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# CASSAVA PROGRAM DISCUSSION PAPERS

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## **Value Chain Analysis, Household Survey and Agronomic Trial Results Lao PDR**

Vongphaphane Manivong, Laothao Youbee,  
Phantasin Khanthavong, Dominic Smith, Rob  
Cramb, Jonathan Newby and Lava Yadav  
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# Value Chain Analysis, Household Survey and Agronomic Trial Results Lao PDR<sup>1</sup>

Vongphaphane Manivong<sup>2</sup>, Laothao Youbee<sup>3</sup>, Phantasin  
Khanthavong<sup>2</sup>, Dominic Smith<sup>4</sup>, Rob Cramb<sup>4</sup>, Jonathan Newby<sup>3</sup>  
and Lava Yadav<sup>4</sup>

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<sup>2</sup> NAFRI

<sup>3</sup> CIAT

<sup>4</sup> University of Queensland

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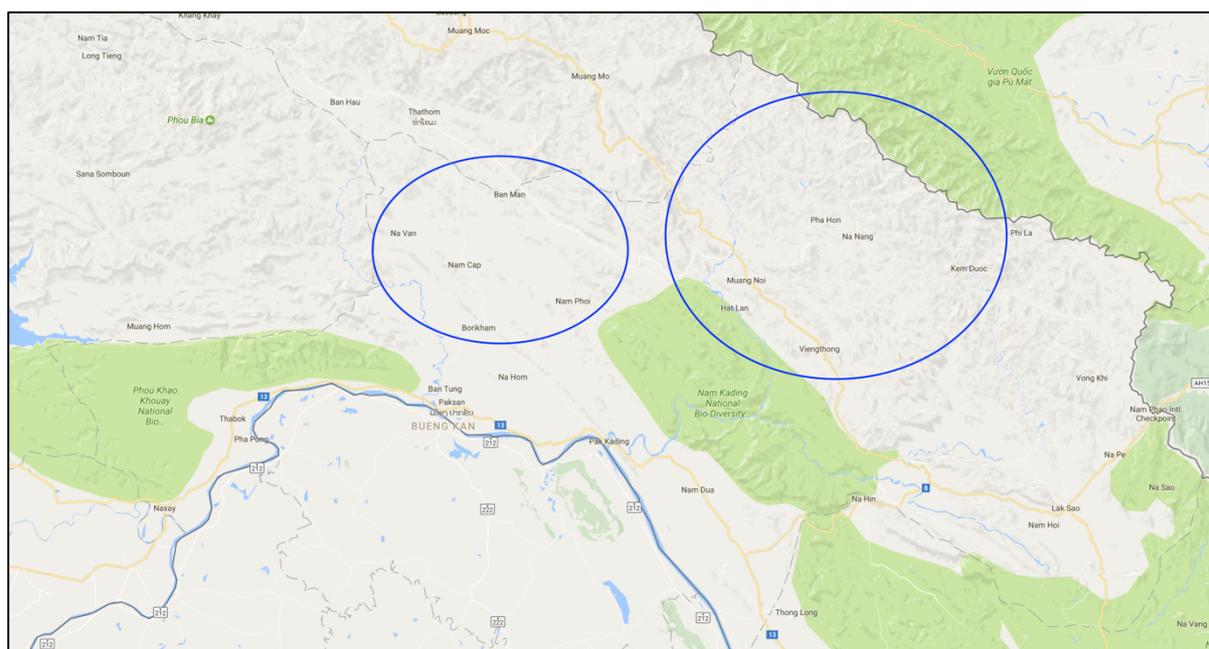


Figure 2: Research Locations, Bolikhamxay Province

Bolikhan District is located relatively close to the border with Vientiane province and also borders with Paksan district where there is an active border trade across the Mekong River to Bueng Ken in Thailand.

## Production Statistics

Table 1: Cassava Production in Bolikhamxay Province (by district), 2011-2016

District	2011-2012		2012-2013		2013-2014		2014-2015	
	Area (ha)	Production (ton)						
Paksan	855	12,825	855	12,825	855	12,825	868	13,888
Thaphabth	550	9,900	493	8,872	572	9,542	145	2,610
Pakkading	2,270	68,086	3,959	118,760	4,067	98,770	3,125	93,740
Bolikhhan	1,724	60,326	2,530	88,533	2,689	94,108	3,128	109,480
Viengkeut	1,010	16,160	4,539	97,501	4,486	126,880	4,670	157,006
Vienthong	370	7,408	637	12,740	687	13,740	1,800	36,000
Xaychomp	730	18,250	415	10,370	415	10,370	207	5,175
Total	7,509	192,956	13,427	349,601	13,770	366,235	13,943	417,899

Lao Indochina Starch made investments in cassava processing in the past in Bolikhamxay, but are no longer active in the district. Two relatively large processing factories currently operate in Bolikhhan – TTL Starch factory (investment from Vietnam) and DDD dried chip factory (investment from Lao PDR).

## Xayabouly

Cassava production in Xayabouly in 2013 was 145,018t from a total area of 4,305ha. Xayabouly is the third ranked province in terms of cassava production, behind Vientiane and Bolikhamxay.

Project activities in Xayabouly are focusing on two of the eleven districts within the province. Kenthao and Paklai districts have been selected as they are the main cassava producing districts in the province.



Figure X: Research Locations, Xayabouly

Paklai district is a significant producer of cassava and has one major starch production factory (Lao Prosper Company) located in Nam Xong village. This factory is owned by a Chinese company. Most of the cassava for the factory comes from Paklai district, but around 20 percent is sourced from Kenthao district and Sanakham district (Vientiane Province).

Farmer focus group discussions were undertaken in Kang village and Khae village in Paklai district. Value chain interviews were conducted with the Lao Prosper Company and two small fresh root traders, one in Bouamlao village and one in Phakeo village.

Kang Village is an old established village with 201 households (196 Lao ethnicity and 5 Khmu ethnicity) and a population of 1,165 (591 women). There are 191 strength households, 3 moderate households and 7 weak households in the village. The village was certified as a development village in 2013 and still retains that status.

Khae village was established more than 260 years ago and includes 254 households (249 strength households and 5 moderate households) with a total population of 1,171 (568 women), all of whom are Lao ethnicity.

Kenthao district is located in the south of Xayabouly province and has a relatively long border with Thailand. There is no starch factory operating in Kenthao district and traders mostly transport fresh root and chips to Thailand. There are a number of large chip processors with drying yards in the district.

Farmer focus group discussions were held in Haddaeng village and HouyEhoum village. Value chain actor interviews were conducted with Soukkaseum Trade Export-Import Company, Malivanh Agriculture promotion and processing company and two small scale traders in fresh cassava root and dried chips, one from Chomphet village and one from Nabone village.

Haddeng village is an old established village located 1 km from Kaenthao district town and includes 144 households with a total population of 669 persons (327 female), all of whom are Lao ethnicity. Households are classified into three groups of households (strength, moderate and weak) are based on political reports.

Houyehoum is a relatively new village (established in 1989), located 14 km from the district centre, with a road passing through the village linking it to Xanakham District, Vientiane Province. There are a total of 87 households in the village, with a population of 401 (189 men), all of whom are Lao ethnicity. There are 78 strong households, 7 moderate households and 2 weak households in the village.

#### Production Statistics

Cassava production in Xayabouly in 2013 was 145,018t from a total area of 4,305ha. Xayabouly is the third ranked province in terms of cassava production, behind Vientiane and Bolikhamxay. Paklai district is a significant producer of cassava and has one major starch production factory (Lao Prosper Company) located in Nam Xong village. This factory is owned by a Chinese company. Most of the cassava for the factory comes from Paklai district, but around 20 percent is sourced from Kenthao district and Sanakham district (Vientiane Province).

## Value Chain Information

### Bolikhamxay

The value chain in Vienthong district is predominately oriented towards exports, both of starch and of dried chips. Given the location of Vienthong, adjacent to the border district of Khamkeut, it is hardly surprising that Vietnam is the major export destination. Both starch and dried chips are exported (largely for subsequent re-export to China), but no fresh roots are exported from the district.

Estimated production in 2014-2015 was 36,000 tons of fresh root of which around 7,000 tons was used to produce about 3,500 tons of chips for the Xin Xin Laos chip trading operation. Xin Xin Laos sourced about 2000 tons of chips on contract from 5 farmer groups within Vienthong. These chips were delivered to Xin Xin Laos by collectors from the villages. The remaining 1,500 tons of chips were sourced from 40 traders who purchased chips mainly from farmers in Vienthong district.

The remainder of the production (~29,000 tons) was (i) processed into dried chips by farmers and sold to small scale traders who then subsequently sold to Vietnamese traders based in Kham Keut district; or (ii) sold as fresh root by farmers to collectors who then sold to the starch factory. As is the case with the linkages to Xin Xin Laos, the linkages between farmers and starch factory and farmers and larger Vietnamese traders are almost exclusively through collectors or medium scale traders.

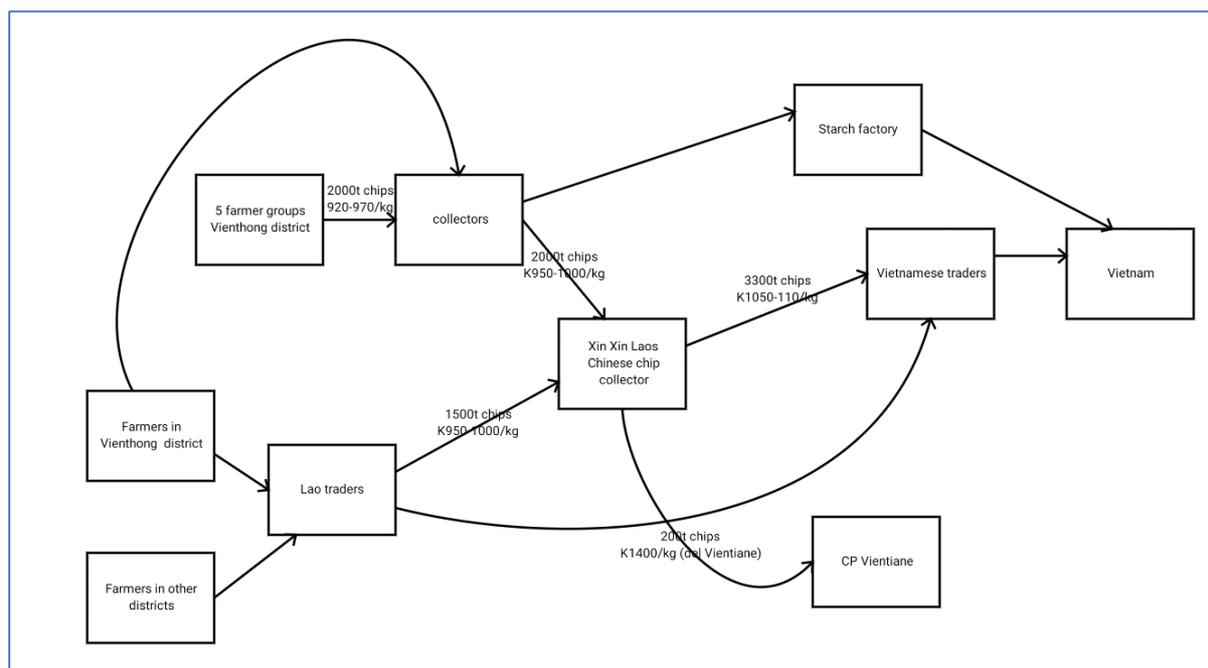


Figure 3: Value Chain Map, Vienthong District

Farmgate prices were in the range of LAK 920-970/kg of dried chips and LAK450-470/kg of fresh root. The gross margins for small scale collectors were around K30-50/kg of dried chips and the gross margin for Xin Xin Laos was between k50-100/kg of dried chips. Although Xin Xin has contracts with farmer groups, these do not include a specification of purchase price. Xin Xin's purchase price decisions are based on a discount on the offer price from Vietnamese traders. Selling prices for Lao traders and Xin Xin Laos were in the range of K1050-1100/kg of dry chips.

A stylised representation of the value chain in Bolikhan district as it operated until 2015 is shown in Figure 4. As was the case for Viengthong district, the value chain in Bolikhan district is predominately oriented towards exports, both of starch and of dried chips. Starch is exported to Vietnam and dried chips are exported to both Thailand and (in small quantities) to Vietnam.

Two relatively large processing factories currently operate in Bolikhan district, the TTL Starch factory (investment from Vietnam) and the DDD dried chip factory (investment from Lao PDR).

Two relatively large processing factories currently operate in Bolikhan district, the TTL Starch factory (investment from Vietnam) and the DDD dried chip factory (investment from Lao PDR).

The TTL starch factory purchased 80% of inputs (around 26,400t of fresh roots) from smallholder farmers in Bolikhan district under a contract farming system and the remaining 20% (6,600 t of fresh root) were sourced from collectors from both within Bolikham district (around 3,300t) and from outside the district (3,300t) as far away as Xieng Khuoang. All of TTL factory production of starch is exported to Vietnam through their sister company in Nghe An province and subsequently for export to China from Vinh Port.

DDD Chip factory also operated a contract farming system in 2015. and purchased all fresh root inputs (41,400t) from these contracted farmers. In addition, DDD purchased a further 13,800t of dried chips from contracted farmers and 2,900t of chips from collectors.

The combined purchasing of TTL and DDD was around 108,000t of fresh roots. Around 3,000t of the inputs for TTL were sourced from outside the district, so approximately 105,000t of the total district production of around 109,000t was accounted for by TTL and DDD. The balance was made into dry chips by farmers and sold by collectors to large traders, mostly in Paksan town.

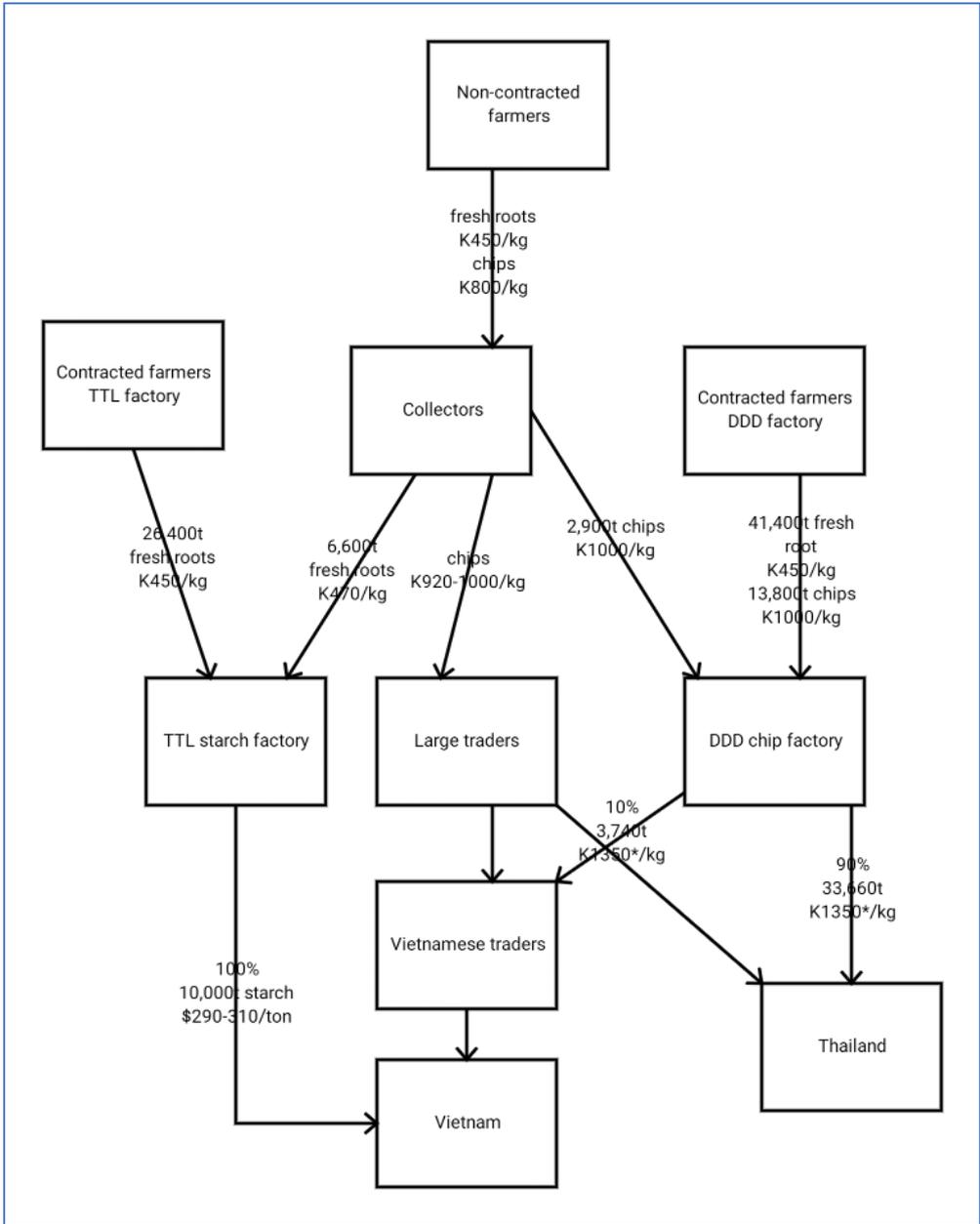


Figure 4: Bolikhhan Value Chain Map (up to 2015)

The situation in the cassava value chain in Bolikhhan district had changed quite significantly in 2016. Both TTL and DDD no longer operated contract farming systems. DDD cited a lack of working capital and falling prices as the reason for this decision and TTL noted that the instability in the market price of starch made it impossible for them to continue to make fixed price contracts with farmers.

Both TTL and DDD continued to operate in 2016, purchasing inputs on a spot market basis. TTL maintained a similar production level to previous years and purchased from both collectors and directly from larger farmers. The level of production and trading by DDD fell significantly in 2016. The majority of purchases made by DDD were from farmer/collectors who had borrowed money from DDD for equipment, or had been given tractors by DDD for land preparation. These farmer/collectors needed to sell chips or fresh roots to DDD in order to pay off their debts.

TTL continued to export starch to Vietnam through its sister company. DDD sold a portion of its production directly to Vietnamese traders but also sold through Lao traders.

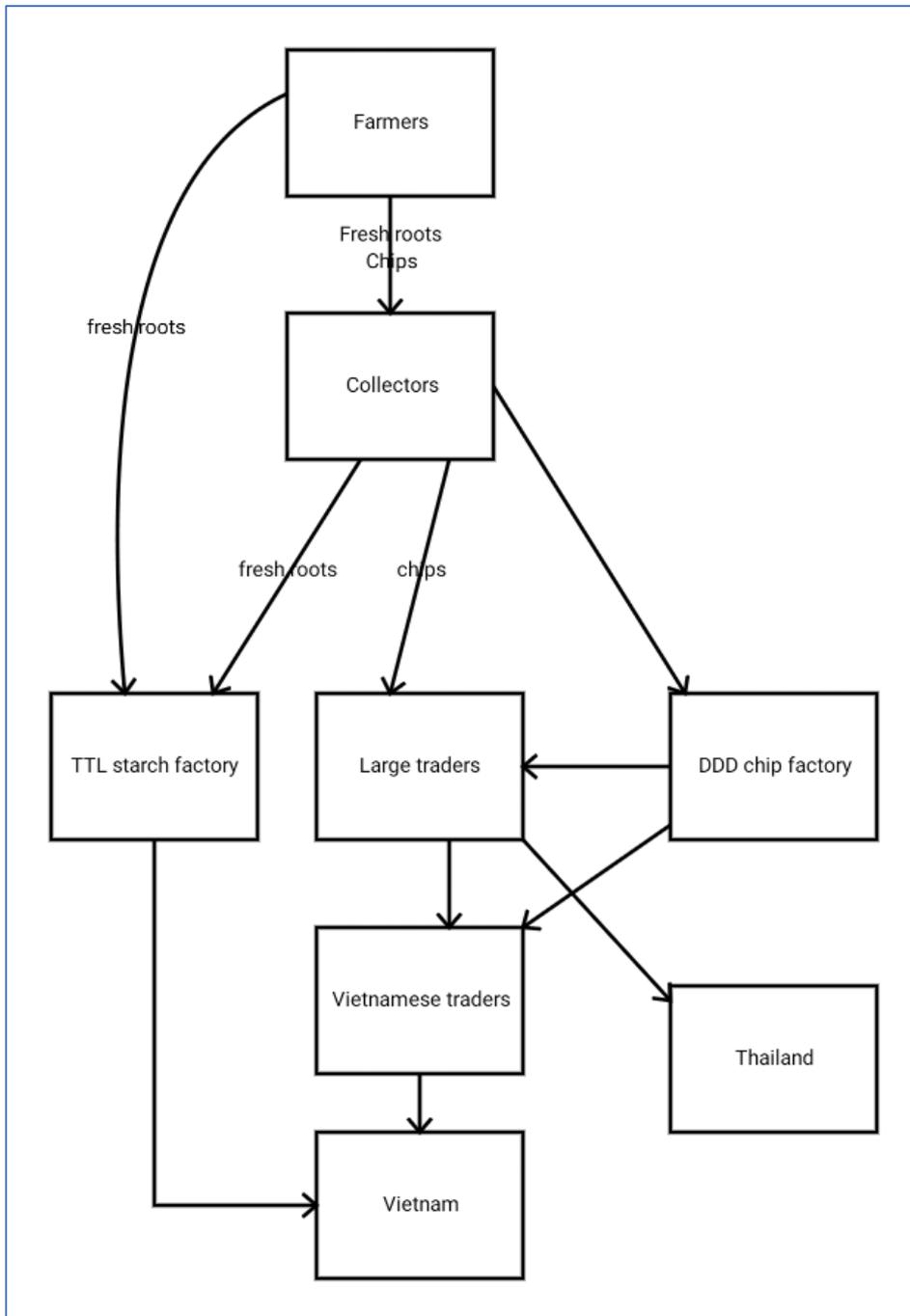


Figure 5: Bolikhan District Value Chain Map (from 2016)

### Xayabouly

As Kenethao district town has a major international border gate with Tha Li district of Leoi province in Thailand, it is hardly surprising that the cassava value chain in Kenethao is oriented towards exports of both fresh roots and dried chips.

Farmers in villages close to the district town either sell fresh roots to small scale chip producers in the village, or produce dried chips themselves. The small scale processors also act as dry chip collectors, purchasing chips from farmers.

The small scale chip producers/collectors sell chips either directly to Thai companies at the border gate, or to one of three larger chip factories located around Kenethao district town. Farmers in more remote villages sell small quantities directly to the larger factories, but the majority of sales are of fresh roots to traders from Kenethao district town who either come to the village to purchase or buy product from farmers who have transported it to Kenethao town.

The 3 major chip factories sell both fresh roots and dry chips to Thai companies at the border gate. The chip factories do not make contracts with the traders supplying fresh roots and are not able to accurately forecast the quantities of fresh roots that they will purchase. The proportion of sales as fresh roots or chips depends on the levels of demand for fresh root by the Thai companies. If there is low demand for fresh root from the Thai companies, the factories in Kenethao district town will produce chips to avoid spoilage. In addition to selling to the Thai companies, Mailivanh company also supplies a small quantity of roots to the Lao Prosper starch factory in Paklai.

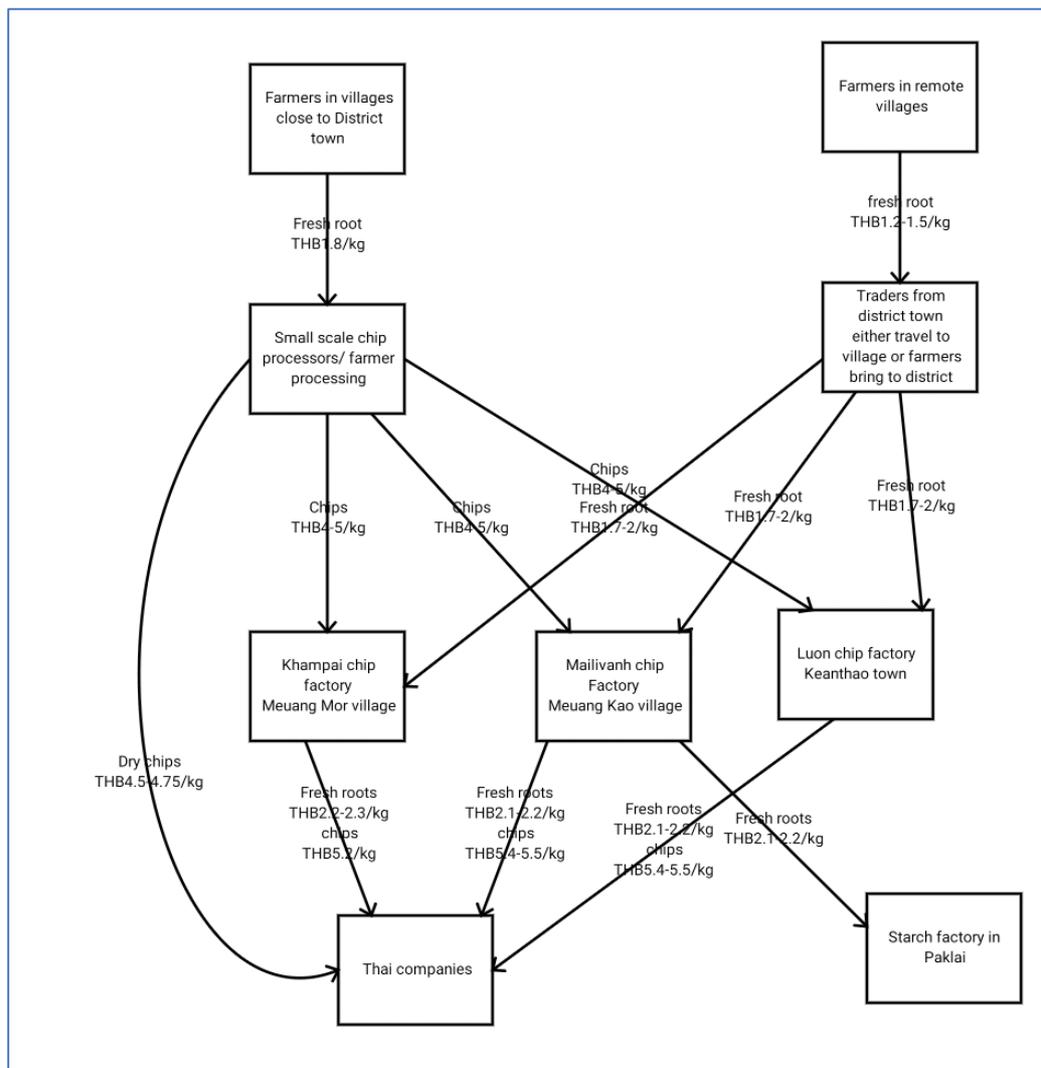


Figure 6: Cassava Value Chain, Kenethao District, Xayabouly

Farmgate prices of fresh root in more remote villages of Kenethao are in the range THB1.2 - 1.5/kg. The price of fresh root in and close to Kenethao district town is between THB1.7/kg and THB2.0/kg.

Chip factories purchase chips from small scale processors and household processors in Kenethao district town at between THB4/kg and THB5/kg. Small scale processors can get similar prices (between THB4.5/kg and THB4.75/kg) when selling directly to Thai companies at the border.

The larger traders/chip processors sell fresh roots to the Thai companies at the border in the price range THB2.1-THB2.3/kg. The price of dry chips is in the range THB5.2/kg – THB5.5/kg.

The value chain in Paklai is oriented almost completely towards the production of starch by the Lao Prosper Starch factory, located in Nam Xong village.

Lao Prosper purchased a total of 30,000t of fresh cassava roots from traders from Paklai, Kenethao and Phiang districts of Xayabouly as well as from Xangkhen district of Vientiane province. All of the starch produced by Lao Prosper is sent by truck to the border with Yunnan province and sold to Chinese buyers.

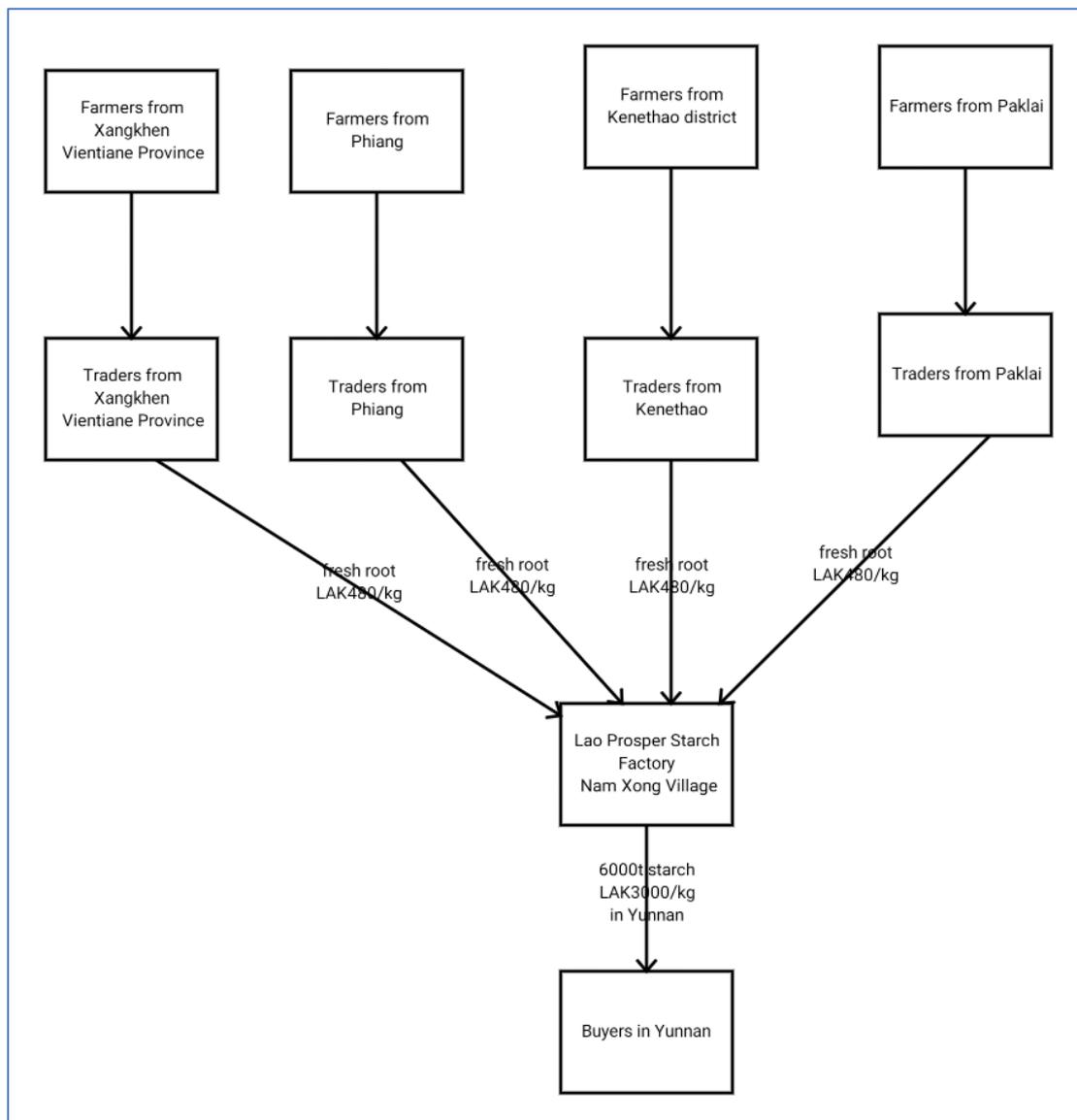


Figure 7: Cassava Value Chain, Paklai District, Xayabouly

The average procurement price is around LAK480/kg at factorygate and the selling price in Yunnan is LAK3000/kg. The factory was not aware of the price paid by the traders to farmers for fresh root, but the price levels reported in Kenethao district were between LAK290 and LAK430/kg for fresh roots at farmgate.

## Location of Project Activities

### Household Survey Locations

The household surveys were undertaken in Bolikhamsay and Xaybouly provinces. Within Bolikhamsay the interviews were conducted in Bolikhan and Viengthong districts and within Xaybouly it was conducted in Kenthao and Paklai districts. A total of 360 households were surveyed across the four districts (90 households in each district).

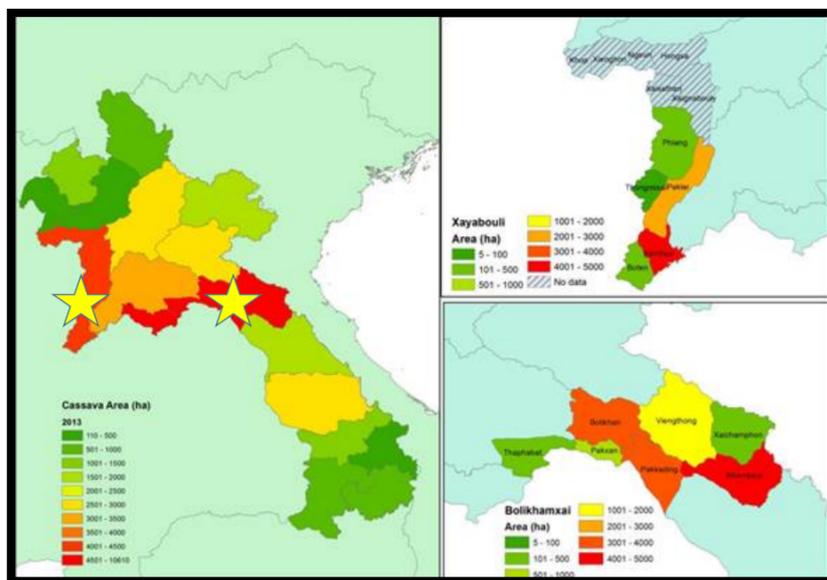


Figure 8: Survey sites

The distribution of household incomes across the four surveyed districts is shown in Figure 9. It is evident that there is some level of income disparity between these districts. Farmers from Paklai have a greater likelihood of being in higher income quartile while farmers from Viengthong are more likely to be in the lower ones.

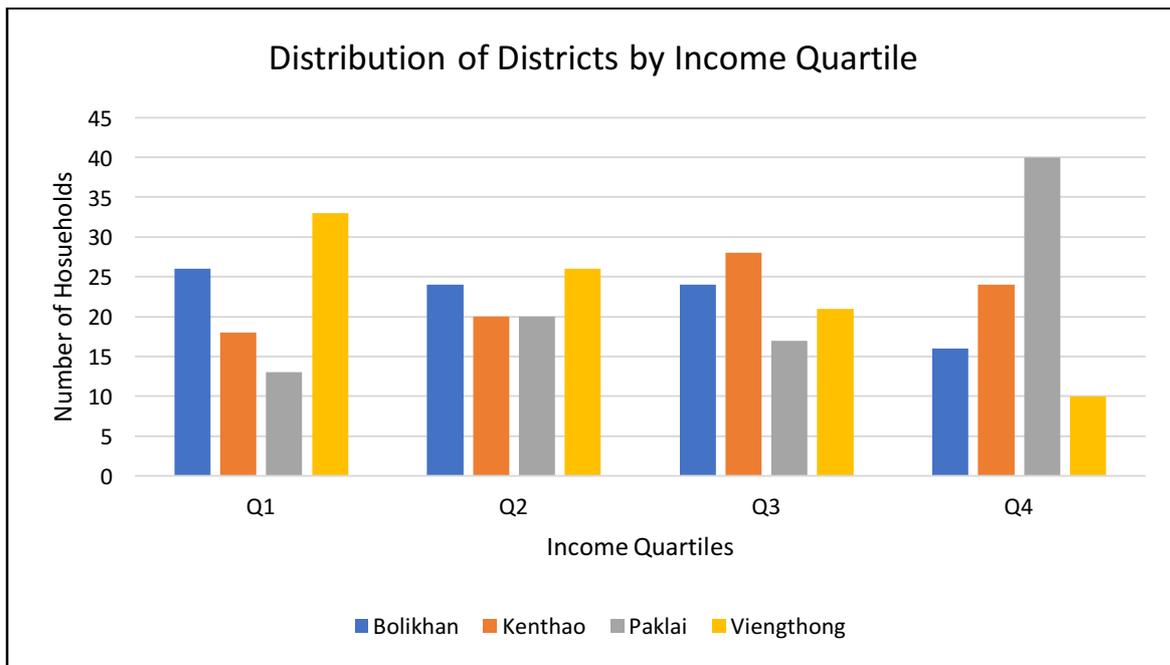


Figure 9: Distribution of districts, by income quartiles

## Livelihood Information

### Time of first cultivating cassava

The adoption of cassava by farmers started attaining significant numbers since 2010. The number of farmers commencing cassava production began rising gradually until it peaked in 2014 and has gradually started decreasing in the past few years (Figure 10).

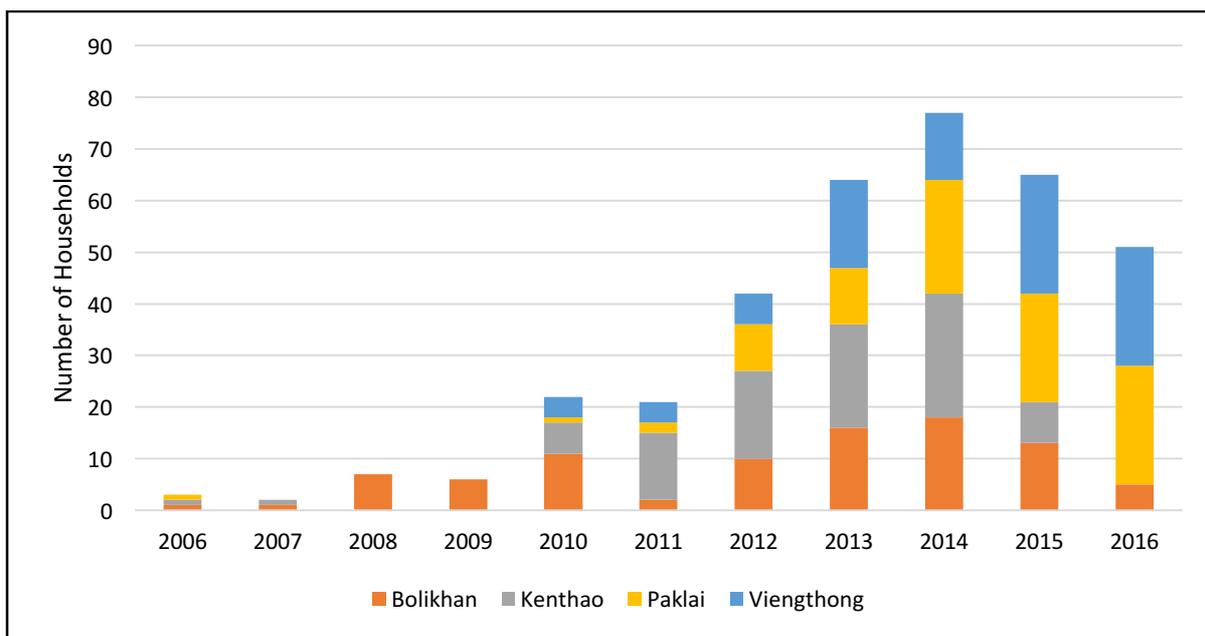


Figure 10: Year of First Cassava Production, by Commune

## Income from various on-farm and off-farm activities

The production of paddy rice is an important contributor to livelihoods of households in all surveyed districts; particularly in Viengthong where it is the most important source and constitutes almost 44% of overall household livelihood. The importance of livestock varies significantly across districts with less than 5% contribution to household livelihood in Kenthao while this contribution is over 16% in Viengthong. The importance of off-farm income is also quite variable across districts where it contributes to about 11% of household income in Kenthao while this contribution is slightly higher than 35% in Bolikhan. Tree crops on the other hand were not a significant source, contributing on average less than half a percent across all districts. More information about annual incomes from various sources is given in Figure 11.

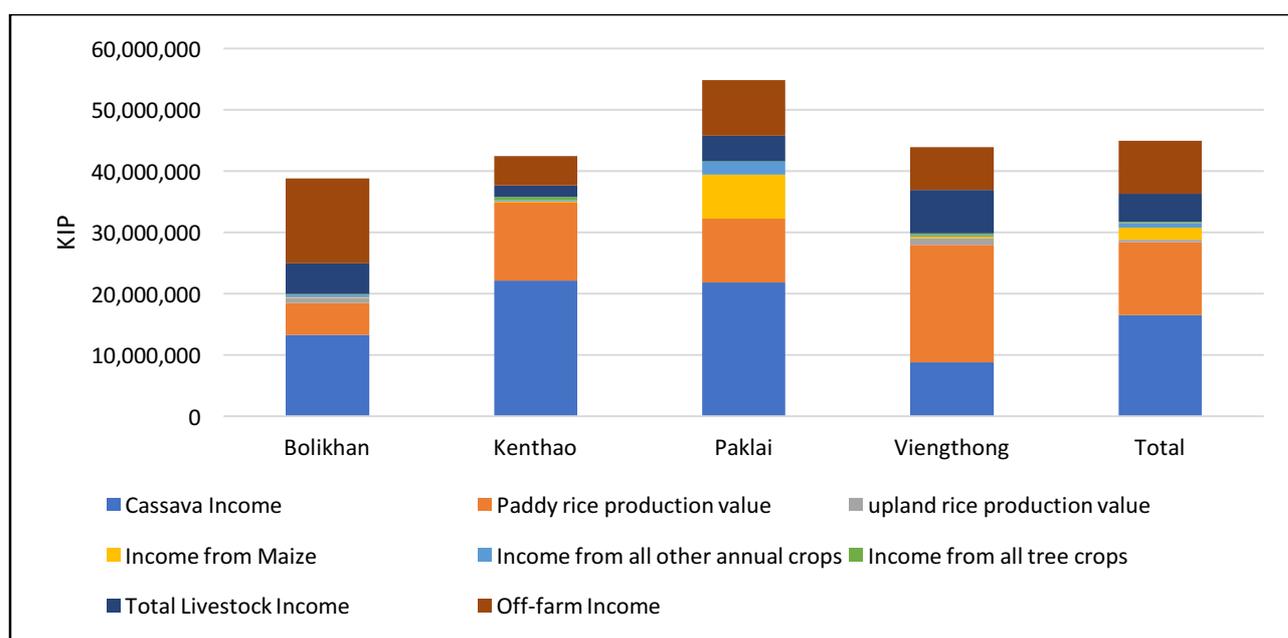


Figure 11: Source of Income, by District

## Importance of Cassava in overall livelihood and in cash income

On average income from cassava production constitutes slightly less than 37% of the overall household income. Households in Paklai district are most dependent upon cassava with income generated from cassava production contributing to over 52% of their household incomes. On the other hand cassava production only constitutes about 20% of income for Viengthong households (Table 2 and Figure 12).

Table 2: Annual Income from different sources, by district (kip)

District	Bolikhan	Kenthao	Paklai	Viengthong	Total
Total Cassava Income	13,351,806	22,201,053	21,894,667	8,858,497	16,576,506
Non-Cassava Cropping Income	6,580,540	13,569,547	19,715,415	20,968,278	15,208,445
Total Livestock Income	5,077,333	1,875,556	4,171,611	7,179,600	4,576,025
Off-farm Income	13,848,889	4,794,722	9,056,667	6,897,600	8,649,470

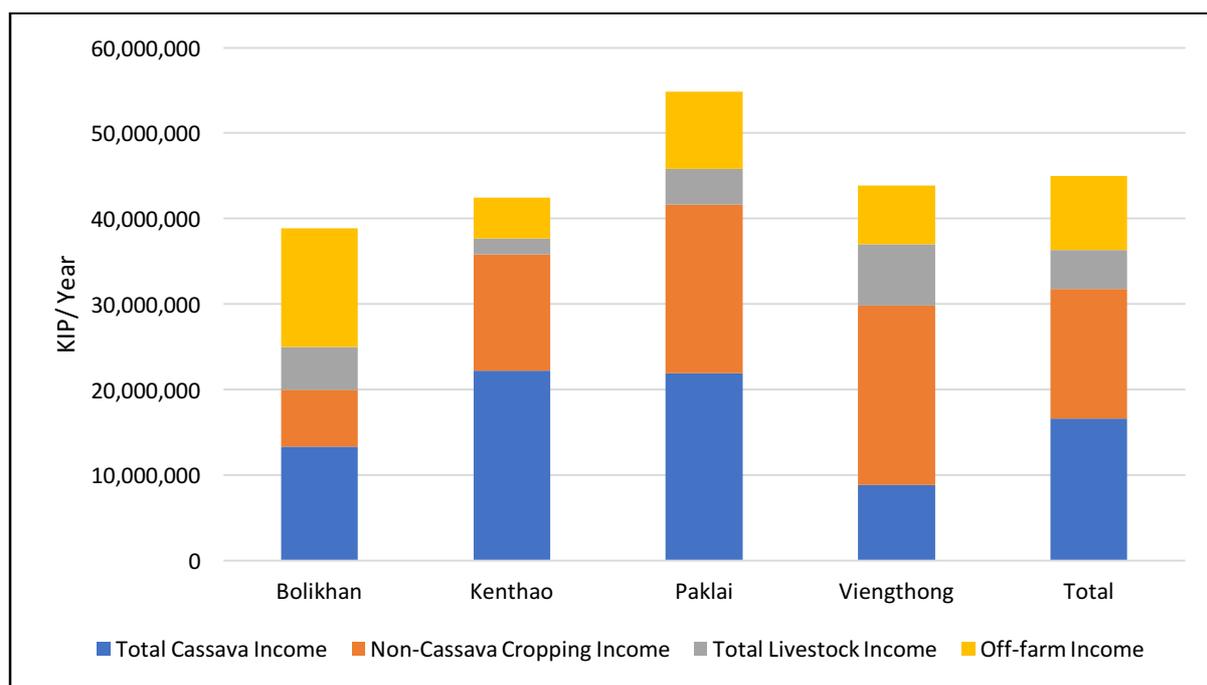


Figure 12: Income Sources, by District

The contribution of cassava to household incomes are quite consistent for the three lower income quartiles where it contributes between 45% and 48% of overall household incomes. However, for the highest income quartile this contribution falls to about 28%. While only about 10% of income is generated from off-farm work for the two lower quartiles, this proportion is roughly double (about 20%) for farmers in the third and fourth quartiles (Table 3 and Figure 13).

Table 3: Annual Income from different sources, by income quartile

Income Quartiles	Q1	Q2	Q3	Q4	Total
Total Cassava Income	7,138,032	12,636,588	19,009,827	27,521,576	16,576,506
Non-Cassava Cropping Income	5,856,082	7,933,643	8,990,518	38,053,538	15,208,445
Total Livestock Income	892,156	2,527,778	5,207,556	9,676,611	4,576,025
Off-farm Income	1,221,500	3,181,778	8,637,622	21,556,978	8,649,470

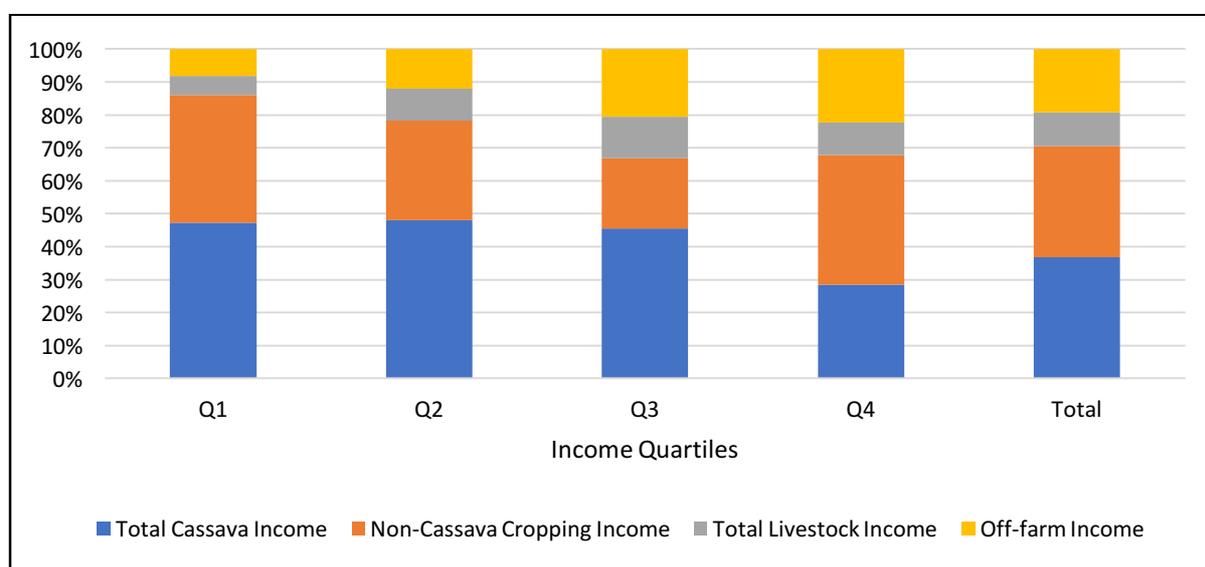


Figure 13: Sources of Livelihood, by Income Quartile

The sources of cash income by income quartile are shown in Figure 14. This is derived by not including the value of the staple crop (paddy or upland rice) in the calculation of gross income. The figure highlights the importance of cassava as a source of cash income particularly to the lowest income households. Income from cassava constitutes 73% of household income for the lowest income quartile and 65% for the second income quartile. Cassava remains a dominant source of household income even for the wealthiest quartile supplying over 40% of their household cash income. The figure also shows the increasing importance of income from off farm sources as households become wealthier.

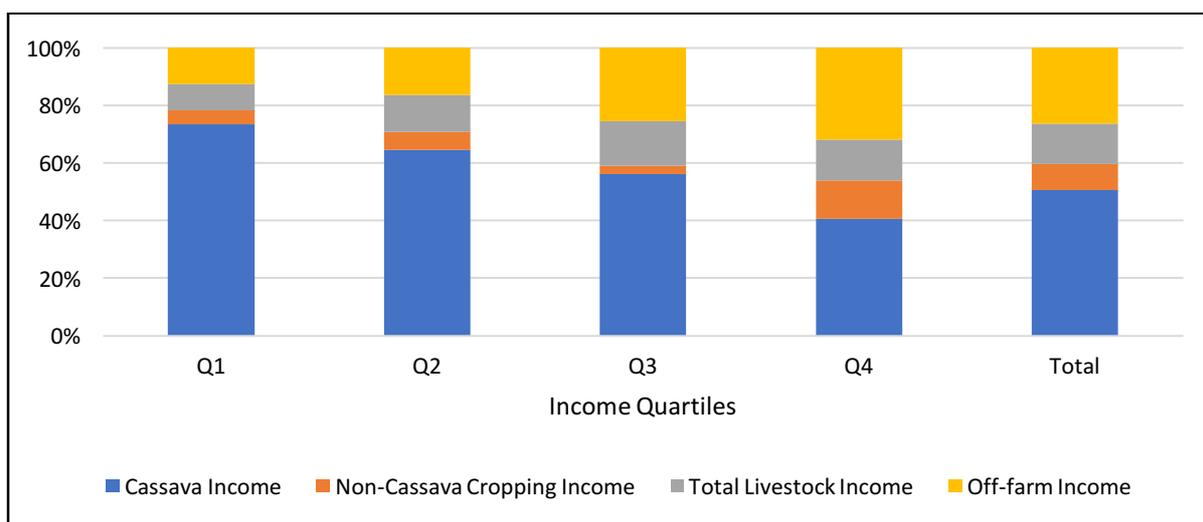


Figure 14: Cash Income Source, by Income Quartile

### Labour Force

Across all surveyed districts, the average household size was 5.19. While an average of 2.51 household members were full time agricultural workers, an average of 4.23 members had at least some involvement in agriculture. The level of involvement with agriculture was similar across men and women.

Table 4: Number of family members by employment status

Employment status in Agriculture	Average Number of Family Members		
	Females	Males	Total
Full time	1.23	1.28	2.51
Never	0.44	0.52	0.96
Part time	0.08	0.07	0.14
Rarely	0.81	0.77	1.58
<b>Total</b>	<b>2.56</b>	<b>2.63</b>	<b>5.19</b>

### Use of labour by gender and household/non-household

Specific gender roles do not seem to exist in the production of cassava. The various tasks involved in cassava production (Figure X) shows an even distribution of person-days per year across male and female agricultural workers.

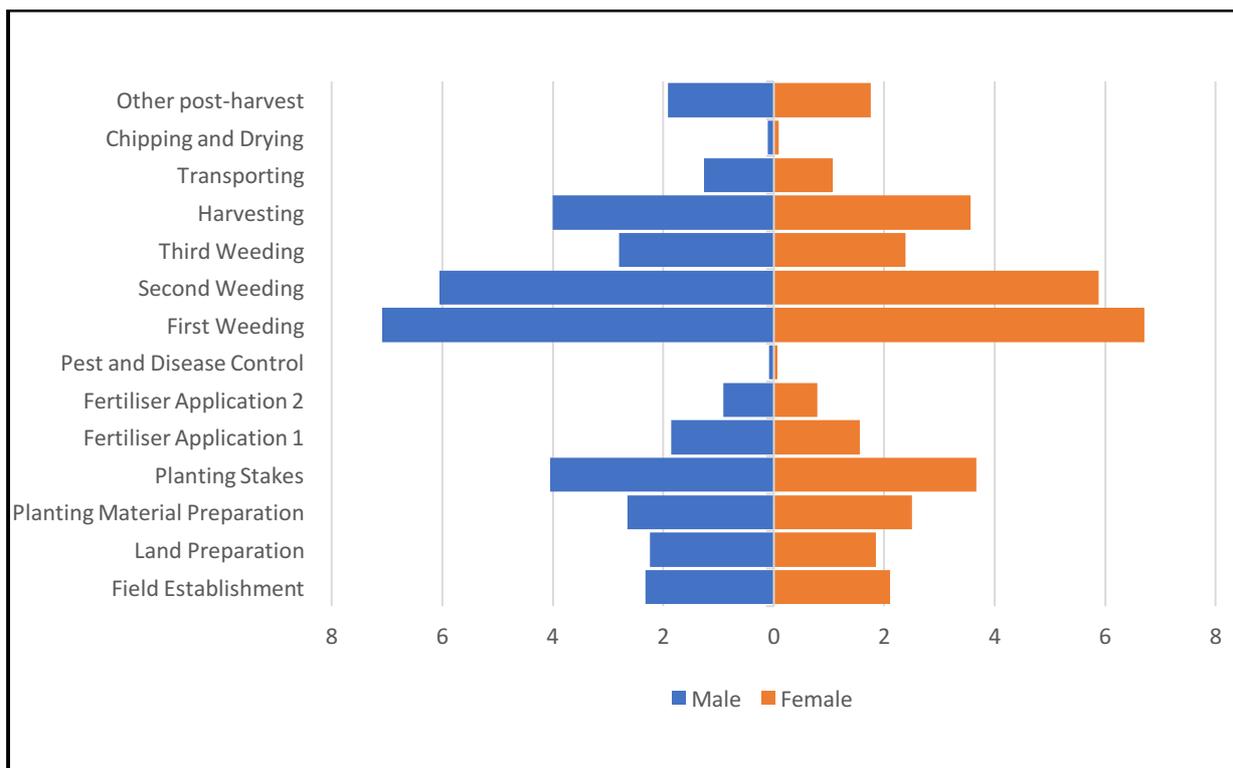


Figure 15: Household Labour Person-Days per hectare, by Gender

Household labour is utilized more often than outside labour except for planting stakes and harvesting purposes. The single largest activity absorbing household labour is weeding, accounting for more than 30 person days of household labour per hectare per year across the three separate rounds of weeding. Harvesting is the other activity requiring significant levels of labour, most of which households depend upon outside labour. Detailed labour utilisation and cost figures are shown in Table 28.

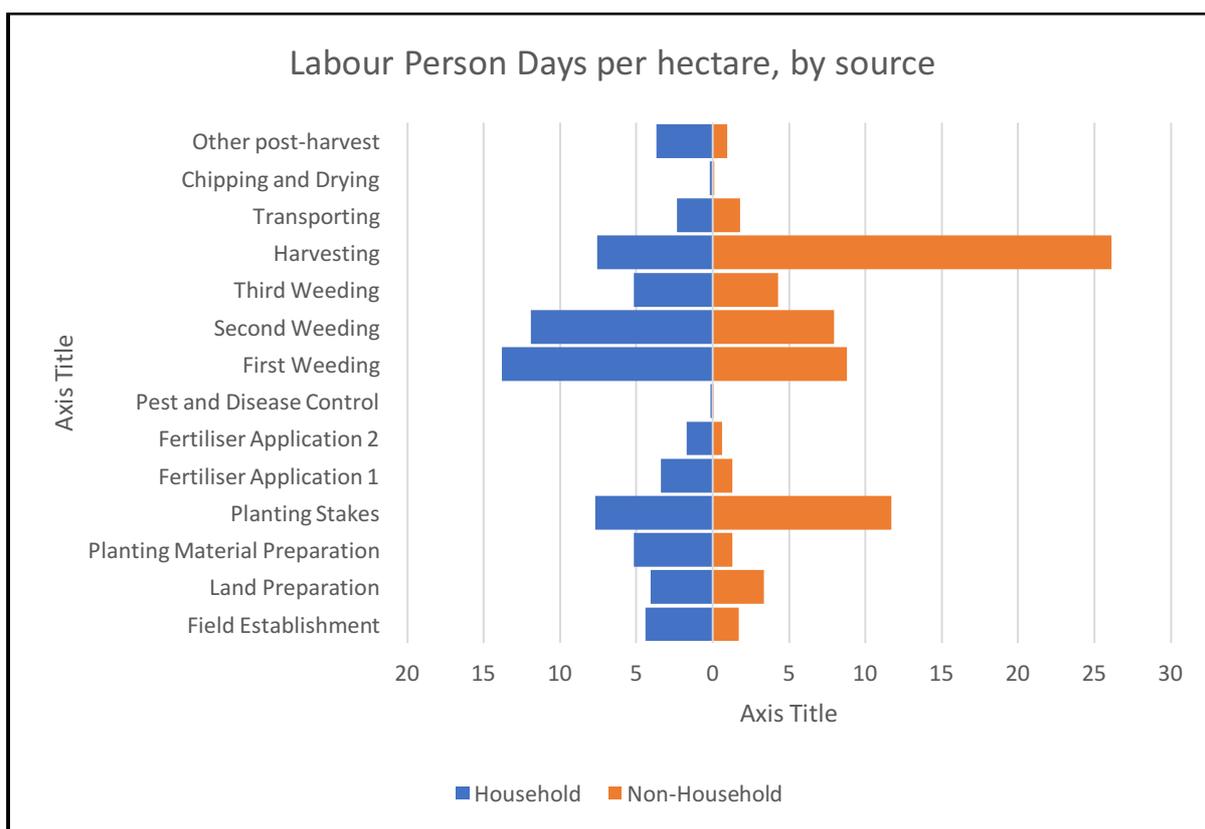


Figure 16: Labour Person-Days per hectare, by Source

### Access to credit

Relatively few households (11% of all households) had taken a loan in the past 12 months, with almost all of them having taken out only a single loan. Quartile 2 reported the highest proportion of households with loans (almost 16%) while less than 8% of households in quartile 1 took out a loan in the last 12 months (Table 5).

Table 5: 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	7.9%	15.7%	8.9%	11.6%	11.0%
% households with 1 loan	7.9%	15.7%	8.9%	10.5%	10.7%
% households with 2 loans	0.0%	0.0%	0.0%	1.2%	0.3%
Average value of total loans received (KIP)	9,916,667	8,807,847	9,562,500	14,200,500	10,608,298

Of those surveyed 58% indicated that their level of debt was either manageable or very manageable while the remaining respondents seemed to at least have some concerns. As shown in Table 6 slightly over 35% reported serious problems with their debt claiming they were 'very unmanageable'.

Table 6: Manageability of debt

How manageable is the current level of debt	Frequency	Percent
Very unmanageable	22	35.5%
Some concern	4	6.5%
Manageable	25	40.3%
Very manageable	11	17.7%
Total	62	100.0%

## Access to information

The most common source of information on agricultural production was through friends and neighbours within the village itself. A significant number of farmers pointed to cassava traders and processors as their sources of information for agricultural production while only a handful regarded their information source to be the province or district government extension programs.

Table 7: Sources of information on agricultural production

Source of Information	Frequency	Percentage
Friends and neighbours in the village	260	72.2%
Cassava Traders	77	21.4%
Family	72	20.0%
Cassava Processors	58	16.1%
Friends and neighbours outside the village	57	15.8%
Other	24	6.7%
District government extension	23	6.4%
TV	13	3.6%
Farmer Group	5	1.4%
Province government extension staff	3	0.8%
Radio	3	0.8%
Non Government Organizations	1	0.3%
Researchers	1	0.3%
Internet	0	0.0%

Friends and neighbours were still regarded as the primary source of information for agricultural markets, however cassava traders and processors also played a greater role in informing farmers about such markets. The role of government extension programs for marketing information on the other hand was almost non-existent.

Table 8: Sources of information on agricultural markets

Source of Information	Frequency	Percentage
Friends and neighbours in the village	243	67.5%
Cassava Traders	158	43.9%
Cassava processors	97	26.9%
Family	48	13.3%
Friends and neighbours outside the village	38	10.6%
Other	17	4.7%
Farmer group	4	1.1%
District government extension	2	0.6%
TV	2	0.6%
Radio	2	0.6%
Province government extension staff	1	0.3%
Non government organisation	0	0.0%
Researchers	0	0.0%
Internet	0	0.0%

### Group membership

A total of 97 households (27% of all households) indicated that they had a household member participating in a group or a mass organization. While about 50% of these households were involved with only one organization, some households had memberships for up to six organizations.

### Ownership of assets

The mode of transportation used by most farmers was a motorbike. The proportion of households owning a motorbike was over 90% with those in the first quartile slightly below at about 87%. Over 75% of farmers owned 2 or 4 wheel tractors, and as shown in figure X a key purpose of the tractors was for cassava cultivation. Over 90% of farmers had a mobile phone and over a quarter even had access to a smart phone.

Table 9: Asset ownership by income quartile

Assets	Q1	Q2	Q3	Q4	Total
Truck	1.1%	1.1%	4.4%	11.1%	4.4%
car	10.0%	3.3%	17.8%	22.2%	13.3%
motorbike	86.7%	92.2%	92.2%	93.3%	91.1%
Lot sing	17.8%	15.6%	26.7%	31.1%	22.8%
two wheel tractor	58.9%	75.6%	75.6%	83.3%	73.3%
four wheel tractor	8.9%	3.3%	2.2%	11.1%	6.4%
water_pump	5.6%	3.3%	2.2%	6.7%	4.4%
generator	1.1%	3.3%	5.6%	2.2%	3.1%
mobile phone	93.3%	88.9%	92.2%	93.3%	91.9%
smart phone	23.3%	18.9%	28.9%	34.4%	26.4%
tv	83.3%	85.6%	92.2%	96.7%	89.4%
dvd player	17.8%	26.7%	26.7%	47.8%	29.7%
radio	23.3%	26.7%	32.2%	36.7%	29.7%
refrigerator	82.2%	80.0%	90.0%	96.7%	87.2%

## Agronomic Information

### Area, production, Current yields and trends

The average cassava production area per household was 2.15 hectares, varying between 1.36 hectares in Viengthong and 3.05 hectares in Kenthao. Average production was about 45 tons, giving a yield of 22.58 tons per hectare (Table 10). The yield per hectare ranged from a high of 27.34 tons per hectare in Kenthao to a low of 17.66 hectares in Bolikhan.

Table 10: Household cassava production characteristics, by district

	<b>Bolikhan</b>	<b>Kenthao</b>	<b>Paklai</b>	<b>Viengthong</b>	<b>Total</b>
Cassava production 2016 (kgs)	31.6	71.3	58.3	20.3	45.4
Cassava Harvest Area 2016 (ha)	1.9	3.1	2.3	1.4	2.2
Cassava Yield 2016 (kgs/ha)	17.7	26.6	27.3	18.8	22.6

In Laos we find a wide range of cassava varieties being adopted by the farmers. The most popular varieties being grown include the FR variety which is adopted by almost 22% of farmers, followed by Rayong, Green Eloup, and Ab ah varieties. Over 20% of farmers are found to be growing varieties other than those listed above while a further 15% are not aware of the varieties they currently have in their farms (Table 11).

Table 11: Proportion of farmers (%) growing various cassava varieties, Laos

<b>Variety</b>	<b>Frequency</b>	<b>Percent</b>
<b>FR</b>	69	21.50%
<b>Rayong</b>	52	16.20%
<b>Green</b>	37	11.53%
<b>Eloup</b>	26	8.10%
<b>Ab ah</b>	23	7.17%
<b>Other</b>	66	20.56%
<b>Don't Know</b>	48	14.95%
<b>Total</b>	<b>321</b>	<b>100.00%</b>

Figure 17 shows the year each of the five major cassava varieties were first adopted by farmers in Laos. It should be noted that these five cassava varieties only represents about 64% of all farms in the Laos survey site. It wasn't until the year 2006 that the first cassava varieties were introduced in Laos when Rayong was the sole variety adopted until 2009 with the exception of FR.

The year 2010 saw the introduction of the Green variety followed by Ab ah and Eloup in 2011 and 2012 respectively. The adoption of all varieties escalated particularly in the years 2014 and 2015. While the rate of adoption of all five varieties were still relatively high by 2016, there seems to have been a sudden drop in the adoption of these varieties in 2017. This may be as a result of saturation of all farmlands.

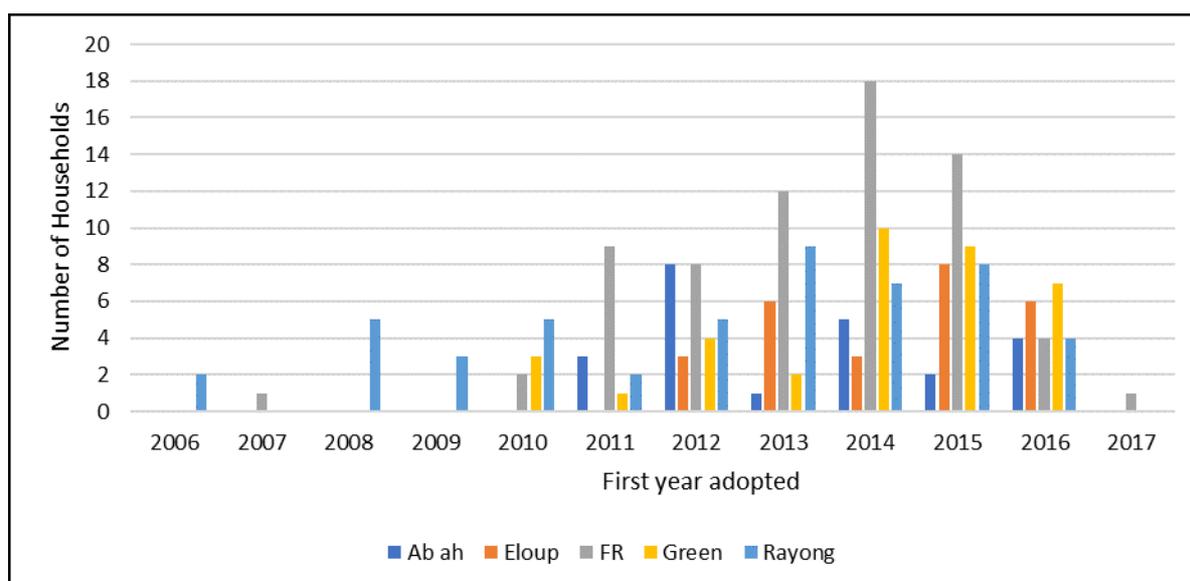


Figure 17: First year for adoption of cassava variety, Laos

### Highest and lowest yields

The average highest cassava yield in the past five years across all districts was 26.55 tons per hectare, with Kenthao leading the rest of the districts with 31.76 tons per hectare. The lowest yield on the other hand was 20.84 tons per hectare with Viengthong at the bottom end with 14.79 tons per hectare.

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

	<b>Bolikhan</b>	<b>Kenthao</b>	<b>Paklai</b>	<b>Viengthong</b>	<b>Total</b>
Highest Cassava Production in the last five years (tons)	49.9	88.8	63.9	24.2	57.2
Area Utilized for Highest Cassava Yield in the last five years (ha)	2.2	3.1	2.2	1.6	2.3
Highest Cassava Yield in the last five years (tons/ha)	25.4	31.8	30.7	17.9	26.6
Lowest Cassava Production in the last five years (tons)	26.3	47.1	39.5	14.7	32.2
Area Utilized for Lowest Cassava Yield in the last five years (ha)	1.8	2.3	1.7	1.2	1.7
Lowest Cassava Yield in the last five years (tons /ha)	15.5	27.1	25.6	14.8	20.8

Cassava yields were declining either moderately or rapidly for about 50% of farmers across all districts. The worst performance was reported in Kenthao where almost 65% of farmers indicated a decline followed by Bolikhan with about 55% reporting a declining trend. On the contrary over 20% of farmers across all districts reported increasing cassava yields with over 28% of farmers in Paklai indicating either an increasing or rapidly increasing cassava yields.

Table 13: Cassava yield trends, by district

Yield Trend	Bolikhan	Kenthao	Paklai	Viengthong	Total
Declining rapidly	25.8%	18.9%	6.7%	8.2%	15.0%
Declining moderately	34.8%	45.6%	31.5%	30.6%	35.7%
fluctuating, but no clear trend	4.5%	1.1%	4.5%	5.9%	4.0%
Relatively constant	20.2%	12.2%	29.2%	41.2%	25.5%
Increasing	11.2%	20.0%	22.5%	11.8%	16.4%
Increasing rapidly	3.4%	2.2%	5.6%	2.4%	3.4%

## Plans for growing cassava in the future

A total of 40% of all farmers surveyed indicated that they intended to plant cassava into the future. A much smaller proportion of about 8% stated that they would not be growing cassava in the future while over 50% claimed to be unsure about their future decisions. The intentions for future cassava production varied across districts and income quartiles (Table 14 and Table 15). Farmers in Viengthong indicated the highest likelihood of planting cassava in the future while it was lowest for Kenthao with only 24% stating such intent. Across income quartiles it was farmers in the first quartile that were most likely to keep up with cassava production into the future.

Table 14: Future production intention, by district

Will you grow Cassava in the Future?	Bolikhan	Kenthao	Paklai	Viengthong	Total
Yes	47.8%	24.4%	34.4%	53.3%	40.0%
No	20.0%	5.6%	2.2%	4.4%	8.1%
Unsure	32.2%	70.0%	63.3%	42.2%	51.9%

Table 15: Future production intention, by income quartile

Will you grow Cassava in the Future?	Q1	Q2	Q3	Q4	Total
Yes	48.9%	40.0%	35.6%	35.6%	40.0%
No	6.7%	8.9%	10.0%	6.7%	8.1%
Unsure	44.4%	51.1%	54.4%	57.8%	51.9%

## Soil Erosion Problems and Control Techniques

Only about 6% of cassava farmers viewed soil erosion as a problem although this perception ranged from a high of 12% of farmers in Bolikhan to a low of about 2% in Paklai. As a result, only a handful of farmers were aware of measures to reduce soil erosion or had received any training for mitigating soil erosion. However, almost 36% of farmers were keen to participate in erosion control measure trials on their land.

Table 16: Soil erosion perception, by district

	<b>Bolikhan</b>	<b>Kenthao</b>	<b>Paklai</b>	<b>Viengthong</b>	<b>Total</b>
<b>Soil Erosion perceived as a problem</b>	12.2%	7.8%	2.2%	3.3%	6.4%
Medium Problem	7.8%	2.2%	1.1%	0.0%	2.8%
Serious Problem	0.0%	4.4%	0.0%	2.2%	1.7%
Small Problem	4.4%	1.1%	1.1%	1.1%	1.9%
Are you aware of any measure to reduce soil erosion?	3.5%	4.4%	0.0%	2.5%	2.7%
Have you had any training on any soil conservation measures?	0.0%	0.0%	0.0%	1.2%	0.3%
Are you interested in trialling conservation practices on your land?	40.0%	26.7%	31.1%	45.6%	35.8%

Adoption of intercropping is also found to be extremely low with only 1% of farmers ever having grown intercrops with cassava and less than half a percent currently growing and form of intercrop. However over 25% of farmers indicated that they were interested in trialling intercrops on their lands.

Table 17: Awareness of intercropping, by district

	<b>Bolikhan</b>	<b>Kenthao</b>	<b>Paklai</b>	<b>Viengthong</b>	<b>Total</b>
Have you ever grown intercrops with your cassava?	0.0%	1.1%	3.3%	0.0%	1.1%
Do you currently grow any intercrops with your cassava?	0.0%	0.0%	2.2%	0.0%	0.6%
Are you interested in trialling new intercrops?	28.9%	18.9%	22.2%	33.3%	25.8%

## Fertiliser adoption, awareness and correct application

The cassava farmers did not apply any type of fertilizer, either organic or inorganic for their cassava production. In fact there was only one farmer that reported having applied any fertilizer to their cassava fields. As expected, less than 5% claimed to have seen a fertiliser trial on cassava. However there is a good level of interest amongst farmers with about 50% indicating an interest in visiting a fertiliser demonstration trial and/or conducting such trials on their own lands.

Table 18: Fertiliser Practice, by district

	<b>Bolikhan</b>	<b>Kenthao</b>	<b>Paklai</b>	<b>Viengthong</b>	<b>Total</b>
Do you apply organic fertiliser to your cassava?	1.1%	0.0%	0.0%	0.0%	0.3%
Do you apply inorganic fertiliser to your cassava?	1.1%	0.0%	0.0%	0.0%	0.3%
Do you understand what the NPK values mean on the fertiliser you apply?	1.1%	1.1%	1.1%	0.0%	0.8%
Have you ever seen a fertiliser trial on cassava?	6.7%	4.4%	3.3%	3.3%	4.4%
Are you interested in visiting a fertiliser demonstration trial to see the result on production and returns?	53.3%	41.1%	52.2%	56.7%	50.8%
Are you interested in conducting a trial on your own land?	47.8%	44.4%	48.9%	53.3%	48.6%

## Weeding and herbicide

Almost 97% of farmers indicated that weeds were a problem and that weeds limited the productivity of their cassava crop. This pattern was relatively constant across all districts.

Table 19: Weed Impact Perception, by district

Do you think that weeds limit the productivity of your cassava crop?	Bolikhan	Kenthao	Paklai	Viengthong	Total
large problem	56.7%	55.6%	54.4%	64.0%	57.7%
medium problem	30.0%	26.7%	27.8%	23.6%	27.0%
Small problem	10.0%	17.8%	16.7%	4.5%	12.3%
No	3.3%	0.0%	1.1%	7.9%	3.1%

Despite almost all farmers indicating that weeds were a significant problem impacting their cassava production, only around 39% of farmers claimed to be using herbicides on their cassava fields. The application of herbicides involved a significant range across districts with only about 2% of farmers reporting the application of herbicides in Bolikhan while the rate of application was close to 85% in Kenthao.

Table 20: Herbicide Practice, by district

	Bolikhan	Kenthao	Paklai	Viengthong	Total
Do you apply any herbicides?	2.2%	84.4%	51.1%	16.7%	38.6%
Have you received any training on herbicide use?	2.2%	6.7%	1.1%	1.1%	2.8%
Do you use protective clothing when applying herbicide?	0.0%	62.2%	41.1%	5.6%	27.2%

Given the seriousness of the weed problem and the low level of herbicide use, it is hardly surprising that a large proportion of farmers (over 88%) practice manual weeding of cassava fields. Most farmers conduct two rounds of weeding over a season (Table 19).

Table 21: Manual Weeding Practice, by district

	Bolikhan	Kenthao	Paklai	Viengthong	Total
Do you conduct manual weeding?	100.0%	83.3%	76.7%	93.3%	88.3%
Missing	2.2%	17.8%	24.4%	8.9%	13.3%
1 weeding	22.2%	27.8%	43.3%	6.7%	25.0%
2 weedings	60.0%	46.7%	28.9%	42.2%	44.4%
3 weedings	12.2%	6.7%	3.3%	38.9%	15.3%
4 weedings	1.1%	1.1%	0.0%	3.3%	1.4%
5 weedings	2.2%	0.0%	0.0%	0.0%	0.6%

## Land Preparation

Over 60% of farmers utilize either 2 or 4 wheel tractors to cultivate their cassava fields although there is quite a bit of variation in terms of employment of tractors across the four districts. Over 95% of farmers use tractors in Paklai, while only about 15% adopt them in Viengthong. The most common method of cultivation in Viengthong is through manual tools which is adopted by 81% of farmers. On the contrary only about 2% of farmers in Paklai use manual tools. Although there is significant disparity with regards to cultivation methods across the four districts (Table 22) one similarity lies in the fact that none of them use buffalo or cattle.

Table 22: Land Cultivation Practice, by district

	<b>Bolikhan</b>	<b>Kenthao</b>	<b>Paklai</b>	<b>Viengthong</b>	<b>Total</b>
Tractor	11.1%	12.2%	12.2%	3.3%	9.7%
4 wheel tractor	66.7%	43.3%	84.4%	11.1%	51.4%
Buffalo or cattle	0.0%	0.0%	0.0%	0.0%	0.0%
Manual Tools	27.8%	32.2%	2.2%	81.1%	35.8%
Make Ridges	66.7%	10.0%	1.1%	4.4%	20.6%
Dibble	0.0%	13.3%	0.0%	14.4%	6.9%

## Cassava Utilization

Almost 81% of farmers across all districts sold fresh cassava. All surveyed farmers in Kenthao and Paklai sold fresh cassava, although this proportion was lower for Bolikhan at 77.8% and Viengthong at 45%. The remaining cassava were mostly sold as dry chips by farmers in Viengthong and Bolikhan. Overall only about 1% of the cassava was used to feed livestock. (Table 23).

Table 23: Cassava Utilization, by district

<b>District</b>	<b>Bolikhan</b>	<b>Kenthao</b>	<b>Paklai</b>	<b>Viengthong</b>	<b>Total</b>
Eat	0.0%	0.0%	0.0%	0.0%	0.0%
Use for own livestock	1.1%	0.0%	0.0%	4.4%	1.4%
Cassava Leaf	0.0%	0.0%	0.0%	0.0%	0.0%
Sell fresh cassava	77.8%	100.0%	100.0%	45.6%	80.8%
Sell Dried cassava	30.0%	0.0%	0.0%	63.3%	23.3%

## Relationship with Traders

Of farmers that sold cassava to fresh root traders, only around 18% described the relationship as strong or very strong, while about 37% regarded the relationship to be weak or very weak. The farmers in Bolikhan and Viengthong who were the only ones involved in selling dry chips had slightly differing perceptions regarding their relationship with traders. Farmers in Bolikhan seemed to have a better relationship with their traders with almost 50% indicating they have a strong or a very strong relationship with them while this was the case only for about 19% of farmers in Viengthong (Table 24 and Table 25)

Table 24: Relationship with fresh root traders, by district

Relationship with fresh root traders	Bolikhan	Kenthao	Paklai	Viengthong	Total
Very strong	1.9%	2.2%	7.1%	0.0%	3.5%
Strong	13.5%	17.8%	16.7%	3.5%	14.9%
Moderate	30.8%	58.9%	46.4%	17.2%	44.3%
Weak	42.3%	20.0%	22.6%	65.5%	30.6%
Very weak	11.5%	1.1%	7.1%	13.8%	6.7%

Table 25: Relationship with dry chip traders, by district

Relationship with dry chip traders	Bolikhan	Kenthao	Paklai	Viengthong	Total
Very strong	15.4%	0.0%	0.0%	0.0%	5.4%
Strong	34.6%	0.0%	0.0%	18.8%	24.3%
Moderate	23.1%	0.0%	0.0%	35.4%	31.1%
Weak	11.5%	0.0%	0.0%	27.1%	21.6%
Very weak	15.4%	0.0%	0.0%	18.8%	17.6%

## Trials 2016-2017

Variety and fertilizer trials have been planted in Bolikhamsay, and variety, fertiliser and intercropping trials have been planted in Xayabouly. The trials were planted in April-May 2017 and are expected to be harvested in February-March 2018.

Variety trials in Laos will involve a total of **7** varieties of cassava to be evaluated with cassava collectors and cassava companies:

1. Kasatsad 50 (KU 50)
2. Rayong 9 (R9)
3. Rayong 11 (R11)
4. Rayong 72 (R72)
5. KM 140
6. KM 21-12
7. Local variety

Fertilizer trials in Laos involve a split-plot design with 3 Replications with 6 treatments and 2 varieties. The objective is to study the response of two cassava varieties to the application of various combinations of fertilizers (N, P and K) in order to find the best and most economic fertilizer rate to obtain and maintain high cassava yields. Risk assessment will be conducted and an effort to evaluate different households' attitudes to risk and debt. This includes assessing variations based on ethnicity, gender and age.

Intercropping trials in Laos aim to study the different legume intercroppings with cassava to find the best and most economic option for farmers in Xayabouly province. The trial has three replications and four treatments (peanut, mung bean, Yard-long bean, no treatment). During the analysis, a strong emphasis will be on changes in labour utilization by gender and age, as well as production and market risk.

## Future plans and partnerships

### Opportunities and new ideas for 2018

The value chain survey and household survey results highlight a number of constraints along both the production and marketing process and as a result point to clear conclusions for future plans and partnerships.

Further promotion of mechanized land preparation could save labour reducing competition with other necessary forms of agricultural production such as rice. Weed is regarded as a significant problem however herbicide application is relatively low. Encouraging herbicide use could further boost production while significantly saving labour which currently is the most labour demanding activity related to cassava production.

The current cassava production methods do not involve any organic or inorganic fertilizer use. Introduction of appropriate fertilizers could potentially result in higher yields. Also higher yielding cassava varieties are likely to have the most potential for increasing yields and improving farmer livelihoods and present the least challenges for adoption.

The dominance of cassava upon overall agricultural production means that any increases in productivity through the introduction of new technologies and management practices could aid in significantly improving farmer livelihoods.

## Detailed Tables

Table 26: Average Household Incomes from various sources (KIP/Year), by district

Average Household Incomes from various Sources (KIP/year)					
District	Bolikhan	Kenthao	Paklai	Viengthong	Total
Cassava Income	13,351,806.44	22,201,052.78	21,894,666.67	8,858,497.22	16,576,505.78
Paddy rice production value	5,183,176.01	12,717,408.30	10,323,387.25	19,129,573.24	11,838,386.20
Paddy rice sale value	573,427.09	2,510,623.06	1,035,518.52	2,647,173.42	1,691,685.52
upland rice production value	828,642.22	0.00	0.00	1,025,149.30	463,447.88
upland rice sale value	147,997.78	0.00	0.00	197,778.00	86,443.94
Income from Maize	44,722.22	200,972.22	7,257,083.33	321,333.33	1,956,027.78
Income from all other annual crops	457,333.33	201,555.56	2,127,722.22	232,222.22	754,708.33
Income from coffee	0.00	0.00	0.00	0.00	0.00
Income from all tree crops	66,666.67	449,611.11	7,222.22	260,000.00	195,875.00
Cropping Income	19,932,346.90	35,770,599.97	41,610,081.70	29,826,775.32	31,784,950.97
Non-Cassava Cropping Income	6,580,540.46	13,569,547.19	19,715,415.03	20,968,278.10	15,208,445.19
Cattle Income	2,434,444.44	1,044,444.44	1,741,666.67	3,865,155.56	2,271,427.78
Buffalo Income	1,172,222.22	305,555.56	1,516,666.67	2,322,222.22	1,329,166.67
Goat Income	161,111.11	0.00	0.00	44,444.44	51,388.89
Pig Income	954,777.78	83,888.89	842,777.78	805,000.00	671,611.11
Chicken Income	250,888.89	429,444.44	46,111.11	53,333.33	194,944.44
Duck Income	103,888.89	12,222.22	24,388.89	22,778.00	40,819.50
Other Livestock Income	0.00	0.00	0.00	0.00	0.00
fish Income	0.00	0.00	0.00	66,666.67	16,666.67
Total Livestock Income	5,077,333.33	1,875,555.56	4,171,611.11	7,179,600.22	4,576,025.06
On-farm Income	25,009,680.23	37,646,155.52	45,781,692.81	37,006,375.54	36,360,976.03
Off-farm Wages	791,111.11	756,944.44	3,062,222.22	1,811,777.78	1,605,513.89
Irregular non-farm income	1,926,666.67	1,000,555.56	1,467,777.78	938,888.89	1,333,472.22
Salary Income	4,668,888.89	1,697,777.78	2,348,888.89	2,144,667.06	2,715,055.65
Remittance Income	2,238,888.89	258,333.33	272,222.22	690,044.44	864,872.22
NTFP income	134,444.44	61,111.11	19,444.44	134,444.44	87,361.11
Timber income	522,222.22	0.00	0.00	88,888.89	152,777.78

Fishing Income	0.00	0.00	88,888.89	0.00	22,222.22
Other Income	3,566,666.67	1,020,000.00	1,797,222.22	1,088,888.89	1,868,194.44
Off-farm Income	13,848,888.89	4,794,722.22	9,056,666.67	6,897,600.39	8,649,469.54
Total Income	38,858,569.12	42,440,877.74	54,838,359.47	43,903,975.93	45,010,445.57

Table 27: Average Household Incomes from various sources (KIP/Year), by income quartile

Average Household Incomes from various Sources (KIP/year)					
Income Quartiles	Q1	Q2	Q3	Q4	Total
Cassava Income	7,138,032.00	12,636,588.33	19,009,826.67	27,521,576.11	16,576,505.78
Paddy rice production value	4,590,428.78	6,343,098.25	7,688,812.28	28,731,205.49	11,838,386.20
Paddy rice sale value	799,388.56	981,896.96	1,317,297.10	3,668,159.47	1,691,685.52
upland rice production value	784,986.34	392,239.58	289,844.53	386,721.07	463,447.88
upland rice sale value	108,294.11	179,148.32	48,444.44	9,888.90	86,443.94
Income from Maize	348,444.44	625,083.33	856,972.22	5,993,611.11	1,956,027.78
Income from all other annual crops	132,222.22	401,000.00	102,111.11	2,383,500.00	754,708.33
Income from coffee	0.00	0.00	0.00	0.00	0.00
Income from all tree crops	0.00	172,222.22	52,777.78	558,500.00	195,875.00
Cropping Income	12,994,113.79	20,570,231.71	28,000,344.59	65,575,113.78	31,784,950.97
Non-Cassava Cropping Income	5,856,081.79	7,933,643.38	8,990,517.93	38,053,537.67	15,208,445.19
Cattle Income	467,600.00	1,572,222.22	3,025,333.33	4,020,555.56	2,271,427.78
Buffalo Income	55,555.56	245,555.56	1,293,333.33	3,722,222.22	1,329,166.67
Goat Income	0.00	122,222.22	44,444.44	38,888.89	51,388.89
Pig Income	327,555.56	422,222.22	615,000.00	1,321,666.67	671,611.11
Chicken Income	34,777.78	58,333.33	157,222.22	529,444.44	194,944.44
Duck Income	6,666.89	40,555.56	72,222.22	43,833.33	40,819.50
Other Livestock Income	0.00	0.00	0.00	0.00	0.00
fish Income	0.00	66,666.67	0.00	0.00	16,666.67
Total Livestock Income	892,155.78	2,527,777.78	5,207,555.56	9,676,611.11	4,576,025.06
On-farm Income	13,886,269.57	23,098,009.49	33,207,900.15	75,251,724.89	36,360,976.03
Off-farm Wages	245,388.89	397,777.78	931,111.11	4,847,777.78	1,605,513.89
Irregular non-farm income	345,555.56	1,269,444.44	1,381,111.11	2,337,777.78	1,333,472.22
Salary Income	0.39	466,666.67	3,138,000.00	7,255,555.56	2,715,055.65

Remittance Income	160,000.00	522,888.89	1,020,177.78	1,756,422.22	864,872.22
NTFP income	117,777.78	33,333.33	41,666.67	156,666.67	87,361.11
Timber income	66,666.67	33,333.33	511,111.11	0.00	152,777.78
Fishing Income	0.00	0.00	11,111.11	77,777.78	22,222.22
Other Income	286,111.11	458,333.33	1,603,333.33	5,125,000.00	1,868,194.44
Off-farm Income	1,221,500.39	3,181,777.78	8,637,622.22	21,556,977.78	8,649,469.54
Total Income	15,107,769.96	26,279,787.27	41,845,522.37	96,808,702.67	45,010,445.57

Table 28: Labour costs for various production activities (KIP/Year), by district

Name of District	Bolikhan	Kenthao	Paklai	Viengthong	Total
Field Establishment Household Labour	64,928.77	53,718.25	81,689.36	238,283.73	109,655.03
Field Establishment Outside Labour	10,000.00	5,555.56	555.56	17,851.08	8,490.55
Land Preparation Household Labour	46,606.31	43,907.09	36,646.70	281,800.04	102,240.04
Land Preparation Outside Labour	20,074.07	21,984.90	4,914.35	46,898.15	23,467.87
Planting Material Preparation Household Labour	116,653.56	118,461.82	127,470.34	305,820.10	167,101.46
Planting Material Preparation Outside Labour	15,292.93	18,123.86	49,884.26	42,612.43	31,478.37
Planting Stakes Household Labour	206,650.15	242,170.16	219,533.06	242,434.41	227,696.94
Planting Stakes Outside Labour	58,870.83	110,585.19	381,508.19	49,431.22	150,098.86
Fertiliser Application 1 Household Labour	277.78	0.00	0.00	0.00	69.44
Fertiliser Application 1 Outside Labour	0.00	0.00	0.00	0.00	0.00
Fertiliser Application 2 Household Labour	0.00	0.00	0.00	0.00	0.00
Fertiliser Application 2 Outside Labour	0.00	0.00	0.00	0.00	0.00
Pest and Disease Control Household Labour	7,577.38	11,992.69	7,530.42	4,589.95	7,922.61
Pest and Disease Control Outside Labour	0.00	0.00	0.00	0.00	0.00
First Weeding Household Labour	359,751.21	126,987.41	226,123.12	388,348.21	275,302.49
First Weeding Outside Labour	63,644.90	17,578.22	127,255.60	70,996.47	69,868.80
Second Weeding Household Labour	223,241.33	66,669.36	78,583.21	307,480.16	168,993.51
Second Weeding Outside Labour	29,646.22	4,595.02	24,950.62	35,456.35	23,662.05
Third Weeding Household Labour	76,393.82	4,913.79	1,370.37	143,794.09	56,618.02
Third Weeding Outside Labour	5,218.86	925.93	0.00	11,111.11	4,313.97

Harvesting Household Labour	519,138.23	602,924.79	380,958.53	671,523.37	543,636.23
Harvesting Outside Labour	160,555.97	271,580.46	575,050.57	44,510.58	262,924.40
Transporting Household Labour	170,175.80	134,367.90	140,445.38	322,204.03	191,798.28
Transporting Outside Labour	29,069.75	37,834.12	88,364.37	22,175.93	44,361.04
Chipping and Drying Household Labour	169,962.61	0.00	333.33	333,154.21	125,862.54
Chipping and Drying Outside Labour	6,833.33	0.00	0.00	32,962.96	9,949.07
Other post-harvest Household Labour	74,316.61	22,794.96	66,107.35	178,617.72	85,459.16
Other post-harvest Outside Labour	2,240.26	0.00	6,481.48	17,500.00	6,555.44
Total Labour	2,437,120.68	1,917,671.46	2,625,756.17	3,809,556.31	2,697,526.15
Household Labour	2,035,673.56	1,428,908.21	1,366,791.18	3,418,050.05	2,062,355.75
Outside Labour	401,447.12	488,763.24	1,258,964.99	391,506.28	635,170.41