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FARMER FIELD BOOK ANALYSIS

ISLA Programme Vietnam 2016-17

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INTRODUCTION

- The companies Acom, Louis Dreyfus Commodities, Olam Vietnam Ltd and Simexco are partners in the ISLA landscape programme in Vietnam. With co-funding from ISLA, JDE Coffee and Lavazza, these companies implement landscape level projects in parts of their respective coffee supply chains. A component in each of these projects is the implementation of the Farmer Field Book (FFB). In the context the ISLA programme the FFB implementation serves multiple purposes:
  - Provide detailed multi-crop performance data to participating farmers and farmer groups;
  - Assist companies to obtain better insight into the performance of their suppliers; and
  - Provide insight into the degree to which the ISLA programme is meeting its objectives.
- Across 2 provinces 900 farmers keep daily records of their farming activities, investments and returns as well as their production assets and their tree stocks. In Dak Lak 600 farmers are participating, in Lam Dong 300.
- The programme started in July 2016, at which point the coffee season was already underway for 6 months. For this period no daily records are therefore available. The first 6 months for which daily records are missing were included via a backward recording form in which farmers summed up their activities and investments for this period.
- In June 2016, selected staff and managers from the 4 companies were trained in using the FFB for data collection and digitisation of data. In January 2017, staff and managers were trained in data quality checking, analysis and reporting.
- With the FFB programme we generate 4 types of reports:
  - Individual Farm Performance Reports: Detailed performance reports on a per farm and per ha basis;
  - Farmer Group Reports: Detailed reports at farmer group level, allowing farmers to compare their performance to that of their peers;
  - Company Reports: Reports for each company, containing more in-depth statistical analysis on supply chain level; and
  - **ISLA Programme Report**: Overall report combining FFB data from 4 different companies with in-depth programme level analysis.

READERS' GUIDE

- To facilitate time-pressed readers, we have put the **Conclusions** in the first section. Subsequent sections contain the background analysis on which the conclusions are based.
- The section **Household and Farm Profiles** outlines a characterisation of the FFB farmers and their farming system. It also includes a classification of farms across **Agro-Forestry Classes**.
- The **Farm Management** section deals with labor use, payment of workers, the gender wage gap, nutrient management, irrigation, the use of biocides and specifically of products banned by sustainability standards and national law, and replanting of coffee.
- In the **Production** section we dive deeper into production and productivity figures, where deemed useful we split these by province and Agro-Forestry Class. We identify drivers for productivity.
- **Farm Economics** shows cost of production, revenue and profit margins, including Benefit Cost Ratios (BCR) and Return on Assets (ROA) ratios for farmers. Farm management variables that drive the RoA are identified.
- In the **Environmental Performance** section we discuss the Environmental Impact Quotient and coffee related carbon emissions.
- **Recommendations** are provided in the final section.

Key Metrics from FFB Analysis

2.28	Benefit Cost Ratio
10.9%	Return on Assets
410 m^3/Mt coffee	Irrigation water
1.28 Mt CO_2/Mt coffee	Emissions
30/Mt coffee	EIQ
13% of farmers	Use of banned pesticides
3.5%	Gender wage gap

Conclusions

CONCLUSIONS

- **Household and farm profiles:**
  - Most farmers are male; the share of ethnic minority farmers is relatively high in Lam Dong at 27% and 44% for males and females respectively.
  - 57% of farmers fall in the 45 to 59 years age bracket, while 17% is over 59, this may affect future supply availability.
  - Contrary to 10 years ago, farms are much more diversified, mostly with pepper and avocado, especially in Dak Lak.
  - One third of the communes, with 50% of the farmers, have on average highly diversified farms. Nearly all of these are in Dak Lak.
  - We identify 3 Agro-Forestry Classes. Farmers with more than 30% of non-coffee trees are labelled as Highly diversified, between 15% and 30% non coffee trees are Medium diversified and farmers with less than 15% non-coffee trees are considered Monocrop coffee farmers.
  - Coffee planting densities are remarkably similar across the 3 agro-forestry classes. Smaller farms tend to be more diversified, in Dak Lak the difference between farm size in relation to the level of diversification is significant.

- **Labor use:**
  - Labor use amounts to close to 1,678 hours per ha. Most of the work is done by men. Hired labor per ha makes up 32% of total labor. Less than 5% of farmers hire no labor.
  - Hired labor use increases in importance on farms larger than 2 ha. Larger farms make more efficient use of labor in hours worked per Mt coffee produced.
  - Weeding, pruning and harvesting make up 70% of total labor use. Level of danger (spraying) and seasonal demand (harvesting) influence daily rates for hired labor.
  - The gender wage gap is low but in favor of male workers, unless the hiring farmer is female, in which case the gender wage gap favors female over male workers.

CONCLUSIONS

- **Farm management:**
  - Average irrigation volume per Mt is around 410 cubic meter/Mt and 1,081 l/tree. We find few significant differences between Agro-Forestry Classes
  - Farmers in Dak Lak use significantly more irrigation water per tree and per Mt.
  - Farmers predominantly use surface water and open wells for irrigation. Higher energy costs per unit water does not correlate with lower use.
  - Improvements in nutrient management can be made by most farmers. N applications can be reduced, while K applications need to increase.
  - On 43% of farms, fertiliser cost savings can be made through a reduction in N and an increase in K applications.
  - Rejuvenation: using an approximation of tree age, we do not see a major concern over replanting of coffee farms.
  - 44% of farmers spray biocides, 13% of them use biocides not allowed by UTZ & 4C despite being certified.
  - The issue with using banned biocides pertains to 16 products and 9 active ingredients.
  - The issue with using nationally banned biocides is concentrated in 7 communes. Use of biocides banned by the standards is more wide spread.

- **Production:**
  - Average productivity is 4.13 Mt green bean per ha in Lam Dong and 3.05 Mt/ha in Dak Lak. We find no correlation between farm size and productivity for the whole sample, although regional deviations from this do occur.
  - Distribution of production volumes shows that 20% of the farmers are responsible for 40% to 46% of production. Supply distribution is comparable between the provinces. We find no significant differences in productivity between the 3 Agro-Forestry Classes within each province. Differences in production between classes are explained by farm size.

CONCLUSIONS

- **Production:**
  - We identify 8 key factors that explain variability in productivity, 5 of them are directly related to farm management.
  - Farmers are almost consistently making large investments and productivity is very high, hence several farm management variables such as the volume of N applied or the volume of irrigation water do not show up as significant.
  - K applications and pruning labor are limiting factors and could be optimised to further enhance productivity.

- **Farm economics:**
  - Farmers earn on average excellent returns of 2.28 VND on every VND invested in coffee.
  - Without factoring in opportunity cost, farmers need a coffee price of 13,358 VND/kg green bean to reach break-even in Lam Dong and 13,600 VND/kg in Dak Lak,
  - 74% of farmers have a benefit-cost ratio larger than 2. There is no geographical concentration of farmers that are less efficient.
  - The average rate of Return on Assets is 10.9%, and almost all farmers are sufficiently profitable. Farmers with poor returns (<8%) produce just 16% of the total supply.
  - We find that Return on Assets can be improved with a reduction in N applications.

CONCLUSIONS

- **Environmental performance:**
  - The environmental impact quotient per ha is 30 and 10 per Mt coffee.
  - The EIQ in both provinces increases with a higher level of diversification. Across the entire group of FFB farmers there are no significant differences.
  - Carbon emissions average 1.28 Mt per Mt green bean. Fertiliser contributes 60%, followed by energy (40%) and biocides (<1%).
  - Pollution does not pay off: the largest carbon emitters are significantly less profitable as they tend to overspend on fertiliser.

Results
Household and Farm Profiles

HOUSEHOLD PROFILES: FARMER FIELD BOOK RECORDS ARE KEPT BY 900 FARMERS IN 25 COMMUNES IN 12 DISTRICTS OF LAM DONG AND DAK LAK PROVINCE

Lam Dong province			
District	**Commune**	**Nr of FFB farmers**	**Share of total**
Di Linh	Gung Re	13	4%
	TT Di Linh	55	18%
	Tan Chau	55	18%
	Tan Lam	73	24%
	Tan Nghia	18	6%
	Tan Thuong	2	1%
	Loc Ngai	5	2%
	Hoa Ninh	21	7%
	Dinh Trang Hoa	28	9%
	Loc An	8	3%
	Loc Duc	20	7%
	Loc Thanh	2	1%
Total		**300**	**100%**

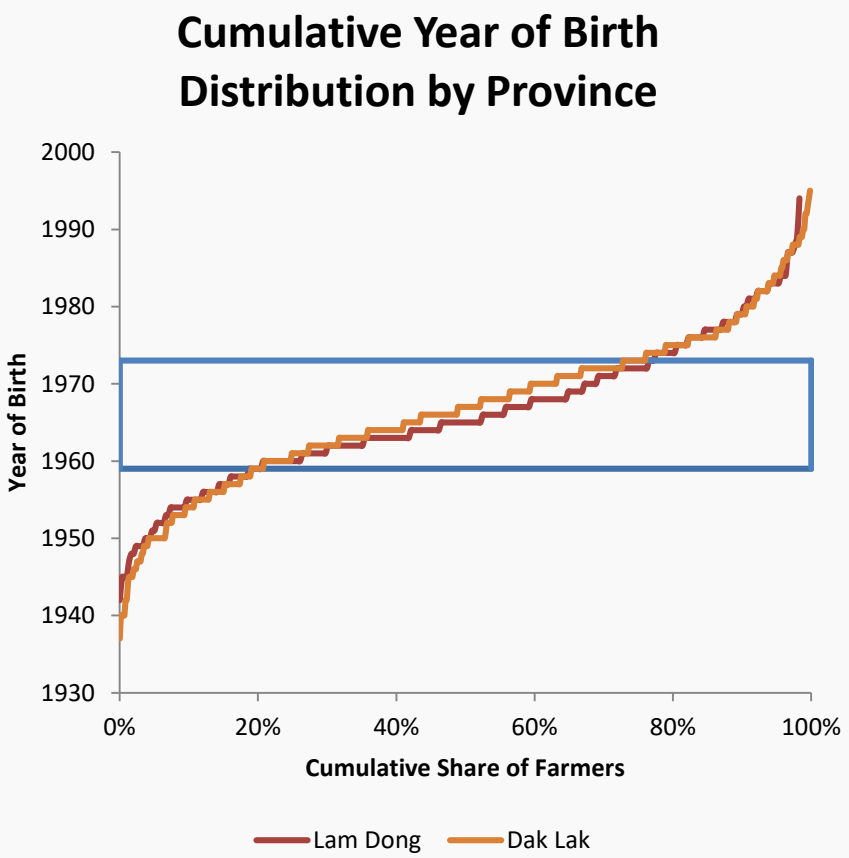
Dak Lak province			
District	**Commune**	**Nr of FFB farmers**	**Share of total**
Buon Ho	Dat Hieu	16	5%
	Binh Tan	30	10%
	Thien An	30	10%
	Thong Nhat	30	10%
Cu M'gar	Ea Drong	66	22%
	Ea Pok	50	17%
Eah' Leo	Dlie Yang	30	10%
	Ea Hiao	14	5%
Krong Nang	Ea Toh	114	38%
	TT Krong Nang	28	9%
	Ea Tan	114	38%
	Dlie Ya	28	9%
TP Buon Ma Thuot	Tan Hoa	50	17%
Total		**600**	**100%**

HOUSEHOLD PROFILES: MOST FARMERS ARE MALE, THE SHARE OF ETHNIC MINORITY FARMERS IS RELATIVELY HIGH IN LAM DONG

Aspect	Units	Lam Dong	Dak Lak
Gender	% male	90%	89%
Year of birth	Year	1966	1967
First year of growing coffee	Year	1994	1995
Ethnicity (male)	% kinh	73%	87%
Ethnicity (female)	% kinh	56%	87%
No. of female children in household (<16 years old)	#	0.47	0.58
No. of male children in household (<16 years old)	#	0.44	0.57
No. of people dependent on farm for their living	#	4.1	4.2
Land ownership	% red book	97%	94%
Education level (male)	% primary or higher	69%	62%
Education level (female)	% primary or higher	69%	66%
Decision-making	% with joint decision making	60%	80%
Participating in projects since	Year	2012	2012

- FFB farmers are predominately males in their early fifties who have been growing coffee since the mid-nineties.
- The majority of male and females in the households are of the Kinh ehtnic majority.
- We find a very weak (R^2=0.10) postive correlation between belonging to the Kinh ethnic group and practicing joint-decision making with regards to farm management.
- Average age does not differ significantly between the provinces.
- The number of people dependent on the farm for their living is 4.1 to 4.2 persons on average.
- Nearly all farmers have de-facto ownership of their land via the so-called red book. There is some renting of land observed among 5% of the farmers.
- On average FFB farmers have engaged with a coffee project since 2012.

HOUSEHOLD PROFILES: 57% OF FARMERS FALL IN THE 45 TO 59 YEARS AGE BRACKET, WHILE 17% IS OVER 59, THIS MAY AFFECT FUTURE SUPPLY AVAILABILITY



- 57% of farmers fall between the blue lines, i.e. in the 45 to 59 years age bracket, and only about 10% of farmers is younger than 35 years. This makes the coffee sector very different from the total VN workforce, where 45% are younger than 35 years**
- In many coffee producing countries, the age of coffee farmers is also high (average age in Colombia 56 years; Afrika >60 years)
- We should bear in mind that farmers generally are older than the average age of the workforce, not only because farming is not seen as an attractive proposition for young people, but also because the required investment in land and equipment can be a barrier to entry for those younger people that do wish to farm.
- Farmers being self-employed entrepreneurs tend to work beyond the age of 65, 17% of the FFB farmers are over 59 years old.
- Looking 5 to 10 years ahead it is certainly wise to monitor the share of farmers across the age groups and perhaps it is already useful to stimulate younger farmers to enter the sector to avoid being caught out by the bulk of farmers that will retire at some point.

** vietnam-ustrade.org/index.php?f=news&do=detail&id=35&lang=english

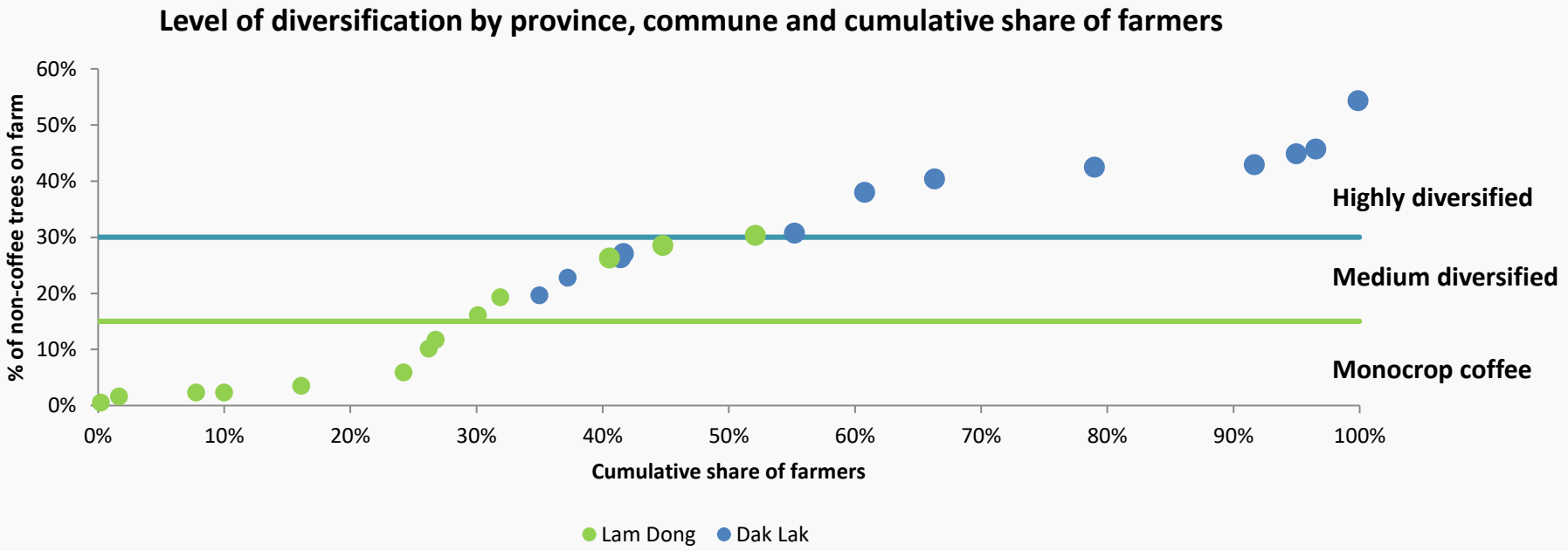
FARM PROFILES: CONTRARY TO 10 YEARS AGO, FARMS ARE MUCH MORE DIVERSIFIED, MOSTLY WITH PEPPER AND AVOCADO AND ESPECIALLY IN DAK LAK

Aspect	Units	Lam Dong	Dak Lak
Total farm size (ha)	Ha	2.59	1.62
Total coffee area (ha)	Ha	2.54	1.33
Nr of coffee trees per ha	#	1,102	1,063
Total nr of coffee trees	#	2,781	1,415
Total nr of avocado trees	#	25	56
Total nr of cashew trees	#	<1	2
Total nr of macadamia trees	#	2	4
Total nr of citrus trees	#	<1	<1
Total nr of pepper vines	#	85	679
Total nr of durian trees	#	17	32
Total nr of other trees	#	136	175
Contribution of coffee to total family income	%	86%	67%

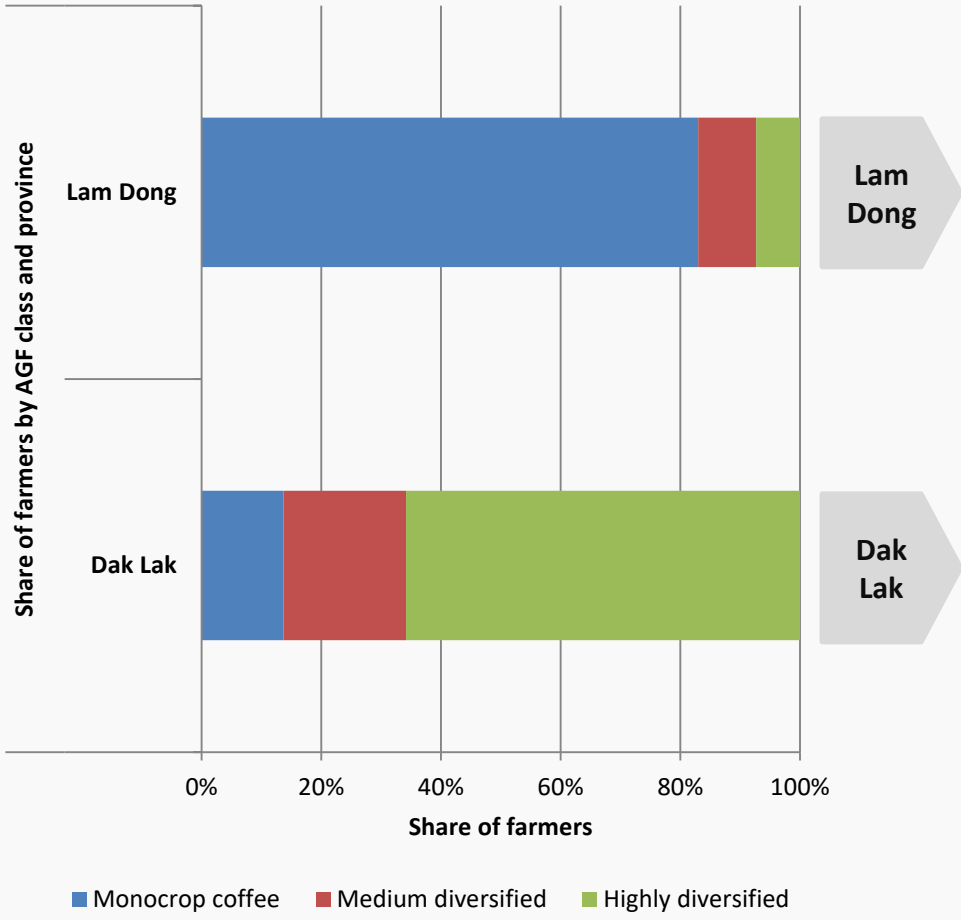
- In total the FFB farmers keep records for 1,558 ha of land.
- Average farm sizes and tree stocks differ significantly between farms, with the larger farms in Lam Dong.
- Compared to 10 years ago, fewer farmers practice a mono-cropping strategy, the level of intercropping is significantly higher in Dak Lak.
- The planting density of coffee has gone down a bit over time from 1,100 trees per ha 10 years ago to 1,063 today in Dak Lak, while in Lam Dong this is still 1,102.
- Among farmers that intercrop, pepper is by far the most popular secondary crop in both provinces.
- We find it surprising that coffee planting density did not go down more with an increase in pepper production.
- Avocado and durian are gaining traction as secondary or tertiary crops, but their uptake is not as wide-spread as that of pepper.
- Despite this, farmers indicate they continue to rely primarily on coffee for their family's income although this may change if pepper prices go up and coffee prices go down at the same time.

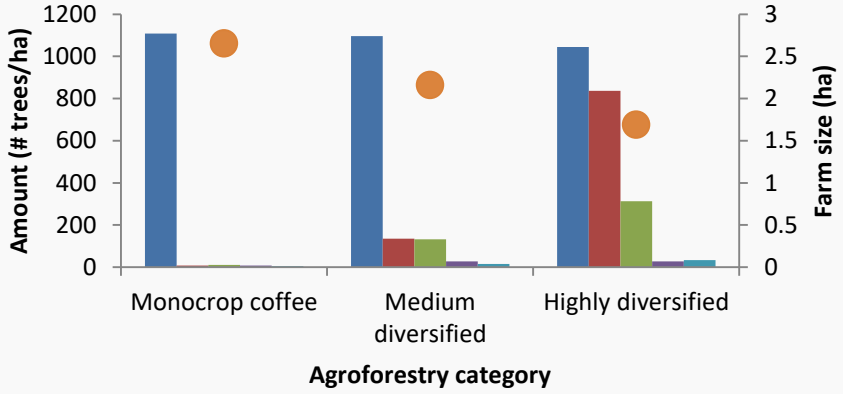
FARM PROFILES: ONE THIRD OF THE COMMUNES, WITH 50% OF THE FARMERS, HAVE ON AVERAGE HIGHLY DIVERSIFIED FARMS. NEARLY ALL OF THESE ARE IN DAK LAK.

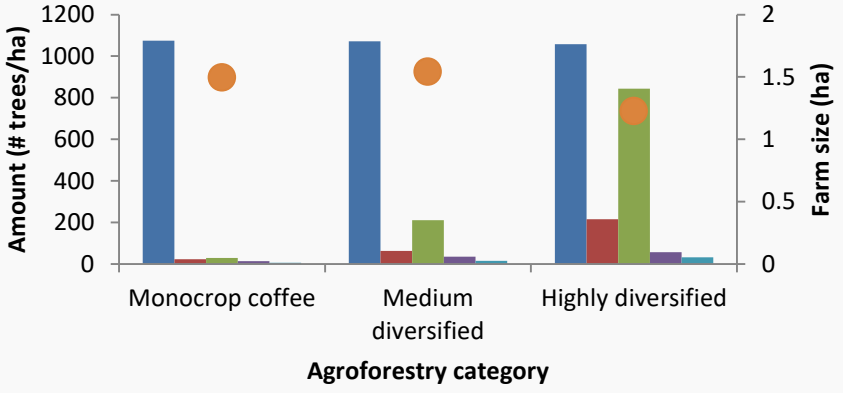
- The Agro-Forestry classification is based on the share of non-coffee trees on a farm. Farmers with less than 15% of non-coffee trees fall under the “Mono-crop coffee class”, farmers with 15% to 30% non-coffee trees are considered “Medium diversified”, farmers with more than 30% non-coffee trees are considered “Highly diversified”.
- Pepper and other tree species (usually the trees that pepper is growing up against), are by far the most popular crop after coffee. We see no significant difference in coffee planting density between the Agro-Forestry Classes, which indicates that contrary to expectation, non-coffee crops do not necessarily compete for space with coffee on the farm.



FARM PROFILES: COFFEE PLANTING DENSITIES ARE REMARKABLY SIMILAR ACROSS THE 3 AGRO-FORESTRY CLASSES. SMALLER FARMS TEND TO BE MORE DIVERSIFIED, IN DAK LAK THIS DIFFERENCE IS SIGNIFICANT

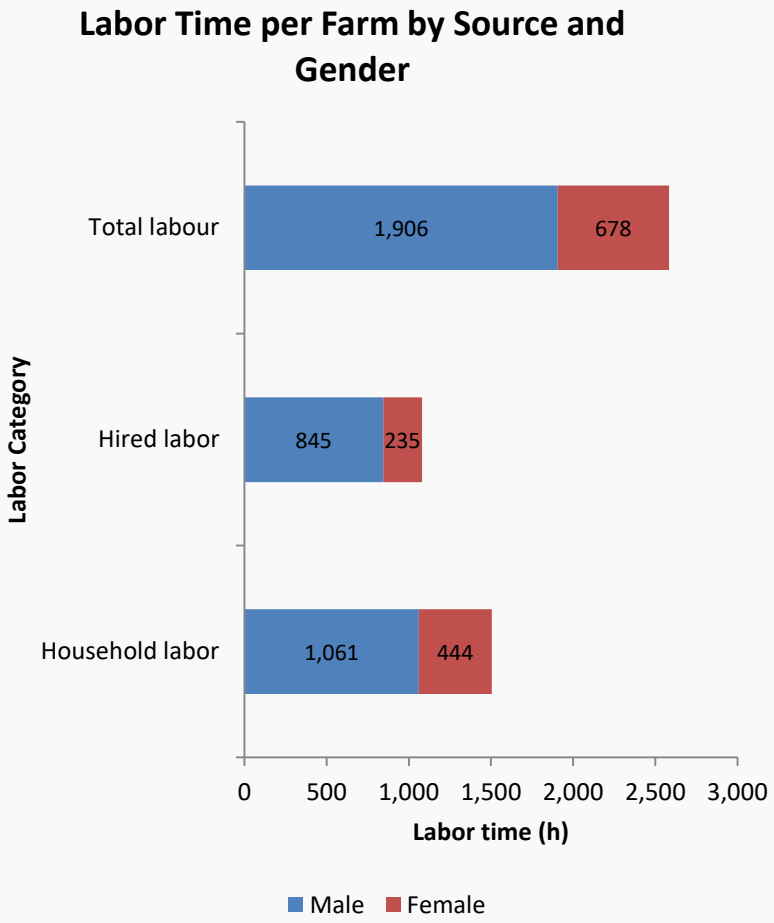




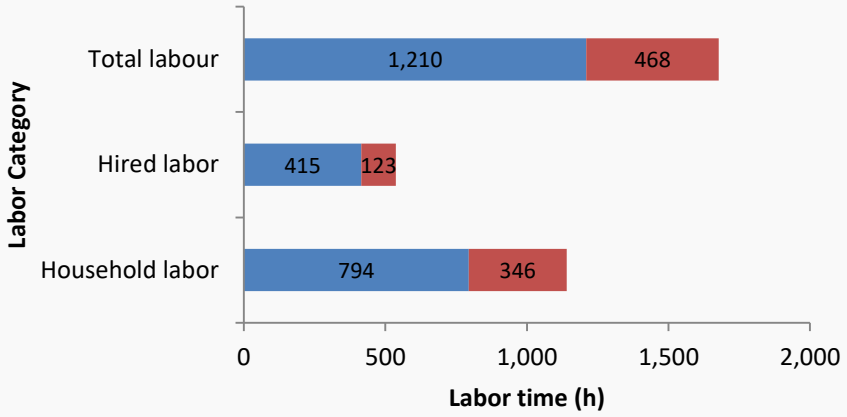


Results
Farm Management

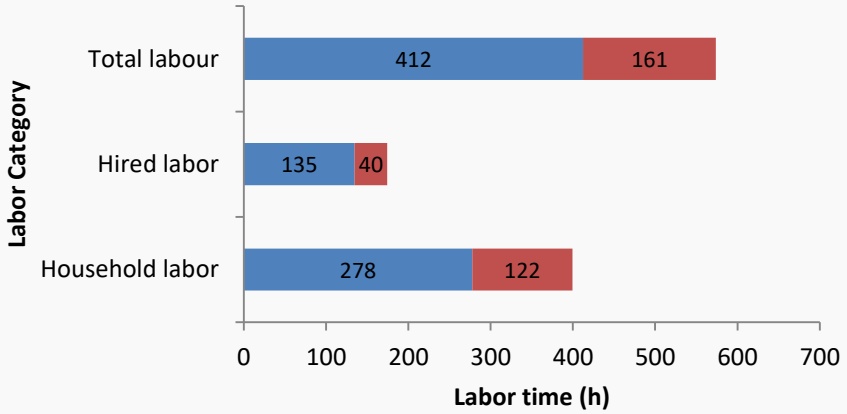
FARM MANAGEMENT - LABOR: LABOR USE AMOUNTS TO 1,678 HOURS PER HA. MOST OF THE WORK IS DONE BY MEN. HIRED LABOR PER HA MAKES UP 32% OF TOTAL LABOUR. LESS THAN 5% OF FARMERS HIRE NO LABOR



Per ha



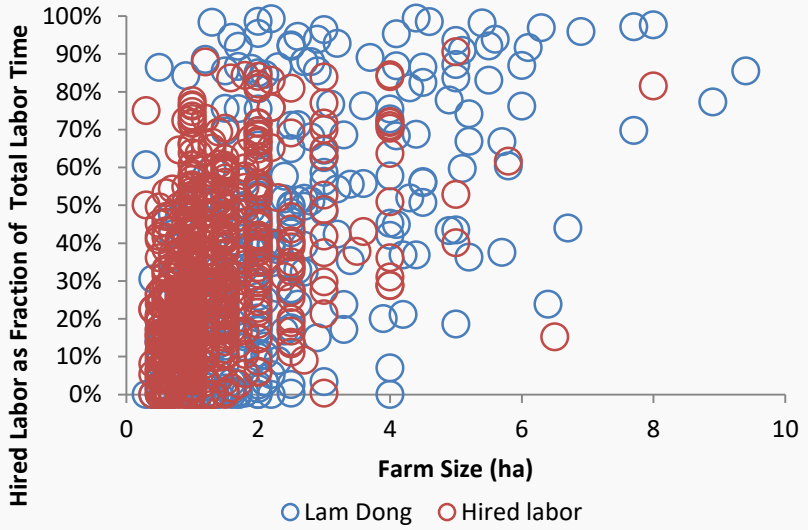
Per Mt



FARM MANAGEMENT - LABOR: HIRED LABOR USE INCREASES IN IMPORTANCE ON FARMS LARGER THAN 2 HA. LARGER FARMS MAKE MORE EFFICIENT USE OF LABOR

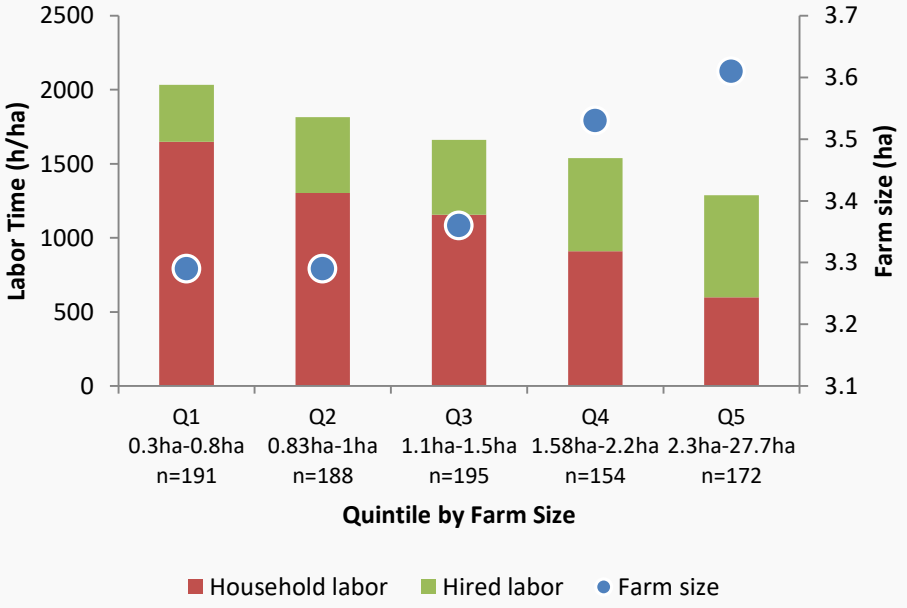
- Up until 2 ha in farm size farmers can manage most of the work by themselves, except for harvesting. In quintile 4 and 5 hired labor and household labor are almost on par or the first exceeds the latter.
- As farm size increases, labor becomes a limiting factor and farmers make use of it more efficiently. Total labor use per ha is significantly lower, while productivity is statistically comparable between the farm size quintiles.
- We should note that the larger farms are more prevalent in Lam Dong where productivity is also higher.

Hired Labor as Fraction Total Labor Time by Province and Farm Size

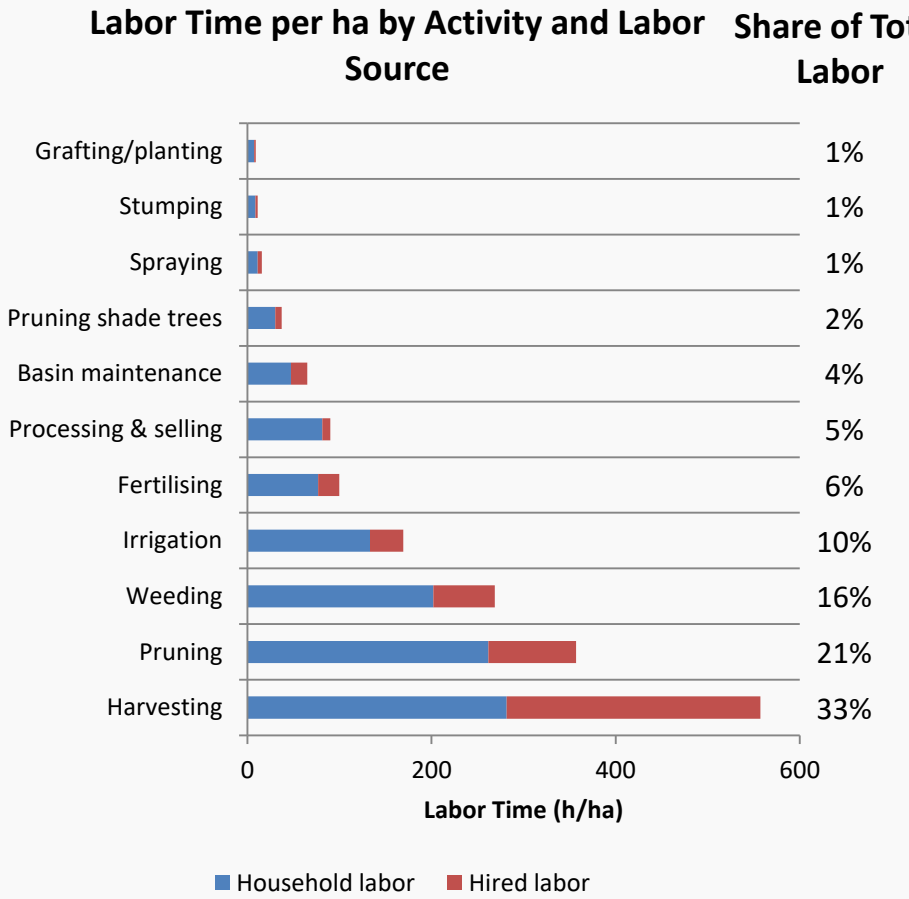


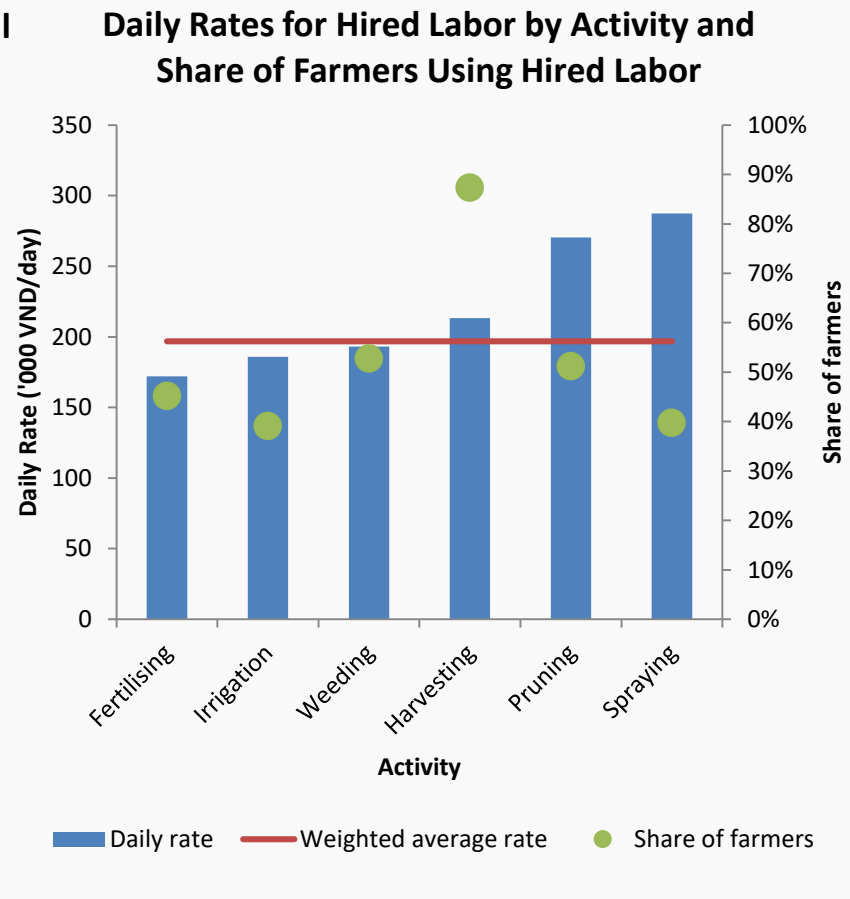
X-axis truncated at
10 ha for readability

Labor Time Per Ha and Productivity by Source and Farm Size Quintiles

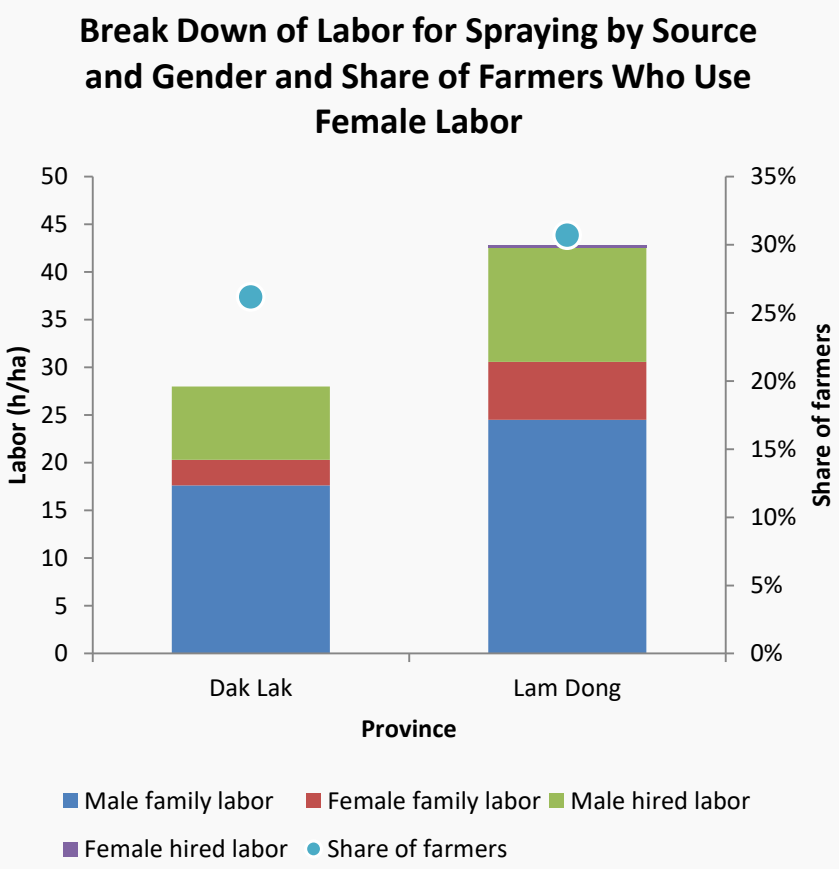


FARM MANAGEMENT - LABOR: WEEDING, PRUNING AND HARVESTING MAKE UP 70% OF TOTAL LABOR USE. LEVEL OF DANGER (SPRAYING) AND SEASONAL DEMAND (HARVESTING) INFLUENCE DAILY RATES FOR HIRED LABOR





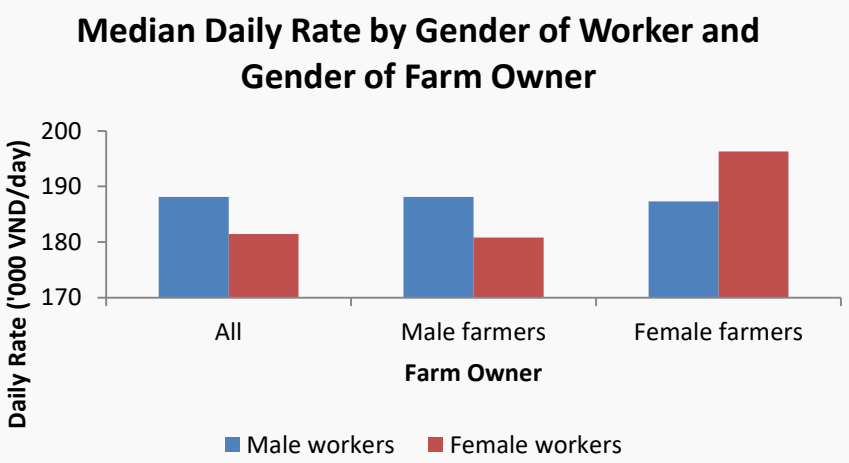
FARM MANAGEMENT - LABOR: 26% TO 31% OF FARMERS THAT SPRAY USE FEMALE LABOR FOR SPRAYING

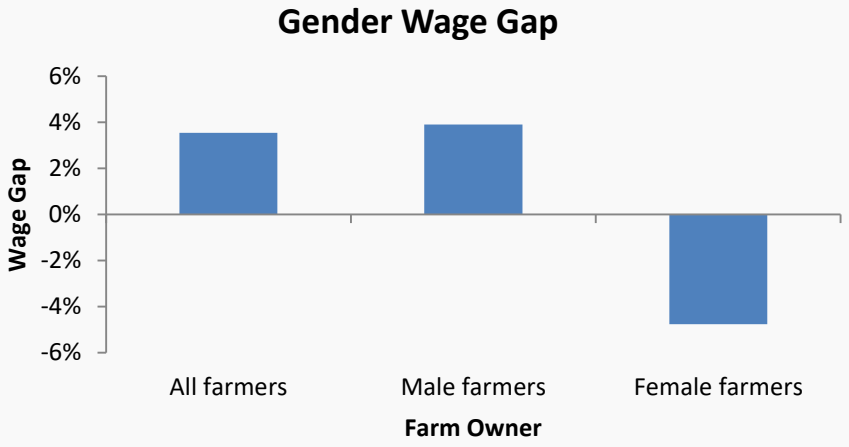


- In Dak Lak, 29% of the farmers sprayed biocides during the past season. Of these, 26% used female labor for spraying.
- In Dak Lak, female labor for spraying comes exclusively from the family, none of it is hired externally.
- The female family members provide 10% of the total labor used for spraying.
- In Lam Dong, 72% of farmers sprayed biocides during the past season. Of these farmers, 31% used female labor, nearly all of it originated from the family. Just 1.4% of farmers indicated they hired female labor for spraying externally.
- In Lam Dong the females provided 14% of the total labor used for spraying.
- To safe-guard reproductive health, it is generally not recommended for women to apply biocides. The UTZ standard limits this to women who are breast-feeding or pregnant.

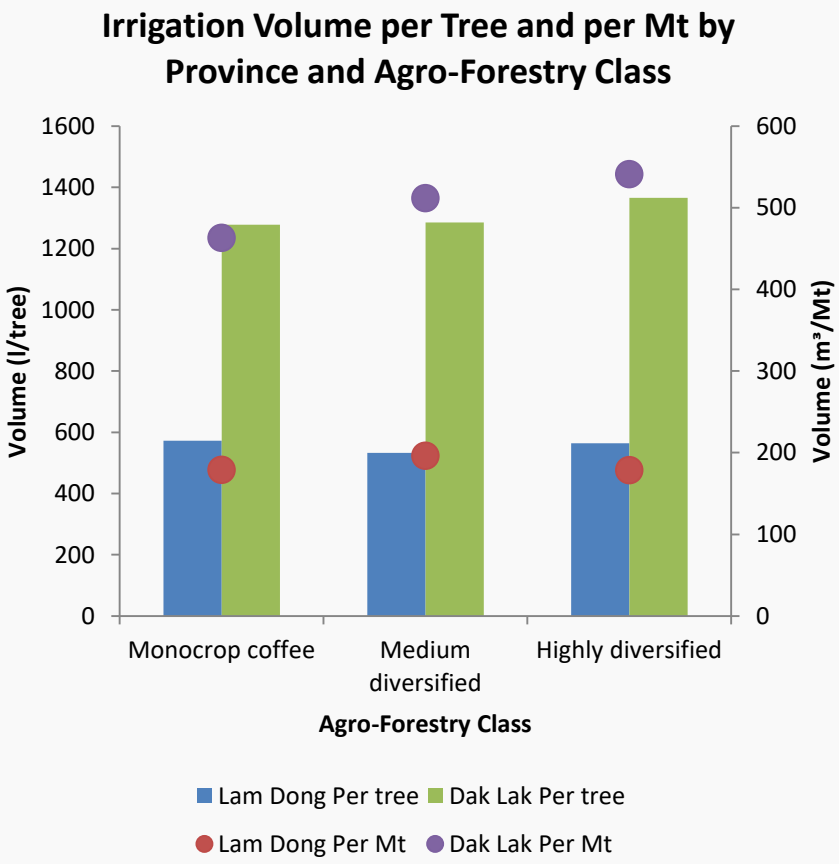
FARM MANAGEMENT - LABOR: ON AVERAGE FEMALE WORKERS EARN SLIGHTLY MORE PER DAY. THE GENDER WAGE GAP IS LOW BUT IN FAVOUR OF MALE WORKERS

- Male hired workers are more likely than female hired workers to engage in potentially dangerous activities like spraying biocides. However, even after controlling for this phenomenon, female workers on average still get paid slightly more per day worked than male hired workers. This difference is not statistically significant.
- Breaking down the daily rates by gender of farm owner shows that on average female farm owners pay their workers less than male farmers.
- The OECD defines the gender wage gap as the ratio between the median earnings of men and women relative to the median earnings of men. A gender wage gap larger than zero means that men earn more than women, a negative gender wage gap value means women earn more than men.
- Using this definition, we find a +3.5% gender wage gap among hired workers across the sample. However, when we break this down by the gender of the farm owner, it shows that female farmers have a negative gender wage gap of -4.7%. They pay their female hired workers more than males.
- By comparison, a country considered egalitarian in this respect, like Norway, has a +7.1% gender wage gap.





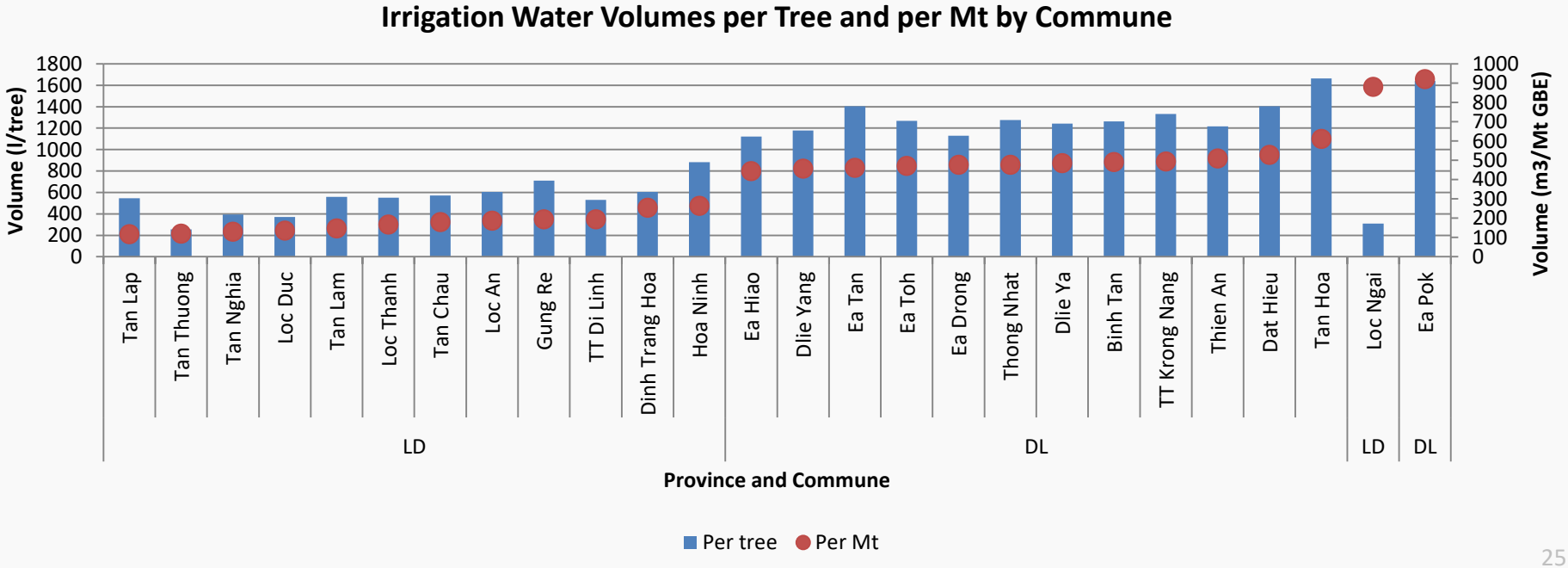
FARM MANAGEMENT - IRRIGATION: AVERAGE IRRIGATION VOLUME PER MT IS AROUND 410 CUBIC METER/MT AND 1,081 L/TREE. WE FIND FEW SIGNIFICANT DIFFERENCES BETWEEN AGRO-FORESTRY CLASSES



- In the absence of wide-spread water meter usage on farms, irrigation volumes are estimated by farmers themselves. At the start of the programme each farmer was supposed to have received instructions on how to use a 200 l barrel and time how long it takes to fill this with his irrigation pump. During irrigation, the farmer times how long the pump is running, divides that by the time it takes to fill the barrel and multiplies that by 200 l to estimate the irrigation water volume. If this was done properly, the volumes presented here are the best approximation possible.
- A central idea of the ISLA programme is that more diversified farming systems could use less irrigation water. We do not see this reflected in the data. In Lam Dong no significant differences between the Agro-Forestry Class were found, whereas Highly Diversified farmers in Dak Lak use more water per Mt coffee than the Monocrop coffee farmers.
- Some of irrigation water may have been for other crops growing in the same field. A better metric would be look at the amount of profit per liter water used. But data on revenue and costs for other crops was not consistently collected. The indicated data should be measured in the current season.

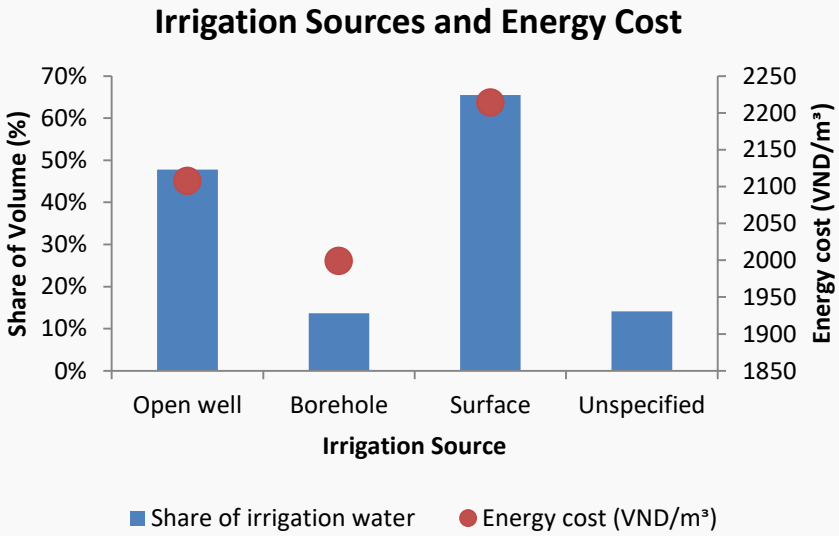
FARM MANAGEMENT - IRRIGATION: FARMERS IN DAK LAK USE SIGNIFICANTLY MORE IRRIGATION WATER PER TREE AND PER MT COFFEE. A FEW OUTLIERS OCCUR

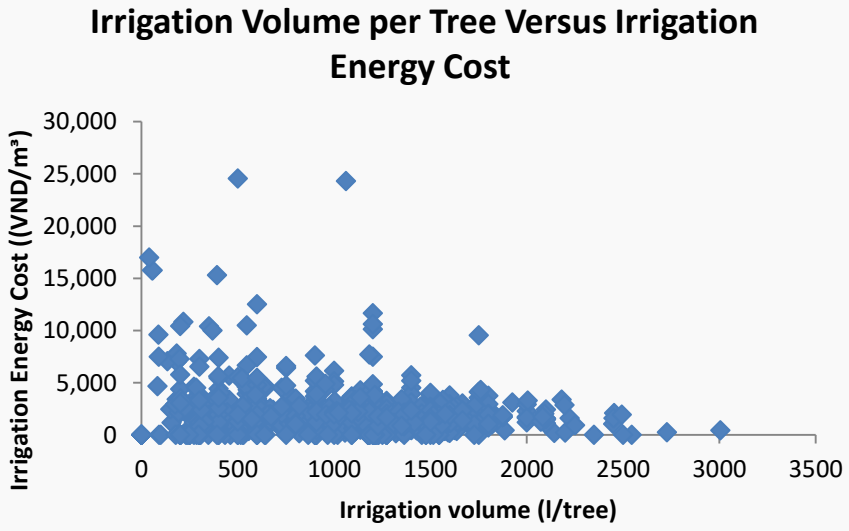
- In the absence of rainfall and evapotranspiration data at commune level, we can not be certain if the irrigation volumes applied are sufficient or excessive. It appears that most farmers are irrigating roughly in line with, or just above general recommendations.
- A programme-wide training programme on irrigation does not appear to be needed, instead a targeted approach in the least efficient commune(s) or those that target the top 5%-10% irrigation water users across all communes is probably more efficient.
- If new water-saving irrigation techniques are introduced, it would make sense to focus on farmers the least efficient communes, as this would probably generate the largest water-savings per USD invested.



FARM MANAGEMENT - IRRIGATION: FARMERS PREDOMINANTLY USE SURFACE WATER AND OPEN WELLS FOR IRRIGATION. HIGHER ENERGY COSTS PER UNIT WATER DOES NOT CORRELATE WITH LOWER USE

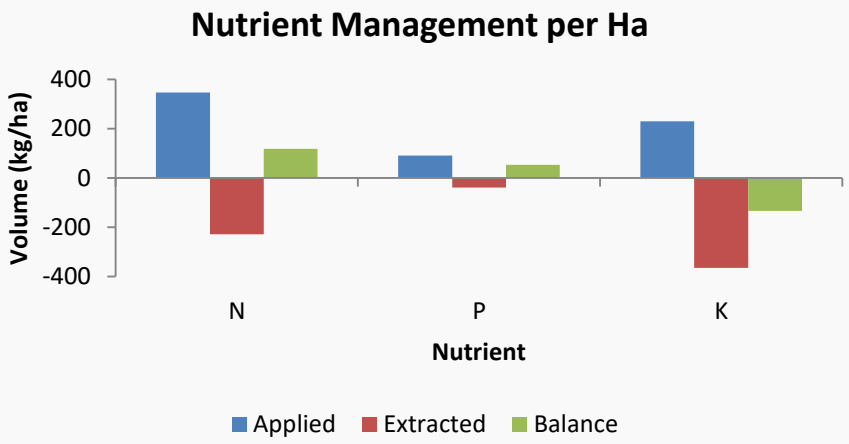
- The large majority of irrigation water comes from surface water and open well sources with the first being more prevalent in Lam Dong and the second in Dak Lak. While the establishment costs of a new open well are significant, operational energy cost is on average lower than that for surface water pumping.
- We find no correlation between energy cost per unit water and the volume that farmers use. Indicating that pumping water is considered cheap relative to the perceived risk of applying insufficient water. Implementation of a water pricing scheme, which is presently being debated in Vietnam, would need to take this into account.
- A small share of farmers did not specify their water sources, a point of attention for the data collectors.

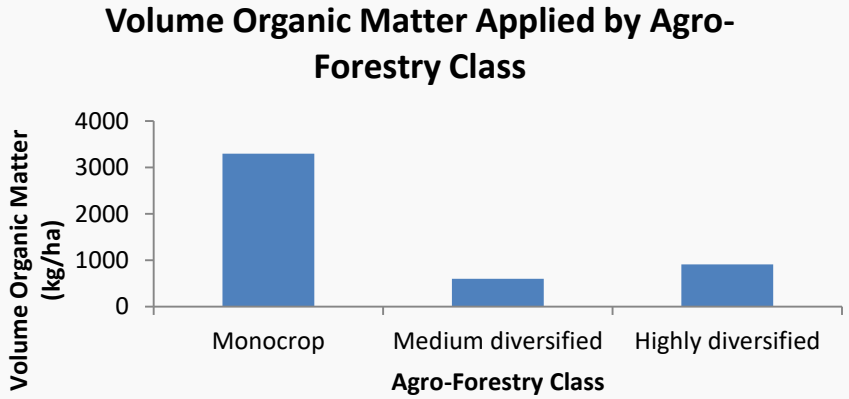




FARM MANAGEMENT - NUTRIENTS: NITROGEN IS OFTEN OVER-APPLIED, WHILE POTASSIUM APPLICATIONS DO NOT MEET CROP REQUIREMENTS

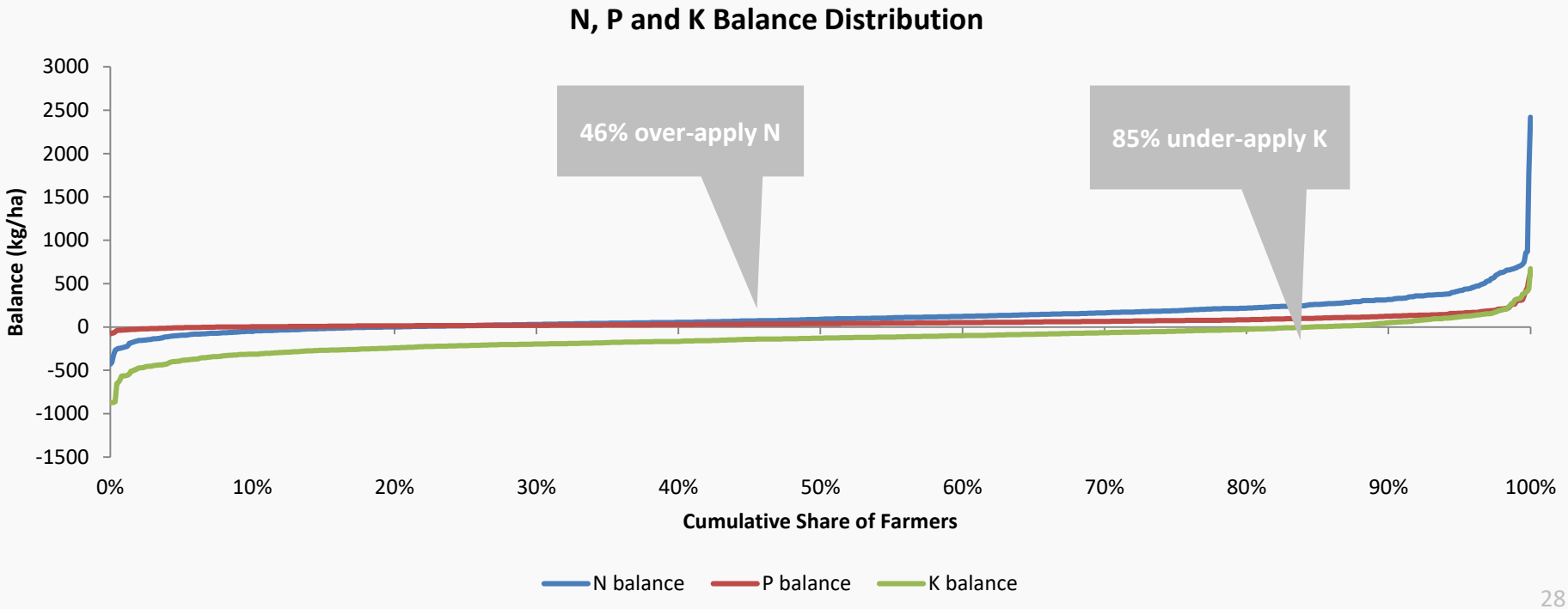
- The nutrient balances are calculated by subtracting the amounts of N, P and K contained in the fresh cherry harvest from the volume N, P and K applied through fertilisers, compost and manure. This calculation does not take into account of the efficiency of uptake, availability to the tree and losses from leaching.
- For N we suspect an over-application of 100 kg/ha should be enough to compensate for such losses. Current over-application of N is 119 kg/ha on average.
- The average K applications does not meet crop requirements.
- Most nutrients are applied via fertiliser. Just 18% of farmers apply organic matter to their farms. Assuming an average N content of 0.6% for organic matter, the average organic matter application is 9.8 Mt/ha for the 18% of farmers that use it and 1.7 Mt/ha for all FFB farmers.
- An interesting observation is that Monocrop coffee farmers apply significantly more organic matter per ha than farmers in the other 2 Agro-Forestry Classes. Perhaps Medium and Highly diversified farmers feel they have enough organic matter already from litter fall of trees.





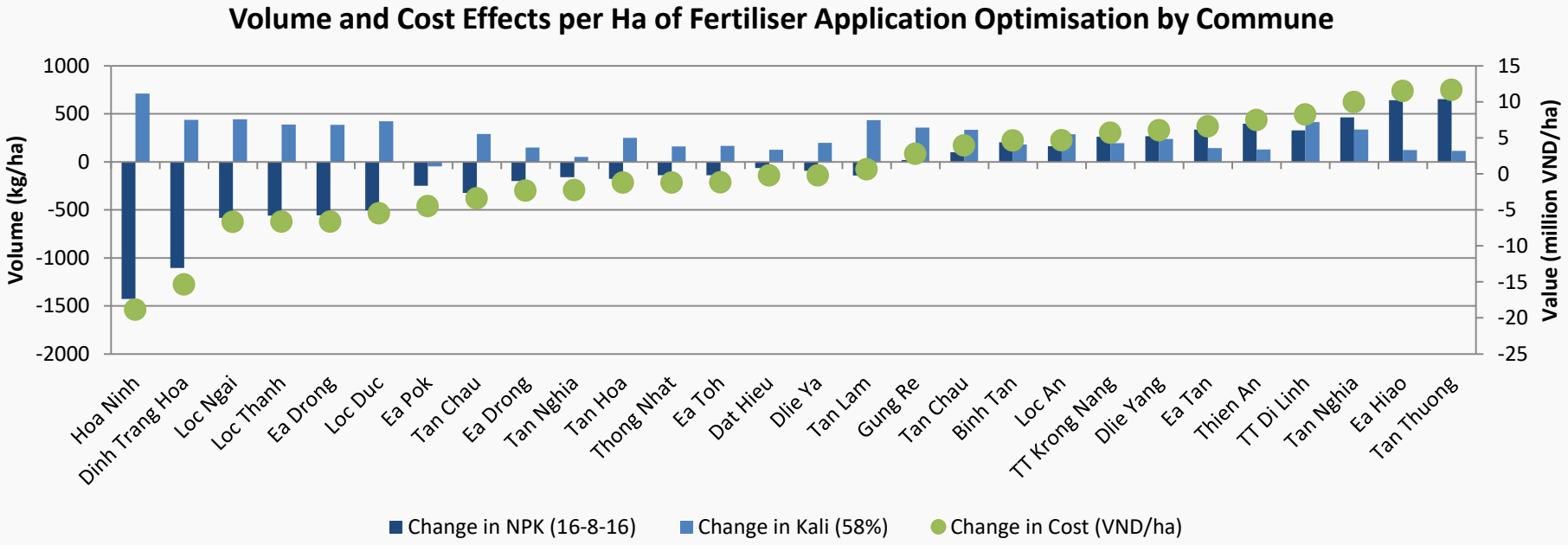
FARM MANAGEMENT - NUTRIENTS: IMPROVEMENTS IN NUTRIENT MANAGEMENT CAN BE MADE FOR MOST FARMERS. N APPLICATIONS CAN BE REDUCED, WHILE K NEEDS TO INCREASE.

- Farmers that are closer to the optimum K application levels tend to be those that over-apply N and P. This is because most farmers predominantly use NPK instead of single nutrient fertilizers.
- A change in fertiliser applications is required for the majority of farmers, with larger K and reduced N volumes. Farmers can cut back on their NPK applications to a level where they have a surplus of around 100kg N. This will also reduce their K application. To compensate they may have to add a Kali application to balance things out.
- A programme-wide training on how to determine nutrient application levels based on expected yield is advisable, this would have to include financial modelling of effects of alternative fertiliser applications.



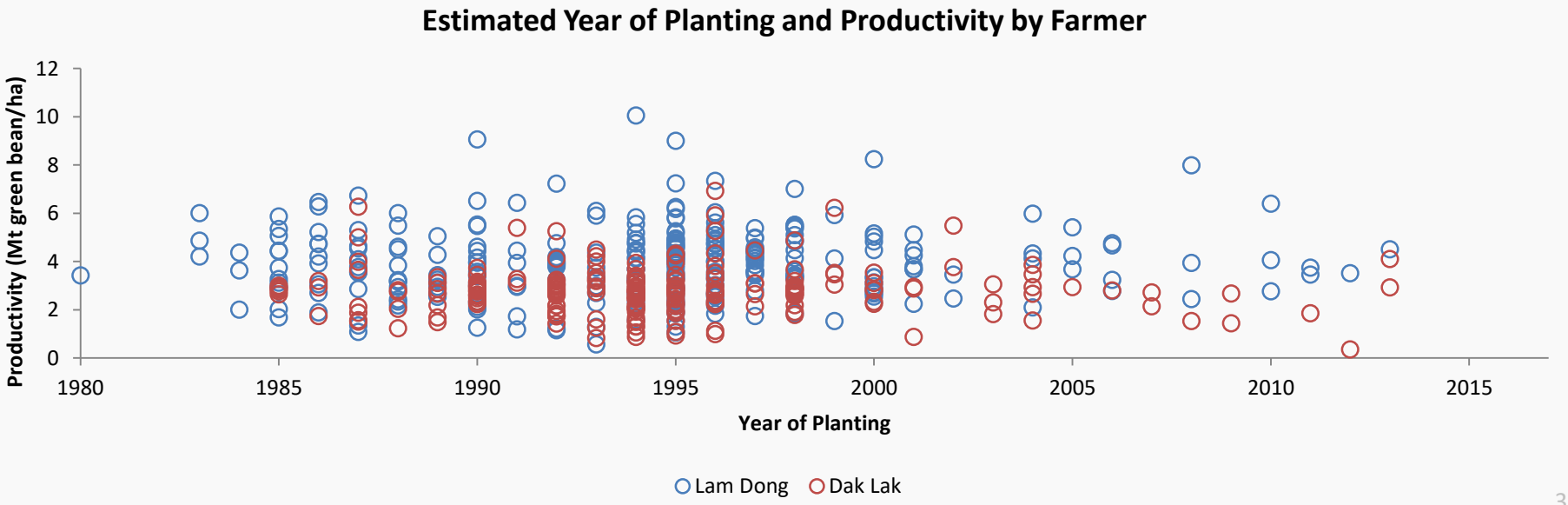
FARM MANAGEMENT - NUTRIENTS: ON 43% OF FARMS FERTILISER COST SAVINGS CAN BE MADE THROUGH A REDUCTION IN N AND AN INCREAS IN K APPLICATIONS.

- By changing the N balance to a level of +100 kg/ha and increasing K applications to a level where the removal equals the application, farmers in 12 communes would have to increase their average fertiliser cost, while in 13 commune savings can be made.
- We used the most commonly applied NPK 16-8-16 formula priced at 16,600 VND/kg and Kali (58%) priced at 6,800 VND/kg for this calculation.
- Average fertiliser cost across the FFB group of farmers under this scenario would decrease by 185,231 VND/ha. This average hides some of the very significant cost changes that occur at the individual farm level. We would expect to see an increase in productivity from a more balanced K situation, yielding a greater positive result still.



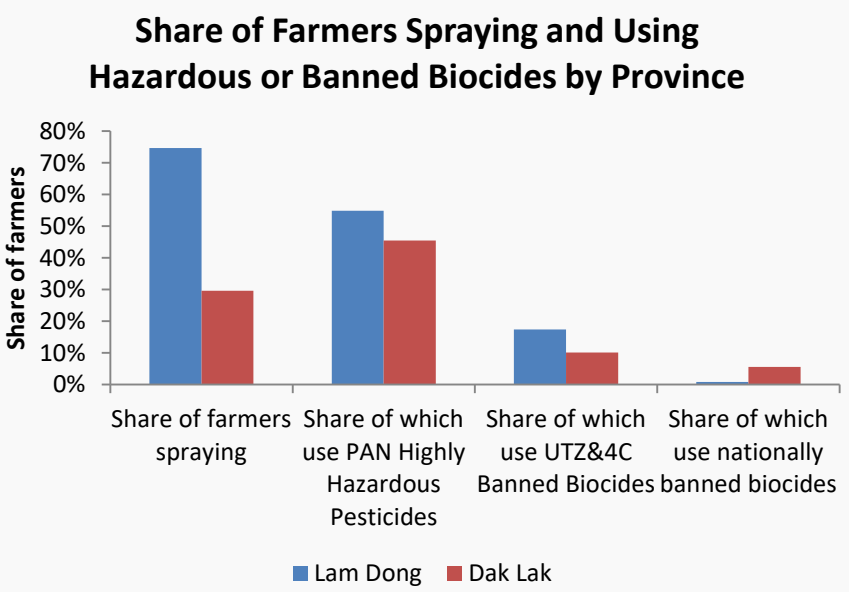
FARM MANAGEMENT - REJUVENATION: USING AN APPROXIMATION OF TREE AGE, WE DO NOT SEE A MAJOR CONCERN OVER REPLANTING OF COFFEE FARMS

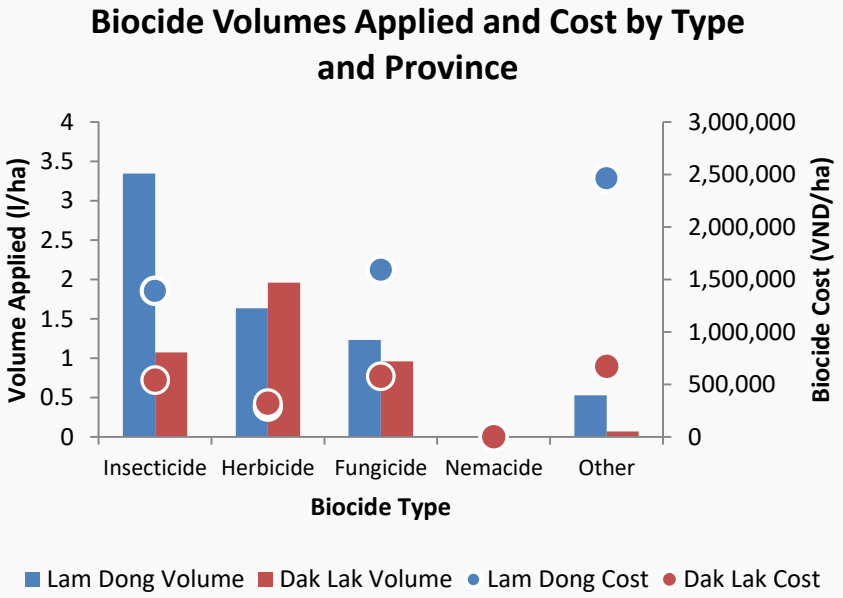
- Some stakeholders in the Vietnam coffee sector are concerned about ageing plantations and an expected decline in production. In the FFB data we do not find a strong correlation between estimated year of planting coffee and productivity.
- We use a proxy for tree age, taking the year in which a farmer started production. Since the sector was essentially established in the late eighties, early nineties we can be confident that trees are at least not older than shown here, but they might be younger if farmers replanted at some point between the late eighties and today. To make this analysis more robust, for next years, the plan is to get a complete tree stock overview for each farmer by the year in which each batch of trees on a farm was planted,.
- We do see that 26% of the FFB farmers have replanted during the last season. Among those that replant, the average replacement rate is 23% (or 247 trees replaced or newly added per ha over the season) and the average approximated tree age at the point of replanting is 21 years.



FARM MANAGEMENT - BIOCIDES: 44% OF FARMERS SPRAY BIOCIDES, OF THOSE 13% USE BIOCIDES NOT ALLOWED BY UTZ & 4C DESPITE BEING CERTIFIED

- A minority of farmers (44%) spray biocides, but the 2 provinces differ profoundly in that they spray and also in what they spray. 52% of farmers that spray use biocides that are considered highly hazardous to human health and the environment.
- 13% of those that spray use biocides containing active ingredients that are not allowed by UTZ and 4C. A small share of farmers use biocides that are banned under Vietnamese law.
- A small volume of unspecified biocides are used at very high cost. These are probably different types of foliar fertiliser, which may add some trace elements, but it is usually cheaper for farmers to add trace elements by using fortified NPK formulas.
- No nematicides (to control nematodes) were used. The latter is surprising as nematodes are considered to be a growing problem in Vietnam. Apparently nematodes are not a major concern for farmers in the areas where the FFB is being implemented.





FARM MANAGEMENT - BIOCIDES: THE ISSUE WITH USING BANNED BIOCIDES PERTAINS TO 16 PRODUCTS AND 9 ACTIVE INGREDIENTS

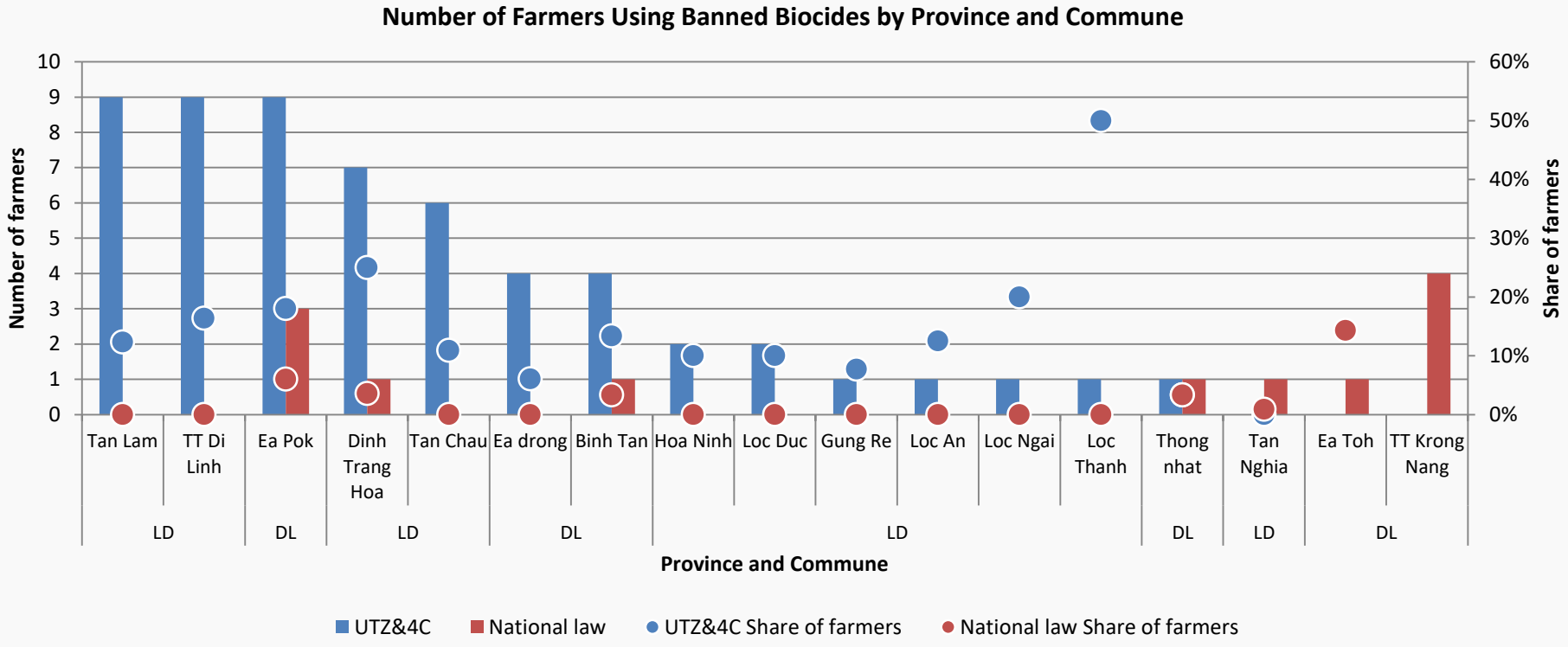
- Some biocides like Suprathion are available in the market from different manufacturers.
- Given that half of the FFB recording period consists of backward recorded data, not all manufacturers are known.
- Farmers make use of 16 biocides that are either banned by law or not allowed under the UTZ & 4C standards.
- The 16 biocides contain 9 different active ingredients not allowed by the UTZ & 4C standards, while 3 of them are banned under national law, but apparently still available in the local market.

Trade name	Active ingredient 1	Active ingredient 2	Manufacturer	UTZ & 4C	National law
2,4-D	2,4-D		Vietnam		X
Ambush	Permethrin		Don't know	X	
Bop 6EC	Carbosulfan		Don't know	X	
Map permethrin	Permethrin		Mappacific	X	
Marshat 2SC	Carbosulfan		Don't know	X	
Mokak	Ethoprophos		Don't know	X	
Ofatox	Fenitrothion*	Trichlorfon	BVTV 1 trung ương	X	
Supracide 4EC	Methidathion		Don't know	X	
Suprathion 4EC	Methidathion		Isxaren	X	
Suprathion 4EC	Methidathion		Syngenta	X	
Tasodant-6EC	Permethrin		Don't know	X	
Thio-m	Endosulfan		Trung quoc	X	X
Vi BenC 5BTN	Benomyl		Don't know	X	
Vibasa	Carbofuran		Vietnam	X	X
Vibasu 1H	Carbofuran		Don't know	X	X
Vifu super.5GR	Carbosulfan		Vipesco	X	

* Fenitrothion is not banned by UTZ & 4C, but trichlorfon is, hence the inclusion of Ofatox in this list.

FARM MANAGEMENT - BIOCIDES: THE ISSUE WITH USING NATIONALLY BANNED BIOCIDES IS CONCENTRATED IN 7 COMMUNES. USE OF BIOCIDES BANNED BY THE STANDARDS IS MORE WIDESPREAD

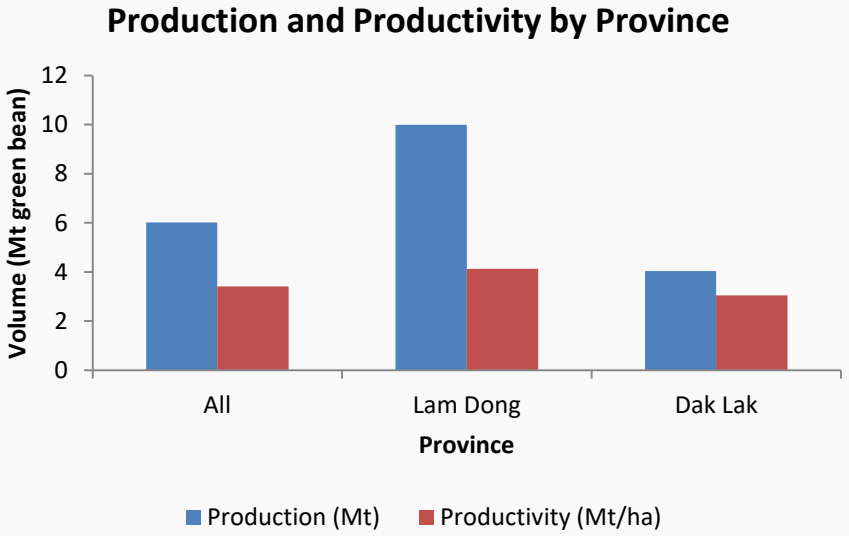
- The number of farmers using nationally banned biocides is limited to just 12 farmers out of the 396 FFB farmers that spray biocides. This occurs in both provinces.
- The use of biocides banned by UTZ & 4C is more widespread and is also occurring in both provinces.

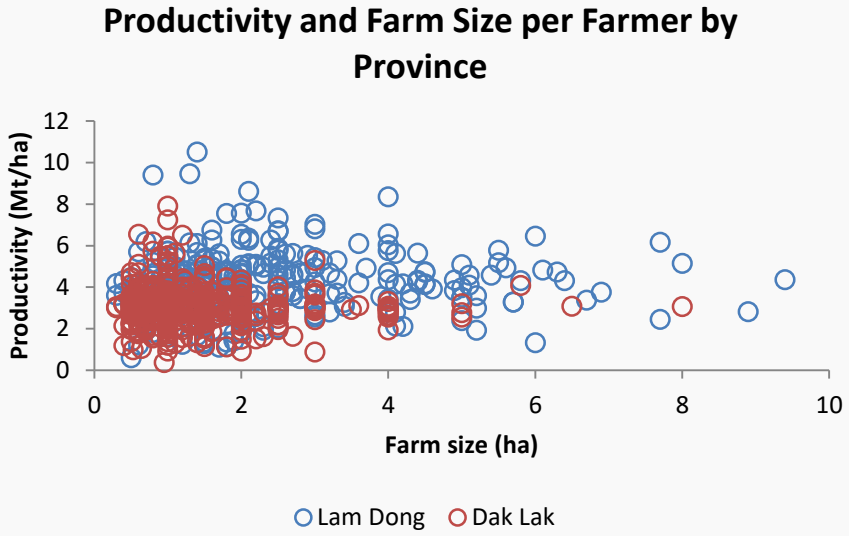


Results
Production

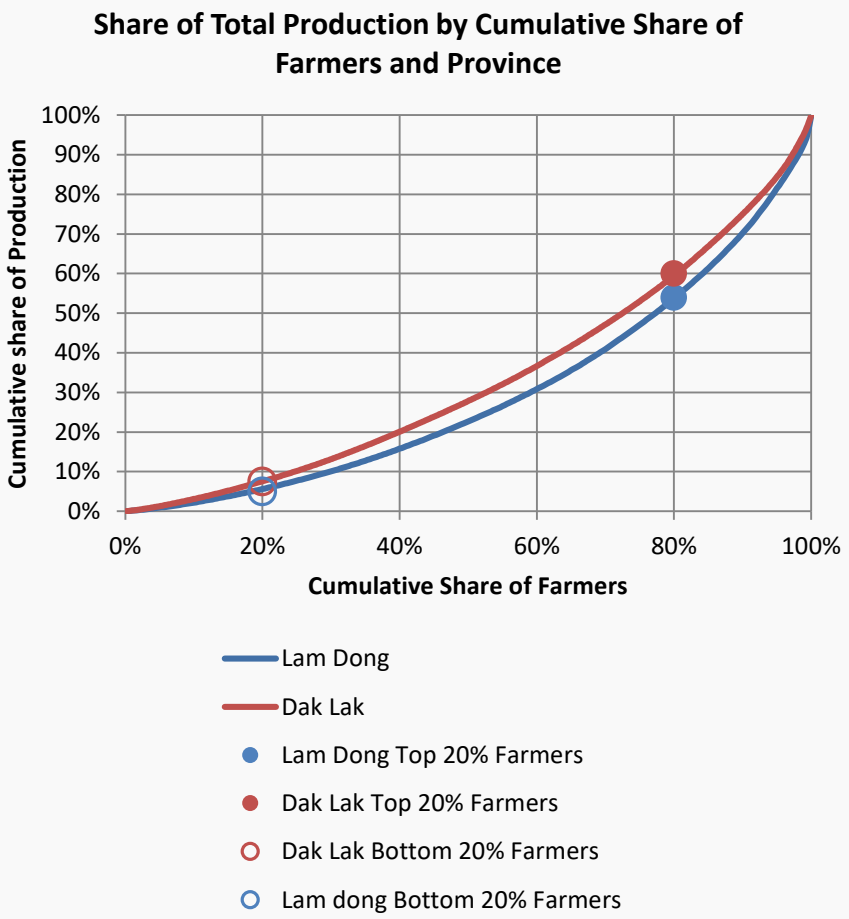
PRODUCTION: AVERAGE PRODUCTIVITY IS 4.13 MT GREEN BEAN PER HA IN LAM DONG AND 3.05 MT/HA IN DAK LAK. WE FIND NO CORRELATION BETWEEN FARM SIZE AND PRODUCTIVITY

- In many origins one can find a significant correlation between farm size and productivity in which larger farms tend be less productive. This is not the case in Vietnam, which indicates that farmers with larger land holdings have sufficient capital and managerial acumen to manage larger scale operations. In some communes in the FFB sample this phenomenon does apply, but on average across the entire sample it does not.
- This indicates to us that the envisioned land law which would allow farmers to aggregate larger land holdings is not a threat to production and supply availability.
- The top producers are in Loc An commune and average 4.6 Mt/ha. The least productive area is Ea Pok where farmers average 2.40 Mt/ha.





PRODUCTION: DISTRIBUTION OF VOLUMES SHOWS THAT 20% OF THE FARMERS ARE RESPONSIBLE FOR 40% TO 46% OF PRODUCTION. SUPPLY DISTRIBUTION IS COMPARABLE BETWEEN THE PROVINCES

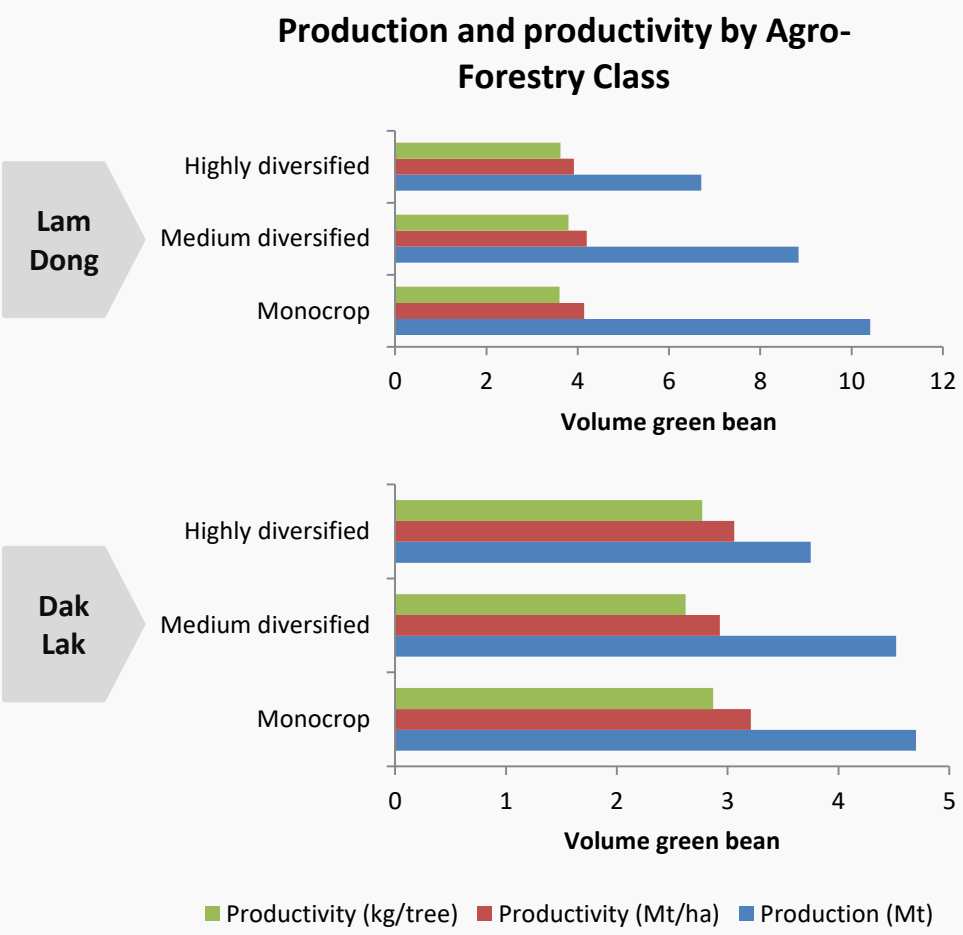


- The total volume produced by the FFB farmers is 5,420 Mt green coffee.
- Productivity in the lowest quintile is significantly lower than that in all other quintiles.
- Higher production is explained primarily by larger farm sizes.
- The bottom 20% of farmers by production have an average farm size of 0.79 ha and supply 7% of the volume.
- The top 20% contribute 44% of volume with an average farm size of 3.39 ha.

Quintile by production	Farm size (ha)	Productivity (Mt/ha)	Production (Mt)	Total production (Mt)
Bottom 20%	0.79	2.87	2.10	380
Lower middle 20%	1.10	3.22	3.47	632
Middle 20%	1.48	3.37	4.92	876
Upper middle 20%	1.91	3.68	6.93	1,254
Top 20%	3.39	3.91	12.80	2,278
Total				**5,420**

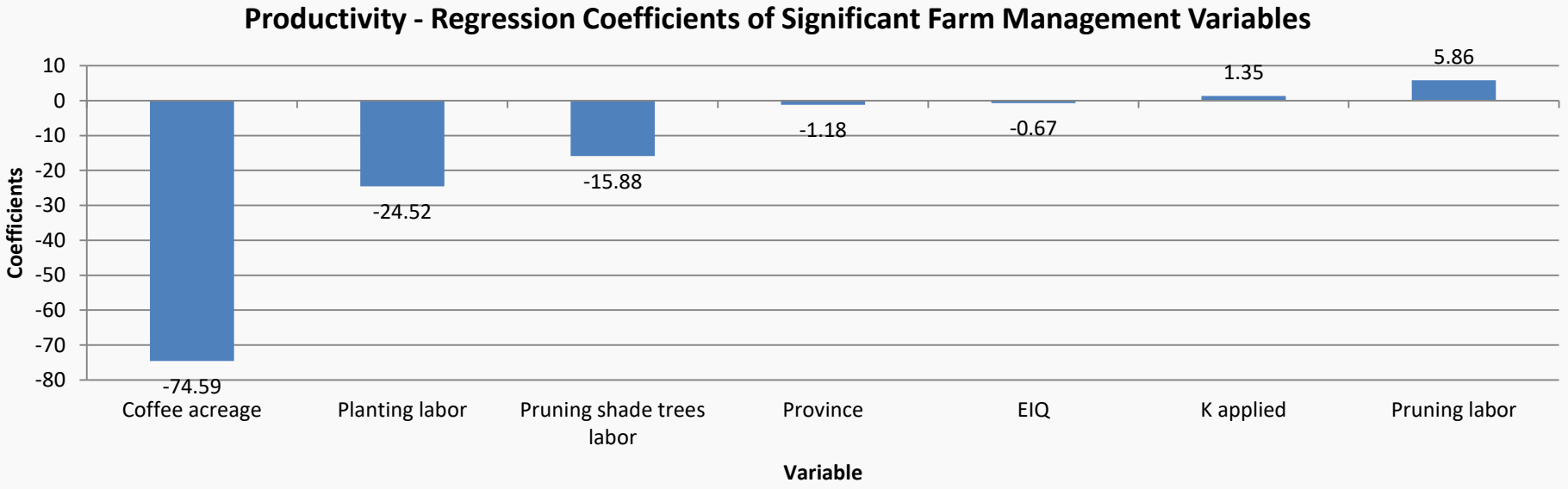
PRODUCTION: WE FIND NO SIGNIFICANT DIFFERENCES IN PRODUCTIVITY BETWEEN THE 3 AGRO-FORESTRY CLASSES. DIFFERENCES IN PRODUCTION BETWEEN CLASSES ARE EXPLAINED BY FARM SIZE

- Some coffee trading and export companies have expressed concerns about coffee being replaced by competing crops resulting in reduced supply.
- This analysis shows that for companies in the ISLA programme such concerns are not (yet?) warranted.
- Coffee production from Highly Diversified farmers is lower, but this is explained by their smaller farm sizes when compared to Monocrop farmers.
- Despite slightly lower coffee tree planting densities, the average productivity per ha and per tree among Highly Diversified farmers is not significantly different from Monocrop production systems.
- Against this background we argue that a more diversified farming system is in the interest of coffee traders. Supply availability is not affected, while farmers resilience to price shocks is improved.
- With longer term data available we could analyse if Highly Diversified farmers are better able to maintain coffee production levels after a coffee price drop. We hypothesise that they are, through cross-subsidising of coffee production with revenues from other crops.



PRODUCTION: MODELLING PRODUCTIVITY IDENTIFIES 8 KEY DRIVERS FOR PRODUCTIVITY, 5 OF THEM ARE RELATED TO FARM MANAGEMENT

- We constructed a regression model with 26 explanatory variables, 11 related to the household characteristics, 2 to the farm (acreage and level of diversification) and 13 to farm management (see annex 1). Dummy variables for province are included. In this model, we do not control for commune contrary to our analysis in the company reports
- The variables shown below are those that have a significant correlation with productivity levels.
- The model turned out to be fairly robust. It explains 22% of the variability in productivity between farmers. We would expect this to increase with access to sufficiently granular weather data.
- Most coefficients are measured in kg green coffee per ha, except for province, which is measured in Mt green bean/ha, and the labor variable which is in days. This means that with one additional day of labor on a listed activity, all other variables being equal, productivity would change by x kg.



PRODUCTION: FARMERS ARE ALMOST CONSISTENTLY MAKING LARGE INVESTMENTS AND PRODUCTIVITY IS VERY HIGH, HENCE SEVERAL FARM MANAGEMENT VARIABLES DO NOT SHOW UP AS SIGNIFICANT

- **Farm management factors that did not feature**: We were a somewhat surprised to note that aspects of Nitrogen input, biocide cost and irrigation water as well as labor time for all non-harvesting and processing activities combined do not show up as significant factors. What we think is going on is that farmers are already at or close to maximum efficiency (from a productivity point of view). For models like these it helps to have variability among the explanatory and dependent variables. By having poor performers in the sample, the effects of those doing a good job become visible. Similarly, a number of farmers with low fertiliser input and lower productivity will show the effects of applying more fertiliser, but most farmers in the group are heavy fertiliser users, hence such a correlation does not show for Nitrogen.

- **Important factors that do feature:**
  - **Coffee acreage**: across the entire sample average productivity does not differ much by farm size, but if we control for a host of other variables, then we see a slight reduction of -74 kg/ha with every additional ha in farm size.
  - **Planting labor**: We see a reduction of 25 kg/ha with every additional day spent on planting new trees. Often such planting is replacing ageing trees which are either removed or heavily stumped prior to planting which explains this effect.
  - **Pruning shade trees labor:** Every additional day spent on pruning shade trees correlates with a 15 kg decrease in productivity. We suspect farmers that engage in this activity probably had excessive shading, hence the reason to prune shade trees. Excessive shading in turn is known to reduce flowering and hence productivity.
  - **Province:** Measured in Mt/ha, province explains a lot of the variability. Farmers in Dak Lak in this model have 1.18 Mt/ha lower productivity.
  - **EIQ**: With every additional Environmental Impact Quotient point, productivity is lower by 0.63 kg/ha. Farmers do not tend to spray for fun, but rather when pest and disease outbreaks require it. We think it is safe to assume that farmers with higher EIQ values had more pest and disease issues, for which the EIQ is then a proxy.

PRODUCTION: K APPLICATIONS AND PRUNING LABOR ARE LIMITING FACTORS AND COULD BE OPTIMISED TO FURTHER ENHANCE PRODUCTIVITY

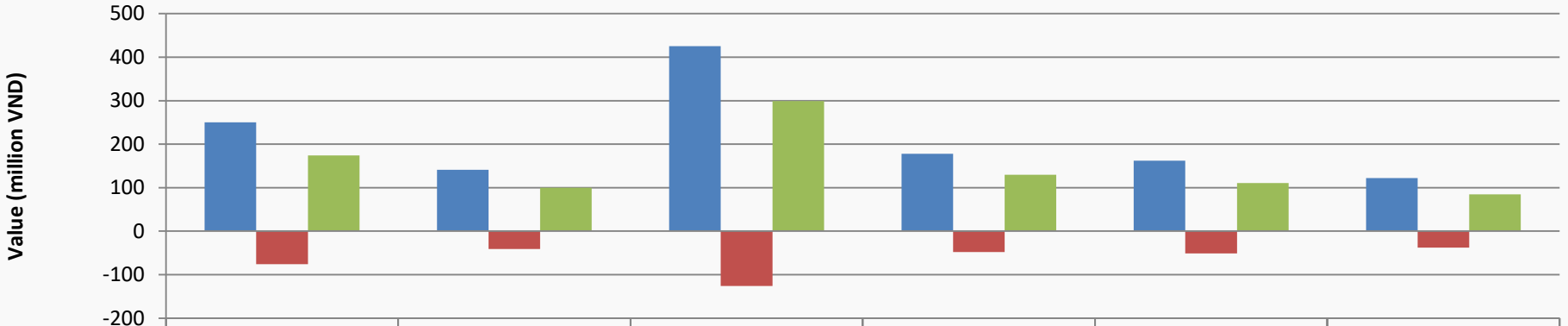
- **K application**: We saw earlier that many farmers are not applying enough K. The model confirms this, with every additional kg of K applied, productivity goes up by 1.35 kg green bean per ha. A kg of Kali cost around 6,800 VND/kg and contains 58% of K. This means an additional kg of K costs 11,724 VND, and yields a return of 1.35*42,000VND=56,700 VND/kg K applied. This gives the average farmer more than enough margin to do such an investment and spend some time on the application.
- **Pruning labor**: The art of producing coffee is the art of producing branches on which the cherries grow. Pruning is a very important activity that is critical to achieve high productivity. We think this is one of the reasons why so few farmers hire labor for pruning but rather do it themselves (see the labor section). In this model, every day spent on pruning correlates with a yield increase of 5.86 kg/ha. This may also explain some of the price sensitivity of farmers. Under current prices, the additional day of pruning yields a return of 246,000 VND at an estimated opportunity cost of household labor of 200,000 VND/day this is clearly worthwhile to do. Should farmers experience a coffee price below 34,000 VND/kg then we would expect to see a decline in pruning and hence productivity in the subsequent season.

Results
Farm economics

FARM ECONOMICS: FARMERS EARN ON AVERAGE EXCELLENT RETURNS ON EVERY VND INVESTED IN COFFEE

- With an average production of 6.02 Mt green bean per farm and a coffee price of 43,200 VND/kg green bean, farmers generated an average turnover (volume times price) of 250 million VND or 141 million VND/ha. Price levels are as much as possible taken from farmer reported data. For farmers who had not sold their entire crop at the time of data analysis, we used a default price of 9,000 VND per kg fresh cherry.
- During the 2016/17 season farmers on average earned a profit margin of 173.9 million VND per household from coffee with an investment of 76.1 million VND. This gives an average Benefit-Cost Ratio (BCR) of 2.28 VND earned for every VND invested. With a BCR of 1 a farmer would be at break-even where the profit margin is equal to the total costs.

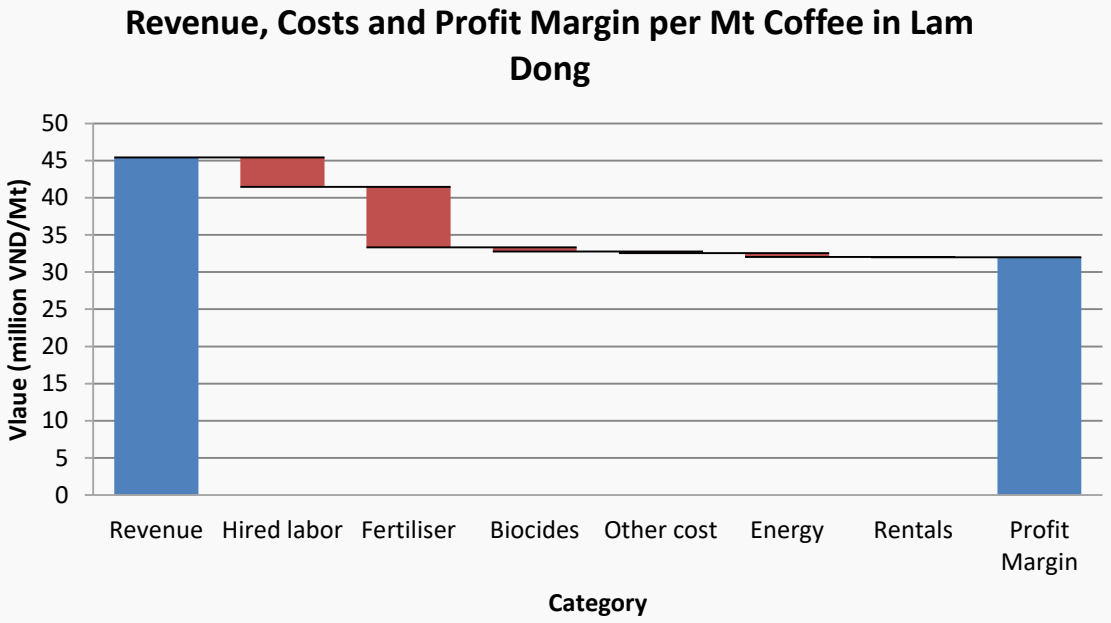
Revenue, Total Costs and Profit Margin per Farm and per Ha by Province

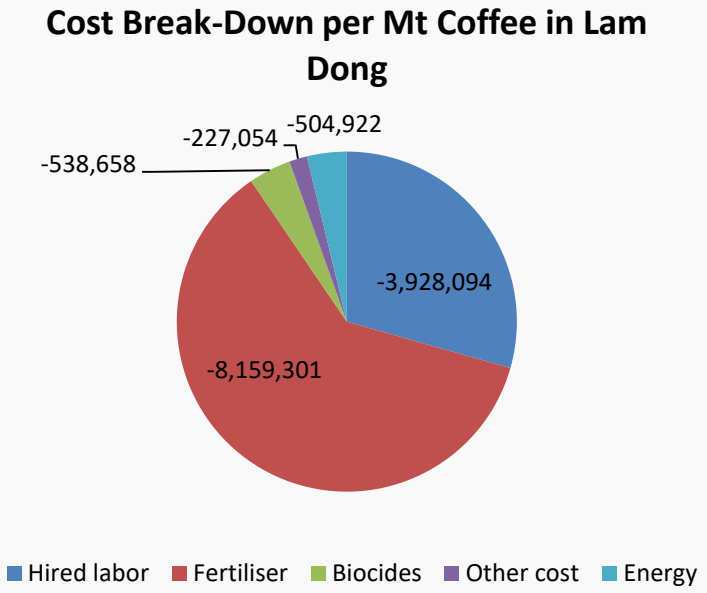


	All		Lam Dong		Dak Lak	
	Per farm	Per ha	Per farm	Per ha	Per farm	Per ha
Revenue	250,000,000	141,000,000	425,000,000	178,000,000	162,000,000	122,000,000
Total Costs	-76,100,000	-41,000,000	-126,000,000	-48,200,000	-51,300,000	-37,500,000
Profit margin	173,900,000	100,000,000	299,000,000	129,800,000	110,700,000	84,500,000

FARM ECONOMICS: AFTER FACTORING IN OPPORTUNITY COST, FARMERS NEED A COFFEE PRICE OF 13,358 VND/KG GREEN BEAN TO REACH BREAK-EVEN IN LAM DONG

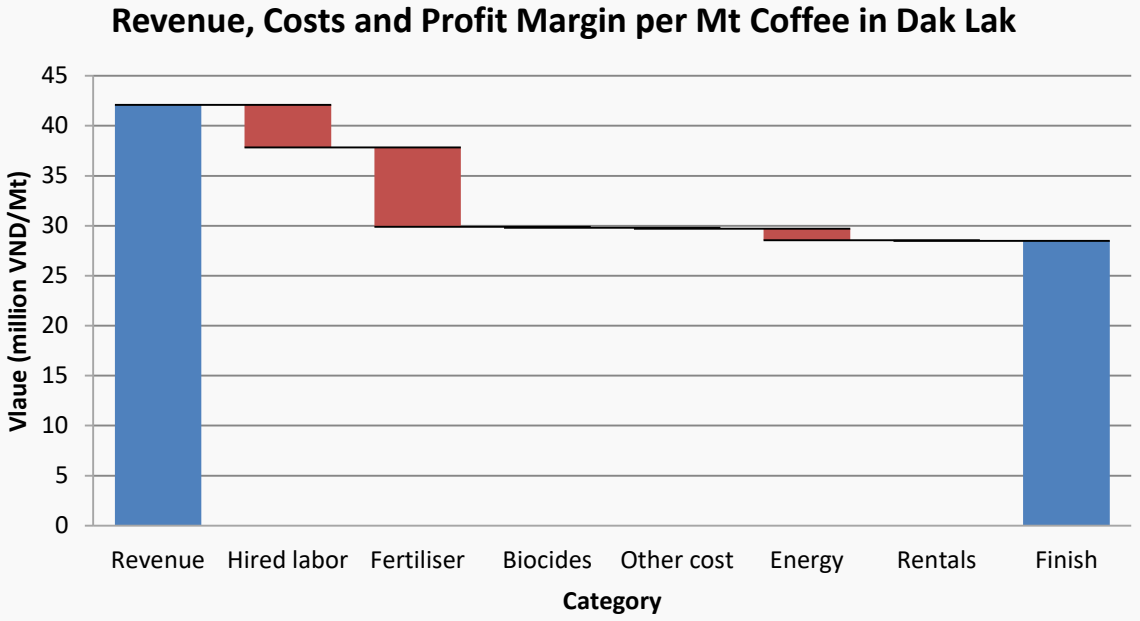
- Excluding household labor opportunity cost, farmers earned 32.04 million VND per Mt of green bean.
- Fertiliser is the single largest cost item, followed by hired labor. Energy costs are surprisingly low, we suspect not all of the energy cost were properly recorded.
- The category Other cost consists primarily of cost for planting material.
- Production cost, excluding opportunity cost comes in at 13.58 million VND/Mt.

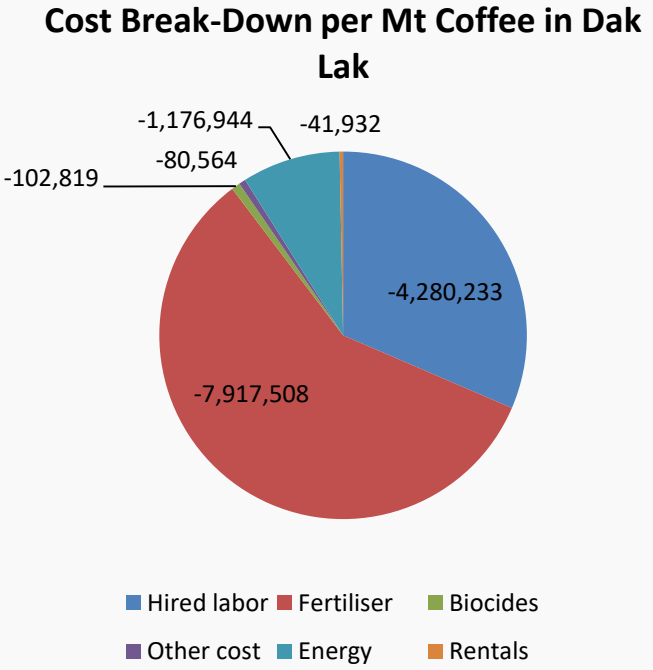




FARM ECONOMICS: AFTER FACTORING IN OPPORTUNITY COST, FARMERS NEED A COFFEE PRICE OF 13,600 VND/KG GREEN BEAN TO REACH BREAK-EVEN IN DAK LAK

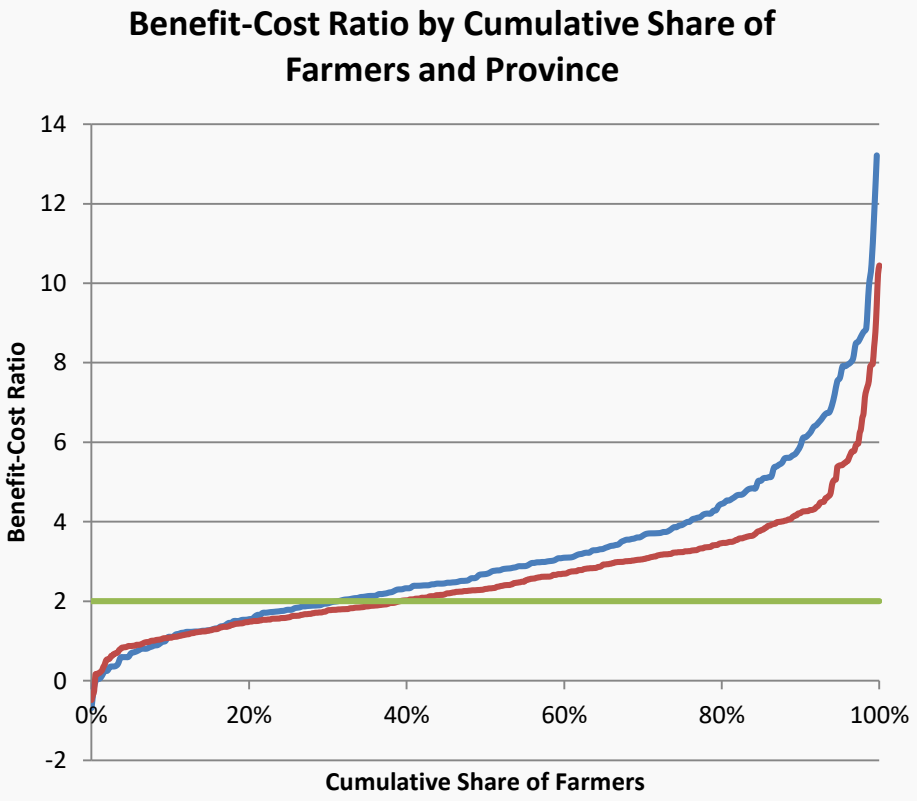
- Excluding household labor opportunity cost, farmers earned 28.50 million VND per Mt of green bean.
- Fertiliser is the single largest cost item, followed by hired labor. Energy costs are in line with what we would expect.
- The category Other cost consists primarily of cost for planting material.
- Production cost, excluding opportunity cost comes in at 13.60 million VND/Mt.
- Despite farm size, productivity and farming systems differences between the provinces, the production costs per Mt are remarkably close, indicating consistency in both farm management and data collection.





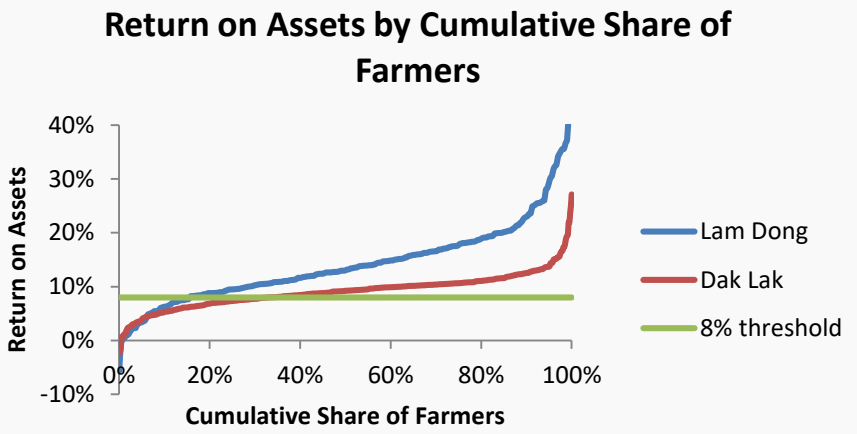
FARM ECONOMICS: 74% OF FARMERS HAVE A BENEFIT-COST RATIO LARGER THAN 2. THERE IS NO GEOGRAPHICAL CONCENTRATION OF LESS FINANCIALLY EFFICIENT FARMERS

- We do not (yet) know at which point farmers consider other opportunities more attractive than coffee. We do think that the Benefit-Cost Ratio (BCR) is one of the deciding factors, although we doubt a farmer would ever calculate it.
- With a BCR of 1 a farmer is breaking even on his investment. In Lam Dong, 9% of farmers have a BCR lower than 1. In Dak Lak this is 7.5%.
- Annual dips in the ratio are to be expected, for example when a farmer invests in stumping and/or replanting part of his farm or when coffee price crash after the bulk of investments have already been made.
- If we assume that a farmer would need a longer term BCR greater than 2 for coffee to remain attractive and economically viable than 31% in Lam Dong and 39% of the farmers in Dak Lak are at greater risk of ceasing production, should their Ratio remain as is in the coming seasons.
- Beyond the 40% mark the distributions between the provinces diverge, indicating that from a BCR perspective coffee production appears to be more economically viable in Lam Dong province.



FARM ECONOMICS: THE AVERAGE RATE OF RETURN ON ASSETS IS 10.9%, ALMOST ALL FARMERS ARE SUFFICIENTLY PROFITABLE. FARMERS WITH POOR RETURNS (<8%) PRODUCE JUST 16% OF THE TOTAL SUPPLY

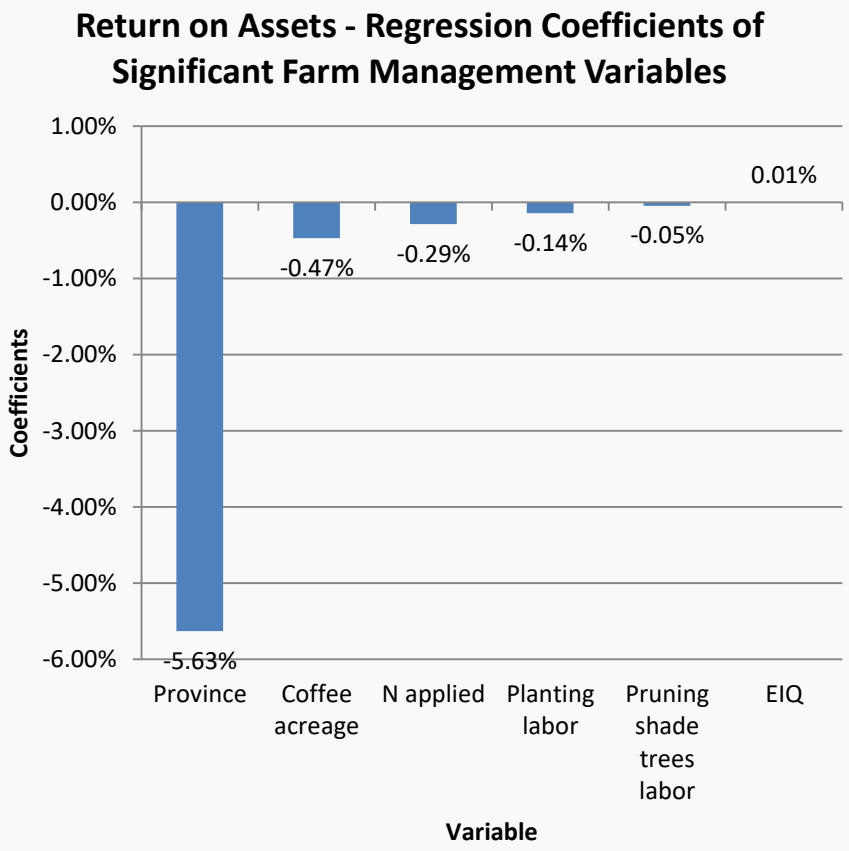
- The Return on Assets (RoA) is calculated by dividing the total assets value of a farmer by his profit margin (revenue minus total cost).
- We have valued land at an estimated current market value of 900 million VND/ha and added that to the production assets data from the FFB. This gives farmers an average asset value of 1.58 billion VND, of which 2.1% is in the form of machinery and equipment.
- Further assuming a minimum Return on Assets of 8% for coffee to remain economically viable, shows that 15% of farmers in Lam Dong and 32% in Dak Lak are in the higher risk category. As with the BCR, a seasonal snap-shot is insufficient and longer term data is required to provide more insight.
- When we create quintiles of Return on Assets, it becomes very clear that productivity is critical. Farm sizes do not differ significantly between the RoA groups. The productivity levels differ significantly between each single group and explain 60% of the variability in RoA.
- As part of the economic viability discussion, gaining more insight into farm financial ratios such as these and how to improve them will be useful.



Quintile by Return on Assets	Farm size (ha)	Productivity (Mt/ha)	Production (Mt)	Total production (Mt)
Bottom 20%	1.61	2.30	3.69	594
Lower middle 20%	1.70	2.92	5.03	850
Middle 20%	1.65	3.18	5.28	855
Upper middle 20%	1.82	3.60	6.68	1,126
Top 20%	1.88	5.05	9.43	1,668
Total				**5,420**

FARM ECONOMICS: MODELLING RETURN ON ASSETS SHEDS SOME LIGHT ON POSSIBLE FARM MANAGEMENT IMPROVEMENTS TO ENHANCE RETURNS

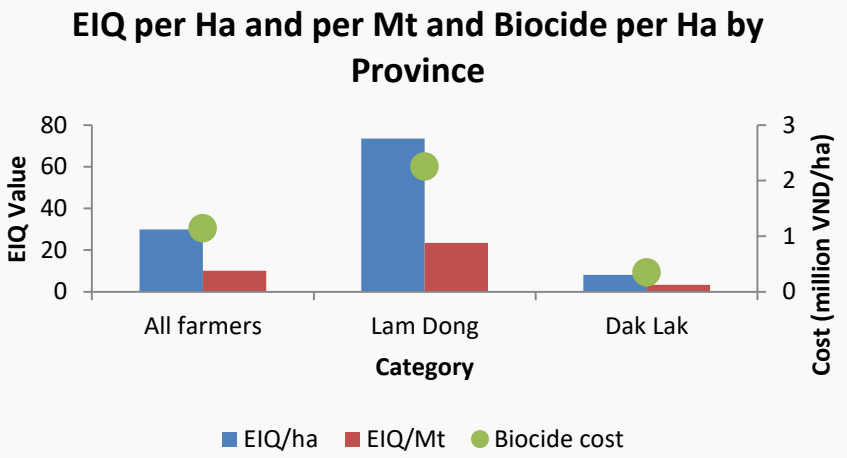
- The return on assets model is fairly robust, explaining 23% of the variability in the sample.
- **Province**: Confirming what we have seen before, farmers in Lam Dong are not only more productive but also have better RoAs.
- **Coffee acreage**: With every additional ha, other things being equal, the RoA drops by -0.47 percentage points, largely as a result of increased hired labor costs.
- **N applied**: In the productivity model we did not find an effect of N application because a large majority of farmers is over-applying N. The RoA model shows us the financial effects of this, with every additional 100 kg of N applied per ha, the RoA drops by -0.29 percentage points.
- **Planting labor**: Logically, this factor also features as costs are accrued while benefits from enhanced production follow 2 to 3 years later.
- **Pruning shade trees**: We suspect a similar phenomenon as the productivity model explains the negative correlation with pruning shade trees and the RoA
- **EIQ**: Every additional EIQ point shows a positive correlation of +0.01 percentage points on the RoA.

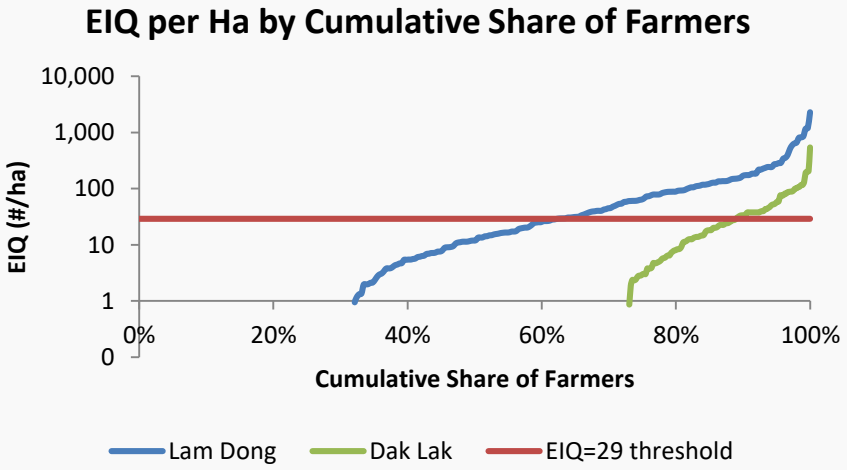


Results
Environmental performance

ENVIRONMENTAL PERFORMANCE: THE ENVIRONMENTAL IMPACT QUOTIENT PER HA IS 30 AND PER MT COFFEE 10.

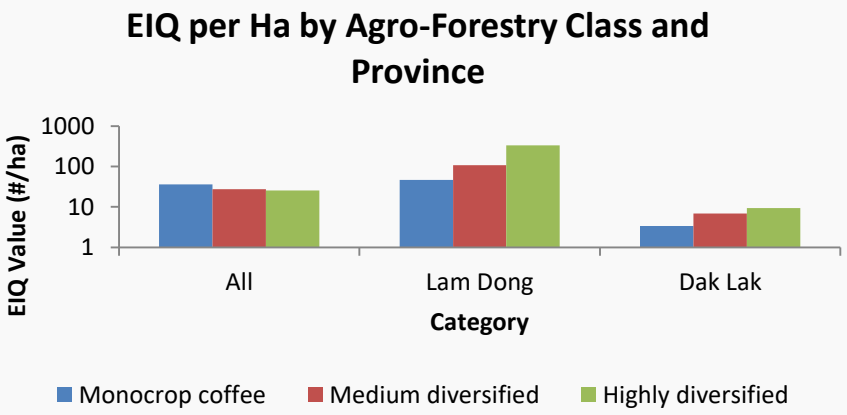
- The EIQ is a compound index value that aims to give an index figure for the toxicity of a pestcide. The FFB software calculates EIQ values using the Cornell University's EIQ database and the volumes and active ingredients of the pesticides used by farmers.
- The average EIQ for all farmers, including those that do not spray, is 30 per ha. Average biocide cost for all farmers is 1.14 million VND/ha.
- The differences between the provinces are significant, with farmers in Lam Dong having a much higher EIQ than those in Dak Lak.
- In the absence of benchmark EIQ data for coffee production we decided to set an arbitrary treshold of 29. This value represents the median EIQ value of all the 900 FFB farmers in the ISLA programme that spray.
- To achieve such a reduction, the companies in Lam Dong need to work with 72% of their farmers. In Dak Lak 11% of farmers exceed the 29 point threshold.
- Contrary to Lam Dong, there does not appear to be a need for a programme-wide training on pesticide use in Dak Lak.

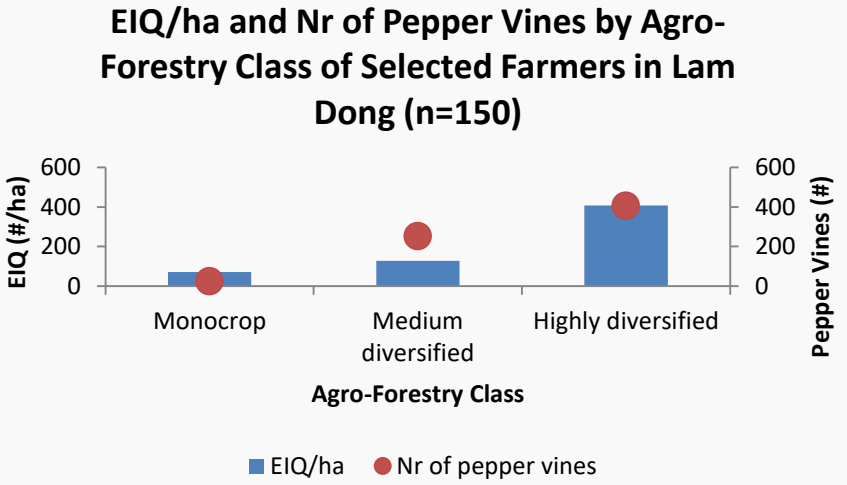




ENVIRONMENTAL PERFORMANCE: THE EIQ IN BOTH PROVINCES INCREASES WITH A HIGHER LEVEL OF DIVERSIFICATION. ACROSS ALL THE FFB FARMERS THERE ARE NO SIGNIFICANT DIFFERENCES

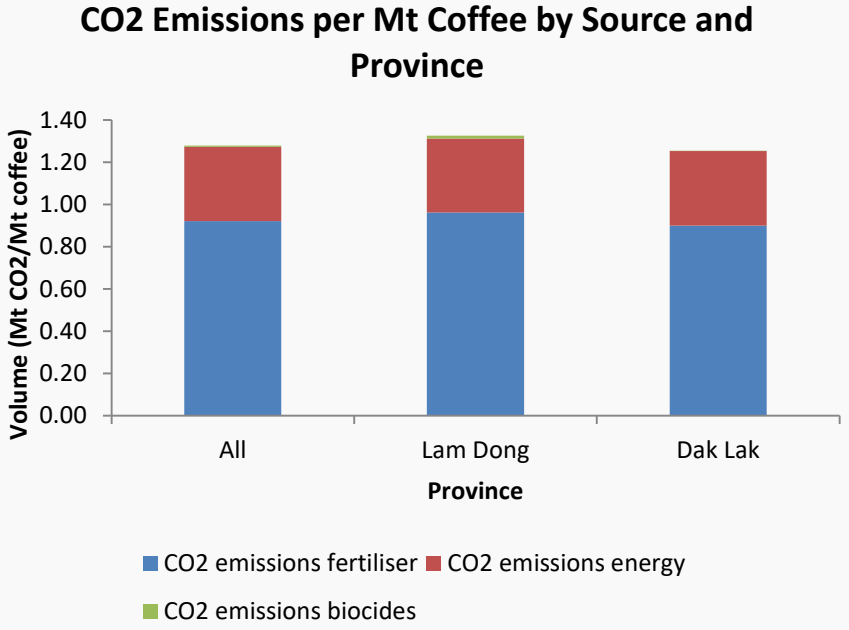
- In both provinces we see an upwards trajectory of the EIQ with the level of diversification.
- Intersting to note is that the EIQ in Highly Diversified farming systems in Dak Lak (that often grow pepper) is so much lower than that of even the Monocrop coffee farmers in Lam Dong, while pepper is known to require significant fungicide applications.
- In one of the Lam Dong projects we see a strong increase in EIQ correlating with the number of pepper vines that farmers grow.
- Technical support on decision-making for spraying for farmers that grow other crops than coffee in Lam Dong appears to be important if the EIQ is to be reduced.
- While local agro-ecological conditions differ between the provinces, Highly Diversified farmers in Dak Lak show that it is possible to grow pepper and still have a relatively low EIQ

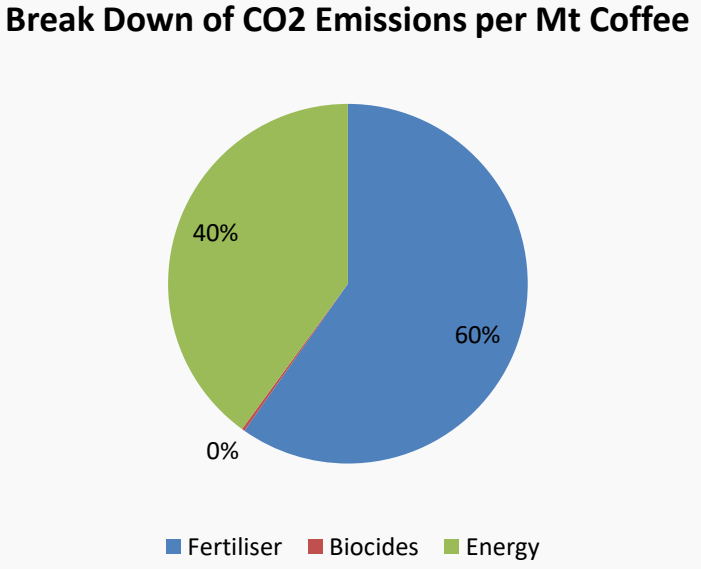




ENVIRONMENTAL PERFORMANCE: CARBON EMISSIONS AVERAGE 1.28 MT PER MT GREEN BEAN. FERTILISER CONTRIBUTES 60% OF THE EMISSIONS

- The FFB software calculates the CO2 equivalent emissions from energy, biocides and fertiliser. For each type of these inputs we use IPCC criteria and data for embodied energy and emissions associated with application.
- Emissions average 1.28 Mt per Mt green bean. Of this, 60% comes from fertiliser, while energy, mostly for irrigation and transport contributes 40%. The contribution from biocide related emissions is negligible.
- In communes where emissions exceed the average, farmers tend to have used more fertiliser than needed for their production.
- Average emissions for all FFB farmers are 3.77 Mt per ha, if we assume 625,000 ha of coffee in Vietnam then coffee production contributes 1.6% of Vietnam's 152 million Mt total emissions** while contributing and estimated 3% to GDP.

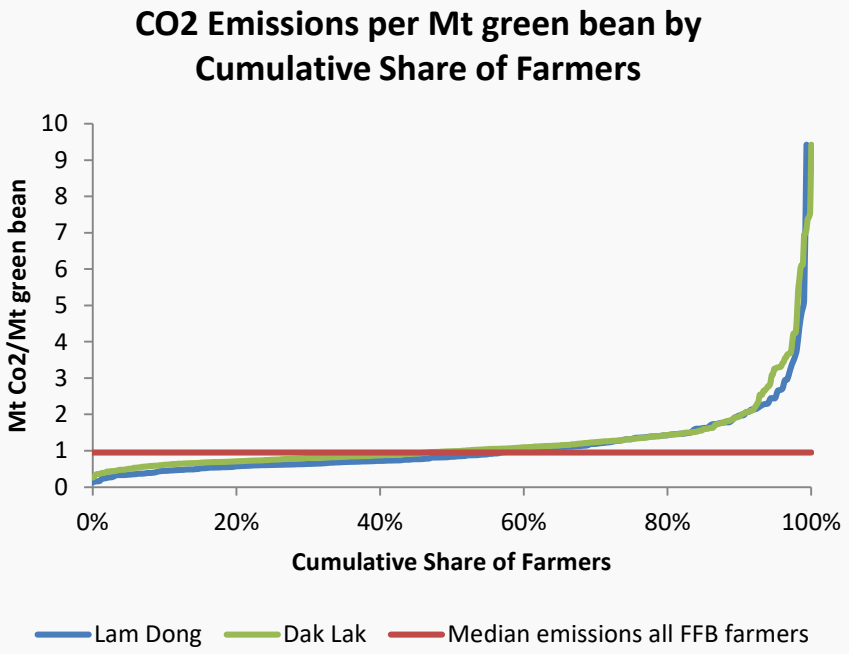


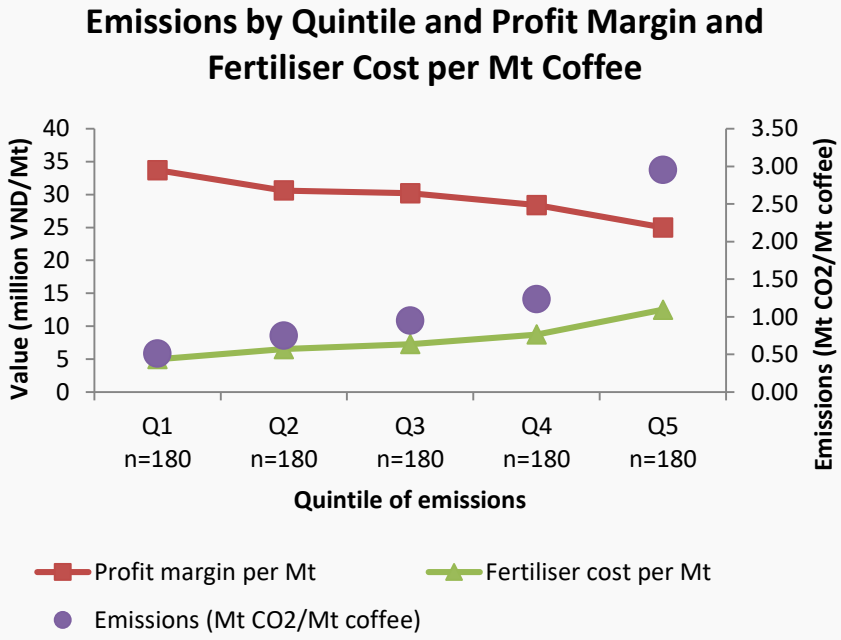


** http://data.worldbank.org/indicator/EN.ATM.CO2E.KT

ENVIRONMENTAL PERFORMANCE: POLLUTION DOESN'T PAY-OFF, THE LARGEST CARBON EMITTERS ARE SIGNIFICANTLY LESS PROFITABLE AS THEY TEND TO OVERSPEND ON FERTILISER

- Comparing the most carbon efficient farmers who emit on average 0.51 Mt CO2 per Mt green coffee with the top 20% emitters shows that the former are far more profitable. Revenues of the latter are 51% lower, largely because they spend 45% more on fertiliser per Mt coffee.
- Significant carbon emission reductions *and* revenue improvements can be achieved with improved nutrient management.





Recommendations

RECOMMENDATIONS

- **FFB implementation:**
  - Overall data quality is very good, with the possible exception of the data on irrigation volume. The original recommendation on irrigation value was to have each farmer measure the time it takes to fill a 200 l barrel and then during irrigation measure the time the pump is running to estimate total irrigation volume. We are not sure if this was done, if not, it would be advisable to do so.
  - If possible, it would be desirable to add 60 or so farmers to the FFB who fall in the Medium or Highly diversified categories in Lam Dong province. Presently, the distribution of Agro-Forestry Classes correlates too closely with the provinces and Agro-Forestry related conclusions are therefore valid for provinces only and not generally applicable for the whole sector. Still, Dak Lak province supplies between 5% and 7% of the global robusta supply, so even if findings apply to provinces only, this is still of tremendous value.

- **Farm management:**
  - The use of biocides banned by the UTZ & 4C standards needs to be stopped. We do not advise to penalise farmers who use these biocides, as this may affect what they report in the future. Rather, a personal visit by company staff to provide advice and alternative options is recommended. We also recommend to discuss this issue with local pesticide dealers and ask them to stop stocking these biocides. This doesn't need to affect their financial bottom line as alternatives are available.
  - K applications are too low and N application generally too high, the latter depressing the Return on Assets. Farmers may be hesitant to make significant changes to their nutrient management. We advise for each farmer to set aside 30 coffee trees where he tries out the recommendations (from his personal farm report the farmer can, possibly with help from the agronomist, determine how to change his fertiliser applications to better meet crop requirements. For the 30 trees that are part of such an on-farm test, volumes and types of fertiliser as well as yields need to be tracked and compared to the other trees.

RECOMMENDATIONS

- **Farm management:**
  - Similarly, we think that more or new training on how to determine nutrient requirements is needed. In the absence of soil tests, we advise to train farmers on how to determine the expected yield, prior to the first fertiliser application. A kg of fresh cherry contains about 0.5% N, 0.068% P and 0.6% K. With these values and the nutrient content of fertilisers the amount required can be calculated (with some additional N application to cover for N losses due to emissions and leaching into the ground water).
  - If soil tests are done, we advise to test out the recommendations on a small number of trees first and carefully evaluate the economic effects. In our experience not all soil laboratories provide good advice, often over-estimating how much needs to be applied.

- **Farm economics:**
  - While most farmers earn good or acceptable returns, both from a BCR and RoA perspective, there is a share that do not. We recommend the companies to seek these farmers out and try to determine what is driving their low returns and how that affects their future plans for coffee and/or diversification. While farmers are unlikely to stop production in any given year, a continued low return may change that. For coffee trading companies we feel it is important to understand such mechanisms.

- **Environmental performance:**
  - The average EIQ of coffee from the FFB farmers may be low, but there are a number of communes in Lam Dong where highly toxic biocides are used. The project implementers in those areas are advised to see if it possible to assist farmers with the highest EIQs to reduce their toxicity footprint.
  - Carbon emissions can be reduced significantly. If the fertiliser advice is implemented we would expect to see a reduction in the carbon footprint as well, while allowing farmers to make better returns.

AGRI LOGIC

About Agri-Logic

Agri-Logic – management, consultancy and research - operates where agricultural production, development, international trade and consumer markets intersect. We combine a thorough understanding of farm level reality and commodity trade with scientific research skills and a track record in sustainability strategy design and implementation, to help clients deal with sustainability challenges and market requirements.

ANNEX 1: MODEL SPECIFICATIONS

- Variables included in productivity and RoA models:
  - Female kinh
  - Male kinh
  - Share of coffee trees
  - Primary school
  - Secondary school, DNF
  - Secondary school
  - Higher than secondary school
  - Male Kinh
  - Female Kinh
  - Nr of dependents
  - Training time
  - Coffee acreage
  - N applied
  - P applied
  - K applied
  - EIQ
  - Irrigation water
  - Pruning labor
  - Pruning shade trees labor
  - Weeding labor
  - Biocide cost
  - Planting labor
  - Basin maintenance labor
  - Gender
  - Year of birth
  - Total labor, ex harvesting and processing
  - Province