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List of Abbreviations

ACIAR	Australian Centre for International Agricultural Research
AIPD-Rural	Australia Indonesia Partnership for Decentralisation – Rural Economic Program
CHCG	Collins Higgins Consulting Group
CIP	International Potato Center
DAFWA	Department of Agriculture and Food of Western Australia
DFAT	Australian Government's Department of Foreign Affairs and Trade
EI-ADO	Analysing Agribusiness Development Opportunities in Eastern Indonesia
EJ	East Java
EWINDO	East West Seed Indonesia
FFS	Farmer Field School
FIL	Farmer Initiated Learning
FGD	Focus Group Discussion
GAP	Good Agricultural Practice
GOI	Government of Indonesia
IC/PM	Integrated Crop/Pest Management
IVEGRI	Indonesian Vegetable Research Institute
masl	meters above sea level
M4P	Markets for the Poor
MT	metric ton
NTB	West Nusa Tenggara
NTT	East Nusa Tenggara
PISAgro	Partnership for Indonesia Sustainable Agriculture
PMCA	Participatory Market Chain Approach
R&D	Research and Development
SME	Small-Medium Enterprise
TOR	Terms of Reference

Preface

This project is one of five lead commodity value chain studies undertaken as part of the larger $1 million Australian Government's Department of Foreign Affairs and Trade (DFAT) funded project Eastern Indonesia Agribusiness Development Opportunities (EI-ADO). In this project, Australian Centre for International Agricultural Research (ACIAR) commissioned research to identify lead commodity value chains to be the focus of a new DFAT program Australia Indonesia Partnership for Decentralisation – Rural Economic Program (AIPD-Rural).

This report titled *Eastern Indonesia Agribusiness Development Opportunities (EI-ADO)- Analysis of Potato Value Chains* [1], was prepared by the Collins Higgins Consulting Group Pty Ltd, as commissioned by ACIAR. The information and recommendations from this study will inform DFAT in the design of the AIPD-Rural program.

The report involved the analysis of secondary data, field trips and key informant interviews with stakeholders in the potato value chain of Eastern Indonesia. The field work for the report was carried over the month of October 2013 across East Java and NTB.

The author of the study is Chris Wheatley, with support provided by Budhi Prasetya and Teddy Kristedi. Structural and reviewer input was provided by Tiago Wandschneider. Field support and data collection was provided by Krisnadi Yohannas in East Java and Ketut Puspadi in NTB.

Thanks must go to: the interviewees and industry stakeholders who generously gave their time to answer questions; and to ACIAR external reviewers who provided inputs and comments in framing the report.

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

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Executive Summary

Introduction

The aim of the potato value chain study is to identify development constraints and private sector agribusiness development opportunities with potential to increase incomes of the poor in NTT, NTB and East Java provinces in Eastern Indonesia. These results will be an input to future ACIAR projects and a new Australian Government's Department of Foreign Affairs and Trade (DFAT) program: Australia Indonesia Partnership for Decentralisation - Rural Economic Program (AIPD-Rural). The study focuses on two main distinct value chains:

- Potato for fresh consumption (Granola variety) mainly in East Java, and
- Potato for processing (Atlantic variety) mainly in Lombok, NTB.

The M4P methodology was used, with fieldwork involving key informant interview and farmer focus group discussions conducted in East Java and NTB during September/October 2013, supplemented by key informant meetings in West Java in July, and in Jakarta in October. Attention was also given to cabbage, as a crop associated with potato production systems in some locations.

Potato in Indonesia

In a global context, Indonesia is a minor producer of potato (< 1 million ton/yr) with yields of 18.2 ton/ha, comparable to those of other Asian countries. Over the last decade, potato exports from Indonesia have declined substantially to very low volumes (<5,000ton/y) while imports have dramatically increased (to >80,000ton in 2011). Potato is an important component of highland (>1,000masl) vegetable production systems across Java, Sulawesi and Sumatra. Within East Java, the main potato producing area is around Mt Bromo crater, comprising four districts (Pasuruan, Probolinggo, Malang, Lumajang), and also the area around Batu. In NTB, potato production is restricted to the Sembalun area to the east-north-east of Mt Rinjani in East Lombok. Production in NTT is minimal and this province was not included in the study. Demand for fresh potato – Granola – is slowly increasing in line with urban population growth, although consumption (as vegetable, not staple) remains limited to approximately 2kg/capita/y, mainly through traditional market channels. Processing demand is increasing (growth rates not divulged by commercial actors); industry processing capacity is expanding, as is SME scale processing in East Java (using Granola as raw material). There are problems for domestic production of Atlantic to meet this demand.

Description of potato value chain in Indonesia

The value chains for fresh consumption (Granola) and processing (Atlantic) are well differentiated, and are described separately. For Granola, the main production areas around Mt Bromo and Batu are linked to terminal markets through rural collectors, intermediaries/traders and wholesalers. There are a number of rural markets close to the production areas (e.g. Mantung in Malang and Tosari in Pasuruan) which serve as assembly points for shipment to wholesale markets in or near Surabaya, or directly to terminal markets. The main end markets are:

(a) Local urban centres e.g. Malang, Probolinggo towns;

(b) Other major population centres in East Java (e.g. Surabaya, Kediri);

(c) Cities elsewhere in Java, especially Jakarta and Semarang, or

(d) Other islands including Kalimantan, NTB and NTT, with shipment via ports in Surabaya and Semarang.

Finally, there is a specific market developing for premium quality potato to the tourist market in Bali, with shipment via ferry from Banyuwangi in the SE extremity of East Java.

For farmers, potato is one of several vegetable crops commonly produced in rotation, including cabbage, carrot, spring onion, tomato and chili. The main planting time is November/December, although in higher altitudes areas (Pasuruan) planting and harvesting is possible year-round. Crop rotation with non-Solanaceous species also helps to control pests and diseases. Compared to these other crops, potato is seen by farmers across the province as the most risky, with high production costs and moderate income/ha. This is based on the costs of seed and agrochemical inputs, the severity of plant production constraints (diseases especially) and the cost of their control, combined with market price uncertainty. However, farm gate prices in East Java in recent years have ranged between IDR 4-6,000/kg for commercial grade tubers. Farm yields of 12-18ton/ha are common, rising to 20ton/ha. Net income/ha for the most recent crop ranged between IDR13-41 million, compared to over IDR 117 million/ha for one cabbage crop investigated.

Potato is usually harvested by the producer, and may be graded on-farm too. Grades are complex, but the main commercial grade (e.g. for shipment to other islands, where storage life in important) are denominated A, AB or AL. Grade B is usually for local markets and the much smaller grade C are commonly retained for seed use on-farm. Losses during the marketing process are usually minimal, except in the rainy season when rotting can elevate them to the 2-5% level. Wholesale and retail prices indicate moderate margins at the intermediary level. Retail prices in Malang market were IDR 9,000/kg. In supermarket, potato is a minor component of the fresh produce offer, with very low turnover (20kg/week/store, IDR 14,000/kg) and poor quality on view. Higher value bagged and selected potato is also on offer at much higher prices (IDR 30,000/kg).

Granola variety is also used, around Batu, as the raw material for processed potato chips (*kripik*) produced by a cluster of28 SMEs targeting the *oleh-oleh* market for tourists to the area. Although currently taking relatively small volumes of potato (500 ton/y) there are likely many unregistered operations, and the market is expanding, but based on an unsuitable potato variety for processing.

Production of Atlantic variety for processing is limited to Sembalun in East Lombok, and forms part of Indofood's raw material supply chain. Farmers are organised into groups, supported by farmer leaders/convenors and Indofood field staff, supplied with potato seed, given access to finance for input supply (cost discounted from potato sold to Indofood) and guaranteed a price (currently IDR 3,850/kg) at harvest. Problems with seed supply and quality have affected the smooth operation of this system in recent years, and some farmers have shifted to other crops (or to Granola production). As a result, Indofood apparently failed to meet Atlantic production targets for Sembalun in 2012. Harvests are organised by the farmer leaders according to Indofood's schedule, and transport is contracted directly by Indofood to deliver the produce to factories in Semarang and Jakarta.

The main constraints for the Granola value chain are on the production side, as there is little scope to improve traditional market chains, and the modern sector (supermarkets) remains

too small to justify attention. The most frequently mentioned constraints by producers were poor yields and high production costs, which relate to potato seed quality and cost, and also to crop management issues and especially the relatively high use of agrochemicals during crop production cycle. The issues around potato seed are (a) high cost and limited supply of certified seed tubers of good quality and (b) locally produced uncertified seed tubers from clean meristem culture are of varying quality and also high cost (c) the farmer practice of using seed retained from previous harvests, over several cycles (up to G8-10) results in gradually increasing disease pressures and lower yields over time. There is also no pipeline of potential new varieties under evaluation in East Java. While current farm gates prices were seen as acceptable by farmers, there were concerns voiced about imports of ware potato from China, with potential to cause price falls below production costs.

The *kripik* value chain around Batu has a major problem in that a non-processing variety – Granola- is the only raw material available. This increases costs (for raw material and processing) and impacts negatively on product quality.

For Atlantic potato, improved supply of good quality seed is also a major issue for the producers in Sembalun. Improving the relationship between farmers and Indofood – perhaps through contracts – would be another positive development.

Cross-cutting issues

Potato is a crop that demands investment to give good returns – in seed, purchased inputs and also labour. As such, it is not suited to the very poor, unless accompanied by adequate credit to finance input purchase. The labour requirements do however offer opportunity for rural employment for landless households. The combination of high production costs and fluctuating market prices (for Granola) means that producers need to have tolerance for, and manage, risks at both production and market sides.

At farm level, women are commonly involved in all potato production activities except land preparation and pesticide application, but women may be paid at lower daily rates. Men are more usually involved in selling their produce, and will often hand over the income received to women who are responsible for management of household budgets. The use of agrochemicals can be a negative factor for the environment, especially at high application rates/frequencies, and issues such as worker protection, water resource contamination, and safe disposal of containers are all valid. Additionally, there are increasing environmental regulations around productive use of highlands, and many of the potato production areas in both East Java and East Lombok border on national parklands where reforestation is taking place. Tourism is expanding in these areas, and is increasing in importance to local economies and employment.

Pro-poor value chain development opportunities

1. Upgrading the *kripik* value chain in Malang and Batu districts, through linking the *kripik* producers with a farmer group in Malang (Ampel Gading) that is already producing a new processing variety (Bliss). Processors in Batu are keen to evaluate and promote a new variety, and the recent development of seed production facilities and the program of G0 production of Bliss potato seed, is a promising development that can be supported. Introducing a high dry matter variety has potential to reduce processing costs, and thus allow processors to pay a higher price/kg for fresh potato tubers, as an incentive for varietal adoption. If benefits were divided equally between producers and

processors there is scope to increase net income/ha by IDR 12 million. Although the total current market size is relatively small (500ton/year) it is growing by approximately 20-25% annually, according to one manufacturer.

2. Improving local supply of quality potato seed for the fresh market. Poor quality seed is the main constraint faced by producers, with costs – and lack of finance – holding them back from purchasing seed, instead of using their own retained seed for many generations. In order to overcome this constraint, investment is needed in local facilities to produce greater volumes of seed. A number of entrepreneurs are already involved in seed production in East Java, and these can be harnessed to support such expansion, e.g. to 5,000ton/y seed tubers initially (planted at a rate of 1.5ton/ha). Yield increases of 25-35% can be expected from using purchased quality seed, instead of seed retained on farm for many cycles. Assuming an increase from 15 to 20ton/ha, this could result in an additional IDR25 million/ha gross farm income, less cost of purchased seed (IDR15 million/ha), producing IDR 10 million/ha net benefit.

3. Market-based incentives to encourage adoption of efficient use of agrochemicals. More efficient agrochemical use would potentially reduce production costs, increase profitability, as well as reduce residues on fresh produce and the associated adverse environmental impacts. However, current market incentives and farmer practices encourage inefficient usage (over-application etc.). Input suppliers and field staff of agrochemical firms are incentivised to expand sales. However, there is a logic to reducing agrochemical use as it (a) helps to prolong product life, by reducing pressures on pests and diseases to evolve resistant strains and (b) may facilitate development of higher value markets that value food safety and the environment. This requires more study, and interaction with agrochemical firms, and exploration of tourist markets (e.g. Bali and Mt Bromo) and related branding for premium potatoes.

4. Development of contract agriculture for Atlantic potato supply to Indofood. The Atlantic supply chain developed by Indofood has problems with seed supply – poor quality, late delivery etc. The fixed price offered by Indofood is attractive even if (usually) lower than Granola price. Indofood operates a policy of not using written contracts with farmers, or group convenors, apparently due to historic problems with contract farming in West Java. Use of written contracts could improve the operation of Indofood's raw material supply, to lock-in production to the processing factories, and work to farmers advantage if conditions such as seed tuber supply (quality and delivery dates) were included. If the introduction of contracts results in more timely delivery of better quality seed tubers, and thus in higher yields per hectare, and reduced seed cost per hectare (as smaller sized potato can be supplied, reducing the weight of seed tubers needed per hectare), the innovation could benefit both farmers (higher incomes) and Indofood (increased Atlantic volumes, reduced need for imports). For example, if seed requirements can be reduced from 2.1 to 1.5 ton/ha (as smaller seed tubers are supplied under contract) even with no change in yield, then production costs will decrease by 0.6 ton x IDR 10,500/kg = IDR 6.3 million per hectare, increasing net income by 19%, (assuming other costs stay the same).

Conclusions

Additional research and analysis is proposed on the potato market in Bali (especially for premium potato products for the tourist market) to determine if this is a worthwhile market to

develop, based on current size, growth potential and desired potato quality criteria; on the process for *kripik* manufacture in the Batu SME cluster, to identify process improvements and product innovations that could be supported (including use of other root and tuber raw materials, such as sweet potato), and policies/regulations especially as regards imports of potato seed, both ware and processing varieties.

1 Introduction

1.1 Background

The Collins Higgins Consulting Group (CHCG) has been contracted by the Australian Centre for International Agricultural Research (ACIAR), under the Analysing Agribusiness Development Opportunities – Eastern Indonesia (EI-ADO), to conduct a value chain analysis of potato across the three study provinces of East Java, Nusa Tenggara Barat (NTB) and Nusa Tenggara Timor (NTT).

The aim of this exercise is to identify development constraints and private sector agribusiness development opportunities with the most potential to increase incomes of poor men and women (not just farmers) in the provinces of NTT, NTB and East Java in Eastern Indonesia. The outcomes of this work will be an input to both future ACIAR projects and a new DFAT program: Australia Indonesia Partnership for Decentralisation - Rural Economic Program (AIPD-Rural).

Two distinct potato value chains coexist across Indonesia:

- Potato for fresh consumption (ware potato), almost exclusively from Granola variety; and
- Potato for the food processing industry, dominated by Indofood and the variety Atlantic.

Potato seed (tubers) constitute a major component of production costs, and seed supply has been identified previously as being of critical importance. Seed of both Granola and Atlantic could be considered as separate value chains in themselves, complicating the conduct of this study. In addition, attention is given to brassica (cabbage) as a rotation crop in smallholder potato production systems.

1.2 Study objectives

Ware potato (Granola)

The study characterises in detail the existing traditional market chains that connect potato producers to markets in East Java and beyond. Smallholder producers costs and returns of ware (Granola) potato production are determined in the main production districts of East Java (highland areas around Mt Bromo, principally), including Malang, Pasuruan and Probolinggo districts. In NTB, the highland area around Mt Rinjani, especially Sembalun, is the area of focus. These areas do not correspond directly with EI-ADO target districts, but represent the main areas of potato production as well as the main points of contact with seed producers from West Java.

In addition, the study includes non-traditional market chains such as those supplying supermarkets in Surabaya and elsewhere in East Java, and value chains for ware Granola potato in Bali and other islands. The study does not include potato production in NTT, as being of very minor and declining consequence.

Processing potato (Atlantic)

The study investigates the production and marketing of Atlantic potatoes, and pays special attention to the arrangements made between growers and Industry, principally Indofood. The

costs and returns are compared with Granola and other crop options. The geographic location for the production component of this study will be the same as for Granola in East Java and NTB.

In addition, the study also includes one cluster of SMEs producing potato crisps/chips, (kripik) in Batu, East Java, to determine whether there is potential for interventions in this industry.

Potato seed

While potato seed is important, indeed crucial, for the development of the sector, it is also the topic of a separate ACIAR-supported study being undertaken shortly by DAFWA. It is essential to minimise duplication across the two studies. Scaling-out improvements to seed potato value chains will be a medium-long term endeavour that is unlikely to deliver benefits to farmers within the timeframe of EI-ADO, and will probably involve national policy level interventions. As this will also be covered by DAFWA, this current study did not investigate "seed potato value chains" i.e. analyses of producing certified seed potato (which may involve a number of specialist seed producers of plantlets, mini-tubers, and seed tubers from G0 – G4), nor the relative merits of using differing technological and commercial options for the production of seed potato (e.g. aeroponics), nor partial seed systems that involve importation of seed to Indonesia.

The current study thus includes potato seed systems only as they directly affect potato value chains as inputs to the production system in target areas. This covers the costs and supply volumes, and trends, of seed potato currently available to potato growers (both Atlantic and Granola) in target areas, whether derived from seed suppliers in East Java and NTB, or from W and Central Java.

The study also investigates existing informal seed systems in target areas of East Java and NTB, and especially at farmer practices for selecting, storing and using seed retained from previous harvests.

1.3 Analytical framework

The study employs the M4P methodology detailed in the manual/guide Making Value Chains Work Better for the Poor (DFID, 2008) which provides a methodology (see next section) for understanding existing value chains, and fostering their development through the design and implementation of interventions that benefit the poorer chain actors, especially smallholder producers.

A major consideration in this study is that the analysis of ware (fresh market) and processing potato is necessarily conducted separately (as far as possible). While macro-data does not usually distinguish between the two (which *de facto* constitute distinct value chains), the primary data collection at field and market levels was oriented around this demarcation. In addition, there is a dearth of accurate and up to date information on processing (Atlantic) potato production, imports, processing and marketing provided by the leading private sector firms, as this is commercially sensitive. In particular, no data were forthcoming from

Indofood, the market leaders for processed potato products in Indonesia, except for information provided as part of the PISAgro partnership program[2].

At production level, potato forms part of a vegetable production system, and any analysis of the production environment needs to consider the relative position of potato vs. other commodities in this system, from both production and market perspectives. Thus while (based on TOR) gross margins were obtained only for cabbage in addition to potato, a wider remit was taken in the focus group discussions to obtain farmers opinions on potato vs other crops relevant for their specific areas.

Based on the analysis of Granola and Atlantic value chains, the study identifies a number of problems and opportunities, and from this proceeds to propose a number of interventions with potential to resolve the problem and/or take advantage of opportunities. Based on previous experience, it is important to consider opportunities (especially in the market) as well as problems to avoid a negative listing of "lack offs…." that may be demotivating in subsequent stakeholder forums. It is also useful to obtain feedback from stakeholders on the relative priority of the different problems and opportunities, as well as their ideas for interventions, before proceeding to define and implement them. Thus the interventions proposed in this study are ideas that require discussion and validation with the various stakeholders involved, and will surely benefit from their input during any subsequent design process.

1.4 Study methodology

The study team was led by Dr Chris Wheatley, partnered with Teddy Kristedi and Budhi Prasetya in all fieldwork locations (West Java, East Java and Lombok). Chris Wheatley and Budhi Prasetya come from a background with the International Potato Centre, while Teddy Kristedi has participated in the other commodity value chain studies in this project. Additional technical and logistical support was provided by Krisnadi in East Java and Ketut Puspadi in Lombok, similar to their roles in previous value chain studies. Stuart Higgins was involved in the initial team planning meeting in Bali, while both he and Tiago Wandschneider participated in a final meeting of PISAgro at Indofood in Jakarta.

Secondary data on potato production statistics (volumes, yields, and production areas), trade and market prices were collected as far as possible from relevant statistical departments at national, provincial and district levels. In addition, FAOSTAT data was used for longer-term analysis, and for import/export trade statistics. Note that this data does not differentiate between imports of ware and processing potato. Demographic data was also obtained from provincial and district agencies.

The policy environment for potato, and especially regarding seed systems, was recently reviewed comprehensively by the Value Chain Centre of Padjadjaran University in Bandung, in a report commissioned by the Syngenta Foundation. Grateful acknowledgement is made of the use of this information in this report (Anon, 2013).

[2] *Partnership for Indonesia Sustainable Agriculture, public private partnership that includes a potato component led by Indofood. www.pisagro.org*

Primary data was collected from respondents (individual and group) using checklists following the M4P methodology, and adapted from similar checklists employed in the previous studies. Semi-structured interviews and focus group discussions were usually conducted at the place of business of all market actors and service providers. Most farmers were interviewed in focus group discussion sessions that were usually held in meeting rooms or houses of village leaders, conveniently located for the farmers involved. The team divided responsibility for questioning and note-taking, with completed notes compiled and circulated via Dropbox.

Gross margins for both potato and cabbage were estimated based on detailed interviews with individual producers, who were asked to provide specific quantified information on production costs and income received, for the latest harvested plot/field of each crop as appropriate.

Interviews were conducted with relevant R&D support organisations such as the Indonesian Vegetable Research Institute (IVEGRI), The Assessment Institute for Agricultural Technology (BPTP) and the Universities of Brawijaya and Mataram, especially concerning seed issues.

While there were no problems obtaining appointments with SMEs and individual entrepreneurs involved in both potato seed and processing ventures, it proved more difficult to obtain appointments with large scale private sector businesses. Only in the case of EWINDO was this successfully achieved, with one very useful and open meeting at their headquarters in Purwakarta. One final meeting with Indofood was obtained, in the context of a meeting with the PISAgro potato working group that Indofood coordinates, but even then the participants were from Indofood's communications department, not those directly involved in their commercial potato production and processing activities. However, field staff of Indofood in Sembalun, Lombok were interviewed.

As agreed during the initial planning meetings, the study was focused on potato production regions in East Java and NTB only, since production in NTT is minimal. In addition, some fieldwork was conducted in the main potato production areas of West Java (Pangalengan and Garut) and with key R&D institutions and seed suppliers in that province, in order to provide a better picture of the state of the art from this main centre of potato production in Indonesia.

The specific survey locations and key informant categories are indicated in Table 1. In East Java, the main production areas are located around Mt Bromo (denominated the Tengger region) and adjacent to Batu. Wholesale markets in Malang and Surabaya were also included. An additional production region, in Bondowoso, was added later, once this was identified as a location where Indofood is developing potato production for processing.

In Lombok, the only production area of note is in Sembalun (East Lombok), while market actors in Mataram were also interviewed.

For this study, it was necessary to distinguish between fresh (ware) and processed potato value chains (i.e. those dominated by Granola and Atlantic varieties respectively). East Java is exclusively dedicated to ware potato, except for the Bondowoso production region, while Atlantic dominates production in Sembalun on Lombok, linked to Indofood. Only in Sembalun was it possible to directly compare and contrast Granola and Atlantic produced in the same location.

Table 1 Matrix of locations and key informant categories

	Agrochem. retailer	Seed producers/firms	Farmers (FGD/groups)	Farmers	Collectors	Wholesalers	Supermarket suppliers	Transporter	Supermarkets	Traditional retailers	processors	Processed product ,retailer	DINAS	Researchers
West Java		4	2			3	1				1			2
Jakarta						3					1			
East Java														
Malang		1	3		2	4			1	2			1	1
Pasuruan	1	1	1	1	1									
Probolinggo	1	1	1	1		2				2				
Batu	2	1	1			1					5	2		
Surabaya						5			1				1	
NTB														
Sembalun	1	1	2	3	1						1		1	
Mataram						2		1						1
Total	5	9	10	5	4	20	1	1	2	4	8	2	3	4

Source: Fieldwork 2013

1.5 Report structure

The report structure follows the analytical framework, in considering first (in section 2) the macro-level situation of potato in Indonesia, including policies. Section 3 presents the results of the fieldwork, with separate sub-sections for Granola in East Java and Atlantic in Lombok, in order to differentiate between Granola/ware and Atlantic/processing value chains. Note that this is largely, but not entirely, congruent with geography (Granola in East Java, Atlantic in Lombok). However, the East Java section includes the *kripik* processing enterprises, since they use Granola as raw material, while the Lombok section also includes a discussion of the production area in Bondowoso, East Java, linked to Indofood. Section 4 covers cross-cutting issues and section 5 the constraints and potential interventions. Some concluding remarks are presented in Section 6. Annexes include the checklists and fieldwork schedule, and field notes.

2 Potato in Indonesia

2.1 Indonesia's position in global production and trade

Indonesia is a minor producer of potato, with under 1 million ton production in 2011, 55,000ha and an average yield of 18ton/ha (Table 2). This represents 0.26% of global production, at slightly below average global yields of 19.4 ton/ha. The two major producers of potato in Asia are China and India with 88 and 42 million ton respectively. Australia and New Zealand have the highest yields (35 and 49 ton/ha respectively). India, China and Bangladesh are the main Asian exporters. Indonesian potato production and yields are, however, higher than Philippines, another largely tropical Asian country.

Table 2 Global potato area, yield, production, and trade data, 2011

Country	Area Harvested (Ha)	Yield (tons/Ha)	Production (tons)	Seed (tons)	Import Quantity (tons)	Export Quantity (tons)
Australia	32,153	35.1	1,128,208	115,000	0	37,291
Bangladesh	460,197	18.1	8,326,389	534,000	6,049	53,717
China	5,426,652	16.3	88,350,220	2,902,430	22,723	376,995
India	1,863,200	22.7	42,339,400	3,040,000	0	217,949
Indonesia	54,819	18.2	995,488	62,000	80,876	5,122
New Zealand	10,724	48.7	522,000	52,200	0	24,190
Philippines	8,171	14.8	120,574	8,096	8,303	0
Russian Federation	2,202,600	14.8	32,681,470	6,495,700	1,466,232	41,658
Global Total or Avg	19,180,576	19.5	373,158,351	31,900,522	12,243,448	12,257,461

Source: FAOSTAT December 2013

Figure 1 below shows that since 2000, potato exports from Indonesia have declined substantially, while imports have increased, especially since 2008. Exports are largely from Sumatra Island to Singapore and SE Asia markets. However, they have declined significantly, due to issues around quality and food safety (pesticide residues). The export market is not relevant for potato value chains from the target study areas in East Java and Lombok, although one isolated wholesaler in Surabaya market was found to export potato to China on a regular basis (22 ton container per month).

Imports of potato, on the other hand, have expanded dramatically since 2008 (Figure 1). The statistics do not indicate how much of the imports are seed potato, nor which variety. The strong likelihood is that imports until 2010 were mainly Atlantic variety, including seed potato from Australia, and also potato to be used directly for processing in Indofood's factories in West and Central Java. Since 2010, imports of ware potato from China and Bangladesh have expanded dramatically, although key informants report these are periodic in nature. This is an indication that domestic production of Atlantic is insufficient to meet Indofood's needs, especially given market growth for processed potato products.

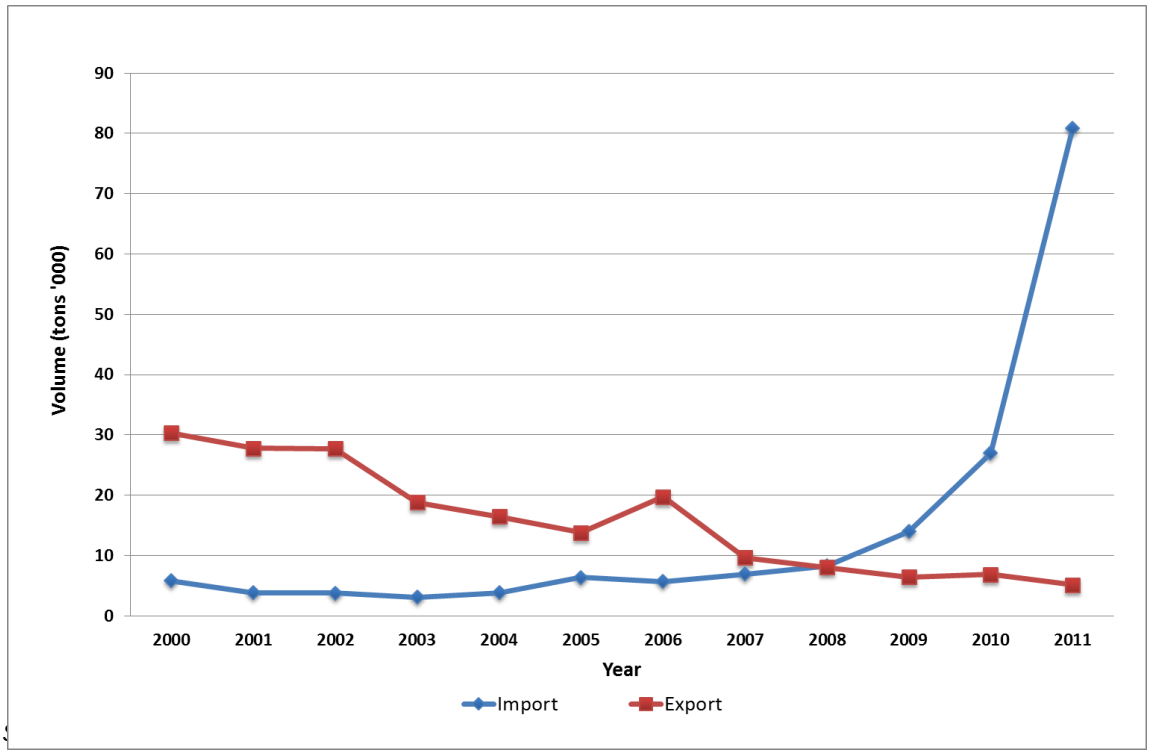


Figure 1 Potato import and export volumes ('000 ton)

2.2 Socio-economic importance

This section will provide a general overview, with detailed information on East Java and Lombok in the following section. As stated earlier, potato is an important crop for smallholder farmers located in relatively limited high altitude agricultural areas of Java and Lombok. From both a production and consumption perspective, potato is of limited importance nationally, but within these specific production environments is a major source of income for farmers, as one component of vegetable production systems. However, relatively few farmers are solely reliant on potato for their income, since production is usually seasonal and crop rotation is advisable to maintain low/moderate disease pressures over time.

The potato crop has relatively high production costs, even if farmers use retained seed from previous harvests, since repeated if targeted applications of agrochemicals are necessary to achieve even moderate yields. Thus, farmers need to have their own capital or access to finance in order to grow the crop. In the study, several options were found that permitted farmers with little capital to produce potato (see section 3.2.2 for details), including:

- Delayed payment of agrochemical inputs;
- Credit/loans from formal and informal sector; and
- Finance from seed supplier or trader, usually combined with a profit-sharing arrangement.

Even with these arrangements, risks remain both on the production (low yield) and market (low prices) sides. Potato is not therefore a crop well suited to the very poor and risk averse farmer, especially if land rental is also included. The exception to this may be the schemes

linked to Indofood where (at least) the sales price is fixed and known in advance, and credit for inputs may be provided.

Direct potato consumption is not important from a local or national food security perspective, even in areas where it is a major crop. Potato contributes to food security through the income it generates for producers, used (in part) to purchase food. Farmer focus groups consistently reported that their own consumption of fresh potato was usually limited to unmarketable tubers (small size). Similarly to urban consumers, potato is eaten as a vegetable, not a staple.

The potato crop is linked to the food processing industry in two ways:

a) Through a scheme operated by Indofood in a number of production regions (including Bondowoso and Sembalun in this study) where farmers are supplied with Atlantic seed tubers and "group convenors" linked to Indofood purchase the resulting crop at harvest for transport to processing factories for production of *kripik* (potato chips/crisps).

b) Purchase by many small-medium scale *kripik* producers, in this study concentrated around Batu, but also found in other locations in East Java. This sector does generate some employment (mainly in urban areas, and also mainly female).

While many potato traders interviewed were women, farmer focus groups were consistently all male, despite repeated attempts to ensure inclusion of women. This indicates some of the difficulties in covering the gender issue in the study. However, the focus groups did provide information on the roles women take in the production, harvest and marketing process. It is also relevant that while men may collect the income from potato sales, in some areas it is common practice to hand this over to the women for them to manage.

Environmental issues: there are two major environmental issues associated with potato production in Indonesia. The first is the use of agrochemicals in crop production. Pest and diseases are major challenges in potato production, and tend to increase in intensity over time in areas where the crop is grown repeatedly across seasons and years. Phytophthora infestans is a serious disease that can reduce yields significantly, especially in the rainy season. Agrochemicals are essential to maintain yields, but add to production costs and increase the production risks for smallholder farmers. While the issue of pesticide residues has apparently not yet entered the consciousness of consumers in urban markets, it is likely to do so in coming years. The Bali tourist market may see the first signs of this. The other issue is related to environmental degradation in high altitude areas. The upland production areas most suited to potato are relatively limited in Java and Lombok, being restricted to the slopes of major volcanos such as Mts Bromo and Rinjani. These are also important tourist – domestic and international- areas, and the location of national parks at higher altitudes. In both Lombok and East Java, potato production either borders on the national parks, or is actually located within the park boundaries. This raises issues of the impacts of intensive agriculture within or in areas adjacent to national parks, including deforestation and water abstraction/pollution. In the medium to long term, climate change is likely to hasten the upward movement of agriculture, intensifying these challenges. Thus research efforts are being re-oriented towards development of potato varieties suited to lower altitudes and hence tolerant of the different disease and pests found there. However, this is a long term endeavour which will not provide pay-off in the timeframe required for our study.

2.3 Production

2.3.1 Geographical distribution

Potato production in Indonesia is limited to areas more than 1,000 masl. These are usually associated with mountainous, often volcanic, highlands, which occur in Java, Sumatra and Sulawesi provinces. Thus, the bulk of potato production is found in provinces located on these islands, with some limited additional production around volcanoes on other islands (Bali and Lombok, for example). Table 3 shows that the eight main potato-producing provinces in 2009-11 were all in Java, Sumatra or Sulawesi, with <4% of both area and production found outside those provinces. Only one of these provinces falls within the AIPD-Rural area – East Java – with approximately 10-13% of national potato area and production during this period. Both NTB and NTT are minor potato producers (around 300 and 100 ha respectively), with the area to the east-north-east of Mt Rinjani on Lombok constituting the only major producing region across those two provinces.

Table 3 Harvested potato area and production by province in Indonesia

	Potato area (Ha)			Potato production (ton)		
	2009	**2010**	**2011**	**2009**	**2010**	**2011**
West Java	15,344	13,553	11,327	320,542	275,101	270,155
Central Java	18,655	17,499	16,585	288,654	265,123	250,404
North Sumatra	8,013	7,972	7,203	129,587	126,203	123,078
North Sulawesi	8,740	8,555	7,905	142,109	126,210	114,538
East Java	9,529	8,561	6,563	125,886	115,423	85,521
Jambi	5,296	4,860	4,954	94,368	84,794	89,102
West Sumatra	1,661	1,816	1,629	28,820	31,949	29,530
South Sulawesi	1,433	1,531	1,654	11,802	7,627	18,420
NTB	268	367	210	5,030	5,130	3,755
NTT	162	129	41	1,476	542	162
Other	2,137	1,688	1,811	28,030	22,701	20,723
Total	71,238	66,531	59,882	1,176,304	1,060,803	1,005,388

Source: Center for Agricultural Data & Information Ministry of Agriculture of Indonesia

Within East Java, the main potato producing area is the Tengger area around the Mt. Bromo crater, roughly 1-2,300 masl. This is divided administratively into four districts (Pasuruan, Probolinggo, Malang, Lumajang), which thus appear as the four main potato producing areas in the province (Table 4 and Table 5). Other production areas are found around the slopes of other volcanoes (e.g. Bondowoso, Batu). Banyuwangi is a potential highland production area as yet little exploited. Batu is also the location of a thriving potato processing SME cluster, and some of the production areas in Malang district are located close to Batu, to serve that market. The other districts of East Java are largely lowlands unsuited to potato production. They comprise <2% of provincial potato production areas and volumes.

Table 4 Potato planted area by district in East Java (Ha)

	2006	2007	2008	2009	2010	2011
Pasuruan	2,393	4,144	3,968	3,705	3,581	3,294
Probolinggo	2,547	3,471	2,486	3,236	4,152	2,850
Malang	719	685	848	825	730	891
Lumajang	330	627	413	423	626	283
Magetan	267	406	322	365	340	170
Batu	213	282	258	340	198	331
Bondowoso	44	12	12	5	31	59
Banyuwangi	4	0	0	0	0	0
Other districts	69	90	81	141	72	91
Total East Java	6,586	9,717	8,388	9,040	9,730	7,969

Source: DINAS Pertanian, East Java

Table 5 Total potato production by district in East Java, 2006, 2007 and 2009 (ton)

	2006	2007	2009
Pasuruan	33,981	36,404	67,487
Probolinggo	26,421	26,247	32,095
Malang	11,077	11,500	11,415
Lumajang	4,558	4,296	5,420
Magetan	4,183	3,112	4,025
Batu	5,834	16,320	5,380
Bondowoso	965	800	56
Banyuwangi	43	0	0
Other districts	820	691	1,381
Total East Java	87,928	99,370	127,259

Source: Center for Agricultural Data and Information, Ministry of Agriculture, Jakarta. Data for 2008 not available.

For reference, the population (number of households) in the main sub-districts producing potato are shown in Table 6. Not all households are agricultural, although in some districts the vast majority are. Not all sub-districts fall entirely within the potato-production altitude range – some include lower elevations.

Table 6 Number of households per sub-district included in the study, 2011

District	Sub-district	Number of households	Notes
Malang	Ampel gading	16,620	
	Poncokosumo	26,965	
	Pujon	16,554	
	Ngantang	16,191	
Pasuruan	Tosari	2,284	
Probolinggo	Sumber	7,346	2010
	Sukapura	5,291	2010

Source: East Java Central Statistics Agency, BPS

2.3.2 Trends

As shown in the tables of the preceding section, potato production in Indonesia has declined since 2009, while production in East Java peaked in 2009 and has declined since then. Key informant and FGD interviews across the province indicated that indicated that the formal production statistics may be severely under-estimating potato production. In Tosari, Pasuruan district and in Sumber, Probolinggo district they reported annual potato production areas of 6,000 ha and 4,000 ha respectively for those two sub-districts alone. This compares to official statistics of 8-10,000 ha for the whole province (Table 4). This apparent discrepancy makes discerning trends from the official statistics moot. Key informants and FGDs also report a trend towards declining yields and profitability of potato compared to other vegetable crops, which would imply some decrease in total production over time, although this was more marked in some locations (e.g. Sumberbrantas, Jurang Kuali) than others (Tosari and Sumber).

2.3.3 Production systems, including seasonality

The production systems for Granola and Atlantic are discussed separately in their respective section of this report (sections 3.2.2 and 3.3.2).

This section will only provide some additional information on the cropping calendar across the main production regions. In general, potato is produced, along with other vegetables, on rainfed land in the rainy season (October – February) and on irrigated land during the dry season (March – August). This seasonality appears more marked in Probolinggo than Pasuruan (Table 7). In Probolinggo, December and March are the main potato planting months, whereas in Pasuruan plantings are more evenly spread through the year, indicative of the somewhat different rainfall patterns at higher altitudes such as Tosari. Thus, the supply of potato from Tosari is continual, whereas from Probolinggo there are periods of relative scarcity (e.g. November-December). Even where planting times are limited by seasonal rainfall patterns, there is some flexibility to harvest times as the maturity times of Granola vary between 90-110 days, and the harvested crop can be stored on-farm for a short period as well. Taken together, these factors probably explain the lack of any consistent seasonality in market prices for fresh potato in East Java (see section 2.5.1)

Table 7 Monthly planted and harvested potato area (ha) in Probolinggo and Pasuruan districts, East Java, 2010

	J	F	M	A	M	J	J	A	S	N	O	D
Probolinggo District												
Planted area (ha)	162	165	352	535	389	128	49	63	41	432	460	1,376
Harvested area (ha)	40	375	538	443	394	438	264	263	179	131	83	0
Pasuruan District												
Planted area (ha)	295	253	236	336	325	345	218	174	350	519	262	268
Harvested area (ha)	227	432	567	298	365	206	236	371	466	156	169	206

Source: DINAS Pertanian, East Java

2.4 End markets/ demand

2.4.1 Product uses

As previously mentioned there are two main end uses for potato – fresh market and processed products. The fresh market is dominated by traditional market channels, with supermarkets taking a very minor percentage of total volumes, even in Jakarta. Fresh ware potato is consumed as a vegetable not a staple, with per capita consumption of only 3-4 kg/year.

The main processed product is kripik (chips/crisps) in a variety of flavours, packages and sizes. Indofood (Lays) is the market leader, with a number of smaller firms operating at national level, and many SMEs serving local and regional markets. A previous CIP project, funded by ACIAR using the PMCA methodology, has worked to develop innovation in products and packaging in this SME sector in West Java around Bandung, with considerable success.

Note that French fries for the fast food market use a frozen, reconstituted and imported product, not based on domestic potato production.

2.4.2 Demand structure

Consumer demand for both fresh and processed potato is concentrated in the major urban centres of Java. The production areas of West and Central Java supply most of the fresh potato for this market (Pangalengan, Garut, Dieng etc). Some supplies derive from East Java (including via traders in Dieng) and some from outer islands (Sulawesi and Sumatra).

Supermarkets visited in Bandung, Malang and Surabaya reported unbagged fresh potato sales of only 5-10 kg/week/outlet. In addition, there are several bagged potato brands on sale that advertise their nutritional and “pesticide free” status at premium prices, but without certification. This represents a very minor trade volume at best. The bulk of fresh potato is retailed in traditional market outlets or by street sellers.

In contrast, supermarkets display a wide selection of processed potato products, based on *kripik* in both bagged and tube (Pringles type) packaging. Indofood dominates, with special in-store displays in many supermarkets. Local SME brands may have some presence in supermarkets, but tend to be situated in aisles dedicated to traditional/local products, not snack foods.

2.4.3 Demand trends

During the study, demand trends for the fresh market were described by chain actors – especially wholesalers with long term experience of participation in this market – as one of modest growth, due largely to population growth over time, rather than any increases in consumption per capita. Given existing dietary and consumption patterns there is little reason to expect this situation to change in the medium term. The “modern” supermarket sector remains of minor importance and this will not change in the short-term.

In contrast, the snack food sector is recording significant market growth, although Indofood has not divulged any specific figures relating to this. However, their recent expansion of capacity to produce processed potato products indicates their confidence that this sector will continue to grow robustly. Indofood’s primary concern is clearly around raw material supply, not market demand.

Additional information on demand trends is provided in later sections of this report.

2.4.4 International trade

Exports

As shown previously in Figure 1, exports have declined markedly since 2000, and in 2011 totalled only 5,122 tons. Of this, 3,351 tons was exported to Singapore and 1,353 tons to Malaysia, with additional small volumes to other Asian regional countries. If this export trade is to revive, it will be based on the potato production region adjacent to Singapore and peninsular Malaysia, i.e. in northern Sumatra, and not from East Java or NTB.

Imports

FAOSTAT data on potato imports show an opposite trend to that of exports, with dramatic increases in recent years (see Figure 1). Looking in detail at the countries that exported potato to Indonesia in 2010 and 2011 (Table 8) and based on interviews with wholesale market actors in Jakarta and Surabaya, it can be surmised that the imports from China and Bangladesh are largely of ware potato for direct consumption, and which pass through the main wholesale markets. Several traders in East Java reported handling imported potato from China in 2011, for example. However, this importation appears intermittent, as volumes from China in 2010 were only 1,800 ton, compared to over 40,000 ton in 2011. A recent analysis of time series data (Andriyanto et al. 2013) found that ware potato imports may well have acted to reduce prices in the fresh market, leading to reduced return to producers, and that production volumes were influenced by the scale of imports (perhaps as farmers switched to other crops).

Table 8 Potato imports (ton) to Indonesia by country, 2007-1013

Country	2007	2008	2009	2010	2011
China	1,531	323	2,123	1,801	40,234
Bangladesh		288			3,907
Australia	1,397	2,342	8,741	11,999	10,932
Canada	2,579	4,601	2,174	8,554	11,928
France				25	2,625
Germany				50	5,272
UK	475	47		750	939
NZ				1,226	1,050
Total	6,952	8,289	14,007	26,958	80,876

Source: FAOSTAT

Smaller volumes of potato are recorded as imports from Australia, Canada and EU countries (Germany, France and UK). These are most likely to be seed potato (perhaps largely Atlantic) imported by or on behalf of Indofood for their production areas across Indonesia. These imports totalled over 30,000 ton in 2011, but only 20,000 ton in 2010.

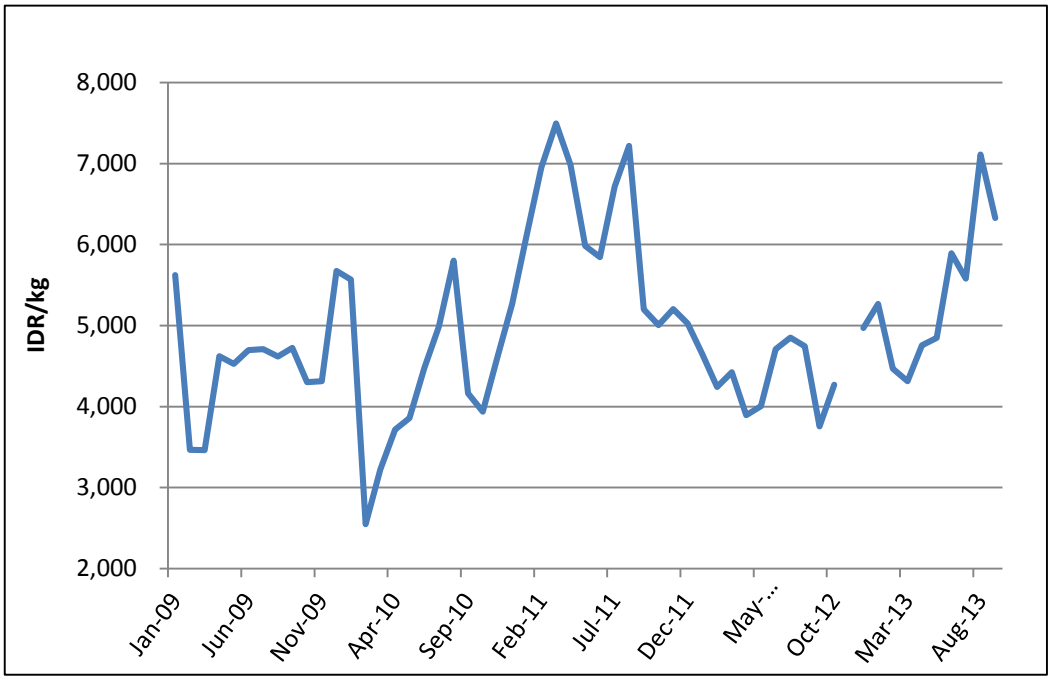
Finally, FAOSTAT records imports of frozen potato, used as a raw material for French fries in the fast food industry, which are mainly sourced from the USA (11,500 ton in 2010 and 13,900 ton in 2011). Additional volumes are imported from Netherlands, Canada and New Zealand (2,285, 1,926 and 1,717 tons respectively in 2011).

2.5 Prices

During the course of the study obtaining time series of potato prices at farm gate, wholesale and retail levels was consistently a major problem. Potato is not seen as an important enough commodity for markets to maintain a statistical database on historic prices. Only one time series for a wholesale market was obtained – for Mantung market in Malang district (but near Batu town, not the Tengger/Mt Bromo area). Further primary information was gathered from interviews with market actors and farmers, but this is mostly relevant for the most recent year or two.

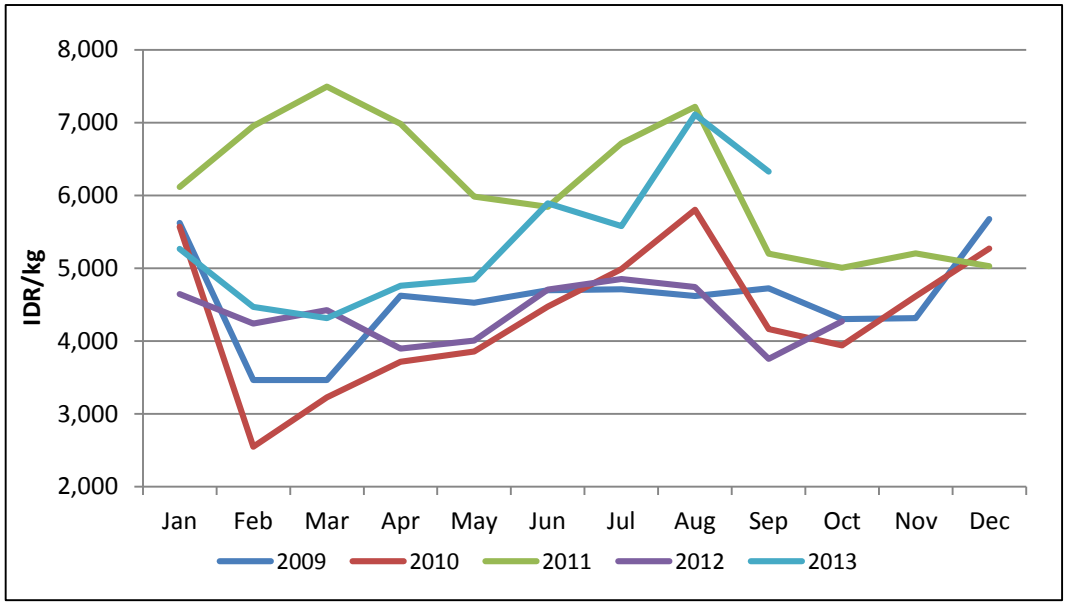
2.5.1 Price seasonality and trends

Granola/ware potato prices fluctuate according to macro factors relating to supply e.g. climatic conditions, disease pressures affecting yield, and the relative attractiveness of potato vs other crops for farmers to plant each season. But there are also seasonal variations based on demand, which tends to increase around the times of major festivals e.g. Idul Fitri. The Mantung data (Figure 2) show that in most years from 2009 to 2013 there is a peak in prices around July-August, and a low point around February-March (except in 2011). In Figure 3 the time series from January 2009- July 2013 shows a price range of IDR 3-7,000/kg. Prices fell below IDR 4,000/kg in early 2009 and 2010, and were above IDR 6,000/kg for most of 2011, and again in recent months in 2013 (then declining). For the most part, prices have been in the range of IDR 4-6,000/kg. Note that the period of high prices coincides with the timing of imports from China, which may have been deliberately aimed at securing price declines for consumers.



Source: Mantung market administration

Figure 2 Mantung assembly market monthly potato price fluctuation, 2009-13 (real prices)



Source: Mantung market administration

Figure 3 Mantung assembly market potato prices time series, 2009-13 (real prices)

Mantung is a rural market close to the production areas in Malang and Batu. The prices reported at this market are similar to those collected during the farmer focus group interviews in those areas. Table 9 gives the farm gate prices reported by all the focus groups in East Java. These largely agree with the Mantung market data, and probably indicate some degree of integration among the different rural markets, as they are all supplying the major urban centres of East Java as well as the outlying islands.

Table 9 Farm gate prices (IDR/kg), September 2013, in survey areas, from FGDs

Grade	Ngantang, Malang	Tosari, Pasuruan	Wonokerto, Probolinggo	Ngadas, Malang	Sumberbrantas, Batu
Super					9,000
A		6,000			
AL			6,000	7,000	8,500
AB	4,500		6,000	6,000	
ABC					
B		5,000			
BC					7,500
C		3,000			
TO		2,000			2,000

Source: FGD fieldwork

Figure 4 and Figure 5 show the monthly - seasonal - fluctuations in retail and wholesale prices from Mataram, Lombok, and Figure 6 shows the trend of average whole and retail price over time, from 2007. Since the majority of the ware potato in Lombok is imported, largely from East Java, prices would be expected to follow a similar trend to that found in Mantung, but with higher absolute values due to the cost of transport by boat to Mataram. However, this does not appear to be the case. There is no clear pattern of seasonal variation in prices across the years at either retail or wholesale level. Average wholesale prices do increase over time, and reach a maximum of IDR 10,000/kg in 2011, but then decline sharply to only IDR 3,000/kg in both 2012 and early 2013. Oddly, retail prices show no such decline in price after 2011, indicating either that traders were able to increase margins substantially (unlikely) or that there is an error in data collection/recording in this data series. By the time of our fieldwork, wholesale prices were back at higher levels, around 8-9,000/kg for AB grade and IDR 9-9,500/kg for AL grade Granola from Java, according to Mataram traders. The low wholesale prices in 2012 may be an indication of the effect on the wider market of imports of cheaper potato from China.

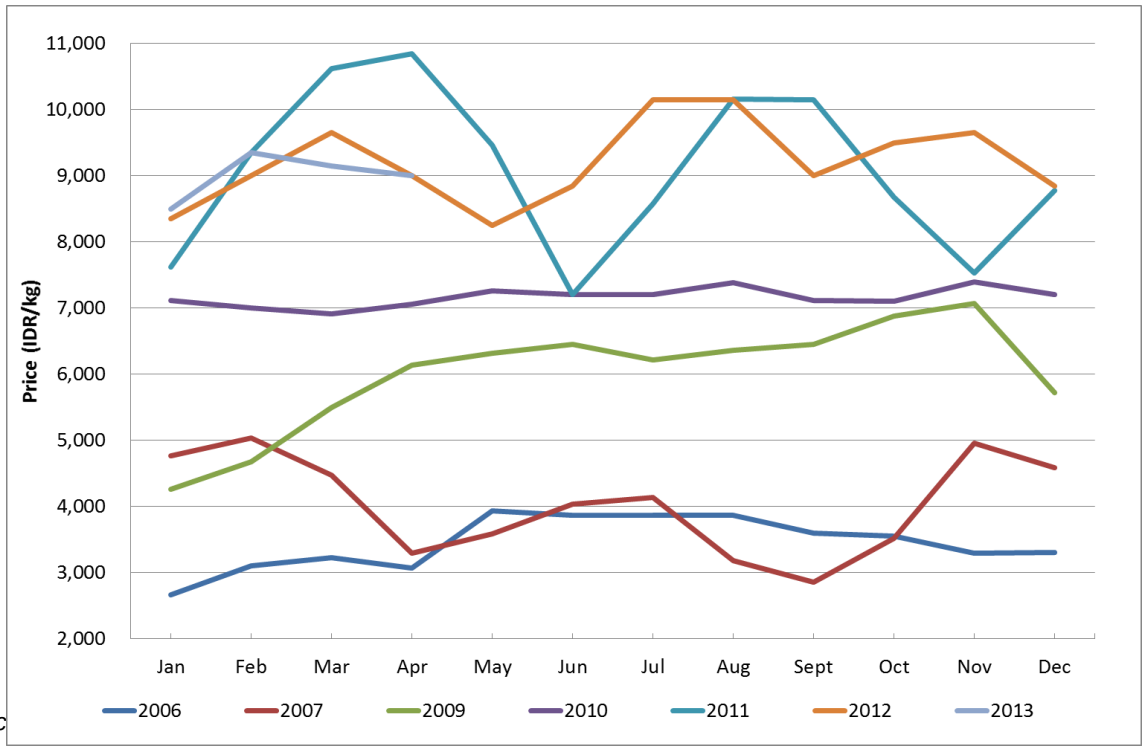


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Figure 4 Monthly fluctuation in potato retail price, Lombok (2006-2013, with 2008 missing)

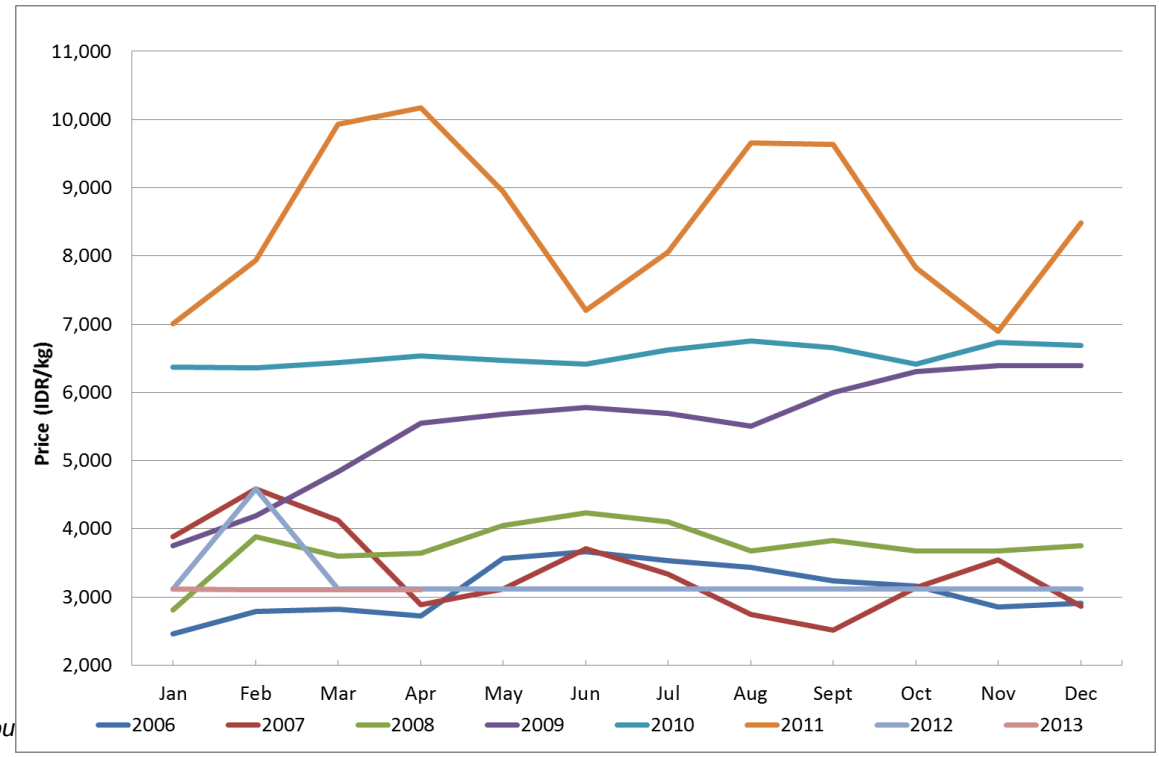

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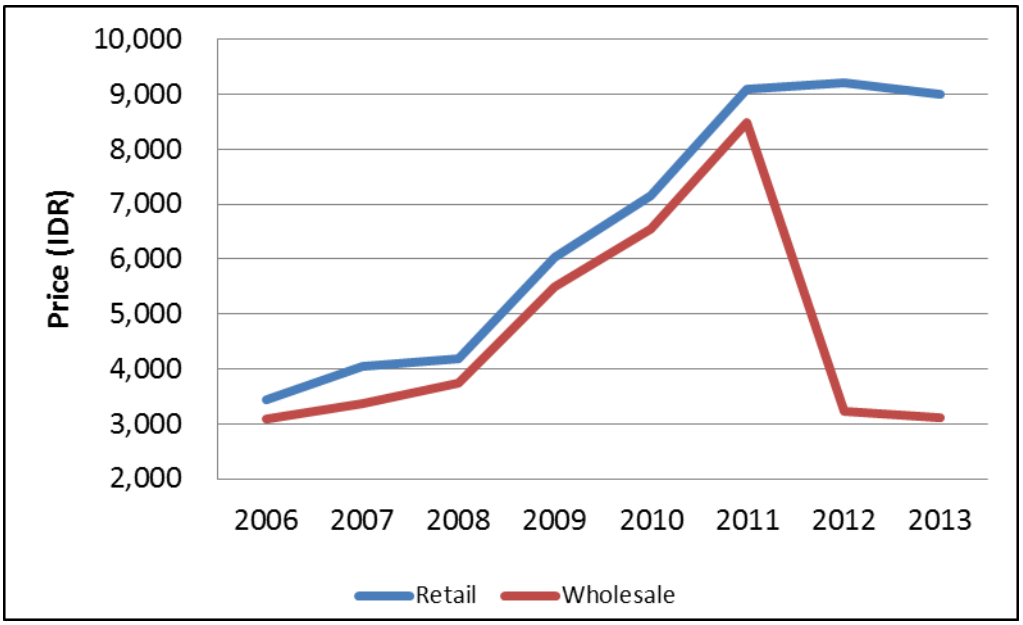
Figure 5 Monthly fluctuation in potato wholesale price, Lombok, 2006-2013



Source: DINAS NTB

Figure 6 Average annual retail and wholesale potato price time series, Lombok, 2006-2013

2.5.2 Quality premiums

As Table 9 indicates, there are definite price differentials between different grades of potato, but the terminology is confusing and varies by location/market. There are generally three main commercial grades:

- A (AL) large tubers in undamaged state, selected to transportation to more distant markets (Jakarta, Kalimantan…);
- B medium tubers, some damage permissible, marketed locally within the province; and
- C small tubers mainly used for seed, or local markets only.

TO indicates non-commercial tubers, also used for seed.

There also exists in some locations a “super” grade of very large tubers, targeted specifically at the Bali market.

There are no agreed absolute size criteria used to distinguish the different grades of tubers, although market actors seem have a common understanding of the grading system. Only the Bali super tubers have specific measurable standards (number of tubers/kg, or minimum weight/tuber).

2.6 Policies and regulations

The policy environment for potato in Indonesia concerns both trade (import and – to a lesser degree – export) and varietal development and dissemination of seed potato within Indonesia. The vegetative nature of potato seed complicates the seed system, and also the international trade in seed potato. There are also some inter-provincial quarantine barriers to movement of potato seed.

The remarkable stability of potato varieties in Indonesia is a feature of the potato system. Granola and Atlantic have dominated ware and processing markets for several decades, despite concerted efforts in varietal development by public sector agencies, and importation of novel varieties by various parties over time. While this stability may in part be due to the suitability of the two current varieties for their end uses, it may also be seen as a function of the policy and regulatory barriers that exist to regulate varietal testing, release and adoption in a vegetatively propagated crop such as potato.

A recent report by the Value Chain Center of Padjadaran University, Bandung (Anon, 2013), summarises the legal and regulatory environment pertaining to potato variety development and seed dissemination:

- Law number 12/1992 – Plant Cultivation Systems. Seeds of new varieties may be introduced and disseminated in Indonesia by government or by authorised entities/individuals, after due certification that quality standards have been met. Violations merit fines and prison terms.
- Law number 29/2000 – Plant Variety Protection. PVP can be provided to new, distinct and stable varieties, for 20 years. Under this law, the rights holder can give consent to other parties to use the variety, including for seed multiplication and sales. Local, community varieties fall under state control. Research activities fall outside this regime.
- Law number 13/2010 – Horticulture. Regulation of seed businesses (ownership and functions) registration, launching and distribution of new varieties. Seed imports require permits, meet specified quality requirements and are only allowed if they cannot be produced domestically or domestic needs are not met. Certification is required for seed quality assurance. The government prioritises domestic investment, with foreign investment limited to 30% and requires technology transfer to domestic partners.
- Regulation number 48/SR120 of 2012. On Horticulture seed production, certification and distribution monitoring. Vegetative seed can be produced by private parties and public sector agencies with a certification of their quality systems issued by an appropriate body in the horticulture sector. Seed must be certified by the Seed Inspection and Certification Service (BPSP). A seed production license is required for seed distribution. This license requires seed producers to produce quality seed, maintain documentation, report regularly etc. Seed certification involves quality control and post-harvest handling including field examination, seed quality testing and results in issuance of a certificate and label (yellow for seed producer seeds, white for foundation seed, purple for stock seed and blue for extension seed).

The system for seed certification involves four generations of tuber multiplication, of which at least the final two generations (G3 and G4) take place in open fields. G1 and G2 are usually produced under screen protection, with G0 mini-tubers produced in glasshouse conditions from plantlets. This multiplication procedure is required to provide a sufficient volume of seed

tubers, but also acts to increase costs and (especially in the final two multiplications) increases the probability of seed degeneration from pests and diseases prevalent in such open field conditions.

Regarding potato trade, in 2010 the ASEAN-China Free Trade Agreement came into effect, under which tariffs were reduced to 0% for commodities under the Early Harvest Program which covers vegetables (except sweet corn), and facilitates the import of potato for direct consumption. This is evidenced by the import statistics, and reports of potato from both China (and Bangladesh) in wholesale markets over the last two years. However, the government appears more reluctant to issue permits for the importation of seed ware potato, given the priority for expanding domestic production outlined above.

Another complicating factor is that in March 2012 a new rule was implemented under which Jakarta port will no longer be allowed to discharge fresh fruit and vegetable imports. The only approved entry points are now the Ports of Surabaya, Medan & Makassar and Jakarta International Airport. In July 2013, imported potato from China was observed arriving by road in Jakarta wholesale market, presumably from Surabaya.

Permits for the importation of seed potato of Atlantic variety for processing use (by Indofood) are issued, but with delay periods of three months (according to Indofood itself). These have traditionally been sourced from Australia.

Key informants commented that the regulations governing the importation of fresh produce/vegetables appear to be managed rather ad-hoc manner in response to consumer price fluctuations, rather than with a longer term perspective taking into account producers and consumers together. There was a ban on potato imports of horticultural products including fresh potato between January and June 2013 (Ministry of Trade regulation), but imports resumed in July 2013, apparently timed to precede Idul Fitri, when food prices usually increase. During the market visits in East Java in September-October 2013 there were no reports or observations of imported potato, but imported carrots from China were observed in several locations.

Also of note is the new regulation in NTB that establishes a quarantine inspection of potato seed imports to Lombok, in order to maintain the PCN-free status of the island. However, we were informed by Mataram University contacts that the province still lacks a means to test potato seed for this nematode.

2.7 Value chain development programs

There are no other comprehensive potato value chain development programs in Indonesia. The only other initiatives encountered during this study were aimed mainly at improving potato seed systems:

- The PISAgro potato program which focuses on Atlantic potato, and is led by Indofood and is focused on the Atlantic seed system for Indofood's own growers.
- Other public-private sector varietal development efforts, mainly in West Java, for novel processing varieties, including Median and Bliss.
- One private sector enterprise in Lembang, West Java, employing aeroponic technology for certified potato seed production.

3 Description of Potato Value Chain in Indonesia

3.1 Overview

In East Java, Granola is the dominant variety, although from a number of different sources that are reflected in the nomenclature commonly used by producers and traders (Granola-Lembang, Granola Kembang). Granola is the main variety in all production areas around Mt Bromo (Tengger), and Batu, for both the fresh market and for the processed potato cluster of SMEs located in Batu (Table 10). Only in Bondowoso is there a relatively recently developed area of Atlantic potato growers, linked to Indofood, for processing. This area is also trialling a different variety (Bliss). Many of the other areas in East Java currently producing Granola were formerly - since the early 1990s - involved in Atlantic production for Indofood, but this has gradually declined, and disappeared, due to poor yields and low prices/incomes.

Table 10 Overview of potato uses and varieties in East Java and Lombok

End use	Variety	East Java	Lombok
Fresh consumption	Granola	Dominant in all areas except Bondowoso	Minor production in mixed vegetable systems, mainly on rainfed land, in rainy season.
	Other	Minor presence of Klon variety, uncertain origin	None
Processed products	Atlantic	Only grown in Bondowoso, for Indofood	Dominant, off-season in irrigated land, for Indofood
	Granola	Produced in Batu and Malang, for the potato *kripik* cluster of SMEs in Batu	None
	Other	Trials of Bliss variety in Bodonowoso	None

Source: Fieldwork key informants and FGD

In Lombok, potato is only produced in the Sembalun area. This is another Indofood-linked scheme, based on the Atlantic variety, with production – on irrigated land – timed to supply factories during the off-season for production in Java. In addition, there is limited production of granola for the fresh market, mainly grown on rainfed land during the rainy season in Sembalun.

As the dominant varieties, value chains and end uses of potato from East Java and Lombok are quite distinct, they will be analysed separately in this report. The East Java section will concentrate on Granola for both fresh and SME-processing uses, while the Lombok section will focus mainly on Atlantic for the Indofood scheme. In addition, in Lombok it was possible to compare Granola and Atlantic production/marketing from the farmer perspective, so this will also be presented.

Finally, in both East Java and Lombok, potato production forms part of a broader vegetable production system. Previous projects and studies have focused on the association with brassicas, especially cabbage. However, in both East Java and Lombok, a more varied production system was usually found, with potato (both Granola and Atlantic) produced in rotation with a number of other crops – especially carrot, spring onion - as well as cabbage.

Different production areas tended to be associated with different rotation crops, and this will be highlighted in the relevant sections. For the purposes of this study, comparative production costs/gross margins were only obtained for cabbage, however.

3.1.1 Value chain structure

The structure of the potato value chains in the study is highly complex, even considering Granola/ware potato separately from Atlantic/processing potato. The situation in East Java is characterised by a number of discrete potato production areas that each provide potato for several intermediate and terminal markets. The terminal markets comprise:

- Local urban centres in East Java;
- Urban centres in Central and West Java and Jakarta;
- Markets outside Java, as far afield as Batam and Papua, with shipments mediated by agents and via ports in Surabaya, Semarang and Banyuwangi; and
- Export market in China (one case only).

The market locations in East Java fall into three categories:

1. Markets in or adjacent to potato production areas, with a focus on assembly and transport to other wholesale markets (e.g. Tosari, Pasuruan);
2. Wholesale markets outside production areas, supplying urban centres, markets outside Java and some local retail trade (Mantung and Porong); and
3. Wholesale and retail markets in the main cities of East Java that supply local retail trade and some markets further afield (Malang and Surabaya).

Potato production areas are generally located above 1000 m, on the slopes of volcanoes. Mt Bromo, as the main volcano in the province, has the largest potato production region above this critical altitude. In fact, the potato production areas of Pasaruan, Probolinggo, Lumajang and most of Malang are located on the slopes of Mt Bromo, in what can be identified as a single largely contiguous production area (Tengger) across these districts. In addition, some of the production in western Malang district is located near Batu, on a different highland area. Further east, Bondowoso and Banyuwangi are also highland regions around other volcanoes of more limited area.

The markets for Granola potato from East Java are quite diverse and differ by production region, based largely on market access factors. Thus, much of the production from Batu and the nearby areas of Malang district are marketed either to the processing cluster in Batu itself, or to major wholesale markets in Central and East Java – including Semarang and Jakarta. This may be direct, or via wholesalers in Dieng (Central Java). Potato from the NW slopes of Mt Bromo (Pasuruan) tends to be marketed in Surabaya, or via wholesale markets there to points further afield, including other islands of Indonesia. The eastern slopes of Mt Bromo (Probolinggo) market Granola mainly to Bali, via the ferry that provides direct access from Banyuwangi port on the extreme eastern point of Java island. The W and SW slopes of Mt Bromo in Malang district market to Malang itself, to Surabaya and also to Bali. This combination of market channels, based on both geographic factors and to some extent on personal contacts, provides a diverse and dynamic set of end markets for fresh consumption. The areas beyond Java that were reported as end markets for Granola include Papua, Sumatra, Kalimantan, Bali, NTB and NTT.

Another feature of the potato value chains in East Java is the presence of key individuals who perform several functions in the value chain in their geographic areas of action/influence. A single individual may be a seed supplier, a provider of finance for potato production (for both seed and ware markets), a potato *kripik* processor, and/or a ware potato trader/wholesaler. Such individuals, or family firms, are found in Batu, Pasuruan, Malang and Probolingo districts. Understanding their roles, motivations and future plans/strategies is key to identifying potential interventions in the districts where they operate.

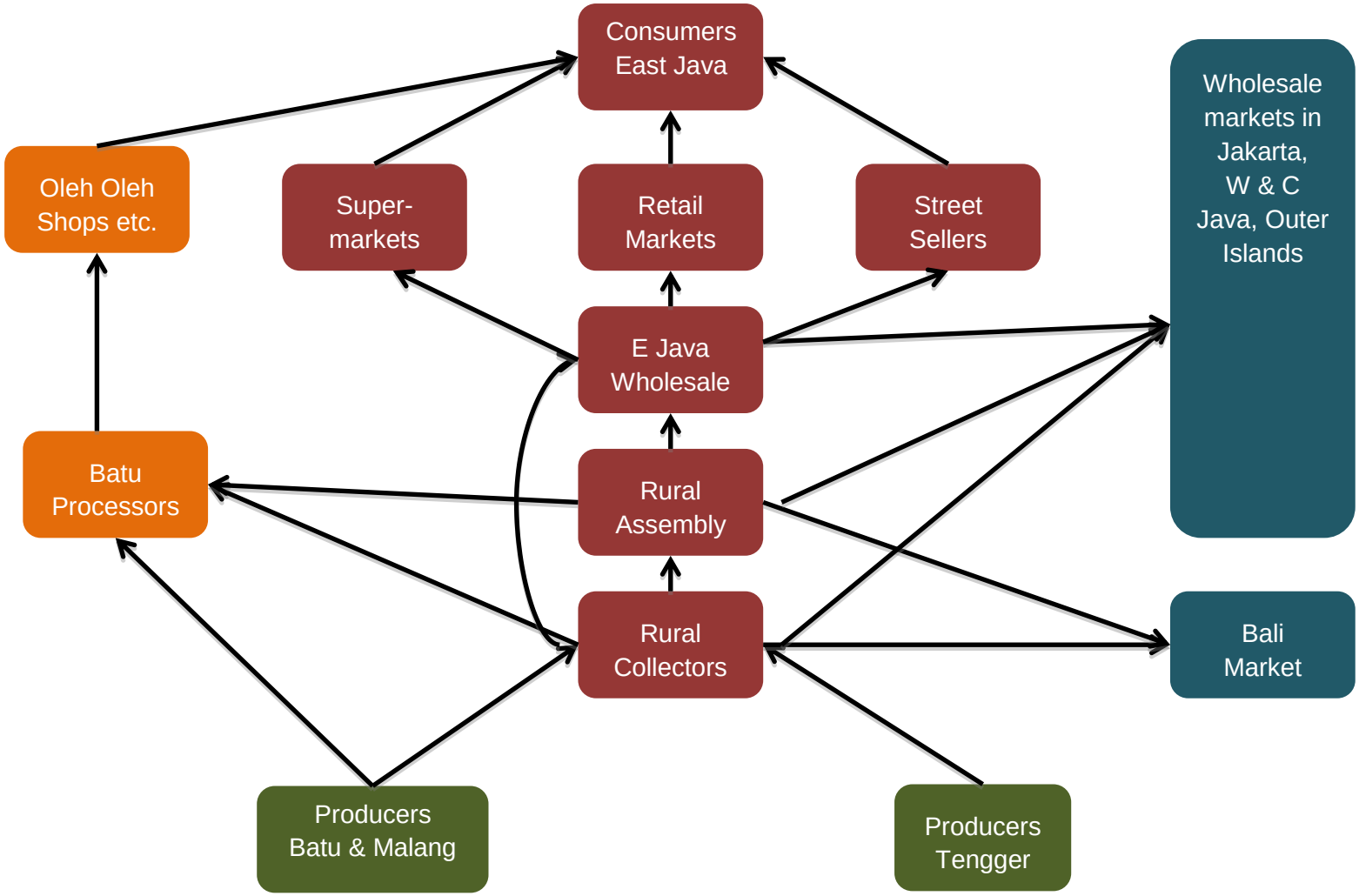
Figure 7 gives a schematic overview of the Granola value chain in East Java, which includes the Batu processing cluster as well as the fresh market. In the discussion that follows, it is important to bear in mind that the Granola value chain is also differentiated by end market (local, major urban centres across Java and some of the outer islands, and to Bali). There is no single channel for supplying these diverse end markets, and personal contacts between assembly agents, wholesalers and market actors in the end markets appear to be important in determining produce flows. Many of these arrangements are longstanding and built on trust. The examples given here will focus on value chains involving Mantung, Tosari and Porong rural assembly markets, Kebutan (Surabaya) and Malang wholesale markets, and Surabaya, Malang and Probolinggo retail markets, plus the actors involved in the processing value chain at Batu. Although Porong is outside the potato production area, its strategic location, convenient to several production areas and urban markets, makes it an important wholesale market with some characteristics of rural assembly.

The diversity of end markets, and the numbers of traders and intermediate markets (rural and urban wholesale) means that the value chain structure for Granola in East Java is different from that described in Bali (Sukayana et al., 2013) where production (from one main area) is focused on supplying the main local market and “price monopoly in the marketing channels” was found.

One other general issue to note at this stage is that of trust between producers and market actors. While many of the trading relationships found in East Java are longstanding, a recent study (Puspitawati, 2011) of trust in the potato value chain in West Java found that for unorganised smallholder producers, the main issues affecting trust were price transparency and joint problem solving. Farmers organised in field schools were also sensitive to the price issue, and to the size of the operation of the buyer/trader.

There is also considerable uncertainty over the volume of potato production (and area of production) in East Java. While the formal statistics report about 85,000 ton of production in 2011, key informants in the main Tengger area of production were agreed that this is an understatement. One informant (seed producer and supplier) estimated production at 12,000 ha with average yield of 15 ton/ha, and a total production of 180,000 ton for the province. More information on volumes traded in individual markets will support the contention that production is larger than the official statistics record, if less than this unofficial estimate[3].

[3] *Due to this uncertainty, volumes of potato traded are not provided in Figure 7*



Source: Fieldwork, key informants and FGD

Figure 7 Granola value chain, East Java

3.1.2 Product standards and coordination systems

Information on potato grades and their respective prices are presented in section 2.5.2., and Table 9 and Table 13. The coordination system relating to potato grading is informal, with sorting carried out either on-farm or by local collectors or wholesalers, who grade by experience rather than using any objective criteria.

Official standards are, however, applied to seed potato that is certified and distributed under the formal scheme documented in the policy section of this report. This system is accepted and implemented by the participating parties, although it would be put under strain if volumes were to expand greatly in the future.

3.2 East Java – Granola value chain

3.2.1 Input distribution

Potato is vegetatively propagated, and the supply of seed tubers has long been recognised as a critical issue for potato production, both by growers and researchers. Commonly, 1.5 - 2.0 ton of Granola seed is planted per hectare, to produce 15-20 tons marketable potato. Seed represents approximately 40% of production costs in many areas, if purchased. Formal certified seed systems providing seed tubers of guaranteed provenance, variety, generation and health (virus free) are available, but exist alongside more informal seed systems that supply uncertified and thus less expensive seed. In addition, farmers often (and in many areas invariably) select, save and reuse seed from previous harvests. While this reduces costs, it also contributes to build up of diseases over time, and consequent yield - and income - reduction. Thus, the seed issue is related to the farmer's desire and ability to purchase seed, to credit access and so on.

The Provincial DINAS estimates that there are around 8,000 ha of potato in East Java, requiring 12,000 ton of seed, but that only 2% of this is locally produced certified seed, with another 2% of certified seed from West Java, leaving around 95% of seed as uncertified. There are nine active potato seed producers in East Java, of which Sentral Paguyuban Pasuruan, Tengger Mandiri and Citra Mandiri are the largest.

The prices obtaining for certified seed (Table 11), according to DINAS regulations are:

Table 11 Official certified seed prices

Generation	Price IDR/kg
G0	15-25,000
G1	
G2	16,000
G3	13,500-14,000
G4	9,000-12,000

Source: PBTP, Malang and Tosari

In the different areas of East Java visited for this study, different practices related to seed were observed. The seed supply system is complex and dynamic, with many actors and a range of motivations. Understanding the details of the seed system goes beyond the remit of this study, nevertheless a useful body of information was collected. A generalised seed system can be described as follows:

1. Meristem tissue culture of selected tubers, to provide material that is “clean”, i.e. free of viruses and other diseases as far as possible. The cultures are grown in test tubes in dedicated laboratories, and result in plantlets that form the first “seed product”.
2. Plantlets can be distributed to seed producers with dedicated facilities (glass and screen houses), or retained by the same production unit. These plantlets can be multiplied through sequential cuttings (5 times or more) to increase their number, before being planted out in glasshouse environments to produce the initial “knol” or G0 tubers.
3. G0 tubers need to be grown for a further 2 generations (i.e., up to G2) in screenhouses, to maintain their virus-free status. This is usually carried out in a field-based facility in the target production area, to acclimatise the tubers to this environment.
4. Generations G3 and G4 are produced in open fields, using good production practices as far as possible to avoid pest and disease contamination.

The process of moving from G0 to G4 takes time (approximately 100 days/cycle, plus dormancy periods of 3m or more between cycles) but results in the production of sufficient volumes of seed at G4 to meet expected demand.

In East Java, the production of plantlets and knol is limited to two facilities which each produce Granola from seed sources that they have cleaned via meristem culture themselves:

- BPTP in Malang, which produces Granola-Kembang; and
- Brawijaya University in Malang, which produces the self-denominated Granola-Kembang-UB.

Granola-Lembang seed is also widely available, from suppliers based in West Java (e.g., Hikmah Farms). This is derived originally from plantlets provided by IVEGRI in the past. Finally in Batu some processors are using Granola-German, which is derived from imported seed from Germany (in 2007).

The most important local seed supplier is BPTP-Malang, which supplies plantlets to a seed facility in Tosari, Pasaruan that is operated by the provincial government. Alongside this, the manager of the Tosari facility is also operating his own seed business that focuses more on G3-G4 production using a network of out-growers at higher altitude. These two businesses in Tosari can provide both certified and uncertified Granola seed, at differential prices. The manager/operator also provides finance and some technical assistance to growers, to support their use of this seed for commercial production (see later).

3.2.2 Production

Five focus groups were conducted with potato farmers in East Java, comprising two in Malang district (Ngantang and Ngadas), one in Pasaruan (Tosari), one in Probolinggo (Wonokerto) and one in Batu (Sumberbrantas). In addition, several individual farmers and farm leaders were interviewed for further insights. This section summarises the results of these FGDs and interviews, as well as incorporating additional information from other informants as appropriate (e.g. local collectors, input suppliers), and drawing on detailed information from the gross margin data that is presented later in this report.

The smallholder production systems within which potato crop is produced are quite varied, with potato situated as one of several vegetable crops in a two, three or four crop rotation system depending on location. There is also a sense that, over recent times, the importance of potato in the system has decreased, i.e. the production systems have become more varied as other vegetables have taken a larger role.

Potato seed

Tosari is the location of the provincial potato seed production facility, and also of private sector seed multiplication in East Java (linked to this facility). Farmers stated that even in Tosari where certified seed is most available, around 90% of the potato is produced using retained seed from previous harvests, although this may decrease to about 60% in Wonokitri, the village closest to the seed facility. Doubt was expressed on the yield advantage of using certified seed, especially given the higher cost of this seed. Farmers in Ngantang source their potato seed from Tosari, but again use uncertified seed from known farmers in Tosari, i.e. there are well established trading linkages for informal potato seed distribution across the province. This uncertified G5 seed costs IDR 6-7,000/kg, in Ngantang, and compares with IDR 12-14,000/kg for G3/4 seed tubers. The Tosari area is known for seed production, and the relatively high altitude (over 2,000masl) helps to reduce pest and disease pressure.

Potato seed is planted at a rate of about 1.5 ton/ha, implying a cost/ha of IDR 21,000 for the G3/4seed, compared to minimal opportunity cost of using retained grade C small tubers from previous harvests, or about half that cost of using uncertified G5 tubers. Thus, it is important for farmers to be certain that purchasing more expensive seed will indeed provide significant yield benefits, to compensate for the higher costs incurred.

In Wonkerto, Probolinggo, the local trader sources certified seed from West Java (Hikmah Farms) and supplies this to local farmers. The common farmer practice is to purchase this seed, and then use retained seed from this source for 2-3 cycles before returning to repurchase certified seed once more. This reduces costs while minimising yield declines over time. The cost of certified seed is IDR 375,000/25kg box (i.e., 15,000/kg). The quality of seed from West Java was said to be superior to that from Tosari. Yields for potato from certified seed were reported by farmers as 15 ton/ha, compared to 12 ton/ha from using retained uncertified seed. If more intensive use is made of agrochemicals, yields can be increased by 5 ton/ha for both types of seed. In Ngadas, farming was disrupted by an eruption of Mt Bromo in 2007-8. Following this, DINAS distributed potato seed (G3) to affected households, and retained seed from this source is still the main potato seed used in the area today, although some farmers are purchasing seed from Tosari. Poor quality seed is cited as one of the major constraints in this area.

In Sumberbrantas, there is a long history of potato production, since the 1980s, although production systems are now more diverse. Farmers have several options: they can procure G3/4potato seed from the nearby facility of University of Brawijaya or from BPTP, but many also procure G0 tubers and multiply themselves in nursery plots up to commercial G3 or G4. This seed is retained and used up to G7 before repurchasing seed again.

Potato variety

While Granola is the dominant variety used for the ware potato market, there are several types of Granola present in the province that are recognised by farmers. These have emerged over time, as the result of different virus clean-up and regeneration efforts made by

public sector institutes. Granola-Lembang being produced by IVEGRI and Granola-Kembang by BPTP-Malang. In addition, University of Brawijaya has produced its own Granola (Kembang-UB) and in Batu there are also reports of Granola-German, resulting from an importation of seed from Germany made around 2007. The fieldwork for this study encountered both Granola-Lembang and –Kembang in most locations, with no clear preference for one or the other across the province, but some local preferences in specific villages apparently based on adaptation of local conditions. Feedback from farmers on the characteristics of the two types of Granola lacks consistency, but is reported here (Table 12).

Table 12 Characteristics of Granola-Kembang and Granola-Lembang reported by FGD respondents

Characteristic	Location	G-Kembang	G-Lembang
Days to harvest	Ngadas	120	90
Disease resistance (high altitude)	Ngadas	Better	Susceptible
Yield	Ngadas	High (20 ton/ha)	Moderate (15 ton/ha)
High altitude adapted	Tosari	Yes	Less adapted
Susceptible to stem rot in rainy season	Wonokerto	Yes	Less susceptible
Seed storage	Wonokerto	Higher losses	4-5 months OK

Source: FGD East Java

Thus, Wonkerto farmers prefer Granola-Lembang, while in Tosari and Ngadas Granola-Kembang is more popular. Both are common in the other locations. Across these production zones, other varieties are hardly grown or marketed, although Klon can be found but appears to have no characteristics that would justify a preference over either of the main Granola varieties. Granola-German, found in the Batu area linked to some of the *kripik* processing enterprises, is preferred for *kripik* production, but since supply is based on seed that has now been retained for many generations, it is unlikely to be grown for much longer unless new seed sources can be procured.

Input supply

Agrochemicals are critical for potato production, both fertilizers and pesticides. According to the gross margin studies, they constitute on average 26% and 38% of total production costs respectively (see Table 19). While seed costs can be minimised through use of retained seed, there are few strategies yet employed by potato farmers to reduce agrochemical dependency. Pesticides are supplied by local input shops, which are common at village level in vegetable production areas. The main production constraints, especially Phytophthora infestans, are catered for with a range of products from the main agrochemical firms. In several areas, including Tosari and Wonokerto, they may also support field demo plots with key farmers/input suppliers. In Wonokerto, Tosari (and Sembalun in Lombok) input suppliers may provide credit until harvest to support purchases. Where key individuals are supporting potato production systems at local level (e.g., through providing inputs, seed or/and purchasing harvested potato) the provision of agrochemicals and technical advice to accompany the products, is one component of this support. For example, in Sumber, Probolinggo, Pak Cacing coordinates a network of 100 smallholder potato farmers to whom he supplies seed and agrochemicals, plus technical advice. He also purchases the crop at

harvest for marketing in Bali and elsewhere. Input provision is a key component of his support system.

As is common in the many similar situations, agrochemicals are used with few of the protective measures employed that under GAP. Applications are made without use of protective clothing, masks or gloves, and they are not usually sold in the input supply shops. Doses may be exceeded, or applications made more frequently than advised. Containers are not stored nor disposed of appropriately. In one instance, plastic containers were recycled with other plastics, potentially entering the food chain in the future. Input supply shop staff, and agrochemical company field staff appear to have little incentive to remedy this situation, nor the knowledge or interest to encourage farmers to reduce pesticide usage (or to improve efficiency of applications), as staff may receive bonus payments based on sales volumes.

In Sumberbrantas, farmers were well aware of the problems caused by excessive and long-term use of both chemical fertilizers and pesticide products, claiming that soil exhaustion (compounded by reduced organic matter content) and pesticide residues were the main factor responsible for potato yields decreasing markedly since the 1980s (30 ton/ha in 1980s vs 15 ton/ha now). They are making efforts to increase usage of organic fertilizer.

Production constraints

The main production constraint mentioned across the province of East Java was Phytophthora infestans, which can potentially reduce yields by almost 100%, but for which a number of agrochemical products offer good control, at a cost, according to key informants across East Java. They did not, however, indicate the presence of specific problems with a range of other diseases such as bacterial wilt or the potato cyst nematode, both of which are present in East Java, based on expert knowledge. Thus, while key informants/FGDs across East Java reported that diseases are not usually constraints that negatively affect yield, or even root quality, but rather serve to increase production costs as more frequent applications are required, this may not be a completely accurate picture of the production issues. But it explains the perception of farmers that potato is the most risky crop to produce – the chances of severe disease problems are quite high – especially in the rainy season – and the increase in production costs that this implies act to decrease profitability of the crop, or raises the prospect of losses if the market price falls at harvest time.

Dawson (2012) found that in West and Central Java, there was a negative correlation between yield and insecticide expenditure, indicating there that information to guide their efficient use is lacking at farm (and extension?) level, resulting in wasteful, unnecessary applications.

Use of certified seed will also help to reduce the degree of infestation/infection, but if neighbours are using lower quality retained seed, this may not translate into higher yields, or lower production costs.

The rotation of potato with non-Solanaceous crops such as cabbage, carrots and onions is another strategy employed to reduce losses and costs, and may partially explain the growing diversity of production systems in formerly potato-dominant areas such a Sumberbrantas (along with market factors).

Harvest and grading/sorting

In all locations except Ngantang (see next section), farmers take responsibility for harvesting their crop, with additional labour either hired or family, or both. Women may be paid less per

day than men, but would usually not undertake the most heavy duty tasks. Across the province, there are usually several local collectors willing to make offers for harvested potato at any given farm. Farmers may invite collectors to see the produce on-farm (stored in a room) either before or after sorting. Prices may be for mixed crop, or for graded produce. Small tubers (grade C) are usually retained for seed use on farm.

In some specific cases, farmers are linked directly to collectors/traders through prior arrangements that may also involve provision of inputs (seed and agrochemicals). One such system operates in Tosari where Pak Yuli, the manager of the provincial seed production facility (and operator of his own private seed business) also funds a network of potato farmers in a 50: 50 arrangement, whereby he provides the certified seed and required inputs, farmers provide land and labour, and the profits (after discounting input costs) are split 50:50. Similar (but not identical) systems operate with key individuals in Sumber, Wonokerto and around Batu (for the *kripik* cluster).

Where farmers sort and grade potato before sale, differential prices are paid.

3.2.3 Collection

The local rural collectors who buy potato from farmers in Ngantang often use the “tebas” system where a price is agree with the farmer two weeks before harvest, and the collector takes responsibility for harvesting (and the risks of low yields etc.). Fifty percent of the agreed price is paid up front and the rest after harvest. However, these rural collectors are not linked only to the market in Mantung – one interviewed in Ngantang also sells potato to wholesale markets in Malang, Kediri and via an agent in Batu, direct to Kalimantan, without passing through Mantung market at all. Total volumes may be 10 ton/day to Malang and 25 ton/day to Kediri, for example, with a total volume of 35 ton/day on average. Farmers in Ngangtung, supplying to these local collectors, reported current farm gate prices work out at around IDR 4,500/kg (an increase from IDR 3,000/kg in 2010-2012). These rural collectors do not provide any technical assistance to producers.

3.2.4 Wholesaling

Mantung Market

This market, close to the potato production region of Pujon and Mantung (Batu and western Malang districts) has two traders that specialise in potato, and others who deal in smaller volumes along with other vegetables. The two potato traders handle approximately 5-6 ton/day (max 10 ton, min 2 ton) each (i.e. about 3,000 ton/y), with potato sourced from three main production areas: locally (Pujon/Ngantang), the nearby area of Jurang Kuali/Sumberbrantas and the more distant but larger production area of Tengger (mainly around Tosari). Tengger and Jurang Kuali is year round, while from Pujon is between July and December only. Rural collectors deliver potato to Mantung market, providing the direct link to farmers. From this market, the two traders sell to two main channels:

a) 40% of volume to wholesalers from towns in E and C Java (Jombang, Kediri, Tuban, Babat etc.); and

b) 50% to markets outside Java, including Banjarmasin (via Semarang port) and Pontianak (via Surabaya port).

(Note that an additional 5% constitute losses during the marketing process.)

The traders indicate that quality and price differences exist for potato purchased from the different production areas (Table 13), although price does not appear to reflect quality (as reported by the wholesalers) exactly.

Potato shipped to Kalimantan requires a good storage life, hence AL grade is usually used for this market as these tubers are selected to avoid those with damage (i.e. shelf life is a section criteria here).

Table 13 Wholesale price for different production sources of Granola in East Java

Price (IDR/kg) September 2013	Ngantang	Jurang Kuali	Tengger
AL		7,000	6,500
AB	4,800		4,200
B		4,000	3,200
C	3,500	3,500	2,700
TO	1,900	2,500	1,900
Overall Quality	Average	Best	Good

Source: Fieldwork East Java key informants, market wholesalers, traders

Tosari market

Tosari market in Pasuruan, in the heart of the Tengger potato production region, is a major hub of potato marketing: the market is almost exclusively devoted to potato. The market houses 10 traders handling around 6-7 ton/day, plus a further 40 smaller traders with 2 ton trucks. On a year round basis, the market probably moves around 40-60,000 ton potato. With an average yield of 12-15 ton/ha, this relates to a production area of around 4,000 ha and some 6,000 farming households with 0.5-1 ha of potato each. The traders themselves indicated that the Tosari market handles 250 ton/day of potato, which would imply an even larger annual volume (around 75,000 ton/year, for a market operating on 300days per year). The traders venture beyond Tosari to procure potato year round, covering other areas in Tengger, including Probolinggo and Malang districts.

Potato from Tosari market is sold to wholesalers in Keputran market in Surabaya, to kripik processors in Batu, including the larger firms operating there such as Citra Mandiri (see section xx) who also on-sell ware potato to Bali. The selling price obtained by Tosari market traders in September 2013 ranged between IDR 6,800-7,200/kg. Key informants reported that potato marketed from Tosari is distributed as follows:

- 50% to towns in East Java, including Batu, Malang, Surabaya as well as markets in Porong and Mantung;
- 10% to Jakarta;
- 10% to Kalimantan;
- 5% to Bali;
- 5% to Central Java (Semarang, Yogjakarta, Solo);
- 10% to other destinations; and
- 10% to the processing industry, mainly comprising the local SME sector around Batu, plus one large firm in Surabaya via Porong market.

Surabaya wholesale markets

Pabean market

Pabean market sells a range of fresh produce, especially onions, shallots and chili, but little ware potato. Two dedicated potato traders were identified during one visit, one small-scale retailer, and one larger scale vendor selling into both wholesale and retail markets. The retail vendor sells about 250kg potato per week, and sources supplies via local middleman in Batu. Current buying and selling prices are IDR 8,500/kg and IDR 9,000/kg respectively. The larger wholesale vendor sources 1.5 ton/week ware potato from Probolinggo via a local middleman. Tubers are graded into two classes (large and small/medium) with buying and selling prices shown in Table 14.

Table 14 Potato price by size class, Pabean Market, Surabaya

Prices (IDR/kg)	Large tubers	Medium/small tubers
Buying price Sept 2013	7,900	7,500
Selling price Sept 2013	9,000	8,000-8,500
% of supply	60%	25% medium, 15% small

Source: fieldwork market traders in Pabean

Sales are either to other market sellers (retail level) who purchase in units of about 50kg once per week, and individual householders who buy 2-5kg per purchase. The price range over the last 3 years was reported as IDR 5-6,000/kg (minimum), and IDR 9-12,000/kg (maximum) by the two traders. The high prices are associated with the Idul Fitri period. Note that in 2012 imported potato from China was available in this market at much cheaper price (IDR 3,000kg) but consumers largely remained loyal to local potato based on the better quality characteristics such as storage life and eating quality. Both vendors also agreed that losses during the marketing process were much higher in the rainy period than in the dry season (around 13% vs 2%) due higher level of rotting, especially in damaged tubers.

The wholesale vendor also delivers ware potato to other markets outside Java, including Biak, Flores, Bima (NTB) and Bawean Island, for a total of about 2ton/month. This volume is declining over time due to increasing transport costs.

The costs for operating in Pabean market are IDR 66,000/month, including security fees. This market does not appear to be a major location for potato trade.

Porong Market

Porong is located 30 km south of Surabaya, in a location convenient for transportation of fresh produce from several production areas in the province. As well as providing a location for wholesaler into Surabaya markets, it also serves as a trading point for fresh produce to other urban centres in East Java. Market volumes traded are increasing at the expense of Kaputran Market, according to the Administration of Porong market.

The potato vendors interviewed in this location had all come down from high altitude production areas, mainly in the Tengger region around Mt Bromo and also from Batu, largely using 2-3 ton flatbed trucks. There were many such vendors specialising in potato (market estimate is 25), as well as others who carried potato as one of several fresh vegetable items in their trucks. Two such traders specialising in potato were interviewed. See Table 15 for details.

Table 15 Large and small trader comparison, Porong Market

Characteristic	Trader 1 (large truck)	Trader 2 (small truck)
Production area	Tosari, Pasuruan	Probolinggo
Volume (ton/day)	4 (more in peak season)	2.2
Buys from:	Farmers directly	Farmers directly
Own truck	Yes	Yes
Transport cost (IDR/ton)	120,000	225,000
Buying price (IDR/kg)	4,000	7,000 (large/medium)
Selling price (IDR/kg)	AL – 7,000 (75%)	7,500
	AA – 4,500 (15%)	
	AB – 3,500 (5%)	
	TO – 3,000 (5%)	1,500
Losses	5-10% (most in rainy season)	

Source: fieldwork, market traders in Porong

While the selling prices agree, there is a discrepancy around buying prices, especially considering the higher transport costs from Probolinggo, which is more distant from Porong than Pasuruan.

Operational costs, in addition to transport, include IDR 3,000/sack of 70 kg for packing, IDR 50,000 for loading and unloading each truck and IDR 20,000 per truck for market fees. These total about IDR 70/kg on top of potato buying and transport costs.

Sales are largely to wholesalers, either in Surabaya market, or to markets further afield including Madura and Gresik. Sales units are usually 0.5-1 ton for each buyer. Smaller traders may purchase by the sack (70 kg approx.).

While these traders reported volumes increasing over time, problems identified included post-harvest losses in the rainy season, pests and diseases affecting quality of tubers, the issue of imported tubers from China depressing prices for traders and farmers, and occasionally daily fluctuations in prices produce risks of paying more (to farmers) than the market price obtaining in wholesale markets later that day.

Keputran Wholesale market

Keputran is a main wholesale market in Surabaya, but there are relatively few specialised potato traders. We identified about five, and interviewed two in detail (Table 16). One wholesaler deals with both potato and cabbage while the other specialises in potato alone.

Table 16 Indicative characteristics of potato traders, Keputran wholesale market

Characteristic	Trader 1 (Potato)	Trader 2 (Potato/cabbage)
Potato volume ton/day	4-5 (every 2 days)	7 every day
Own truck	Yes 2 ton	Yes,
Buying price (farm)		
Selling price (IDR/kg)	9,000 (large)	9,000 (large, 5 ton/day)
	8,500 (medium/small)	7,500 (medium/small, 2 ton/day)
Selling units	20kg/buyer (retailers)	
Market fees		IDR 125,000/month
Labour costs		IDR 1.5 million/month (sorting, packing, customer service etc.)

Source: fieldwork, traders in Keputran

The larger wholesaler here has two interesting business characteristics:

a) Organises about 20 farmers in Probolinggo, with one local collector. The wholesaler provides finance to farmers for potato production, and along with the local collector (who may be his employee) he arranges planting and harvest dates to ensure a continuous supply of ware potato.

b) Since 1998 he has exported potato to China, sending one container-load of 22 ton ware potato per 3-4 weeks. Although this potato is expensive compared to Chinese potato (in China) the quality is high. 2 ton/month potato is also shipped to other islands of Indonesia, including Merauke Papua.

3.2.5 Processing

A cluster of processing enterprises is located in and around Batu, a major tourist area. The raw materials used include potato, other roots and tubers especially sweet potato and cassava, and fruits such as banana, jackfruit and apple. Products are a range of snack foods, aimed at the small gift (*oleh-oleh*) market for domestic tourists. The enterprises range from informal micro-scale to formal, registered SMEs. In the formal sector, the Industry DINAS collects data for 27 enterprises that focus on potato products. In total the Industry DINAS monitors 262 SMEs in Batu, 85% of which process agricultural raw materials, and a total of 27 processing potato as their main raw material, to produce *kripik* (chips/crisps).

Of the 27 potato-based SMEs in this cluster, the four longest established were in operation (or established) in 2006, when the DINAs dataset starts. At that time, there were 67 SMEs registered in Batu in total. Approximately 3-5 new potato processing enterprises have been established each year since then, in line with the growth of the tourist industry in and around Batu. Between them, they use a total of 475 tons potato raw material annually, with a value of US$ 100,000 (approx. US$ 0.20/kg fresh tubers), producing product with a value of US$ 750,000. This represents significant value added during the process to produce potato chips/crisps, the main product. See later for more detail of the process.

There is one firm producing more than 100 ton of products, two firms producing between 50-100 ton, and another three producing 10-50 ton. Eight enterprises produce less than 2 ton product/year. Sixteen for the firm provided the Industry DINAS with details of hired labour, with a total of 75 workers employed (gender not specified). Finally the DINAS industry data indicate that the largest firms market 50-70% of their products in Batu, with the remainder outside the local area. The smaller firms tend to market more locally, up to 100%. A study of

four of the largest enterprises by Mustaniroh et al. (2011), reported that the attributes of the *kripik* product that influence consumer purchase are quality (taste and a crunchy texture) price, distribution/availability in retail outlets and promotional strategy employed, such as radio or brochures and internet. The identified one firm (Gizi Foods) as market leader, one as challenger (Leo brand) and two as followers (Citra Mandiri and Rimbaku)

The DINAS data does not, obviously cover the micro-scale informal and unregistered sector. There are likely many such informal "enterprises" operating at household level, and selling to very local neighbourhood markets, or to the formal sector enterprises for retail marketing (i.e. effectively acting as sub-contracting producers for the formal sector). One medium scale processor estimated 100 of these unregistered household businesses exist. Volumes per processing unit will however be limited.

For the value chain study, three larger and two small-scale (but still registered) enterprises were interviewed. In all cases, these were family businesses. The smaller ones only processed potato, while the larger ones manufactured a product range that used additional raw materials including other roots and tubers and fruit, although potato was the mainstay of the businesses concerned.

While many of the SMEs are individual/family businesses, a few (4 for potato) are group enterprises that have been established mainly (it seems) in order to access support from DINAS (technical assistance and grant funds for equipment). DINAS support is only available for groups. The groups are organised for the purposes of input/raw material supply, and marketing while the potato processing is still carried out in individual households.

The three larger scale businesses interviewed were Citra Mandiri, Gizi Foods and the business of Pak Nur (Rimba Ku brand), and the two smaller household-level enterprises were those of Ibu Rumanah and Pak Suwaji, all located in Batu town. The larger firms process around 1 ton/day of fresh potato, with the number of days/month varying by season. The smaller household enterprises process around 100 kg/day. Both Citra Mandiri and Pak Nur also produce potato on their own farmland (3ha in the case of Pak Nur) in the Batu area. All of the larger firms produce a wide range of processed food products from other roots and tubers, fruit. Citra Mandiri also markets fresh (ware) potato.

The common features of these processing enterprises, regardless of scale, are:

- The potato raw material used is Granola, supplied from nearby production areas (Malang and Batu) but also from further afield in Tengger (e.g. Tosari, Pasuruan) as necessary. There is no supply of Atlantic for processing in this processing cluster, as Indofood (or its agent) is the only importer.
- The use of Granola complicates the process of *kripik* production, with a poor conversion rate (8-10 kg Granola produces 1 kg of *kripik*, compared to only 4-5 kg raw material required if Atlantic is used) and increased processing costs as the lower dry matter content of Granola means that an extra drying stage in the *kripik* process is required for Granola only.
- *Kripik* production involves significant labour, largely female, for washing, peeling, slicing, drying, frying and packaging. Where equipment is used, e.g. for slicing, it is manually operated.

- Drying is by natural sun-drying, leaving the product subject to quality variation due to climatic factors. Oven drying is possible but raises costs and may result in off-odours in the end-product. None of the larger enterprises are using artificial drying as yet.
- For the household enterprises, raw material costs constitute the bulk of production costs for *kripik*. For 1 kg of end product, 10 kg of Granola is required (IDR 80,000) plus other input costs (oil, bags etc.) totalling IDR 5,000, and with a sales income of IDR 100,000 from 1 kg of fried *kripik*, this leaves about IDR 10,000 to cover labour and profit margin. For the larger businesses, raw material costs will be somewhat lower as they are procured wholesale not retail (or sourced from their own farms) but hired labour will need to be costed.
- The major market is local tourists in Batu town itself. The *kripik* is sold in a wide range of outlets in Batu, including the *oleh-oleh* stores that have arrangements with tour firms and bus companies. The smaller enterprises also sell in their local neighbourhoods to local consumers. The larger enterprises also market outside Batu. Kimba Ru brand, for example, is on sale in Surabaya airport outlets.
- The firms report a stable or slightly increasing production volume for potato *kripik* in Batu. The DINAS data suggests that as new SMEs are regularly appearing, the total market should be expanding over time, in line with tourist growth.

According to these businesses, the main problems faced are:

1. The dearth of good quality potato raw material for processing. Granola is intrinsically poor quality for processing, and also suffers from various production problems in the main local production areas (especially Jurang Kuali – see later) that decease quality and reduce yields. Both Citra Mandiri and Pak Nur are exploring options for improving raw material supply involving both production practices and seed on the farms they operate themselves. Pak Nur farms 3 ha and is also in cooperation with local farmers who control another 25 ha land. Citra Mandiri is a seed supplier to farmers in Batu, Malang and Pasuruan, and also markets ware potato to higher value markets in Bali. The firm is thus able to grade potato according to market outlet, and use lower value Granola for processing, with premium tubers marketed in Bali at higher prices. The Bali market will be discussed later.
2. Seasonality of potato processing, due to the inability to dry the sliced potato during the rainy season. Demand is continuous, meaning that inventory management is important to maintain supplies of the end product. However, the rainy months are not consistent (the rains reportedly started earlier this year) complicating the picture.
3. Other issues raised by these producers include the need to improve packaging, innovate products (skin-on chips?) and improve quality.

Note that the Batu DINAS Industry reports a growing trend for tourists to visit rural/agricultural areas of the district, with consequent demand for food products on sale in rural areas, not just Batu town. This could open opportunities for more processing enterprises based in potato production areas.

The processor also produces potato on his own farm, and well as purchasing from other supplies around Batu (in Batu and Malang districts) Raw material supply for potato is 100% Granola, but of different classes (G-German, Kembang and Lembang) with G-German

identified as the best option. Atlantic is preferred for processing (better conversion rates) but from a farmer's perspective yields are so low (5-7 ton/ha) that it is not a feasible economic option. Granola-German is based on seed tubers retained from an importation of Granola seed from Germany in 2010, which gives high yield and good quality, but this is now declining with each successive generation of retained seed planted. Citra Mandiri reported that yields of Granola in Jurang Kuali have declined from 30 to 20.ton/ha since 2005, and that problems with quality (e.g., nematodes) have also increased.

3.2.6 Retailing

Traditional markets

Small retailers in the traditional markets, and street sellers who cover outlying neighbourhoods selling a range of fresh produce, constitute the main route for household consumers to purchase potato in urban areas. Potato wholesalers sell by the sack to retailers. Street sellers purchase smaller volumes on a more frequent basis, often from market-based retailers.

In Malang, for example, at the Pasar Baru retail market, one retailer purchases an 80kg sack of yellow potato from the wholesale market (pasar Gadang) every 3 days. The purchase price is IDR 8,000/kg, and selling price is currently IDR 9,000/kg for small tubers and IDR 10,000 for large tubers. She has two regular buyers who are street sellers, purchasing 5kg/day each. Individual households will buy in 1-2 kg units. Another retailer in the same Malang market buys 500 kg every 2 weeks (IDR 8,500/kg purchase price), and sorts into three grades (small, medium, large, selling at IDR 10,000, 11,000 and 12,000/kg respectively. The main purchasers are restaurants (3 x 70 kg/week each). Individual household consumers purchase in 1-2 kg units.

In Probolinggo retail market, one small retailer buys one sack of mixed grade yellow potato weighing 50kg every 3 days, and sells 15-20 kg/day, usually in 0.5 kg units to local consumers. The retailer sorts into three size grades (large, medium and small sized tubers). The purchase price for the 50 kg sack is 110,000, with a 20-25,000 delivery cost from the wholesale market at Pasar Bawangan. The retail selling price is 13,000/kg, and overall demand is assessed by the retailer as stable.

In general, the retailers have a stable business providing a small but regular income. Trends are difficult to discern – some speak of increases, others of relative stability, while one market-based retailer complained of competition from sellers just outside the market (who do not pay the market fees) taking business from her. The retailers do not know about potato varieties, and usually classify tubers by size into 2-3 grades (although some may be more rigorous than this). Losses are low (0.4% was mentioned) as turnover is rapid.

Kripik retailers (oleh-oleh stores in Batu town)

The small-scale *kripik* processors in Batu have many potential outlets for their products, as Batu is a major centre of domestic tourism and *kripik* caters to the *oleh-oleh* market. There are many *toko* (stores) established along major roads in and around Batu which specialise in *oleh-oleh*. These may well have arrangements with bus firms for stop-overs to take advantage of tourist passengers. These stores are well stocked with a wide range of snack foods, typically using fruit, grain and root/tuber raw materials. Potato *kripik* is one of the major products stocked and promoted, but competes with similar products made from root and tuber crops (cassava, sweet potato, taro), fruit (apple, jackfruit etc.) and pulses/grains

(soy, maize). Products may be flavoured and – often – coloured. Two of these stores in Batu were visited, and the product range studied.

The major local brands sold in one store (Vigour company shop) were Vigour, Gizi Food and Cavina brands. Dried jack fruit and apple chips were the highest selling individual products, followed by *tempe*, and then potato and sweet potato *kripik.* Not surprisingly, Vigour's own brand of potato chips is the highest seller, followed by Cavina and Gizi. In another store, the best-selling potato *kripik* brands were totally different – Bumiaji Foods, Kentang Dua Apel, Selecta and also apple –flavoured chips from Citra Mandiri, but produced from potato starch (not fresh tubers). The prices for these products are highly variable, with most in the IDR 12-15,000/100 g range, but some cheaper (IDR 9,000/100 g) and others more expensive (Selecta, IDR 22,500/100 g). Cassava chips are significantly cheaper (around IDR 3-5,000/100 g), while sweet potato *kripik* is priced around IDR 3,500-6,000/100 g. Each store has around six brands of potato *kripik*, with pack sizes varying between 50-500 g. Sweet potato and cassava are made into a wider range of products, including some orange and purple sweet potato products that take advantage of the purple and orange-fleshed varieties grown locally.

Supermarket retail

Carrefour and Giant supermarkets were visited in Surabaya and Malang respectively. In both outlets, loose Granola potato was sold alongside a number of branded bagged potato products. The loose potato volumes are very small (15-20 kg/week only) and the quality of the fresh produce was poor, with several green tubers prominent in the display. Turnover is slow. Each display also contained several different brands of bagged potato with slogans indicating attributes such as diet, health and pesticide free (but with no commensurate certification). Brands included Charaka Farms, SHIRA and Kenturcky (Healtho) potato. The loose potato retail price was around IDR 14-15,000/kg in both supermarkets, compared with prices of IDR 22-35,000/kg for the selected and bagged product. Sales staff indicated that potato was not a priority for the fresh produce sector of these stores. Suppliers were local (from Malang in both cases) and also provide a range of other vegetables. The supermarket channel does not, therefore appear to offer much scope for expanding marketed ware potato volumes in the near future, in East Java. This agrees with the findings of Natawidjaja et al., (2007) that the modern, supermarket sector comprises only 1.6% of ware potato volumes in West Java, although farmers producing for this market channel received a greater proportion of the value added than those selling into traditional market chains.

The picture was similar in West Java and Jakarta where an interview in Bandung with supermarket supplier Bimandiri revealed that the business was being restructured. Previously, Bimandiri had supplied 0.8-1 ton potato/day to supermarkets including Carrefour (40 outlets), Hypermarket and Lotte Mart, all in the greater Jakarta area, both loose/bulk and bagged products. The relatively small volumes, large number of outlets to provide with stock via daily deliveries and the complexities of fluctuating prices paid by the supermarket chains, probably acted to reduce the medium term profitability of this enterprise. Bimandiri reported that their sales of bagged potato in Jakarta were under pressure from other brands (that make unsubstantiated health and pesticide-free claims), and that the overall demand for potato in existing supermarkets was stable, but increases as new supermarkets open. The general conclusion from these interactions with supermarkets and their suppliers is that this channel is not one that would repay investment in interventions.

Processed potato products

The snack food shelves in all supermarkets contain multiple products of the major food firms that process potato, including Indofood (Lay, Chitato), Mister Potato, Acefoods etc. There are also prominent stand-alone displays of Indofood products in many stores. The aisles dedicated to local and traditional foods may also contain one or few brands of locally produced *kripik* (potato chips/crisps), alongside a wider range of other such products from fruit, grain and root/tuber raw materials. It is interesting that the local products may be priced higher per unit weight than the mass-market brands (Table 17).

Table 17 Price and bag sizes for representative processed potato products in two East Java supermarkets

Brand and Product (*Kripik*)	Price (IDR/pack)	
	Carrefour, Surabaya	Giant, Malang
Local (Manna Madu Batu)	20,190/130 g	
Local (Surabaya Syafrida)		15,600/60g
Chitato	10,050/80 g	
Mister Potato	13,000/110 g	
Lays	20,150/184 g 8,400/79 g	

Source: fieldwork, observations

Neither the supermarket not Indofood were willing to provide details of sales trends for the processed products, although Indofood did state, in the Jakarta meeting, that the business is expanding. The opening of a third factory for production of these products near Jakarta is evidence of this.

3.2.7 Costs and margins

Table 18 shows a summary of the results of the gross margin analysis for potato plots from six farmers in different sub-districts across East Java, two each from Malang and Pasuruan, plus one each from Probolinggo and Batu. All six are from Granola variety, three granola – Kembang, two Granola-Lembang and one not known. There is considerable variation in the production systems, with potato grown in rotation with rice, carrot, spring onion and cabbage. Only one of the plots was irrigated, in Ngantang. The main points to draw from this comparison are:

1. Production costs ranged from IDR 14 to 58 million/ha, with higher yields associated with higher production costs.
2. Three of the farmers used retained seed (farmers 1, 3 and 5), two purchased seed and one (farmer 2) obtained seed from a supplier who financed production for a 50% share of profits (i.e. no cost outlay for the farmers). Interestingly, two of the plots from retained seed yielded 16 ton/ha, not far below the maximum yield obtained (17 ton/ha) from purchased seed. (One farmer sold the crop before harvest, so it is not possible to obtain yield data. This was the irrigated plot.). For gross margin calculations, the price of uncertified seed (i.e. “good seeds from certain farmers”) from the local market is used to represent/estimate the cost of retained seeds.
3. Seeds and agro-chemicals are the major investment cost. Together, they contribute around 60-70% of total cost. Some farmers are, however, minimizing their production cost by using retained seed consecutively for up to five generations before they buy

quality seed. This is often uncertified or retained seed from other farmers. Another common strategy is farmers work with a private investor, who provides finance to cover production costs in return for a percentage share of profits, depending on the type/intensity of seeds, fertilizers and agrochemical applications.

4. The lowest production costs were found in Tosari where use of retained seed and family labour limited expenses to purchased inputs only; however, this was also the scenario that gave the lowest yield (only 6.4 ton/ha). The other scenario with low yield (Sumber) at 11 ton/ha also had lower than average production costs. In three of the scenarios, yields were around 16-17 ton/ha: reasonable but not high. Farmers in the Sumberbrantas focus group reported much higher yields in the past (20-30 ton/ha) with declines due to soil exhaustion associated with continuous intensive production and application of artificial fertilizers, as well as increasing disease pressures.

5. The average price/kg for commercial tubers was IDR 5,320, with a range of IDR 4,000-7,000/kg. Most plots produced some additional income through sale of small tubers, or these were retained for seed use, resulting in a cost saving for the next potato crop.

6. Net income varied between IDR 8 and 50 million/ha, with the lowest amount associated with poor yield and low price/kg for the harvested crop. This scenario also displayed low production costs and use of family labour. In the case of the Ngantang farmer, he negotiated a price for the crop before harvest (yield unknown) and the rural collector, who took responsibility for the harvesting, carried the risk of unknown yields. The other scenarios produced net incomes/ha between IDR 23-35 million, which is satisfactory for potato, whilst still lower than the amounts recorded for other vegetable crops. The most profitable scenario was in Ngadas, where they achieved a higher yield (17 ton/ha) and price per kg (7000/kg), possibly due to better land quality and intensive farm management. Farmers in Ngadas also have the capacity to store a large percentage of their yield to wait for better prices and manage their cashflow carefully. Expansion opportunities, however, are limited with farms located adjacent to the national park.

Table 18 Gross margins (IDR/ha) for Granola potato production from 6 farmers across the main production districts of East Java

Item	Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Farmer 6
Village	Sumberbrantas	Sumber	Tosari	Ngantang	Tosari	Ngadas
District	Batu	Probolinggo	Pasuruan	Malang	Pasuruan	Malang
Variety	Granola-L	Granola-L	Granola-K	Granola	Granola-K	Granola-K
Rotation	Carrot – cabbage	Rice- cabbage	?	Rice-cabbage	Carrot- cabbage	Spring onion intercrop
Market	Local collector	Local collector	Local collector	Local collector	Local collector	Local collector
Irrigation	No	No	No	Yes	No	No
Total yield/ha incl. seed and TO	12 ton ABC + 0.8 ton small	8 ton AL + 3 ton seeds	5 ton AL + 0.4 TO + 1 ton seeds	-	12 ton AL + 0.7 ton TO + 3.5 ton seeds	8 ton AL + 6 ton store + 3 ton seeds
Production costs (IDR)						
Seed	20,000,000	16,000,000	7,000,000	11,785,714	10,000,000	9,600,000
Fertilizer	5,445,000	5,680,000	3,792,000	7,204,286	3,000,000	3,240,000
Agrochemicals	18,870,000	3,270,000	3,482,000	4,507,143	16,820,000	10,160,000
Other	360,000	-	-	-	-	187,200
Labour	12,575,000	4,480,000	-	5,088,571	11,000,000	11,848,000
Land rent	-	-	-	1,785,714	600,000	-
Loans	770,000	-	-	-	-	-
Tax	35,000	20,000	50,000	118,571	-	-
Water fees	-	-	-	21,429	-	-
TOTAL Costs	58,055,000	29,450,000	14,324,000	30,511,429	41,420,000	35,035,200
Income by Source						
Commercial	60,000,000	48,000,000	20,000,000	71,428,571	55,200,000	56,000,000
Small (TO)	1,600,000	-	400,000	-	840,000	24,800,000
Seed	24,000,000	15,000,000	2,500,000	-	8,750,000	6,000,000
TOTAL Income	85,600,000	63,000,000	22,900,000	71,428,571	64,790,000	86,800,000
Net income/ha	**27,545,000**	**33,550,000**	**8,576,000**	**40,917,143**	**23,370,000**	**51,764,800**

Source: Field interviews 2013

Table 19 presents in more detail the production cost data in percentage terms for each farmer. This shows that fertilizers represent on average 15% of total production costs (range 9-23%) while agrochemicals (pesticides) account on average for 25% of these costs (range 11–40%). Seeds, if costed, account for 38% of total cost and is the main production cost for farmers. This highlights the importance of purchased inputs to potato production in most of the main production areas.

Table 19 Breakdown (%) of production costs by type of expense, for each Granola potato plot (farmer) studied in Table 18

	Farmer						
Item	**1**	**2**	**3**	**4**	**5**	**6**	**Average**
Seed	34.5	54.3	48.9	38.6	24.1	27.4	38.0
Fertilizer	9.4	19.3	26.5	23.6	7.2	9.3	15.9
Pesticide	32.5	11.1	24.3	14.8	40.6	29.0	25.4
Labour	21.7	15.2		16.7	26.6	33.8	22.8
Other	2.0	0.1	0.4	6.3	1.5	0.5	1.8

Source: fieldwork 2013, gross margin data collection

3.2.8 Cabbage production

In two locations in Malang, East Java, data were obtained on the production and gross margins for cabbage production (Table 20), in order to better understand the rotation systems within which potato is frequently produced. In one of these areas, on non-irrigated land in Sumberbrantas close to the Jurang Kuali zone near Batu, cabbage is part of a rotation with carrot and potato. In the other location, on irrigated land in Ngantang (Malang), the rotation is with rice and potato. The two sets of production costs and net incomes differed greatly between the two areas, with Ngantang having much higher unit seedling costs (IDR 230/unit vs IDR 60), but lower labour, fertilizer and much lower pesticide costs. Both gross and net income were higher in Sumberbrantas, and with net income at IDR 117 million per hectare, cabbage was far more profitable than potato (or other crops). In Ngantang, the net income of 45 million per hectare is still attractive and higher than potato in many cases.

Table 20 Gross margins for cabbage production in two locations in East Java

	Sumberbrantas	Ngantang
Plot area	1.2 ha	0.75 ha
Cabbage variety	Grand II	Grand II
Rotation	Cabbage – potato-carrot	Rice – potato- cabbage
Production costs		
Seedlings	4,800,000	6,900,000
Fertilizer	6,750,000	3,278,000
Pesticide	11,460,000	1,465,000
Sub-Total	*22,830,000*	*11,643,000*
Labour costs	9,780,000	4,600,000
Taxes, land rent etc.	100,000	1,348,000
Total production costs	32,710,000	17,591,000
Gross Income	173,000,000	51,591,000
Net income	140,290,000	34,009,000
Net income/ha	117,000,000	45,345,000

Source: fieldwork, gross margin data collection

In Sumberbrantas, carrot is currently even more profitable than cabbage and with lower production costs, although we did not collect detailed figures on this point. However, the recent availability of imported Chinese carrots in several wholesale markets across the province, is likely to depress farm gate prices for that commodity shortly. In both these production areas, potato and cabbage are seen as one of several alternative vegetable crops that farmers can consider. Other crops include spring onion, with tomato and chili at lower altitudes. It would thus be incorrect to describe these production areas as mainly potato, or even potato-cabbage oriented, as farmers appear to be quite dynamic in their crop selections, based on market and crop production (disease and pest prevalence etc.) conditions. Further information on the production systems of brassicas and potato in Indonesia can be found in Dawson et al. (2011).

3.3 Atlantic in Lombok

The Sembalun vegetable production area in East Lombok is a highly favoured, irrigated intensively managed area of about 600 ha at 1,100 masl on the slopes of Mt Rinjani in East Lombok district. The irrigated lands are bounded by hills in all directions, making this quite isolated from other production environments. The area is well known for vegetable production – tomato, chili, brassicas and potato – and irrigation allows for production during the off-season in other areas, an attractive proposition for Indofood as a source of processing potato for their factories in Java. Sembalun is thus the only one of the study areas where Atlantic variety dominates, and where the processing value chain is the major marketing option for farmers. However, Granola production is found, largely on the non-irrigated rain-fed hillsides during the rainy season. It is also important to note that potato is one of the crops in this system, providing farmers with a diversified income portfolio, and also implying that Atlantic competes not only against Granola variety, but also against alternative crops when farmers decide what to plant.

Indofood has developed and controls this value chain (essentially converting it into their supply chain) using a number of mechanisms:

- Control of the supply and distribution of Atlantic seed, via their importers (from Australia) and distributors.
- Seed distribution is undertaken by "farmer group convenors" who work directly with Indofood field staff to procure and distribute seed to farmer members of these groups.
- Delayed payment for input supply, if farmers procure inputs from suppliers linked to Indofood, with the cost discounted from payments made on sale of the harvest.
- Marketing of the harvested crop via the group convenors to Indofood factories in Java (Semarang and Tangerang), with pre-arranged harvest times, transportation, etc.
- Presence of two field staff in Sembalun to assist with the organisation of seed supply/distribution and harvesting/dispatch, as well providing technical assistance during the crop production cycle as needed.

Adnan Bulu, Y. G and Prisdiminggo (2012) describe the dynamics of the Atlantic production system in Sembalum starting with 32 farmers and 4 ha in 2006, production increased to 150 ha from 612 farmers in 2009, then declining to only 74ha with 274 farmers by 2011. Yields per hectare were 19.7, 15.3 and 24.6 ton/ha in 2009, 2010 and 2011 respectively. They report a profit margin/ha of IDR 37 million.

3.3.1 Input distribution

Atlantic seed is provided by Indofood and distributed through the farmer convenors and groups established for this purpose. Although farmers involved in this scheme are committed to selling their produce to Indofood on harvest (at the time specified by Indofood) there are no written contracts, even between Indofood and the farmer leaders/convenors.

During the last two years (at least) the Atlantic has been deficient in quality, despite certification from the exporting country (Australia). The main issue with farmers is the large size of the individual seed tubers (at the upper end of the Australian standard and over the limit of the Indonesian standard). As the potato fields are planted with a specific number of seed tubers per hectare, larger sized tubers imply a greater weight of seed needed to plant each hectare. Farmers report approximately 2 ton seed/ha is required using the Atlantic seed supplied in 2013 by Indofood. As the cost is fixed (IDR 10,500/kg) by Indofood, this impacts negatively on production costs[4]. Granola in contrast, usually requires only 1-1.5 ton seed/ha and the seed available in Sembalun costs IDR 8,500/kg. In addition, the Atlantic seed has been delivered late, so that farmers are forced to both plant and harvest outside the optimum period (for Indofood's own procurement purposes), and this also has adverse knock on effects with subsequent crops in the rotation. The delayed arrival of the seed may, at least in part, be due to the bureaucracy associated with securing approval for seed potato imports.

Farmers linked to the Indofood scheme can also avail of agrochemicals – fertilizer and pesticides – with delayed payment. The payments from Indofood are channelled through the farmer groups – each group is connected with a specific input supplier that the farmer must use. While transport costs are deducted by Indofood itself, the input costs are deducted by the convenor and paid directly to the input supplier, with a 10% charge added for the late payment. The input suppliers tend to have arrangements with particular agrochemical firms

[4] *Farmers report attempting to plant cut tubers to overcome the size problem, but with poor results*

(Syngenta is one) and may be involved with arranging field days, demo plots etc. linked to those firms.

3.3.2 Production

The planting season on irrigated land is June – August, with harvesting September-December. Potato is planted in rotation with rice, carrot, chili and cabbage. Atlantic was introduced to Sembalun around 2005, with initial adaptation trials, leading to commercial production for Indofood by 2006. The average farming household has 0.2-0.3 ha of irrigated land, plus a further 0.5 ha of rainfed land. Across the five villages in Sembalun, there are around 7,000 households, 95% involved with agriculture. There are two farmer groups organised for the Indofood Atlantic scheme, one group with 368 farmers, the other with around 70 farmers, and a total of 240 ha of Atlantic in production this year.

From the farmer focus group discussion, the main points are:

- The seed problem, outlined above, which greatly increases costs,
- The susceptibility of Atlantic to diseases, especially Phytophthora, and
- The relatively low price paid by Indofood for Atlantic tubers (reported as IDR 5,500/kg delivered to the processing factory on Java, which equates to IDR 3,850/kg farm gate in Sembalun).

See the costs and margins section for details of the production costs for Atlantic experienced by one of these farmers.

3.3.3 Collection

Collection is relatively straightforward, as it is organised by the farmer convenor in coordination with Indofood and the transporter responsible for delivering the produce to the factory. The harvested potato is stored for 1-2 days, and sorted as necessary (cost IDR 45/kg for labour), then loaded onto a small 2-3 ton truck for transport to Lemour in the lowlands below Mt Rinjani (cost IDR 150/kg) where the potato is transferred to a large 15-20ton truck for onward shipment to Java. The large truck cannot enter Sembalun due to the poor road infrastructure, which necessitates this transfer.

3.3.4 Transport and processing (Indofood)

The transporter holds a contract with Indofood to ship all the Atlantic produced in Sembalun to the processing factories in Java. This is estimated to cost around IDR 700-800/kg to Semarang, or IDR 800-900/kg to Tangerang. Transport takes 3 days to the Semarang factory, and 4 days to Tangerang. The trucks from Lemour follow a route that takes them from Mataram to Bali by ferry, where they transfer to another boat from Bali to Banyuwangi in East Java, from where they proceed by road. 80% of the total volume goes to the Semarang factory, 20% to Tangerang. The truckload of 20 ton will lose weight during transport, estimated at 150 kg/truck. The transporter in Mataram was contracted by Indofood to transport the Atlantic to Java indicated that in 2012 only 3,800 ton of potato was actually shipped, compared to a planned volume of 7,000 ton. This indicates the size of the shortfall in production being experienced by Indofood, which can be attributed to the problems with seed and relative profitability of the crop.

3.3.5 Granola in Sembalun

The value chain for Granola in Sembalun is complex, with presence of a local collector in Sembalun itself, and larger wholesale traders in traditional markets in East Lombok and in Mataram. Note that much of the Granola sold in Mataram and other markets in Lombok is from East Java (Jurang Kuali was frequently mentioned as a source of quality potato). Granola from Sembalun is mainly available during the November/December and July/August periods. At wholesale level, Granola from Java is priced higher than from Sembalun (September 2013: IDR 8,200/kg vs IDR 6-7,000/kg) based on quality and storage life. The wholesaler in Masbagik market, East Lombok, ships Granola to Sumbawa Island, along with other vegetables. However, volumes are quite limited (150kg potato/day), but this represents 50% of his potato supply (roughly 4 ton/week for all traders in the market).

This trader noted that there is a small volume of Atlantic potato marketed through the same channels (i.e., that "escapes" the Indofood supply chain). The incentive for this is the price. Atlantic sells at IDR 7,000/kg in the wholesale market, probably representing a farm gate price of around IDR 5,000/kg. Volumes are small – only 70 kg sacks occasionally. Atlantic is noted for its very short shelf life, only 3-4 days, with a high risk of losses during marketing.

3.3.6 Costs and margins: comparison of Atlantic and Granola

The price paid by Indofood is non-negotiable, and fixed each season. The price last season (IDR 3,850/kg) was less than that prevailing for Granola (IDR 5-6,500/kg, depending on quality/size), despite yields/ha for Atlantic being lower than for Granola. The gross margin table (Table 21) shows costs and returns for both Atlantic and Granola production as obtained last year by one farmers who produced both varieties, with Atlantic on irrigated land in the dry season, and Granola on non-irrigated land in the wet season (both 0.33 ha area). The end result is that net income/ha from Granola was triple that of Atlantic, although the total for Atlantic was still a reasonable IDR 33 million/ha, and comparable to that reported previously by Adnan Bulu and Prisdiminggo (2012).

From a farmer perspective, a lower return/ha from Atlantic is acceptable, to a certain extent, as the Indofood supply chain provides certainty on price, and also permits production without prior outlay of cash to purchase the required inputs. This is appreciated by the poorer farmers who lack their own capital and cannot access finance. However, the recent frustrations with seed supply and quality, combined with relatively poor yields have led several farmers to shift to other crops, or Granola, in recent times. One farmer was clear that his production of Granola was limited only by capital availability, and that Atlantic production will decline as his capital expands to allow him to shift to the more profitable Granola. Other farmers spoken to had shifted to other crops (carrot etc.) in response to this situation.

Table 21 Gross margin of Atlantic and Granola in Sembalun from a single farmer, Sembalun Lawang, Lombok Timur

Variety	Atlantic G4	Granola-K G6(?) retained
Rotation	Garlic – potato - carrot	Potato - carrots
Market	Indofood	Local collector
Irrigation	yes	No
Planting date	July 2013	February 2012
Area (ha)	0.33 ha	0.33 ha
Yield	7.5 ton	8.5 ton
Total yield/ha incl. seed and TO	7.5 ton/ha	5 ton super + 2 ton + 1.5 ton seed
Production costs (IDR)		
Seed	7,350,000	3,825,000
Fertilizer	4,800,000	3,875,000
Agrochemicals	1,475,000	1,030,000
Labour	4,250,000	3,700,000
Land rent	0	0
Loans	0	0
Tax	150,000	0
Water fees	0	0
TOTAL	18,025,000	12,430,000
Income by Source (IDR)		
Commercial	28,875,000	32,500,000
Small (TO)	0	10,000,000
Seed	0	0
TOTAL	28,875,000	42,500,000
Income		
Net income	10,850,000	30,070,000
Net income/ha	32,550,000	90,210,000
Notes	Indofood price IDR 3,850/kg	Super price IDR 6,000/kg Other grade price IDR 5,000/kg

Source: fieldwork, gross margin data collection

3.3.7 Potato production for processing by Indofood in East Java

During the course of the fieldwork in East Java, it became apparent that in one area outside the original framework for this study, Indofood is developing a new production area for processing potato – in Bondowoso. This is another highland region further east in Java. An additional short visit was therefore made to Bondowoso to investigate potato production in this area, as it appeared to be different from the other areas studied in East Java, where Atlantic production had declined to near zero in recent years. In addition, a visit was made to a farmer group in Ampel Gadding, SE of Malang district, where seed production of processing potato is being established, linked directly to the Bondowoso scheme of Indofood.

In Bondowoso, there are only around 60-80 ha of potato on a limited amount of “grey land” owned by the Forest Authority, producing 1,100-1,600 ton of potato annually. 80% of this is for Indofood. Potato is relatively new is this area, and is not the main crop. It is perceived by farmers to have higher risk and have higher production costs than alternatives (cabbage, chilli, spring onion). 70 farmers are involved with Indofood, and report the same problems

with Atlantic seed as found in Sembalun (also some seed was rotten on arrival this year). There is no scheme to finance agro-inputs for these farmers. Indofood pays within 1-4 weeks after harvest, and the group convenor may advance payment up to 50% in some cases. In this area, farmers are also experimenting with Bliss variety, from two sources: imported from Australia and produced locally by the Ampel Gading farmer group. Reports on Bliss are mixed, with farmers favouring the variety due to lower agrochemical and labor requirements (better disease resistance than Atlantic), but Bliss takes longer to mature (110 vs 90 days for Atlantic) and does better at higher altitudes. There appear to be no difference in yield between Atlantic and Bliss, the seed price is similar as is the price paid by Indofood. Bliss produces more uniform sized tubers, however.

In Ampel Gading, a group of 20 farmers is investing in 7 greenhouses for the production of Bliss variety. Currently they are receiving plantlets from West Java (Garut entrepreneur) and producing G0, which they sell to the Indofood farmer-leader/group convenor in Bondowoso, where the tubers are being multiplied to G2 and beyond, to supplement the imported Bliss from Australia. Three 60 day cycles of G0 production have been completed already. In the last cycle, Indofood purchased 200,000 G0 knol at IDR 1,100/unit. This effort is interesting, in that it represents a major investment for production of seed tubers of a new variety by smallholder producers, with potential for substantial income generation if successful. However, there are issues around the sustainability of the scheme and the scale of operation that need to be resolved. (See later). Ampel Gading has the potential and interest to go beyond G0 to G2 production on their own land, if markets for this seed expand.

Farmers producing Bliss variety for Indofood in Bondowoso were interviewed, and provided some comparative information on the new variety and Atlantic.

- Bliss is harvested at 105 days, Atlantic at 90 days.
- Bliss performs best at higher altitude than Atlantic.
- Bliss is a shorter, more compact plant than Atlantic and thus needs fewer labour hours as is easier to manage.
- Bliss is less susceptible to Phytophthora than Atlantic.
- Bliss requires less sprays that Atlantic (8 vs 10 applications)
- Bliss produces more tubers, of smaller and more uniform size (14-16 tubers/kg) than Atlantic - perfect for processing.
- Bliss requires more time/labour at harvest since it has longer/deeper roots.
- Both varieties yield 7 tons of tubers per 1 ton of seed. However, Indofood field staff claim Bliss can perform better, this season yield were reduced by early delivery of seed tubers.
- Both Indofood seed cost to farmers, and their potato buying prices/kg are identical for the two varieties.

3.4 Constraints

3.4.1 East Java fresh market value chain

The major constraints in the Granola fresh market value chain for potato are on the production side. Demand growth will occur in line with population and income increases, but fresh potato consumption/capita will likely remain at modest levels, given the dietary position of potato as a vegetable, not a staple. The traditional market channels will also continue to dominate, as consumers maintain a preference for purchasing fresh produce in wet markets rather than supermarkets. Thus the most serious constraints identified in this study relate to the potato production and immediate post-harvest steps of the value chain. Specifically, the most frequently mentioned constraints by producers were poor yields and high production costs, which relate to potato seed quality and cost, and also to the relatively high use of agrochemicals during crop production cycle.

The issues around potato seed can be summarised as:

- High cost and limited supply of certified seed tubers of good quality;
- Additional supplies of locally produced uncertified seed tubers from clean meristem culture are of varying quality and also high cost; and
- Farmer practice of using seed retained from previous harvests, over several cycles (up to G8-10) results in gradually increasing disease pressures and lower yields over time.

A reliable, timely supply of certified, quality seed at reasonable cost is an unmet need voiced by farmers across the province of East Java. A related constraint is the lack of any alternative variety to complement Granola for the fresh market. Although IVEGRI in West Java has an active program of varietal development, there are no varietal adaptation trials active in East Java, and thus no improved varieties in the pipeline for these production regions. BPTP-Malang does not have a mandate for these activities either.

The other major component of production costs is agrochemical – pesticides and fertilizers. It is notable that in the Jurang Kuali area that has the longest tradition of potato production (since 1980s) the farmers, traders and *kripik* processors all comment on the problem of declining yields which they attribute to a combination of soil exhaustion (from continuous cropping based on applications of chemical fertilizers over decades) and increasing disease pressures. Crop rotations and an increased use of organic fertilizers have to date failed to counteract this situation.

This situation is compounded by the limited availability of highland agricultural areas suited to potato production, giving little scope to move production zones to other areas. The current production zones, at more than 1,000 masl are increasingly constrained by environmental regulations, especially where they border or encroach on protected areas around the major volcanoes. Considerable effort (and time) would be required to develop varieties suited to lower altitudes, however.

Shelf life of ware potato is important for marketing across Java, and especially to the outer islands. Traders have strong opinions on the storability of potato from particular production areas, and comment that early harvest is strongly related to short shelf life, and that problems increase during the rainy season. Improved potato tuber quality, both inherently and allowing a greater proportion of tubers to reach higher grades (sizes) would benefit both producers and traders, and perhaps encourage demand as quality improves in urban

markets. The poor quality of loose tubers on sale in supermarkets is very obvious, for example: an indication of slow turnover in this type of retail outlet.

Although market prices show fluctuations, producers did not in general consider low prices a major constraint. Farm gate prices are usually above IDR 4,000/kg, and often above IDR 6,000, which are attractive to producers. The high production costs per hectare do, however, translate into a real risk of losing money if prices fall drastically, hence the strong adverse opinions held by all actors in this value chain regarding imports of ware potato (from China and Bangladesh). This highlights another constraint: import policy. It appears that decisions to allow importation of ware potato are made on a tactical rather than strategic basis. When market prices are high (or when food demand is high at times of festivals/holidays) importation will be permitted. At other times not. According to informants, import regulations are confusing, subject to change at short notice and applied/enforced somewhat erratically. There may also be differences of emphasis within the national government, with the Ministry of Agriculture concerned over farm incomes, and trade/consumer ministries more concerned about consumer prices and inflation in urban areas.

3.4.2 East Java *kripik* processing value chain

The *kripik* processing cluster of SMEs around Batu has expanded over the last 10 years in line with increased tourism in the Batu area. The *kripik* producers have clearly identified one major constraint that affects their business: the lack of good processing quality raw material. The only available variety is Granola, not a processing potato, with low dry matter content. Replacement of Granola by a processing variety would have multiple benefits for these SMEs:

- Reduce the conversion rates from fresh tubers to final *kripik* product (i.e. number of kilos of potato to produce 1 kg of *kripik*) and hence reduce raw material costs, which constitute the bulk of production costs for *kripik*.
- Eliminate the need for the drying step in the processing operation, if high dry matter potato can be used, also reducing production costs.
- Improve end product quality (colour, taste etc.).
- Enhance competitiveness of the product against both larger scale processed potato manufacturers and *oleh-oleh* from other raw materials.

Other constraints on the *kripik* processing sector include poor packaging and deficient product marketing and promotion. If the main problem can be resolved, there would be good potential to expand markets through actions in these areas.

3.4.3 Indofood processing value chain

The Indofood processing value chain is at first sight an obvious contender for attention, since it already links smallholder producers to expanding markets in the modern sector of the economy. But the indications from this study are that the constraints operating in this value chain act to reduce its attractiveness for pro-poor value chain interventions. Although Indofood can offer a fixed price, removing market uncertainty for producers, the price is lower than that normal price of Granola in the fresh market, and results in income/ha lower than those obtained from production of other vegetable crops in the same system. Thus, across the production areas included in this study, a picture of Atlantic production linked to Indofood

appears to be attractive only in the medium term. Once farmers realise that, across seasons, Atlantic provides less profit than alternative crops (or Granola), production tends to decline and cease. This has occurred in Jurang Kuali, Tosari, Ngadas and Probolinggo, the main potato production locations in East Java. The recent attempt by Indofood to promote Atlantic production in Bondowoso (an area already producing other vegetable crops) may follow a similar trajectory.

In Sembalun, Lombok, Indofood has been more successful in establishing and maintaining a viable Atlantic production area. Providing finance for the production costs is one way to encourage Atlantic production, especially for farming households with insufficient capital to fund their own input purchases up front (for other crops). However there are signs that farmers in Sembalun are also moving away from Atlantic production, hastened by poor recent experiences with the tardy distribution of poor quality seed by Indofood over the last two years.

Improving the supply and quality of Atlantic seed in Sembalun would thus help to cement the relationship between Indofood and farmers, mediated by the group convenors. The lack of formal contractual arrangements between any of the actors may also be a constraint to consolidation and expansion of this value chain.

3.5 Chain development prospects

Competitiveness analysis: potato competes with other vegetable crops across relatively limited highland agriculture areas of East Java. Based on consideration of production costs, risk and profitability, potato is seldom ranked as the best option by farmers consulted in this study. Potato usually has higher per hectare production costs than alternative crops (especially carrot and cabbage), is perceived as riskier from a production perspective (due to disease pressures leading to yield declines) and with lower net income/ha. However, there is no single "best option" for farmers across the province – different vegetables appear favoured in different production regions. In addition, the need for crop rotation based on climatic factors, and to reduce disease pressures and diversify income sources, means that farmers will continue to plant potato as one component of a diversified vegetable production system. But it may not be the main component. In the measure that potato production can be made more attractive (based on better seed, reduced production costs, higher yields and prices etc.) it will enhance its role in these systems over time. This is not a static situation, as other crops are also implementing innovations over time.

There is also competition within potato between fresh (Granola) and processing (Atlantic) varieties and value chains, a competition that Granola has decisively won in East Java, and which remains fluid in Lombok. Any varietal innovation in either of these value chains could change this equation, however.

3.5.1 Strengths

- Tradition of production, knowledge of production practices, disease control, etc.
- Consistent market demand (fresh) and expanding demand (processed).
- Longstanding nature of traditional trading relationships in fresh market chains, including outside the province.

- Commitment and support of Indofood for the processing value chain, related to the need for domestic raw material supplies.
- Vibrant SME *kripik* processing sector around Batu.
- Network of key entrepreneurial individuals/enterprises around the province (East Java) with capacity and interest in improving potato value chains, including the seed system.

3.5.2 Weaknesses

- Seed supply system. Supplies of quality certified seed are limited and expensive. Uncertified seed is of variable quality and retained seed, most commonly used by farmers, contributes to yield and disease problems over time.
- Public sector institutions: the role of universities, DINAS and BPTP is limited to the initial steps of seed production (meristem culture, G0 production) but in volumes inadequate for supplying more than a small percentage of producers. There is no active potato research program in either East Java or Lombok, and only limited input from the national R&D institution, IVEGRI.
- Reliance on agrochemicals for maintaining potato yields in the face of strong disease pressures, and production intensification over time.

3.5.3 Opportunities

- Increasing consumer demand for processed potato products (Indofood and SME sector).
- Expanding tourist market (SME sector).
- New processing and ware potato varieties for disease resistance, eating/processing quality, high yield etc., and also suited to production at lower altitudes.

3.5.4 Threats

- Climate change, reducing cool climate areas suited to potato production over time.
- Application of policy, especially related to imports of ware and seed potato for both fresh market and processing value chains.
- Disinterest of agrochemical firms in encouraging more efficient (i.e. reduced) use of agrochemicals in potato production.
- Changes in relative production costs, risk and profitability of competing crops (carrot, cabbage, spring onion, chilli etc.)

3.5.5 Drivers of change

- Climate change, increased environmental protection measures, demographic changes reducing land availability in areas suited to potato production.
- Consumers: absolute numbers, urbanization, income increases, consumption habits and dietary changes, tourist market development etc.
- Technology: storage, transport, processing, packaging.

4 Key Findings and Conclusions: Poverty, Gender and Environment

4.1 Poverty

Potato is a crop that demands high use of inputs, especially if quality seed is purchased. Even with the small plot areas common in East Java and Lombok (0.3 – 1 ha/household) the cost of potato production requires financial resources that may be beyond the reach of poor families. Thus we need to be clear at the outset that potato, like other vegetable crops, is probably not suited to alleviating poverty for the very poor and risk averse farming households in the target areas. The detailed production information shows that potato production does frequently involve the use of hired labour, and this can represent a useful source of income to the poorer households who cannot themselves produce vegetables due to resource constraints. Up to 225 days per hectare of hired labour was reported (50% for crop spraying) by respondents in this study, although other households use family labour only, so this is not universal. But given the total area of potato in East Java (at least 10,000ha) the hired labour requirement is a worthwhile source of income for the poor and landless.

In order to facilitate inclusion of poor farming households in potato value chains, it will be necessary to:

- Ensure finance for inputs at reasonable rates, either via the input suppliers directly or through access to credit by the farmers themselves; and
- Reduce risk as much as possible, on the production side through timely and effective technical assistance, provision of quality inputs, etc.; and on the market side, through market arrangements that provide certainty over pricing in advance of harvest.

The processing value chain linked to Indofood provides the best example of this situation, with finance, technical assistance and guaranteed prices in place. It is not inconceivable that similar arrangements could be developed for the SME processing cluster in Batu, especially since some of the linkages between producers and processors are already in place. The traditional fresh market with Granola is more challenging in that respect.

But in general, it is important that any initiatives with respect to potato are taken with due consideration for the capacity of resource-poor households to be involved, and to develop mechanisms in support of this wherever feasible. In defect of this, there is a risk that innovations will serve to benefit the less poor households who have ready access to finance and other assets, including land.

4.2 Gender

At farm level, women are commonly involved in all potato production activities except land preparation and pesticide application. In most cases, there was little distinction between men and women in their activities, although women may be paid at lower daily rates than men (e.g. IDR 20,000/day vs IDR 25,000/day in Ngadas, Malang). Men are more usually involved in selling their produce to rural collectors, and will usually receive the income from this.

However, in many cases this is handed over to women who are responsible for management of household budgets. One other point of note is that the farmer focus groups were exclusively male in composition (despite repeated requests for inclusion of women), and this probably reflects cultural sensitivities in meeting with outsiders, but perhaps also indicates a dominant position for men in the household decision-making process. This is important when considering which crops to plant, or when to apply pesticides, for example.

In other value chain functions, women are more prominent, with several of the wholesalers and many traditional retailers being women. In Batu, some of the processing enterprises, including medium scale as well as household-level, are owned and managed by women. Women also constitute the majority of the labour force involved in kripik production (slicing, drying, frying, packaging etc.).

In order to benefit women, attention could be given to facilitating their involvement in decision making at the level of households, farmer groups and the small-medium enterprises with which they may be involved. Capacity building and education will be key to this. Enhanced access to finance for entrepreneurial activities could also assist.

4.3 Environment

There are two main areas in which the environment is important for potato value chain: use of agrochemicals and the upland ecosystems in which the crop is produced.

High yields of potato invariably imply high use of agrochemical inputs during the production cycle. In Probolinggo, one key informant provided an example of 40 ton of pesticide applied to 100ha of potato crop in the course of one season last year. Agricultural input supply shops contain an impressive array of pesticides designed to control major pests and diseases. Most agrochemical firms market a range of products to this end, with regular updates and innovations. They sponsor field days and demonstration plots in production areas. Some input suppliers provide credit for producers who are regular clients, with payment after harvest for a surcharge (10% commonly). Agrochemicals contribute some 15-30% towards total production costs, with higher percentages for those plots yielding more (indicating that they are effective). However, little attention is paid by farmers or suppliers to the negative aspects of agrochemical use. In common with other farmers across the developing world, use of protective gear during applications is minimal (and it is not sold in these outlets). Farmers may often double dose under the misapprehension that this will increase effectiveness. Empty containers are recycled along with other plastic items, with potential to enter the food chain as food containers. Pesticide run-off and residues on fresh produce are unmonitored. Input suppliers and agrochemical firms have no incentives to encourage efficient or reduced use as this would reduce sales in the short term.

Potato is produced in a relatively narrow band of land above 1,000 meters in altitude, but below the stepper summit zones of the active volcanoes of East Java. Around Mt Bromo, in the Tengger area, the higher elevations are a protected area (Mt Bromo National Park). The potato production zone lies just below the park, and in some areas falls within the park boundaries. This is the case in Ngadas, Malang district, at over 2,000 masl, where 100 ha out of 350 ha of agricultural land (170 ha in potato) is rented from the park authority and which will (in theory) be replanted with native trees in the short-medium term. As tourism is a major economic activity in these areas, and potato producers themselves benefit from this (as drivers, guest house and *warung* operators etc.), potato production needs to adapt to

these constraints. Over time, the agricultural areas in the highland elevations will decline, and other economic activities will become more important to the local population. Within and adjacent to these protected areas, issues such as agrochemical run-off into streams and soil contamination will become increasingly important over time.

5 Pro-Poor Chain Development Opportunities

5.1 Presentation and Assessment of "Market-Based Solutions"

Based on the results and findings of this study, a number of interventions have been identified by the team that have the potential to resolve constraints and/or realise opportunities identified in the study. The presentation of these interventions also reflects the requirement to focus on those with scope and scale to benefit target poor households within the timeframe of the project. This is a major consideration that will be discussed before an assessment of individual interventions.

From this study it clear that a focus on potato in East Java, NTB and NTT brings some challenges:

- Malang district is the only important potato producing area that is included with the project target districts. The main production regions in Pasuruan, Probolinggo and Lumajang fall outside this category. In Lombok, Sembalun is not a project area (located in East Lombok). As potato is limited to production in highland areas, there is little scope to expand production to other target districts that are mainly located in the lowlands.
- Potato farmers in general are not the poorest of farming households, and many have access to sufficient capital to finance production of 0.5-1.0 ha of the high-input crop each season. Care needs to be taken that project interventions are not captured by the less poor households in target rural areas, and with potato this may be an issue in some locations.
- The project is seeking impact at scale, but the numbers of potato farmers are relatively modest, and many of them could more accurately be described as mixed vegetable farmers, who produce potato during one season/year at most.
- The project is also seeking impact in a relatively short time-scale (3-5 years). With potato, there is almost no public sector R&D effort in East Java and Lombok, and thus no pipeline of new varieties or other production technologies that have potential for rapid uptake. Private sector involvement in R&D is relatively recent, uncoordinated and largely focused on seed supply issues.

These challenges and constraints limit the potential interventions that can be considered. For example, in the policy area there may well be potential to improve regulations relating to the import of both seed and ware potato. However, it is unlikely that such policy innovations could be designed, considered, approved and implemented in a sufficiently agile manner by the relevant Indonesian departments and agencies, to have an impact within desired timeframe. There is also potential to improve crop management practices (e.g. introduction of GAP), as recommended by Dawson (2012) using methodologies such as FFS, IPM, ICM and FIL. However, these are human resource intensive methods that require active facilitation by external agencies (with the high cost this entails), and are thus unlikely to be compatible with the market-led approach sought in this study. For example a recent 3ie report on farmer field school methodology (Waddington and White, 2014) concludes that "Drawing on a systematic review of over 500 documents, this study finds that, although FFSs have changed practices

and raised yields in pilot projects, they have not been effective when taken to scale. The FFS approach requires a degree of facilitation and skilled facilitators, which are difficult to sustain beyond the life of the pilot programmes. FFS typically promotes better use of pesticides, which requires hands-on experience to encourage adoption. As a result, diffusion is unlikely and has rarely occurred in practice." For this reason, the interventions developed in the following sections are those where private sector-led actions can have an impact – even if relatively modest – in the desired timeframe, and with reasonable prospect for being sustained beyond the lifespan of the current project.

5.1.1 Upgrading the potato *kripik* value chain in Malang and Batu districts, East Java

The processed potato SME cluster in Batu is expanding, based on potato raw material sourced from Batu, Malang and Pasuruan districts. As explained previously the industry is constrained by the lack of a processing variety suited to *kripik* production.

While no new processing variety has yet been formally released in East Java, the farmer group in Ampel Gading, Malang district, is already producing G0 of a processing variety (Bliss) that is undergoing trials with Indofood in Bondowoso. Indofood has indicated that the processing quality of Bliss is similar to that of Atlantic, and the price offered is the same that for Atlantic. The Ampel Gading farmer group is very keen to seek other customers for their Bliss G0 (there is no contract with Atlantic) and they also have potential and interest to produce up to G2 of the same variety. The major *kripik* producers in Batu (e.g., Citra Mandiri) already organise much of the potato production through links with farmers in Jurang Kuali, Sumberbrantas and into Pasuruan. They have expressed strong interest in participating in trials of processing varieties with the farmers they organise. The Ampel Gading group obtains Bliss plantlets from an entrepreneur in Garut, West Java, who also has a license from IVEGRI for another new processing variety developed at that institute (Medians variety). It is possible that this variety could also be included in any trials with Batu processors. Median has been formally released as a variety in Indonesia.

The introduction of a new processing variety for the Batu *kripik* cluster would have major economic advantages for the industry, and this should flow through to the potato producers through price incentives to grow the new variety that processors are demanding. A major concern for processors is the conversion rate from fresh potato to processed product. Currently with Granola, the conversion rate is between 8:1 and 10:1, i.e. between 8 and 10 kg of fresh Granola are needed to produce 1kg of *kripik.* The key determinant of the conversion rate is dry matter content of the tuber, which in Granola is only 17-19%. Atlantic, the usual processing variety, has a dry mater content of 22-25%, which translates to a conversion rate of between 5.9:1 and 6.6:1. Bliss variety should be similar to Atlantic in this respect. If the processors were to switch to the high dry matter variety, raw material costs (which commonly account for about 80% of total production costs for root crop processing) would decrease by between 25-35%. If the economic benefit of this saving were divided equally between processors and potato producers (e.g. in Sumberbrantas, see gross margin data, Table 18), though a higher farm gate price per kg paid for the processing variety (e.g. increasing from IDR 5,000 to IDR 6,000/kg) then, even if crop productivity and production costs remained unchanged, farmers would benefit from an additional IDR 12 million per hectare of net income (given a yield of 12ton/ha). Any increases in yield or decreases in production costs (due to reduced pesticide applications) would be additional to this figure.

For the processors, there are also additional benefits, including reduced processing costs (as no drying step is needed for high dry matter content raw material) and better product quality.

Specific interventions with active involvement of the Batu SMEs and farmer groups as partners around this concept could therefore be:

- Expansion of the G0 Bliss seed production greenhouse facilities with farmers in Ampel Gading, Malang;
- Local production of Bliss G2 seed in Ampel Gading, with group farmers and non-members in the wider community;
- Production trials of Bliss variety in the main production areas for Batu *kripik* SMEs, in Malang, Batu and Pasuruan districts in order to evaluate the suitability of Bliss for this production region, and for processing in Batu; and
- Introduce production and trials of Median variety to East Java from Garut.

If the introduction of a new processing variety is successful, then there are a range of other value chain upgrading activities with the SMEs themselves that could be supported, including:

- Upgrading processing, product quality and packaging design;
- Market development beyond local *oleh-oleh* outlets;
- Enhancing business skills of smaller scale business owners, especially women;
- Establishment of a *kripik* industry association in Batu to drive forward innovations into the future; and
- There may also be opportunity, through policy dialogue, to open importation of processing potato to the wider SME sector, beyond the large-scale firms already benefiting from this (i.e. Indofood).

Note that the ACIAR-supported PMCA project in West Java, completed in 2012, worked closely with potato processors around Bandung, with success in enhancing product, market and business innovations for the benefit of all chain actors, including producers. In this project, a highly participatory innovation process was implemented with small scale entrepreneurs, facilitated by local NGOs in Bandung. Since the project was completed in 2012, continued monitoring demonstrates that further commercial innovations have since developed, i.e. the process is sustainable without continued external facilitation.

In Batu there is also potential to include support to other raw materials beyond potato, including cassava, sweet potato, taro and fruit (bananas, etc.). This wide range of processed products is already produced in Batu, often by the same SMEs that make potato *kripik*. Working with these SMEs could therefore have flow-on benefits to producers of these other raw materials, often located in lowland production areas that are targeted by the DFAT project. This warrants further study.

Another option is to support local production of Bliss and/or Medians plantlets, at BPTP or Brawijaya University for example, in order to avoid dependence on a non-local supply in the long term.

5.1.2 Improving local supply of quality potato seed for the fresh market

Granola seed is currently derived from a number of plantlet/G0 sources, some in East Java (BPTP and U Brawijaya), from West Java (Hikmah etc.) and sporadic imports (Germany). The plantlets from BPTP-Malang are grown to G0 tubers in a provincial facility in Tosari, producing 500,000/year, then 700,000 mini-tubers of G1, 40 ton of G2 and 30 ton of G4. In addition, there is a privately run operation that produces G2 to G4 tubers using this G2 seed as an input. Production is currently 15 ton G2, 80 ton G3 and 200 ton G4. With 1.5 ton/ha of seed required, this implies sufficient seed to plant only 130 ha of potato. Tosari alone has 5-6,000 ha of potato under cultivation according to this manager of this facility. The University of Brawijaya facility for production of seed is even smaller, producing only 100,000 knol G0 annually. The scale of the local seed tuber production is sufficient for only a small fraction of local potato production. Additionally, the multiplication of G3 and G4 takes place in open fields, with the crop unavoidably subject to some disease and pest pressures, so that this seed is no longer as clean as that produced in protected screenhouse conditions up to G2. Thus, local seed is consistently reported by farmers as of variable quality, and many farmers prefer to purchase from West Java instead. However, supply of this seed is also limited, and may require travel to West Java to select and purchase the seed. For example, the organiser of potato production in Sumber, Probolingo (Pak Cacing) supplies 50 farmers with certified G4 seed from Hikmah Farms in Pangalengan.

Farmers also complain about the cost of certified seed, at IDR 10,000/kg for G4 and 12,500-15,000/kg for G3. This represents an investment of IDR 15 million per hectare in seed alone, if G4 is used. It is also clear that most farmers are using their own seed retained from previous harvests, over the course of several crop cycles. Farmers select the smallest, non-marketable tubers for seed use. This seed is stored at home on-farm in darkened rooms, but with little dedicated management, over a 3 month period between harvest and planting (for dormancy to break).

No local seed supply for Granola in Lombok exists, but the University of Mataram is developing a small-scale system based on greenhouse/screenhouse facilities in Sembalun. Plantlet acclimatization is underway, and G0 should be produced early in 2014 for the first time (if all goes to plan). Famers in Sembalun are keen to develop local Granola seed supplies, and one farmer is already using G0 (from Java) to produce G3 for ware Granola production. (Note – Atlantic must be purchased from Indofood, so a locally produced supply of this variety is not possible).

There is therefore a strongly felt need by potato farmers to improve the supply of good quality Granola seed tubers at reasonable cost. The preferred option is to support the development of a local supply, rather than depend upon imports from West Java or further afield.

This situation appears to be unchanged since the comprehensive paper of Fuglie et al. (2005) which identified three policy options for development of the Indonesian potato seed system: encourage seed imports, promote local public and private sector initiatives and/or enhancing the informal seed system. The Indonesian government appears to be encouraging the second option (e.g. support to private sector and farmer groups, subsidy for public sector seed production across Java and in Lombok). But as noted above, supplies are insufficient, cost is an issue and seed quality appears to vary. Enhancing the informal seed system

through technical assistance to producers, and introducing seed plot techniques alongside the development of local seed supply systems, could ameliorate these constraints.

Dawson et al (2011) propose a seed system that combines elements of the first two options above, with imports of G2 Granola from W Australia, and subsequent production of G3 and G4 using growers in disease and pest-free locations in Indonesia (e.g. Sembalun, NTB). This will be investigated in a separate study in 2014 and is not pursued further here.

There are a number of key individuals in East Java who are already involved in several functions with the potato value chain, including seed supply:

- The manager of the seed production facility in Tosari, who also runs the private business alongside this that produces G4 seed. He also finances production by local producers who cannot afford to purchase the seed up-front;
- A leading farmer in Sumber, Probolinggo, who organises 50 farmers, provides seed, other inputs and technical assistance, as well as organising the marketing of potato to Surabaya and Bali;
- A farmer, seed trader and input supplier in Sukapura, Probolinggo; and
- A *kripik* producer in Batu who organises production by farmers in both Batu and Tosari.

These key entrepreneurs provide a basis for discussion of detailed plans on how to support and facilitate investments in facilities, practices and protocols, including certification, required to expand the production of Granola seed potato sufficient to meet demand, as well as how to improve the existing informal seed system that operates alongside the formal channels.

The main constraints to expanding seed supply are financial, as regards funds needed for the facilities and the finance required for producers to purchase the seed. The parties involved are generally agreed that the certification process itself is reasonable and that the entities involved function adequately. Additionally, local markets for uncertified seed of higher quality than farm-retained seed are also possible to expand. These do currently exist (e.g. around Tosari) and represent a potentially useful intermediary stage between returned seed and fully certified seed tubers, at a lower cost to producers. In this case, the seed tubers would be produced at the same facilities but would not undergo the certification process. The G3 and G4 cycles are produced on high altitude farms with lower pest and disease pressures, with which Tosari is well endowed. The commercial networks already exist for seed tubers from Tosari to reach other districts of East Java, especially Malang and Batu.

The possible specific actions that AIDP-Rural could support include:

a) Expansion of facilities for production of G0-G2 seed tubers, at Tosari, with private sector actors currently involved in the business;

b) Expansion of the number of seed producers (G3 and G4) in areas of low disease pressure, and organisation of technical assistance and implementation of crop rotation plans and planting schedules in line best practice to minimise these production constraints during the potato cropping period.

c) Expansion of credit schemes to facilitate purchase of certified and higher quality but uncertified seed tubers by poorer potato producers. These may be based on existing schemes operated by local entrepreneurs (seed suppliers, traders, etc.).

d) Include messages on enhancing informal seed production in ongoing technical assistance, including use of dedicated seed plots, to complement the formal seed system expansion.

Note that these proposed actions are all based on the expansion of existing arrangements already operational in localised areas such as Tosari and Sumber. The key to success will be gaining the active support of the local actors involved, especially the rural-based entrepreneurs who are already the prime movers in the current situation.

At this stage it is not possible to quantify the scale of financial support required, as this will involve active participation of the key actors, who would be expected to co-invest at a level appropriate for their means and scale of operation.

The benefits of this support would be felt by two types of potato producer:

a) Seed potato producers, especially those directly involved in the production of G3 and G4 seed potato in open fields, at higher altitudes in Tosari. This would be in the low hundreds of farmers (for a total demand of 5,000 ton seed tubers/year).

b) Smallholder potato producers who purchase the seed tubers from this source. These would be from across the province but especially in Malang and Batu districts where commercial links are already strongest. Within 3-4 years, this could reach 3-4,000 producers (1.5 ton seed per hectare, 1 ha/farm). However, farmers would be unlikely to purchase this seed every year, unless terms of finance were very favourable, as yield declines for 1-2 cycles of retained seed are not usually significant (according to key informants).

Where farmers do switch away from using retained seed for many cycles to using purchased higher quality seed tubers, yield increases of 25-35% can be expected (e.g. from 15 to 20 ton/ha) based on the experience of key informant potato seed producers in Malang and Pasuruan districts. (And perhaps lower production costs as fewer pesticide applications may be required.) An additional 5 ton/ha productivity, with a farm gate price of IDR 5,000/kg, produces an additional IDR25 million gross income. This needs to be offset by the cost of the purchased seed (1.5 ton @ 10,000/kg) at IDR 15 million, i.e., producing a net benefit of IDR 10 million/ha for the farmer. Productivity gains can be expected to accumulate (at decreasing rates) over the next one or two cycles if retained seed from this new source is used, but this may decrease net income if some commercial tubers are retained as seed rather than sold.

5.1.3 Market-based incentives to encourage adoption of the efficient use of agrochemicals in potato production

As noted in section 2 of this report, the potato is a high input crop, with major quantities and expenditure on both pesticides and fertilizers. Reduction in agrochemical use would have the advantages of reducing costs, reducing residues on the marketed produce and also decreasing adverse environmental impacts. However, it would also increase the risks of lower yields and crop losses from disease, especially Phytophthora. The current situation where farmers base pesticide applications on advice from input supply shops and (directly or indirectly) from field-staff of agrochemical firms with commission-based incentives to maximise sales, is not favourable for this change occurring.

There are two trends that may provide a rationale for this:

- The increasing enforcement of environmental regulations in protected areas, and limitations on agriculture in highland environments generally.
- Rising consumer concern over food safety and environmental degradation, at least in more sophisticated urban and tourist markets.

While these are slowly developing trends, over the long term they should have an influence on production practices. It would help, however, if market-based incentives to adopt GAP for potato production, and especially around maximising the efficiency of pesticide applications, could be identified and promoted. The tourist market developing rapidly around Mt Bromo could offer such an opportunity. Tosari operates 200 jeeps for hire to tourists (to visit Mt Bromo), while Sukapura in Probolinggo has an additional 500 jeeps for hire. Driving to Mt Bromo involves passing through the potato production areas, making them candidates for agro-tourism development. Both villages have numerous guesthouses and restaurants oriented to the tourist market. The potential to link improved production practices to the local tourist market could be explored.

The Bali market also represents an opportunity for producers in East Java, especially in those areas closer to the port of Banyuwangi in the far east of the island, where a ferry departs directly for Bali. Although Bali does have one potato production area, it does not appear sufficient to supply the local market, since traders in several areas of East Java reported regular shipments of ware potato (Granola) to Bali via Banyuwangi. These include 7 ton/day from one trader in Sumber and 65ton/week from another in Tosari (via Citra Mandiri in Batu). The price paid in Bali is significantly higher than in East Java wholesale markets, more than compensating for the additional transport costs. Citra Mandiri report a selling price in Bali of IDR 9,000/kg, compared to IDR 7,500/kg in local markets, but with an IDR 750/kg transport cost to be considered.

The Bali market demands premium sized potato, variously described as 200g/tuber or supersize (2 per kg). These may be used preferentially for baked potato in tourist restaurants and hotels in Bali, but this is not known by the traders in East Java, since they deal with an agent there. This information indicates that the Bali market for ware potato has some different characteristics from the traditional potato value chain operating in Java, based on the link to the tourist market, with an international customer base that has different dietary patterns from Indonesian consumers, and where concerns over food safety are high (especially east Asian consumers). This market may therefore have the best potential to value food safety (relating to pesticide residues) and eating quality. There may thus be scope to develop differentiated fresh potato products targeted specifically at the Bali market (restaurants and hotels geared to the tourist trade, especially the more up-market segments), and this would deliver a price premium for producers in East Java. It would require them to adjust production practices to meet GAP criteria, and to maximise the production of high unit weight tubers required by this market.

In this study it was not possible to investigate the local tourist or Bali markets for ware potato. This will be needed in order to take this concept further, to develop a set of activities and define the potential impacts, number of beneficiaries etc. However, there is potential to benefit producers of potato across the Tenger production area in East Java, including part of Malang district (Ngadas). Ngadas would be an ideal location, given the need to promote ecological production practices in areas within and adjacent to the Mt Bromo national park. There may be potential for branding a “Mt Bromo” potato for the local tourist and Bali market.

The Ngadas production area in Malang district produces 140 ha of potato (250-300 households). The Tengger areas around Mt Bromo in Pasuruan and Probolinggo, where the main tourist markets are located, probably contain around 8-10,000 ha of potato (16-20,000 households).

5.1.4 Development of contract agriculture for Atlantic potato supply to Indofood

The Atlantic supply chain developed by Indofood has a number of problems of concern to both the company and their farmers. Many of these relate to seed supply – poor quality, late delivery, etc. which are also reported by Adnan Bulu, Y. G and Prisdiminggo (2012) suggesting they are systemic, not temporary. Other problems concern the poor yields obtained from Atlantic, due to the disease susceptibility of this variety. The fixed price offered by Indofood is (usually) lower than that obtaining in the fresh market for Granola (which has higher yields per hectare in many locations), making Atlantic relatively unattractive option compared to producing potato for the fresh market, or growing alternative crops. Thus, Atlantic production has all but ceased in East Java, and indications are that in Sembalun a similar trend is developing.

Indofood operates a policy of not using written contracts with farmers, or farmer group convenors, apparently due to historic problems with contract farming in West Java. Thus, farmers are constrained in their freedom to sell to other end users (competing processors, or side-sell into the fresh market) only by group peer pressure, and the probability of being excluded from next year's seed supply. Indofood field staff actively monitor potato crops in the field to ensure side-selling is minimised.

Would use of written contracts improve the operation of Indofood's raw material supply, from the perspective of both parties? It would act to lock-in production to the processing factories, and guarantee prices at the start of the season. It could also work to farmers advantage if conditions such as seed tuber supply (quality and delivery dates) were included. A careful consideration of the potential contract arrangements, and sanctions for non-compliance, is needed before the advantages and disadvantages of contracting can be assessed. It would be worthwhile to engage with Indofood and the main farmer groups that supply the firm in Sembalun (and Bondowoso) to make this assessment. Adnan Bulu, Y. G and Prisdiminggo (2012) report that the cooperation between farmers and Indofood is positive overall, so efforts to resolve the current problems are worthwhile.

If the introduction of contracts results in more timely delivery of better quality seed tubers, and thus in higher yields per hectare, and reduced seed cost per hectare, the innovation could benefit both farmers (higher incomes) and Indofood (increased Atlantic volumes, reduced need for imports). For example, if seed requirements can be reduced from 2.1 to 1.5 ton/ha (as smaller seed tubers are supplied under contract) even with no change in yield, then production costs will decrease by 0.6 ton x IDR 10,500/kg = IDR 6.3 million per hectare, increasing net income by 19%, (assuming other costs stay the same) using the example from Sembalun (gross margin Table 21). This could benefit all the Indofood farmers in Sembalun (400+) as well as encourage farmers to take up Atlantic production in Bondowoso, East Java. However, the attitude of Indofood to this idea remains to be determined, as they have not been positive in the past.

5.2 Illustrative Project Facilitation Activities

5.2.1 Batu *kripik* chain upgrading

The main change actors here are the *kripik* producers, who have a clear incentive to promote and facilitate the adoption of new potato processing varieties by farmers in the production areas they are linked with (and often organise directly). Indeed, since our visit, contacts with the study team have continued, to ask for help in making contact with the seed producers of this new variety.

The farmer group in Ampel Gading has successfully implemented investments to construct seven greenhouses for G0 seed production, and is starting to experiment with aeroponics technology. They would require support to expand their facilities further to cope with demand if the Batu option is viable. It would be reasonable to expect varietal trials to continue for two seasons with production ramping up after that if both production and processing prove successful. The potential scale of the impact is relatively large, comprising:

- Ampel Gading (Malang district) farmer group members, plus other farmers who can produce G2 seed (20 members + 100 households).
- Malang district producers in Pujon and Ngantang, Batu district producers in Jurang Kuali and Sumberbrantas and Pasuruan district producers in Tosari, linked to Citra Mandiri. In total these farmers supply at least 850 ton/year for this industry. This implies around 115 producers (0.5 ha per household, 15 ton/ha average yield). While apparently modest in number, this does have potential to expand significantly. The main *kripik* firm estimates current demand growth at 20-25% annually. Another firm stated that if a good processing variety can be adopted, then their potato production supply requirement for *kripik* could increase from 25 ha to 400 ha over time (i.e., 800 farmers approximately, for one firm). This indicates that scale can be achieved over time, and provides justification for an integrated approach to the chain that includes market and product innovations to assist demand expansion.

In addition, the 27 formal SMEs (and unknown number of informal ones) employ many women in their production facilities (100+?), and this employment would expand in line with market growth due to improved business performance. Finally, Batu is promoting agro-tourism, and expects numbers of visitors to rural villages to increase, with opportunities for new SMEs to start producing for these rural tourists over time.

An initial meeting is proposed between the *kripik* producers in Batu and the Bliss seed suppliers in Ampel Gading, facilitated by project staff, to explore and develop this concept, and to agree their respective roles, responsibilities and contributions, as well as any external assistance required.

5.2.2 Improving local supply of quality seed for the fresh market

The total demand for seed is difficult to estimate as there uncertainty over the area of potato production in East Java. While official statistics record around 6-8,000 ha potato in the province, the key informants reports 5-6,000 ha in Tosari sub-district alone, and another reported the area in Sumber, Probolingo as 4,000 ha. The likelihood is that the official figures are an under-estimate of the total potato production. Assuming total provincial production of 10,000 ha/year, this implies demand for 15,000 ton of seed. However, most farmers will be able to retain seed for 2 or 3 cycles, without adversely affecting yield. This reduces potential

demand to (say) 5,000 ton/year. Supplying this volume will require significant investment in facilities and in ensuring that farmers can access the finance needed to avail of these inputs. Development of the details of this scheme is beyond the remit of this study, but will require direct partnership between the producers of plantlets from meristem culture (currently BPTP-Malang and University of Brawyijaya), the public sector facilities already involved (Tosari and Sumberbrantas) and the private sector represented by the entrepreneurs concerned. There may be potential to involve large scale private sector firms, of which EWINDO is the most relevant. However, their interest is mainly on processing potato linked to Indofood. They are also likely to be involved with efforts to develop and evaluate new varieties of ware potato to replace Granola, although this will be a longer term initiative.

The potential beneficiaries of improved seed supply include most if not all potato producers across the province, including those most of interest to the project in Malang district (Ngadas, Ngantang, Mantung, Ampel Gading, etc.). However, the current areas of focus for local seed production are in Tosari (Pasuruan) and Sumberbrantas (Batu). In some areas, highland producers close to 2,000 masl could benefit from being dedicated seed producers, gaining higher prices for seed quality tubers, and able to sell the rest of the harvest on the fresh market. Other producers will benefit from using the improved seed via increased yields, reduced agrochemical applications and higher prices if increased proportions of higher grade potato can be produced and harvested.

A suggested initial activity is to convene a meeting with all local actors to discuss this concept and for them to develop investment and workplans for the next 2-3 years to realise this aim.

5.2.3 Market-based incentives for efficient agrochemical use in potato production

The main agrochemical firms would be the principal change agents in this intervention. This may seem counter-intuitive, since the objective is to encourage reduction in agrochemical usage through more efficient and targeted use of these products. However, for some firms with longer-term outlooks, there is potential to increase the effective lifespan of plant protection products by limiting use, and especially by reducing product over-applications, so that pests and diseases develop resistance less rapidly. This may well require exploratory meetings with higher level management and technical staff. If any firm is interested and willing to participate in trials, then a pilot area could be developed, such as Ngadas in Malang district where the ecological imperatives for reduce agrochemical use are strongest, or Tosari, where tourist presence is greatest. If this supply-side push can be combined with demand side pull (price premiums for ecologically produced potato in tourist markets) then prospects for wider adoption would be enhanced.

At this stage it is not possible to estimate economic gains, and the benefits will go beyond the economic to the ecological.

5.2.4 Contract Atlantic production for Indofood

AIDP-Rural would need to facilitate a dialogue with Indofood in the first instance to assess their interest and willingness to pilot a contract arrangement with one or more farmer groups in year 1, expanding to other groups over time. This could take place within the context of the PISAgro potato working group, led by Indofood. Currently this group is focusing on seed supply issues, so the contract option could be seen as one mechanism for improving the

supply at farm level, as well guaranteeing that the production is sold to Indofood at agreed prices. The project could act as honest broker intermediary facilitating discussions and agreement on contract provisions with Indofood and the farmer group(s).

6 Key Findings and Recommendations

6.1 Value Chain development constraints and opportunities

As detailed in Section 3.4 of this report, the main constraints for both fresh and processed potato are in the production component of the value chain. For the fresh market, demand growth is modest, and opportunities in the supermarket sector are not yet attractive. Among smallholders, potato appears to be losing ground to other vegetable crops such as carrot and spring onion which have lower production costs, are perceived as less risky to produce, and provide greater income/hectare in many cases. The production areas in high altitude regions are also under pressure from natura resource constraints while tourism provides alternative income generation options in the Mt Bromo (Tengger) and Batu areas. Thus, there is a strong need to improve potato production to enhance the competitive position of the crop and ensure that supplies continue to meet demand. There has been little innovation in potato production in recent years – varieties have remained unchanged for decades, agrochemical applications continue to be the norm (although product innovation is continuous) most importantly farmers continue to use seed retained from previous harvests rather than purchase higher quality seed from trusted suppliers. The Batu SME potato processing cluster represents a clear case where an inappropriate variety – Granola – is used to produce a product (*kripik*) that has seen strong demand growth in recent times. In Lombok, the development of an integrated value chain for the processing industry by Indofood is hindered by the lack of sufficient high quality seed tubers (despite annual imports from Australia) that act to depress yields and profitability of the potato growers. See section 3.4 for more details.

6.2 Pro-poor chain interventions

The interventions outlined in section 5 above address the constraints and opportunities from section 3.4. These were developed taking into account the timeframe that AIDP-Rural is working to, i.e. that varietal development is too long term an endeavour to be considered. The interventions proposed therefore focus on:

- Piloting an existing but novel variety (Bliss) in the Batu processing cluster, based on seed tubers produced already by the farmer group in Malang district;
- Expanding seed multiplication and distribution systems in East Java, based on support to existing entrepreneurs (e.g. in Tosari, Pasuruan), with finance schemes to encourage poorer farmers to avail themselves of this input;
- Efficient use of agrochemical inputs, with development of market-based incentives if possible; and
- Development of a contract potato production scheme associated with Indofood's operations in Lombok (and potentially in Bondowoso, East Java).

6.3 Areas requiring further research and analysis

- Investigation of the potato market in Bali, and the tourist market in the Mt Bromo area, to determine if it will be possible to develop differentiated products and hence market-based incentives for reduced and more efficient pesticide use in potato production in highland areas close to Mt Bromo.
- The details of process technology and economics for *kripik* production in the Batu cluster, to identify potential improvements in process efficiency and innovations in product quality and presentation that will help this enterprise cluster to develop and increase demand for potato raw material. This should also look at other raw materials (roots and tubers, fruits) that will allow the enterprises to expand product range and use their equipment more efficiently across seasons, as well as to benefit producers in other lowland agricultural production areas.
- Policies and regulations are rather a grey area, not well documented, known or (it seems) enforced. A better understanding of the policy environment for the potato sector, and especially the law and regulations around importation of both ware and seed potato, would be helpful. The situation around the late importation of over-sized, certified Atlantic seed imports from Australia indicates that even large businesses such as Indofood have problems in this area.
- The potato seed industry in Indonesia is complex. Considerable effort was expended in this study, including with the main actors in West Java, yet it was difficult to construct a coherent account of the situation from the variety of sometimes conflicting reports obtained. There is a degree of mistrust and rivalry between actors that will surely influence the implementation of any seed-sector interventions proposed here, so a good understanding of the main actors, their aims and constraints is important (as far as possible). The study did not attempt to calculate costs and returns for the production of plantlets or seed tubers themselves (i.e. seed was seen as an input to the potato value chain, not a component of it, as agreed in the TOR) but this will be necessary if the aim is to support expansion of seed production by some of the local actors.

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8 Annexes

Annex 1: Field work schedule

Dates	Location	Purpose
19-20 July	Ubud, Bali	Team meeting
24 – 27 July	West Java (Bandung, Lembang, Garut and Pangalengan)	Interviews with IVEGRI (potato breeder), potato seed producers, farmers, supermarket supplier, traders and processors.
23 August	Lembang, West Java	Interview with IVEGRI (economist)
28 August	Bogor	Interview with EWINDO
16 September	Purwakarta and travel to Surabaya	Interview with EWINDO (at production facility)
17 September	Surabaya, East Java	Interviews with DINAS, wholesale market actors and supermarket visit.
18-19 September	Surabaya, Batu and Malang, East Java	Interviews with farmers, rural collector, market traders, input supplier and processor
20- 23 September	Pasuruan, Probolinggo and Malang, East Java	Interviews with farmers, local collectors, wholesalers, market retailers, seed producers and input supplier
24-25 September	Batu and Malang, East Java	Interviews with DINAS (Industry), farmers, kripik processors and retailers, input supplier and seed producer.
26-27 September	Malang, East Java	Interview with PBTP (seed production), market wholesaler and retailer, University of Brawijaya seed producer and supermarket visit. Also farmer group G0 seed producer.
28 September	Travel to Surabaya and Mataram, Lombok, NTB	
29 September – 2 October	Sembalun and Mataram, Lombok, NTB; travel to Jakarta	Interviews with farmers and farmer conveners; rural collectors, wholesalers, transporter and retailers; input suppliers, extension agents and Indofood field staff; University of Mataram researchers (plantlet production).
3 October	Jakarta	Meeting with Indofood and PISAgro. Team meeting.
16-18 October	Bondowoso, East Java	Interviews with DINAS, farmers, farmer leader, Indofood coordinator and extension agent
25 October	Bandung	Meeting with Value Chain Center, University of Padjadjaran, Bandung.

Annex 2: Checklists

1. Input Suppliers (include seed potato providers)	
1. Background information	▪ Location/address/contact ▪ No. and location of field staff (if seed or agro-chemical company) ▪ Product portfolio ▪ Other background information
2. Technical know-how	▪ Knowledge of potato cultivation and post-harvest technologies ▪ Sources of technical information and knowledge about potato ▪ Knowledge gaps
3. Input sales	▪ Inputs sold to potato growers o Agrochemicals and fertilizer - including brands o Potato seed – including variety (Granola, Atlantic) and generation (G) with prices ▪ Gaps in product portfolio and reasons ▪ Importance of potato growers as clients ▪ Main barriers to an increase in input sales to potato growers o Agrochemicals and fertilizer o Seed potato ▪ Strategies to increase input sales
4. Environment and human health	▪ Environmental and human safety issues associated with agro-chemical use ▪ Are farmers aware of these issues? Are these issues discussed with farmers?
5. Linkages with suppliers	▪ From whom does the retailer purchase agro-chemicals and potato seed? ▪ Services provided by suppliers (training, trials and demos, technical information, samples, credit, etc.) ▪ Strengths and weaknesses in the relationship with suppliers
6. Linkages with buyers	▪ Profile of buyers (farmers - scale, landholdings - versus traders, gender, location, etc.) ▪ Length of trading relationship, frequency of sales ▪ Services provided to buyers (technical information and advice, trials and demos, product samples, credit, …) ▪ Strengths and weaknesses in the relationship with buyers ▪ Trends, business expansion
7. Constraints, opportunities and interventions (wrap-up)	▪ Key constraints faced by the retailer (w/ranking) ▪ Opportunities for increasing input sales to potato growers ▪ Does the key informant see any opportunities for collaboration with a development project intervening in the potato sub-sector? If yes, what are the opportunities for collaboration?

2. Farmers (Focus Group Discussions)	
1. Background information	▪ Village / district ▪ Number of households living in the village
2. Socio-economic importance of potato and brassicas	▪ Ranking of crops in terms of area and income ▪ Importance of livestock ▪ Ranking of household income sources (farm and non-farm) ▪ Approximate contribution of potato, brassica and other rotation crops (separately) to household income: < 10%; <20%; … o Now compared with 5 yrs ago ▪ How typical or atypical is the village as far as the socio-economic importance of potato and brassicas are concerned?
3. Potato and brassica development processes	▪ Timeline of potato and brassica production and marketing development in the village; comparison w/ other villages ▪ Trends of potato and brassica production over time (5yr ago) – increasing or decreasing?
4. Typology of potato and brassica growers	▪ Approximate % of households in the village that grow potato and/or brassica ▪ Typical farm size and range (for farmers with potato only, potato + brassica or brassica only) ▪ How typical or atypical of the village are potato and brassica producers (i.e. are they better off or not?)
5. Potato and brassica production systems	▪ potato varieties (Granola, Atlantic and any others) and brassica types/varieties grown in the village, ranking of varieties, and differences with other villages in the area ▪ Other crops used in rotation with potato ▪ Reasons behind crop and varietal choices (including relative costs of production, yields and income) ▪ Planting and harvesting times (seasonal calendar for both potato and brassica and other rotation crops) ▪ Potato-brassica rotation practised? Description, advantages and dis-advantages of the rotation. ▪ Irrigation, fertilization, disease and pest control, other cultivation practices ▪ Harvest and post-harvest practices ▪ Hiring of labour ▪ Key changes in cultivation and post-harvest practices (last 5 years) ▪ Possible improvements to current production and post-harvest systems ▪ Factors driving or hindering technology adoption (e.g. price incentives, technical know-how, physical access to inputs, cost of inputs, other)
6. Gender (production)	▪ Gender – decision making on crop choices ▪ Gender division of labour within the household ▪ Gender composition of hired labour ▪ Gender roles in input purchases and product sales ▪ Gender and agrochemical use
7. Environment and human safety	▪ Key environmental issues in potato cultivation ▪ On-farm use of chemicals; storage and handling of agro-chemicals ▪ Water issues: supply, irrigation, availability and constraints if any

8. Input purchases	▪ Input suppliers, including potato and brassica seed (profile and location) ▪ No. of input dealers in the area and distance ▪ Input payment procedures (prompt/delayed payment; payment in kind) ▪ Provision of technical information and advice by input suppliers ▪ Other services provided by input suppliers (e.g. credit, trials and demonstrations, free product samples) ▪ Constraints/problems in access to inputs (price incentives, technical know-how, physical access, cost, credit, etc.)
9. Buyers and transactions	▪ Buyers of potato (Granola, Atlantic for ware or seed) and their relative importance ▪ Number of potato collectors/buyers in the area ▪ Stability in farmers-buyer relationship ▪ Forms of payment (advance payment, on the spot, delayed payments) ▪ Services provided by collectors and other buyers (inputs, credit, …) ▪ Information flows between farmers and buyers (technical/market) ▪ Strengths and weaknesses in the relationship with buyers
10. Potato utilization profile and food security status	▪ % of potato crop (by variety) that is sold, retained for seed, consumed on farm, fed to livestock, waste. Criteria for allocation to different end uses. ▪ Trends over time ▪ Importance of potato consumption to household food security ▪ Decisions on potato seed: when to use own seed, when to purchase new seed, and how often. ▪ Farmer selection of seed: criteria, quality, problems.
11. Product quality	▪ Quality standards of buyers, sorting on farm ▪ Farmers' awareness and assessment of the quality of their potato
12. Prices	▪ Price trends (farm-gate) and expectations about future prices ▪ Price seasonality (farm-gate) ▪ Price differences between different varieties, grades, and qualities ▪ Price determination processes (negotiation, competition between buyers)
13. Sources of technical information	▪ Main sources of technical information (ranking and gender differences) ▪ Assessment of different sources (regularity of interaction, type of information provided, and reliability of the information provided) ▪ Knowledge gaps (cultivation and post-harvest, incl. gender differences)
14. Sources of market information	▪ Main sources of market information (ranking and gender differences) ▪ Assessment of different sources (regularity of interaction, type of information provided, and reliability of the information provided) ▪ Strengths and weaknesses in farmers' knowledge of markets (incl. differences between men and women)
15. Credit	▪ Sources of credit for households in the village (formal and informal) ▪ Ranking of credit sources in terms of their importance ▪ Advantages and disadvantages of different sources of credit ▪ Changes in access to credit over the past 5 years ▪ Gender differences in access to credit ▪ Uses of credit

16. Constraints and opportunities	▪ Key problems and constraints (production and marketing) ▪ Key opportunities (production and marketing) ▪ Barriers to access to these opportunities ▪ Recommendations for intervention: what type of interventions would enable farmers to improve potato and brassica production and marketing? Please prioritize (for each crop as appropriate)… (Note – compare with cabbage where relevant. Are constraints similar or not. Does one crop or the other have advantages/disadvantages especially re production systems.)

3. Collectors and Assembly Traders	
1. Background information	▪ Location/address/contact ▪ Number of years trading potato
2. Potato sales	▪ Tons of potato traded per annum (last 3 years) ▪ Distribution of sales within the year and changes over the past 3 years ▪ Challenges and strategies to increase potato sales
3. Varieties	▪ Varieties traded ▪ Share of different varieties, and reasons ▪ Recent changes in variety portfolio, and reasons ▪ Assessment of different varieties (agronomic performance, seasonality, appearance, eating quality, processing quality/industry demand, consumer demand, export potential, price)
4. Production systems in the area	▪ Cultivation and post-harvest practices (potato and brassica) ▪ Farm productivity and product quality; changes over the past three years and reasons ▪ Innovations with greatest potential to increase farm productivity and incomes, and barriers ▪ Environmental issues associated with local potato & brassica production systems
5. Linkages with suppliers	▪ Villages from where the trader procures potato ▪ Number of potato farmers supplying the trader ▪ Does the trader buy from the same farmers in different years? ▪ Services provided to farmers (e.g. input credit) ▪ Information flows from the trader to farmers, and vice-versa ▪ Purchasing conditions set by the trader (variety, quality, pricing, payment procedures, other) ▪ How does the trader coordinate purchases from farmers? How is the negotiation process conducted? ▪ Strengths and weaknesses in the relationship with farmers
6. Linkages with buyers	▪ Main buyers, their profile (location, legal status, scale) ▪ Changes in the last 3 years and reasons ▪ Stability in the relationship with buyers ▪ Services provided by buyers (e.g. advances) ▪ Information flows from the trader to buyers, and vice-versa ▪ Conditions set by buyers (quality, volumes, delivery times, pricing, payment procedures, other) ▪ Contractual relationship with buyers, coordination of supplies, negotiation of transactions… ▪ Strengths and weaknesses in the relationship with buyers
7. Quality management systems	▪ Quality grades and standards applied by the trader and buyers ▪ Quality management systems by the trader, upstream suppliers and downstream buyers (e.g. sorting, grading, packaging, transportation) ▪ Coordination systems for compliance with quality grades and standards ▪ Sanctions for non-compliance ▪ Strengths and weaknesses in quality management systems

	▪ Typical quantitative and qualitative product losses experienced ▪ Strategies to improve quality management and challenges ▪ % of rejects, wastes or losses; any value/use for rejects/damaged tubers?
8. Sources of market information	▪ Main sources of information about potato markets (ranking) ▪ Assessment of different sources of market information (regularity of interaction, type of information provided, and reliability of the information) ▪ Gaps in market information and market know-how
9. Services	▪ Key external services for a successful potato trading business ▪ Who provides these services? ▪ Main weaknesses and gaps in service provision; how can these be addressed?
10. Gender	▪ Gender of suppliers ▪ Gender of collectors and assembly traders ▪ Gender of buyers
11. Prices	▪ Current purchasing and selling prices ▪ Price trends, expectations about future prices, and reasons ▪ Differences in the prices paid by different buyers ▪ Price seasonality ▪ Current potato purchasing and selling prices for different varieties and grades
12. Costs	▪ Main marketing costs (variable and fixed) ▪ Costs per ton sold
13. Business environment	▪ Assessment of the policy and regulatory environment (on potato supply, prices, demand and on provision of inputs and services) ▪ Assessment of support infrastructure ▪ Assessment of other business environment dimensions
14. Constraints, opportunities and interventions (wrap-up)	▪ Opportunities for the development of the potato collection business ▪ Strategies and barriers to develop or access these opportunities ▪ Key challenges and constraints (w/prioritization) ▪ What should be done to address challenges and constraints? ▪ Recommendations for public and project interventions aimed at enabling these developments ▪ Does the trader see any opportunities for collaboration with a development project intervening in the potato sub-sector? If not, why not? If yes, what are the opportunities for collaboration? How would s/he rank them?

4. Wholesalers / Inter-island Traders	
1. Background information	▪ Location/address/contact ▪ Range of produce traded ▪ Number of years trading potato
2. Potato sales	▪ Tons of potato traded per annum ▪ Distribution of sales within the year ▪ Different market channels and their relative importance ▪ Growth trends in different market channels/segments ▪ Challenges and strategies to increase potato sales
3. Varieties	▪ Varieties traded ▪ Ranking of different varieties according to sales, and reasons ▪ Differences in varieties traded per market channel or type of client ▪ Key changes in the variety portfolio (last 3 years) and reasons ▪ Assessment of different varieties in terms of seasonality, appearance, eating quality, consumer demand, export potential, and market prices
4. Supplying areas	▪ Relative importance of different provinces / districts, and reasons ▪ Differences between supplying areas in terms of variety and quality ▪ Changes in the relative importance of different supplying areas, and reasons ▪ Seasonality of different production areas
5. Linkages with suppliers	▪ Type and profile of suppliers, and relative importance ▪ Length of trading relationship with suppliers (years). Frequency of contact. ▪ Any competition among wholesalers/traders for suppliers ▪ Services provided by the trader to suppliers (e.g. advances) ▪ Information flows from the trader to suppliers, and vice-versa ▪ Purchasing conditions set by the trader (variety, quality, pricing, payment procedures, other) ▪ Does the trader have a contractual relationship with suppliers? If yes, what are the terms of the contract? If not, how does s/he coordinate with suppliers? How is the negotiation process conducted? ▪ Strengths and weaknesses in the relationship with suppliers ▪ Trader's strategy to address weaknesses in the relationship with suppliers
6. Linkages with buyers	▪ Main buyers: location, legal status, and scale, length of trading relationship, frequency of contact ▪ Main utilization of potato by buyers: fresh market, processing, seed market…. ▪ Changes in buyer portfolio during the last 3 years, and reasons ▪ Services received from buyers (e.g. advisory, market information, …) ▪ Information flows from the trader to buyers, and vice-versa ▪ Conditions set by buyers (quality, volumes, delivery times, pricing, payment procedures, other) ▪ Does the trader have a contractual relationship with buyers? If yes, what are the terms of the contract? If not, how does s/he coordinate with buyers? How are transactions negotiated? ▪ Strengths and weaknesses in the relationship with buyers and strategies to

	address weaknesses
7. Quality management systems	▪ Quality grades and standards of the trader and buyers ▪ Quality management systems by the trader, upstream suppliers, and downstream buyers ▪ Coordination systems for ensuring that quality grades and standards are met ▪ Sanctions to suppliers and the trader for non-compliance ▪ Strengths and weaknesses in quality management systems ▪ Typical quantitative and qualitative product losses experienced
8. Sources of market information	▪ Trader's assessment of his/her access to information about potato markets ▪ Main sources of information about potato markets ▪ Assessment of different sources of market information (regularity, type of information, and reliability of the information) ▪ Gaps in market know-how
9. Prices	▪ Current purchasing and selling prices (different varieties, different grades) ▪ Potato price trends for different varieties, and reasons ▪ Are there any clear differences in the prices paid by different buyers? ▪ Price seasonality within Indonesia
10. Costs	▪ Main costs to the wholesaler (variable and fixed) ▪ Costs per ton sold
11. Business environment	▪ Assessment of the policy and regulatory environment in Indonesia ▪ Trader's assessment of support infrastructure ▪ Trader's assessment of other important business environment dimensions
12. Constraints, opportunities and interventions (wrap-up)	▪ Key opportunities for the development of the potato trading business ▪ Barriers to develop or access these opportunities ▪ Strategies to develop or access these opportunities ▪ Key challenges and constraints (w/prioritization) ▪ What should be done to address challenges and constraints? ▪ What are the key changes or developments that can enable the development of seed and ware potato trading? What needs to change? What are the key innovations required? ▪ Recommendations for public and project interventions aimed at enabling these developments ▪ Does the trader see any opportunities for collaboration with a development project intervening in the potato sub-sector?

5. Traditional Retailers	
1. Background information	• Location/address/contact
2. Fresh potato sales	• Quantity of potato sold per week/month/year • Seasonality in potato sales • Sources of potato supply (locations, including imports) • Timing and trends in the sale of imported potato, if any
3. Varieties	• Varieties sold • Share of different varieties in sales • Key changes in the variety portfolio (last three years) and reasons • Assessment of different varieties in terms of seasonality, appearance, eating quality, consumer demand, export potential, and market price
4. Linkages with suppliers	• Type and profile of suppliers • Information flows from the retailer to suppliers, and vice-versa • Length or trading relationship with suppliers, frequency of contact • Strengths and weaknesses in the relationship with suppliers
5. Quality management systems	• Quality grades and standards at the retail end • Typical quantitative and qualitative product losses at the retail end
6. Gender	• Gender of traditional retailers • Gender of retail customers
7. Prices	• Price differences between varieties and grades, and reasons • Price seasonality, and reasons • Current potato purchasing and selling prices (different varieties, different grades)
8. Costs	▪ Main costs to the retailer (variable and fixed) ▪ Costs per kg

6. Modern Retailers	
1. Background information	▪ Location/address/contact ▪ Number of outlets and geographical distribution ▪ Offices responsible for procurement of vegetables/fresh produce
2. Potato sales	▪ Weekly / monthly / annual potato sales ▪ Tends in potato sales (last 3 years) and projections for next 3 years ▪ Seasonality in potato sales ▪ Ranking of varieties according to sales volume ▪ Trends in the sale of different varieties, and reasons ▪ Share of imports if any, in total sales ▪ Timing and trends in the sale of imported potato, and reasons ▪ Origin of imported potato, and reasons
3. Linkages with domestic suppliers	▪ Origin of potato within Indonesia, and reasons ▪ Who supplies potato to the retailer? ▪ Requirements to become a registered supplier o Any minimum volume? ▪ Number and profile of suppliers (location, scale, legal status, etc.) ▪ Stability/changes in the supplier portfolio ▪ Terms of the contract with potato suppliers (e.g. quality, volumes, delivery times, pricing, payment procedures, other) ▪ Strengths and weaknesses in the relationship with suppliers
4. Quality management systems	▪ Quality specifications of the retailer ▪ How have these changed over the past 3 or 5 years? ▪ Sanctions for non-compliance with quality standards (and other contractual requirements) ▪ Strengths and weaknesses in quality management systems along the retailer's potato chain
5. Prices	▪ Price differences across varieties and grades ▪ Differences between the price of local and imported potato ▪ Seasonality of potato prices
6. Opportunities and interventions (wrap-up)	▪ Opportunities for development of contractual relationships with new suppliers ▪ Recommendations for public and project interventions aimed at supporting the development of high-quality modern retail chains for potato ▪ Does the supermarket see any opportunities for collaboration with a development project intervening in the potato sub-sector? If yes, what should be the focus of the collaboration?

7. Exporters	
1. Background information	▪ Location/address/contact ▪ Number of employees ▪ Number of years exporting potato
2. Potato exports	▪ Quantity of potato exported in the last 3 years, and reasons behind inter-annual variations o Fresh ware potato o Processed potato products (identify) ▪ Relative importance of exports (% of total potato sales, with indication of other market channels) ▪ Timing of potato exports and reasons ▪ Varieties exported and reasons ▪ Export potential of different varieties ▪ Processed product types exported, and reasons ▪ Strengths and weaknesses of Indonesia as a fresh and processed potato exporter ▪ Potential for development of potato exports (fresh or processed)
3. Destination markets, regulations and requirements in these markets	▪ Destination markets, relative importance, and reasons (by product type) ▪ Main competitors in these markets ▪ Export regulations in Indonesia ▪ Import regulations in destination markets ▪ Quality and other requirements in different export markets
4. Quality management systems	▪ Export quality standards ▪ Quality management systems by the company and upstream suppliers (e.g. cleaning, drying, sorting, grading, packaging) ▪ Coordination systems for ensuring compliance with export standards ▪ Strengths and weaknesses of quality management systems along the exporter's chain ▪ Sanctions for non-compliance with importers' requirements ▪ Typical quantitative and qualitative losses in the potato export trade ▪ Quality of potato exported by the company and competitors in Indonesia
5. Linkages with buyers	▪ Who buys from the exporter in destination markets? ▪ Since when does the exporter have a business relationship with different buyers in these markets? ▪ Services provided by importers (e.g. advisory, market information, …) ▪ Information flows from the exporter to importers, and vice-versa ▪ Conditions set by importers (quality, volumes, delivery times, pricing, payment procedures, other)? ▪ Does the exporter have a contractual relationship with importers? If yes, what are the terms of the contract? If not, how does the exporter find buyers and how are transactions negotiated? ▪ Strengths and weaknesses in the relationship with importers

6. Linkages with suppliers	▪ Who supplies the exporter? ▪ Profile of suppliers (location, scale, legal status, etc.) ▪ For how long has the exporter had a business relationship with different suppliers? ▪ Functions performed by suppliers (e.g. cultivation, sorting, grading, packaging, other) ▪ Services provided to suppliers (e.g. technical, inputs, credit, other) ▪ Information flows from the exporter to suppliers (e.g. variety, cultivation, quality, delivery times, other) ▪ Information flows from suppliers to the exporter ▪ Conditions set by the exporter (variety, quality, volumes, delivery times, pricing, payment procedures, other) ▪ Does the exporter have a contractual relationship with suppliers? If yes, what are the terms of the contract? If not, how does the exporter access supplies for export? How is the negotiation with suppliers conducted? ▪ Strengths and weaknesses in the relationship with suppliers
7. Services	▪ What are the key services for a successful potato export business? ▪ Who provides these services? ▪ What are the main weaknesses and gaps in service provision?
8. Prices	▪ Price seasonality within Indonesia and in export markets o Fresh potato o Processed products ▪ How do export prices generally compare with domestic prices? ▪ Are there any clear differences in the prices paid in different export markets? ▪ How are purchasing prices determined? What are the price differences across varieties and grades? ▪ How are export prices determined? What are the determining factors? What are the price differences across varieties and grades?
9. Business environment	▪ Assessment of the policy and regulatory environment in Indonesia ▪ Assessment of support infrastructure
10. Constraints, opportunities and interventions (wrap-up)	▪ Key opportunities for the development of potato exports from Indonesia ▪ Key challenges and constraints: what is preventing Indonesia from becoming a significant potato exporter? Why isn't Indonesia more competitive in regional markets? ▪ Necessary innovations and developments ▪ Recommendations for public and project interventions aimed at enabling these innovations and developments ▪ Does the exporter see any potato opportunities for collaboration with a development project intervening in the potato sub-sector?

8. Processors	
1. Background information	▪ Location/address/contact ▪ Number of employees ▪ Range of company products ▪ Number and location of processing facilities ▪ Total turnover and export turnover
2. Purchases of potato	▪ Tonnes of potato purchased in 2012 o By variety ▪ Trends in potato purchases and reasons (last 5 years)
3. Quality specifications	▪ Quality specifications for potato
4. Procurement systems	▪ Supplying areas and reasons ▪ Number and profile of potato suppliers ▪ Stability in the relationship with suppliers ▪ Strengths and weaknesses in the relationship with suppliers ▪ Contracting arrangements and conditions (duration of contract, varieties, quality specs, volumes, regularity of supply, pricing formula, etc) ▪ Challenges and constraints
5. Imports	▪ Tonnes of imported potato in 2012 ▪ Trends in imports of potato, and reasons ▪ Seasonality of imports ▪ Import regulations
6. Prices	▪ Price seasonality within Indonesia (raw material) ▪ Price differentiation across grades
7. Products	▪ Type and volume of processed potato products manufactured, trends over last 3 years ▪ Indication of production costs and overheads (especially potato costs as % of total costs) ▪ By products? Value, volumes
8. Processes	▪ Equipment and other assets used in potato processing, value of assets. ▪ Main processes involved ▪ Waste management, if any ▪ Constraints faced (reliability of electric power, water quality etc.)
9. Interventions (wrap-up)	▪ Recommendations for public and project interventions in the potato chain ▪ Does the processor see opportunities for collaboration with a development project intervening in the potato chain?