MASSEY UNIVERSITY
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Value Chain Analysis (Legume, maize, cattle, vegetable, mango, cassava and cashew) in Nusa Tenggara Barat

Authors:

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UNRAM PRESS

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PREFACE

Value-chains are a fundamental business model that describe the transformation of a product or service into value. Value-chain analysis maps the strengths and weaknesses of each of the steps involved with bring a product to market, and is used across the global economy to identify opportunities to increase the overall value within a value chain.

In the context of agriculture, value-chain analysis maps the actors and activities that bring an agricultural product to final consumption and can identify specific products that will benefit from development. The target benefits of development can include improved quality and price for the product, increased efficiencies in the value chain to reduce transaction costs, or new strategies to connect products to markets. In all cases, the aim of development is to increase the value in the chain, while reducing costs.Value-chain analysis is commonly used in the design of agricultural development projects to ensure the efficiency and sustainability of aid funding investment.

The East Indonesia Innovative Farm Systems and Capability for Agribusiness Activity (IFSCA), funded by the New Zealand Aid Programme of the New Zealand Government's Ministry of Foreign Affairs and Trade (MFAT), used a value chain approach to define specific products for agricultural development. IFSCA's overall aim is to use innovation and capability to create economic opportunities from sustainable farming in marginalised areas of West Nusa Tenggara Province

(NTB). IFSCA operated from 2016-2021 as a collaboration between Massey University in New Zealand and the University of Mataram in Indonesia, in partnership with the Provincial Government of West Nusa Tenggara Province, and the district governments of Lombok Utara and Dompu. Value chain analysis during design identified corn and cattle in Dompu and horticulture in North Lombok as products/sectors that would benefit from agricultural development.

At the time of writing, the IFSCA project is drawing to a close. Sustainability of IFSCA's value chain interventions will be ensured through the ongoing work of the University of Mataram (Centre for Sustainable Farm Systems), the North Lombok Horticultural Agribusiness Development Institute (LPAH), the Agribusiness Support Centre Institute (LP2A), the district governments of North Lombok and Dompu, and the farmers and value-chain actors that have been part of IFSCA over the past 6 years. This book presents the findings of IFSCA's baseline value chain analysis. I invite you to review IFSCA's baseline value-chain findings, and I encourage you to follow the progress of value-chain development by reviewing the project's Factsheets on the www.ifsca.nz website.

11th December 2020

Professor Christopher Anderson

IFSCA Project Leader

Group Leader Environmental Sciences

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INTRODUCTION

Rationale for this report

Massey University and the University of Mataram (Unram) are working with the New Zealand Aid Programme to design an agricultural activity that will contribute to poverty reduction in the eastern Indonesia province of West Nusa Tenggara (NTB) (Activity). This is to be achieved through increased productivity in the agricultural sector or a stimulation of agribusiness activity.

Specifically the activity is intended to:

- Create opportunities for the uptake of innovations by farmers in target areas
- Embedding agribusiness innovation in farmer groups stimulating economic activities within adjoining communities; and
- Improving economic opportunities and increase economic returns throughout NTB via investment and intervention in the existing agricultural system.

The general approach to design the Activity is to use value-chain analysis to inform the definition of outputs that will lead to targeted outcomes. There are numerous agricultural products grown in NTB, and assessing everyone is beyond the scope of the current project. Therefore, during a project team meeting held at Massey University from 7th to 10th October 2014, a short list of

specific agricultural products was selected for value chain analysis.

This short list consisted of four products in each of the two districts of Dompu and North Lombok:

Products	North Lombok	Dompu
	Corn	Corn
	Cattle	Cattle
	Mango (lower priority)	Cashew
	Vegetables	Soybean

These products were selected based on existing information, and the policy of district and provincial government. Value chain analysis was intended to define specific opportunities for intervention that could underpin an Activity Design Document.

Field work to conduct the value chain analysis was carried out between the 3rd and 9th November 2014. Each of the short listed products was assessed, and the resulting analysis of the value chain for each product is presented in this report.

The specific objectives of this report are to:

- Define the agricultural products that will be targeted during the Activity implementation
- Provide a clear justification for the selection of the agricultural products based on a market map for each product
- Identify parts of the value chain where innovation can achieve the goal of agribusiness development; and
- Consider enabling environment factors for each target product.

The Massey-Unram project is one of many agricultural development activities that have focussed, or are currently focusing on specific value-chains in NTB. The Australian Government (through DFAT) is particularly active in this space. DFAT is working to design a

comprehensive $112 million development programme for Eastern Indonesia: the Australia Indonesia Partnership for Decentralisation – Rural Economic Development Program (AIPD-Rural).

Decision on the specific values chains to be targeted by AIPD-Rural is being coordinated by ACIAR through the Eastern Indonesia Agribusiness Development Opportunities (EI-ADO) programme. EI-ADO has ranked the top 16 (of 32) commodities in eastern Indonesia with the 'most potential to increase the incomes of the poor' (Figure 1). Of these 16 commodities, the top 5 were selected for detailed value chain analysis. Each of the subsequent top 5 value-chain reports published by ACIAR (the ACIAR reports) has been reviewed during the current value-chain analysis, and important points are reviewed in the current report.

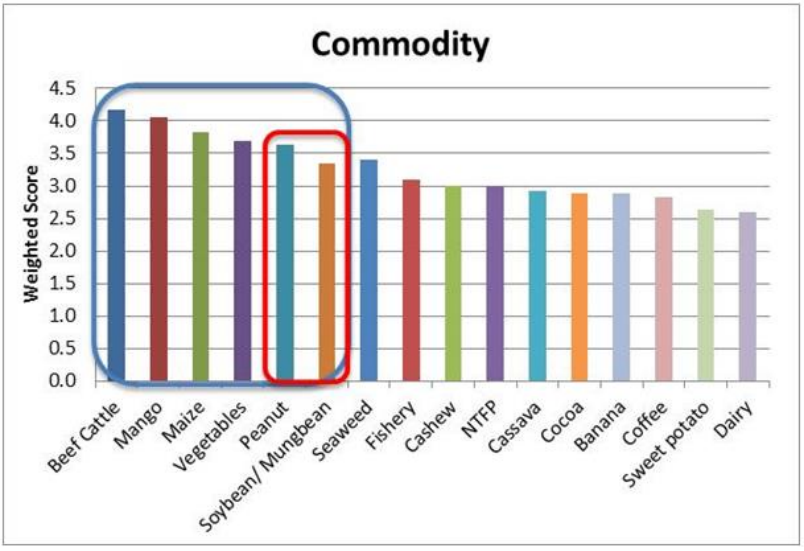


Figure 1. EI-ADO ranking of agricultural commodities produced in east Indonesia with the greatest potential to increase the income of poor farmers (source Collins Higgins Consulting). Commodities in the blue box were selected for value-chain analysis. Those in the red box were covered in a single report.

The goal of AIPD-Rural is to increase the net income of 1 million poor male and female farmers by at least 30% by 2022 (300,000 by 2017). AIPD-Rural's strategy is to address systemic constrains of the agricultural sectors that are important to poor people in target districts through improved farm practices, increased access to input and markets, and an improved sub-national business enabling environment.

The design of AIPD-Rural is occurring in partnership with Indonesia National Government Policy, including the National Medium-Term Development Plan (2010-14) targeting five commodities to achieve 90% self-sufficiency by 2014 – rice, soybean, sugar, maize and beef.

Structure of this report

The Massey-Unram value chain report (this report) presents value chain analysis of the following products:

- Soy bean
- Corn
- Cattle
- Fresh produce (covering vegetables, mango and cassava)
- Cashew

The value chain for each product is preceded by a review of key and relevant information from the corresponding ACIAR report supplemented by other information available to the project team.

No separation of the value chain for a specific product is made between the two districts. Generally the agricultural system underpinning each value chain is the same in Dompu and North Lombok. The relative importance of each value chain to poor farmers, however, changes across the two districts. This is a function of climate, geography, culture, and socio-economic conditions.

The report concludes with a section which presents contextual analysis of how the Massey-Unram partnership is relevant to agricultural development and to the attainment of the Activity goals. Common themes identified during the value chain analysis are then delineated through SWOT analysis. These common themes are used to propose interventions for the Activity.

Limitations of this report

The value chain analysis presented in this report is based on the findings of seven days of field work, and considerable desk review and discussion between members of the project team. The value chain analysis described in this report has sought to complete an analysis of the agricultural system in Dompu and North Lombok, rather than conduct detailed analysis of the value chain of a specific product. Essentially six products were assessed across two districts in seven days. This report should not, therefore, be compared to the ACIAR reports, which focused, with considerably greater resource, on specific value chains. These ACIAR reports can be consulted for additional detail on the specific value chains.

The project team has taken care in writing this report to ensure the accuracy of the contained information. However, Massey University and the University of Mataram cannot accept responsibility for the accuracy or completeness of the information or opinions presented in this report.

Background to West Nusa Tenggara Province

West Nusa Tenggara (NTB) province is an archipelago of 280 islands but with only two extensively populated islands: Lombok Island (4,739 km^2) and Sumbawa Island (15,415 km^2) (Table 1). The province is split into ten districts, each consisting of a number of sub-districts

and villages. The province experiences a monsoon climate, with a rainy season generally occurring from October to March. However, rainfall has proven unpredictable in recent years, and this has been attributed to climate change, and more specifically to the alternating sequence of El Nino and La Nina. The two districts targeted in this value-chain report are Lombok Utara (North Lombok or KLU), on Lombok Island, and Dompu on Sumbawa Island (Table 2).

Table 1. Key socio-economic figures for NTB Province (source Collins Higgins Consulting Group, 2012)

Population	4.5 million
Growth rate	1.17% per year
Population density	242 people per km^2
Households (million)	1.25 million
Average household size	3.6
Literacy rate (male/female)	81.05% (85.94%/76.74%)
Contribution of agriculture to RGDP (2008)	23.22%
Potential agricultural land	1,106,599ha
Utilised agricultural land	497,893 ha

Table 2. Key social-economic figures for North Lombok and Dompu districts (source Collins Higgins Consulting Group, 2012)

	North Lombok	Dompu
Area	809.53 km^2	2324.60 km^2
Population	200,063	219,216
Capital	Tanjung	Dompu
Number households	55,396	53,073
Average people/household	3.61	4.13
%female	50.68%	49.41%
Adult literacy	76.66%	88.67%
Poverty rate[1]	43.12	19.89
Average size of a plot of land	0.30 ha	1.0 ha

Note 1: poverty rate is the percentage of the population below the official government national poverty line.

The official Indonesian government 'poverty line' is determined by a complex function taking in what the poor spend on food to reach 2,100 calories a day, as well as costs associated with non-food goods such as housing, clothing, education and health care[1]. In 2010 this was IDR 232,989 per month (approx. US$23)for urban residents or IDR 192,354 (approx. US$19[2]) per month for rural residents There is considerable debate about the usefulness of this indicator. The Collins Higgins Consulting Group use an index of '1.5 times' the official poverty line to include the near poor, or those close to poverty. Using this index, the percentage of poor people for North Lombok increases to 79.9% and for Dompu to 47.4%.

The economy of NTB is dominated by mining/quarrying and agriculture. Together these two sectors contribute 56.2% of GDP. Agriculture is largest employer within the province, with over 47% of the population over the age of 15 involved with this sector. The importance of agriculture underpins PIJAR, the policy of the current provincial government to focus on the three commodities: corn, cattle and seaweed. Economic growth in 2010 was 6.3 %.

Despite economic development related to mining and agriculture, the incidence of poverty in NTB remains high, particularly in rural areas. Like the rest of Indonesia, a large proportion of NTB's population has limited skills, and there is a defined gender gap in the involvement of females in education and vocational skills training. Male literacy for NTB was reported in 2010 as 85.94% and female as 76.74%. This is below the Indonesian average of 95.35% for males and 90.52% for females. The World Food Programme believes that socio-economic conditions prevalent within NTB contribute to poor health and nutrition of the population, especially

[1] http://www.economist.com/blogs/banyan/2011/08/indonesias-poverty-line
[2] A rough exchange rate of USD$1 = IDR 10,000 can be considered in the reading of this report

young children and women of development age (WFP, 2013). Specifically, stunting is prevalent in 48.2% of children under five, and 30.5% of this age group are underweight. The severity of under-nutrition is ranked as critical, indicating long-term effects on children's health and mental development. The Human Development Index ranks NTB 32 out of 33 of all Indonesian Provinces.

Approach to Design: The M4P development framework. Making Markets Work for the Poor

This section provides a review of the Swiss Agency for Development and Cooperation (SDC) and Department for International Development (DFID) supported Making Markets Work for the Poor (M4P) approach to poverty reduction (Tschumi and Hagan, 2008). This is the guiding development framework which is being used by the Massey-Unram team in the design of the current Activity.

The M4P approach to development simply defines markets as 'an arrangement through which buyers and sellers exchange goods and services'. Markets have an essential role in economy in that they stimulate choice and competition so that producers are incentivised to continually improve their efficiency and product quality, thereby offering better value to consumers. In this context, markets are important to everyone, but are especially important for the poor. In the framework of M4P, markets are the direct means through which the poor participate in economic activity. Markets must work better for the poor if this sector of the population is to increase income.

For the poor to effectively participate in markets, M4P recognises a range of basic services that are essential to strengthening capacity of people to take advantage of market opportunities. M4P lists traditional services such as education, health, water and sanitation, but also services of growing relevance such as mobile telephony, vocational training and basic finance. In many scenarios, poverty is directly influenced by exclusion,

inequality or deprivation in market systems. Failure to engage the market can be a direct function of limited access to basic services, especially to those of growing relevance.

The M4P approach also focuses on the nature of market systems and interactions between actors in the value chain.

> *In a perfect economic world it is assumed that there are no costs to exchange between buyers and sellers. In the real world however buyers and sellers often lack information, lack trust or are physically separated, erecting barriers to exchange which then take resources to overcome (these are known as transaction costs). More efficient markets find ways of dealing with these costs, through mechanisms for defraying risk, making information available, maintaining and enforcing standards, and protecting consumers (these are known as institutions).*
>
> (Tschumi and Hagan, 2008)

M4P is a development approach that can effect systemic[3] change to the thinking of how market systems operate. This change has the potential to deliver substantial, sustainable impact. At the heart of M4P is consideration of how poor people interact with market systems and consideration of what role poor people can best play in the overall system. The aim of M4P is create capacity and opportunity for poor people to enhance their lives using the market system. Key to M4P development is an 'environment that enables' growth, governed by regulations, but also inclusive of relevant information, services and levels of skills and knowledge.

> *M4P success story: Katalyst, an NGO working to transform the vegetable sector in*

[3] Systemic in this context describes an action to address the underlying causes of 'under-performance' of the system as a whole and of poor people within it

> *Bangladesh. Katalyst, rather than paying for the direct delivery of training to farmers, worked initially with one (and then several) input supply firms to build their capacity to offer training to retailers so that they, in turn, would change their business offer to farmers (provide better information and advice). This approach led to a 20-30% productivity gain in vegetable production.*
>
> (Tschumi and Hagan, 2008)

M4P aims to achieve large-scale change, and justifies its legitimacy to this aim through its focus on enhancing the complete system to influence many. Development projects created under the M4P framework therefore need to continually think about extension beyond the immediate context, to leverage sustainable, expanding and enduring change. Large-scale change in the context of M4P does not necessarily mean that projects need to be national or highly resourced. Pilot-projects are acceptable. But to achieve target large-scale impacts, such projects need to be grounded in the 'incentives of players, the transactions between them and the supporting functions required for growth.'

M4P defines sustainability in the context of market: 'The market system capability to ensure that relevant, differentiated goods and services continue to be offered to and consumed by the poor beyond the period of intervention'. Key to sustainability is recognition of the facilitation role of development actors in the market. M4P development partners exist outside of the market, stimulating changes within a market system without becoming part of it. Organisations in an M4P project play an active and catalytic role that enables others to do, rather than do themselves. This role must be consistent with a vision of how the market system can work more effectively and sustainable in the longer-term.

Development actions should be guided by analysis, and M4P recognises that in many market systems information gathering and analytical capacity may be

limited. In response, M4P interventions need to develop and transfer analytical capacity to market players so that the information function can continue in the future. Collaborative innovation between public and private players can be the key to improving a market system's performance in this area.

> *The poor are dependent on market systems for their livelihoods. Therefore changing those market systems to work more effectively and sustainably for the poor will improve through livelihoods and consequently reduce poverty. More accessible and competitive markets enable poor people to find their own way out of poverty by providing real choice and opportunities.*
>
> (Tschumi and Hagan, 2008)

METHODOLOGY

The overarching methodology applied during this field study was a semi-focused survey implemented under the framework of M4P. Three techniques were used to collect data: Focus group discussion, field observation, and In-depth interview with stakeholders.

Research at each location was initiated with a focus group discussion facilitated by the Bupati and relevant staff (either agriculture and/or animal husbandry). Participants in the group discussion were selected by the Bupati office. Discussion was conducted in Bahasa, and co-chaired by Dr. Nonong (Unram) for crop value chains or Dr. Dahlan (Unram) for cattle value chains, and the relevant government official (Head of Agriculture and/or Head of Animal Husbandry). During these group discussions the co-chair followed the questionnaire template provided as an appendix to the Mission Plan[4]. Questionnaire forms were not distributed. Instead, the listed questions were used to facilitate discussion. The purpose of the group discussion was to identify the various actors in the value chain, and to collect initial data on both the actors and the key value-chain steps. A key topic of discussion and debate related to the bargaining power of actors in the various transaction processes of a value chain.

Questions during the group discussions with crop farmers followed the appendix of the Mission Plan more closely than discussions with cattle growers. To engage

[4] Submitted by the project team to NZAid

with cattle farmers, the style of questioning needed to be different, and related to cattle-specific production issues: feed, animal health, sales, as well as to the dynamics of the inter-island cattle trade, the current opinion on local vs exotic cattle, and the role of local government in the retribution of each head of cattle sold in the local and inter-island cattle market.

Local government, Kepala Dinas (Head of Department), was a key player in these group discussions (Head of Agricultural Department, Head of Animal Husbandry Department and Head of Extension Service). Kepala Dinas contributed the district government's position on assistance to cultivate crops or to grow cattle and on the standing policy to develop agricultural commodity in each district.

Table 3 summarises the number and sector affiliation of the attendees at the focus group discussions in Dompu and North Lombok (two separate discussion meetings in Dompu and a single meeting in North Lombok).

Table3. Participants in the focus group discussion

	Univ. (project team)	Input Suppliers	Producers / Farmer Groups	Govt. officer/ Extension workers	Traders	Users Hotels	NGO TVRI	Total
Dompu (crops)	9	3	13	26	-		-	51
Dompu (cattle)	9		7	4	2		1	23
KLU	12	1	13	25	-	3	3	57

Focus group discussions occurred on Monday 3rd November afternoon (with the Dompu Head of Agriculture Department), Tuesday 4th November morning (with Dompu Head of Animal Husbandry Department) and on Friday 7th November afternoon (with the North Lombok Head of Agriculture and Animal Husbandry Department).

In-field observation followed from the group discussion. Livestock and cropping operations were visited during the field visits. In Dompu, three livestock operations were visited; two feed lots (collective pens) and a refugee camp for cattle displaced from dry areas of the district. There was no field visit to corn and soybeans farming operations in Dompu as the field mission was conducted outside the planting season for those crops. However, famer groups were visited at two farmer houses (one corn and one soybean). In North Lombok, field observations were conducted at a cattle feed lot (Ngiring Datu) operated by a formal grower group and at vegetable farming operations in Sambik Bangkol Village to witness methods of vegetable cultivation (Tomatoes, Shallot, Snake beans and Chillies). One cassava farming operation was also visited.

During these field visits, in-depth interview were conducted with cattle growers and crop farmers. Questions asked to the cattle growers at the visited feed lots (and refugee camp) could be grouped into three issues: regarding feed, method of growing, and method of selling the cattle. The Issue of feed was explored in order to quantify the availability of feed, methods of feed collection and types of feed used. The issue of growing was explored in order to assess disease control, frequency of feeding and the issue of cattle theft. The issue of marketing was explored to assess the general nature of the relationship of the cattle growers with collectors. The marketing part of the beef value chain was not assessed, in this mission, in any detail. No cattle buyers were interviewed during the field mission.

The purpose of in depth interviews conducted during the field visits with crop farmers (corn, soybeans, vegetables and cassava) was to verify the validity and context of data collected during the preceding focus group discussions. The questions posed to farmers were the same as those asked during the group discussion. Specifically, data was collected on farm inputs, including the name of farm input suppliers, the method of purchasing farm inputs, the price of farm inputs

(subsidised and non subsidised), and the role of extension in choosing farm inputs. The sequence of techniques involved used by farmers to cultivate corn, soybeans, vegetables and cassava was also interrogated, including the role of extension in the process of cultivating crops. Finally, issues related to yield and marketing were explored with the farmers. Specifically, data on the quality of the product sold by farmers (e.g. water content for corn), the price received by farmers, the method of payment, the quantity of product sold, the actors involved in transactions, and systems for transportation, were collected.

Separate in depth interviews were also held with a corn wholesaler in Dompu. This wholesaler, perhaps the most significant private sector actor in Dompu, provided information on the farmers who supply corn, daily drying capacity, the system used to optimize dryer use, their commitment to develop corn farming in Dompu, and the nature of the business relationship that large wholesalers have with inter island or overseas buyers (primarily feed mills).

Field questions and templates and schedule

The field questions and templates, as well as the location of the districts visited in the field work and the detailed schedule for the field visit, are recorded in the Final Work/Mission Plan for the Design.

Project team members

Table 4 lists the members of the Massey-Unram team and outlines expertise and responsibilities. All team members contributed to this report.

Table 4. Massey-Unram value-chain analysis team

Institution	Team member	Expertise
Unram	Prof. Mohamad Taufik Fauzi	Plant scientist and project management (Unram team coordinator)
	Prof. Sri Widyastuti (KLU only)	Food technology
	Prof. Eko Basuki	Food technology
	Dr. Sukartono	Agriculture
	Dr. Bambang Hari Kusumo	Agriculture
	Dr. Dahlanuddin	Animal science
	Dr. IGL Parta Tanaya (Nonong)	Value chain analysis
	Ms. Yulfia Yanuartati (KLU only)	Value chain analysis and community development
Massey	Dr. Christopher Anderson	Soil science: project leader
	Dr. Janet Reid	Agricultural systems
	Prof. Steve Morris	Animal science
	Prof. Julian Heyes	Post-harvest technology

VALUE CHAINS

Legumes (Soybean and Mung bean)[5]

Soybean

Consumption of soybeans in Indonesia is increasing, although the nation is not a major producer on a global scale. National production in 2012 was 0.9 million tonnes, which is much lower than that of the leading global producer, USA (80 million tonnes). Soybean productivity in Indonesia is low on a global scale. ACIAR ascribes a benchmark standard of 3 tonnes/ha (derived from production rates in USA, China and Latin America). Productivity for the whole of Indonesia was 1.37 t/ha in 2011, with an average figure of 1.17 t/ha for NTB. Within NTB productivity was 0.97 t/ha in Dompu, and 1.73 t/ha in North Lombok (BPS, 2012). Production of soybean from NTB represented almost 10% of 2011 national production. In Dompu, 10,833 t of soybean was harvested from 11,158 ha of land in 2011, although this harvest was the lowest since 2004 (with the exception of 2007) and reflective of a decreasing trend in production.

Indonesian production of soybeans meets approximately one third of national demand. Soybean imports from the USA make up 86% of the balance of demand. Total imports in 2011 were 1.91 million tonnes.

[5] The review presented here is a synopsis of relevant information extracted from the ACIAR legume value chain report: Cambon, S. and Rachapuit, R., 2013. Final Report: Eastern Indonesia agribusiness development opportunities (EI-ADO) – analysis of legume value chains. Prepared by Collins Higgins Consulting Group Pty Ltd. for ACIAR. Project Number AGB-2012-008.

The high dependence on soybean imports is of concern to some parts of the Indonesian Government. The Governor of NTB Province specifically highlighted soybean imports from the USA as an example of limited 'food sovereignty' in specific agricultural commodities during a November meeting with the project team. Demand for soybeans is increasing each year, with an average 10% annual increase since 1998.

Soybean demand within Indonesia is driven by the tempe and tofu industries. The ACIAR report records a preference from the tofu industry for local soybeans due to the higher germ content and fresh quality. Reportedly one kg of locally produced soybeans can produce 10% more tofu than imported soybean. There is evidence of considerable soybean processing in NTB, with production facilities for tofu in Bima and Mataram. Tofu and tempeh is mostly sold in wet markets as this staple is perceived as a 'poor man's food' with high demand in poor or rural areas. However, there is a growing demand within the urban middle class sector for diversified, innovative products (e.g. flavoured product and well packaged product).

A number of development programmes have focussed on the soybean value chain throughout Indonesia, with some focus on NTB (Table 5).

Table 5. Summary of development programmes targeting the soy value chain

Funding agency and programme	**Years active**	**Objective**	**Outcomes**
Soybean[6]			
Mercy Corps managing the Sustainable Consumption and Production in the Soybean Processing Industry in Indonesia Program (SCoPe Indonesia): part of the European Commission's Switch Asia Program and the Renewable Energy and Energy Efficiency Partnership (REEEP)	Feb 2012 to 2015	To drive change in tempe and tofu production processes in order to develop a more eco-friendly and hygienic processing sector	
Indonesian run programmes with tempe and tofu processor associations and cooperatives	Past; years of activity unknown	Improve hygiene at processing units, training in accounting and management; organising international buyer conferences	No awareness in NTB of the existence of these programs
Provincial	Ongoing		Assume

[6] Table populated with data from the ACIAR legume value chain report

level initiatives to assist tofu/tempeh processers obtain Halal certification			successful; certification by processers has followed as a result

Mungbean[7]

ACIAR made a limited analysis of the mungbean value chain in NTT Province as part of the legume value chain project and this data is relevant to NTB. Mungbean is a relatively uncommon crop in Indonesia, with an estimated production of 50,000 tonnes / year. Mungbeans are grown as an alternative to soybean by some farmers in NTB. Demand is predominantly from the urban and rural poor, although there is inter-island trade (NTT to Surabaya and some subsequent export. There is some import of mungbeans from Surabaya to NTT during out of season periods).

Mungbeans have a variety of end-uses despite the limited production:

- Fresh sprouts
- Sweet porridge
- Cakes and snacks
- Starch and flour (for infant formula)
- Mungbean drink (sold in tetrapak packaging throughout Indonesia and exported)
- Mungbean stover is used as an ingredient in animal feed and as a source of protein to animals.

There is no evidence of any past, present or proposed agricultural intervention in the mungbean value

[7] Although mungbean was not a target product for the design mission, some data on the value cahin for mungbean was collected during the field mission. Mungbean is a viable alternative to soybean. Relevant literature is reviewed in this section, and some commentary on the mungbean value chain is included with soybean.

chain in NTB, although a previous ACIAR report did map, in detail, the mungbean value chain in NTT[8].

Soybean value chain for Dompu

Soybean appears to be commercially grown in Dompu only; there was no evidence of large-scale soybean farming in North Lombok. The area of soybean cultivation in Dompu is larger than corn, but due to lower yields, the soybean harvest is inferior to corn (Figure 2). The area under soybean cultivation in Dompu shows a general downward trend with time. The reason for this trend is unknown.

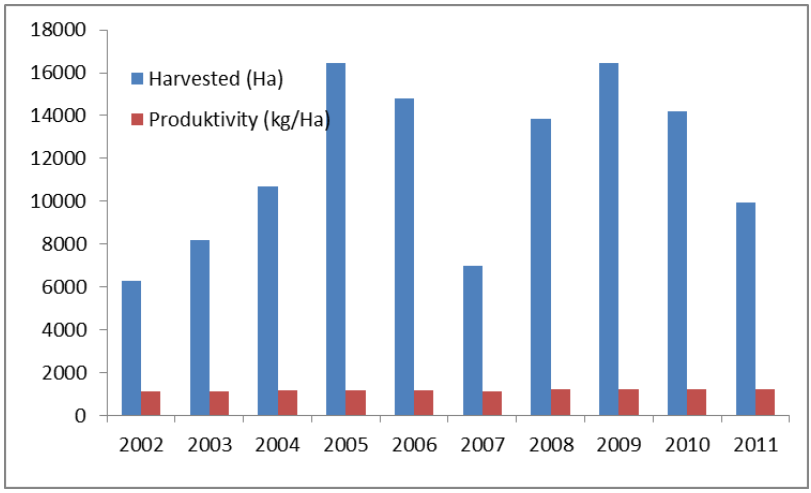


Figure 2. Area under cultivation and productivity of soybean farming in Dompu

Value chain actors and product flow

The value-chain map for soybean in Dompu is presented in Figure 3.

Soybean is cultivated in rain-fed areas of Dompu, normally without soil tillage. The cost of land preparation (cited as the major input cost to farmers) is therefore minimal. Land for soybean is cleaned from

[8] Adar et al., Mungbean value chain analysis in East Nusa Tenggara Province and Potential for Linkages with other major mungbean markets in Indonesia. ACIAR SMAR2007/68 – Productivity and Profitability Enhancement of Tropical Pulses in Indonesia and Australia.

grass and bushes. Some farmers may clean the land manually using traditional tools like hoes, crowbars and choppers. Some others use herbicides like Basmilang 480 SL (isopropyl amina glyphosate), Gemaxone 276 SL (paraquat dichloride), and Round up 486 SL (isopropyl amina glyphosate). Farmers will then sow soybean seed using dibble method (i.e. by hand). The cultivars of soybean grown by farmers in Dompu are Anjasmoro and Romo. Spacing row of soybean is 30 cm x 30 cm with 2-3 seeds per hole.

Two weeks after planting, soybean is fertilized using NPK (150 kg/ha) and POC (liquid organic fertilizer) at the rate of 4 – 6 L/ha two-to-three times during crop development. Farmers will spray their soybean with herbicide (Rumpas) only when the need is apparent.

There are no other activities undertaken; farmers simply wait until their soybean crop is ready for harvest 90 – 115 days after sowing. Farmers can therefore allocate their time to other profitable jobs(for example, logging, hunting and collecting honey, collecting sand and stone to be sold as building materials or working to load Dam Truck with sand and stone).

Harvesting is conducted by hand, and once harvested a thresher is used to separate the soybean from the shell. The threshers used to do this are in limited supply. In the village where an interview was conducted the farmers stated there was a need for 20 threshers during the harvest, but only 8 were available. Immediate access to a thresher is essential to preserve post-harvest quality; soybeans degrade quickly and the price drops accordingly if it is wet during the harvest season and if there is a pause between harvest and threshing (as little as one day).

Collectors and wholesalers both travel to villages during the harvest season and make cash payments to farmers for their crop. Farmers report that they can always sell their entire crop, although the price is fixed by the buyer. Smaller buyers on sell the soybean to larger traders, with most product absorbed by the tempe and tofu industries,

although a small proportion of the soybean harvest is processed into bean sprouts.

Finance to the soybean farmers appears to come from input suppliers. Bank finance in Dompu appears to be limited to wholesaler activity. The reason why farmers do not engage directly with a bank is unclear. Farmers do, however, access finance. Within the farmer group there was consensus that cash flow from soybean farming was sufficient to pay 70% of costs with cash. The residual 30% is financed.

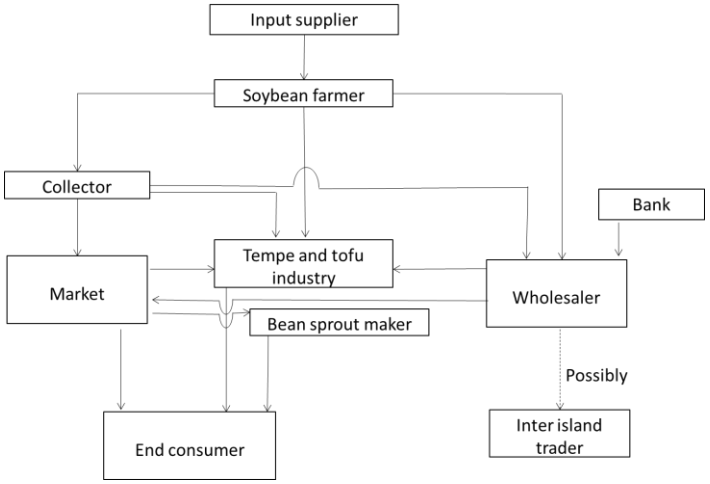


Figure 3. Value chain map for soybean in NTB (predominantly in Dompu)

Economic analysis of soybean farming in Dompu

Interviews were conducted during the field mission with farmer groups from one Dompu village. The interviewed farmers represented the interests of 1,200 farmers cultivating 1,800 ha of land (500 households). These farmers therefore represent a significant proportion of the total soybean sector in Dompu (11,158 ha in 2011). These farmers also cultivate mungbeans on a crop rotation, although the scale of this activity was not quantified. Data on the income accrued from soybean farming and mungbean farming is presented in Table 6. Famers plant a rotation of soybean, then mungbean, then land is left fallow.

Table 6. Revenue associated with soybean and mungbean farming in Dompu

	Soybean	**Mungbean**
Average yield	1.7 t/ha[1]	0.7 t/ha
Average price	IDR 7,000 kg[2]	IDR 12,000 / kg
Gross revenue	IDR 11.9 million	IDR 8.4 million
Net costs	IDR 15 million[3]	
Net revenue	IDR 5.3 million	

Notes. [1]Yield ranges from 1.6 to 1.8 t/ha [2]Top price is IDR 7,300 / kg [3]cost reported was for the entire year, across the soybean and mungbean crop. Farmers reported that mungbeans were more labour intensive, but the comparison to soybean was not quantified.

The average yield for soybean is greater per hectare than for mungbean, and this yield increase offsets the lower price (per kg) for soybean; soybean is therefore perceived to be a more profitable crop and this justifies (to the farmers) the greater focus on this legume. However, Unram's expert in legume production (Dr.

Komang) states that the reported mungbean yield is sub optimal due to the farmers' poor choice of cultivar. There is potential to increase the reported yield from 0.7 t/ha to 1.2 t/ha, with no increase in net cost. This would effectively increase the net revenue of the farmers by IDR 6 million per hectare.

Farmers in Dompu believe that their product is exported to Lombok Island as raw material to make tofu and tempe.

Information flow and relationship between the value-chain actors

There is better apparent communication within the soybean value chain in Dompu than in the value chain for other products in NTB (Figure 4). There is effectively a two-way flow of information between soybean farmers and collectors, soybean farmers and the tempe (tofu) industry, and between soybean farmers and wholesalers. Farmers are connected with all actors that absorb production within the value chain (buyers). The content of information from the farmers to the buyers includes availability, the price, the amount and the quality of the product. The content of information from the buyers to the farmer includes target water content and the brightness (quality) of soybean. Communication is by phone and sometimes through farm visits by the buyers. As the largest buyer, the tempe and tofu industry has the most influence in defining the target quality of products, and on when the product should be delivered to the industry. Industry also communicates product demand (daily or monthly).

There is also two-way flow of information between collectors and wholesalers. Collectors deliver information about availability and quality of the product, while the wholesaler gives information about the price, quality standards and supply continuity. There is a possible flow of information between wholesalers and inter-island

traders, however limited data on this communication has been collected.

There is communication between the market and the tempe (tofu) industry and between the market and bean sprout producers. Information is mostly related to the availability and the quality of soybean. Communication between market and end consumer is related to the availability of the product and consumer quality demands.

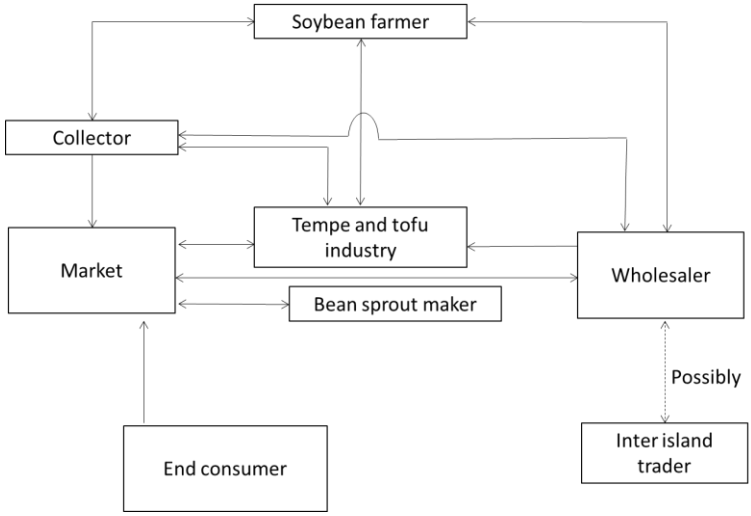


Figure 4. Information flows with the Dompu soybean value chain

Possible interventions in the soybean value chain

Farmers interviewed in Dompu expressed a need for assistance in the following areas to increase income from their farming operations:

- Field training in better agricultural practices (demonstration farms or tests farms)
- Access to irrigation in order to grow a second crop of soybean (no interest in a second crop of mungbean)
- High yielding varieties of soybean and mungbean

These requests suggest an underpinning lack of technical capability in the agricultural sector. Farmers are well informed of the market demand for soybean, and this presumably explains their decision to farm soybean not maize. However, there may be a better economic case for mungbean farming. Soil and water management is lacking in the area; there is no evidence for nutrient budgeting. Legumes will be adding nitrogen to the soil, but there is no quantification of this fertiliser affect. There is a role for education and better farming systems in the soybean value chain.

Maize[9]

Maize[10] is a focus crop for Indonesia and for NTB. In Particular, Dompu district has seen a considerable increase in plantation area since 2011. This is in response to the Provincial Government Policy PIJAR (saPI/cattle, JAgung/corn and Rumput laut/seaweed) which has defined corn as one of three commodities for development (along with cattle and seaweed). The focus on corn can be attributed to the climate in NTB, fertile soils, and the familiarity of people in NTB (particularly Dompu) to grow this crop. The area of corn plantation in Dompu in 2012 was approximately 27,000 ha. Assuming each 'farm' is 1.0 ha, corn supports 27,000 households in this District (almost 50%). Maize was harvested from just over 6,000 ha in North Lombok in 2011.

There is global demand for corn. In 2010 CIMMYT estimated that global demand for corn would double between 2010 and 2050. In 2012 almost 840 million tonnes of maize was harvested from 174 million ha across 163 countries. Indonesia is a net importer of maize, and in 2011 imported 2.89 million tonnes (total

[9] The review presented here is a synopsis of relevant information extracted from the ACIAR maize value chain report: Flewelling, J., Fox, P., Pupadi, K. and Adar, D., 2013. Final Report: Eastern Indonesia agribusiness development opportunities (EI-ADO) – analysis of maize value chains. Prepared by Collins Higgins Consulting Group Pty Ltd. for ACIAR. Project Number AGB-2012-007.
[10] Maize and corn are used interchangeably in this value-chain report

production approximately 18.1 million tonnes). Despite these figures, some maize is exported, and this may become more common practice in the ASEAN market. ACIAR quotes 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."

Human consumption of maize in Indonesia is low (20% of maize produced); the commodity is predominantly used to make poultry feed (this statement is apparently true for much of Asia). The proportion of maize supplied from NTB to national feed mills may be even higher (there is no feed mill in NTB).

The Indonesian Government had an ambitious target of being maize self-sufficient by 2014, with a national budget between 8.5 and 10.3 billion IDR allocated each year to this target. This funding is allocated to water supply/pumps, dryers, shellers, seeds, fertilisers (50% of total budget), pesticide and extension services. Maize productivity in NTB has increased from 2.5 t/ha in 2007 to 5.4 t/ha in 2012, presumably due to efforts towards this target.

There are parameters for various maize grades but feed mills do not pay a premium for quality product. Instead there are price discounts for excessive moisture on a sliding scale. ACIAR's position is that buyers of poultry rations place minimal or no importance on the metabolizable energy or nutritional value of feed, and therefore there is no impetus towards adoption of feed quality standards that would put a premium price on nutritionally superior product.

Subsidy programmes for maize production

- Bantuan Langsung Benih Unggul (BLBU) (Direct Support for High-Yielding Seeds of Maize and Rice), Ministry of Agriculture programme that provides free hybrid maize seeds (3 million tonnes in 2012)

- Cadangan Benih Nasional (CBN) (national Seeds Reserve) Ministry Agriculture programme that provides seeds for replanting after natural disaster induced crop failure
- Sekolah Lapang (SLPHT) (Field School for Integrated Pest Management) Ministry of Agriculture field training and demonstration programme that promotes integrated pest management strategies with hybrid seeds with an aim to build farmer knowledge and innovation in rural communities
- Seed Subsidy Programme provides subsidies for commercially distributed seeds

A major concern with these programmes voiced by NTB farmers is that subsidised seed arrives late, often after the planting season, OR it is seed that they believe is poorly suited to their land. Possible explanations for these problems are corruption (choice of seed dictated by seed companies with private interests) or an overly bureaucratic distribution system (leading to untimely decisions).

Maize has been the target of a number of national and international development programmes. A review of literature guided by the ACIAR research on this product is summarised in Table 7. This review has been restricted to programmes directly applicable to, or relevant to, NTB.[11]

[11] This literature review is not exhaustive, but is useful in the context of the current ADD preparation to provide an overview of activity in the corn value chain in NTB

Table 7. Literature review of key development initiatives that have targeted the corn value chain in NTB (in whole or in part)

Funding agency and programme	**Years active**	**Objective**	**Outcomes**
Corn[12]			
CGIAR – Global Alliance for Maize (CRP 3.2) www.maize.org	From 2011 (National)	Identify areas where national extension services are unable to reach Indonesia's maize farmers, and endorse the full use of available international initiatives to deliver extension services	Blueprint for R&D anchored to nine initiatives: 1. Socioeconomies and policies for maize futures 2. Sustainable intensification and income opportunities for poor 3. Smallholder precious agriculture 4. Stress tolerant maize for the poorest 5. Towards doubling maize productivity 6. Integrated postharvest management 7. Nutritious maize 8. Seeds of discovery 9. New tools and methods for national institutions, entrepreneurs and farmers
DFAT – Stimulating the demand for better quality open pollinated varieties of seeds	Since 2011 (NTT, TTU)	Improve food security by boosting productivity and production of maize	Improved seed from CBN and DFAT funded extension by an NGO targeted 427 farmer groups in 106 villages. Sustainability of this initiative is unclear Current strategy is to shift from free seed to improved commercial system to sell improved seed
National programmes (government and NGO)	Occasional (NTT)	Seed aid programmes to encourage farmers to use	

[12] Table populated with data from the ACIAR maize value chain report

		certified seed	
Private sector (seed producers and agro-chemical companies)	Semi-regular (NTB)	Product related learning centre and demonstration plots	
DFAT, Caritas Australia, World Neighbours and VECO (Belgium)	Funded by DFAT since 2007 (NTT)	NGO (YMTM) project to promote agricultural production and greater bargaining power for farmers; technical training is on production systems, from production to harvesting	Working with 450 farmer groups in four districts covering 11,336 households

Key constraints in developing the corn value chain reported by ACIAR

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

'Majority of farmers lack access to or are not well informed about improved maize seed varieties.'

ACIAR proposes that a sustainable delivery mode for implementation is via input supply manufacturers, maize wholesalers, retailers and feed mills that have incentives to deliver this market based solution to farmers over the longer term. Many of these value chain actors want to improve the way they disseminate information to farmers, however staff often lack skills in training and extension for farmers.

Quality control is a key impediment to development in the corn value chain. Aflatoxin is a contaminant in corn that can exceed acceptable levels based on weather conditions during growth (drought at flowering time exacerbates infection) and poor drying (i.e. poor quality

control). ACIAR reports that farmers and most collectors and traders have not heard of alfatoxin and none in the value chain have a solid understanding of the conditions that lead to infections. Actors lack access to a cost-effective analysis method.

Based on the extensive experience with the corn value chain in NTB (and Indonesia), ACIAR recognises several gender-related issues that should be considered during any development initiatives that target this value chain (Table 8).

Table 8. Cross-cutting issues (gender) relevant to development within the corn value chain

Intervention	Risk
Training course	Women may have lesser ability to travel to training events not at village level Timing may clash with domestic duties Women are less prepared for training based on level of prior education
More effective systems: mechanised seeding, weed management	Reduce amount of weeding required, a job generally done by women. Opportunity is more time for other income generating activities
Post-harvest processing	Women have a considerable role in threshing, drying and (where relevant) storage. Providing access for women to relevant technology and tools could be targeted. Modernising some of the storage facilities and practices, while allowing women to remain in control of the activity, could help provide women with knowledge and retain their visibility at home.

Maize value chain for Dompu and North Lombok

The maize value chain within both target districts is essentially the same, and in this report, is discussed together. Maize is produced for animal feed, and is exported to Java as a raw product for further processing. The primary difference between the two districts is the utilisation of irrigation. In Dompu corn is rainfed, with one harvest per year. In North Lombok there is better availability of infrastructure for irrigation, and two or possibly three harvests can be achieved each year.

Value chain and actors

The following actors with specific function in the value chain were identified during the field visit (Figure 5):

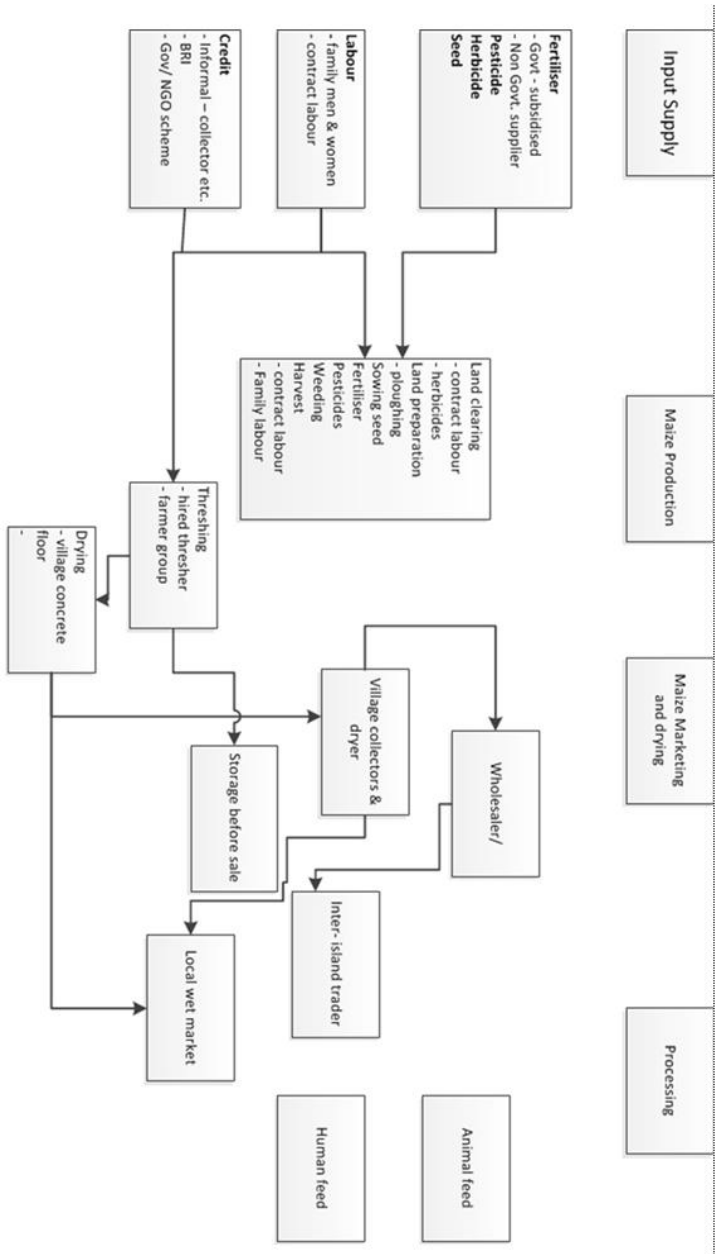


Figure 5. Map of the core processes along the maize value chain (Dompu and North Lombok Districts)

Central government provides subsidised fertiliser and sometimes seed. The allocation of fertiliser farmers receive is usually less than they require. Those farmers who can afford to, buy additional fertiliser at an unsubsidised rate from local suppliers.

Local input suppliers (called *pengecer)* sell farmers fertiliser, seeds, pesticides and herbicides. The suppliers may also provide inputs on-credit to farmers with repayment agreements ending after harvest ("*yarnen*" system in Indonesian). Interest rates on these loans may be up to 10% per month.

Dryland farmers indicate that they choose a supplier based on the quality and type of inputs they can provide. Farmers have been growing maize for over ten years and are familiar with inputs that contribute effectively to yields. This is likely to be the reason why they select suppliers on this basis.

Farmers will choose a supplier who offers the lowest price inputs assuming other factors are the same. Farmers look to suppliers to provide other services, for example, to provide credit, to offer various methods of payment, to provide information on market issues, and to give payment relief if the harvest fails (essentially insurance; dryland farming is totally dependent on rainfall and is therefore carried out at higher risk than in irrigated areas). Poor farmers are very dependent on suppliers for these services, as there are few government credit schemes for farmers who do not cultivate paddy rice. Official government-managed credit schemes (where available) come with strict terms due to poor past repayment on credit schemes. Payment defaults were not necessarily the fault of the farmers; in some cases intermediaries in the value chain have been a fault. The requirements banks place on loans is a disincentive for farmers accessing credit from banks.

Farmers tend to purchase inputs from suppliers who have a good reputation in the village areas.

Traditionally, farmers tend to trust people who have high economic status and are well known for their services. For example, farm input suppliers who are financially strong and have many customers would be assumed to have higher rank status. Reputation is the most significant factor for farmers in the North Lombok in choosing farm input suppliers.

Dryland farmers prefer to choose suppliers who can provide a delivery service for the farm input to their home or farmyard. Transportation infrastructure is very poor; non-asphalted roads are very slippery in the rainy season and hard or dusty in dry season. Farmers also consider favourably the ability of suppliers to meet the specific schedule of their activities. For example, some farmers may choose to plant later than others or may have cash either before or after the optimal time to plant, fertilise or use pesticides. The ability of suppliers to meet the needs of a famer is considered to be the second most important factor in choosing a supplier for farm inputs.

Farmers grow maize on their own land but some farmers who do not own land may lease land. An example of an arrangement for leased land in North Lombok is an income split of 33% to land owner and 66% to maize grower (keeper) with up to 1 hectare of land per grower. Alternatively, a farmer may lease land for a set amount (e.g. 1 million IDR per hectare year).

Most dryland farming activities are performed manually. Farmers perform land preparation, weeding, fertilising, pest control and harvesting using simple technologies mostly without mechanisation. In preparing their land farmers use traditional equipment such as hoe, chopper, axe, crowbar and plough to till their land. Hoeing is an essential but simple skill requiring basic tools and is completed using family labour. Ploughing is animal-assisted and thus is less labour intensive.

After land is prepared, planting is the next activity. A decision on when to plant is based on several considerations such as: season trend, seed availability,

labour availability, and suggestions from suppliers or extension agents (where these exist). Farmers pay significant attention to the seasonal trend. Most farmers start planting after the second major rain. Many also based their decisions by watching tidal, zodiac or flowers of certain trees like silk cotton and cashew nut. Most farmers plant a local seed instead of certified (high yield) seed. The planting technique is essentially the same for all cereal crops. Corn, soybean and peanut are planted with the dibble technique, while cassava is planting with the stake technique.

Cultivation is managed throughout the growing season. Crop management consists of three activities: weeding, fertilising and pest control (if necessary). Grass is generally not cut, but is pulled out of the soil and is achieved using a small metal stick to dig the soil. Fertilisation is carried out 1-2 days after weeding so that weeds do not preferentially absorb the applied nutrients. Fertiliser application is conducted by family members, not by labourers. Farmers fertilise twice, first with urea (200-300 kg/ha) and second with NPK (200-300 kg)[13]. Extension agents provide support to farmers to actively control pests. Extension here appears to be dominantly provided by chemical companies, with some support of government agents.

The last stage of farm production is harvesting, and peak harvesting coincides with the end of the rainy season. Harvest time is associated with a period of abundant employment and therefore people who have casual jobs outside the village return home to provide labour during the harvest. Four types of labour are practiced: sharing, bee working (*besiru*), own harvest and hired labour.

[13] There was some confused about the rate of fertiliser used. Some farmers claimed 200 kg urea and 300 kg NPK others claim 300 kg urea and 200 kg NPK. Farmers may have been confused in the interview OR they may be using inappropriate rates.

Farm labourers: An alternative arrangement for landless farmers is to work on existing farms. Labours are not paid cash, but receive 10% of the crop value. Farm labourers are utilised throughout the production of maize by those farmers able to afford the labour. Labour is used for land clearance, sowing, weeding, pest management, and harvest. The labour availability at harvest was the most critical for all farmers interviewed during the field mission as it was in high demand and if not available at the right time the implications on grain quality could be significant given harvest can occur in the wet season.

Thresher owners: a number of arrangements were highlighted with regard to farmers' access to maize threshers.

- A farmer group owned a maize thresher and group members paid an amount to lease the thresher at harvest time. The amount covered repairs and maintenance on the thresher as well as the cost of employing people to transport the thresher and run it.
- A collector in North Lombok owned two threshers which he leases out to farmers in the village he collected maize from at a rate of IDR 10,000 per 100kg grain.

Village maize collectors (called *pelele)*: most farmers sell maize grain primarily to collectors who then sell it on to larger traders who then trade inter-island. However there are a number of variations on this. Village collectors buy and collect maize from small-holder farmers at the village level and they may sell to a trader or may sell to a larger collector who then on sells to a trader. In Dompu small holder farmers transport grain on motor bikes to a collection point where loads are combined into a truck load and the collector then transports this to the wholesaler.

The collector/buyer comes to the farm at harvest and negotiates a price for the grain with the farmer. Collectors in general have information as to when different farmers will be harvesting their maize. However, the grain may not be collected until the collector has purchased sufficient grain to fill a truck. One truck may contain approx. 10 to 12 tonnes of grain. Collection may occur between 2 to 4 days after the sale price has been negotiated.

Collector agents who want to buy corn from a certain farmer will give the farmer several sacks as a container. Farmers will put their corn into the sack if the water content is within 15% - 18%. As compensation of giving the sacks, farmer must add 1-2 kg of corn per sack. This means that farmer have to put 51 to 52 kg of corn in the price of 50 kg. This extra 1 – 2 kg per sack is also as compensation when the water content predicted by farmer is higher than that measured by the wholesaler (observation based on a single interview; extent of this practice is not fully known).

A collector interviewed in North Lombok sourced maize from between 10 to 15 smaller village collectors. He owned two trucks which he used to also transport the grain to the shipping agent.

Wholesaler: these actors deal with larger volumes of maize usually supplied by village collectors. A truck load may be the smallest volume they will accept (as was the case in Dompu) hence few farmers are able to supply directly to the wholesaler. The wholesaler is likely also to have capacity to dry grain and to store grain for a period of time before selling on to a trader off shore.

The biggest wholesaler in Dompu is PT Seger Agro Nusantara (SAN). This wholesaler has a big modern high capacity corn dryer. This dryer has a capacity of 500 to 1000 ton per day to reach 15% of water content. SAN buys corn with water content of 18% and below (capacity is inversely proportional to water content). This water content is normally used to decide corn price. SAN only

buys corn at least one truck (4 – 5 tons) per buying, therefore an individual farmer usually cannot meet that requirement. Furthermore, SAN will only purchase from farmers who have a bank account; payment is made directly to an account.

In North Lombok a collector interviewed had capacity to store 400 T of maize. He stores grain when the price of maize drops but for a maximum of 3 months, and usually for a lesser period of time. The storage area is also used to dry maize.

Finance providers: This role is provided formally by Banks for those who have collateral and those willing to go through the bureaucracy to apply for loans. However, an important source of credit for farmers is local suppliers, other farmers and collectors. Some farmers also receive credit through micro-credit schemes run by NGOs.

Village collectors also act as a creditor for farmers, but rely on the traders they sell to on other islands for finance to cover these payments to farmers. These arrangements are informal.

Product volume and flow

Maize is a commodity product in NTB. Government directives and development programmes have significantly increased the area under cultivation and the harvest volume in Dompu, but not in North Lombok where there is more competition for land use (Figure 6, 7). However, there has been no sustained productivity increase with time. Production increases in 2011 (for North Lombok) and 2012 (for Dompu) have not been attributed to technical intervention or increased agricultural capability in these two districts. The reported increases in area under cultivation and harvest yield will have labour implications at harvest, during drying and beyond. Greater volumes of grain if provided over a longer period of time will improve the efficiency of existing

infrastructure of wholesalers, storage facilities and driers with a consequent flow on effect for employment. The private sector is responding to market demand. The investment by PT Seger Agro Nusantara (SAN) in a significant maize drying facility in Dompu exemplifies this private sector response to the potential for corn production in NTB.

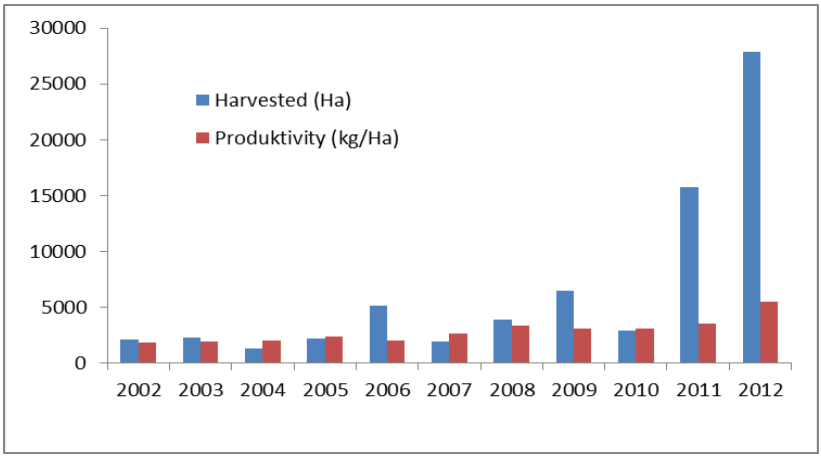


Figure 6. Harvested area and productivity for maize in Dompu district (BPS, 2013)

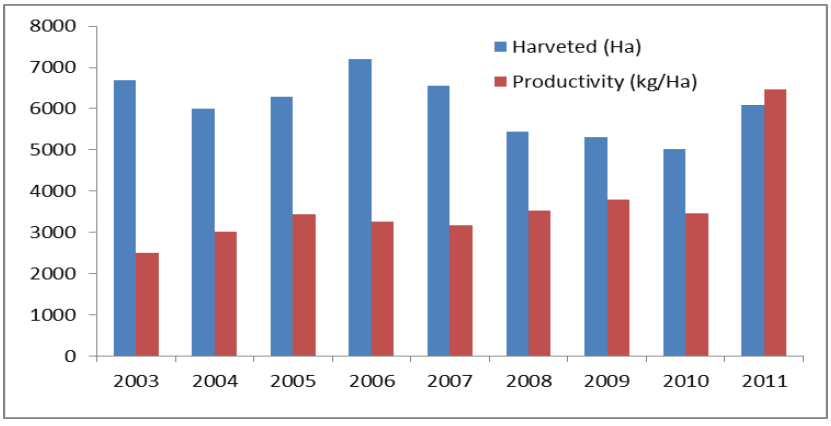


Figure 7. Harvested area and productivity for Maize in North Lombok District (BPS, 2012)

Maize value is enhanced at the farm level when the crop is harvested and dried in a timely way. Drying has the potential to increase the value of the corn harvest value with specific moisture contents desired for different marketing channels. Surabaya market, for example, requires 15 – 17% moisture content for processing in to animal feed. Bali market requires 17 to 18% moisture for processing in to human food products. Quality can be compromised during inter-island transport.

There is very little evidence of technology use along value chain from input supply to trading. There is some use of scales to weigh grain at point of sale and of moisture testing equipment; however, farmers raised clear issues in terms of trust in the use and calibration of scales and many examples of subjective assessment of water content and grain quality evident.

Application of fertiliser, pesticides and herbicides is generally ad hoc and not informed at the farm level by data on soil fertility or crop requirements, appropriate application rates nor safe handling of chemicals. Evidence provided of animal deaths resulting from the ingestion of feed contaminated with herbicide.

Economic analysis of maze farming in Dompu and North Lombok

The gross margin for 1 hectare of maize is quantified in Table 9.

There is variation in Gross Margins reported, and individual farmer circumstances and yield also obviously impacts on the Gross Margin. Gross margins established during case study work in North Lombok by Mataram University indicate a range across different varieties from a GM of IDR 8,755,216 /ha (R/C ratio 2.27) to a low of IDR 4,695,820 /ha (R/C ratio 1.69).

Table 9. Gross margin calculation for maize farming in NTB

Maize: cost	Unit	Quantity	Description	Rate in Rupiah (Rp) /Unit	Amount (IDR)
Revenue:					
Area	ha	1	Dry land		
Crop yield	kg	4,663			
Total Revenue	kg			2,770	12,918,972
Costs					
Lease land	ha	1			1,000,000
Seed	kg	28			1,200,000
Fertiliser					425,000
Pesticides				Estimated*	600,000
Labour				Est. Total	2,974,000
• weeding					
• sowing					
Harvest					
Post harvest					
• Threshing	tonne	4.6		50,000	
• Drying	tonne	4.6		50,000	
Other Costs					
Petrol/ transport	truck	1	on truck basis	400,000	400,000
Loading/unloading	truck	1		200,000	200,000
Total Costs					5,799,139
Profit					7,119,833
R/C					2.22

Information from a North Lombok collector and wholesaler indicated farmers receive between IDR 2,900 to IDR 3,000 / kg maize grain and the collector is paid IDR 3,400 /kg maize grain. The costs to the collector are not clear. Farmers receive less when the maize is transported to a more distant market.

Evidence highlights that farmers and in particular small holder farmers and those who do not own land have limited equity and are constrained in their ability to access credit because of this. Farmers in the main are price takers with limited ability to influence the price they receive. Increasing productivity would have a significant impact for these farmers, likewise their ability to accurately gauge the quality of the maize they have harvested (water content and mould) as well as the weight they are selling would strengthen their ability to negotiate a price from the collector. However, more significant would be the ability to dry their grain and control the quality. In addition farmers would also gain value from being able to store grain to allow them to sell at a time when the price for grain was higher rather than having to take the spot price. Likewise, assured and planned access to a thresher as well as labour for timely sowing/planting and harvesting.

Farmers' ability to assess and retain quality of grain by ensuring a specific moisture content and quality and also having some flexibility as to when they sell would increase their ability to secure a better price for the grain they produce. This is likewise influenced by their ability to access harvesters at the right time and also a thresher to ensure the grain quality does not deteriorate. This is a critical point; simply increasing yield will not overcome issues of post-harvest quality. Increased productivity must be accompanied by drying floors, storage capacity and technical intervention to manage the post-harvest process.

There is evidence in Dompu of a government-funded storage scheme where farmers are able to store their grain provided it can be verified as being of a certain moisture content and quality (University of Mataram has

the accreditation to quantify moisture content and quality in partnership with the government extension service, but, as yet, has not begun to). Farmers receive payment for up to 70% of the grain value when placed in storage and can withdraw the residual value at their discretion. However, due to farmers' inability to ensure dry high quality grain, examples were provided where traders and collectors are utilising the storage and benefitting from the scheme rather than farmers.

Information flow and relationship between the value-chain actors

A simplified map of the inter-relationships between the actors in the maize value chain is presented in Figure 8.

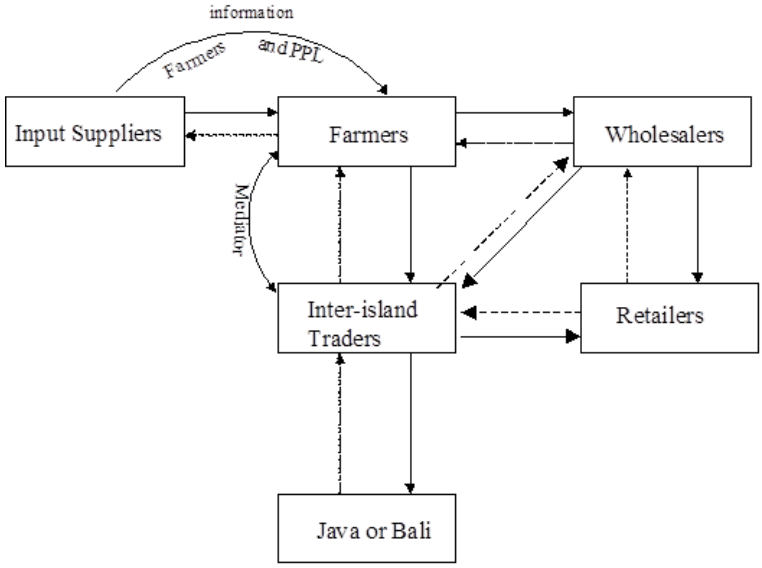


Figure 8. Relationship and information map for the actors in the NTB maize value chain

Farmers have very limited information on the market for maize and find out the price they will receive for their maize at point of sale at harvest. The exception

is when they are able to store the grain until such time as the price improves but the extent to which farmers have this ability appears limited.

Input suppliers and village collectors of grain have regular and strong links with farmers and this is the dominant pathway for information flow. Collectors have a relationship and link with wholesalers: however, in the main, farmers have very limited links with the wholesaler and no links or information in regard to requirements of the trader, processor or consumer.

Evidence from both Dompu and North Lombok highlights that the wholesalers actively communicate with the entities to which they sell. The large wholesalers in Dompu were knowledgeable and strongly connected into the market; however, they had limited communication links back to farmers. The poor farmers are therefore marginalised in the value chain. They have limited ability to respond to market signals, and, when coupled with a desperate need for cash flow, must accept spot prices.

Potential interventions in the maize value chain

There is significant potential to increase farm productivity by improving the provision of information to enhance farmers' decisions around superior/better suited maize varieties, fertiliser and pesticide use and the timing of applications.

Farmers' ability to capture greater value from the maize value chain is linked to securing greater certainty in their ability to harvest and sell high quality grain at the required moisture content at a time when the price for grain is high. This requires farmers having access to affordable credit, adequate labour and threshing equipment at harvest, verified moisture testing and weighing equipment and ability to store grain.

Timely and accurate meteorological data will enable farmers to make better sowing and harvesting decisions, as well as increase the period over which grain is

currently harvested and supplied to wholesalers and processors. The use of different varieties of maize with varying growing periods, and a higher level of multiple crops of maize will enhance the efficiency of the wholesaler and processes infrastructure as well as increase the income of farmers.

Improving farmers' management of water within their maize production systems has the potential to increase productivity on farm. Irrigation for greater maize productivity and production is an opportunity in some areas. This is reliant on the development of capability to identify appropriate and sustainable sources of water and how best to harvest and utilise the water for maximum efficiency.

Throughout the maize value chain there is the opportunity to improve the accuracy and relevance of data that will enhance the overall value chain. Making relevant data available in a timely manner for different actors in the value chain will enable improved decision maker and lead to a higher performing value chain. Farmers and the extension service have very limited appreciation of how information about the requirements of wholesalers – processors and consumers could inform maize production systems in NTB. This is in part because currently farmers are primarily price takers with limited ability to influence the value ascribed to their maize.

Cattle

The Indonesian beef value chain can be eloquently summarised in one-word, complex. However, the east Indonesian Agricultural Development Opportunities project (EI-ADO part of AIPD Rural) ranks Beef-Cattle as the commodity which has the most potential to increase the income of poor people in east Indonesia (interestingly, dairy has the least potential of 16 commodities). This is perhaps because cattle, more than any other agricultural commodity, is a part of the lives of the poor people of east

Indonesian. Cattle are a system of wealth, investment and status in society, not just a source of dietary protein.

ACIAR have completed a comprehensive review of the beef value chain in east Indonesia[14]. Key information relevant to the Massey-Unram project is reviewed in this section.

Livestock are an important part of the economy of east Indonesia. ACIAR estimates that livestock accounted for 30.1% of NTB agricultural GDP and 10.2% of total provincial GDP in 2010, the highest for any province in Indonesia. Cattle represent the single largest contribution to these figures (approximately 50%). Cattle have unique potential to create value within the supply chain: Deblitz et al. (2011) estimated that the farm-gate value of an animal can increase by about 70% by the time it reaches slaughter level and another 70% by the time the beef enters the retail market. As reported by these authors, 'value is created in the chain through margins of industry actors, while product transformation generates value for providers of goods and services'. The cattle sector represents a significant employer in east Indonesian. In 2009, the government of NTB estimated that 182,000 farmers were involved with cattle production (assuming 4 cattle per farmer).

The farming system for cattle differs to that for cropping. The inputs to cattle farming are breeding, animal health, and feed and water. NTB holds an enviable position that the province is free of certain diseases, and the breeding stock is in demand throughout Indonesia. Animal health is affected by issues that typically affect livestock in tropical environments (trace element deficiency, disease and parasites). Feed and water, however, are major constraints on the farming system in NTB where the distinct dry season is associated with significant feed gaps.

[14] Waldron, S., Mayberry, D., Dahlanuddin, Mulik, M., Quigley, S. and Poppi, D. Final Report: Eastern Indonesia agribusiness development opportunities (EI-ADO) – analysis of beef value chains. Prepared by Collins Higgins Consulting Groups Pty Ltd. for ACIAR. Project number AGN-2012-005.

Cattle systems in east Indonesia in general can be considered unproductive when measured through key indicators (calving rates, growth rates, turnoff rates etc). The systemic reason for this lack of productivity is related to the poor utilisation of existing resources in a strategic way to meet key constraints. Waldron et al. (2012) apportion this failure equally between resource constraints and the knowledge, skills and animal husbandry/management techniques of the farmers:

> *Good cow nutrition, evidenced by good condition, is essential for high reproduction rates in cattle. Cows need to be fed sufficient quality and quantity of feed to maintain body condition, especially in the few months before and after calving and when the energy demands of pregnancy and lactation are highest. Poor cow condition at calving results in prolonged post-partum anoestrous, which in turn increases calving interval and reduces calving percentages. Inadequate nutrition of growing animals delays development of puberty in heifers and growth rates of fattening cattle.*

Cow nutrition, a function of feed availability, is therefore a key impediment to the productivity of the cattle value chain. The government has ambitious targets for cattle numbers, however the carrying capacity of the land must be considered. A new paradigm would be to match cattle productivity to the availability of feed and water, and in so doing, to realise greater income from the existing value chain. There is considerable debate over the actual capacity of land in Indonesia to feed cattle. Conflicting reports from university and government suggest that various provinces can sustain greater numbers, or have already exceeded carrying capacity. Perhaps a more realistic goal is to increase productivity of existing cattle through improved live weight gains thereby decreasing time to slaughter and in females improving reproductive outcomes. There is consensus that to

increase cattle numbers, alternative forages and crop residues need to be more effectively integrated into the cattle farming system. Upskilling in technical and scientific capability to contribute to more effective natural resource management is clearly needed in this area.

The cattle value-chain has been the subject of extensive collaborative research between ACIAR and Indonesian research and government agencies. Australia has been the principle actor in the development of the east Indonesian (including NTB) cattle sector (Table 10).

Table 10. Areas of intervention for collaborative Australia-Indonesia cattle projects

Area	Intervention
Feed	Planting and managing tree forages (especially leucaena and sesbania) Utilisation of crop residues (rice straw and corn stover) Targeting the quality of feed to animals with different nutritional requirements (e.g. maintenance or during lactation)
Housing	Feedlots and pens to increase sanitation and reduce disease hazards for calves
Reproduction	Move to a system of controlled mating as opposed to free mating
Calf development	Calf management to reduce post-natal loss and growth rates Consider the cow-calf system to target production of a calf every year

Research has been driven by a target to increase productivity through reducing the time it takes to bring a calf to saleable weight. Managed cow nutrition, and matching of feed availability to cow number has significant potential to increase the income of poor farmers. However, experience from the projects described here shows that farmers are risk adverse to new technologies and systems even if they are simple, low-

cost and promise to generate economic and social benefits. Waldron et al suggest that the attitudes of farmers must be understood and addressed in any development programme.

Indonesia is not self-sufficient in cattle, with significant import of both live cattle and boxed beef. Current imports are in the order of 238,000 head of cattle in 2013 and 41,000 tonnes of boxed beef (based on government quotas). Imports of boxed beef alone represent 10% of the countries production. However the scale of Indonesian beef demand is such that there is no risk of imports displacing the domestic sector, especially in east Indonesia which is less integrated into international markets.

The ACIAR review provides some clarity on the numbers of animals exported from NTB. Waldron et al. report that 13,476 cattle were slaughtered for export in 2012, and 13,400 exported as breeders. NTB was the dominant province in east Indonesia to export breeder cattle. This trade is regulated by standards for Bali cattle breeders, 'base prices' set by provincial government, exporter permits and quota.

Indonesia has a system of national beef standards that specify language and measurements used to define quality of cattle, beef, processes, certification and labelling and microbiological standards. However, there is no evidence that these standards form the basis of trade. These are not widely recognised, accepted or used. Therefore, while there is a theoretical system to ascribe a premium price to quality, in practice this system does not contribute the value chain. Any higher value ascribed to cuts of meat, services or hygiene is due to the personal preference of certain more 'affluent' consumers (and premium prices are being accepted by consumers in high end retain outlets).

The price of beef is primarily controlled by the timing of religious festivals and purchase from other provinces especially for breeding stocks. Sales of beef increase considerable during Ramadan and Idul Fitri,

with price increases of up to 10% incurred. Beef prices are reasonably consistent outside of these times. Prices also increase when other provincial governments buy breeding stocks or feeders from NTB. This usually happens from June each year when government budgets are available. Targeting production to coincide with these times of increased price is possible but technically difficult without appropriate capability. This does, however, present a definite opportunity for increased income to cattle farmers.

The Indonesian government has a long-standing (since 1999) ambition to become self-sufficient in beef (PSDSK programme). The current targets of this programme are

- To increase the cattle herd to 14.23 million by 2014 (12.4% annual increase on current)
- To increase production to 420,200 tonne per year (10.4% annual increase on current)
- Restrict imports to 32,000 tonnes (10% total consumption)
- Increase employment in the industry by 76,000 people per year
- To increase revenue for producers to minimum provincial wages
- To ensure beef is safe, healthy, intact (i.e. not mixed with other meat) and Halal

To achieve these national targets, the government of NTB has implemented the Bumi Sejuta Sapi programme (BSS; land of one million cattle), with a target increase in the population to 1 million by 2014 (685,000 in 2012). Integral to PSDS are government policies to facilitate attainment of the target numbers. Guidelines on infrastructure, including abattoirs, are included in these policies. Waldron et al. report that the government of NTB has renovated a former JICA-built abattoir on the outskirts of Mataram and plans to integrate this with a

feed mill, composting plant and fattening operations. As of the date of the current report, there was no apparent progress with this initiative. However, regulation of slaughtering and the subsequent sale of beef at wet markets are targets that the government is actively pursuing.

The Indonesian beef sector champions several industry development programmes (Table 11). These are internal programmes that do not appear to be funded by international donors. However, their existence is important in the context of any new development activity. A requirement for farmers to participate in these programmes is affiliation with a farmer group (kelompok). The existence of farmer groups is therefore a common theme throughout the Indonesian cattle sector.

Table 11. Summary of Indonesian cattle development programmes

Programme	Status	Intention
The rescue of productive females (run by provincial government)	Active across Indonesia Funding of 106.7 billion IDR to NTB 2010-2012	Provincial government will purchase productive cows from slaughterhouses or markets and redistribute these
Incentives for pregnant females (run by provincial government)	Active across Indonesia Funding of 49.4 billion IDR to NTB 2010-2012	Participating target farmers are paid for successful pregnancies
Cattle distribution schemes run by numerous government and private sector agencies	Across Indonesia but of major impact in NTB.	Effectively a subsidy for cattle production, especially breeding Waldron et al. (2013) report that 'virtually the whole cattle herd of NTB can be traced back to distribution schemes conducted over the past three decades'. Includes the SMD scheme (graduates building the village

		programme)
Village breeding programmes (managed by provincial government)	Across Indonesia, with major impact in NTB	Increase genetic diversity in the cattle herd
Government finance	Active although uptake is reportedly limited	Cattle-specific finance schemes to expand cattle production. One for larger-scale breeding operations and another for small-holder fattening operations. Finance is distributed through state banks according to a set application criteria. Extension and provincial government have a roll in endorsing the technical capability of an applicant

Cattle value chain for Dompu and North Lombok

The value chain for cattle in Dompu and North Lombok as defined from the field work underpinning this value chain report, is presented in Figure 9. Given the dominance of the cattle sector in Dompu, much of this value-chain analysis is based on data collected from this district.

There are two main cattle production systems in NTB, semi extensive (most common) and semi intensive systems.

Value chain and actors

In the extensive system, the most common system in Dompu, cattle generally free graze native grasslands. For example on Sumbawa, in the area of Doro Ncanga north of Dompu (an area of around 30,000 ha native

grassland on the western flanks of Mt Tambora) farmers only visit their cattle during the weekends. In other areas farmers may collect their cattle in pens at night. In Doro Ncanga, there is no problem of feed availability during the wet season, but farmers face a very difficult feed situation in the dry season (especially from August to mid November). During the dry season feed and drinking water for cattle may become very scarce. During this time, farmers may spend money to transport crop residues but they cannot do anything to provide drinking water. As a result, many cattle died during the peak of dry season. In response, some farmers have to move their cattle from the native grassland during the peak of the dry season to an area where they can provide feed and water for their cattle. Alternatively, some farmers in the dry season hire trucks and travel at least 4 hours every couple of days to collect forages.

In the semi intensive system, cattle are housed in pens and fed by cut and carry. Feeds are mostly native grass in the wet season, and crop residues in dry season. Some farmers feed tree legumes (mostly leucaena) or soybean waste for fattening. Farmers are beginning to plant leucaena. While others have started to utilize wild leucaena that can be found still growing well in the dry season

Native grass is the most commonly available feed in the wet season but is very scarce in the dry season. Based on a survey in Doro Ncanga area, the varieties of native grasses are: *Heteropogon contortus* (56,36%), *Imperata cylindrica* (14,88%), *Aksonopus* sp. (9,80%), *Aeschynomene americana L.* (7,75%), *Cyperus rotondus* (3,82%), *Sporobolus indica* (1,22%), *Themeda villosa* (2,98%), *Sacsiolepis indica* (1,25%), *Paspalum conyugatum* (1,29%), and *Arachis pintoi* (0,65%).

The most important constraints are a) lack of feed especially in the dry season, b) lack of drinking water in the extensive systems, c) poor animal health – parasites and d) lack of good quality or genetically superior bulls (the best bulls are sold for meat, farmers retain inferior ones – negative selection).

Cattle breeding is mostly done with natural mating. There is no systematic selection of bull for mating so most cows are mated with any bulls available. Artificial insemination is very limited.

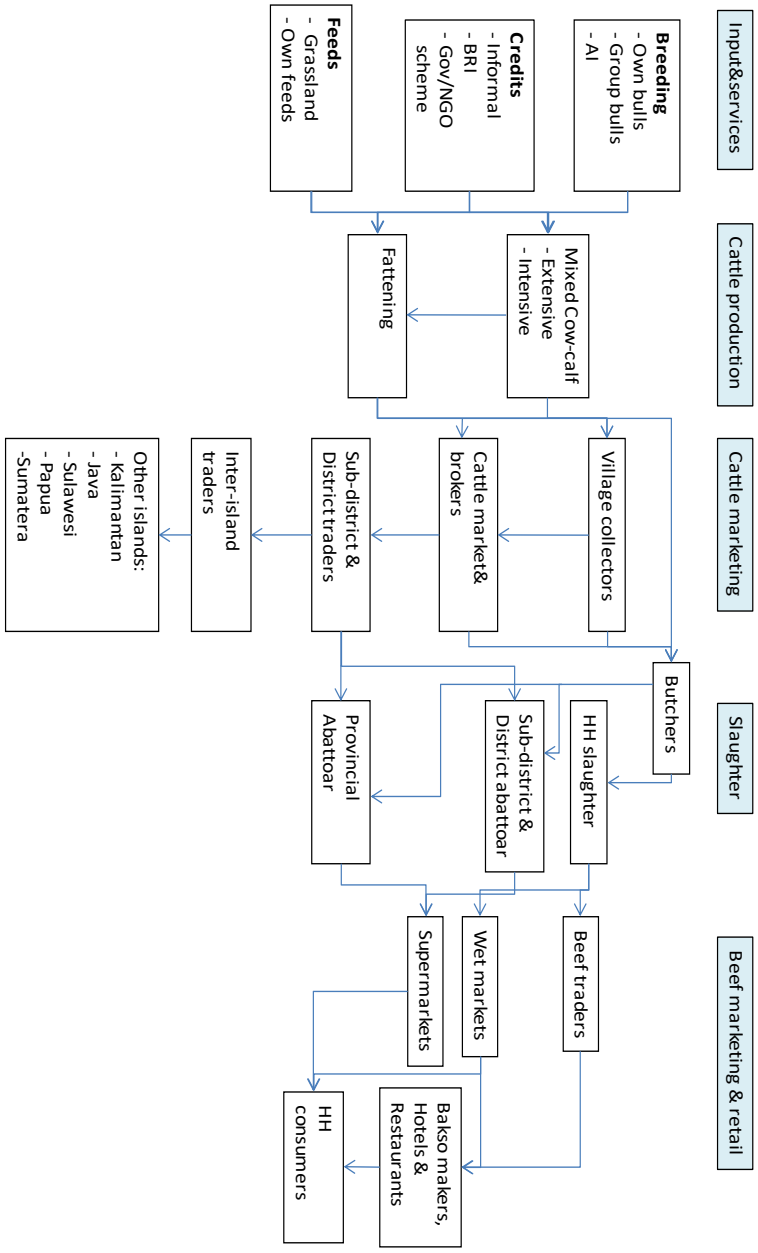


Figure 9. Cattle value chain for NTB (Dompu and North Lombok)

There are two main functions of cattle in Dompu; as saving and for social status. In some areas, farmers still use cattle to till land, however, most farmers consider cattle as their bank account. This means that farmers will sell their cattle only when they need an appreciable amount of money. Even if a good price is offered, farmers will generally not sell their cattle if they do not need money. If farmers can overcome their needs without selling their cattle, they will not sell their cattle despite the price on the local market. The average poor farmer in Dompu and North Lombok generally does not see cattle farming as a business enterprise (there are, of course, exceptions). Some farmers have access to bank loans from Bank Rakyat Indonesia (BRI) using their motor bike as the collateral.

In the extensive systems cattle owners employ workers (often landless farmers who do not have cattle) to take care of their cattle. Typically, a cattle owner employs 3 workers. All workers are men (there are no women involved in this area).

In the more intensive systems, cattle growers can be those who own the cattle (owner) or those who feed other people's cattle (keeper). The relationship between cattle owner and keeper is based on profit sharing. Feed collection is mostly done by men, while women and children involved in the feeding of cattle and provision of drinking water.

Traders employ collectors to buy cattle from farmers. Collectors will receive a fee from the traders (typically IDR 50,000 per head of cattle collected). Some collectors are also traders who use their own money to buy from farmers and sell them to the inter island traders. There is, however, no commercial cattle enterprise in Dompu. All production systems are run by traditional farmers of both small and medium scale.

Product volume and flow

NTB is the biggest supplier of Bali cattle breeding stocks. This is because NTB have been declared free of strategic diseases especially SE (Septicaemia Epizootica) and Brucellosis. Within NTB, the district of Dompu is a supplier of Bali cattle breeding stocks for the province.

Cattle is therefore a significant industry in Dompu; the cattle population reached 105,000 head in 2014 (natural increase of 8-10% per year from 2012-2014). Dompu has an annual export quota of 7,000 beef cattle and 1,000 cattle breeding stock with annual revenue of more than IDR 33 biillion. The annual revenue from cattle export is reviewed annually and can be increased if the district can increase cattle productivity (the export "quota" for each district is based on the natural increase of cattle population).

Assuming that each farmer can grow 5 head of cattle, then the number of farmers working in the cattle industry in Dompu is 21,000 people. However, there is a significant number of people working in support of this industry include people working as traders, collectors, butchers, and beef sellers.

There is no livestock market in Dompu. Farmers mostly sell cattle through collectors who work for the big traders. Cattle selling is not based on live weight so traders mostly win as they are much better in predicting value of the cattle; farmers are generally marginalised in the sale process although some progressive groups are adopting initiatives such as cattle weighing and scoring prior to sale. The minimum live weight of beef cattle to be sold or slaughtered is 250 kg but many are slaughtered illegally below 200 kg liveweight. Traders or collectors buy cattle on estimated cattle live weight and approximate carcass dressing percentage (not by weighing).

After purchase, cattle are collected in a temporary holding ground (prepared by the traders) for several days waiting for selection by traders. Cattle are then brought

to quarantine facilities at an export port (domestic export) where they are tested and quarantined for 7-12 days.

Only cattle ready to be slaughtered are allowed to be sold from Sumbawa island to Lombok (direct to abattoirs), to avoid the spread of Anthrax into Lombok. However, some "black market" traders also sell beef cattle into the Lombok live cattle market. The problem faced by traders in Dompu is that the buyers (traders or butchers) in Lombok determine the price.

Cattle selling to Lombok is based on recommendations by the Provincial Dinas Peternakan to avoid overstocking of beef cattle in the abattoirs. Traders in Dompu have asked the Head of Provincial Dinas Peternakan to allow them to sell more cattle to Lombok because the price in Lombok is much higher than in Dompu.

Traditionally, beef cattle were sold to Jakarta market, but due to high price in NTB, NTB cattle are no longer competitive in the Jakarta market against imported beef. Most inter island trading is to Kalimantan where the price is better. Two types of cattle sold to Kalimantan, Bali cattle breeding stocks and beef cattle ready to be slaughtered. Cattle are transported to other islands through Badas Port in Sumbawa district, not directly from Dompu because there is no proper harbour facilities.

The transport of cattle from one island to another is inefficient. There is a lack of ships in Indonesia for the inter-island transport of agricultural products, and there are no specialised cattle ships; cattle are exported on general cargo vessels. This leads to sub-standard conditions for animal welfare, and live weight losses of up to 10% can be expected.

Traders complain about the long and expensive process to arrange for export permits. This is a key driver behind the illegal export of cattle. NTB officials (including those in Dompu) want to reduce sale of live cattle to other islands and to increase the sale of frozen beef. This will solve the issue of weight loss of cattle during

transportation. This also expected to increase added value of cattle in NTB.

The private sector is supportive of this new initiative and a company (Dua Putra Jakarta) is ready to buy boxed beef from NTB. However to comply with national regulations, all cattle to be slaughtered should be tested for diseases. There is, limited infrastructure for cattle slaughter in Dompu, and the number of animals slaughtered reflects this. In 2013 only 1,175 head of cattle were slaughtered in the district, with an average of 10 per day (increased during religious festivals).

Information flow and relationship between the value chain actors

Communication between cattle producers and traders is very poor. Traders show little interest in helping farmers to improve productivity and quality. Farmers have limited access to market information and therefore they cannot sell their cattle at the 'best possible' price.

Government services in support of the cattle sector are generally limited to providing/ distributing assistance in the form of live cattle, equipment or materials. Very little extension is provided to improve the cattle production system.

Dinas Peternakan (the District Livestock Service Office) provides a free animal health service to the farmers. However, the service is still inadequate as some farmers still have to purchase their own medicines when their animals are sick. Dinas Peternakan regularly collects specimens for Anthrax and SE (Septicaemia Epizootica)

Possible interventions in the cattle value chain

Analysis of the cattle value chain in Dompu defines the inability of farmers to consistently provide sufficient quantity of high quality feed as the key constraint to the

transformation of the cattle sector to release an increase in income to the poor. Farmers in Dompu have long been spoiled by the large area of native pasture where they can let their cattle to free graze all year around. This native pasture has been declining in area and carrying capacity as the district herd increases, and this makes it difficult for farmers to sustain high numbers of healthy cattle. Compounding this issue is a lack of technical capability within most farmer groups to grow healthy cattle using a cut and carry system and a lack of drinking water during the peak of the dry season.

The constraints identified in the previous paragraph create a situation where the Dompu cattle production system is today less productive than other parts of Indonesia, and consequently, the quality of beef cattle from Dompu is generally lower than beef cattle in the more intensive areas of NTB such as Lombok. Beef cattle from Dompu reach slaughter weight at an older age (typically 4-6 years) and an older age typically lowers beef quality.

There is considerable opportunity to target the rate of live weight gain in Dompu cattle, and to increase the general health of the district herd. There will likely be a consequential increase in the herd size as more healthy cows produce more calves that reach productive age. In the short and medium term, the opportunity is therefore to improve on-farm production to improve productivity and quality of beef cattle. Farmers need technical assistance in the development of dryland feeding systems and drinking water supply. The carrying capacity of land needs to be better defined, and a more sustainable system of feed production implemented. In the long term there is an opportunity to develop the processing and marketing nodes of the value chain.

These interventions are in line with the government policy to increase cattle population and to develop a beef processing facility to enable Dompu to sell boxed beef to markets like Jakarta.

Technical support and education in sustainable cropping systems based on climate and soil conditions would be to improve farmers' capacity to establish tree legume based feeding system, which has proven to be the most suitable feeding system for the dry areas. Technical support and education would also improve the capacity of farmers to provide sufficient drinking water for cattle throughout the year. Education of farmers to conserve surplus grass during the wet season as hay for the dry season will also enhance food security for cattle. There is also significant opportunity to divert waste product from other dry land farming systems in Dompu (corn and soybean) to the cattle value chain. There is currently very little innovation in mixed rations and feed types for cattle in Dompu (and North Lombok).

The described interventions are expected to improve productivity by at least 50% through increasing weaning rate, growth rate and massive reduction in cattle mortality in the peak of dry season. Healthy cows will produce more calves, and a halving of the time necessary to bring an animal to slaughter weight will release consider new income into the district. This income can be shared with poor farmers either directly (as owners) or through greater employment.

There is also good potential in Dompu to educate farmers in herd management. For example, the introduction of selected high performance bulls in an area (1 bull for every 50 cows) from June to December will lead to calving when feed is in good supply and quality subsequently improving the survival and growth rates of calves, and ensuring cows are ready to calf again the following year.

Fresh produce

The Mission Plan for this project selected both vegetables and mango as targets for the value-chain analysis in North Lombok. During the field visit the project team recognised the extent of local demand for

fresh produce (fruits and vegetables) from hotels in North Lombok District. In this section of the report mango and vegetables are therefore combined into the broader product category of fresh produce. Tree crops (including mango, cashew) require an expensive lead-in period of several years before reaching full production capacity whereas cropping decisions around annual fruit (such as melons) and vegetables can be made within a season. Tree crop value chain analysis therefore has to be considered primarily in terms of making better use of currently planted areas.

Fresh produce is a large category of products rather than a specific product, and a review of the value chain for each constituent product is beyond the scope of this report. Four products have, however, been the focus of research and development in Indonesia: tomato, chilli, shallot and mango. Each of these products was covered in the EI-ADO work, and a review of relevant background information for each of these products is presented here (from both and national and NTB perspective)[15].

Tomato[16]

Tomato is the fifth most important vegetable in Indonesia in terms of cultivated area (after chilli, cabbage, shallot and potato). NTB contributes approximately 3% of Indonesian domestic production of tomatoes (Province ranking is 10). In 2011, tomato was grown on 1,516 ha of land in NTB, an increase of 35% over the area in 2007. Production in NTB in 2011 was 33,864 tonnes, a 237% increase over 2007 (the 4th highest increase of 19 provinces). The average tomato yield in NTB was calculated by ACIAR to be 20.3 t/ha.

[15] EI-ADO also reviewed the potato value cahin in eastern Indoneisa, however potato is now covered in the current project.

[16] The review presented here is a synopsis of relevant information extracted from the ACIAR legume value chain report: Wandschneider, T., Gniffke, P., Kristedi, T. and Boga, K., 2014. Final Report: Eastern Indonesia agribusiness development opportunities (EI-ADO) – analysis of tomato value chains. Prepared by Collins Higgins Consulting Group Pty Ltd. for ACIAR. Project Number AGB-2012-009.

This is higher than the national average, but still considerable lower than the 50 t/ha yield that is expected for the main tomato producing regions of the world. Total tomato production throughout Indonesia in 2011 was 954,000 tonnes (fresh tomatoes). Of this, only 675 tonnes was exported. There are practically no imports, and so following on from these data, Indonesia is essentially self sufficient in tomatoes. However, globally, demand for a wider diversity of fruit and vegetables is known to accompany increasing affluence.

Several constraints to Indonesian operation in the domestic and ASEAN tomato trade exist:

- Importers are concerned with high pesticide residues on Indonesian tomatoes
- Lack of cold chains is a major barrier (perishable commodity)
- Prices are subject to significant variation throughout the year, often rising or falling by a factor of four or five in just two or three months; as a result it is very difficult for farmers to predict future price movements. Planting decisions are often made on spot prices, leading to excess product four months later, depressing prices

Value-chain analysis in east Java (Malang) established that tomatoes are graded according to size (A, B, C) with a price differential between these grades. Tomatoes are packed into wooden boxes (60-65 kg capacity) and stacked in trucks. This is suitable for transport to local market, but not adequate for inter-island transport where up to 60% of final product must be discounted due to physical damage (crushing, splits, rots) at some times of the year. ACIAR identifies packaging as an area for intervention, even in an advanced production area such as Malang.

Transfer of market outlook assessment capacities to village traders and farmer extension groups to empower these agents to better anticipate market dynamics

leading to better planting decisions and higher profits. The university sector is well-placed to provide this training, both directly through industry-orientated short courses, and indirectly through 'train the trainer' initiatives. ACIAR specifically recognises this potential role of universities. However, an appropriate curriculum needs development. This applies to the whole fresh product sector.

Shallot[17]

Shallot is the third ranked vegetable crop in Indonesia in terms of cultivated area (after chilli and cabbage). For the period 2009-2011, NTB comprised almost 11% of the total cultivated area (102,437 ha for all of Indonesia), with NTB having the greatest area of shallot farming outside of Java. Total national production over the period 2008-2012 was an average of 944,182 tonnes per year. Shallot farms in Indonesia tend to be 0.5 ha (or less in size) and involve a considerable amount of labour. There is no data available for shallot production in Dompu, although there is significant production within the districts bordering Dompu (Sumbawa to the west, and Bima to the east). Bima is the 'centre of shallot production in NTB' and some data are given in Table 12. However, availability to land forced farmers to look elsewhere from 2005. Some farmers moved to Dompu, but many have chosen to cultivate in Sumbawa Besar, often renting land during the dry season (i.e. not migrants to the district). Most product (70%) from NTB is sent to markets outside the District. The residual 30% is sent to Mataram, or retained for local consumption. Productivity across Indonesia (including NTB) is reasonable constant, with a national average yield of 9.5 t/ha. There is some export of shallots (1.2% of production

[17] The review presented here is a synopsis of relevant information extracted from the ACIAR shallot value chain report: Wandschneider, T., Boga, K., Ly, K., Gniffke, P., Harper, S. and Kristedi, T., 2014. Final Report: Eastern Indonesia agribusiness development opportunities (EI-ADO) – analysis of shallot value chains. Prepared by Collins Higgins Consulting Group Pty Ltd. for ACIAR. Project Number AGB-2012-009.

on average over the years 2008-2012) which some of this export from NTB (Sumbawa). There is significant import of shallots. Over the years 2007-2011 this was 110,000 tonnes per annum (on average).

Shallots are a dry season crop, generally grown between April and October, with a peak in harvest over August and September. Shallots are a labour intensive crop; ACIAR reports an average of 290 person-days per hectare allocated to production. This crop, therefore, creates a significant amount of on-farm employment (40% women). In many villages, shallots represent the single most important source of agricultural income. Shallots can be stored for several months, without major loss in quality. This reduces price volatility relative to perishable crops such as tomatoes.

Table 12. Shallot production in Bima

	Bima
Cultivated area (ha)	7,000
Average net farmer income per ha ('000 IDR)	43,000
Average wage income per ha ('000 IDR)	13,000
Total net farmer income (million IDR)	300,000
Total wage income (million IDR)	90,000
Total farm income (million IDR)	390,000

There is active international support of the shallot sector through variety development and testing (Table 13). ACIAR also describes a collaborative University of Wageningen and Indonesian Vegetable Research Institute project which compared two varieties (true seed and seed bulb).

Shallot cultivation requires inputs of fertiliser, seed, pesticides and soil preparation. ACIAR highlights that farmers in some locations have no access to soil analysis services and apply fertiliser on the basis of local experience and norms. This leads to suboptimal and fertiliser efficiency rates. Inappropriate and unsafe pesticide use is also common practice.

Shallots are graded according to size (Super-jumbo, Grade A-C) with a decreasing price set according to grade. Choice of variety is the single most important determinant in the grade of the crop.

Table 13. Existing development programme related to shallots

Funding agency and programme	**Years active**	**Objective**	**Outcomes**
Shallots			
AIPD-Rural in partnership with private sector (PPP model)	Imminent start	Promote true seed shallot in Bima and Sumbawa Besar	Technical knowledge in the production of bulbs, fertilisation, pest management and disease control

Chilli[18]

Chilli is the major vegetable crop grown in Indonesia. There is a distinction between big chilli and small chilli. NTB has a large area of small chilli cultivation (Table 14), although the productivity of the land is low in comparison to Java (4.2 t/ha compared with 12.8 t/ha), and the yield in NTB has saw a 16% decrease over the period 2009-2011.

Table 14. Chilli production in Indonesia and West Nusa Tenggara (2009-2011)

	Small chilli		Big chilli	
Indonesia	102,760 ha	569,075 tonnes	116,758 ha	827,815 tonnes
NTB	5,142 ha	22,530 tonnes	708 ha	-

Price volatility for big chilli is greater than small chilli due to the decreased perishability and lower input

[18] There is no chilli value chain report available from the EI-ADO project. Information on chilli presented here has been obtained from a presentation on this value chain provided to the first author by the EI-ADO team. No work on the chilli value chain was conducted in NTB during the EI-ADO project.

need for small chilli. Better systems for post-harvest processing are considered essential for the development of this product value chain (grading, packaging, cold storage) and there is a defined need to transfer knowledge on seedling quality with respect to susceptibility to virus.

Mango

Mango is extensively grown throughout NTB although the scale of farming is generally low; one or several trees grown in home gardens or near homes. Mango will grow in poor soils and under dry conditions. Production has increased considerably in recent years, from 71,958 tonnes in 2001, to 613,206 tonnes in 2008 (SADI, 2010). Mango production and post-harvest handling in North Lombok has been the focus of several Australian development projects. In particular, there has been effort to maintain quality for a longer period after harvest so that product can be exported to Asia. Mango was a short list product for analysis in the Mission Plan for this project, but no field data was collected. The following analysis is therefore presented based on desk research subsequently conducted by Unram.

Specific mango value-chain review provided by Unram[19]

North Lombok is a key center for mango production. Mangoes from this district are known to have good quality, and are sold to Bali and East Java. The majority of farmers in North Lombok grow mangoes in their yards rather than specifically in orchards, although individually there are more trees in orchards than those in house yards. The fact that more farmers grow mango in house yards means that majority of farmers grow mangoes not for pure business but more as a hobby or income

[19] There is an EI-ADO value chain report for mango, this report was consulted by the Unram team in the preparation of this value-chain analysis. Wandschneider, T., Baker, I. and Natawidjaja, R., 2013. Final Report: Eastern Indonesia agribusiness development opportunities (EI-ADO) – analysis of mango value chains. Prepared by Collins Higgins Consulting Group Pty Ltd. for ACIAR. Project Number AGB-2012-006.

supplement. The main feature of mango trees in yards is that they are grown in small numbers, usually less than 10 trees, depending on the size of the house yard. In contrast, mango trees in orchards are planted over larger land areas with a higher tree population.

The number of households growing mangoes in North Lombok is 6,777, with a mango population of 78,584 trees (2013 Agricultural Census). The average production per farmer in North Lombok is about 457 kg.

Most mango trees in North Lombok are in their productive stage of growth (i.e. planted in the past). This is therefore a mature value chain. Consequently, farmers do not spend significant money buying agricultural inputs such as fertiliser, pesticides, etc. They do not even water the trees[20]. Farmers usually depend on rain for irrigating the trees, except at the time of planting the seeds/seedlings. These practices show the lack of technology adoption in mango farming. There is limited evidence for the re-planting of mango trees. Current interventions focus on the existing harvest, not on the sustainability or the market potential of the future harvest.

The practice of no application of fertilizer, pest control, and lack of regular watering (irrigation) logically causes low production and (presumably) leads to low income from the production. This may consequently be reflected in the low proportion of income contribute to family income from mango. There is good scientific evidence now of the relationship between soil nutrition and the productivity of fruit trees.

Mango does not represent the main income for poor farmers, but rather an opportunity to supplement income that may be derived from other sources. Mango trees are grown in house yards as shade, and as a mechanism to promote a supply of cooler air around houses. Mango

[20] The authors of this report note that even at the end of the dry season in North Lombok and Dompu, mango was showing no sign of water stress, and was producing apparently bountiful fruit. Conditions at the time were very dry, and cattle, in contrast, were suffering from lack of feed and water.

trees grown on orchards with annual planting of other crops, such as cassava, sweet potato, corn, and vegetables are also considered as supplementary income. Producers on orchards expect and gain more income from the annual crops rather than from mangoes. As a result of this, farmers put less attention on mango production activities.

There is no processing involved in the farming system described here, with the exception of sorting by inter island salers and buyers from Mataram. A limited amount of mangoes purchased from the open market are used for producing semi-dried fruit products by Phoenix Mas in Mataram. These products are sold throughout Indonesia and there is considerable scope for expansion of processed products from mango (and other fresh produce).

Farmers and their family members generally plant of mango seedlings purchased from nurseries. The only fertiliser used at planting is manure which is dug into the planting hole. Seedlings are watered regularly. After the trees established, farmers rarely water the trees, and rarely fertilise the soil. Watering is generally conducted by the farmer's wife. Occasionally, farmers prune the trees, although there is no guidance on this.

At harvest, farmers sell mango fruits by two systems. They can either sell the entire fruits that are still on the trees (locally known as '*tebasan*'), or they can harvest and weigh the fruit. Most farmers sell mangoes using the *tebasan* system due to the simplicity of the system. The preference of farmers is the *tebasan* system and this is easy money, does not require additional labour, and reduces the risk of mango fruits being taken or asked to be given free of charge by relatives/friends (as the fruits are in possession of traders). Some farmers, however, elect to sell their mangoes through harvesting and weighing the fruits. From the perspective of this analysis, the *tebasan* system should be avoided as this places farmers in a disadvantaged market position. However, farmers do not recognise this disadvantage.

Education and information on the value chain is essential to release greater value to these farmers.

Village collectors buy mangoes by coming to farmer houses or orchards. In the *tebasan* system, village collectors employ several workers to harvest and to load/unload the fruits. In the competing weighing system, farmers harvest their mangoes and sell them to village collectors. The bargaining of the price is based on weight of the fruits depending on size and quality. The price attributable to fruit is based on size and quality. Small retailers buy mangoes from village collectors late in the afternoon and sell the fruits in the morning at their fruit stalls. Buyers from Mataram buy mangoes from village collectors based on weight. Buyers come to village collector houses to bargain based on the size and quality of the fruits.

Collectors may store the fruits for up to three days in order to ensure that their selling quota is reached. Village collectors have the potential to sell mangoes to inter island traders who store the fruits in a storage building before export to Bali or Java Island.

There is no change made to the product during the described steps of the value chain. The only processes relate to sorting based on the size and quality of mangoes. Over ripe mangoes will be sold to small retailers. Mangoes that are ripe and almost ripe are sold to subdistrict collectors, or to inter island salers, or to buyers from Mataram. The unripe ones will be sold to small retailers who will sell them to consumers for making fruit salad (called *rujak*). The rotten mangoes are thrown away by village collectors[21].

Three separate market channels determine the market price of mangoes (Channels 1-3):

The price of mangoes ascribed to channel 1 is IRD 3,000/kg bought by village collectors. Village collectors sell them to small retailers/fruit vendors at the price of

[21] There is no data available on the distribution of product between these classes in North Lombok

IRD 7,500/kg. Finally, the mangoes sold by fruit vendors to consumers with the price of IRD 9,000/kg. Product in this channel is self-harvested by growers and sorted by weight.

Mangoes ascribed to channel 2 are sold to village collectors at the price of IRD 1,167/kg. The village collectors sold them to subdistrict collectors at the price of IRD 2,500/kg. The subdistrict collectors sell mangoes to inter island sellers at the price of IRD 10,000/kg. Product in this channel follows the *tebasan* system. The price is this channel is lower per kg due to the large amount of product sold this way.

Mangoes that go through channel 3 are sold at the price of IRD 3,556/kg to village collectors who then sold them at the price of IRD 11,500/kg to inter island sellers. The price of mangoes sold to buyers from Mataram is based on bargaining between village collectors and the buyers (no fixed price). Product is sold through this channel by more entrepreneurial farmers who sort fruit to achieve a better price.

Technology and the associated flow of information has had an effect on the mango value chain. Mango collectors generally sell fruit from village houses or from city markets to outside buyers. Collectors can also directly send fruit from houses to Java, including Jakarta, to buyers who they have an existing relationship with (transport logistics are the responsibility of the buyer). The ability of collectors to do business has, anecdotally, become more simple with the availability of mobile phones. Using mobile telephony, information and transactions can be more easily managed. With respect to the transportation of fruit, coordination can be more easily made through amicable arrangements by the two parties. Outside buyers can send one or more trucks to collect fruit at agreed prices, or collectors can send fruit at a negotiated cost of transportation or inclusive price of the fruit.

Possible interventions in the mango value chain:

The North Lombok value chain has very limited (almost no) capacity to preserve (post-harvest processing) or process mango fruit at times when the fresh product price is low due to increased supply, especially during the mango harvesting season. Associated with this is a lack of capability of markers to understand market information and to predict market demand[22].

Farmers also lack capability to produce high quality mangos and to increase the productivity of mangoes due to a lack of tree maintenance (including fertilising, pest control and watering) and extension in crop management. Most farmers do not consider mango farming as pure business. The variety of mango under cultivation is also questionable. Lack of investment in new varieties chosen for production has impacted on the income that is accrued to poor farmers through the mango value chain.

There is significant opportunity for North Lombok (and NTB) to supply off-season mangos to the Indonesian market when the price is higher through controlled use of paclobutrazol to alter timing of fruit set. Yields from off season mango are, however, low.

Cassava

Cassava was not specifically on the final short list for value-chain analysis. However this product was briefly assessed during field work. Cassava is only grown in North Lombok. This product received a low ranking from EI-ADO for its potential to increase the income of poor farmers, but it is a popular crop in parts of NTB and throughout Indonesia. Cassava tubers are a staple source of carbohydrate for many poor farmers in dry areas. Analysis of the cassava value chain is presented here based on limited data collected during the field value-chain analysis, and information provided by the Unram team. The EI-ADO project did not conduct a detailed value-chain analysis for cassava.

[22] Constraints to the value chain in this context relate to lack of coordination between demand and supply. This issue is covered in more detail in the analysis of the mission data for all fresh produce (fruit and vegetables)

Compilation of field and Unram data on the cassava value-chain

Cassava (*Manihot utilissima*) is very easy to grow in marginal, suboptimal or dry land and can produce about 15-18 tonnes/ha without agricultural inputs (including irrigation and fertiliser), although yields as high as 26 tonnes/ha can be realized with better soil and crop management. Cassava is seldom grown as a monoculture; cassava in North Lombok is generally intercropped with corn. Cassava and corn are planted at the same time, at the start of the rainy season, but corn is harvested much earlier. Corn can be harvested 95 – 115 days after planting, however cassava requires 10 – 16 months before harvest. Corn may be replanted in the following year before cassava can be harvested. Cassava requires limited soil inputs. Stakes are inserted in the ground and left to grow. Any fertiliser applied to an intercrop is for corn, not cassava. Farmers frequently claim that this crop 'saves them money'. While waiting to harvest their cassava they may seek other forms of employment to earn extra income.

North Lombok currently produces approximately 27,037 tonnes of cassava each year (Nusa Tenggara Barat in numbers, 2013), from between 1,000 and 1,500 ha of land. The annual harvested area and productivity of cassava in North Lombok fluctuates considerably. Reports from farmers indicate that the potential income from cassava is in the order of IDR 22-24,000,000 per hectare per season (10 – 16 months). However, cash flow is an issue. Income is only accrued at harvest, more than one year after planting

Fresh cassava is highly perishable with a shelf life about 2-3 d after harvest, but village-scale processing allows drying of cassava for animal feed or processing into milled products. Most cassava is currently sold as fresh tubers to local market at a relatively low price. Based on interviews with farmers, the value chain of fresh cassava in North Lombok is very short:

Farmer ⇨ intermediate ⇨ collectors ⇨
distributed buyers to local market

Traditional uses of cassava are as a cooked fresh tuber, fried snacks, fermented cassava, and other foods with short shelf life. There is enormous potential for locally-processed cassava at the village level to generate products such as Cassava Starch (Tapioca), Modified Cassava Starch, High Quality Cassava Starch (HQFS), or other intermediate products (Figure 10). One operator claimed to be buying tubers at IDR 570 /kg and processing this and selling flour for IDR 2,000 /kg in an attached shop (North Lombok) or 3,500 IDR/kg at markets in Mataram.

Potential products

Fresh cassava can be processed by farmers into simple products including dried cassava (Gaplek), tapioca and modified cassava starch (Mocaf). Dried cassava (Gaplek) has become the "most wanted" product after wheat flour. Gaplek might be processed as sliced or grated cassava which can be dried either under the sun or in an oven. Tapioca can be sold locally to local markets and to traditional food processors as an ingredient in bakso, cilok, kerupuk, and as a raw material in industries that synthesise HFS and citric acid.

Using available resources at farm and village level, activities such as harvesting, cleaning, sorting, size reduction, drying and packaging are all currently practiced in some locations. Past Unram activity has delivered technical knowledge for village-scale products up to cassava flour. The general system appears to involve predominantly male farmers harvesting the cassava and selling as a cleaned tuber to predominantly female small-scale processors, who reduce the cassava size, air dry the product and then mill it into various products.

Gaplek (dried cassava chips). Farmers produce dried chips by peeling, washing, slicing and drying fresh cassava. Gaplek has MC 12-13%, shelf life 6 months, recovery: 33% (one kg cassava gives 0.33 kg of chips). Fresh cassava is valued at IDR 500 / kg but is highly perishable; Gaplek is valued at IDR 800 / kg.

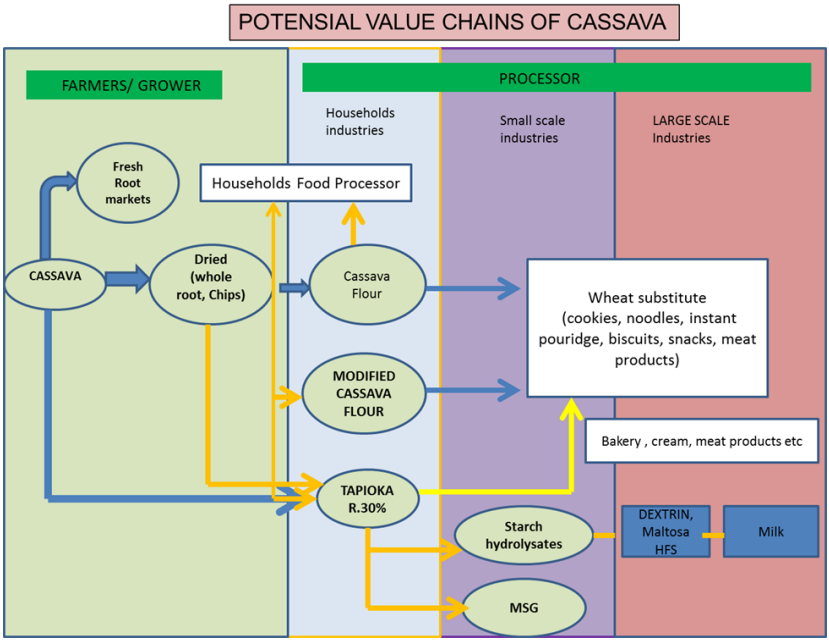


Figure 10. Extended value chain for cassava indicating the range of potential value-added products that can be created from harvested tubers

Tapioca. One kg of fresh cassava will result in 0.4 kg tapioca and 0.16 kg onggok (for feeding cattle). Production requires peeling, washing, grating, pressing, starch sedimentation, drying and packaging. Tapioca processing is an environmentally friendly industry. Solid waste can be used for cattle feed and liquid waste is safe for agriculture irrigation. Value IDR 6,500-7,500 / kg.

Mocaf (Modified cassava flour). Three kg fresh cassava gives 1 kg cassava chips; then these can be processed into 0.8 kg mocaf. Production requires peeling,

washing, grating, soaking / fermentation, pressing, drying, milling and packaging. Value IDR 3,500-4,000 / kg.

Despite the high potential for increased use of cassava products, significant investment, institutional support and technology development are required. Any intervention in this value chain must promote the provision of small-scale processing equipment at village level and determine private sector interest in developing larger-scale integrated systems for incorporating cassava into rice flour and producing blended products such as cassava and rice noodles or biscuits at low cost.

Vegetable value chain in North Lombok

The value-chain map for fresh vegetables in North Lombok is presented as Figure 11.

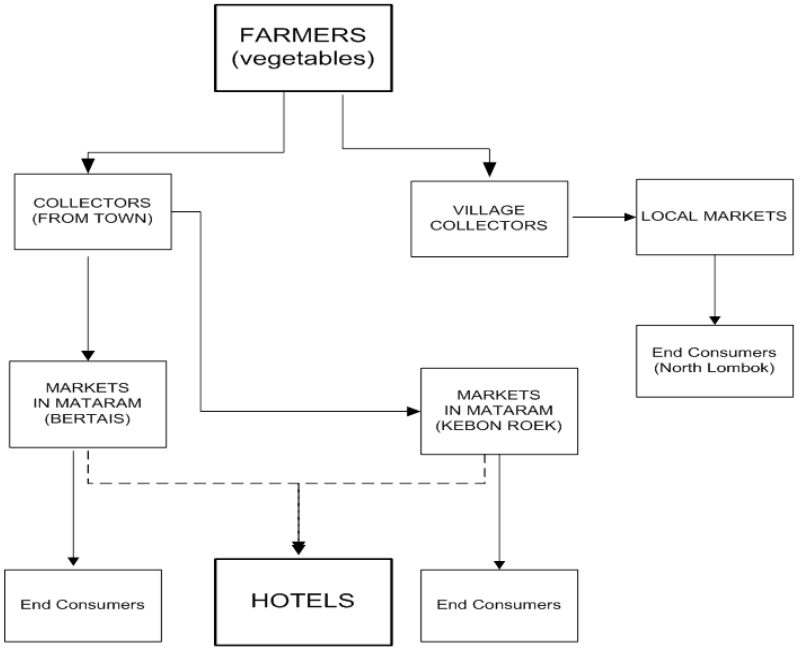


Figure 11. Map of product flow in the North Lombok vegetable value chain

Value chain and actors

North Lombok is an active area for vegetable production (particularly tomatoes, shallots, long bean, and chilli). Farmers dominantly grow vegetables using irrigation during the dry season (April to December), although in some upland areas vegetables are also produced during the wet season. Farmers are very keen to develop horticulture (vegetables as well as fruits) as they recognize the demand for fresh products that exists within the district. Tomato, shallots and chilli are considered high value, but these are rotated with nitrogen-fixing snake beans and cucumber which are considered low value but are important to reduce disease build-up in soil (the value of this is likely poorly understood).

The sequence of farming activities to produce vegetables in North Lombok is land preparation, sowing, fertilisation, pest control and harvesting. Farmers carry out most of these activities using simple tools and structures such as bamboo frames or tripods.

For land preparation, farmers usually use traditional tools such as hoes, choppers, and crowbars. Sometimes, they use cattle to plough the soil. After ploughing the soil, farmers usually make raised beds so that the land has good drainage. When making raised beds, the soil is mixed with manure and home-made PGPR (Plant Growth Promoting Rhizobacteria and *Trichoderma* cultures) which are used as natural protectants against virus risk[23]. Farmers who have enough money usually use black plastic mulches to sustain soil moisture and to prevent weeds. Farmers who do not have enough money will not use mulch from their farm. The cost of using black plastic mulches is around IDR 2,200,000 per hectare. Most activities are carried out by family members and hired labour. The cost of land preparation is IDR 700,000 to IDR 800,000 per hectare. Seeds of vegetables are grown in a seedbed and

[23] Use of biological agents to promote growth and protect against pests and disease can work, but must be accompanied but sufficient technological capability to ensure the use of such agents is effective.

the seedlings are transplanted on the raised beds already prepared.

Other than organic fertilizers (manure and PGPR), farmers also fertilize their soil using Urea and Ponstan. Pests are controlled using pesticides with no apparent attempt to use natural enemies for biocontrol. Farming activities are carried out mostly by family members.

Harvested product is purchased directly from the farm by either village collectors (buyers) or those from the larger towns in the district. Tomatoes, chilli and long bean are harvested frequently with an interval of three days depending on maturity level of fruit. The periods of harvest could be longer than 30 days depending on the viability of crops in the field. However, the peak harvesting period is between 10 to 15 days depending on variety. Shallots are harvested once annually and are dried before sale to collectors.

Collectors (buyers) travel to farms during the harvest period in direct response to contact from the farmers. The head of a farmer group has the responsibility to act as an informant to the buyers. Communication is via mobile phones. Some farmers conduct market research prior to contacting the buyers by visiting produce markets in Mataram City (there are two main 'big' markets: Kebon Roeq Market and Bertais market). They pretend to be buyers or end-consumers and research the retail price of fresh produce. Once they obtain a price they return to their village and report this market information with their farmer groups.

The buyers who visit North Lombok are generally from Mataram, but there are some local collectors from Tanjung and Gangga (local Markets). There is no sale of fresh product to hotels and restaurants in North Lombok. North Lombok hotels (located along coast of main island and on the Gilli Islands) buy vegetables each day from Mataram and Bali although reportedly, much of this produce is from outside North Lombok District (Lombok island, Bali, Java and from international suppliers). No information on the origin of fruit and vegetables used in

North Lombok hotels and restaurants was collected during this mission. Hotels have an informal contract with produce sellers in Kebon Roeq Market and Bertais Market. The market grades product to meet the quality standard of individual hotels.

Product volume and flow

This field research described in this report was unable to quantify the volume and flow of all fresh produce in North Lombok. However, consultation with stakeholders during the field mission indicated that the demand for fresh produce from the North Lombok tourism sector is potentially large. The secretary of the planning board of North Lombok suggested that farmers could be better trained and supervised on how and where to sell their products. From his departments' perspective, some farmers do not want to grow some vegetables/fruits because they do not know the market demand and where the buyers are. He presented a challenge to the private sectors in North Lombok to help farmers to link to the market. Specifically, he suggested that it was the function of district government, especially the agricultural and tourism department, to link the farmers to the supplier so that farmers understand the demand schedule and product requirements (quality) of hotels and restaurants.

In response to this challenge, the Head of the Agricultural Department for North Lombok, under the guidance of the Unram team, made contact with 19 hotels in North Lombok, to establish the daily, and by calculation the monthly and annual requirement of fresh produce.

These 19 hotels represent a total of 724 rooms (ranging from no-star to five star hotels). The total number of hotel rooms in North Lombok is 3,399. To explore the potential scale of fresh produce demand in North Lombok, demand was calculated as a function of room, and then projected for all hotel rooms in North Lombok (Table 15).

The annual demand for many of the fruit and vegetables is high: annual demand for tomato in Table 15 is 257 tonnes; for small chilli 15.6 tonnes. Little of this product is likely to be sourced from North Lombok directly as it is not graded locally. There is supply within NTB to satisfy this demand, however there is scope to increase production from North Lombok and to market these products to tourists as 'locally, sustainable and ethically produced' providing food safety can be ensured.

Economic analysis of the fresh produce sector in North Lombok

Meaningful economic analysis of the fresh produce sector in North Lombok is dependent on quantitative data on product flows, value, and the associated costs of production. A formal commercial fruit and vegetable sector in North Lombok (where it exists), is very young, and therefore quantitative data simply does not exist. Systems to record and collect this data need to be implemented. However, some qualitative analysis of the flow of money within the sector can be put forward.

The fresh produce market is strongly directed by the end of consumer: collectors act as buyers under instruction from consumers (hotels and markets). Field evidence suggests that collectors will travel to farms and buy product based on agreed price. Attribution of a quality class to products is the responsibility of the buyer, and therefore the bargaining position of farmer to influence price is mostly very low.

Table 15. daily, monthly and annual demand for fresh fruit and vegetables from hotels in North Lombok District

		Daily (kg)		Monthly (kg)		Yearly	
	Fruit	**Actual 19 hotels**	**Estimate all hotels**	**Actual 19 hotels**	**Estimate all hotels**	**Actual 19 hotels (kg)**	**Estimate all hotels (tonnes)**
1	Papaya	168	789	5,040	23,662	60,480	284
2	Watermelon	233	1,094	6,990	32,816	83,880	394
3	Melon	120	563	3,600	16,901	43,200	203
4	Pineapple	155	725	4,635	21,760	55,620	261
5	Orange	164	768	4,905	23,028	58,860	276
6	Mango	50	232	1,485	6,972	17,820	84
7	Strawberry	20	92	585	2,746	7,020	33
8	Apple	84	392	2,505	11,760	30,060	141
9	Banana	158	742	4,740	22,253	56,880	267
10	Snakefruit	62	289	1,845	8,662	22,140	104
11	Avocado	31	143	915	4,296	10,980	52
12	Guava	2	9	60	282	720	3.4
13	Starfruit	8	35	225	1,056	2,700	13
14	Pear	26	120	765	3,591	9,180	43
15	Dragon fruit	6	26	165	775	1,980	9.3
16	Grape	11	52	330	1,549	3,960	19
17	Passionfruit	6	28	180	845	2,160	10
18	Rambutan	76	354	2,265	10,634	27,180	128
	Vegetables						
1	Tomato	152	714	4,560	21,408	54,720	257
2	Chilli (big)	43	203	1,298	6,091	15,570	73
3	Chilli (small)	9	43	278	1,303	3,330	16
4	Shallot	40	189	1,208	5,669	14,490	68
5	Garlic	38	176	1,125	5,282	13,500	63
6	Potato	151	709	4,530	21,267	54,360	255
7	Carrots	87	406	2,595	12,183	31,140	146
8	Napa cabbage	27	127	810	3,803	9,720	46
9	Chinese cabbage	21	96	615	2,887	7,380	35
10	Onion	84	392	2,505	11,760	30,060	141
11	Cauliflower	44	208	1,328	6,232	15,930	75
12	Cowpeas	7	31	195	915	2,340	11
13	Cucumber	51	237	1,515	7,113	18,180	85
14	Long eggplants	29	134	855	4,014	10,260	48
15	Water spinach	22	103	660	3,099	7,920	37
16	Snap bean	26	122	780	3,662	9,360	44
17	Bean sprouts	15	68	435	2,042	5,220	25
18	Sweetcorn	35	164	1,050	4,929	12,600	59
19	Lettuce	31	146	930	4,366	11,160	52
20	Paprika	6	26	165	775	1,980	9.3
21	Celery	6	26	165	775	1,980	9.3

Assumptions:

Actual cumulative demand was ascertained through interviewing the management at 19 hotels in North Lombok district. These hotels represent 724 of 3,399 rooms in the district. A key assumption is that the average demand per room calculated from the 19 hotels is applicable to all 3,399 rooms in North Lombok. Occupancy is not considered in this exercise. The estimated values are indicative of demand.

Vegetable production is a high capital, high risk business. Very few farmers in North Lombok have sufficient working capital to run their production. Farmers will commonly borrow money from local money lenders who also act as collectors. Farmers use this money to buy input suppliers such as seeds, fertilizers, pesticides and to finance production cost. Vegetable crops are very susceptible to pests and disease. It is not uncommon for a farmer to lose an entire crop. Technical capability to manage pest and disease is on many farms limited. Although the potential rewards from vegetable production are high, many farmers in North Lombok continue to pursue traditional farming practices such as maize production. Economic analysis (Table 16) needs to be interpreted in the light of variable risk of crop failure, generally higher with higher revenue to cost ratios.

Table 16. Economic Analysis of Vegetable Production in North Lombok (per 0.05 ha)

Items	Tomatoes	Shallots	Snake beans	Chilli
Costs (IDR)				
Land rent	300,000	300,000	300,000	30,625
Farm inputs	2,025,000	2,020,000	1,595,000	177,000
Labor	770,000	530,000	450,000	516,000
Others	50,000	50,000	50,000	227,250
Total	3,145,000	2,900,000	2,395,000	950,875
Revenue (IDR)				
Production (kg)	3,000	550	2,000	200
Price / kg	3,000	9,000	1,800	7,000
Total	9,000,000	4,950,000	3,000,000	1,400,000
Revenue/Costs	2.86	1.71	1.50	1.47

Information flow and relationships between the value chain actors

Information flow within the North Lombok vegetable value chain mirrors that of the money flow. Major market sellers respond to demand communicated by consumers (hotels) and respond accordingly through communication with collectors. Major markets in Kebon Roeq and Bertais appear to understand the requirements (volume and quality) that hotels want to buy. Requirements are passed to collectors who work directly to farmers. Collectors in this way can inform farmers of likely demand cycles, and influence what the farmer plants. Similar communication also occurs in the local market in North Lombok although demand appears to be driven by domestic consumers, not the tourism industry. The system functions, but is inherently biased against allowing farmers to make decisions based on their own assessment of future demand and prices.

Possible interventions in the fresh produce value chain

The fresh produce value chain in North Lombok is very informal, and needs support to ensure that potential

to create value for local farmers is exploited. The major constraint is the total lack of any postharvest facilities, such as local packhouses, where fresh products can be sorted, cleaned, graded and packaged for transport to different markets. By partnering with anticipated village-level government investment, a network of local facilities could be built and operated by farmer groups to provide centralized points for collectors to come. In time their profitability may allow installation of cool storage facilities (either using refrigeration or simpler temperature reduction systems such as night air cooling). Over time, collectors will need to improve product handling efficiency: washable and returnable standardized plastic crates have been important in the developed world. Eventually traders will need to invest in refrigerated trucks to compete for quality with Chinese or Thai products, and markets will need overnight cool storage facilities.

Another intervention is to develop formal procedures for communicating and implementing food safety systems: enforcing withholding periods to ensure freedom from pesticide residues, and improving fertilizer and handling practices to minimize the risk of contamination with human pathogens. There is a local FDA-approved certification system in operation for certifying dried fruit products produced by Phoenix Mas; quality grade standards and food safety regulations need to be communicated to growers and enforced by regional inspectors to effect a step-change in confidence in food safety for fresh products.

Finally, the intervention of a Massey-Unram partnership provides scope for a series of on-line tools, calculators and cellphone apps to be developed by staff and students to handle the delivery of locally-relevant information in Bahasa Indonesia in an accurate and up-to-the-minute form. Risk warnings for pest population explosions, fertilizer and irrigation advice to match crop phenology, advice on identifying disease or nutrient deficiency symptoms, harvest grade standards and approved postharvest sanitisers, current market prices in

local and urban centres and seasonal predictions for supply and demand can all be developed and maintained through our partnership. Final year undergraduates may be able to serve as assistants to professional extension officers as part of their practical training.

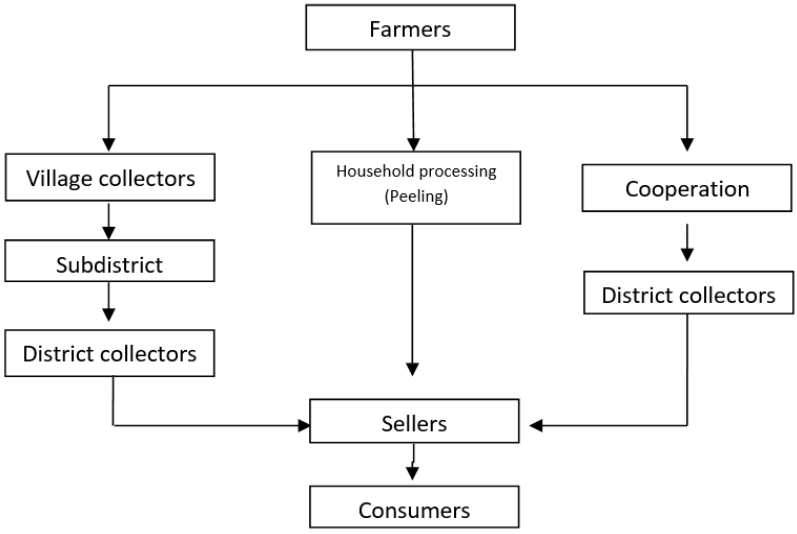
Cashew

Very limited information on the cashew value-chain was obtained during the field mission. There was no direction from Bupati in either district to develop the cashew sector. This is presumably due to the lack of investment in cashew trees over the past 20 years. Analysis of the value-chain in this section of the report is therefore brief, and is based on available literature.

Cashew value chain

Cashew has traditionally been an important crop for NTB as it is a low-maintenance crop with low water requirements that can grow on barren lands and does not compete with other commodities for space or resources. Cashew is predominantly an export crop; harvested nuts (in shell) are not perishable and can be readily transported. Approximately 13,500 tonnes of cashew nuts are produced annually in NTB from an area of 67,000 ha. The planted area in Dompu is 11,520 ha and in 2013 produced 4,854 tonnes of in shell product. The planted area in North Lombok is 13,857 ha and in 2013 this produced 2,000 tonnes of product (NTB in figure, 2013). An estimated 650,000 ha of land are considered to be suitable to cashew cultivation across NTB although the crop is only cultivated on 200,000 ha of land.

The cashew value chain for North Lombok was described by Yuniarti (2009)



Farmers carry out very little maintenance cashew trees. This is because the trees are old (productivity is decreasing) and almost abandoned. Farmers simply wait for plants to bear fruits each year, and harvest this. Most of the harvest is sold to village collectors in the form of unpeeled nuts (90%), with a small proportion sold for household processing (8%) and to cooperatives of cashew farmers (2%).

Unpeeled cashew nuts are sold to village collectors at the price of IDR 5000/kg. Sellers (wholesalers) process the cashew nuts and sell them at the price of IDR 50,000 to 60,000/kg, while those processed by households are sold at the price of IDR 28,000 – 31,000/kg.

The market potential for cashew is good; demand exceeds supply and farmers therefore always sell their crop. However the value chain is perceived as being of look profitability as the price returned to farmers is low and there is limited potential to value add to the product.[24]

The cashew value chain in Dompu is different (Figure 12).

[24] http://www.bi.go.id/id/umkm/penelitian/regional/ntb/Documents/01DaftarIsiPenelitianKPJUNTB 2012.pdf

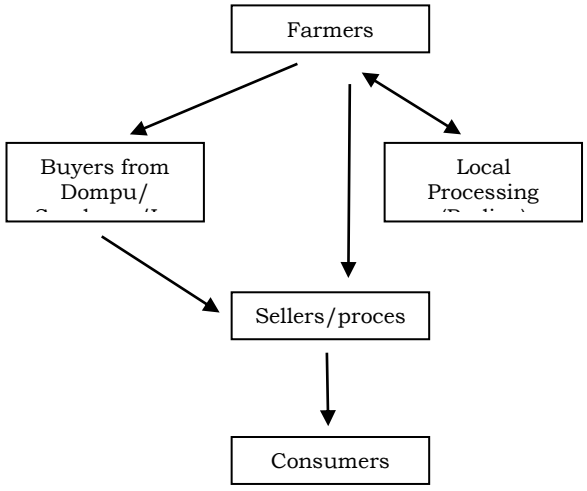


Figure 12. Value chain map for cashew in Dompu.

Agricultural inputs in Dompu, like North Lombok are essentially non-existence; as the plants are again old and near the end of their productive potential. The authors of this report witnessed many fields of abandoned cashew trees in Dompu. Discussion with farmers indicated that all trees were planted 20-30 years ago. For cashew production to be a viable business new trees must be planted.

At harvesting time, buyers from as far away as Lombok travel to farmers' houses/yards and purchase unpeeled cashew nuts at the price of IDR 8,000 – 9,000/kg during the peak harvesting season and IDR 15,000 towards the end of the season or early in the season when supply is limited. Local buyers from Dompu/Sumbawa have storage facilities that can hold a volume of 3 trucks and can therefore stockpile product before on-selling to larger buys in Lombok.

The cost of peeling cashew nuts in Dompu is IDR 50,000/day. The processed cashew nuts are sold at the price of IDR 60,000 – 100,000/kg.

Interventions to be targeted in this Activity

Context: Education for Rural People

The development programme Education for Rural People (ERP) was launched in 2002 under the leadership of the Food and Agriculture Organization as part of the implementation process for the Millennium Development Goals (MDGs) (specifically MDG1, 2, 3 and 7). ERP was created in response to the realisation that education is a neglected key to food security. ERP has a central premise that people, not institutions or technology, are the driving force of development.

ERP has a mandate to redefine agricultural education:

> *'Today, a broader view of the life skills necessary to thrive in rural areas has emerged. There is a need to broaden the agricultural education paradigm to embrace the concepts of sustainable rural development'*
>
> (Gasperini and Acker, 2009)

ERP mandates that agricultural education must be redefined to reflect changes in rural areas in order to prepare individuals to succeed in increasingly knowledge-based rural economies linked to global supply chains. Agricultural education needs to respond to the changes in technology, emerging natural resource challenges, opportunities for on-farm and off-farm employment, the need to adapt to climate change, and opportunities in entrepreneurship and small enterprise development (Van Crowder et al., 1998). The position of ERP is that better educated rural people have better employment prospects, better health, greater food security, less vulnerability to shocks, and better coping mechanisms in dealing with the forces of climate change, food crises, globalization and challenges to cultural traditions.

Illiteracy as an impediment to education is a common theme of ten years of lessons from ERP. Where the rural poor are illiterate they are essentially excluded

from the knowledge that would improve their capacity and productivity, increase their income and food security, connect them to the market from which they are largely marginalized and enhance their livelihoods and citizenship (Burchi and De Muro, 2007).

> Farmers in the highlands of North Lombok are generally well educated. They predict market cycles and research crop developments. Their education gives them access to finance, and entrepreneurs invest in opportunities. The dryland farmers, in comparison, are generally illiterate. They are subsidence farmers and cash flow is their main concern. Their lack of education impedes efforts to escape the poverty cycle.
>
> (Dr. Komang, University of Mataram, December 2014)

FAO recognises the role of universities in this new paradigm of agricultural education leading to sustainable rural development. Programmes that offer non-formal basic education and training have the opportunity to reach out to children, youth and adults who have not had the opportunity to pursue a formal education. Universities can play a key role in training teachers and extension staff, in assisting with the development of curriculum, in developing new technologies of relevance to rural people, in leading agricultural innovation systems, and helping with monitoring and evaluation of educational rural programmes (Acker and Gasperini, 2008).

Extension is an important aspect of ERP, but is often neglected as an education programme. From the perspective of ERP, this is because extension typically falls outside the jurisdiction of the ministry of education. When this impediment is recognised, there are examples of working models which can implement the new agricultural education paradigm. Farmers Field Schools (FFS), for example, are an example of interministerial

collaboration by which governments, often with NGO technical assistance, reach out to rural youth and adults in non-formal education and to children at the primary school level. Such programmes contribute to prepare future farmers while teaching about language, mathematics, drawing, science, agriculture, environment, and in some cases, entrepreneurship. In many countries, such institutions are found operating as joint ventures between teachers and extension.

Curricula in the context of redefined agricultural education must reflect new topics in sustainable rural development including sustainable agriculture approaches, social change processes especially for those planning to work in extension and with NGOs, and a better understanding of emerging challenges such as climate change, variability in agricultural input and product costs, and the impacts (and opportunities) associated with participation in global supply chains. To be successful and to meet the needs of the rural poor, programmes must place learning in context so that basic knowledge and competencies as well as technical and life skills are included in educational programmes. Again, higher agricultural education has a role to play here. In the words of Acker and Gasperini (2008) 'the engaged university is one that seeks out opportunities to work directly with communities, and in so doing, the community and the university are both strengthened.'

> An ERP example from Nigeria: University outreach delivers seminar to local farmers[25]
>
> *The University of Uyo in Nigeria, in collaboration with a local agricultural development programme and agriculture and community education initiative carried out a seminar for men, women and youth with a theme 'Agriculture as a Business'.*

[25] http://www.fao.org/NR/edu/abst/edu_081001_en.htm page 78

Topics included how to profit through scheduling operations to maximise production and take advantage of market demand; improved types and breeds of crops and livestock; and fertiliser management to maximise production and environmental responsibility.

Farmers unanimously appreciated the series and stated that this was the first opportunity they had to access expertise and education in their own village. In a follow up plan, students and advisor agreed to return to the village to demonstrate good crop and livestock practices that meet the needs and interests of farmers.

Context: The role of universities in society

Universities around the world are evolving a new model for 21st century higher education. The historical role of universities in society, and the potential of these institutions to global development has been the subject of much debate and discussion. The President of Arizona State University, Michael Crow, recently described universities as 'valuable ideas generators with vast influence and the potential to manifest technologies and concepts that can change lives the world over'. He furthermore stated that universities must be socially embedded, with a culture of academic enterprise and knowledge entrepreneurship that will foster development through direct engagement (Crow, 2014).

In a 2010 address to Royal Irish Academy in Dublin, the Harvard President, Drew Faust, described society as one where knowledge, more than ever, is replacing other resources as the main driver of economic growth, and education has increasing become the foundation for individual prosperity and social mobility. Through international partnership universities 'nurture the hopes of the world: in solving challenges that cross borders; in unlocking and harnessing new knowledge; in building

cultural and political understanding; and in modelling environmental that promote dialogue and debate' (Faust, 2010). These developmental advances are catalysed by universities. Systems that underpin the in-country infrastructure needed to sustain development are created by universities while other institutions falter in dispiriting succession.

> *I had the privilege of witnessing one remarkable example of such an initiative first hand when I travelled to Botswana last fall. Collaboration between Harvard and the government of Botswana has over a decade and a half made significant progress in AIDS prevention and treatment. One of its greatest successes has been in all but eliminating mother-child transmission of HIV/AIDS in a study population. It was an unforgettable lesson for this university president about the kind of difference our institutions can make—a lesson rendered powerfully real when I met with a group of the mothers and their healthy, bright-eyed children. When I asked one woman about her hopes for her three-year-old daughter, she smiled and replied, "I want her to go to Harvard.*
>
> (Faust, 2010)

Universities therefore, become central actors in the training of a labour force adequate to the new conditions of production and management and a critical source of equalisation of chances and the democratisation of society (Castells, 2009).

Universities have a core function to educate, and in the context of the significant role of education in alleviating poverty, especially in rural areas, organisations such as UNESCO have challenged higher agricultural education to initiate and lead the articulation

of a vision for the future that serves the needs of both agriculture and all who inhabit rural areas.

Through supporting others levels of education (primary, secondary, vocational and adult) with critical expertise on agriculture and natural resource management, agricultural universities have unique capability to contribute to rural development, poverty reduction and food security (Atchoarena and Holmes, 2005).

UNESCO recommends that agricultural universities in developing countries create new partnerships with schools, academia (including developed-country universities) and stakeholders in the rural sector to realise the potential of this capability. Agricultural universities also need to expand representation in governance and hold continuous dialogue with policymakers. The linkage of university agricultural extension with community education has the opportunity to become a community-based catalyst for rural development.

It is in the context of the role of education in rural development and upon reflection of the responsibilities of universities in today's society, that common impediments to the value chain of agricultural products in Dompu and North Lombok are identified in the next section of this report, and targeted for intervention (the Activity).

SWOT analysis of the value chains

The value chain of the products targeted in the field value-chain analysis fall into three logical categories:

1. Corn and soybean (and mung bean) produced through large scale dry-land cropping (with or without irrigation) dominantly in Dompu where the area of available land is greater
2. Cattle produced throughout Dompu and North Lombok

3. Fresh produce grown at small farming operations, e.g. fruit and vegetable, predominantly in North Lombok

SWOT analysis of the value chain for the short-listed products targeted in the field mission was advanced for these three criteria (Table 17). SWOT analysis of the value chain of these product categories not of the individual products is presented in Table 17.

SWOT analysis was conducted according to the TOWS matrix of Weirich (1982). Integral to this matrix is the classification of strengths and weaknesses as internal to the existing value chain. Opportunities and threats are the contextual factors and characteristics that exist now and that represent a potential opportunity or threat to the chain in the future.

Table 17. SWOT analysis for the value chain of three product categories investigated during the field value chain analysis

	Dry land cropping (soybean and corn)	Cattle	Fresh Produce
Strengths	• Multiple collectors in the chain • Well established and capable wholesalers in chain • Strong market for maize exists • Existing farmer group structures- working together • Labour pool to support production and harvest exist • Storage systems SRG exist in some places	• Farm: - Integrated crop/livestock systems – complementary • Existing strong market with demand greater than supply into foreseeable future • An existing value chain is working linking input suppliers to producers to collectors to traders etc. • Farmers have long traditional experience and knowledge of Bali cattle • Bali cattle have a strong provenance, cultural link and recognition in the Indonesian market place • Hardy animals • Brucellosis free • Low maintenance	• Existing diversified markets exist, with growing demand from (a) low-price local wet markets, (b) high price (but high demand for safety) hotels in district and (c) local urban centre (Mataram) within trucking distance • Existing short value chain links a few irrigated suppliers through collectors to these local and regional markets • Soils are free-draining and irrigation water is available in places • Grower groups exist that provide scale, with clusters of ca. 15 growers co-

		• requirements – compact • Large area of dry land, used for crops in wet season only	operating to generate reasonable volumes of products and make product collection reasonably efficient
Weakness	• Farmers price takers • Limited ability to dry grain or store grain • Low productivity • Poorly informed use of fertilisers and pesticides – ad hoc application • Fertiliser amount available uncertain • Very lumpy supply of maize to collector (high % all harvested at same time) • Inefficient use of infrastructure for collector/wholesaler due to lumpy supply • Uncertain access to critical inputs including seed and fertiliser (not able to store) • Lack of standardised moisture testing in some areas	• Farm – low level of productivity (due to high mortality rates, poor breeding and feeding) • Many farmers constrained by lack of access to credit • Anthrax in cattle • Farmers price takers – spot market and lack price information • Information about consumer/retailer requirements at farm level very limited to non-existent • Lack of transparency along chain • Quality differentiation limited – no formal quality standards • Small regular local market – low value	• Intrinsically higher-risk, more perishable, products than grains and tubers • Farmers constrained by lack of access to credit • Higher costs of production than grains and tubers and higher risk of losses from pests and diseases • Perishability leads to large risk of quality loss in chain; and farmers are paid only for products actually sold (i.e. they carry risk of product failure after it has left their hands) • Information about consumer/retailer requirements at farm level are very limited • Lack of transparency along chain

	• Lack of trust in accuracy of scales for weighing farmers harvest by collector • Collectors lack trust in farmers' honesty about harvest amounts (Dompu only?) • Knowledge and skills to efficiently manage irrigation among farmers limited • Women's labour valued at lower rate than men's	• Food safety uncertain?? • Potential value lost in uncertain shipping schedule – cattle left on port for potentially days and weight loss in transport also possible • Farmers view cattle as bank rather than a productive enterprise that can be farmed	• Quality differentiation almost nil on farm – no formal quality standards • Local market is low value • Food safety very uncertain • Minimal experience with protected cultivation • Irrigation required
Opportunity	• Technology for testing soils and providing appropriate advice on fertiliser use exists • Improved varieties suited to different growing conditions exist/ closed pollination • Improved varieties that will extend harvest period exist • Research capability in corn production exists • Water storage capacity exists in some areas • Subsidised fertiliser and seed available • Bioethanol demand and	• Government extension service exists • Government directive for more cattle • Growing wealthy Indonesian middle class who eat Bali beef • Technologies/ knowledge and infrastructure exists to support and lead to increased productivity • Models for farmer group feedlot systems that are working well exist • Smart communication	• Government extension service exists • District Governor keen on boosting local supply for tourism • Growing wealthy Indonesian middle class is growing domestic tourism and 'export' to other islands • Technologies/ knowledge and infrastructure exist to increase productivity • Payment system based on quality delivered to next

	technology exists • Entrepreneurial collectors and wholesalers with capacity to expand operations • Markets differentiates value on basis of colour and moisture content • Market for animals and human feed strong	technology and infrastructure exists • Models of standards and quality assurance schemes exist • Cattle valued by farmers – will be a part of farm systems for a long long time • Research expertise in Bali production systems exists – Mataram has expertise • Regular short periods of peak demand (e.g Ramadan)	actor in chain, with information about product quality flowing right back down the chain from market to grower • Adoption of postharvest handling systems suited for developing countries • Development of web-based tools and smartphone apps for enhancing information flow • Global models of standards and quality assurance schemes exist • Research expertise exists – Mataram has expertise, including protected cultivation • Port development and urban development in North Lombok on long-term plan will increase demand for local consumption and opportunities for export

Threats	• Labour market limited particularly at harvest • Climate change – uncertainty of rainfall / climate extremes • Competition from other land uses	• ASEAN market opening up – competition for Bali beef • Alternative higher quality beef in the marketplace • Biosecurity system not failsafe – disease risk exists • Capacity of extension organisation – capability of extension agents? • Climate change and the occurrence of prolonged dry period	• Climate change: reduced rainfall, greater frequency of droughts and storm events • ASEAN market opening up – increased competition from Thailand, Vietnam • Higher quality competitor fruit and vegetables available in market • Food safety scare from human pathogen or pesticide residues could close market • Pest or disease outbreaks can be locally devastating • Capacity and capability of extension system

Note: SWOT analysis can continue through discussion with NZAid and Warwick Thomson prior to the submission of the ADD. The TOWS matrix analyses strengths and weaknesses vs opportunities and threats. The aim of the TOWS matrix is to define strategies which will record max, max outcomes for strengths vs opportunities; min, max outcomes for weaknesses vs opportunities; max, min outcomes for strengths vs threats; and min, min outcomes for

Activity interventions defined through common themes

M4P describes five scenarios of market system change that will lead to development in the context of the M4P framework:

1. Improved delivery
2. Changes in practice, roles and performance of important system players and functions
3. Changed attitudes of, and evident ownership by, market players
4. Demonstrated dynamism of market players and functions (for example, responsiveness to changed conditions in the system)
5. Independent and continuing activity in the systems

Based on analysis of the value-chain of six products in the context of the M4P framework, the Massey-Unram project team defines education is a key mechanism to deliver these scenarios of change to the agricultural system operating in Dompu and North Lombok. The project team therefore believes that education has potential to act as a catalyst for poverty reduction in NTB.

The project team does not, however, believe that sustainable poverty reduction will come through focussing on specific value chains.

Several common themes have become apparent in each of the value chains, irrespective of the type of product. These themes are indicative of dysfunction and/or inefficiency within the existing agricultural system (of Dompu and North Lombok and likely of NTB in general).

These themes include:

- Lack of capability in soil, water and crop management (irrigation, fertilisation, pesticides) due to lack of expertise within extension and poor technical knowledge within farming communities. This could be classified as a lack of capability in natural resource management
- Poor engagement (for most products) of farmers with the value chain. This leads to farmers being 'price takers' due to a lack of knowledge, technology or technical capability
- Poor choice of crop varieties that are best suited to farmers' needs (i.e. cropping or cattle fodder) and the prevailing climatic, geographic and environmental conditions
- Poor access of farmers to bank finance making them unnecessarily reliant on high-interest rate loans
- Lack of systems for post-harvest processes, management and quality control (in all value chains) that prevent farmers from directly participating in existing and potentially profitable markets

The project team believes that each of these themes can be targeted through education. This will require the design of appropriate curriculum. However, a developed country-developing country university partnership is uniquely qualified to complete this task.

The University of Mataram has a government directive to provide extension within the community: 20% of the time of Unram staff should be allocated to extension. However, current capability within Unram is poorly suited to this task. The project team proposes to develop the capability of Unram through the Activity to provide extension to poor farmers within Dompu and North Lombok. Massey would essentially empower

Unram to perform this government mandated job. Extension by Unram is not proposed as a replacement for existing government and private sector extension. Extension from Unram will be implemented in partnership with the existing services, supporting existing providers with higher education-based research and teaching.

Extension (through vocational training, demonstration and technical assistant) will target the common themes identified in this value-chain analysis. The project team therefore proposes to not focus on specific products, but on the agricultural system that underpins the productivity and profitability of the value chain for each product.

The long-term outcome of this approach would be the creation of the requisite research, development and extension system (R, D & E system) within Unram and NTB necessary for sustainable, NTB-led development of the province's agricultural sector.

The value chain analysis described in this report has shown that there is substantiated and defendable opportunity for increases in productivity across all targeted value-chains. A development project *could* target this productivity increase in a specific value chain through a focussed intervention. However, the Massey-Unram team believes that this is not the most sustainable pathway to poverty reduction. Instead, the Massey-Unram team proposes to create the R, D & E system necessary for the rural poor to personally take advantage of market opportunities. The catalyst for this change will be education.

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