
CASSAVA PROGRAM DISCUSSION PAPERS

Value Chain Analysis, Household Survey and Agronomic Trial Results - Sikka

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Wani Hati Utomo², Yudi Widodo³, Kartika Noerwijati³, Ruly
Krisdiana³, Suhartini², Erwin Wisnubroto²,
Dominic Smith⁴, Rob Cramb⁴, Jonathan Newby⁵ and Lava
Yadav⁴

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² Universitas Brawijaya

³ ILETRI

⁴ University of Queensland

⁵ CIAT

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Country Information

Research is being undertaken at two sites in Indonesia – the provinces of North Sumatra and Nusa Tenggara Timur. Research in North Sumatra is concentrating in Simalungun Regency while research in Nusa Tenggara Timur is concentrating on Sikka Regency on the island of Flores.

The two research sites have significantly contrasting value chains for cassava. Cassava production and processing in North Sumatra is long established and commercialised with a well-developed system of factories and traders. Cassava production in Sikka is predominately of sweet cassava as a staple crop. Small scale processing into snack food, dried chips and mocaf is developing, but the sector can still be classified as almost entirely non-commercialised.



Figure 1: Research Locations, Indonesia

As shown in Table 1, the total area of cassava production, in Nusa Tenggara Timur is greater than that of North Sumatra. A combination of better agro-climatic conditions, more commercialized production and higher yielding bitter varieties mean that the per hectare yield of fresh root in North Sumatra is over three times higher than the average yield in Nusa Tenggara Timur. This in turn means that the annual cassava production figures in North Sumatra are almost double that of Nusa Tenggara Timur.

Table 1: Characteristics of cassava production by site, Indonesia 2014

Province	Area of cassava (ha)	Average fresh yield (t/ha)	Annual production of fresh root (t)	Main industries	Number of factories
Nusa Tenggara Timur	79,164	10.2	807,473	Fresh market Kripik Dry chip (<i>gaplek</i>)	Very small scale gaplek, kripik, mocaf and tiwul processing
North Sumatra	47,141	32.2	1,517,940	Starch Snack food	9 starch 8 non-starch

Province Information

The province of Nusa Tenggara Timur consists of 21 regencies and the autonomous capital city of the province (Kupang). Although more than 500 islands make up the province, the majority of the land area and population are contained in the three main islands of Flores, Sumba and Timor. The population in 2014 was estimated at around 5,000,000.

Sikka regency is located in the eastern portion of the island of Flores and contains Maumere, the main town of the island. The population of 325,000 lives in two distinct zones –Maumere and the surrounding coastal plain in the north of the regency, and the surrounding mountainous sub-districts.



Figure 2: Location of Sikka Regency within Nusa Tenggara Timur

Value Chain Information

Value chains for cassava in Sikka can be differentiated into two main types. The predominant value chain is that for sweet cassava varieties. This value chain accounts for at least 90-95 percent of the cassava produced in Sikka – a reflection of the place of cassava as

a staple food crop for much of the population. A small amount of bitter cassava is produced in the coastal plain close to Maumere as an input to small scale processing of modified cassava flour (MOCAF) and tiwul. This bitter cassava value chain is likely to remain small in the absence of further investments in MOCAF and tiwul processing or the construction of a starch processing factory.

Sweet Cassava Value Chain - The value chain system for sweet cassava that currently exists in Sikka can be classified as closed and self-sufficient. Cassava production is predominately undertaken within mixed farming systems in the mountainous sub-districts in the south, east and west of the regency (above ~300m ASL) by smallholders with around 1ha per household. The households undertake a wide variety of activities to support their livelihoods, including production and fermentation of cacao, production of cashew, coconuts, maize, peanuts, cloves, candlenuts and livestock rearing including goats and pigs. Cassava is grown both for consumption and also for sale in local markets – both direct to consumers and also to traders. Rice is increasing in importance as a staple food, especially amongst younger people and this would imply that an increasing proportion of cassava is being marketed by farmers in order to get money to buy rice.

Much of the cassava produced in the hilly zone stays in the hilly zone – based on farmer focus groups and key informant interviews we estimate that 25 percent of production is consumed within the cassava farming household for food and a further 5 percent is utilized by the household for livestock fattening and for gapek (dried cassava) production. In addition, a further 30 percent of production is sold to rural consumers, either directly by farmers in local markets or through traders in local markets. In all, around 60 percent of the production is utilized within the hilly rural areas, with approximately 40 percent being traded into the coastal, more urban zones – in particular into Maumere town.

The main customers for fresh cassava roots in the urban markets are households. An estimated 35 percent of production is accounted for by this channel. The remaining 5 percent of cassava production is sold as inputs to the small-scale processing industry for kripik and cookies that is operating predominately in Maumere and adjacent districts.

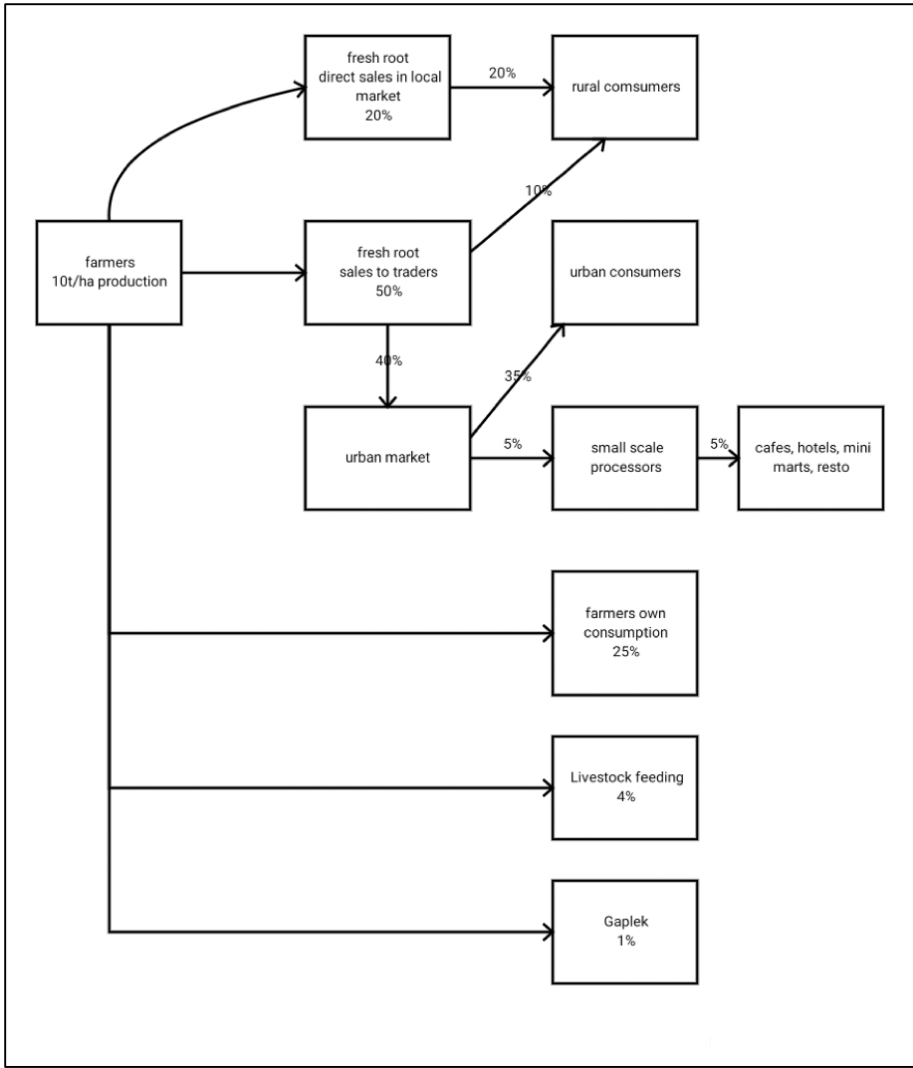


Figure 3: Sweet Cassava Value Chain, Sikka

Actors

Sweet Cassava Farmers: Farmers in the upland villages of Sikka plant cassava as part of a widely diversified farming system that includes food crops and industrial crops on an average of 1-2 hectares as well as keeping a variety of livestock types.



Figure 4: Typical mixed production gardens in upland Sikka Regency

In addition to farming activities, many farmers in upland villages participate in a number of different off-farm activities. In Bloro village, many of the men have off-farm employment as stonemasons or bricklayers. In Lusitada village, a significant proportion of the village are involved in copra processing and between 80 and 90 percent of the women are involved in weaving.

Potential interventions identified by cassava farmers in all three villages included transfer of higher yielding sweet cassava varieties to increase food security and marketable surplus. Farmers were also interested in receiving training on small scale cassava processing, including processing of cassava chips. Farmers were also cautiously interested in trialling bitter varieties of cassava, but only if they could be assured of a market outlet.

Urban Market Traders

At least three types of trader in the urban markets can be identified: (i) farmer/traders – take their own produce and produce procured from other farmers at farmgate or in rural markets and bring to urban marketplaces for sale. These traders often bring a variety of products, including fresh cassava root, taro, chayote, sweet potatoes for sale and stay 2 or 3 days until all products are sold⁶; (ii) multiple market traders – operate in more than one market, depending on the day of the week. For example, traders would buy products in the market in a rural market and then bring to Pasar Alok (Mauwere) for sale on Tuesday (main market day in Pasar Alok) and also buy products in Pasar Alok and bring to the rural market for sale; (iii) fixed market vendors – buy products from farmer/traders and multiple market traders and sell in a fixed stall at the urban marketplace. Within the value chain the first two types of trader are the most mobile and connected actors.

Processors

In contrast to the initial characterization made during the value chain training exercise in Kota Batu, the processing sector is extremely small, in terms of the absolute volumes of production, the number of actors and the scale of individual actors. Processed products made from cassava in these micro-industries include kripik (fried cassava crisps), Tiwul, modified cassava flour and cookies/cakes. At present, none of these industries exceed the scale of 10 tons of fresh cassava root input per year and it is unlikely that the processing sector as a whole absorbs any more than 50- 60 tons of fresh cassava root per year.

Information Flows

Information flows in the system would predominately be with the multi-market traders and farmer/traders described above. However, the ad-hoc nature of the relationships between these traders and other actors in the value chain mean that they are unlikely to be an effective means of transmitting messages/information/innovations from the project and indeed there are relatively few obvious incentives for them to do so.

⁶ The length of time necessary to stay in the market was noted in farmer focus groups as a constraint

In terms of disseminating information/behaviour change messages etc. to farmers, the key information node within the value chain will be the local market at district level. Almost all households within a district will attend these markets as customers and/or vendors on a regular basis.

Relationships

The predominant form of relationship in the value chain appears to be spot/ad-hoc relationships – farmers sell cassava when they need cash and likely do not generally cultivate long-term or contractual relationships with the consumers or traders whom they sell to. At the other end of the value chain, processors also indicate that they will buy from multiple traders in the market, and generally do not form long-term or contractual relationships with their suppliers.

Location of Project Activities within province

Value Chain Survey Locations

Fieldwork was carried out in both Maumere and the surrounding coastal plain area and the mountainous surrounding sub-districts. Farmer focus group discussions were held in: Bloro Village and Lusitada Village (Nita sub-district) and Dobo Village in Mego sub-district. Value chain actor surveys and interviews were undertaken in and around Maumere town and in Aibura Village in Waigete sub-district. Figure 5 shows the farmer focus group locations in blue and the value chain survey/interview locations in orange.

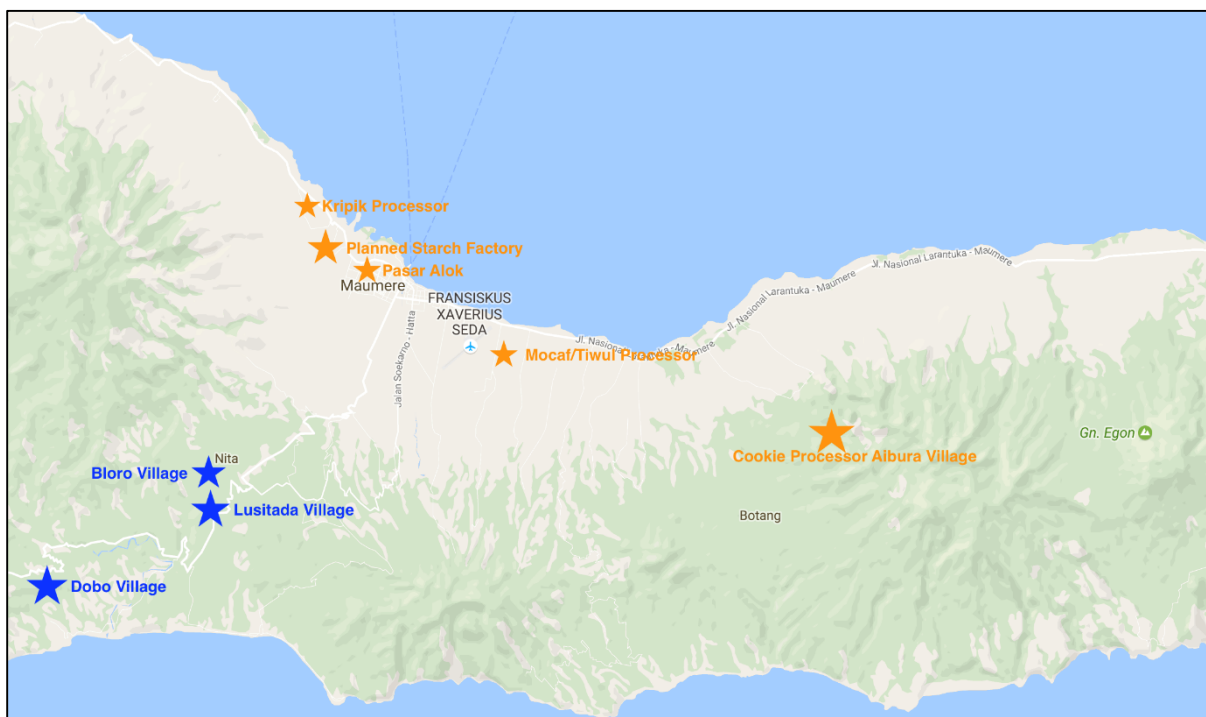


Figure 5: Focus Group and Value Chain Survey Locations, Sikka Regency

Household Survey Locations

Household surveys were conducted across four communes, Kangae and Kewa Pante in the lowlands and Koting and Nita in the uplands. As a result of relatively small sample sizes across communes much of the survey data is analysed between lowland communes with a total of 60 households and upland communes with 54 households.

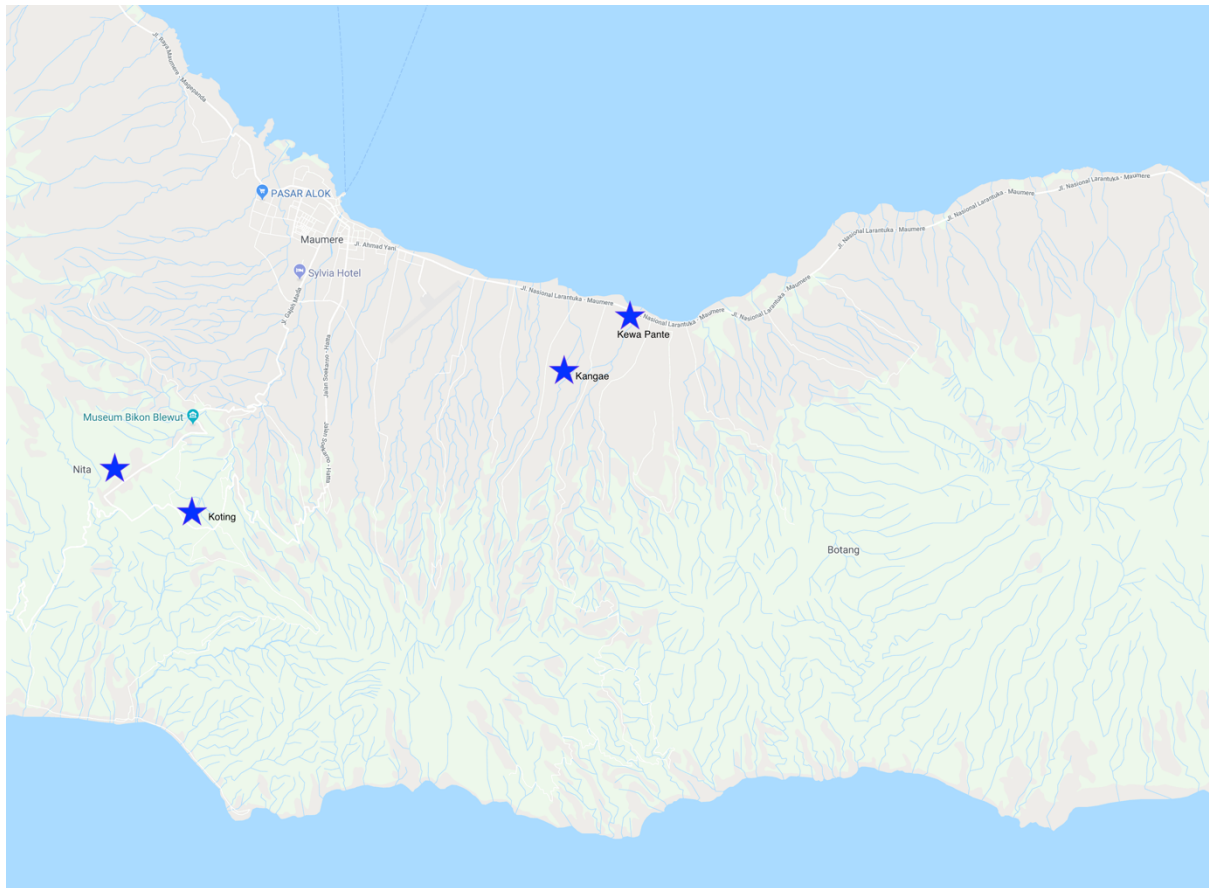


Figure 6: Household Survey Locations, Sikka Regency

Table 2: Households by Survey locations

Communes	Total households	Region	Total
Kangae	59	Lowland	60
Kewa Pante	1		
Koting	16	Upland	54
Nita	38		
Total	114	Total	114

Figure 7 shows the distribution of household incomes across the two surveyed regions. Although the same number of households from both lowland and uplands are included in the fourth income quartile, for the lower three income quartiles there is a clear relationship between the location of the household and their income status. For these lower quartiles, the likelihood of being in the lower income group is higher for those from the lowland areas.

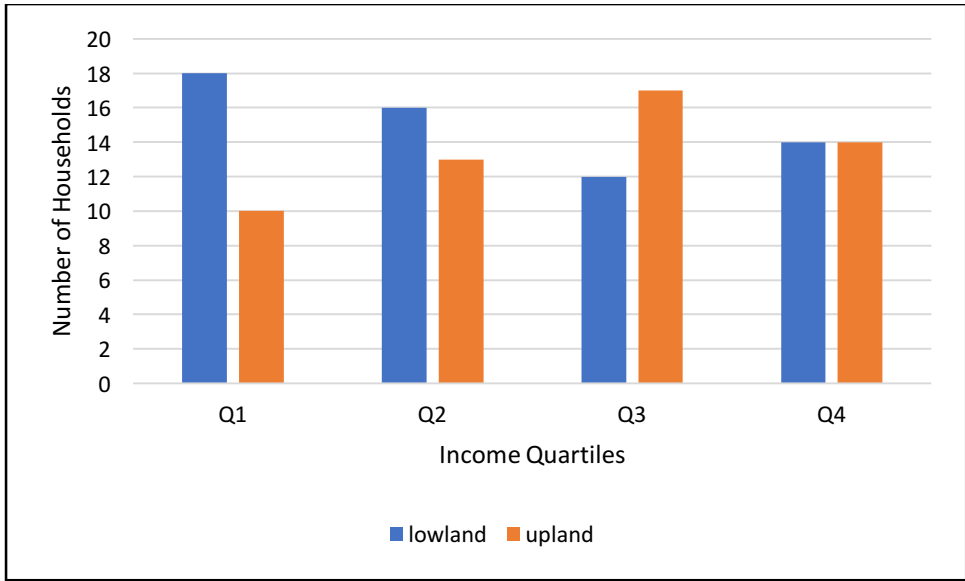


Figure 7: Survey respondents by income quartile and location

Livelihood Information

Time of first cultivating cassava

Cassava has been grown in both upland and lowland areas in Sikka for a long time with about 25 percent of farmers having adopted them before the 1960s. There was a spike in the number of farmers adopting them in the 1980s and since then the additional number of adopters have remained relatively constant over the past few decades.

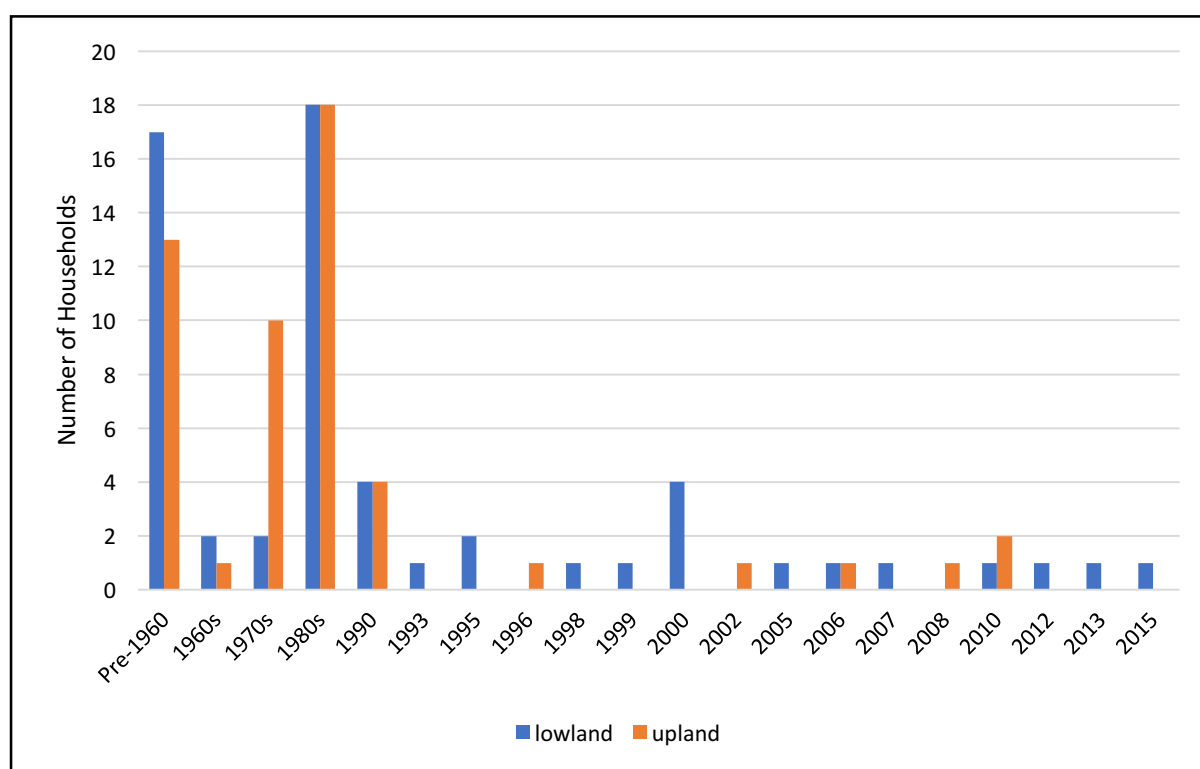


Figure 8: Year of First Cassava Production, by Region

Income from various on-farm and off-farm activities

Across both upland and lowland areas cassava is an important crop contributing to about a fifth of overall household income. While moderate levels of paddy rice and upland rice are produced in both regions, they are produced exclusively for household consumption. In the upland areas peanuts are a significant source of income contributing to almost 15% of overall income.

On the other hand, mungbeans are an important crop in the lowlands areas contributing almost 7% to household income followed by maize which contributes slightly less than 5%. Tree crops such as cocoa, coconuts, bananas and cashew contribute another 13% to household income, although the significance of tree crops are higher in the uplands where the contribution to overall income is over 20%. Livestock related income, particularly from

the sale of pigs provides another 10% of household income, while this contribution is significantly higher for lowland areas in relation to upland areas. A dominant source of income for both regions is via off-farm sources contributing almost 30% to overall household income.

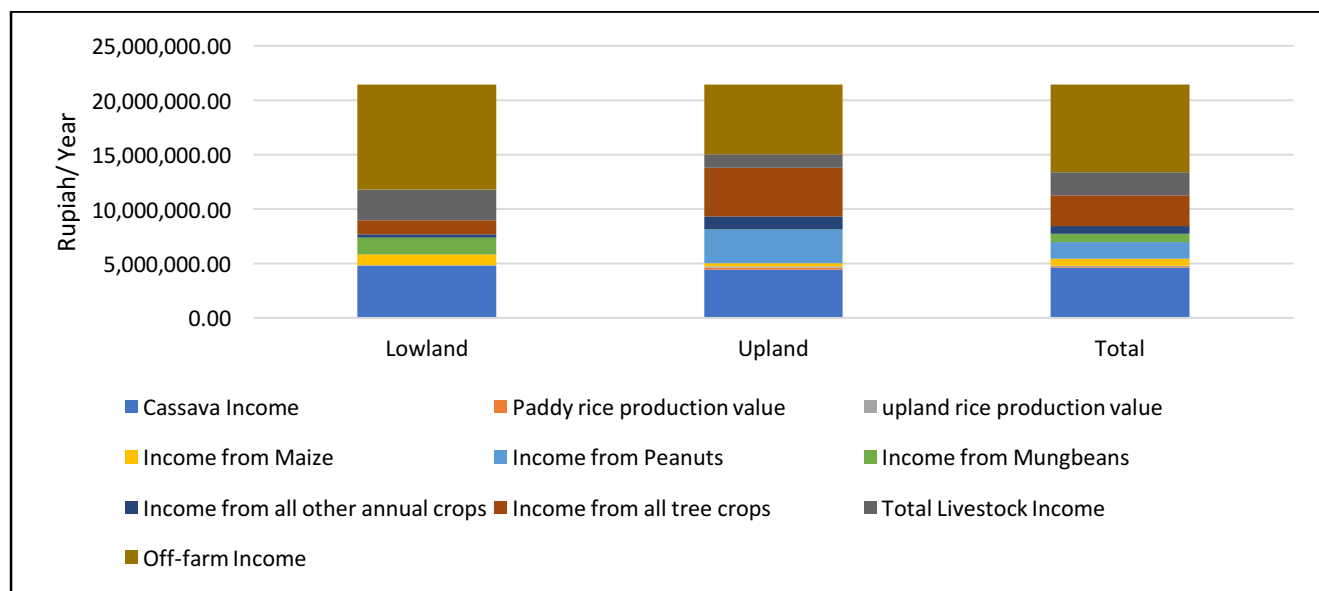


Figure 9: Source of Income, by Region

Importance of Cassava in overall livelihood and in cash income

The contribution of cassava to overall household income is quite even across both upland and lowland areas with a contribution of about 20%. However, there is much variation across the two regions in terms of other sources of income. Crops other than cassava are the dominant source of income for upland farmers, contributing to over 43% of household income. Some of these crops include annual crops such as peanuts but mostly tree crops such as cocoa, coconuts and bananas. The contribution of crops other than cassava for lowland households is slightly less than 20%. Livestock plays a greater role in generating income for lowland households where it contributes to over 13% of household income while this contribution is less than 6% for upland households. The dominant source of income for lowland households is through off-farm sources which contributes to almost 45% of total income where as this contribution is slightly less than 30% for upland farmers.

Table 3: Annual Income from different sources, by Region

Region	Lowland	Upland	Total
Cassava Income	4,797,940	4,476,103	4,645,491
Non-Cassava Cropping Income	4,170,950	9,333,961	6,616,586
Total Livestock Income	2,868,250	1,258,518	2,105,745
Off-farm Income	9,624,850	6,385,185	8,090,271

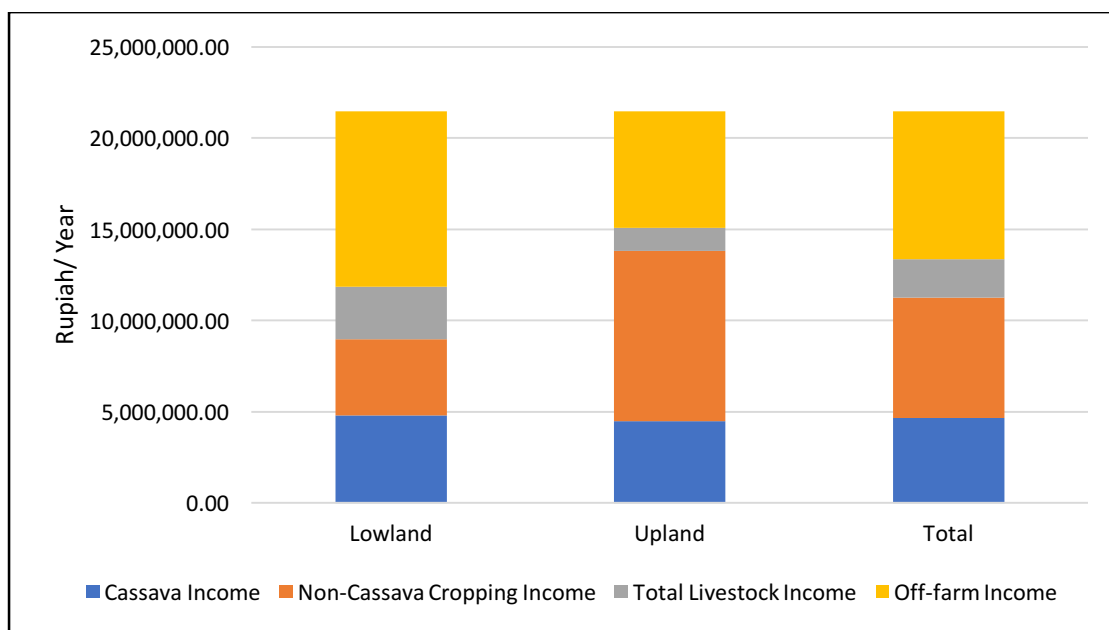


Figure 10: Income Sources, by Region

The contribution of cassava to overall household income varies across income quartiles although there isn't a clear relation between the two. Amongst all income quartiles cassava seems to be of least importance for the highest income group. This is also the case for cropping income other than cassava; where the lowest income group is most dependent upon income from these crops while it is the least important source of income for the highest income group. On the other hand, of all income groups, households in the fourth quartile are most dependent upon off-farm sources for their overall income.

Table 4: Annual Income from different sources, by income quartile

Income Quartiles	Q1	Q2	Q3	Q4	Total
Cassava Income	1,005,107	3,315,086	5,415,813	8,865,960	4,645,491
Non-Cassava Cropping Income	1,766,117	3,792,551	7,555,951	13,419,035	6,616,586
Total Livestock Income	321,428.	1,325,689	1,923,103.	4,887,142	2,105,745
Off-farm Income	1,153,964	3,177,586	6,622,413	21,635,000	8,090,271

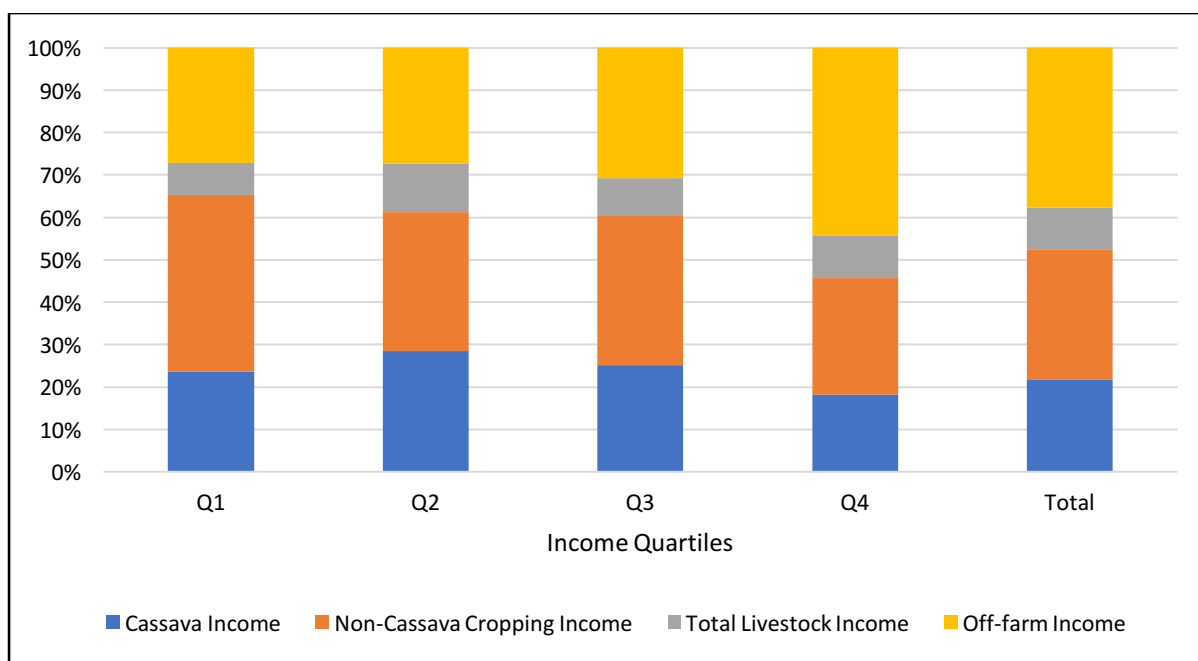


Figure 11: Sources of Livelihood, by Income Quartile

Labour Force

Across all surveyed areas, the average household size is 4.37. While an average of 1.38 household members are full time agricultural workers, an average of 3.12 members have at least some involvement in agriculture. This implies that about 30% of household members have no involvement in agriculture, most of whom are children. While there isn't a significant difference between men and women with regards to agricultural participation, men are more likely to be full time agricultural workers while women are more likely to be involved only part time.

Table 5: Number of family members by employment status

Employment status in Agriculture	Average Number of Family Members		
	Female	Male	Total
Full time	0.66	0.72	1.38
Never	0.74	0.51	1.25
Part time	0.68	0.52	1.20
Rarely	0.26	0.28	0.54
Total	2.34	2.03	4.37

Use of labour by gender and household/non-household

Specific gender roles do not seem to exist for most activities related to the production of cassava. The various tasks involved in cassava production (Figure 12) generally shows an even distribution of person-days per hectare across male and female agricultural workers. However, this does not mean all tasks are gender neutral. Activities such as harvesting, transportation, fertiliser application and pest and disease control are dominated by men

while chipping and drying along with other post harvest work are generally managed more by women.

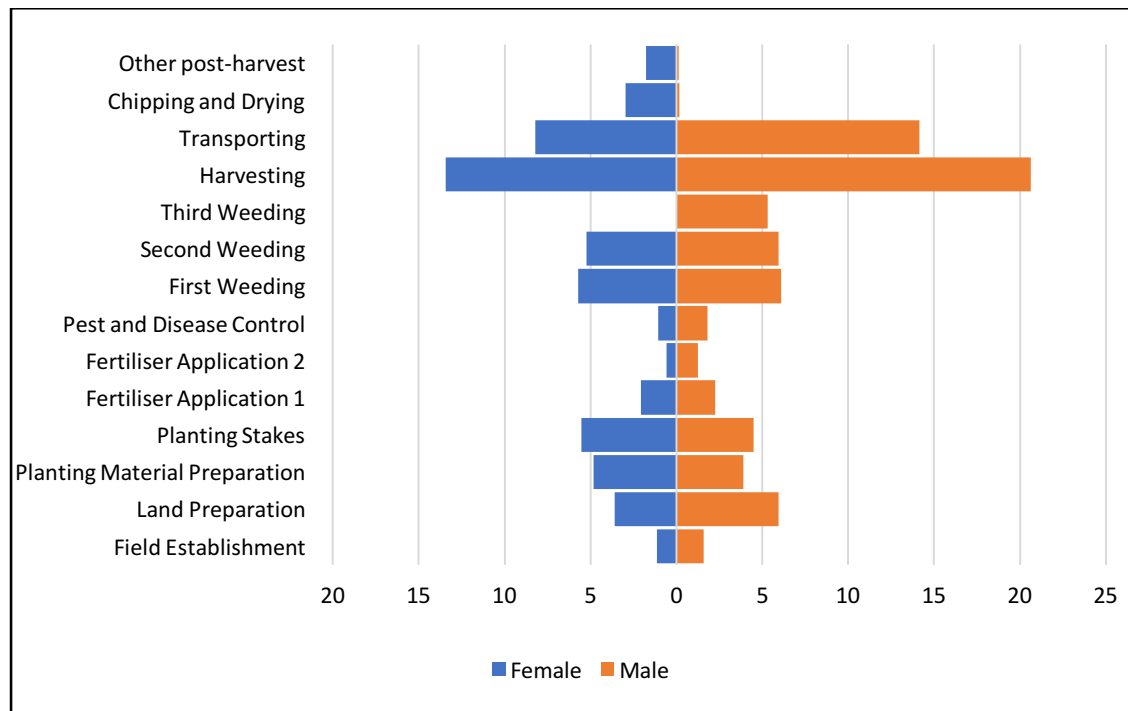


Figure 12: Household Labour Person-Days per hectare, by Gender

Household labour is utilized more often than external sources of labour for most agricultural activities related to cassava production. Tasks such as chipping and drying, pest and disease control, fertilizer application and field establishment are almost exclusively conducted by members within the household. Relatively more non-household labour is utilized only for preparing the land which is likely due to the need for agricultural equipment such as tractors which the households do not own themselves and hence have to depend upon external sources (Figure 13).

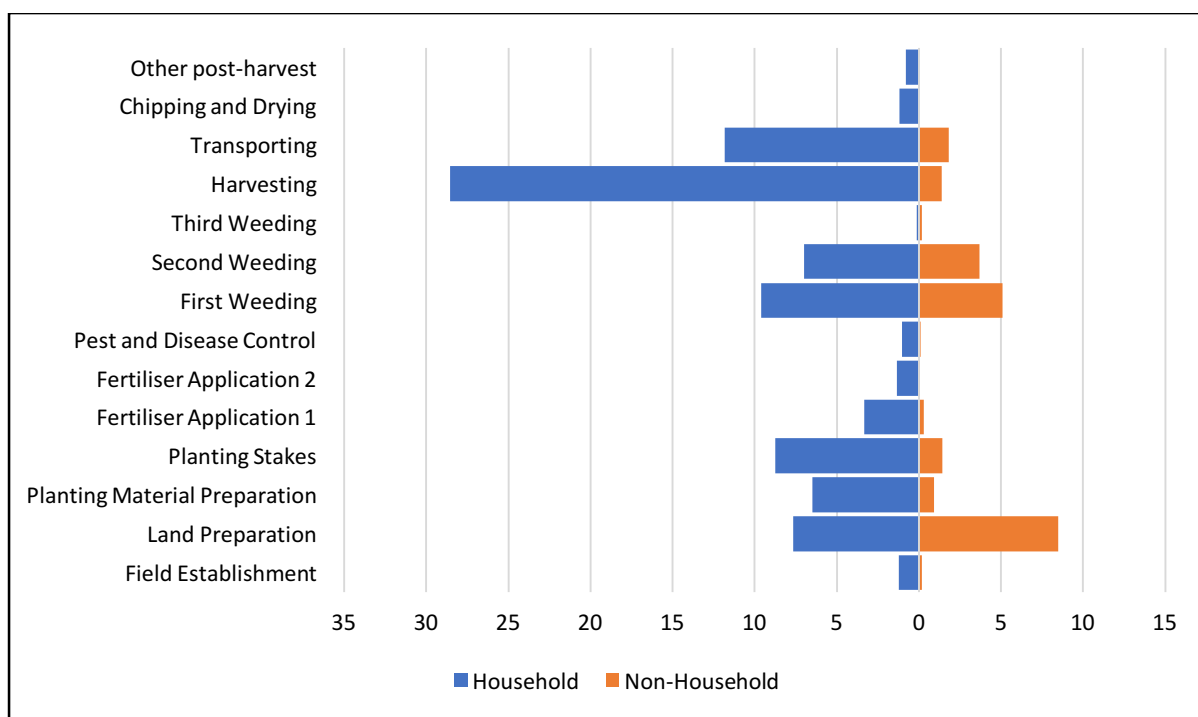


Figure 13: Household Labour Person-Days per hectare, by Gender

Access to credit

Slightly over 40% of households have taken a loan in the past 12 months, with a majority of them having taken out only a single loan. Households in the lowest income group are almost twice as likely to have taken a loan compared to those in other income groups. While this group is the most likely to take loans, the total value of loans however is higher for the highest income groups (Table 6).

Table 6: Proportion of households having taken loans

Access to Credit	Q1	Q2	Q3	Q4	Total
Percent of households that received a loan in the past 12 months	60.71%	31.03%	34.48%	35.71%	40.35%
% households with 1 loan	53.57%	27.59%	34.48%	32.14%	36.84%
% households with 2 loans	0.00%	3.45%	0.00%	3.57%	1.75%
% households with 3 loans	3.57%	0.00%	0.00%	0.00%	0.88%
Average value of total loans received (Rupiah)	3,843,750	2,838,888	7,300,000	4,100,000	4,467,777

Of those that have taken a loan, 86% indicate that their level of debt is either 'manageable' or 'very manageable' while the remaining respondents seem to have at least some concerns. As shown in table X below, slightly under 13% report 'some concern' while one respondent even indicates that his/her debt is at 'worrying' levels.

Table 7: Manageability of debt

How manageable is the current level of debt	Frequency	Percent
Worrying	1	1.61%
Some concern	8	12.90%
Manageable	41	66.13%
Very manageable	12	19.35%
Total	62	100.00%

Access to information

The most common source of information on agricultural production is through ‘friends and neighbours within the village’ which is followed by ‘farmer group’ and ‘family’. The role of farmer groups in providing information on agricultural production highlights the importance of these groups in rural settings. The presence of non-government organizations also have a role to play in delivering agricultural production related information with almost a fifth of households citing them as a source. Another fifth of households claim to have received information from province or state level governments. Cassava traders and processors however do not seem to provide much information related to agricultural production with only a handful citing them as their source of information.

Table 8: Sources of information on agricultural production

Source of Information	Frequency	Percentage
Friends and neighbours in the village	80	70.18%
Farmer Group	65	57.02%
Family	60	52.63%
Non Government Organizations	22	19.30%
District government extension	15	13.16%
Province government extension staff	10	8.77%
Friends and neighbours outside the village	7	6.14%
Other	7	6.14%
Cassava Traders	6	5.26%
Internet	2	1.75%
TV	1	0.88%
Cassava Processors	0	0.00%
Researchers	0	0.00%
Radio	0	0.00%

Similar to the source of information for agricultural production, information on agricultural markets are also obtained primarily from ‘friends and neighbours within the village’ followed by ‘family’ and ‘farmer groups’. This is followed by non government organizations as well as extension from district governments. However key market participants such as cassava traders and processors are only cited by a handful of farmers as their source of information.

Table 9: Sources of information on agricultural markets

Source of Information	Frequency	Percentage
Friends and neighbours in the village	83	72.81%
Family	60	52.63%
Farmer Group	59	51.75%
Non Government Organizations	20	17.54%
District government extension	16	14.04%
Friends and neighbours outside the village	10	8.77%
Cassava Traders	7	6.14%
Other	4	3.51%
Province government extension staff	2	1.75%
Internet	1	0.88%
Cassava Processors	0	0.00%
Researchers	0	0.00%
TV	0	0.00%
Radio	0	0.00%

Group membership

Almost 65% of respondents indicate that they have a household member participating in a group or a mass organization. Most of the individuals involved with a group are with a single organization with only about 10% having membership to two organizations. Farmer groups are the most popular organizations attracting the most membership with almost 80% of group membership associated with such organizations while 20% are also involved with savings groups.

Ownership of assets

The mode of transportation used by most farmers is a motorbike. The proportion of households owning a motorbike is slightly under 50% with a higher likelihood of ownership for the richer income groups. Owning a car is extremely rare, with only a handful, especially in the higher income groups owning one. Despite the efficiency gains related to the use of tractors in agricultural production, none of the farmers own any tractors. As shown in Table 10, there are farmers both in lowlands and uplands that use tractors to cultivate their lands; however, these must be hired for the purpose. Slightly over 50% of farmers own mobile phones although only a handful of them have smart phones.

Table 10: Asset ownership by income quartile

Assets	Q1	Q2	Q3	Q4	Total
truck	0.00%	0.00%	0.00%	0.00%	0.00%
car	3.57%	0.00%	3.45%	7.14%	3.51%
motorbike	35.71%	37.93%	48.28%	75.00%	49.12%
lot sing	0.00%	0.00%	0.00%	0.00%	0.00%
two wheel tractor	0.00%	0.00%	0.00%	0.00%	0.00%
four wheel tractor	0.00%	0.00%	0.00%	0.00%	0.00%
water pump	0.00%	0.00%	0.00%	0.00%	0.00%
generator	0.00%	0.00%	0.00%	3.57%	0.88%
mobile phone	46.43%	51.72%	62.07%	57.14%	54.39%
smart phone	0.00%	0.00%	3.45%	3.57%	1.75%
tv	60.71%	89.66%	72.41%	78.57%	75.44%
dvd player	0.00%	0.00%	3.45%	3.57%	1.75%
radio	10.71%	0.00%	6.90%	25.00%	10.53%
refrigerator	7.14%	0.00%	6.90%	25.00%	9.65%

Agronomic Information

Area, production, Current yields and trends

The average cassava production area per household is 0.46 hectares, with very little variation between lowland and upland farms. Average production is about 4 tons, resulting in a yield of about 8.5 tons per hectare (Table 11). The yield per hectare ranges from 7.8 tons in the lowlands to 9.2 hectares in the uplands.

Table 11: Household cassava production characteristics, by Region

Region	lowland	upland	Total
Cassava production 2016 (tons)	3.81	4.25	4.01
Cassava Harvest Area 2016 (ha)	0.48	0.44	0.46
Cassava Yield 2016 (tons/ha)	7.82	9.23	8.48

Highest and lowest yields

The average highest cassava yield in the past five years across all surveyed areas was over 10 tons per hectare while the average lowest yield in the past five years reached a low yield of 6.18 tons per hectare.

Table 12: Highest and Lowest Production in last 5 years, by Region

Region	Lowland	Upland	Total
Highest Cassava Production in the last five years (tons)	4.43	4.72	4.57
Area Utilized for Highest Cassava Yield in the last five years (ha)	0.49	0.44	0.47
Highest Cassava Yield in the last five years (tons/ha)	9.77	10.63	10.18
Lowest Cassava Production in the last five years (tons)	2.76	2.93	2.84
Area Utilized for Lowest Cassava Yield in the last five years (ha)	0.48	0.45	0.47
Lowest Cassava Yield in the last five years (tons/ha)	5.77	6.65	6.18

Cassava yields are reported to be declining either rapidly or moderately for about 23% of all farmers although this stated rate is relatively higher for lowland farmers compared to their upland counterparts. For a majority (over 55% of all farmers) the yields are relatively constant while a handful report increasing yields.

Table 13: Cassava yield trends, by Region

Region	Lowland	Upland	Total
Declining rapidly	8.33%	3.85%	6.25%
Declining moderately	20.00%	13.46%	16.96%
fluctuating, but no clear trend	15.00%	15.38%	15.18%
Relatively constant	50.00%	61.54%	55.36%
Increasing	6.67%	5.77%	6.25%
Increasing rapidly	0.00%	0.00%	0.00%

Plans for growing cassava in the future

When asked if they believed they would be growing cassava in five year's time, every single farmer provided a positive response which is a promising sign for the future of cassava in the region.

Soil Erosion Problems and Control Techniques

Only a quarter of cassava farmers view soil erosion as a problem in their production. As expected this perception ranges from a high of about 43% in the uplands to a low of about 8.5% in the lowlands. Although soil erosion is considered more of a problem in the uplands, it is mostly considered a 'medium' problem where it has not reached serious levels but at the same time is not a small problem either. Upland farmers are more likely to be aware of soil conservation measures compared to lowland farmers, although less than 6% of upland farmers claim to have this knowledge. Although not considered a serious problem by most, over 67% of farmers are interested in trialling conservation measures on their own lands.

Table 14: Soil erosion perception, by Region

Region	Lowland	Upland	Total
Soil Erosion perceived as a problem	8.47%	43.40%	25.00%
Small Problem	0.00%	3.77%	1.79%
Medium Problem	5.08%	28.30%	16.07%
Serious Problem	3.39%	11.32%	7.14%
Very Serious Problem	0.00%	0.00%	0.00%
Are you aware of any measure to reduce soil erosion?	1.69%	5.88%	3.64%
Have you had any training on any soil conservation measures?	1.69%	0.00%	0.01%
Are you interested in trialling conservation practices on your land?	59.57%	76.19%	67.42%

Adoption of intercropping is found to be extremely high with almost all farmers having grown intercrops with cassava and also currently involved in the practice. Perhaps because most farmers are aware of the benefits of intercropping, over 72% of farmers revealed an interest in trialling new intercrops on their lands.

Table 15: Awareness of intercropping, by Region

Region	Lowland	Upland	Total
Have you ever grown intercrops with your cassava?	100%	96%	98%
Do you currently grow any intercrops with your cassava?	100%	100%	99.08%
Are you interested in trialling new intercrops?	70.69%	75.00%	72.73%

Fertiliser adoption, awareness and correct application

Fertilizer application reported by respondents is relatively low with an average of about 21% stating the use of organic fertilizers, while the adoption of inorganic fertilizers is higher at 50%. The use of organic fertilizers is higher in upland areas while lowland areas seem to favour inorganic fertilizers more. Over 27% of farmers claim to be aware of NPK values related to fertilizers that they use. Although only a handful of farmers have seen a fertilizer trial, a majority of them are interested in visiting a fertilizer demonstration trial (almost 86% of all farmers) as well as conducting fertilizer trials on their own lands (83% of all farmers).

Table 16: Fertiliser Practice, by Region

Region	Lowland	Upland	Total
Do you apply organic fertiliser to your cassava?	13.56%	28.85%	20.72%
Do you apply inorganic fertiliser to your cassava?	55.93%	43.40%	50.00%
Do you understand what the NPK values mean on the fertiliser you apply?	27.12%	26.92%	27.03%
Have you ever seen a fertiliser trial on cassava?	5.08%	9.62%	7.21%
Are you interested in visiting a fertiliser demonstration trial to see the result on production and returns?	88.14%	83.02%	85.71%
Are you interested in conducting a trial on your own land?	84.75%	81.13%	83.04%

Weeds, weeding and herbicide

Almost all farmers identified weeds as a problem for agricultural production limiting the productivity of their cassava crop. However less than 2% consider weeds to be a 'large problem' while a majority (74%) believe that it is a 'medium problem'.

Table 17: Weed Impact Perception, by Region

Region	Lowland	Upland	Total
large problem	3.33%	0.00%	1.79%
medium problem	76.67%	71.15%	74.11%
Small problem	18.33%	26.92%	22.32%
No Problem	1.67%	1.92%	1.79%

While almost all farmers are aware of the severity of the weed problem, it appears that herbicide is used by less than 10% of farmers. The lack of exposure to herbicides is confirmed with only two farmers in total claiming to have received any training on herbicide use (Table 18). The unavailability of herbicide is managed through more traditional methods where over 91% of farmers claim to control weeds manually. Conducting up to two rounds of weeding is most common across both lowland and upland areas (Table 19).

Table 18: Herbicide Practice, by Region

Region	Lowland	Upland	Total
Do you apply any herbicides?	10.17%	5.77%	8.11%
Have you received any training on herbicide use?	3.39%	0.00%	1.80%
Do you use protective clothing when applying herbicide?	1.69%	0.00%	0.01%

Table 19: Manual Weeding Practice, by Region

Region	Lowland	Upland	Total
Do you conduct manual weeding?	89.66%	96.15%	91.07%
1 weeding	7.69%	24.49%	15.84%
2 weedings	84.62%	75.51%	80.20%
3 weedings	7.69%	0.00%	3.96%

Land Preparation

Over 50% of farmers utilize either 2 or 4 wheel tractors to cultivate their cassava fields although the likelihood of their use is higher in the lowlands as expected. The employment of manual tools is the most common method of land cultivation especially in the upland areas where their use is twice as likely in relation to the lowlands. Making ridges are not a

popular choice for both lowland or upland farmers with less than 17% having implemented them.

Table 20: Land Cultivation Practice, by Region

Region	Lowland	Upland	Total
Tractor	38.33%	11.11%	25.44%
4 wheel tractor	33.33%	16.67%	25.44%
Buffalo or cattle	0.00%	0.00%	0.00%
Manual Tools	38.33%	77.78%	57.02%
Make Ridges	16.67%	16.67%	16.67%

Varieties

The most common variety of cassava that is planted is the 'Yellow' variety followed by 'White' variety with only a handful of farmers still planting the local variety (Table 21). Most of the farmers obtain their cassava for planting within the community. A handful of them also claim to have received them directly from their parents. NGOs and other sources play a very limited role in providing cassava varieties to farmers (Table 22). These varieties have been introduced at different time periods, however most of the farmers are unable to recall when they began planting them.

Table 21: Cassava Variety Type

Variety type	Frequency	Percent
Yellow	107	88.43%
White	10	8.26%
Local	4	3.31%
Total	121	100.00%

Table 22: Source of Cassava Variety

Source of Variety	Frequency	Percent
Within Community	106	87.60%
Parents	10	8.26%
NGO	2	1.65%
Other	3	2.48%
Total	121	100.00%

Table 23: Year Cassava Variety Received

Variety obtained since	Frequency	Percent
Unknown length of time	111	91.74%
1962	1	0.83%
1970	1	0.83%
1987	2	1.65%
1988	1	0.83%
1989	1	0.83%
2002	1	0.83%
2006	2	1.65%
2015	1	0.83%
Total	121	100.00%

Cassava Utilization

Cassava is a popular crop in the diets of farmers in Sikka with over 95% stating they consume them within the household. The surveyed households indicate having on average three cassava meals per week although eating them is more popular in upland areas compared to lowland areas (Table 24). On average about 9 kilograms of cassava are consumed by the households each week.

Cassava leaf is also harvested by over 38% of farmers for feeding to livestock. With cassava as a significant source of income, over 63% of households are involved in selling fresh cassava. However, dried cassava is rarely sold with only two farmers from the lowland area claiming to be involved in the business.

Slightly over 50% of farmers feed cassava to their domestic animals, primarily pigs followed by goats and chicken (Table 26). Feeding cassava to animals is more popular in lowland areas relative to upland areas although similar amounts (16 kgs on average per week) are fed to animals in both regions.

Table 24: Cassava Utilization, by Region

Region	Lowland	Upland	Total
Eat	95.00%	96.30%	95.61%
Use for own livestock	61.67%	42.59%	52.63%
Cassava Leaf	41.67%	35.19%	38.60%
Sell fresh cassava	61.67%	64.81%	63.16%
Sell Dried cassava	3.33%	0.00%	1.75%

Table 25: Cassava Consumption, by Region

Region	Lowland	Upland	Total
Meals per week	2.51	3.37	2.91
Amount per week (kgs)	8.71	9.00	8.85

Table 26: Cassava for domestic animals, by Region

Region	Lowland	Upland	Total
Pigs	60.00%	37.04%	49.12%
Goats	15.00%	7.41%	11.40%
Chicken	8.33%	3.70%	6.14%
Cattle	0.00%	0.00%	0.00%
Buffalo	0.00%	0.00%	0.00%
Fish	0.00%	0.00%	0.00%

Relationship with Traders

Only about 50% of farmers involved in selling fresh cassava responded when asked about their relationship with their fresh root traders. Of those that responded, under 12% of lowland farmers considered their relationship with their fresh root traders to be 'strong' or 'very strong' while this proportion was twice as high for upland farmers. On the contrary, almost 53% of lowland farmers claimed to have a 'very weak' relationship with their traders. With about 29% of upland farmers claiming the same, the situation seemed relatively better but still concerning considering a significant proportion of farmers (57%) reporting the relationships with their traders as being 'weak' or 'very weak'.

Of the two lowland farmers that were involved in selling dry chips, only one provided a response indicating that the relationship with his/her trader was 'strong'.

Table 27: Relationship with fresh root traders, by Region

Region	Lowland	Upland	Total
Very Strong	11.76%	4.76%	7.89%
Strong	0.00%	19.05%	10.53%
Moderate	23.53%	23.81%	23.68%
Weak	11.76%	23.81%	18.42%
Very Weak	52.94%	28.57%	39.47%

Trials 2016-2017

2016 Trials

In order to introduce new genotypes from Malang to the project sites for evaluation in 2017, a small amount of material was transferred in 2016 and established as demonstration trials. Phytosanitary processes were adhered to for the transfer of the cassava stakes to reduce the risk of transfer of pest and disease.

Variety trials in Sikka in 2016 were planted in January and harvested in November. The trials involved 3 replications of 8 varieties:

1. Sika Putih, Local variety, sweet
2. Sika Kuning, Local variety, sweet
3. Mentefa, Introduction variety, sweet
4. Tambah Udang, Introduction, sweet
5. Faroka, Introduction variety, bitter
6. UB ½, Introduction variety, bitter
7. UB 14772, Introduction variety, bitter
8. Gajah, Introduction variety, bitter

Fertilizer application rate for the trials was 300 kg Urea (46% N); 150 kg SP₃₆ (36% P₂O₅); 100 kg KCL (50% K₂O) per hectare.

The results were mixed. Due to a very dry season the cassava did not grow well (less than 30% for each plot) However, using the measurements from individual crops (means of 6 to 9 plants/plots), the growth and yields obtained. The initial results of the introduced varieties are promising compared to the local varieties (Sika Putih and Sika Kuning), however farmer preferences will be assessed during the 2017 trial. This including the interest in commercial bitter varieties compared to the traditional eating varieties that have a lower yield but command a higher price in the market – although for small volumes.

<i>Cassava varieties</i>	<i>Branch No</i>	<i>Plant height (cm)</i>	<i>Tuber No</i>	<i>Tuber yield (kg/plant)</i>
Sika Putih	2.04 ± 1.03	157.86 ± 11.53	4.86 ± 1.14	2.80 ± 0.52
Sika Kuning	2.20 ± 0.77	169.70 ± 7.72	4.75 ± 1.03	2.74 ± 0.66
Mentega	2.00 ± 1.20	164.75 ± 14.02	9.85 ± 2.67	5.06 ± 0.46
Tambak Udang	2.00 ± 0.77	152.76 ± 6.83	11.00 ± 2.19	5.57 ± 0.57
Faroka	2.28 ± 0.48	143.42 ± 2.63	9.75 ± 1.28	5.12 ± 0.84
UB ½	2.77 ± 0.92	143.31 ± 14.66	7.72 ± 1.80	4.22 ± 0.45
UB 1472	1.95 ± 0.88	157.55 ± 22.26	7.15 ± 1.08	4.31 ± 0.49
Gajah	2.00 ± 0.95	180.28 ± 5.03	10.08 ± 2.82	6.85 ± 1.20

2017 Trials

Variety and intercrop trials were planted in Sikka.

Variety trials in **Sikka Regency**, NTT were planted in November 2016 and involve evaluation of 10 varieties:

1. Sika Putih, Local variety, sweet
2. Sika Kuning, Local variety, sweet
3. Mentefa, Introduction variety, sweet
4. Tambah Udang, Introduction, sweet
5. Faroka, Introduction variety, bitter
6. UB ½, Introduction variety, bitter
7. UB 14772, Introduction variety, bitter
8. Gajah, Introduction variety, bitter
9. Malang 6, Introduction variety, bitter
10. Aldira , Introduction variety, bitter

Fertilizer rate for all varieties is 300 kg Urea (46% N); 150 kg SP₃₆ (36% P₂O₅); 100 kg KCL (50% K₂O) per hectare.

Due to exceptionally dry season, cassava could not grow well (~30% of each plot was affected) and there was heavy presence of mealy bugs. However, the fresh root yield was calculated from individual plant measurements (means of 6 to 9 plants/plots). Fresh root yield of high yielding varieties ranged from 31.2 to 45.7 t ha⁻¹ which was 1.2 to 1.7-fold higher compared to local varieties (Table 28).

Table 28: Average fresh root yield (t/ha) and mealy bug infestation (%) of different varieties tested in experimental fields and in farmers' field in Sikka

Varieties	Experimental Field		Farmers' Field	
	Mealy Bugs (%)	Yield (t/ha)	Mealy Bugs (%)	Yield (t/ha)
Sika Putih	20	25.7	-	-
Sika Kuning	25	26.6	-	-
Sika Kuning	41	31.2	100	29.4
Tambak Udang	65	32.5	100	28.2
Faroka	50	36.8	100	34.7
UB 1/2	52	34.8	100	34.2
UB 4472	39	33.6	100	35.7
Gajah	35	45.7	-	-
Malang 6	54	38.5	100	35.2

Intercrop trials in Sikka involve 4 replications of 6 intercrop treatments (cassava plus maize (local system), cassava plus maize (introduced system), cassava plus peanut, cassava plus mungbean, cassava plus soybean). The intercrop has been harvested already and the cassava will be harvested in late September-October. 28 farmers attended field days during harvesting the harvesting the maize intercrops. About 20 of them agreed to practice the introduced maize intercropping system in the subsequent season.

Table 29: Average yield and income from different intercropping trial systems in Sikka

Crops	Yield (t/ha)	Income (millions Rp/ha)
Maize (local system)	3.67 ± 0.56	14.67 ± 2.25
Maize (Introd. System)	4.33 ± 0.79	17.34 ± 3.19
Mungbean	0.63 ± 0.01	10.71 ± 2.40
Peanuts	1.26 ± 0.37	13.83 ± 4.09
Soybean	pod was empty due to insects	

2018 Activities

Variety Evaluation and seed systems

Variety dissemination will be undertaken using 4 varieties prioritized by farmers during the 2017 trials and will be planted with an introduced intercropping system in Sikka. In Larankuta, variety adaptation trials will be undertaken to assess suitability for upland areas with wet climates.

The variety trials will involve Brawijaya University as the project coordinator and technical advice provider, ILETRI as R&D support and provision of varieties, the local agriculture departments to provide advice and guidance to farmers, and traders to support the dissemination of new varieties.

Fertility Management

Fertilizer experiments will be undertaken in Sikka in 2018 in cassava and maize monoculture systems and cassava intercropping systems.

The fertility management trials will involve Brawijaya University as the project coordinator and technical advice provider, ILETRI as R&D support and provision of varieties, the local agriculture departments to review results and local traders to support fertilizer availability – including expansion to Larantuka (East) and Bajawa (West).

In addition to standard fertiliser trials, experiments will be made on organic soil improvement using maize and coconut residues.

Intercropping

Intercropping experiments will be carried out including planting cassava between cashew trees.

The intercropping trials will involve Brawijaya University as the project coordinator and technical advice provider, ILETRI as R&D support and provision of varieties, the local agriculture departments to review results and local traders to support.

After the trials there will be a National-Regional workshop convened in NTT, in order to reach other stakeholders that are interested in cassava intercropping.

Pests and Disease Management

In 2018, a survey on mealybug occurrence in Sikka will be undertaken. The survey will cover the timing of mealybug attacks, the influence of climatic conditions, the effect of mealybug on cassava yield and the susceptibility of different varieties to mealybug.

The pest and disease survey will involve Brawijaya University as the project coordinator and, ILETRI as R&D support and other universities from NTT to support survey activities.

Detailed Tables

Table 30: Average Household Incomes from various sources (Rupiah/Year), by Region

Region	Lowland	Upland	Total
Cassava Income	4,797,940.00	4,476,103.70	4,645,491.23
Paddy rice production value	0.00	147,738.89	69,981.58
Paddy rice sale value	0.00	0.00	0.00
upland rice production value	41,666.67	149,675.93	92,828.95
upland rice sale value	0.00	0.00	0.00
Income from Maize	1,025,200.00	276,518.52	670,561.40
Income from Peanuts	16,666.67	3,111,111.11	1,482,456.14
Income from Mungbean	1,503,666.67	24,074.07	802,807.02
Income from all other annual crops	301,500.00	1,161,064.81	708,662.28
Income from coffee	0.00	0.00	0.00
Income from Cashew	324,416.67	325,351.85	324,859.65
Income from Cocoa	0.00	1,280,518.52	606,561.40
Income from all other tree crops	957,833.33	2,857,907.41	1,857,868.42
Cropping Income	8,968,890.00	13,810,064.81	11,262,078.07
Non-Cassava Cropping Income	4,170,950.00	9,333,961.11	6,616,586.84
Cattle Income	250,000.00	74,074.07	166,666.67
Buffalo Income	0.00	0.00	0.00
Goat Income	639,666.67	79,629.63	374,385.96
Pig Income	1,831,666.67	829,629.63	1,357,017.54
Chicken Income	138,583.33	256,666.67	194,517.54
Duck Income	0.00	0.00	0.00
Other Livestock Income	8,333.33	18,518.52	13,157.89
fish Income	0.00	0.00	0.00
Total Livestock Income	2,868,250.00	1,258,518.52	2,105,745.61
On-farm Income	11,837,140.00	15,068,583.33	13,367,823.68
Off-farm Wages	657,666.67	418,518.52	544,385.96
Irregular non-farm income	2,611,666.67	3,400,925.93	2,985,526.32
Salary Income	2,710,000.00	1,127,777.78	1,960,526.32
Remittance Income	585,000.00	532,407.41	560,087.72
NTFP income	252,000.00	0.00	132,631.58
Timber income	0.00	5,555.56	2,631.58
Fishing Income	0.00	0.00	0.00
All other Income	2,808,516.67	900,000.00	1,904,482.46
Off-farm Income	9,624,850.00	6,385,185.19	8,090,271.93
Total Income	21,461,990.00	21,453,768.52	21,458,095.61

Table 31: Average Household Incomes from various sources (Rupiah/Year), by income quartile

Income Quartiles	Q1	Q2	Q3	Q4	Total
Cassava Income	1,005,107.14	3,315,086.21	5,415,813.79	8,865,960.71	4,645,491.23
Paddy rice production value	48,975.00	202,758.62	14,193.10	11,250.00	69,981.58
Paddy rice sale value	0.00	0.00	0.00	0.00	0.00
upland rice production value	69,017.86	97,413.79	68,103.45	137,500.00	92,828.95
upland rice sale value	0.00	0.00	0.00	0.00	0.00
Income from Maize	262,500.00	394,482.76	669,724.14	1,365,428.57	670,561.40
Income from Peanuts	96,428.57	496,551.72	1,613,793.10	3,753,571.43	1,482,456.14
Income from Mungbeans	366,785.71	683,620.69	737,413.79	1,430,000.00	802,807.02
Income from all other annual crops	83,214.29	342,758.62	935,344.83	1,478,303.57	708,662.28
Income from coffee	0.00	0.00	0.00	0.00	0.00
Income from Cashew	80,357.14	312,896.55	432,586.21	470,178.57	324,859.65
Income from Cocoa	90,000.00	20,689.66	143,517.24	2,209,500.00	606,561.40
Income from all other tree crops	668,839.29	1,241,379.31	2,941,275.86	2,563,303.57	1,857,868.42
Cropping Income	2,771,225.00	7,107,637.93	12,971,765.52	22,284,996.43	11,262,078.07
Non-Cassava Cropping Income	1,766,117.86	3,792,551.72	7,555,951.72	13,419,035.71	6,616,586.84
Cattle Income	0.00	0.00	137,931.03	535,714.29	166,666.67
Buffalo Income	0.00	0.00	0.00	0.00	0.00
Goat Income	17,857.14	51,724.14	100,000.00	1,349,285.71	374,385.96
Pig Income	289,285.71	1,224,137.93	1,582,758.62	2,328,571.43	1,357,017.54
Chicken Income	14,285.71	32,586.21	102,413.79	637,857.14	194,517.54
Duck Income	0.00	0.00	0.00	0.00	0.00
Other Livestock Income	0.00	17,241.38	0.00	35,714.29	13,157.89
fish Income	0.00	0.00	0.00	0.00	0.00
Total Livestock Income	321,428.57	1,325,689.66	1,923,103.45	4,887,142.86	2,105,745.61
On-farm Income	3,092,653.57	8,433,327.59	14,894,868.97	27,172,139.29	13,367,823.68
Off-farm Wages	89,285.71	0.00	413,793.10	1,698,571.43	544,385.96
Irregular non-farm income	60,714.29	1,146,551.72	3,103,448.28	7,692,857.14	2,985,526.32
Salary Income	53,571.43	144,827.59	1,579,310.34	6,142,857.14	1,960,526.32
Remittance Income	160,714.29	813,793.10	732,758.62	517,857.14	560,087.72
NTFP income	0.00	0.00	0.00	540,000.00	132,631.58
Timber income	0.00	10,344.83	0.00	0.00	2,631.58
Fishing Income	0.00	0.00	0.00	0.00	0.00
All other Income	789,678.57	1,062,068.97	793,103.45	5,042,857.14	1,904,482.46
Off-farm Income	1,153,964.29	3,177,586.21	6,622,413.79	21,635,000.00	8,090,271.93
Total Income	4,246,617.86	11,610,913.79	21,517,282.76	48,807,139.29	21,458,095.61

Table 32: Labour costs for various production activities (Rupiah per hectare/Year), by Region

Region	Lowland	Upland	Total
Field Establishment Household Labour	65,238.10	54,938.27	60,359.23
Field Establishment Outside Labour	1,666.67	18,518.52	9,649.12
Land Preparation Household Labour	461,754.96	295,943.56	383,212.72
Land Preparation Outside Labour	186,590.91	686,728.39	423,498.14
Planting Material Preparation Household Labour	401,563.49	237,786.59	323,984.96
Planting Material Preparation Outside Labour	43,888.89	50,308.64	46,929.82
Planting Stakes Household Labour	563,228.70	295,238.09	436,285.78
Planting Stakes Outside Labour	73,943.00	70,679.01	72,396.90
Fertiliser Application 1 Household Labour	190,891.86	140,740.74	167,136.07
Fertiliser Application 1 Outside Labour	26,161.62	3,395.06	15,377.46
Fertiliser Application 2 Household Labour	83,189.48	48,148.15	66,590.96
Fertiliser Application 2 Outside Labour	5,606.06	1,851.85	3,827.75
Pest and Disease Control Household Labour	66,666.67	34,567.90	51,461.99
Pest and Disease Control Outside Labour	10,666.67	0.00	5,614.04
First Weeding Household Labour	584,101.71	365,873.01	480,730.22
First Weeding Outside Labour	340,593.43	159,435.62	254,781.84
Second Weeding Household Labour	459,296.15	227,292.77	349,399.81
Second Weeding Outside Labour	284,482.32	74,867.72	185,191.20
Third Weeding Household Labour	13,333.33	0.00	7,017.54
Third Weeding Outside Labour	17,361.11	0.00	9,137.43
Harvesting Household Labour	1,597,708.85	1,240,255.72	1,428,388.95
Harvesting Outside Labour	60,411.26	80,820.11	70,078.61
Transporting Household Labour	813,498.25	595,502.64	710,237.17
Transporting Outside Labour	98,500.00	119,761.91	108,571.43
Chipping and Drying Household Labour	98,055.56	16,666.67	59,502.92
Chipping and Drying Outside Labour	0.00	0.00	0.00
Other post-harvest Household Labour	56,666.67	18,518.52	38,596.49
Other post-harvest Outside Labour	0.00	0.00	0.00
Total Labour	5,455,193.76	3,571,472.64	4,562,904.81
Household Labour	1,149,871.93	1,266,366.84	1,205,053.73
Outside Labour	6,605,065.69	4,837,839.47	5,767,958.53