge of AF were unaware of its genesis or dangers.

The Indonesian National Standard for maximum allowable AF levels for animal feed is 50 parts per billion (ppb) (Aflatoxin Forum Indonesia, 2010). This compares to a standard maximum of 20 ppb for poultry feed in the US and other countries (USDA, 2009). There is, however, a wide gap between the regulation and what is actually happening in the domestic feed industry. For example, in an interview with PT Charoen Pokphand Indonesia, one of the largest poultry feed manufacturers in the country, it was communicated that the lowest aflatoxin level that can be attained for local maize is 100 ppb. If 90-95% of maize is locally sourced, it is virtually impossible for any feed mill to attain 50 ppb. This is less influenced by varieties used and more influenced by weather conditions during the maize cropping cycle (drought at flowering time exacerbates infection) and post-harvest drying and storage.

Because aflatoxin is an issue for both food and animal feed, the government has been reticent to enforce its maximum allowable levels, presumably to avoid causing alarm among the general public. This hesitancy to enforce AF levels in a systematic way appears to have little to do with lack of data on its effects. In fact, there have been studies conducted in Indonesia documenting the impact of AF (on humans and livestock) dating

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*4 According to company representatives they are about a year ahead of other companies.*

*5 GM seed that is 'double stacked with Roundup Ready and Bt-corn' carries herbicide resistance and corn-borer resistance.*

*6 No data was presented during the Conference to support this claim.*

back to the 1970s, but efforts to enforce the maximum levels and create awareness among the public have yet to be put in place.

## 2.7 Sub-Sector Development Programs

### 2.7.1 Strategic initiatives for maize in Indonesia

#### *CGIAR - Global Alliance for Maize*

Indonesia's Ministry of Agriculture is a formal signatory to, and participant in, the Consultative Group on International Agricultural Research (CGIAR) Research Program (CRP 3.2) – A Global Alliance for Maize. This initiative identifies areas where national extension services are unable to reach Indonesia's maize farmers, and strongly endorses the full use of available international initiatives to deliver extension services to the country's maize sector. In this context, CRP 3.2 and Indonesia's Ministry of Agriculture have developed a blueprint for research and development anchored to nine strategic initiatives that address maize-based farming systems. In addition to the Ministry of Agriculture being a signatory to CRP 3.2, two Indonesian Institutes are formal partners: the Indonesian Centre for Agricultural Biotechnology and Genetic Resources Research and Development (ICABIOGRAD) and the Indonesian Centre for Food Crops Research for Development (ICFORD).

The nine strategic initiatives for maize are:

1. **Socioeconomics and policies for maize futures** – increased effectiveness and positive impacts of maize research on food security, poverty reduction, gender equity, and the environment through better targeting of new technologies, policies, strategic analysis, and institutional innovations.

2. **Sustainable intensification and income opportunities for the poor** – sustainable intensification and income opportunities in six maize-based farming systems where 315 million of the poorest and 22% of all malnourished children live.

3. **Smallholder precision agriculture** – crop management advice and practices that allow 20 million information-constrained smallholders to close the maize yield gap, lower production costs, and reduce agriculture's environmental footprint, especially through more efficient fertilizer use.

4. **Stress tolerant maize for the poorest** – stress tolerant maize varieties that reduce hunger and production shortfalls for 90 million people as climate change and abiotic and biotic stresses become more frequent, widespread, and intense.

5. **Towards doubling maize productivity** – public-private partnerships with the local seed sector and agro-industry to provide better adapted and diverse maize hybrids for smallholders in emerging markets, allowing them to produce enough maize grain to meet the daily requirements of 160 million consumers while strengthening the local breeding sector.

6. **Integrated postharvest management** – integrated approaches to improve food safety and reduce post-harvest losses of grain. Partnerships with the local seed sector and agro-industry to provide better adapted and diverse maize hybrids for

smallholders in emerging markets, allowing them to produce enough maize grain to meet the daily requirements of 160 million consumers while strengthening the local breeding sector.

7. **Nutritious maize** – bio-fortified varieties that will allow heavy consumers of maize to attain healthy and nutritious diets and farmers to benefit from market opportunities.

8. **Seeds of discovery** – cutting-edge research to open the “black box” of maize genetic diversity, permitting researchers to mobilize its full potential in breeding programs worldwide, especially for hard-to-solve problems related to climate change.

9. **New tools and methods for national institutions, entrepreneurs, and farmers** – give small- and medium-scale public and private seed enterprises in developing countries the same tools as multinational ones, so that they can fill demand niches for smallholders.

#### *AusAID - Stimulating the demand for better quality open pollinated varieties of seeds.*

AusAID funded AIPD-Rural has been working in TTU, NTT since 2011 to improve food security by boosting the productivity and production of maize. This is achieved by combining the GoI initiative of distribution of 200 tonnes of improved maize seeds from the National Seed Reserve Program (CBN) with extension services provided by AIPD-Rural to 427 farmer groups in 106 villages in TTU. These extension services were delivered by a locally based NGO, Yayasan Mitra Tani Mandiri (YMTM). While the initiative was considered a success, its sustainability is unclear due to its reliance on the continuous distribution of free maize seeds by the CBN (which is often hampered by productivity-reducing delivery delays) and unpredictable public support to finance its extension services.

In 2012 AusAID revamped its strategy by piloting a transition model, away from free seed distribution and towards developing a commercial market for improved maize seeds. The aim is to stimulate at least 10,000 small farmers in TTU and neighbouring districts to purchase better maize seeds at a commercial price, through local agricultural inputs suppliers. The model aims to generate widespread farmer-awareness of the productivity impact of this variety of seed, as well as improving access to its purchase. The model will build the capacity of three local private maize seed producers, assisting them to expand their production volumes and marketing efforts (primarily via demonstration plots and education initiatives) while also assisting 20-30 local agricultural input retailers to promote the availability and impact of better seeds.

### 2.7.2 Non-Governmental organization programs

Apart from CGIAR and AusAID, several other maize-focused initiatives were implemented in NTT. Benu et al, (2011), reports that in NTT, for food security reasons, both the GoI and NGOs have run occasional seed aid programs in order to encourage farmers to use certified seed instead of replanting retained seed.

The World Food Program, for example, supports maize farmers to increase the food security capacity of poor families and develop maize-based feeding programs for school-age children.

In NTB and EJ, the maize program is largely driven by government funded initiatives. Some private sector actors, such as seed producers and agro-chemical companies, have conducted some learning centre/demonstration plots for farmers, but not specifically targeted to maize.

Outside of government support to the sector, there were no maize-focused development programs identified by the study team in NTB or EJ. YMTM, an NGO founded in 1988, was identified as active in NTT. Since 2007, this organisation has received funding from AusAID to implement projects in agro-forestry and agricultural sustainability. This support has not been focused on a specific crop and includes food crops, livestock and perennial crops. YMTM forms farmer associations to promote agricultural production and greater bargaining power for farmers, which includes a focus on increasing the productivity of peanuts and maize. Geographic coverage for one of the organisation's AusAID funded projects, called the 'Antara' project, is TTU in Timor and Nagekeo in Flores. YMTM's program covers five districts: Nagekeo, Ngada (Flores), and three in Timor (TTS, TTU and Belu). YMTM receives funding from AusAID, Caritas Australia, World Neighbours, and VECO (Belgium).

YMTM provides technical training on production systems, from production to harvesting. Two villages are supervised by one YMTM field assistant, who also supervises farmers from post-harvest handling to marketing (for all agro-forestry commodities). In the market, they supervise and assist farmers to link up with traders and provide advice on how to negotiate with them. The organisation is working with 450 farmer groups in four districts (for its AusAID programs), covering 11,336 households.

# 3 Maize Commodity Chains in Indonesia

## 3.1 Overview

The maize value chain maps below provide visual representations of the flow of purchase and sale of maize, from input stage to end markets. Given the differences in production systems and end markets between value chains across the target provinces, Figure 19 is representative of the chain in NTB and EJ, while Figure 20 is for NTT. NTB and EJ have been grouped together due to the fact that their primary end markets are poultry farms and farmers that use maize for feed. Both maps are described in greater detail below.

### 3.1.1 Chain structure

In Figure 19, there are two channels, or end markets, for maize in NTB and EJ. The primary channel, or Channel 1 (shaded yellow), represents the maize that is destined for animal feed, while the second channel, or Channel 2 (shaded green), is the maize that is ultimately for human consumption. The thicker black arrows demonstrate that the vast majority of the commodity ends up in animal feed production. Based on findings from interviews, it is estimated that nearly 100% of maize produced in NTB and 70% produced in EJ is destined for animal feed.[7]

[7] *The data for EJ is based on interviews with the provincial DINAS office in Surabaya.*

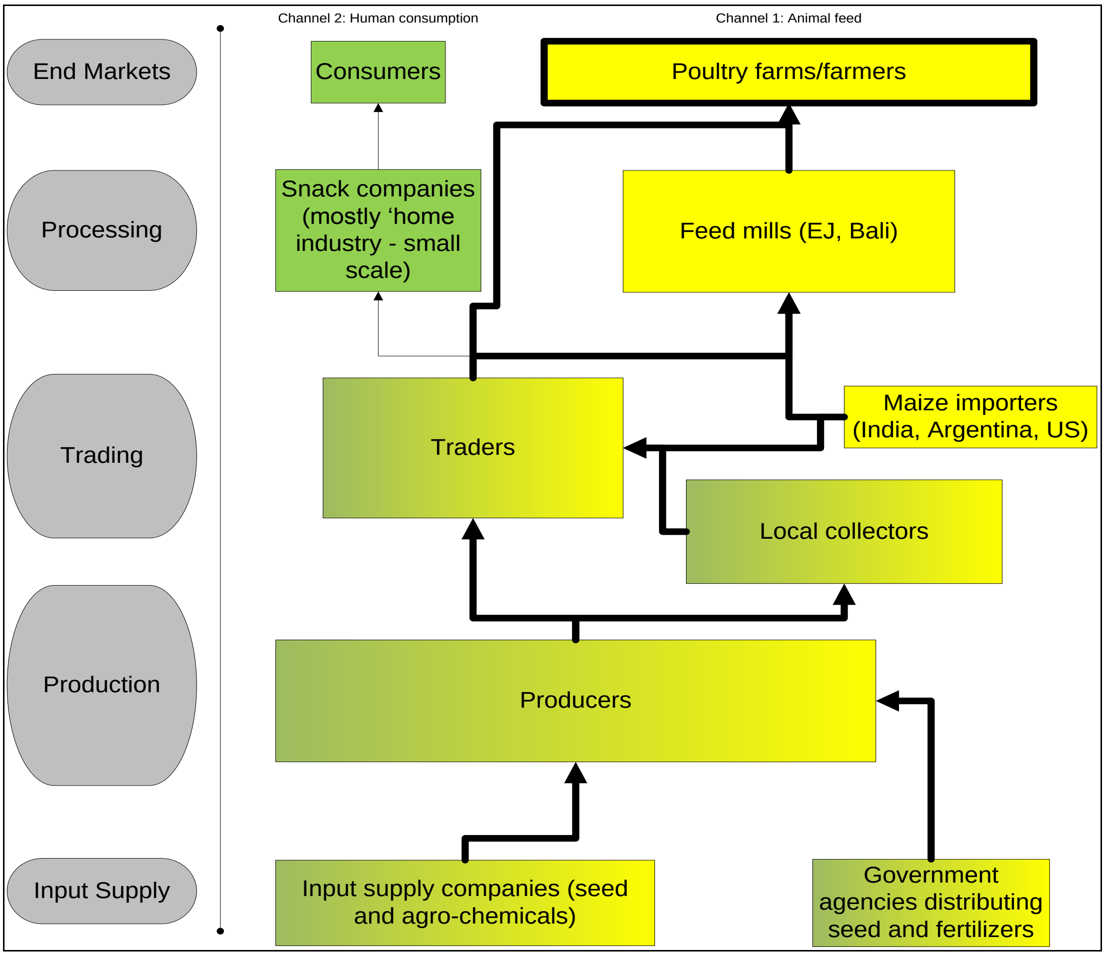


**Figure 19 Maize value chain map for NTB and EJ**

### *Channel 1: Animal feed*

The key actors in this channel are the farmers (producers), traders and feed mills. For the maize that ultimately ends up as a key component of animal feed, farmers obtain their inputs (seed, fertilizer, etc.) from both private sector input suppliers as well as via public sector seed distribution programs. Some farmers perform post-harvest activities such as husking, drying, shelling (removing the kernels from the cob) and transportation; while others conduct minimal post-harvest activities before selling to traders - seemingly in order to obtain cash in hand as quickly as possible. Most small and large scale traders and collectors dry, store and transport the maize before it goes to feed mills and poultry farms where it is processed into feed. Very few farmers sell directly to feed mills - in fact, representatives of two of the large scale feed mills noted that they had previously attempted to procure maize directly from farmers, but with little success. This was primarily due to logistical challenges such as payment and transportation, as well as concern about jeopardizing longstanding commercial relationships with traders and wholesalers. Both feed mills and traders sell either the feed or the maize to poultry farms and farmers. Some poultry farms and farmers process the maize into feed themselves, and others purchase already processed feed.

### *Channel 2: Human consumption*

It is estimated that 30% of maize (in EJ, on the island of Madura) is used for human consumption. On the island of Java, processors were identified and interviewed in Malang district to assist in understanding the flow of maize that is processed into snacks. The commodity flows in much the same way as it does in Channel 1, but in this case traders also sell maize to individuals or businesses (instead of feed mills) that process the maize then sell it (mostly locally).

The value chain map for NTT (see Figure 20) is divided into three channels. Channel 1 (shaded in grey) shows the predominant channel of maize in NTT: farmers that cultivate maize for their own consumption. Channel 2 (shaded in orange) shows farmers that are growing and selling maize that is ultimately used for human consumption and processing into snacks. Channel 3 (shaded yellow) shows the small but growing channel of maize used for animal feed in NTT. The three channels are described in greater detail below.

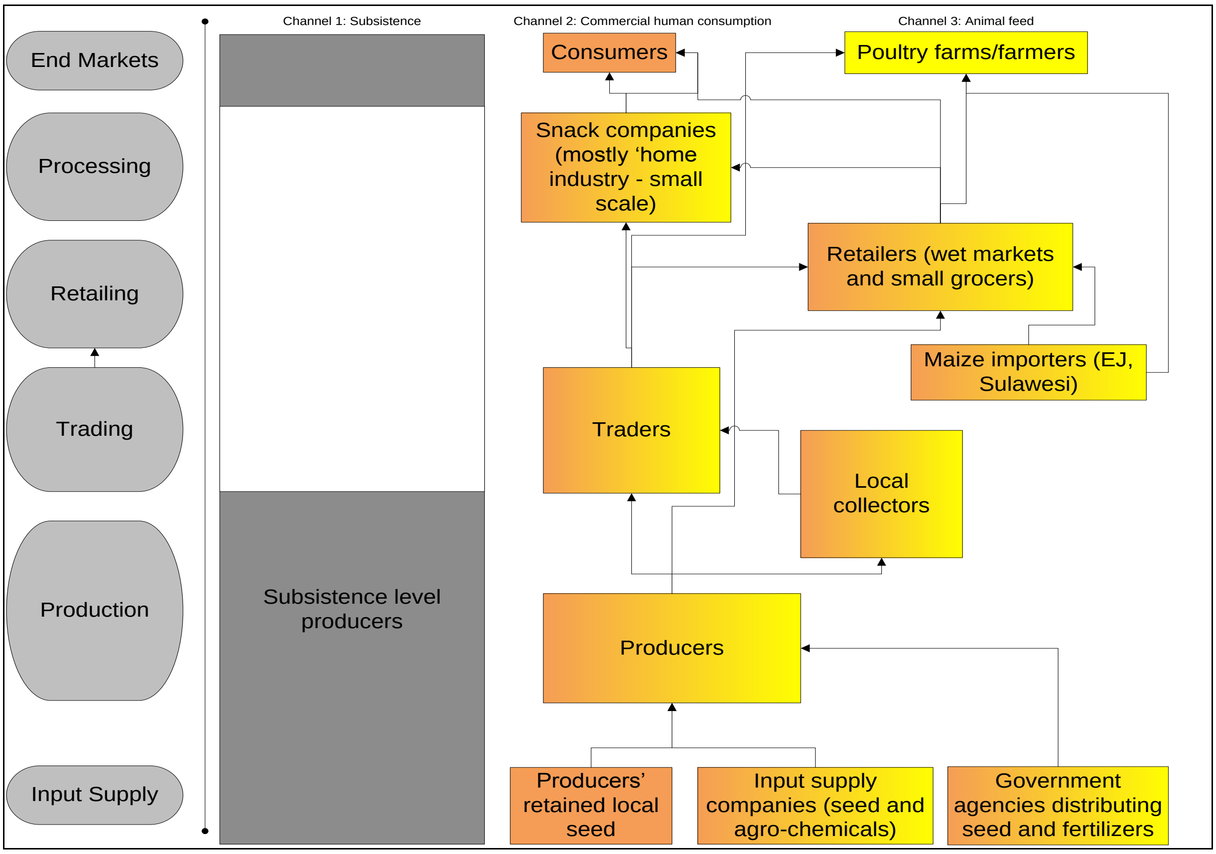


**Figure 20 Maize value chain map for NTT**

## *Channel 1: Subsistence*

Maize has been cultivated in NTT for several hundred years. As previously described, the majority of farmers in NTT grow a type of 'local' maize that they cultivate with retained seed from the previous years' harvests. This is typically a white variety of maize that local farmers find to be more weevil resistant than the subsidized modern (yellow) composite varieties such as 'Lamuru'. No fertilizer or other inputs are used with this local seed variety. Farmers traditionally plant the maize in the same hole as other crops such as sweet potato, cassava, mungbean and sometimes even rice. After the harvest season, the farmers tie, bundle, and dry a portion of the maize over the kitchen fire and put the rest of it in the sun. The maize intended for consumption (rather than for seed) is stored (in some parts of NTT it is stored in a raised hut-like structure called a 'lopo') and consumed as needed. In rare cases, or in a bad production year, farmers purchase grain from the market to use as seed. While the yield per hectare, or productivity, is a key driver for farmers in EJ and NTB, ensuring that there is enough maize to feed their families for the year is the primary goal of farmers growing maize in NTT. Cash income for farmers in

NTT is likely to come from other sources, such as animal husbandry or selling crops like betel nut and cashews. This channel captures 75% of maize produced in NTT (Benu et al, 2011).

#### *Channel 2: Commercial human consumption*

There is a small but growing number of farmers in NTT who are both consuming and selling maize. Almost all of the members of one farmer group interviewed in Kupang district, for example, were selling approximately 50% of their harvest. This is higher than figures quoted in research by De Silva et al in 2011 indicating approximately 25% of maize produced is sold by farmers.

According to Benu et al, 2011, of the maize sold into local markets in the districts of Kupang and TTS, between 70-80% is sold to local collectors, approximately 10-20% is sold direct from farmers to retailers and the remaining 10% is sold direct from farmers to local consumers. Very little maize (only 5-10%) is sold between districts. For these channels, the maize varieties include both the more traditional local white variety as well as yellow varieties that are primarily composite seed.

Storage and transportation in NTT are largely functions of the collectors and traders. Similar to what was observed in EJ, some of the grain is purchased by relatively small-scale processors who make snack items from the maize and sell it to retailers and individuals. It is important to note again that NTT is a net importer of maize, and much of the yellow maize used for household consumption and also processed into snacks is imported from Sulawesi and Java in order to satisfy growing local demand.

#### *Channel 3: Animal feed*

According to key informants interviewed in NTT, there is growing demand for animal feed in NTT. BPS data (2010) indicates 6% of local production is destined for animal feed. Benu et al 2011 found the livestock industry in Kupang district sources 75% of its maize (mostly hybrid) from Java or Makasa and 25% from local producers.

Almost all traders that were interviewed in NTT expressed the belief that local supply did not satisfy local demand and they ‘imported’ maize from Java and Sulawesi. One Kupang-based poultry farmer indicated that he has imported 100% of his maize (200 tonnes per year) for the last two years due to a shortage in local supply. This compares to previous years in which he used approximately 70% local maize.

The value chain map and actors for channels 2 and 3 in the NTT map are essentially the same. The main difference is the primary end markets – poultry farms and farmers using maize for feed. Some retailers are selling maize directly to consumers for household consumption, while others are grinding it and selling it to small-scale poultry producers as an input into animal feed.

### 3.1.2 Product standards and coordination systems

#### *Product standards*

There are several ‘standards’ of importance to market actors when buying and selling maize, including moisture content, presence of foreign materials, and seeds that are broken, dead, mouldy, and/or damaged. Testing for the presence of aflatoxin is conducted by industrial scale feed manufacturers but, as noted above, aflatoxin is not a concern for the majority of market actors interviewed in this study.

**Table 11 Maize grading - Charoen Pokphand Indonesia**

| Parameter (maximums) | Grade 1 | Grade 2 | Grade 3 |
|---|---|---|---|
| Moisture (%) | 16.0 | 28.0 | 28.0 |
| Aflatoxin (ppb) | 50 | 100 | 100 – 150 |
| Foreign material (%) | 1.0 | 2.0 | 2.0 |
| Broken or dead seed (%) | 2.0 | 3.0 | 4.0 |
| Mouldy seed (%) | 2.0 | 5.0 | 7.0 |
| Damaged seed (%) | 3.0 | 5.0 | 7.0 |

*Source: PT Charoen Pokphand Indonesia*

Table 11 presents the standards PT Charoen Pokphand Indonesia, one of the largest feed manufacturers in the country use to grade the maize upon receipt.

**Table 11 Maize grading - Charoen Pokphand Indonesia**

| Parameter (maximums) | Grade 1 | Grade 2 | Grade 3 |
|---|---|---|---|
| Moisture (%) | 16.0 | 28.0 | 28.0 |
| Aflatoxin (ppb) | 50 | 100 | 100 – 150 |
| Foreign material (%) | 1.0 | 2.0 | 2.0 |
| Broken or dead seed (%) | 2.0 | 3.0 | 4.0 |
| Mouldy seed (%) | 2.0 | 5.0 | 7.0 |
| Damaged seed (%) | 3.0 | 5.0 | 7.0 |

*Source: PT Charoen Pokphand Indonesia*

The most important product standard observed during the value chain assessment is moisture content. In Indonesia the standard moisture content for maize used in animal feed ranges from levels of 17-20% (this compares with international limits of around 12-14%). In spite of its importance, as well as a penalty system for selling maize that is above the standard, existing incentives for farmers, collectors and traders are yet not strong enough to encourage improved post-harvest practices.

Most farmers, collectors, and traders lack (or do not employ) drying technologies and methods to effectively dry maize, particularly during the rainy season which results in maize with high moisture content. At the time of sale, buyers apply a “penalty” or “discount” using a sliding price scale that depends on the moisture level. Yet almost all maize, regardless of moisture content, is sold. Table 12 below shows the penalties applied for maize with moisture content above the standard.

**Table 12 Penalties applied for above standard moisture content**

| No | Moisture content (%) | Deduction (%) of the purchase price |
|---|---|---|
| 1 | < 17 | 0.0 |
| 2 | 17.1 – 17.5 | 0.6 |
| 3 | 17.6 – 18.0 | 1.2 |
| 4 | 18.1 – 18.5 | 1.8 |
| 5 | 18.6 – 19.0 | 2.4 |
| 6 | 19.1 – 19.5 | 3.0 |
| 7 | 19.6 – 20.0 | 4.0 |
| 8 | 20.1 – 20.5 | 5.0 |
| 9 | 20.6 – 21.0 | 6.0 |
| 10 | 21.1 – 22.0 | 8.5 |
| 11 | 22.1 – 23.0 | 11.0 |
| 12 | 23.1 – 24.0 | 13.5 |
| 13 | 24.1 – 25.0 | 16.0 |
| 14 | 25.1 – 26.0 | 19.0 |
| 15 | 26.1 – 27.0 | 22.0 |
| 16 | 27.1 – 28.0 | 25.0 |
| 17 | More than 28.0 | rejected |

*Source: PT Charoen Pokphand Indonesia, 2012*

Given the relatively low margins in the maize trade, the discount or penalty can add up to significant losses for traders and collectors depending on the quantities traded. Despite the importance of moisture for feed manufacturers and the penalties applied, few farmers, traders or collectors currently invest in equipment to ensure that maize is well dried or use standardized tools to test for moisture content.

Most farmers in NTB and EJ sun-dry maize using plastic tarpaulins. Most collectors and traders dry maize in the same way, but rather than plastic tarpaulins, some use concrete pad for sun drying. The incentives for traders to invest in more expensive drying equipment (a flatbed dryer, for example) for maize alone are minimal since drying maize only needs to be done for two months out of the year if harvest occurs in the rainy season.

For testing moisture content once maize has been dried, a number of interviewed farmers use a traditional test in which they bite a kernel of maize to determine if the moisture level is acceptable. If the kernel breaks into three or more pieces, the moisture level is considered to be too high. If it breaks into two pieces, then it is acceptable. Even some traders and collectors use this type of traditional ‘bite test’ or simply use a visual test to gauge the moisture content. According to some collectors and traders interviewed, farmers lack incentives to decrease moisture levels in maize because decreased moisture results in lower weights.

Promoting improved and expanded vertical collaboration among value chain participants in a market-based governance system can be challenging, as there is often a lack of incentives for buyers to invest in their supply chain (providing technical assistance, inputs and support to suppliers, for example). While some opportunities may exist to work with innovative buyers looking for higher quality product or new varieties, greater opportunities may exist in promoting improved value chain ‘support markets’ and collaborating with companies like seed, input and equipment supply companies.

## 3.2 Input Distribution

### 3.2.1 Public sector channels for seed distribution

The national maize research institute, The Indonesian Cereal Research Institute (ICERI) is the main public sector research institute for maize seed. It is responsible for producing breeder's seeds (derived directly from research programs) of released cultivars. Foundation seed (coming from the breeder's seed) is handled by provincial seed centres and then public and private sector seed growers (input supply companies) implement mass production and commercialisation.

Parastatal input supply companies such as PT Pertani and PT Sang Hyang Sri (SHS) produce a significant amount of maize seed. These companies are nominally private, though the government holds 100% share ownership. After producing they sell maize seed either directly to farmer groups, through their own retail outlets, through government extension initiatives (BPTP), or through various private input supply shops. Private input supply shops then sell directly on to farmers.

More information on these and other public sector organizations involved in the maize value chain can be found in section 3.8.

### 3.2.2 Private sector channels for marketing seed

Private input supply companies are increasing in number and outreach across the AIPD-Rural provinces. These can be divided into multinational companies (DuPont, Bayer, Syngenta, Nufarm, etc.), and mostly Java-based Indonesian companies (Petrokimia /Petrosida, Aman Asri, Royal Agro, Sari Kresna, and Biotek). In addition, there are several prominent input supply companies focusing strictly on seed (mostly maize, vegetable, and sometimes rice) such as BISI, East-West Seed, Pioneer Seed, and Primaseed, among others.

These companies contract with provincial distributors, who sell both to retailers as well as to farmers. The distributors then subcontract with two levels of retailers (known in the industry as 'R1' and 'R2').R1 retailers are typically larger and also act as distributors to smaller R2 retailers, typically small village-based shops. While there may be as many as 10-20 R1 retailers in a given district, typically there are at least one to two R2 retailers in every village.

Input supply companies also work collaboratively with government agencies such as DINAS to coordinate field demonstrations for both seed and other agro-chemicals. They provide brochures and technical information manuals to their distributors and input supply shops. During field interviews, input supply shop representatives indicated that the flow of technical information to them, as well as to farmers, was insufficient. Suggestions for improvement included more frequent field demonstrations and more hands-on, practical training materials.

### 3.2.3 Adoption of hybrid and OPV varieties

EJ is the centre of hybrid seed production in Indonesia. Adoption of hybrid seed varieties in EJ, particularly in rain fed and irrigated lowland areas where transportation networks and the agro-industry is more developed, has been widespread (Swastika et al., 2004). Both hybrids and OPVs are used in NTB. Interviews during field research indicated widespread use of hybrid seed in NTB, although it remains unclear what percentage of seed used is hybrid versus OPV.

Up until 2004, the rise in NTB's production was attributed to the increased use of land area for maize (Swastika et al., 2004) whereas in EJ it was attributed to increases in productivity. However, by 2010 NTB's productivity levels surpassed EJ. This has been attributed by some to the greater use of hybrids in NTB and an increase in government subsidies for hybrids in the province since 2007.

The majority of seed used in NTT is locally produced, though government subsidized OPV seed is also distributed. Although hybrid seeds are not as pervasive in NTT as compared to EJ and NTB, they are sold in Kupang, and can be found on the shelves of small input supply kiosks in the districts of TTS and TTU.

### 3.2.4 Other inputs

Farmers purchase chemical inputs (fertilizer, pesticide, and herbicide) from private field agents that represent input supply companies, as well as from local retailers and distributors. Farmers and retailers with questions about the proper usage of inputs can contact field agents of input supply companies. These field agents, and the companies they represent, also organize periodic village meetings, demonstration plots, and field days to demonstrate the use of their products. Two companies interviewed in NTT have four to five field agents each for the province, and one input supply company interviewed in EJ has 72 agents (for EJ alone).

## 3.3 Production and gross margins

### 3.3.1 NTB

In NTB, the harvested area and productivity of maize have almost doubled in the last five years (see Table 5 in section 2.3.1). The harvested area remains relatively low, however at 117,000 ha in 2012, compared with 1.2 million ha in EJ. The average land area of farmers in NTB is 0.5ha[8] and the average yield, at 5.4t/ha is the highest among the three AIPD-Rural provinces. There is potential to expand maize production areas in NTB and the study team witnessed land clearing for maize.

In terms of post-harvest handling, most farmers remove the husk, dry, and then shell the maize (separating the kernels from the cob). Drying and shelling is done internally or outsourced, particularly if a nearby farmer owns a shelling machine. Farmers sell almost all of their maize[9] to local collectors and traders with no formal contract involved. The farmers interviewed by the study team sell their maize as quickly as possible after harvest. Some farmers sell to the same collectors year after year, while others sell to different collectors (whom they may or may not know) on the basis of best price. The interaction with these collectors occurs once per harvest season, at the time of sale.

A key constraint for farmers in NTB is a lack of agronomic knowledge and post-harvest expertise. It is predicted they will also face future problems with weeds, pests and diseases, as per the norm for farmers in EJ and NTT.  The farmers in NTB have not yet had to deal with these problems on a large scale because maize production is relatively recent, and weeds get worse with continuous maize cropping.

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[8] *This is according to primary information provided in interviews by provincial level DINAS representatives.*

[9] *Farmers interviewed in EJ and NTB sold all of their maize, whereas farmers interviewed in NTT that sold a portion of their harvest sold about 50%.*

According to a study published by Swastika et al (2004), the percentage contribution that maize makes to household income for farmers in NTB is as follows: 49% for poor farmers, who are defined as having less than 0.5 ha; 44% for medium farmers, or those that have 0.5-1 ha; and 41% for rich farmers, or farmers with more than one ha.

### 3.3.2 EJ

The average land area for farmers in EJ is 0.3 ha and the average yield is 4.7 t/ha, which is the same as the national average (BPS, 2012). Most production characteristics are the same as NTB including the end market, sales to collectors and timing of sales.

Given the history of maize cultivation in EJ, (40-50 years in EJ compared to 10-15 years in NTB and hundreds of years in NTT), high humidity, and intensive production systems, the prevalence of pests and diseases is quite high. Downy mildew *(bulai* in Bahasa Indonesia), is a growing problem. One farmer interviewed lost 50% of last season's production to the fungus. While there is relatively greater outreach of public and private sector entities providing technical advice to farmers, such as DINAS and input supply companies, there is still a lack of technical knowledge among farmers.

Maize constitutes a smaller percentage of farmers' income in EJ than in NTB (per 2004 data). In irrigated areas, maize contributes 20% to poor farmers' income, 22% to medium farmers and 15% to rich farmers. In dry land (rain fed) areas, it contributes 22% to poor and medium farmers' income and 24% to rich farmers (Swastika et al, 2004).

### 3.3.3 NTT

The average land size for farmers in NTT is between 0.3 and 1 ha, with average yield the lowest of the three provinces at 2.6 t/ha (BPS, 2012). *[Note: maize tends to be intercropped with other crops in NTT so it is difficult to accurately estimate yields per hectare. Data should therefore be interpreted with caution.]* Maize in NTT has been cultivated solely for human consumption for several hundred years, and as such, selling maize is a relatively new phenomenon. Only a small number of farmers (mostly near Kupang) grow maize for commercial purposes and use some inputs. These farmers sell to local collectors and traders. The majority of this maize is ultimately sold by retailers in wet markets.

Subsistence level farmers outside of Kupang, including those interviewed in Flores and Timur, are producing maize primarily for their own household consumption. No chemical inputs are used, and seed is retained from the previous year's harvest.

### 3.3.4 Farm Profitability

As the field coordinators for this study had to rely on farmers selected by local DINAS staff, it was a challenge to find 'representative' farmers to interview for gross margin analysis. In NTB and EJ, in particular, the research team had the impression that the selected farmers were neither the 'poorest' nor representative of most farmers.

The costs and margins analysed in this section represent three farmer types: one from NTB producing hybrid maize with inputs; one from NTT producing the composite variety Lamura with limited inputs, but linked to a market; and one farmer from NTT who produces a local variety, primarily for subsistence, and is not closely linked to a market.

### *Farmer 1 Profile: Hybrid maize producer using inputs, NTB*

An NTB farmer from Bima growing upland rain-fed maize since 2010, with over 1 ha dedicated to maize production. He purchases subsidised hybrid seed from the government and sources his inputs from local retailers. The farmer receives no technical information from input suppliers, and limited government extension services are offered. He sells his grain directly to a local collector. 100% of the farmers in his village use hybrid seed and no maize is retained for personal consumption.

A summary of the costs and margins for the farmer's rain-fed, upland maize grown with hybrid seed is in Table 13 below. A more detailed account is provided in Table 23 in Annex 3.

**Table 13 Maize costs and margins, hybrid maize farmer, Bima (NTB), 2012**

| | | |
|---|---|---|
| Yield (kg/ha) | 5,430 | |
| Price (IDR/kg) | 1,900 | |
| Revenue/ha (IDR) | 10,317,000 | |
| **Costs** | **Rate IDR/ha** | **Percentage of total costs** |
| Seed | 600,000 | 10% |
| Pesticide | 385,000 | 7% |
| Fertiliser | 555,000 | 10% |
| Labour | 4,117,500 | 71% |
| Others (transport) | 150,000 | 2% |
| Total cost | 5,807,500 | 100% |
| Gross margin (IDR/ha) | 4,509,500 | |
| Gross margin (US$/ha) | 460 | |

*Source: Maize team calculations based on information supplied during an individual farmer interview in Kore village, Sanggar subdistrict, Bima, NTB*

The farmer achieved a yield of 5.4 t/ha. The average yield in NTB in 2012 was 5.4 t/ha, and the majority of farmers in the province plant maize in the rainy season.

Labour accounts for 71% of total costs, while inputs such as seed, fertilizer and pesticides represent 27% of total costs.

The cost of hybrid maize seed represents 39% of all material input costs and 10% of the total cost of production. This was comparable to fertilizer. Pesticides account for 25% of total input costs.

Nearly 60% of all labour costs are incurred during harvesting, threshing and drying. Labour required for land preparation and planting represents 24% of total labour costs, or 17% of total production costs (see Table 23, Annex 3).

### *Farmer 2 Profile: Modern OPV maize producer using inputs, NTT*

A farmer in Kupang in NTT produces the composite maize variety Lamuru under rain-fed conditions. He retains 50% of production for personal consumption and the remaining 50% is sold to the local farmer group which acts as a local collector and input provider. The farmer group provides inputs such as seed, fertilizer and herbicide on credit at planting time, and for this he contributes 100kg of maize (approximately US$ 25) to the group, in addition to repaying the cost of inputs. He retains very little seed for planting due to losses from weevils and repurchases seed each year. The farmer uses all family labour. Labour rates in NTT were observed to be nearly 50% lower than labour rates in NTB. A summary of the gross margin analysis is below in Table 14 with a complete breakdown provided in Table 24 (Annex 3).

**Table 14 Gross margin modern OPV maize farmer based in Kupang (NTT), 2012**

| | | |
|---|---|---|
| Yield (kg/ha) | 2,800 | |
| Price (IDR/kg) | 2,500 | |
| Revenue/ha (IDR) | 7,000,000 | |
| **Costs** | **Rate IDR/ha** | **Percent of total costs** |
| Seed | 200,000 | 6% |
| Pesticide | 605,000 | 17% |
| Fertiliser | 420,000 | 12% |
| Labour | 2,175,000 | 60% |
| Others (transport) | 214,000 | 5% |
| Total cost | 3,614,000 | 100% |
| Gross margin (IDR/ha) | 3,386,000 | |
| Gross margin (US$/ha) | 345 | |

*Source: Maize team calculations based on information supplied during an individual farmer interview in Letmafo village in TTU district, NTT*

Da Silva et al (2012) surveyed 60 farmer respondents in Timor Island (NTT) and found the average yield for composite maize production to be 2.75 t/ha for modern OPVs and 3.5 t/ha for hybrid varieties. The average cost of production for OPVs and hybrid varieties was 1,800,000 IDR and 2,400,000 IDR respectively.

In the above example, yield is in line with the provincial average; however total input costs are nearly 50% higher than the findings from Da Silva's research. This may be due to the improper (high) use of herbicides and fertilizer, which are supplied by the farmer group.

Once again labour costs are the largest contributor to total costs at 60%, and the net margin for this OPV maize producer is approximately 75% of the example hybrid maize producer from NTB (Farmer 1).

With 50% of the maize sold, the net income to the grower is approximately US $170 per annum.

### *Farmer 3 Profile: Local OPV maize producer using no inputs, NTT*

Table 15 presents the gross margin for a subsistence wet season maize farmer in the TTU district of NTT. The farmer sells only 20% of the maize produced, retaining 80% for personal consumption and for replanting. The detailed analysis can be found in Annex 3.

The farmer only plants the white local variety in a mixed plant pattern with other crops and achieves a low yield of only 1,000 kg per ha. The farmer is reluctant to use modern OPV or hybrid seed as they believe it is susceptible to weevils and requires fertilizer. Inputs are not purchased, planting seed is retained from the previous season and only family labour is used.

Nevertheless, the data shows the potential returns if the farmer did sell all the maize direct to a retailer and pay for seed replacement and costed family labour. It is worth noting that applying a value on family farm labour is open to debate for subsistence maize production in NTT. However, there are opportunities for farmers to source off farm income in the region.

**Table 15 Gross margin for local variety maize producer, TTU (NTT), 2012**

| | | |
|---|---|---|
| Yield (kg/ha) | 1000 | |
| Price (IDR/kg) | 3,500 | |
| Revenue/ha (IDR) | 3,500,000 | |
| **Costs** | **Rate IDR/ha** | **Percent of total costs** |
| Seed | 150,000 | 9% |
| Labour | 1,530,000 | 89% |
| Others (transport) | 40,000 | 2% |
| Total cost | 1,720,000 | 100% |
| Gross margin (IDR/ha) | 1,780,000 | |
| Gross margin (US$/ha) | 182 | |

*Source: Maize team calculations based on information supplied during an individual farmer interview in Melati village, Naibenu sub district inTTU district, NTT*

As expected, the proportion of total costs allocated to family labour for subsistence farming is high, at 89%. The only monetary outlay is for fuel to transport maize to the collector (2%). Seed costs at 9% represent the opportunity cost of seed replacement for planting.

The yield achieved in the above example is quite low, at only 40% of the provincial average of 2.5 t/ha. However, total input costs (90% labour) align with findings from Da Silva et al (2012) at approximately 1,700,000 IDR/ha. The low yield is most likely as a result of farmer practices whereby maize, rice and beans are all planted in the one field at the same time. At 10kg/ha, the maize planting rate is 50% of the optimal planting rate.

With 20% of maize sold to a retailer in the market, the disposable household income derived from maize equates to US $36 per annum.

## 3.4 Collection

Collectors buy maize directly from farmers before selling it to larger-scale traders or, in some cases, directly to feed mills or poultry farms. The number of intermediaries (collectors) between farmers and the feed mills varies, depending on distances and infrastructure. Some collectors are located in the same villages and subdistricts as the farmers, while others are located in district and provincial towns and capitals that are sometimes on different islands. Many collectors act as ‘sub-collectors’ (or agents) to other collectors.

Regarding gender, all of the collectors interviewed were male, although on a few occasions their wives were involved and familiar with the business. Collectors typically pay for transportation in order to gather maize from farmers directly at the farm gate, transporting it to other collectors or traders (and sometimes directly to poultry farms and small-scale feed mills). The collectors purchase dried or semi-dried kernels from farmers (usually cash) and either dry it further (in the sun) and store it, or sell it immediately to another collector or trader. For maize, the collectors generally transact with farmers once per harvest.

Most collectors interviewed during the study trade in multiple commodities in addition to maize, such as peanut, cashew, mungbean, tobacco and soybean. Though most collectors are required by their buyers to sell maize below a specific moisture content level, few had any equipment to accurately test for moisture content and used the same traditional testing methods as farmers (i.e. biting and visual inspection). Some incur discounts or penalties for selling maize with moisture content levels above 17% (although this depends on buyer predilection, as not all buyers maintain this standard).

Almost all collectors interviewed in NTT (in both Timor and Flores Islands) noted that the majority of their maize comes from either Surabaya or South Sulawesi due to inconsistent local supply and the fact that the majority of NTT farmers in NTT produce maize for household consumption.

## 3.5 Wholesaling

Predictably, there is a wide range and scale of maize wholesalers or traders. Many of the larger-scale traders interviewed by the study team sell directly to feed mills and poultry farmers, and have a network of collectors under them who bring maize either to their warehouses or directly to the buyers. Traders use their own transportation (trucks) or rent hired trucks. Larger-scale traders rarely transact directly with farmers. Wholesale traders typically have a space dedicated to sun-drying and storage, which is used for the various commodities they trade (not exclusively maize). Several traders interviewed stressed the importance of price and market information for making buying and selling decisions. One trader in EJ, for example, noted that having greater access to price information (for both international as well as domestic prices) would allow him to make better decisions and in general improve his trading operations. Traders are more concerned about ensuring that maize is properly dried, as they face penalties for excessive moisture content levels from their primary buyers, the feed mills. Similar to collectors, traders incur discounts or penalties for selling maize with moisture content levels above 17%. Several larger-scale traders interviewed indicated that they have meters to test moisture levels before selling their maize.

Traders are likely to have contract agreements with feed mills, but are less likely to have contracts with poultry farms and other buyers. One trader interviewed in NTB is taking advantage of the production boom in the province and by building a processing, drying, and storage facility in the district of Dompu. Table 16 below demonstrates the rapid growth of this trader's maize purchasing volumes in NTB over a five year period. The trader experienced a sixteen-fold increase in purchasing volume in just five years.

**Table 16 Sample trader (NTB) purchasing growth, 2008 – 2013**

| Year | Tonnes |
|---|---|
| 2008 | 3,000 |
| 2009 | 5,000 |
| 2010 | 15,000 |
| 2011 | 35,000 |
| 2012 | 50,000 |
| 2013 (projected) | 80,000 |

*Source: PT Indo Perkasa*

## 3.6 Processing

The key processors of maize in Indonesia are poultry feed manufacturers, most of which are based in Java around Jakarta and Surabaya. As noted above, larger-scale manufacturers import only an estimated 10% of their maize requirements. The majority of their supply comes from local production through networks of traders and collectors throughout the country (mostly from Java, South Sulawesi and NTB).[10] The larger-scale feed manufacturers have contract agreements with traders in order to ensure continuity of supply. The feed mills sample test maize before accepting and apply penalties for moisture content levels that exceed their standard (normally 17%). They clean and dry the maize before milling and mixing with other ingredients to make feed rations, which is packaged and labelled before distribution to retailers throughout the country.

In comparison to the feed industry, there seems to be neither significant unmet demand nor growth opportunities for the maize-as-snack market. Given the limited market potential, as well as the risks involved in human consumption of maize snacks with high aflatoxin levels (an issue that none of the snack processors interviewed were aware of), project activities in this area are not advisable.

## 3.7 Retailing

Retailers of maize for human consumption as well as for animal feed are often located in wet (open air) markets at district and sub-district levels. The study team focused on retailers in several wet markets within NTT, both on Timor and Flores Islands. Retailers buy both directly from farmers as well as from traders, sometimes travelling to other larger wet markets to purchase maize and transport it back.

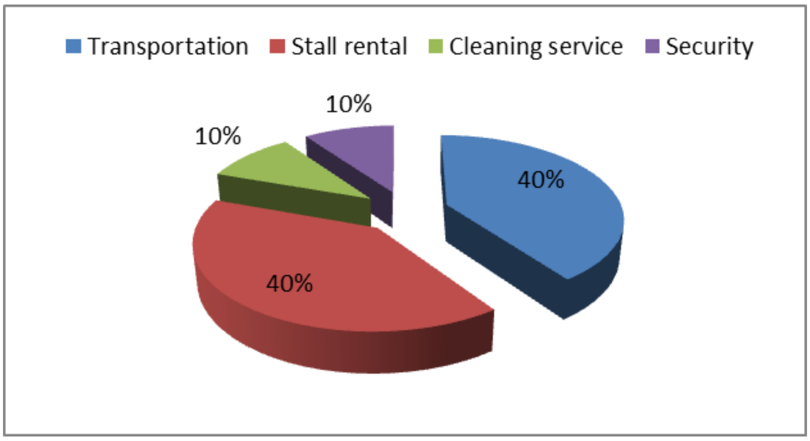
Not all retailers interviewed in NTT knew the origin of the maize they sell. It is likely that the maize sold in these wet markets comes from South Sulawesi, Java and, to a lesser extent, NTT. The retail price for maize can vary greatly throughout the year. One retailer in TTS quoted the following selling prices in a given year to show the seasonal differences:

- January – March: 5,000 IDR/kg.
- April – June: 3, 000 IDR/kg (harvest season).
- July – December: up to 8,000 IDR/kg, and sometimes reaching 10,000 IDR/kg.

*[10] This percentage is based on primary data gathered from two large scale feed mills.*

This retailer explained that she tries to obtain a margin of 500 to 1,000 IDR/kg (between US$ 0.05 to 0.10).

Key expenses for wet market retailers are stall rental, security, market cleaning and transportation of goods. Below is a graphic of average fixed costs (as a percentage) from data gathered from two wet market retailers interviewed in NTT.




*Source: Maize field team, EI-ADO project, 2012*

**Figure 21 Monthly fixed costs for a wet market retailer in NTT**

## 3.8 Value Chain Constraints

This section presents the constraints facing producers and market actors in the maize value chain, based on interviews conducted. The section begins with the major constraints identified as the most important issues to be address by AIPD-Rural in order to build value chain competitiveness and create sustainable impact for low income producers in the targeted areas. These are followed by additional constraints which should also be addressed by the project if possible.

### *MAJOR CONSTRAINTS*

#### *Technical information for farmers on production and post-harvest handling to increase yields and income*

Many farmers lack technical knowledge about maize production (the advantages and correct use of improved seed varieties, the effective utilization of agro-chemicals, post-harvest handling, etc.) which limits their yields and income. Government extension is not able to effectively satisfy this need, nor is it equipped to do so. This lack of knowledge is evidenced by low levels of productivity throughout the country, especially in provinces such as NTT (see section 2).

#### *Lack of access to improved seed varieties*

Of all the inputs used in maize production, none has the ability to affect productivity as much as seed. If farmers can obtain improved maize seed that performs well under local conditions, the efficiency of all other inputs is increased and productivity rises. Despite commendable progress in introducing new and improved maize seed varieties the majority of farmers, especially in more remote areas, lack access and are not well informed about these improved varieties. This is due in part to the lack of private sector distribution channels that reach all farmers with both seed and technical information.

Improved seed will address many issues including disease. As discussed in section 2, farmers in the target provinces increasingly face problems with pests and diseases such as '*bulai'*, or downy mildew, which in the last three years has caused up to 50% losses for some farmers[11], particularly in high intensity agriculture areas such as EJ. The identification, development and marketing of improved varieties to address problems such as this could result in dramatic increases in both production and income levels of farmers.

Moreover, the majority of maize used by the feed industry is produced using hybrid varieties (USDA, 2012b). With the rapid growth of the animal feed business, feed mills will be looking to source increasing quantities of maize that is produced with improved varieties.

### *Lack of access to input credit*

Many farmers interviewed referred to their lack of financial capacity to purchase the seed and agro-chemicals needed for optimal production, exacerbated by rising costs of inputs. Table 17 below was provided by a retailer interviewed in NTB, sharing information on price increases for hybrid maize seed.

**Table 17 Hybrid seed prices in NTB**

| Brand | Price (IDR/kg) last season | Price (IDR/kg) this season |
|---|---|---|
| BISI-2 | 45,000 | 48,000 |
| PAC | 56,000 | (projected) 61,500 |
| DK | 48,500 | 58,500 |
| RK | New | 47,500 |
| Pioneer | 56,000 | (projected) 61,500 |

*Source: Retailer in NTB, October 2012*

Farmers' inability to finance inputs can lead them to forego the use of those inputs and/or purchase inferior quality, which has ramifications on both productivity and profits. One of the reasons that farmers lack access to inputs on credit is the lack of more formal procurement arrangements with buyers – whereby the buyers are sometimes willing to pre-finance the producers.

### *Lack of access to a) appropriate and affordable crop drying technologies, and; b) tools and methods for maize moisture measurement*

As noted in Section 3, one of the most important product standards for maize is moisture content. The moisture level for feed maize in Indonesia is high, ranging from 17-20%. Sun-drying maize grain is a common practice of farmers, collectors and traders, but is problematic when there is high rainfall and humidity during the post-harvest period. Most farmers, collectors and traders lack equipment and facilities to effectively dry maize grain, particularly during the rainy season, which results in lower overall quality of maize in the supply chain. They also lack effective tools and methods for testing the moisture content of their maize.

[11] *This figure cited during field interviews.*

Effectively drying maize is essential for preventing germination of the grain, the growth of micro-organisms and insect infestation once the grain is put into storage. Artificial drying is necessary in unfavourable climatic conditions (such as high rainfall and humidity) to ensure safe storage (International Labour Organization, 1984). Despite the importance of both properly dried maize and a system of 'discounts' or penalties imposed by buyers when the moisture content is higher than the industry standard, most farmers and traders do not see the cost-benefit advantage of improved drying. However, several collectors and traders interviewed in EJ and NTB did express the need for more efficient ways to dry maize (and other commodities they trade).

### *Lack of appropriate technologies and methods to store maize*

Subsistence level farmers in NTT consume the majority of maize they produce and face losses of up to 50% due to poor post-harvest storage conditions (which subject the maize to infestation by mice and weevils) (Benu et al, 2011). Poor storage and weevil infestations also render the maize even more susceptible to aflatoxin (Cooke, 1998).

Subsistence maize yields per hectare in Indonesia are historically low since little or no fertilizer is used and the local varieties have to be of the flint type (very hard) to survive in storage for longer than three months. The traditional varieties have not been selected for yield but for storage ability. Weevils (*Sitophylus zeamais*) can consume up to 80 to 90% of stored maize hybrids in less than six months of traditional storage, which usually involves cobs being hung above a kitchen fire or in a special storage shed where the maize is blackened by the smoke. High-yielding modern maize hybrids are at present not attractive to local farmers because of these associated storage problems.

Research from the National University of Timor Lorosa in East Timor shows that local maize varieties are more resistant to weevils than modern high yielding open pollinated and hybrid varieties when using traditional storage methods (UNTL, 2006). This discourages the use of the improved hybrid and OPV varieties that achieve much higher yields. Farmers are unprepared to invest in inputs to achieve higher yields only to lose the grain post-harvest during storage.

Current higher yielding varieties can be weevil resistant when they are stored in airtight containers. The storage of local varieties can also benefit from this. Local (and modern) varieties can have zero incidences of weevils when stored in sealed airtight containers for up to 33 weeks (UNTL, 2006).

The level of weevil damage to maize varied according to storage method and maize variety. Whereas there was no weevil damage in any sealed (airtight) containers, there were losses for all other methods of storage. Storage of shelled maize in a sack provided no protection, with virtually total loss by 33 weeks. Storage in the sheath above a fireplace, in a tree, or in an elevated house were in many cases quite effective methods of storage for local maize varieties, with some samples showing little weevil damage even at 33 weeks. However, these methods of storage were not effective for modern varieties, with very significant weevil damage in some samples by 15 weeks, and in all samples by 33 weeks. This is a significant finding in relation to the promotion of high yield varieties of maize; their use must be coupled with airtight methods of storage, lest the benefit of the higher yields be lost via post-harvest damage.

Public sector and NGO efforts to introduce such containers in NTT have faced many challenges and the uptake by farmers of tools such as jerry cans and plastic and steel barrels has been slow.[12]

Until maize storage is addressed (e.g. by the use of appropriate airtight containers or weevil resistant seed), or unless a strong market develops for animal feed in NTT, it is unlikely that there will be yield improvement in maize production in the traditional maize growing areas. If maize storage conditions are improved, it is anticipated that the use of advanced inputs and modern OPVs and hybrids will increase.

### *Additional Constraints*

- Farmers in NTB often face labour shortages at maize harvesting time which can result in harvesting taking up to 30 days instead of five. This puts financial constraints on farming households forced to wait a longer period to sell their grain and can also deteriorate the quality of the grain (due to rodents, pests and rainfall).
- Diluted or 'fake' agro-chemicals and seed sold on the market affects farmer productivity, create a bad impression of improved inputs, and damages the brands and competitiveness of input suppliers selling authentic goods.
- The distribution of subsidized inputs from the government (seed and fertilizer) creates disincentives for private sector input supply companies to invest in new products and distribution channels, or to provide training and information to farmers about their products. It also curbs the growth and competitiveness of retailers and distributors. Several input supply retailers interviewed stated that they have experienced decreases in sales volumes since the government subsidy program for seed and fertilizer was introduced in 2007.
- Subsidies for specific types of fertilizer limits innovation with new fertilizers, prompting farmers to choose fertilizers that may not be the most appropriate for their needs.
- Lack of market information on both domestic and international prices for maize results in uninformed decision-making for some in the value chain, potentially limiting income.
- Seed producers (e.g. Monsanto) are still awaiting approval to commercialize GM seed in Indonesia (although they can conduct GM field trials) in spite of farmer demand for the seed and potential productivity gains.
- Feed mills (such as PT Charoen Pokphond Indonesia) have difficulty ensuring consistent quality of maize purchased due to the large network of traders and collectors used. Though for the most part this system works for them, it limits their ability to control quality, increases their costs, and decreases the quality of their end products.
- Poor road conditions in all provinces (particularly during the rainy season) increase the cost of transportation for farmers and collectors, adding to expenses and limiting revenues. As an example, the transportation expenses for a collector in NTB doubles from 50,000 IDR/t in the dry season to 100,000 IDR/t in the rainy season.

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*[12] Cited in interviews conducted by a local commodity specialist working on previous efforts to introduce appropriate storage technologies, as well as a local NGO working in the maize value chain, YMTM.*

- Lack of irrigation in many areas prevents the growing of off-season maize.

## 3.9 Value Chain Development Prospects

The table below presents illustrative market-based solutions that may help to address the constraints outlined in the previous section. These market based solutions will need to be assessed in more detail by further interviews with potential providers and users of the proposed solutions to understand their incentives (or lack thereof) for using/accessing them.

The table also presents the level of priority of the proposed solutions by ranking the ‘potential to increase the growth and competitiveness of the value chain’ and the ‘number of micro, small and medium enterprises (MSMEs) impacted’). Although the ranking given to these two criteria is inherently subjective, it does offer some structure to support the process of future decision-making regarding further research, program design and implementation.

**Table 18 Market-based solutions to address selected constraints**

| Constraints | Market-Based Solution (MBS) | Existing/ Potential MBS Providers | Potential to increase growth and competitiveness of the value chain | No. of MSMEs impacted |
|---|---|---|---|---|
| All provinces | | | | |
| Farmers lack technical knowledge, from planting to effective use of agro-chemicals and post-harvest handling, thereby limiting their yields and income. | 1. Provision of technical information to farmers on production and post-harvest handling to increase yields and income. | *Input supply manufacturers, wholesalers, and retailers* | High | High |
| The majority of farmers in the target areas, especially in more remote areas, lack access to or are not well informed about improved maize seed varieties | 2. Access to improved seed varieties for farmers, such as varieties with resistance to downy mildew | *Seed companies* | Medium/High | High |
| Farmers lack input credit for seed, fertilizer, herbicide, etc. As a result, the economic returns per hectare are not optimized and income from maize is limited. | 3. Access to input credit for farmers | *Wholesalers, feed mills, financial institutions* | Medium | High |
| Most farmers, collectors and traders lack equipment and facilities to effectively dry maize grain. They also lack effective tools and methods for testing the moisture content of their maize. | 4. Access to: a) appropriate and affordable crop drying technologies, and; b) tools and methods for maize moisture measurement. | *Agricultural equipment suppliers* | High | Low/ Medium |
| NTT | | | | |
| Farmers lack access to and training in storage methods and appropriate technologies for maize. Subsistence level farmers in NTT face losses of up to 50% due to poor post-harvest storage conditions | 5. Access to and training in storage methods and appropriate technologies for maize. | *Input suppliers, agricultural equipment suppliers* | Low | High |

This study also identified market actors in the maize value chain with the greatest interest in providing these market based solutions as part of their commercial operations. These market actors face risks and challenges, however, in implementation. These are discussed below in section 4.

# 4 Pro-Poor Value Chain Development Opportunities

In the course of the study, AFE selected market-based solutions that directly address key constraints outlined in the previous section.

These assessments (outlined below) include a presentation of the targeted market-based solutions, any existing/ potential private sector providers of the market-based solutions, as well as the challenges and incentives that these firms may have in providing, or delivering the market-based solutions in a commercially viable and sustainable manner.

The incentives identified under each proposed market-based solution describe specific reasons and motivations for solution providers to reach the target group, such as increased sales, expanded distribution networks, and new product markets. The assessment then presents 'illustrative project facilitation activities' that could be undertaken (through the upcoming AIPD-Rural program) to support targeted firms to overcome the challenges they face in providing selected market-based solutions and also to provide them with incentives to help reduce their risks and encourage them to develop the market-based solution in the short-term.

Finally, potential project impact and outreach estimates have been provided for each proposed market-based solution. Where the proposed market-based solution is quite broad (e.g. improved seed varieties and access to finance to famers) the estimated outreach is based on a percentage of farmers reached using provincial maize production data. Where the market-based solution is focused (e.g. production information to farmers and access to drying technologies for collectors) the estimates are based on AIPD-Rural district maize production figures (see Table 19 below).

**Table 19 Assumptions for calculating estimated outreach for market-based solutions**

| AIPD-Rural Provinces | Maize harvested area (ha) | Ha per Farmers* | Number of farmers* | Current use of hybrid seeds* | Farmers using hybrid seeds* | Farmers using OPV or local seeds* |
|---|---|---|---|---|---|---|
| EJ | 1,257,721 | 0.3 | 2,096,202 | 60% | 1,257,721 | 838,481 |
| NTB | 61,593 | 0.5 | 61,593 | 30% | 18,478 | 43,115 |
| NTT | 244,583 | 0.5 | 244,583 | 20% | 48,917 | 195,666 |
| Total | 1,563,897 | | 2,402,378 | | 1,325,116 | 1,077,262 |
| AIPD-Rural Districts | | | | | | |
| EJ | 194,648 | 0.3 | 324,413 | 60% | 194,648 | 129,765 |
| NTB | 34,722 | 0.5 | 34,722 | 30% | 10,417 | 24,305 |
| NTT | 45,219 | 0.5 | 45,219 | 20% | 9,044 | 36,175 |
| Total | 274,589 | | 404,354 | | 214,108 | 190,246 |

*Source: BPS (National Statistics Bureau 2012)*

** Author's estimates based on field work findings*

It is important to note that the ultimate feasibility of these proposed activities, and the details of how they will be implemented will only be able to be determined closer to project implementation, once more in-depth discussions are held with the targeted market actors.

## 4.1 Provision of Technical Information for Farmers in Production and Post-Harvest Handling

*Corresponding constraint*

Farmers lack technical knowledge, from planting to effective use of agro-chemicals and post-harvest handling, thereby limiting their yields and income. Government extension is not able to effectively satisfy the need for technical information and training, nor is it equipped to do so.

*Proposed provider(s)*

A sustainable delivery model to reach the target group is via input supply manufacturers, maize wholesalers, retailers, and feed mills who have incentives to deliver this market based solution to farmers over the longer term (specific incentives are described in more detail below).

Several input supply companies interviewed expressed a particular interest in improving the way in which they disseminate information to farmers regarding the best use of inputs to improve yields and profitability for farmers. These include Toko Waris (Kupang, NTT), BISI Seed, and CV Sumber Alam (Dompu, NTB).

### 4.1.1 Challenges and incentives for providers of the market-based solution

*Challenges*

The targeted providers' staff are not well equipped with technical knowledge and skills to advise farmers. The geographic coverage for many providers is also limited due to lack of staff. Finally, some farmers are unable to read information provided in training materials.

*Incentives*

Input suppliers have an incentive to provide this market-based solution as it can help them to expand their distribution networks and increase sales with a new customer base. Buyers and mills can develop new and improved sources of supply. As the user of this market-based solution, farmers have the incentive to increase productivity and income.

*Projected impact and outreach*

The focus of this market-based solution should be in production areas within the selected AIPD-Rural target districts, where farmers have better access to input supply shops. Assuming the project will target two major input shops in each district, reaching 10% of maize farmers in the district over the life of the project, the number of farmers impacted is in the order of 40,000.

The following simulation represents the potential impact this market-based solution could have at the farmer level. It is based on Farmer type one from section 3.3.4 – rain-fed system, hybrid, subsidised seed, no technical assistance. The simulation is based on the adoption of the outlined activities each season, and Table 20 shows the impact on gross margin.

- ***Season 1:*** Farmer adopts more targeted use of agricultural inputs (not including seed) and technical advice from input supply companies, resulting in 15% increase in yield (no additional costs).

- ***Season 2:*** Farmer adds improved varieties of hybrid seed (and knowledge in use of those seeds) purchased from input supply company resulting in 25% increase in yield (with 5% increase in costs).
- ***Season 3:*** Farmer adds improved drying and storage techniques and enters into a direct procurement arrangement with a feed mill, resulting in a price increase of 15% (no collector), the removal of a 3% moisture penalty, and a 6% increase in total costs due to additional labour drying requirements.

**Table 20 Gross margin simulation –improved inputs and hybrids, Bima, NTB**

| Cost Component (IDR/ha) | Current Period | Season 1 | Season 2 | Season 3 |
|---|---|---|---|---|
| Change in production | | 15% | 25% | 18%* |
| Total Revenue (IDR/ha) | 10,310,700 | 11,857,305 | 14,821,631 | 17,489,524 |
| Change in total costs | | - | +5% | +6% |
| Total costs (IDR/ha) | 5,807,500 | 5,807,500 | 6,097,875 | 6,167,500 |
| Total revenue-total cost (IDR/ha) | 4,503,200 | 6,049,805 | 8,723,756 | 11,322,024 |
| Total revenue-total cost (US$/ha) | $460 | $617 | $890 | $1,155 |

*Source: Author's calculations*

** Price improvement and reduction in penalties only. Not a yield increase.*

What is evident by this simulation is the increase in gross margin at the farm level possible as a result of the interventions outlined. With a focus on use of inputs, coupled with technical advice on how to apply and use them properly, revenue per hectare could be increased by 34%. By incorporating the use of improved seed varieties (hybrid), a further 44% increase in revenue is achieved. The adoption of all activities across the three seasons will deliver a 151% increase in revenue to the farmer. Under this simulation, the yield realised by the farmer has reached 7.8 t/ha. This is comparable to yields being achieved currently, under similar practices, in EJ.

### 4.1.2 Illustrative project facilitation activities

#### *Description of the activity*

This initiative involves: 1) promoting activities of private sector input supply companies to develop new products adapted to small-scale growers, introduce new varieties, build staff expertise, expand distribution networks, and promote their products and services, and; 2) supporting maize buyers (wholesalers, feed mills, etc.) to provide information and extension services to farmers in their supply chain.

#### *Facilitation role of the project*

Assist / support / build capacity of LFs to:

1. Demonstrate improved seed varieties and production practices to farmers through demonstration plots and field days. The project could support the LFs to:
    - Mobilize producers and conduct site identification;

- Prepare and organize farmer demonstration plots;
- Prepare and deliver farmer field days; and
- Develop indicators and monitor demonstration plots.

2. Train input supply retailers and producers in improved production practices through the safe handling and appropriate use of agrochemicals. The project could support the LFs to:
    - Raise awareness with producers;
    - Develop and print of producers' manuals and pamphlets that present safe handling and appropriate use of agrochemicals, with a focus on graphic rather than text-based delivery
    - Deliver training for input supply retailers and farmers;
    - Prepare and monitor demonstration plots (including data collection); and
    - Organize field days for farmers.
3. Train selected input supply retailers and lead farmers to become distribution and technical support agents for the company's products. The project could support the LFs to:
    - Develop strategies for developing rural agent networks;
    - Prepare and deliver training sessions for input supply retailers and lead farmers;
    - Prepare, organize and monitor demonstration plots and farmer field days.
    - Conduct training of trainers to build the capacity of staff to provide hands-on training in all aspects of maize production to farmers (including spacing, seed utilization, fertilizer application, use of herbicides, irrigation, planting and harvesting schedules, crop rotation).
    - Conduct pilot training programs with producers from which they buy or to whom they sell.

## 4.2 Access to Affordable Improved Seed Varieties

### *Corresponding constraint*

The majority of farmers in the target areas, especially in more remote areas, lack access to or are not well informed about improved maize seed varieties

### *Proposed provider(s)*

A sustainable delivery model to reach the target group is via private sector seed companies that have incentives to deliver this market-based solution to farmers over the longer term (specific incentives are described in detail below).

Several of the seed companies interviewed have expressed an interest in carrying out these initiatives including Pioneer Seed, Monsanto, Syngenta, and BISI.

### 4.2.1 Challenges and incentives for providers of the market-based solution

#### *Challenges*

Private sector seed companies lack distribution networks needed to reach targeted farmers in more remote areas. Staff often lacks skills in training and extension for farmers. Government subsidies of seed represent a competitive challenge. Finally, developing new and improved seed varieties can take several years.

#### *Incentives*

Companies have an opportunity to increase sales by expanding their distribution networks and offering new products that satisfy farmer needs. As users of this market-based solution, farmers can reduce loss and increase income with better seed varieties.

#### *Projected impact and outreach*

Better access to affordable improved seed varieties is potentially applicable to all farmers in the AIPD-Rural provinces, providing benefits to farmers not yet using hybrid seeds. Assuming 10% of farmers increase their use of hybrid seeds as a result of project interventions approximately 100,000 farmers could be reached over the life of the project.

The following simulation represents the potential impact this market-based solution could have at the farmer level. It is based on Farmer type two from section 3.3.4 – OVP to hybrid, retains 50% of production, sells through local farmer group who offer some technical advice but also sell the farmer his inputs. The simulation is based on the adoption of the outlined activities each season, and Table 21 shows the impact on gross margin.

- ***Season 1:*** Farmer maintains both the current level of agricultural inputs and improved OPV use. Technical advice from input supply companies on appropriate fertilizer and herbicide use results in an increase in production of 25% to 3.5 tonne[13]. Harvesting, shelling, drying and packaging of additional yield increases total costs slightly by (4%).
- ***Season 2:*** Technical advice from input supply companies continues. Farmer adopts improved variety of hybrid seed (yield 4.5 t/ha) on 60% of the area. Yield of OPV increases 10%. Farmer's yield increases to 4.25 t/ha. Use of fertilizer, purchase of hybrid seed and additional labour costs increases total costs by 13%. All hybrid seed is sold immediately post-harvest so there is no requirement for airtight storage. OPV is stored for replanting and consumption using traditional methods. Post-harvest losses for Lamuru are equivalent or better than local varieties after 5 months (Murdolelono and Hosang, 2009). There may be a benefit in introducing airtight storage for OPV (e.g. Lamuru) seed retained for consumption for periods longer than 5 months.
- ***Season 3:*** Farmer increases fertilizer use (total cost increase 9% to support improved yields from modern OPV (4.2 t/ha) and hybrid (5.7 t/ha). Total area planted to hybrid increases to 75% with a slight increase in cost for additional seed. The requirement for additional labour (application of inputs, harvesting, threshing, drying and packing) increases total costs by a further 6%. Farmer's yield increases to 5.3 t/ha. Again, OPV is retained for personal use while all hybrid seed is sold.

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*[13] Hosang et al (2010) reports on trials that delivered Lamuru yields of 3.9 t/ha (at Benlutu) and 2.4 t/ha (at Mnelalete)*

**Table 21 Gross margin simulation – modern OPV to hybrid, Kupang, NTT**

| Cost Component (IDR/ha) | Current Period | Season 1 | Season 2 | Season 3 |
|---|---|---|---|---|
| Change in production | | 25% | 21% | 25% |
| Total Revenue (IDR/ha) | 7,000,000 | 8,750,000 | 10,587,500 | 13,234,375 |
| Change in costs | | 4% | 13% | 15% |
| Total costs (IDR/ha) | 3,614,000 | 3,758,560 | 4,247,173 | 4,884,249 |
| Total revenue-total cost (IDR/ha) | 3,386,000 | 4,991,440 | 6,340,327 | 8,350,126 |
| Total revenue-total cost (US$/ha) | $345 | $509 | $647 | $852 |

*Source: Author's calculations*

Similar to the previous simulation (for Farmer one), a focus on the use of inputs, coupled with technical advice on how to apply and use them correctly, can deliver a revenue per hectare increase of 48% in the first season. By adopting hybrid on 50% of the area there is 21% increase in total yield in the second year. With the expansion of hybrid maize area in the third year, along with increased yield, the adoption of all activities across the three seasons will deliver a 246% increase in revenue per hectare. If the farmer maintains the practice of retaining OPV for personal consumption and sells the remainder of production, an additional $626 per annum is achieved by season 3. Under this simulation, the yield realised has reached 5.3 t/ha. This is comparable to the current average maize yield in NTB of 5.4t/ha.

### 4.2.2 Illustrative project facilitation activities

#### *Description of the activity*

This activity involves supporting seed companies to: 1) identify and introduce new varieties of maize seed; 2) participate in lateral learning activities, and; 3) build the capacity of their staff in seed production, storage, and management.

#### *Facilitation role of the project:*

Assist / support / build capacity of LFs to:

1. Identify / introduce new varieties of maize seed. The project could support LFs to:
    - research international seed companies that offer improved varieties;
    - conduct visits to meet with these companies to identify and procure samples; and
    - conduct trials at multiple sites in conjunction with government seed authorities to gain release of new varieties.
2. Support lateral learning activities among private sector seed companies (developing social capital among staff) through facilitation of:
    - Regular workshops and networking meetings among seed companies to share best practices in seed multiplication;
    - Sharing sessions between seed company technical staff and input supply companies; and
    - Demonstrations of new technologies.

3. Build the capacity of staff in seed production, storage, and management through participation at international conferences and training activities such as the World Vegetable Center program on:
    - Seed production, seed health and seedling management;
    - Good agricultural practices;
    - Integrated disease management; and
    - Integrated pest management.

## 4.3 Access to and Training in Storage Methods and Technologies for Maize Farmers

***Corresponding constraint***

Farmers lack access to and training in storage methods and appropriate technologies for maize. Subsistence level farmers in NTT face losses of up to 20% due to poor post-harvest storage conditions. Farmers believe that local maize varieties are more resistant to weevils than improved seed which discourages the use of the improved varieties that can generate higher yields.

***Proposed provider(s)***

A sustainable delivery model to reach the target group is through agricultural equipment suppliers and input supply companies which have incentives to deliver this market-based solution to farmers over the longer term (specific incentives are described in more detail below).

### 4.3.1 Challenges and incentives for providers of the market-based solution

***Challenges***

Farmers have used traditional storage methods for many years and are resistant to change. Companies lack business and marketing plans to effectively promote the most promising methods and equipment.

***Incentives***

Agricultural equipment and input suppliers have an incentive to develop new product lines that they can sell. Farmers have incentives to use these new technologies in order to increase their food security and reduce losses.

***Impact and outreach***

Assuming that 5% of farmers in AIPD-Rural districts can afford or apply the technologies successfully, potential outreach is in the order of 20,000 farmers.

Analysis by IFAD (2011) shows that the introduction of 200L storage drums can increase household income by $19 per drum (assuming a cash income of $100 per annum) or improve food security by 3% per drum. These represent significant benefits through higher yields and increased food security as a first step in further determining and assessing appropriate solutions to this farmer-level constraint. The greatest challenge facing this potential intervention is developing a sustainable market based supply model for large quantities of drums. Only once it is understood why there is a reluctance to use sealed drums can potential private sector solution providers be identified to develop a sustainable production and delivery model. This could perhaps include private seed companies introducing modern OPV varieties that are interested in / willing to also introduce airtight storage, along with any related seed demonstrations/field trials.

Research has shown that the transition from local OPV to modern OPV alone can result in yield increases in the order of 250 to 400% depending on location[14]. Air tight storage should be used to support the transition away from local OPVs to modern OPVs and / or hybrids.

#### *Description of the activity*

Support businesses to establish more formal procurement arrangements (buying stations) with maize producers.

#### *Facilitation role of the project*

Assist / support / build capacity of LFs to:

- Prepare staff to conduct training and extension activities;
- Identify farmers and lead farmers to participate;
- Identify sources of inputs for farmers;
- Develop strategies for financing agricultural equipment suppliers and farmers, including tripartite arrangements with banks;
- Conduct training programs for farmers;

## 4.4 Access to Crop Drying Technologies, Tools and Methods for Maize Moisture Measurement for Collectors and Traders

#### *Corresponding constraint*

Effectively drying maize is essential for preventing germination of the grain, the growth of micro-organisms and insect infestation. However, most farmers, collectors and traders lack equipment and facilities to effectively dry maize grain. They also lack effective tools and methods for testing the moisture content of their maize.

#### *Proposed provider(s)*

A sustainable delivery model to reach the target group is through feed mills, traders, and agricultural equipment suppliers which have incentives to deliver this market-based solution over the longer term (specific incentives are described in more detail below).

### 4.4.1 Challenges and incentives for providers of the market-based solution

#### *Challenges*

Farmers lack incentives to decrease moisture content because they are paid by weight. Traders are hesitant to invest in drying facilities if they can use it only for one crop.

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[14] Da Silva and Murdolelono (2010) report that maize yield in NTT is as low as 1-2 t/ha under traditional practices, but can achieve 3.4 t/ha with modern OPVs and adoption of better farming practices.

#### *Incentives*

There is clear potential for collectors and traders, the users of the market-based solution, to increase income by avoiding penalties for moisture levels above acceptable levels.

#### *Impact and outreach*

The provision of drying and moisture testing equipment will increase the competitiveness of the maize value chain in Indonesia and will have an impact on all value chain actors. If millers are able to source more maize that suits their requirements, they can rely less on imports and purchase more local maize, ultimately increasing the volume of sales for farmers and traders alike.

This market-based solution could be promoted in select districts in EJ and NTB. The estimated outreach to traders and collectors in the next three to four years is 500. Although there may not be an immediate effect on-farmer income, it is expected that income would grow over time as millers purchase more local maize from suppliers. An estimation of the number of farmers linked to collectors in AIPD-Rural districts impacted by this activity is approximately 20,000 over the life of the project.

### 4.4.2 Illustrative project facilitation activities

#### *Description of the activity*

Learning and exposure visits with feed mills, traders and/or equipment suppliers (LFs) could be held to expose them to new types of drying methods and equipment as well as moisture measurement tools. Often these concepts or ideas are best learned by LFs witnessing the new concepts/ products/ methods at work first-hand. It is possible that this could include simple strategies such as understanding and demonstrating more effective use of the polyurethane drying tarps for farmers, traders and collectors. Changes made by LFs make following learning/exploration visits could make operations more efficient and more cost-effective. A second component of this initiative involves stimulating demand for equipment supplier products such as equipment at the MSME consumer level (farmers, collectors and traders, etc.) and supporting the LFs to develop appropriate marketing and distribution channels through intermediary retail distributors.

#### *Facilitation role of the project*

Assist/ support/ build capacity of LFs to:

- Define the purpose and objectives of the study visit.
- Conduct research into potential study / learning sites and companies.
- Contact potential study sites and companies to arrange visit / exchange.
- Determine an appropriate itinerary that is both educational and cost effective.
- Draft contract (if necessary) with hosting agents.
- Coordinate the logistics of travel.
- Maintain communication during the study tour to ensure objectives are being met.
- Evaluate the exposure visit and establish a follow-up work plan to implement new ideas gained from the visit.
- Conduct demonstrations of products and technologies.

- Address the capacity constraints of retail distributors that act as intermediaries between the LF and producers / traders.
- Undertake demand assessment for their products and technologies.
- Meet and communicate regularly with retail distributors as well as consumers so that the LF can develop more appropriate responsive equipment/technologies.
- Develop efficient and cost-effective transactional mechanisms for use with retail distributors.

## 4.5 Access to Input Supply Credit for Maize Farmers

#### *Corresponding constraint*

Many farmers lack the financial capacity to purchase the seed and agro-chemicals they need for optimal production. This is exacerbated by the rising costs of these inputs. One of the reasons that farmers lack access to inputs on credit is the lack of more formal procurement arrangements with buyers – whereby the buyers are sometimes willing to pre-finance the producers.

#### *Proposed provider(s)*

The sustainable delivery model for reaching the target group is through Feed mills and maize buyers who have incentives to deliver this market-based solution to farmers over the long run (specific incentives are described in more detail below).

### 4.5.1 Challenges and incentives for providers of the market-based solution

#### *Challenges*

Feed mills and buyers do not have extensive experience engaging in direct procurement operations with maize farmers (and providing inputs on credit), or have had negative experiences in the past

#### *Incentives*

Companies involved can develop a more assured supply of maize and exercise greater control of quality and traceability. Maize farmers will have access to credit for quality inputs, resulting in higher yields and income.

#### *Impact and outreach*

The proposed market-based solution has the potential to benefit up to 20,000 maize farmers in NTB and EJ over the next three to four years assuming 5% of farmers establish the necessary documents and are able to be reached by banks and micro finance institutions.

### 4.5.2 Illustrative project facilitation activities

#### *Description of the activity*

Support companies to establish more formal procurement arrangements (outgrowing arrangements, buying stations, etc.) with maize producers.

### *Facilitation role of the project*

Assist / support / build capacity of LFs to:

- Identify the feasibility of conducting an outgrowing operation;
- Identify staff and appropriate model for outgrowing;
- Prepare staff to conduct training and extension activities;
- Identify farmers and lead farmers to participate;
- Identify sources of inputs for farmers;
- Develop strategies for financing farmers including tripartite arrangements with banks; and
- Conduct training programs for farmers.

# 5 Cross Cutting Issues

## 5.1 Gender

As with other commodities, men are in charge of buying inputs for maize production (where inputs are bought at all). They are also responsible for deciding if and when maize is planted. Ploughing and preparation of land is also usually carried out by men, while harvesting of maize is usually done in mixed groups of men and women.

Women do have an important role in maize production. They are particularly active in planting and harvesting, and also participate in post-harvesting activities like threshing and drying. The research team found that in NTT, planting is sometimes done in groups and neighbours help each other. In these situations, they do not pay each other for the help provided, but are offered lunch and coffee instead. The expectation is that this support will be reciprocated, in an agricultural application of the broader Indonesian socio-cultural principle of 'gotong-royong' (neighbourly reciprocity).

Previously, women also participated in weeding. However, as the value chain study on maize found, with the increasing use of chemical inputs, there is a decreasing need for weeding. This is both an opportunity for savings in women's labour time and also a threat, because of their reduced opportunity to interact with other women, loss of income and loss of opportunity for reciprocal labour.

The value chain research highlights some problems with current practices in drying maize, where women usually have some involvement. These problems are related to the way maize is purchased from producers and the lack of proper equipment to dry and measure moisture levels in maize. This offers an opportunity for potential training of groups of women regarding how to dry maize properly, and how to negotiate with buyers to ensure they get a good price for their maize with consideration to moisture levels.

Women are also involved in the storing of maize and its management in storage. Some informants claim that while men are closely involved in the storage of maize for household consumption (as it requires climbing up to the storage place), women are responsible for managing the stored maize. A social ritual/convention dictates that in some places, such as in West Timor, only women can access storage facilities to collect the maize for consumption or before cooking. While this is in line with the social norm that women are responsible for household food and administration, it also means that women must stay close to their households at all times to be able to access maize for the family's consumption. This obviously imposes limitations on their capacity to travel far away from the household for long periods of time, for instance to attend training, to go to a distant market, etc.

When maize is to be eaten at home, women thresh and pound the maize, a process called *Luruh* in NTT. Women also sometimes participate in the processing of maize at the household level, especially when this is grown for self-consumption, but also sometimes in small enterprises, to sell as snacks.

Men tend to be in charge of selling maize to collectors both at the farm gate and/or at other selling points. However, some households bring their maize to the market where women are in charge of selling it. As with other commodities, although women obtain the money when they sell maize (and other products) at wet markets, men mostly have control over the household income.

### 5.1.1 Access to and control over resources

As with most other commodities, women have limited access to knowledge on better farming practices and inputs. Men are usually the ones who attend trainings and they are expected by training providers to share their knowledge with their wives. This usually does not occur.

In NTT, wages for men were found to be higher than wages for women, but differences were small and are tending to decrease.

Although women obtain the money when they sell maize (and other products) at wet markets, men still have control over the household income. Women are able to manage money for household expenses, but men decide when and how to make large investments, such as when to buy a water pump or a motorcycle.

### 5.1.2 Decision making

As per above, men decide if and when maize is planted. Both men and women participate in marketing decisions. Women are able to sell maize in small quantities while men are in charge of selling maize when larger quantities are being traded by households (i.e. more than 500 kg).

### 5.1.3 Factors to consider during the implementation of interventions

Women could benefit from direct involvement in training on improved farming practices and use of inputs. However, it is important to note that women may have limited mobility to travel to neighbouring villages or towns for training, so an increased number of smaller training sessions located at the village level would be more appropriate. Women are also involved in a number of household activities that restrict their capacity to attend trainings and tours, which must be factored into the scheduling of training sessions. Furthermore, it may be challenging to contravene social norms that indicate that only men should attend trainings, . The prior educational level of women also needs to be assessed, so that training is tailored to their needs and capacity.

It was noted that restrictions in the mobility of women vary among regions and must be taken into consideration. For instance, informants claim that in NTT, women are able to travel alone (i.e. without their husbands) to study tours, especially if this is done in groups. If they go in groups it is also likely that they will be more motivated.

The provision of information and training in post-harvest handling, as recommended by the maize value chain study, is also a clear entry point for the increased involvement of women in the maize value chain, in particular at the production and/or farm level.

The increasing use of chemical inputs that reduces the need for weeding, where women usually participate, can result in displacement of women for an important income generating activity which is done outside their home, where they can interact with other men and women. However, it can present an opportunity if women use this time in other income-generating activities, preferably outside their homes.

As recommended in the maize value chain report, attention should be given to improving the way maize is dried. Providing better access for women to appropriate and affordable crop drying technologies and tools and methods for maize moisture measurement, along with training on how to use these tools, could help increase the participation of women in maize processing and thus increase their income.

Considering that women play an important traditional role in the storing of maize, the suggested intervention of providing access to, and training on, better storage methods and appropriate technologies can have a natural focus on women. 'Modernising' some of the storage facilities and practices, while allowing women to remain in control of the activity, can help provide women with knowledge and retain their visibility at home.

## 5.2 Environment

The maize value chain study identified several environmental concerns in the sector. The excessive use of inputs, i.e. fertilizers and pesticides, was one such concern. Informants claim that for maize, as for other crops, farmers have limited information on the use of inputs and they tend to overuse them. Furthermore, farmers have little access to sources of information on the use of inputs specific for maize cultivation.

The promotion and adoption of minimum or zero tillage (the use of herbicides to control weed growth) within maize production systems can have positive impacts on soil health (carbon cycling), reduce soil erosion (retaining ground cover) and reduce the risks associated with variable rainfall (mainly reduced) through mulch retention. However, these positive environmental benefits are not without risks.

An issue of concern is the rapidly increasing use of agro-chemicals by farmers (often to reduce labour input requirements), without a proper understanding of their potential impacts and risks to human and environmental health. For example, there is an increased use of herbicides such as Gramoxone, which contains the active ingredient paraquate. Gramoxone is often applied pre-planting in zero or minimum tillage farming systems to vastly reduce tillage costs. If not handled appropriately, however, the herbicide is hazardous to human health. Paraquate was previously banned in Indonesia, but is now widely available in input shops. None of the informants interviewed in NTB province, including extension services officers, government officials, input suppliers or farmers, knew about the risks of using this product. Furthermore, the maize value chain study team found that herbicides with soil residual activity such as atrazine are widely applied without any recognition of their potential residual risks to subsequent crops and offsite environmental consequences.

The value chain study team found that farmers do not clearly understand that agro-chemical have active ingredients, or the way they work. For example, the idea that a product with two active ingredients could do two separate jobs was not understood and there is confusion among farmers between herbicides, insecticides and pesticides.

A further environmental/health concern is that farmers and most collectors and traders are not aware of the risks associated with aflatoxin and according to the value chain study team, none of the value chain actors have a solid understanding of the conditions that lead to infections.. Furthermore, farmers, collectors and traders lack access to a cost effective technology that can test for aflatoxin. Given the absence of awareness in the value chain of the risks associated with aflatoxin, there is currently no ability to ameliorate the problem.

Another concern for the maize value chain team was the potential opening of forest and 'new virgin land' for maize cultivation or degraded grazing land being converted in NTB province. However, informants in the province, including government officials, claim that they are not aware of any forest land being cleared for maize cultivation. They explain the sharp increase in maize production as increases in productivity and cultivation of maize on land previously being used for other crops.

### 5.2.1 Recommendations

The maize value chain study recommends increasing and improving the provision of technical information for farmers on effective use of agro-chemicals and post-harvest handling. This would be most effective with strong participation from farmers and based on a clear understanding of farmers' needs, motives and incentives to (over) use agro-chemicals and close involvement of government extension services, input supply manufacturers, wholesalers and retailers.

The maize value chain study suggests that this can be done through training input supply retailers and producers in improved production practices for safe handling and appropriate use of agrochemicals. This training could be jointly done between private sector companies and public extension workers. This would involve:

- Raising awareness among producers of the risks associated with misuse of agro-chemicals;
- Developing and printing manuals and pamphlets that present safe handling and appropriate use of agro-chemicals;
- Delivering training for input supply retailers and farmers;
- Preparing and monitoring demonstration plots (including data collection); and
- Organizing field days for farmers.

# 6 Further Research and Next Steps

## 6.1 Areas Requiring Further Research and Analysis

### 6.1.1 Storage

As part of the ongoing program design process, it will be important to understand why farmers tend to reject appropriate storage technologies (such as jerry cans and plastic barrels) in NTT where strong evidence suggests these techniques are highly effective at reducing significant post-harvest losses. In previous research by IFAD, to support the Timor-Leste Maize Storage Project Design (2011), post-harvest maize losses are 'realistically' set at 12-15%, but may be as high as 25% of production. Benu et al 2012 has estimated losses to be as high as 50% for certain varieties.

### 6.1.2 Aflatoxin

Although aflatoxin poses a challenge for the maize value chain, market actors generally lack incentives to tackle the issue. As such, the following information is separated out from MBS assessments, as it is unclear whether existing market actors have sufficient commercial incentives to promote a learning campaign on aflatoxin.

***Key constraints***

- Farmers and most collectors and traders have not heard of aflatoxin and none in the value chain have a solid understanding of the conditions that lead to infections. There is little awareness in the value chain and consequently no ability to ameliorate the problem. Poultry are highly susceptible to aflatoxin and, in extreme cases, this can lead to paralysis and death. There is a misconception around the genesis of aflatoxin (even at the level of the largest mills), whereby it is widely believed that aflatoxin is a storage issue alone. In reality, the genesis of aflatoxin infection is in the field - especially where there is a moisture deficit at flowering time and/or grain filling. In approximate terms, the critical infection period would be from 55 days after sowing onwards for a maize variety maturing in 110 days.
- Farmers, collectors and traders lack access to a cost-effective technology that can test for aflatoxin.

***Possible donor program activities to address the constraints***

- Provision of technical information and awareness building for maize farmers, traders, feed mills, poultry farmers and other stakeholders regarding the genesis of aflatoxin, and how to take preventative measures at flowering / early grain filling and post-harvest handling.
- Access to affordable and appropriate technologies for farmers and traders to test aflatoxin levels.

***Illustrative Activities***

- Facilitating collaboration between public health agencies and feed mills regarding a multi-stakeholder social marketing/awareness campaign.

- Facilitate demonstrations / information sessions for traders/ collectors on affordable aflatoxin testing equipment.

## 6.2 Recommended Next Steps

Value chain analysis and incremental program design is an ongoing process that continues into program implementation. As mentioned in section 0, more in-depth discussions with targeted market actors will need to take place as implementation nears. Some of these market actors include:

### *Input supply companies and distributors*

To better understand the incentives of input supply companies to provide the aforementioned solutions of i) provision of technical information to farmers on production and post-harvest handling to increase yields and income, and ii) improving access to affordable, improved seed varieties for farmers, such as those with resistance to downy mildew and hybrids for higher yields.

### *Feed mills in Java*

Two large-scale feed mills in EJ were interviewed, including PT Pokphand Charoen Indonesia and PT Panca Patriot Prima. However, given that these millers are key market actors and potential lead firms for the project, gaining a wider perspective from several additional feed mills may be useful for determining the potential incentives for the actors to invest in the value chain. Some additional feed mills that could be interviewed are PT Japfa Comfeed Indonesia, PT Wonokoyo, PT Cheil Jedang (Samsung), Sarifeed, CV Superindo Jaya Makmur, Sierad Produce, Gold Coin, etc.

### *The Indonesian Feed Millers' Association*

This organisation should be consulted to gain a broad overview of challenges and opportunities for millers. More in-depth questions regarding post-harvest handling, and investments feed millers are interested in for their supply chains, should be addressed.

### *Agricultural equipment manufacturers and suppliers:*

It could be useful to hold additional interviews with equipment suppliers, specifically regarding dryers, moisture meters, storage technologies and irrigation equipment in order to gain a more in-depth understanding of these product lines. Interviews should focus on incentives for manufacturers and suppliers to expand their product lines to demonstrate and sell appropriate equipment.

### *Financial institutions and others in the value chain providing credit to farmers*

Although one credit union was interviewed in Flores Timur (but they do not provide credit for maize farmers due the fact that maize is for household consumption in Flores), more focused interviews should be held with financial institutions and others in the value chain providing credit to maize farmers (such as input suppliers), in order to understand the incentives and challenges around providing credit to these farmers, and at what rates.

Most farmers and MSMEs interviewed that cited credit as a constraint noted that they did not get credit from financial institutions due to collateral requirements. It is also important to keep in mind that credit in itself is not sufficient, but rather a means to an end. In this context, a key need for farmers is access to knowledge and quality, affordable inputs, which at times cannot be accessed due to financial constraints. Table 22 below represents a list of commercial agricultural lenders in Indonesia that could be potential follow-up interviewees:

**Table 22 Top agriculture lenders – commercial banks (as of December 31, 2011)**

| No | Banks | Total loans outstanding | | Outstanding loans to agriculture sector | | % of agriculture exposure out of total o/s |
|---|---|---|---|---|---|---|
| | | IDR | US$ | IDR | US$ | |
| 1 | Mandiri | 125,488,384 | 12,549 | 12,532,772 | 1,253.28 | 10.0 |
| 2 | BRI | 112,838,806 | 11,284 | 12,267,860 | 1,226.79 | 10.9 |
| 3 | BII | 28,486,465 | 2,849 | 3,135,759 | 313.58 | 11.0 |
| 4 | BNI | 65,321,741 | 6,532 | 3,072,329 | 307.23 | 4.7 |
| 5 | Niaga | 41.746.587 | 4,175 | 2,880,846 | 288.08 | 6.9 |
| 6 | BCA | 82,388,633 | 8,239 | 2,736,703 | 273.67 | 3.3 |
| 7 | Permata | 26,489,385 | 2,649 | 1,961,151 | 196.12 | 7.4 |
| 8 | Agro | 1,956,450 | 196 | 838,687 | 83.87 | 42.9 |
| 9 | Danamon | 51,337,052 | 5,134 | 834,290 | 83.43 | 1.6 |
| 10 | Bukopin | 14,682,987 | 1,468 | 825,367 | 82.54 | 5.6 |
| 11 | NISP | 19,113,922 | 1,911 | 413,789 | 41.38 | 2.2 |
| 12 | Mega | 14,037,263 | 1,404 | 148,072 | 14.81 | 1.1 |

*Source: IFC, 2011*

****** *All the figures in millions – 1 US$=IDR 10,000*

It could be valuable to interview firms that offer drying services, such as the Sulawesi-based (and IFC-supported) buyer CV Mas Jaya to better understand their business model and if/how investing in dryers impacted the farmers that supply to them.

Several companies interviewed have expressed interest in participating in such initiatives including PT Phokphand Charoen (Surabaya, EJ). Other dryer manufacturers that might be interested include: (a) PT Rutan- Surabaya, (b) PT Pura Barutama, and (c) PT Jabar Mulia Engineering, Jakarta.

### *IFC PENSA*

It would be useful interview those that were involved in the IFC PENSA project, to understand what worked (and did not work) for increasing economic opportunities for maize farmers in Eastern Indonesia throughout the project.

### *Seeds of Life (SoL)*

While the SoL program in Timor Leste is not adopting a lead firm, MBS approach, the experiences from the program are particularly relevant to the proposed interventions in the maize sector in NTT for AIPD-Rural.

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# 8 Annexes

## Annex 1: Field Work Schedule

Field work schedule

| No. | Date | Province | District | Activity |
|---|---|---|---|---|
| 1 | 30-Sep-12 | Bali | | Team Introductions and Preparation for Reference Group Meeting |
| 2 | 1-Oct-12 | Bali | | Reference Group Meeting |
| 3 | 2-Oct-12 | Bali | | Reference Group Meeting, travel to NTB |
| 4 | 3-Oct-12 | NTB | E. and W. Lombok | Field interviews |
| 5 | 4-Oct-12 | NTB | Dompu | Field interviews |
| 6 | 5-Oct-12 | NTB | Bima | Field interviews |
| 7 | 6-Oct-12 | NTB | Bima | Field interviews |
| 8 | 7-Oct-12 | NTB | Dompu | Field interviews |
| 9 | 8-Oct-12 | NTB | E. Lombok | Field interviews |
| 10 | 9-Oct-12 | | | Travel from NTB to EJ |
| 11 | 10-Oct-12 | EJ | Surabaya | Field interviews |
| 12 | 11-Oct-12 | EJ | Sidoarjo, Mojokerto | Field interviews |
| 13 | 12-Oct-12 | EJ | Kediri | Field interviews |
| 14 | 13-Oct-12 | EJ | Kediri | Field interviews |
| 15 | 14-Oct-12 | EJ | Trenggalek | Field interviews |
| 16 | 15-Oct-12 | EJ | Trenggalek | Field interviews |
| 17 | 16-Oct-12 | EJ | Malang | Field interviews |
| 18 | 17-Oct-12 | | | Travel from EJ to NTT |
| 19 | 18-Oct-12 | NTT | Kupang, | Field interviews |
| 20 | 19-Oct-12 | NTT | Kupang, Flores*[15] | Field interviews |
| 21 | 20-Oct-12 | NTT | TTS, Flores | Field interviews |
| 22 | 21-Oct-12 | NTT | TTU, Flores | Field interviews |
| 23 | 22-Oct-12 | NTT | TTU, Flores | Field interviews |
| 24 | 23-Oct-12 | NTT | TTU, Kupang | Field interviews |
| 25 | 24-Oct-12 | NTT | | Travel from NTT to Bali |
| 26 | 25-Oct-12 | Bali | | Debrief |

Additional interviews were conducted by ACIAR during the International Maize Conference held in Sulawesi from November 22-24, 2012.

[15] *The Flores interviews were conducted separately by the ACIAR representative*

# Annex 2: Checklists

**Consolidated Checklist/Question Guide – Maize**

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| 1. **Background information** | ▪ Location/address/contact<br>▪ Number of employees<br>▪ Other businesses involved in?<br>▪ Other background information | ▪ Location/address/contact<br>▪ Number of employees<br>▪ Other businesses involved in?<br>▪ Other background information | ▪ Village/district/province<br>▪ Number of households living in village<br>▪ Typical incomes of different household categories (poorer, medium, wealthier)<br>▪ Rank main sources of household income (farm and non-farm) in village<br>▪ Rank main crops grown in village (in terms of area/income) and uses | ▪ Location/address/contact<br>▪ Main business<br>▪ No. years trading Maize<br>▪ Other crop trading, if any<br>▪ Number of employees<br>▪ Other background information | ▪ Location/address/contact<br>▪ Geographical presence in Indonesia<br>▪ Other background information |
| | Total Sales in 2011?<br>▪ % certified maize seed sales out of total sales?<br>How many distributors do you have? | Total Sales in 2011?<br>▪ % of agro-chemical sales out of total sales?<br>▪ % maize seed sales out of total sales? | ▪ % of household income from Maize (> 10%; >20%; >30%,..)<br>▪ avg. no. of maize farms in village (% maize ha. out of total ha. in village)<br>▪ What is average maize farm size in village?<br>▪ Changes in scale of maize farmers (last five years)?<br>▪ No. relatively large maize farmers in village (in ha)?<br>▪ Is village typical/atypical for importance of | ▪ Total Turnover in 2011?<br>▪ Quantity of Maize expected to trade in 2012<br>▪ Quantity of Maize traded in past 3 years? Why inter-annual variations (in tonne?) | ▪ Sales trends over past 3 years (by key product)<br>▪ Number of mills, capacity and geographical distribution<br>▪ Number of dryers, capacity and geographical distribution<br>▪ Number of warehouses, capacity and geographical distribution<br>▪ Offices responsible for procurement of maize grain<br>▪ No. of staff |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| | | | Maize? | | |
| | | | ***Socio-economic importance of Maize***<br>▪ Which activities do women participate? How? (labor, inputs, marketing, etc)<br>▪ Are they paid? Is it same as men?<br>▪ Changes in gender roles over past 5 years? Why?<br>▪ Do you hire labour (outside of HH)? What is gender composition of hired labour? | ***Other Businesses/Support***<br>Do you provide other services including:<br>– Transportation? How many trucks? From where to where?<br>– Shelling service?<br>– Maize drying facility? (capacity? Vol. processed per year? technology? how often operational?)<br>– Packaging? how?<br>– Provide loans? How (i.e. in kind, cash) To whom? (men, women, HHs). Explain system | |
| 2. **Technical know-how** | Do you have knowledge of:<br>– maize farming and post-harvest systems?<br>– certified maize seeds, their pros and cons | Do you have knowledge of:<br>– maize farming and post-harvest systems?<br>– agro-chemicals used maize farming/post- | What are your practices for:<br>– land preparation<br>– fertilization (by season)<br>– disease control (by season) | ▪ How is product stored (bulked? segregated by variety/quality?)<br>▪ Storage conditions (min/ max period kept before delivery | |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| | Where did you get this knowledge? (which is best source?)<br><br>What is missing or gaps in your technical know-how? | harvest treatments (pros and cons)?<br>– maize seed varieties (pros and cons)?<br><br>▪ Where did you get this knowledge? (which is best source?)<br>▪ Do you know environmental and human safety issues of different agro-chemicals?<br>▪ Are farmers aware of these issues? Do you discuss them with buyers? How? (i.e., one-to-one, group training)<br><br>What is missing or gaps in your technical know-how? | – pest control (by season)<br>– weed control<br>– harvesting: How do you decide when to harvest?<br>– post-harvest: practices (shelling, drying, storage, grading, packaging, other)<br><br>▪ What are your criteria for making decisions about planting times?<br>▪ What seed rates are used?<br>▪ Is seed treated with pesticides before planting?<br>▪ Changes in maize farming/post-harvest practices (last 5 years)? Why?<br><br>▪ What are Quality standards of buyers (Who sets standards?)<br>▪ How do you know and assess quality of Maize? | to next level)<br>▪ How do you check and assess product quality in storage? is there potential for development | |
| **3. Enterprise Operations** | ***Maize seed sales***<br>▪ What is seasonality and availability of certified seed? | ***Agro-input sales***<br>▪ What agro-chemicals are being sold for maize cultivation/ | ***Maize production systems***<br>▪ Maize varieties grown in village for each season? | ***Maize trading***<br>▪ Trends in maize trading (volume, quality)? Why? | ▪ What are maize quality standards of feedmill? How have they changed over past 3 years?<br>▪ How is maize quality |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| | ▪ What range of certified maize seed varieties do you sell?<br>▪ What were your sales of certified/non-certified maize seeds in 2011?<br>▪ Sales trends for certified/ uncertified maize seed (last 3 years)? Why?<br>▪ | post-harvest treatments by retailer (including brands)?<br>▪ Sales of agro-chemicals and brands in 2011?<br>▪ Sales trends for agro-chemicals and brands (last 3 years)? Why?<br>▪ Names of maize varieties sold as seed by (including brands)? Volume sold in 2011?<br>▪ Which seed varieties do most farmers prefer?<br>▪ Is seed segregated by quality? Does price of seed vary by quality?<br>▪ How is seed quality assessed?<br>▪ Time trends for sale of different maize seeds (last 3 years) and reasons<br>▪ How is seed stock stored? (storage conditions, period)<br>▪ Seasonality of acquiring and sale of seed stock | Ranking of varieties by importance and differences with other villages in area?<br>▪ What is source of planting seed? (market?, seed producer or own seed kept for next planting)<br>▪ Are you aware of any new varieties? What is source of this information?<br>▪ Can you access pure seed of new varieties? How?<br>▪ Reasons behind commodity/varietal choices (advantages, disadvantages of different varieties)<br>▪ Timeline of maize production/marketing processes in village? Same as other villages in district?<br>▪ Factors driving/hindering technology adoption (e.g. price incentives, technical know-how, physical access to inputs, post-harvest application, grading system, other)? | ▪ Strengths/weaknesses of district/province as maize exporter?<br>▪ Timing of maize trading (months)?<br>▪ Domestic supply vs. market gaps in importing provinces/districts?<br><br>***Costs***<br><br>▪ Main costs (variable and fixed)<br>▪ Costs per tonne traded | received from suppliers? Changes (last 3 years)<br>▪ Rewards/sanctions for compliance/non-compliance with product standards?<br>▪ |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| 4. **Linkages with suppliers** | | ▪ Suppliers of agro-inputs for retailer?<br>▪ Technical/other information provided by agro-input suppliers<br>▪ Services provided by agro-input suppliers (training, technical information, samples, credit, etc)<br>▪ Strengths/weaknesses in relationship with suppliers (e.g. trust, guarantees, deterrents, rewards for compliance, sanctions for not)<br>▪ Strategies to address weaknesses in supplier relationships | ***Input Purchases***<br>▪ Number of input suppliers in area (distance to shop)? Changes in last 3 years?<br>▪ Main external inputs used? Changes during last 3 years?<br>▪ Variability of inputs by season? (e.g. input X dry season , input Y @ wet season)<br>▪ Service provided by input suppliers (type of service and how often - e.g. credit, trial agro-chemical samples)<br>▪ Amount and type of technical information provided by input suppliers<br>▪ Input payment procedures (prompt payment versus delayed payment; payment in kind; interest payments) and changes during the last three years<br>Constraints in access to inputs (including price incentive, availability, quantity and quality , | ▪ Who supplies Maize to you?<br>▪ What is supplier profile (gender, location, business activities, scale, legal status, etc.)?<br>▪ What are functions performed by suppliers (e.g. grading, treatments, packaging, other)? Do women participate in any of these activities?<br>▪ What services do you provide to suppliers? (e.g. technical, inputs, credit, etc.)<br>▪ Any services directly provided to women? Which ones?<br>What information flows:<br>▪ <u>from you to suppliers</u>? (e.g. variety, cultivation, quality, delivery times, other)<br>▪ <u>from suppliers to you</u>?<br>▪ What are conditions | ▪ Who supplies maize to the feedmill? Changes over past 3 years?<br>▪ What is supplier profile (location, business activities, scale, legal status, etc)?<br>▪ How long has feedmill had business relationship with different suppliers?<br>▪ What are functions performed by suppliers (e.g., sorting, grading, treatments, packaging, other)<br>▪ What is information flows between the feedmill and suppliers?<br>▪ What are terms of contract between the feedmill and suppliers? (e.g. quality, volumes, delivery times, pricing, payment procedures, other) – Ex. of contract/purchase order?<br>▪ Strengths/weaknesses in supplier relationships<br>***Grain Procurement***<br>▪ Annual maize procurement? Monthly procurement? |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| | | | cost of inputs, other) | set by you (quality, volumes, delivery times, pricing, payment procedures, other)?<br>▪ Do you have contractual relationship with suppliers? If yes, what are terms of contract? If not, how do you link with supplier?<br>▪ How is negotiation with suppliers conducted? (Trust, guarantees, deterrents, rewards/sanctions for compliance/non-compliance)<br>▪ Strengths/weaknesses in the supplier relationships | ▪ Recent trends in maize procurement (over past 3 years) and drivers<br>▪ Share of locally procured and imported maize in total procurement, key changes (last 3 years)<br>▪ Origin of local maize (volumes/per annum)<br>▪ Origin of imported maize (volumes/per annum<br>▪ Advantages/disadvantages (in quality, prices) of locally procured versus imported Maize<br>▪ How important are Eastern Indonesia products to total procurement?<br>▪ Expectations about future maize supply trends (more local products or imports?) |
| 5. **Linkages with buyers** | ▪ Profile of buyers (farmers, input shop/retailers vs govt project, location, etc)<br>▪ What services does seed producer provide to buyers (technical advice, information about new products, product promotion, | ▪ Agro-chemical sales: main constraints? Strategies to increase sales?<br>▪ Maize seed sales: main constraints? Strategies to increase sales? | ▪ Number of maize collectors/buyers in area (Any female collectors?)<br>▪ Forms of payment (advance payments, on the spot, delayed payments)<br>▪ Typical number of collectors buying from one single household | ▪ Who buys from you? What is nature of their business (farmers, larger collector, wholesaler, snack/food producer/feedmill, households)?<br>▪ What services do | |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| | credit, …)<br>▪ Information flows from seed producer to buyers, and vice-versa<br>▪ Strengths/weaknesses in relationship with buyers (Trust, guarantees, deterrents, rewards/ sanctions for compliance/non-compliance)<br>▪ Strategies to address weaknesses in buyer relationships<br>▪ Main constraints in certified maize seed sales<br>▪ Strategies to increase certified seeds sales | ▪ Profile of buyers (farmers vs govt project, gender patterns, location, etc.)<br>▪ What services does input retailer provide to buyers (technical advice, information about new products, product promotion, credit, …)<br>▪ Information flows from retailer to buyers, and vice-versa<br>▪ Strengths/weaknesses in relationship with buyers<br>▪ Strategies to address weaknesses in buyer relationships | per year<br>▪ Stability in farmer-collector/ buyer relations (Trust, guarantees, deterrents, rewards/sanctions for compliance/non-compliance of formal and informal contracts) (can women negotiate with collectors?)<br>▪ Services provided by collectors and other buyers (input provision, credit, technical know-how, market information)<br>▪ Key changes in type of buyer and relationship between farmers and buyers (last 3 years) | they provide to you? (e.g. advisory, market information, product promotion, quality standards, etc)<br>▪ What information flows from you to buyers?<br>▪ What information flows from buyers to you?<br>▪ What conditions are set by buyers (quality, volumes, delivery times, pricing, payment procedures, other)?<br>▪ Do you have a contractual relationship with buyers? If yes, what are contract terms? If not, how do you link with your buyers?<br>▪ How are transactions negotiated? (Trust, guarantees, deterrents, rewards/sanctions for compliance/non-compliance) | |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| | | | | ▪ Strengths/weaknesses in the buyer relationships | |
| 6. **Market information/ Prices** | ▪ How does the seed producer assess the demand or market potential for different seeds? | ▪ How does the retailer find out about new agro-chemicals/seeds in the market? Which of these sources of information is the best and why?<br>▪ How does the retailer assess the demand or market potential for different agro-chemicals/seeds? | ▪ Farmers' assessment of their access to technical information<br>▪ Main sources of technical information about maize (ranking)<br>▪ Assessment of different sources of technical information (regularity of interaction, type and reliability of info. provided)<br>▪ Farmers' assessment of their access to information about maize price/market information<br>▪ Main sources of information about maize price/market information (ranking)<br>▪ Assessment of different sources of price/market information (regularity of interaction, type and reliability of info. provided)<br>***Prices***<br>▪ How is price determined? ( | ▪ Current prices in your location?<br>▪ Who sets price in purchasing? What are determining factors? Are women able to negotiate with collectors?<br>▪ Who sets price in sales? What are determining factors?<br>▪ Price seasonality<br>▪ Price trends (over past 3-5 years)<br>▪ Expectations about future price trends in location and Indonesia in general | ▪ Price differences across grades?<br>▪ Differences between local maize prices and imported maize prices?<br>▪ Seasonality/availability of maize prices<br>▪ Maize price trends (over the past three or five years)<br>▪ Current maize purchasing prices?<br>▪ Expectations about future maize price and requirement trends |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| | | | negotiation, set by traders, auction, government standards)<br>▪ What factors set the price (colour, moisture contents, foreign material, size, loan)?<br>▪ Price differentiation across varieties and qualities<br>▪ How do you find out prices?<br>▪ Current maize prices<br>▪ Price trends over past 3 years (farm-gate)<br>▪ Expectations about future prices<br>▪ Price seasonality (farm-gate)<br><br>***Credit***<br>▪ Sources of credit for households in the village (formal and informal)<br>▪ Ranking of credit sources in terms of their importance<br>▪ Advantages and disadvantages of different sources of credit<br>▪ Changes in access to credit over the past five | | |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| | | | years<br>▪ Gender differences in access to credit | | |
| **7. Constraints, opportunities and interventions (wrap-up)**<br><br>***Types of Constraints*:**<br>✓ Market Access, Trends, and Governance<br>✓ Standards and Certifications<br>✓ Technology / Product Development<br>✓ Management/ Organization<br>✓ Input Supply | ▪ Key constraints faced by seed producer (w/ranking);<br>▪ what can be done to address existing constraints? Who has to do these things?<br>▪ Opportunities for development of seed production business; barriers and strategies to develop these opportunities<br>▪ Recommendations for public and project interventions to develop markets for seeds<br>▪ Does seed producer see any opportunities for collaboration with development project intervening in maize sub-sector? If not, why not? If yes, what are opportunities for collaboration? How would s/he rank them? | ▪ Key constraints faced by the retailer (w/ranking);<br>▪ what can be done to address existing constraints? Who has to do these things?<br>▪ Opportunities for development of agro-input business; barriers and strategies to develop these opportunities<br>▪ Recommendations for public and project interventions aimed at enabling the development of markets for agro-chemicals/seeds<br>Does the retailer see any opportunities for collaboration with a development project intervening in Maize? If not, why not? If yes, what are the opportunities for collaboration? How | ▪ Key production problems/ constraints (w/ ranking)<br>▪ Key marketing problems and constraints; ranking of problems/constraints<br>▪ Strategies to overcome problems/constraints in production and marketing<br>▪ Key opportunities in production/marketing; barriers and strategies to take advantage of opportunities<br>▪ Recommendations for intervention: what type of interventions enable farmers to improve maize production and marketing? Please prioritise.<br><br>***Environment***<br>▪ Key environmental impacts (both positive and negative) associated with maize farming. | ▪ Key opportunities for development of maize business in province<br>▪ Key challenges/ constraints: what is preventing your province from becoming Maize exporter?<br>▪ Why isn't your region more competitive in national markets?<br>▪ Key changes or developments to enable your region to develop Maize? What needs to change? Key innovations required?<br>▪ Recommendations for public/project interventions to enable these developments<br>▪ Does collector see opportunities for collaboration with | ▪ Key opportunities for development of local maize supplies to the feedmill<br>▪ Key challenges and constraints: what is preventing local suppliers from selling to the feedmill?<br>▪ Key innovations required to develop high-quality domestic feedmill chains for maize?<br>▪ Recommendations for public/project interventions to develop high-value maize chains<br>Does the feedmill see opportunities for collaboration with development project intervening in maize sub-sector? If yes, what should be focus of collaboration? If not, why not?<br><br>***Policies and*** |

| | SEED PRODUCER | INPUT RETAILER | FARMERS | COLLECTOR (MAIZE) | FEEDMILL |
|---|---|---|---|---|---|
| ✓ Finance<br><br>✓ Policy/Regulation<br><br>✓ Infrastructure<br><br>✓ Business Membership Organizations | ***Policies and Regulations***<br>▪ what key policies and regulations (regional? national?) are affecting Maize?<br>▪ is policy and regulatory framework (regional? national?) conducive to or undermining maize development? How? | would s/he rank them?<br><br>***Policies and Regulations***<br>▪ what key policies and regulations (regional? national?) are affecting Maize?<br>▪ is policy and regulatory framework (regional? national?) conducive to or undermining maize development? How? | ▪ Storage and handling practices for agro-chemicals<br>▪ Issues related to agro-chemical residues in Maize<br><br>***Policies and Regulations***<br>▪ what key policies and regulations (regional? national?) are affecting Maize?<br>▪ is policy and regulatory framework (regional? national?) conducive to or undermining maize development? How? | development project intervening in Maize?<br><br>***Services***<br>▪ What are key services for a successful maize trading business?<br>▪ Who provides these services?<br>▪ What are main weaknesses/gaps in services?<br><br>***Policies and Regulations***<br>▪ what key policies and regulations (provincial and national) are affecting Maize?<br>▪ is policy and regulatory framework (regional? national?) conducive to or undermining maize development? How? | ***Regulations***<br>▪ what key policies and regulations (provincial and national) are affecting Maize?<br>▪ is policy and regulatory framework (regional? national?) conducive to or undermining maize development? How? |

# Annex 3: Detailed Gross Margins

## *Hybrid Maize Producer, NTB*

**Table 23 Detailed costs and margins hybrid maize farmer, Bima (NTB), 2012**

| Cost Component | Unit | Quantity | Description | Rate IDR/unit | Amount |
|---|---|---|---|---|---|
| **Revenue** | | | | | |
| Area | Ha | 1.0 | | | |
| Main product | tonne | 5,430 | grain | | |
| Total Revenue | IDR | | | 1,900 | 10,317,000 |
| **Material Cost** | | | | | |
| Seeds/Seedlings | kg | 10 | per 1 ha | 60,000 | 600,000 |
| Fertilizer | kg | 50 | NPK | 2,400 | 120,000 |
| | kg | 150 | UREA | 1,900 | 285,000 |
| | lt | 1 | liquid fertilizer | 75,000 | 75000 |
| | lt | 1 | liquid fertilizer | 75,000 | 75,000 |
| Pesticide | litre | 6 | 1 (herbicide) | 35,000 | 210,000 |
| | litre | 2 | 2 (herbicide) | 50,000 | 100,000 |
| | litre | 3 | 1 (pesticide) | 25,000 | 75,000 |
| Total material costs | Rp | | | | 1,540,000 |
| **Labour Cost** | | | | | |
| Land Preparation | md | 10 | | 45,000 | 450,000 |
| Planting | md | 12 | | 45,000 | 540,000 |
| Fertilizer | md | 10 | | 45,000 | 450,000 |
| Pesticide/Herbicide | md | 3 | | 45,000 | 135,000 |
| Harvesting | md | 35 | | 45,000 | 1,575,000 |
| Post-Harvest (threshing) | md | 9.5 | | 45,000 | 427,500 |
| Post-Harvest (drying) | md | 12 | | 45,000 | 540,000 |
| Total Labour cost | | | | | 4,117,500 |
| **Other cost** | | | | | |
| Gasoline/transport | litre | 30 | | 5,000 | 150,000 |
| Total other cost | | | | | 150,000 |
| Total costs | | | IDR/ha | | 5,807,500 |
| Total revenue-total cost | | | IDR/ha | | 4,509,500 |
| **Total revenue-total cost** | | | US$/ha | | **460** |

*Source: Maize team calculations based on information supplied during an individual farmer interview in Kore village, Sanggar subdistrict, Bima, NTB*

### *OPV Maize Producer, NTT*

**Table 24 Detailed costs and margins modern OPV maize farmer, Kupang (NTT), 2012**

| Cost Component | Unit | Quantity | Description | Rate IDR/unit | Amount |
|---|---|---|---|---|---|
| **Revenue** | | | | | |
| **Area** | Ha | 1 | | | |
| **Main product** | kg | 2800 | grain | | |
| **Yield** | kg/ha | 2800 | | | |
| **Total Revenue** | IDR | | | 2,500 | **7,000,000** |
| **Material Cost** | | | | | |
| Seeds/Seedlings | kg | 20 | per 1 ha | 10,000 | 200,000 |
| Fertilizer | kg | 50 | NPK | 2,400 | 120,000 |
| | kg | 150 | Urea | 2,000 | 300,000 |
| Pesticide | litre | 7 | Herbicide | 75,000 | 525,000 |
| | litre | 2 | Insecticide | 40,000 | 80,000 |
| | | | | | |
| **Total material costs** | Rp | | | | **1,225,000** |
| **Labour Cost** | | | | | |
| Land Preparation | md | 20 | | 30,000 | 600,000 |
| Planting | md | 4 | | 30,000 | 120,000 |
| Fertilizer | md | 10 | | 30,000 | 300,000 |
| Pesticide/herbicide app | md | 1.5 | | 30,000 | 45,000 |
| Weeding | md | 4 | | 30,000 | 120,000 |
| Harvesting | md | 10 | | 30,000 | 300,000 |
| Post-Harvest (threshing) | md | 8 | | 30,000 | 240,000 |
| Post-Harvest (drying) | md | 9 | | 30,000 | 270,000 |
| Post-Harvest (packaging) | md | 6 | | 30,000 | 180,000 |
| **Total Labour cost** | | | | | **2,175,000** |
| **Other cost** | | | | | |
| Group Contribution | kg | 100 | | 2000 | 200,000 |
| Transport | kg | 350 | | 40 | 14,000 |
| **Total other cost** | | | | | 214,000 |
| **Total costs** | | | IDR/ha | | **3,614,000** |
| **Total revenue-total cost** | | | IDR/ha | | **3,386,000** |
| **Total revenue-total cost** | | | US$/ha | | **345** |

*Source: Maize team calculations based on information supplied by Damianus Adar, field team member in NTT.*

## *Local Variety Maize Producer, NTT*

**Table 25  Detailed costs and margins local OPV maize farmer, TTU (NTT), 2012**

| Cost Component | Unit | Quantity | Description | Rate IDR/unit | Amount |
|---|---|---|---|---|---|
| **Revenue** | | | | | |
| **Area** | Ha | 1 | | | |
| **Main product** | kg | 1,000 | grain | | |
| **Yield** | kg/ha | 1,000 | | | |
| **Total Revenue** | IDR | | | 3,500 | **3,500,000** |
| **Material Cost** | | | | | |
| Seeds/Seedlings | kg | 10 | per 1 ha | 15,000 | 150,000 |
| **Total material costs** | Rp | | | | **150,000** |
| **Labour Cost** | | | | | |
| Land Preparation | md | 10 | | 30,000 | 300,000 |
| Planting | md | 3 | | 30,000 | 90,000 |
| Weeding | md | 22 | | 30,000 | 660,000 |
| Harvesting | md | 3 | | 30,000 | 90,000 |
| Post-Harvest (threshing) | md | 2 | | 30,000 | 60,000 |
| Post-Harvest (drying) | md | 5 | | 30,000 | 150,000 |
| Post-Harvest (packaging) | md | 6 | | 30,000 | 180,000 |
| **Total Labour cost** | | | | | **1,530,000** |
| **Other cost** | | | | | |
| Transport | trips | 2 | | 20,000 | 40,000 |
| **Total other cost** | | | | | 40,000 |
| **Total costs** | | | IDR/ha | | **1,720,000** |
| **Total revenue-total cost** | | | IDR/ha | | **1,780,000** |
| **Total revenue-total cost** | | | US$/ha | | **182** |

*Source: Maize team calculations based on information supplied by Damianus Adar, field team member in NTT.*