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Vietnam: Rural Connectivity and Agriculture Logistics in Domestic Market Supply Chains

Synthesis report

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Abbreviations

CASRAD	Centre for Agrarian Systems Research for Agricultural Development
CIRAD	International Center of Agricultural Research for Development
FAVRI	Fruit and Vegetables Research Institute
GSO	General Statistical Office
MALICA	Markets and Agriculture Linkages for Cities in Asia
VAAS	Vietnamese Academy of Agricultural Sciences

Foreword and acknowledgments

Physical connectivity is one the pillars of rural livelihoods and rural competitiveness. This is especially true for distant or marginal areas, because remoteness has a strong impact on both the terms of trade and the availability of services. However, data on logistics is less frequently collected and scrutinized than on other rural development pillars such as trade policy, production supply characteristics or investment policies. In particular, remarkably little attention has been given to logistics dealing with remote producers. Yet in order to access markets and services, the "first miles" are by far the most difficult and the most expensive in terms of cost per unit. Acting on this constraint may unlock a hidden potential for rural development. But roads are not enough: besides infrastructures and the so-called "hardware logistics", it is essential to improve the "software logistics", i.e., the associated services, trade procedures and enabling environment.

This report is a contribution to a Multi-country Study on Rural Connectivity and Agricultural Logistics in the Domestic Markets of East Asia under the guidance of the World Bank East Asia team. The report focuses on the logistics of food collection and distribution and the associated institutional arrangements and marketing channels related with specific supply chains ('lines') in Vietnam. It provides an analysis of the obstacles and constraints for selected supply chains of agriculture and food products from farms to markets. It also identifies key opportunities for efficiency improvement in physical infrastructure and institutional arrangements to guide appropriate and cost-efficient logistics intervention or investment.

The study was undertaken through the MALICA consortium (Markets and Agriculture Linkages for Cities in Asia) which brings together Vietnamese and French research centres, including the Vietnamese Academy of Agricultural Sciences (VAAS) and the International Center of Agricultural Research for Development (CIRAD), based in France. The overall study was coordinated in Hanoi by Denis Sautier from CIRAD and Dao The Anh from VAAS with methodological backing from Frederic Lançon from CIRAD.

This synthesis report has been prepared by a team led by Frédéric Lançon at CIRAD comprising Denis Sautier and Dao The Anh. They were assisted by the authors of the two regional studies. The first regional study on Krong No district, in the Central Highland province of Dak Nong, was conducted by a team from VAAS Centre for Agrarian Systems Research for Agricultural Development (CASRAD). The study team was coordinated by Hoang Thanh Tung and comprised Bui Quang Duan, Hoang Xuan Truong, with the participation of Denis Sautier and Dao The Anh. The second regional study on Moc Chau district, in the Northwest Mountains province of Son La, was conducted by a team from VAAS Fruit and Vegetables Research Institute (FAVRI). The team was coordinated by Nguyen Thi Tan Loc and comprised Le Thu Thinh, Le Thi Ha and Le Thi Xuan.

The work was conducted under the guidance of Patrick Labaste from the World Bank who provided many helpful comments and inputs at different stages of the work. Our team is grateful to the extensive and excellent advice received. Any remaining errors are the responsibility of the authors.

Executive Summary

1. This study addresses issues of rural connectivity and agricultural logistics on market accessibility, and their impact on farmers located in remote areas in Vietnam. It is based on information collected in two highland districts: Krông Nô in Dak Nong province (Central Highlands) and Mộc Châu in Son La province (North West mountains) with a key focus on transport issues. An analysis of the cost and benefit of seven marketing lines for maize and one marketing line for chayote indicates that, due to land and household labour availability, as well as seasonal patterns, these crops can be profitably produced in remote areas in spite of additional transport costs borne for reaching consumers' areas.

2. Economies of scale play at the wholesale stage where the product is actually shipped out of the districts at a lower transport cost per kilogram per kilometer, compared to the productivity of transport at the collection stage linking farmers to the district trading hub. However, transport costs at the wholesale level are sensitive to the availability and volume of cargos for the return trip from lowland areas. This means that promoting a specialization of the upland districts in the production of selected crops may improve their accessibility to consumers.

3. Transport cost at the collection stage varies across locations and according to the type of vehicle used. The more densely populated study site in Mộc Châu and the availability of bigger vehicles translate into lower transport costs for linking farmers to the nearest trading hubs. Remote villages in Krông Nô are fewer, however the costs for shipping agricultural products out of their fields are higher, due to the poor accessibility of the trading hub (rural road conditions) and smaller vehicle used (công nong). In Krông Nô, farmers located in remote areas have to bear the expense of hiring motorized trailers for shipment of their agricultural output; the provision of transport services is therefore critical. Adding value at the farm level, through the drying of maize combined with storage facilities to delay the shipment until after the rainy season might be an option to reduce transport cost, provided that adequate credit mechanisms are offered.

4. Accessibility constraints add burdens on social equity between native and migrant farmers in Krông Nô, because the latter settled near the main roads, while distant villages are primarily populated by native ethnic group farmers who are faced with language barriers, more expensive inputs, higher interest rates from traders, as well as higher transport costs and hazards. In contrast, in Mộc Châu the participation of native ethnic groups in commercial agriculture and in trading activities is more widespread, while migrant farmers may have settled also in remote areas.

5. The study concludes that with 33% (on average) of the total costs, transport cost is an important, albeit not overwhelming, constraint for these remote areas of Vietnam. In both study sites, local private entrepreneurs have developed marketing systems that provide outlets to most of the local producers. These marketing services are provided at reasonable costs when taking into account the current level of infrastructure. Consolidated budgets show that these lines are financially viable and profitable in spite of the additional transport costs generated by the remoteness of producers' location. The return for farm family labor is higher than the local labor opportunity cost. Transport cost is not the only component of agricultural production profitability. While competitiveness in highland and upland areas is affected by transport costs, this disadvantage is compensated by labor and land availability, off-season production schedules and by the external economies initiated by the development of new specializations. But in order to develop value-added strategies, road access is not enough. Value chain services are also necessary; namely, input provision, credit mechanisms and transportation services.

6. The higher share of profit going to local collectors compared to the wholesalers illustrates the low level of competition that may prevail among local collectors, compared to the downstream part of the chain. These results are in line with the hypothesis that remote areas correspond to areas of lesser trade competition and higher risks. Costs incurred by remote rural areas due to connectivity limitations appear to reflect not simply transportation costs, but also accrued logistical risks and reduced trading competition.

7. Priorities areas can be identified for empowering farmers into markets. Improving rural roads or track conditions is one option as it reduces the risk and cost for the shipments within the commune. It is also essential that development projects and planners support the development of value chain services, mostly transportation services, input provision and credit, and pay more attention to return loads, which are a critical factor in order to develop an efficient transportation and market access system connecting remote districts and central economic areas.

1 - Accessibility and inclusive development

8. Vietnam has achieved significant progress in rural poverty alleviation over the last decades. However, these effects have had a more significant impact on irrigated lowlands, where farmers have benefited from the agricultural policy focusing on rice productivity increase at the beginning of the economic transition and then from the expansion of the urban and export markets that triggered agricultural diversification towards high value crops. The impact of markets and economic growth remains an issue for upland farmers located in more remote areas. In a more open and diversified agro-economic environment, rural poverty alleviation strategies cannot be limited to agricultural productivity enhancement or to social safety nets. They also rely heavily on market mechanisms and demand-driven production development.

9. The experience from decades of infrastructure support to rural development has shown that although road building is certainly an essential condition to improve livelihoods, it is not the only necessary action for improving remote farmers' position in agricultural markets. Accordingly, while the Vietnamese authorities have pursued their effort to improve rural population accessibility to all-weather road networks, this important area of actions should not hinder the significance of additional policies supporting the availability of logistical services and promoting poor farmers' empowerment into markets through an emphasis on institutional development (farmers' organization), the promotion of new institutional arrangements (contract farming, collective marketing), the reduction of information asymmetries about market knowledge and rural finance development.

10. The goal of this analysis report is to provide development experts with elements for assessing the scope of accessibility and logistical issues on remote farmers' capacities to market their crops and thus maximize the impact of agricultural market expansion on their income.

11. The first part will present the methodology followed to collect qualitative and quantitative information representing different situations of remote rural upland and highland areas, and how these datasets were processed to estimate the costs and benefits associated with the marketing of agricultural products beyond the selected zones. The second part presents the results of the data and information analysis and the implications for prioritizing actions that could contribute to generating income in these territories.

2 - Methodology

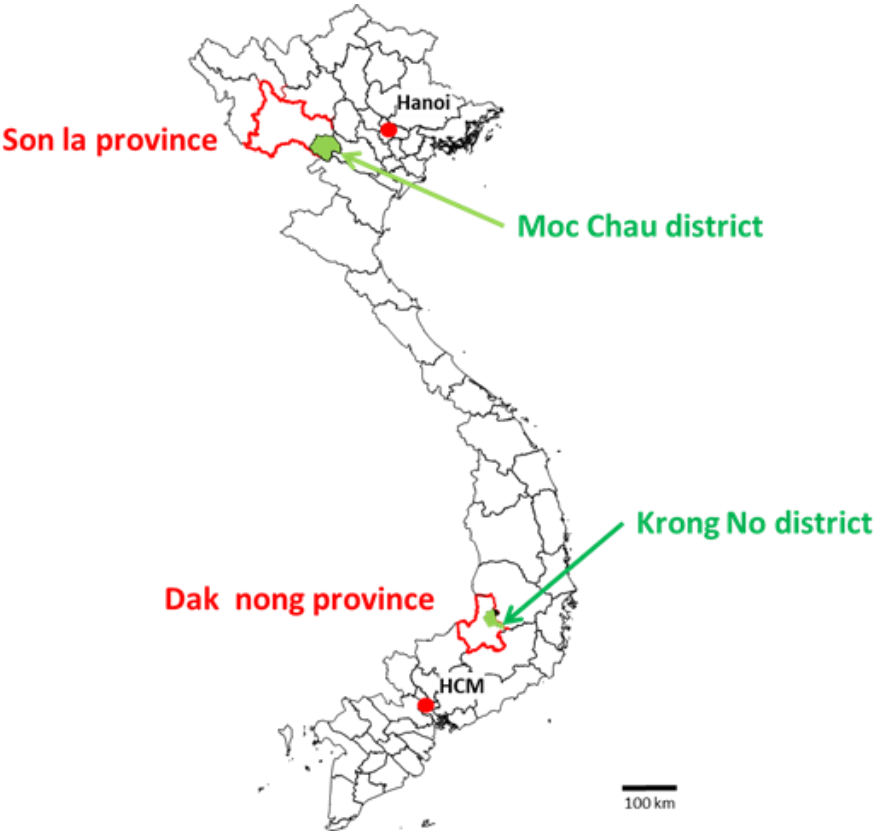
2.1 Study sites and value chain selection

12. The study sites were selected in two highland regions of Vietnam. The first one was the district of Mộc Châu in Sơn La province, in the Northern mountainous area , about 150 km from Hanoi. The second one was the district of Krông Nô in Đăk Nông province, in the Central highlands part of the country , about 300 km from Ho Chi Minh city (Figure 1).

13. Mộc Châu is a typical upland cropping area with a combination of perennials such as tea and common field crops such as maize, cassava and rice. Maize is a major overall source of income for farmers and high value crops (vegetable and fruits) are increasingly being produced to supply urban markets. Krông Nô district presents a rather different setting as the original shifting cultivation relying on forest availability was transformed one generation ago into an intensive crop producing area led by the expansion of coffee production associated with the establishment of a very high number of migrant farmers coming from other regions of the country. Here, vegetable and fruit production play a very minor role compared with Mộc Châu district, while maize and other annual crops provide complementary cash for coffee and rubber producers or an alternative source of income for non-coffee producers.

14. Accessibility constraints add burdens on social equity between native and migrant farmers in Krông Nô, because the latter settled near the main roads, while distant villages are primarily populated by native ethnic group farmers who are faced with language barriers, more expensive inputs, higher interest rates from traders, as well as higher transport costs and hazards. In contrast, in Mộc Châu the participation of native ethnic groups in commercial agriculture and in trading activities is more widespread, while migrant farmers may have settled also in remote areas.

Figure 1 : Study sites location



15. In each district, producers were selected in villages taking into account (i) their distance from the major district town or from the main district road connecting to neighboring provinces and (ii) considering their relative degree of specialization in perishable and nonperishable crops. The objective was to select both perishable crops (vegetable, fruits…) and non-perishable crops in order to assess the impact these features have on issues of accessibility. In addition to cash crops mainly produced for market, the study also monitored the marketing of rice imported in the district to put into perspective connectivity issues with the potential gain or losses that could derive from an increasing dedication into cash crops at the expense of local rice production.

16. Agriculture and markets linkages generate multiple marketing "lines" along a given value chain. The "line" of product has been defined as the basic unit of analysis: it corresponds to a specific combination of players along the value chain, from the producer to the end user outside the district, and reflects a particular geographical configuration of the flow of the selected product. Splitting the complexity of the agricultural value chains into these simple lines allows for a comparison of how location, shipment practices and sequence, and number of players along the chain may impact market accessibility.

2.2 Information collection

17. For each study site secondary data and general information was collected from the local authorities at the district and commune levels while primary information about production and marketing costs was collected from a small sample of players. These players were selected on-site, verifying the consistency between the selling point declared by one player and the purchasing point reported by the following players in order to ensure a consistent and comprehensive coverage of the transportation costs from the field down to users located outside the district. Accordingly, producers were interviewed in locations that were designated as procurement areas by traders interviewed at the marketing hub at the commune level.

18. In terms of value chain length, information collection was restricted to players actually operating within the selected district. Purchasers operating only outside the selected districts were not interviewed. This focus on the up-stream segments of the marketing chain facilitated the matching of primary data collection with the level of resources available for the study. It does not affect the relevance of the analysis about the connection process of these producing areas to the whole value chain. In other words, it is obvious that each producing area selected has a marginal weight in the total volume of operation of the selected chain; the objective was not to conduct a global overview of this chain, nor to assess the share of the value created in this up-stream segment compared to the total value created along the chain. What we are concerned with in our study is an assessment of resources used to connect remote farmers to major trading hubs where their product will then compete with other sources of supply (lowland, peri-urban producers, or imports). The purpose of the study is to assess the role of connectivity as a constraint for these remote farmers' access to markets. It is not to measure the comparative advantage of the selected upland and remote systems in front of other sources of agricultural products in the lowlands. This would have required a comprehensive study of the entire sector of the selected products. Hence we consider that the selected systems are "price takers".

19. Our goal was to take into account the potential diversity of marketing lines that may exist in the selected area within the specific time frame allocated to data collection rather than to interview a large sample of players. Hence, production costs and revenues at the farm level that may be subject to broad variations were estimated on the basis of farmers' declarations but cross-checked and validated against secondary sources and expertise from the local agricultural officers and the research team. For transportation and processing stages down-stream, a limited sample for data collection does not have major implication in terms of representativeness and reliability because the technical coefficients associated with these tasks are less variable than at the production stage, i.e., conversion rate from raw product to processed output, engine fuel consumption, custom rates for loading, unloading cargos... The number of players interviewed per district is displayed in Table 1 and in Table 2 below.

20. The sample interviewed in Mộc Châu was composed of 42 respondents: 14 for the lines of non-perishable product (maize), 14 for the marketing lines of perishable (chayote), 14 for rice. These respondents included 16 producers (maize and chayote), 10 farmers-consumers (rice), 6 local collectors, 5 processors or wholesalers and 5 retailers [1].

Table 1. Sample of players interviewed in Mộc Châu

MAIZE *Communes:*	**To Mua**		**Quang Minh**		**Total**
Villages:	***Remote***	***Connected***	***Remote hamlet***		
Farmers	2	2	3		7
Collectors/Transporters	1	1	1		3
Dryers	1	1			2
Wholesalers/Transporters		1	1		2
CHAYOTE *Communes:*	**Dong Sang**		**Mộc Châu Farm Town**	**Ha Noi**	**Total**
Villages:	***Remote***	***Connected***	***Remote***		
Farmers	3	3	3		9
Collectors/Transporters	1	1	1		3
Wholesalers				1	1
Retailers				1	1
RICE *Communes:*	**Dong Sang**	**To Mua**	**Quang Minh**	**Mộc Châu Farm**	**Total**
Consumer-farmers	2	2	3	3	10
Retailers	1	1	1	1	4

21. In Krông Nô district, the sample was composed of 50 respondents: 25 for the maize marketing lines (non perishable), 6 for the pumpkin lines (perishable), and 19 for rice. These respondents included 12 producers (maize, pumpkin), 8 rice-purchasing farming families, 14 local collectors or retailers and 16 millers/wholesalers/ transporters.

[1] After the survey was carried out, Mộc Châu district was divided in July 2013 into 2 separate districts, named "Mộc Châu" and "Vân Hồ". In this report, Mộc Châu data refers to these 2 districts.

Table 2. Sample of players interviewed in Krông Nô

Communes:	Duc Xuyên		Quang Phu		Tan Thanh		Total
Villages:	(close) Xuyên Hà	(remote) Bon Choih	(close) Phú Xuân	(remote) Phú Lợi	(close) Đắk Lưu	(remote) Đăk Ri	
MAIZE							
Farmers	2	2	1	1	2	2	**10**
Collectors/transporters	1	1	1	1	1	1	**6**
Wholesalers in district	2	1	1		1	1	**6**
Wholesalers out of district	1	1		1			**3**
PUMPKIN							
Farmers		2					**2**
Collectors		2					**2**
Wholesalers in District		1					**1**
Wholesaler out of District		1					**1**
RICE							
Farmers-consumers	1	2	2	2		1	**8**
Miller						1	**1**
Retailers	1	1	1	1		2	**6**
Wholesalers in district	1	1	1	1			**4**
Total	**9**	**14**	**7**	**7**	**4**	**8**	**50**

2.3 Data analysis : cost estimations

22. After the description of each line, a budget was established for each player taking into account how they perform their function within the line. These budgets record the type of equipment used, the quantity of material inputs and services purchased, the quantity of labor paid and other costs (tax…). In order to ensure a higher degree of reliability, cost estimation aimed to distinguish as much as possible the quantity and the unit purchased on the one hand, and the unitary price of each cost item on the other. Durable goods were depreciated using a simple annual linear depreciation without taking into account a salvage value. Cost estimates did not take into account the opportunity cost for capital and labor because there were no strong foundation and references available to select them, and because the purpose of the study does not encompass a full-fledged economic analysis. However, the established budget per operation might be used as an initial basis for the formulation of a cost/benefit analysis .

23. Budgets were established for a given volume of reference on a case-by-case basis. In the case of farmers, the volume of reference was the production of one hectare of crop, while in the case of traders, budgets were developed in reference to the volume sold during one cycle of trade (purchase and resale). For processors, the volume of reference corresponds to one batch of raw material processed by the operator. The actual share of each cost item allocated to producing, marketing or processing the volume of reference was also broken down according to the share of the selected product in the operator's overall volume of activity. This correction accounts for situations where equipment (means of transportation, tools..) are used also for producing, trading or processing other products.

24. In order to capture the whole cost associated with the connection of a production site to the down-stream market, budgets also take into consideration the cost of both in-bound and out-bound trips associated with one full cycle of transportation. For example, when a trader collects products in a

remote village, transportation costs comprise not only the distance driven from the remote village to the trading hub where the collector resells the good to the next player in the chain; transport costs also include the distance initially driven from the trading hub to the remote village in order to purchase the farmers' product. The same rationale is applied to longer shipments from the district trading hub to the outlet located outside the district or the province. Therefore, the estimation of the transportation cost of the selected agricultural product was adjusted with the frequency of the out-bound (or in-bound) trips needed to complete the trade cycle, whenever these corresponding trips were not allocated to the shipment of another product. Giving attention to the whole shipment cost (in-bound and out-bound) does not aim only at improving the reliability of the transportation cost estimate. It also intends to describe the extent to which a better equilibrium in shipments between in-bound flows of goods and out-bound flows of agricultural products may contribute to an overall decrease in transportation costs in the selected districts, thus improving the competitiveness of selected areas on the Vietnamese agricultural market.

25. As a result, a simulated budget was established for each player in the supply chain "line". These individual budgets were then consolidated into one overall budget for each line in order to assess the distribution of costs and net incomes along the line, across the various players. Budgets were consolidated in equivalent to the final product of the line, making use of different recovery ratios from raw to processed product and for post-harvest and handling losses. It was not possible to retrieve price time series from secondary sources that would allow to estimate an average price for each selected product at each stage of the lines, and that, in addition, would take into account the different product qualities or forms (raw, half-processed, processed). Hence, price levels at which the transactions occur at each stage of the line were derived from the information provided by the players interviewed, paying attention to the consistency between selling and purchasing prices in each budget.

26. The net income (total income – total costs) was derived for each player of the line through the consolidated budget. The performance of the system is analyzed on the basis of the return to cash (value of the net income above the total cash invested) which was computed for each player within a line and then for the overall line, on the basis of the consolidated budget. Transportation costs were extracted from the total cost structure in order to analyze whether they are or not related to the configuration of each line (number of players, distance between each players) and to the type of transportation means used at the different stages.

3 - Results : remoteness, connectivity and transport costs

3.1 Marketing lines configuration

27. After verifying the consistency and comprehensiveness of the data set collected from different categories of players it was possible to build up eight lines, four per district. The resulting individual and consolidated budgets obtained for each line are displayed in the Appendix.

3.1.1 Krông Nô marketing lines

28. In Krông Nô, four maize marketing lines were analyzed taking into account the degree of remoteness of the farm location from the all-weather road and the form under which farmers market their product (fresh maize grain or dried maize grain). The data collected on the perishable crop (pumpkin) did not allow to represent the lines comprehensively and consistently from the farmer to

the last player operating within the district; this difficulty also reflects the small volume and the rather minor role played by this category of crops in this area due to its remoteness from large urban markets (Ho Chi Minh) which may be supplied by other areas, while the supply of secondary cities near Krông Nô (such as Buôn Ma Thuột) relies mostly on peri-urban producers.

29. The four maize lines represent different configurations of corn marketing in the district with regard to distance between players, the form under which the product is traded (fresh maize or dried maize) and the final outlet.

30. The first line (KN L1) links a farmer who is located far from the main district road. In this first case, the farmer delivers his fresh maize grain to a nearby village collector who does the primary bulking and ships the product further to a trading hub at the commune center, 10 km away, using a small two-wheel motorized tractor with trailer (Công nong) that can ship around two tons of product per trip. According to the information collected there is no shipment on the return trip from the trading hub to the village. Most likely this is because the volume of goods "imported" in the village (consumers and basic goods) is far below the volume of good exported (i.e, mainly agricultural products) and because farmers in this area are well connected to consumer goods suppliers. Given his limited capacity, this village collector's main function within the line focuses on transportation rather than on the bulking of farmers' supply. One trip rarely corresponds to the shipment of more than two farmers' production and it might be the case that several trips are needed to ship the production of a large farm. The commune-level collector, based in the trading hub, is actually in charge of bulking the commodity before sending it to the nearby dryer. Contrary to the village collector, the commune collector's main function in the system is bulking rather than shipping. He collects fresh maize grain delivered to his store from various locations and forwards it to the dryer with a small, 5 ton capacity truck. The dryer processes batches of around 10 tons of fresh maize grain into 7.5 tons of dried maize grains that can fit the requirements of the pig and poultry industry in Dong Nai province, near Ho Chi Minh city's dynamic market. The wholesaler picks up the dried maize grain directly at the dryer's door and delivers it 300 km away with a large truck with a capacity of 40 tons per trip.

31. The second maize line in Krông Nô (KN L2) presents a different configuration with only three players from the farm to the delivery point outside the district. While the farm also does not have a direct access to the district road, in this case the farmer cannot benefit of the services of a "village collector". He has to pay for the transport of his production to the nearest trader three km away from his farm. Because of these contraints the farmer is incited to add value to its production spending four days of labor to dry 4500 kg of maize before shipping it. However this drying strategy is subject to weather conditions (rainfall) and by the acceptability of lower quality maize by the market.

32. The third line (KN L3) is a variation to the first one (KN L1) as it targets the same high requirement market for the feed industry in Dong Nai province with the same type of technique (mechanical dryer) to process fresh maize grain. The major difference is that the location of the farm is far from the main district road where the maize is dried and there is no village collector. Being in a remote location, the farmer has to cover the cost himself for transportation to bring his product to a commune collector (paying the service of a "công nong" owner). The commune collector then ships the fresh maize grain 30 km to the dryer in another commune near the main road, where the wholesaler picks up the dried maize grain to deliver it to Dong Nai. Comparing KNL3 to KNL1 illustrates that farmers located in remote areas may still benefit from the supply of transportation services to connect their output to the market.

33. The fourth and last line identified in Krông Nô (KN L4) is an alternative of the KN L2 where farmers market dried maize grain rather than fresh maize grain. The difference being that the shipment of product goes to Dong Nai province rather than to the regional market.

Figure 2: Krông Nô marketing lines structure

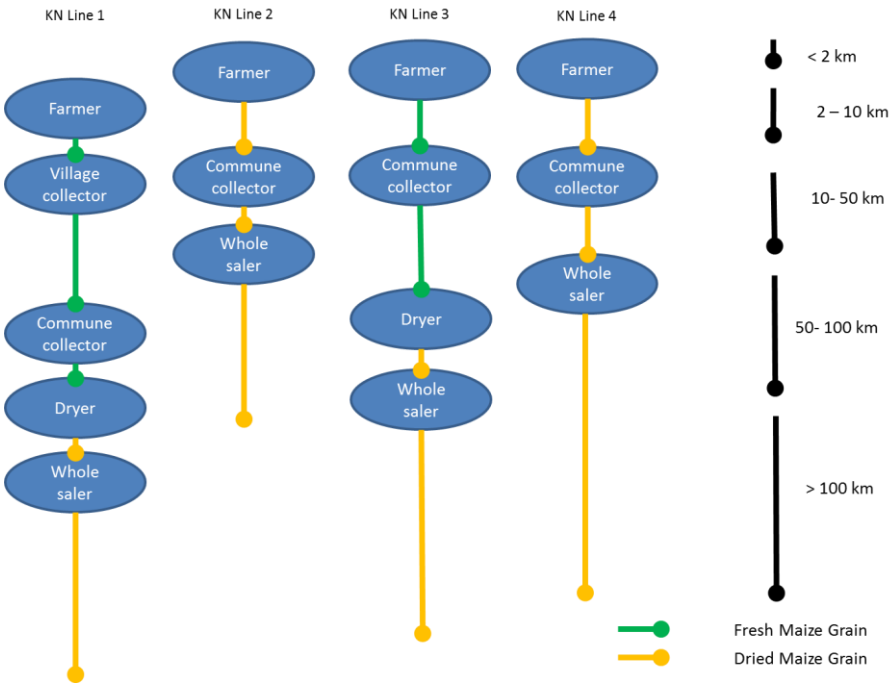
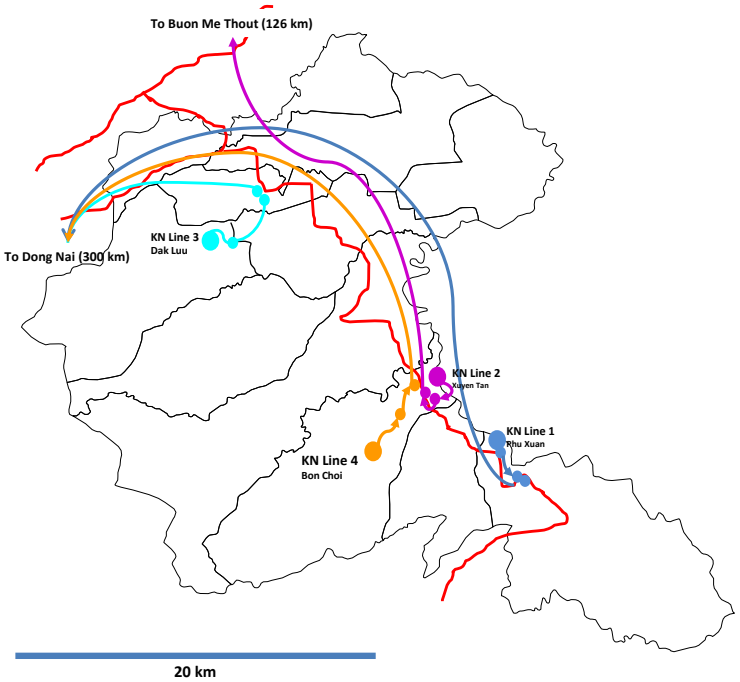


Figure 3: Krông Nô marketing lines spatial configuration



34. Krông Nô district is a significant maize supplier. Its output of 98,052 tons in 2010 ranks first and weighs about 40% of Dak Nong province's 8 districts. In 2012, it cultivated 13,955 ha of maize and produced an estimated 95,000 tons, equivalent to 1.8% of national production. Corn produced in Krông Nô is mainly hybrid yellow varieties for use in the feed industry. Our estimate from traders' interviews is that 90% of this production is directed to Ho Chi Minh City area (mostly to the Dong Nai cluster of feed industries and intensive animal production located 300 km south, where more than 1.2 million heads of pig and poultry are being bred to supply Ho Chi Minh city), while 10% is directed to smaller, closer feed mills, for example in neighboring Dak Lak province. This reflects a good out-bound transportation and connectivity system at the intermediate link between the roadside maize collectors in Krông Nô and the industrial users in Dong Nai. Indeed, feed buyers can send large 30 tons capacity trucks to Krông Nô, where asphalt road access is guaranteed up to the commune centers where big collectors' warehouses are located. The end-buyers are animal feed companies such as Charoen Pokphand foods (CP) or Cargill. But the key role in these transactions is played by middlemen in Dong Nai. These middlemen negotiate the buying price and then ask for private transport service providers to pick up the load in Krông Nô and deliver it back directly at the feed factory. This is a flexible system whereby most of the maize (60% in our traders' sample) is marketed through Dong Nai trucks coming directly to the warehouses of the big, commune-level collectors. The rest is exported by smaller local trucks belonging to the collectors or to transporters. It is interesting to note that there appears to be a trend of reducing the concentration of animal production in Dong Nai, due to land pressure and environmental concerns, which would cause poultry and pig production to be gradually delocalized to the North. Rather than jeopardizing the market for Dak Nong yellow corn it would, on the contrary, reduce the distance between production and feed mills.

35. The situation regarding the perishable pumpkin production is entirely different. Krông Nô pumpkins are marketed in very small volume, and specifically in Bon Choih village where a single outside trader initially invested in seeds in 2006 and asked Kinh producers to grow pumpkins. In 2012 about 15 families were producing an estimated 150 tons per year. Even though the volume is small, it shows that this region has a potential for production which can positively contribute to livelihoods of farmers if there is a future improvement in rural infrastructure and trading network. But these families face many difficulties due to their dependency on a single trader and to the poor rural road conditions between the village production area and the commune hub. In the rainy season, transportation costs to the commune center rose up to 500 VND/kg ($23 /ton); some loads eventually were damaged and could not be sold. This line is worth mentioning since it is part of a larger supply chain through which the Central highlands region is regularly providing pumpkins to Hanoi and Ho Chi Minh city thoughout a large part of the year. However, unless roads are improved, and regular traders extend their network to the area, the potential to develop this trend may disappear.

3.1.2 Mộc Châu marketing lines

36. In the case of Mộc Châu four lines have been characterized from the data set: one marketing line for a perishable product, chayote (MC.L1); and three marketing lines for maize as a non-perishable commodity.

37. The configuration of the three maize lines in Mộc Châu (MC L4, MC L5 and MC L6) [2] are somewhat similar to the maize lines characterized in Krông Nô district. All of them include a bulking process up-stream between the farmer and the dryer, while a wholesaler picks up the dried grain maize at the drying station door to deliver it to the lowland Red River delta region (animal feed mills located in Hung Yên province). However, the configuration of the maize lines in Mộc Châu differs in terms of division of tasks. Drying stations are able to shell the grain from the maize cob before drying the grain, therefore farmers have the possibility to sell their maize on the cob. Yet, this configuration is an option only for the farmers located near a drying station, like in the case of MC L4 and MC L5. When the distance between the farmer and the drying station increases, as in MC L6, farmers and collectors prefer to ship fresh maize grain to the dryer, with a higher value per kilogram transported, in order to reduce transportation cost.

38. In the case of MC L4 the farmer uses his motorbike to carry the maize on the cob out of the field up to the loading point, two km away, on unpaved road, where it is loaded onto the commune collector's truck. Mộc Châu rural collectors are equipped with old, yet robust, four-wheel-drive rural trucks (mostly GAZ, Hoa Mai or IFA brands) with a capacity that can reach more than five tons and that allows them to access remote villages even when road conditions are bad due to weather conditions (rain, quagmires…) and motorbikes can hardly get around.

39. MC L5 represents the case of an isolated farmer who has to bring his production (maize on the cob) to the loading point using horses, six km away from the field, where it is loaded by the commune collector.

40. MC L6 represents a situation of a farmer located in another commune, far from the drying station. Like in MC L4, he uses his motorbike to bring the maize to the loading point. The remoteness from the village to the trading hub requires the services of a village collector who undertakes the primary bulking of the commodity before a district collector picks it up. The district collector then sends the product 22 km away to deliver it to the drying station where the fresh maize grain is dried. Like for the other lines, the wholesaler purchases the dried maize and delivers it to end-users in Hung Yên, 200 km away, using a 30 ton capacity truck or larger.

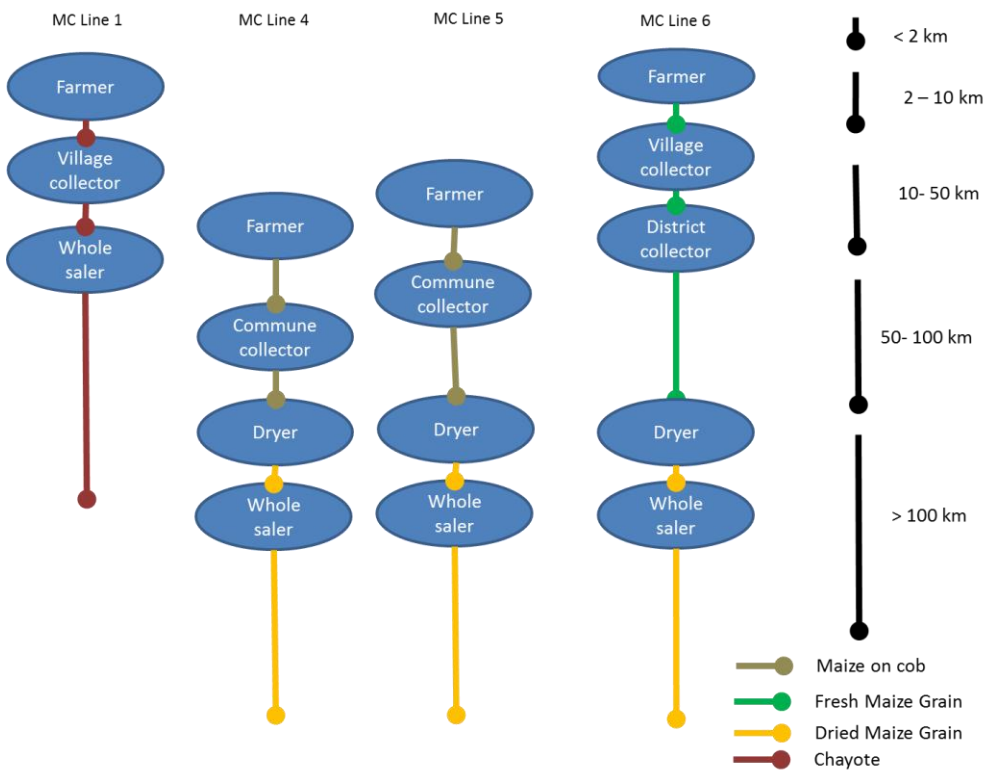
41. In the remote commune of Quang Minh, which still has non-asphalted road access, some maize is still seasonally transported by barge boats down the nearby Black river (*sông Đà)* to Hòa Bình lake, where traders buy it at a disembarkation point before the dam, and then transport it by truck to the same feed mills as with the road marketing channel. This marketing route was not retained for the final analysis because its volume is small and has been declining since the recent road improvement between Quang Minh and To Mua commune, where most maize collection and drying is taking place.

42. The chayote marketing line (MC L1) represents the case of a farmer located nearby the major district road. The configuration of this line is more straightforward than in the case of maize. Indeed, chayote is a perishable product, and therefore no farmer was found to produce it in very remote locations or under high accessibility constraints. The farmer delivers his product to a village collector who is in charge of grading and packing the product in batches that will be purchased by the wholesaler. The wholesaler uses a smaller truck compared with the maize lines, with a specified load

[2] The numbering of the lines is not in sequence. This is because the projected lines MC L2 and MC L3 for chayote marketing in Mộc Châu were eventually discarded, as they did not differ significantly from MC L1 and did not bring significant new information for the analysis.

capacity of 3.5 to 5 tons, and an actual load of 6 tons to 10 tons per trip. The chayote line configuration responds to constraints associated with perishable products. There are a limited number of bulk-breaking points along the chain and the wholesalers prefer to ship smaller batches, while increasing the number of rotations in order to better manage the quality of the product during transport. In the case of this perishable, the village collector's main function is not to ship the product but to provide buffering services between farmers and wholesaler, matching the frequency of chayote harvest on field with the preparation of batches that respond to the demand of Hanoi wholesale vegetable market.

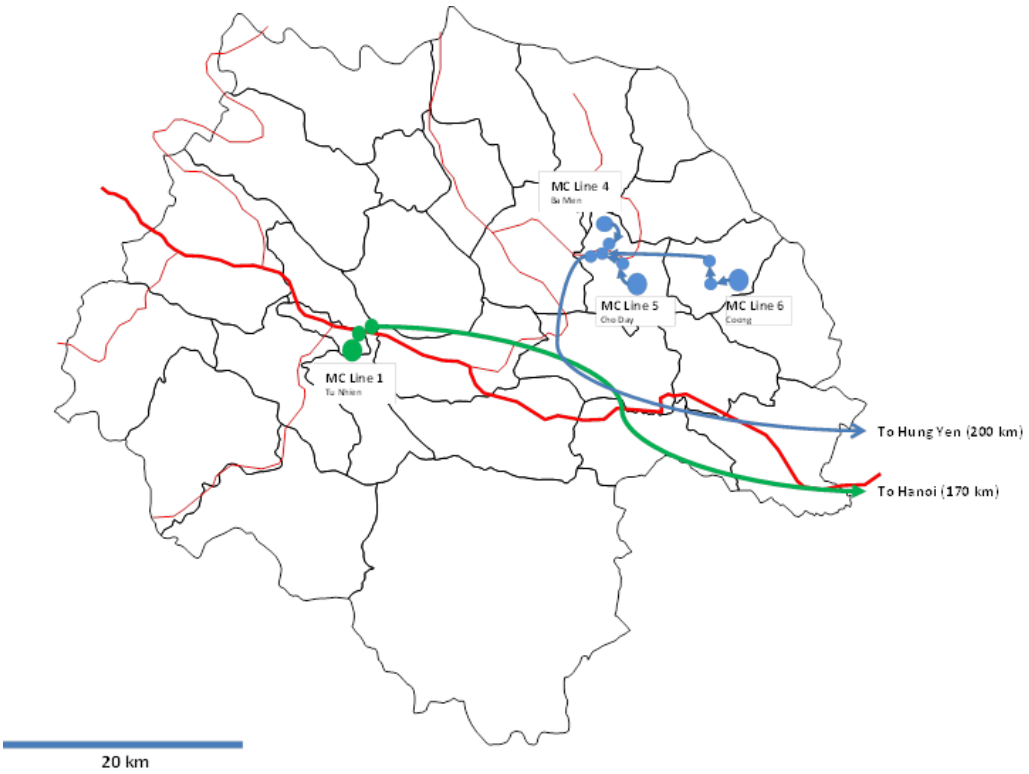
Figure 4 : Mộc Châu marketing lines structure



43. Over the past 20 years, flows of maize from the mountainous provinces of North-West Vietnam have increased dramatically, especially in Son La province. This change was due to a rapidly increasing demand for maize grain from the animal feed industry and to the substitution of maize by higher value crops in the Red river Delta (Dao et al. 2010). In response to such high demand, hybrid maize varieties have been promoted alongside with accessible chemical fertilizers. In Mộc Châu district in particular, it is estimated that the cultivated area of maize, after duplicating in the 1990s, reached 12,000 ha in 2003 and 28,500 ha in 2012, when it totaled 85% of the extension of annual crops (GSO, 2013). The impressive rise in the mid 2000's was due to the availability of herbicides that enabled farmers to overcome labour constraints for weed management, and consequently to cultivate larger areas (Dao et al., 2010). The average maize yield in Mộc Châu also increased, from 2.8 t/ha in 1996 to 3.7 t/ha in 2002 and above 4 t/ha since 2007 (Kong, 2010). The resulting maize output reached 116,000 tons in 2012, equivalent to 2.2% of national production. The high productivity, dynamic market and high price of maize grain make the profitability of maize production superior to that of other annual crops, namely upland rice, leading farmers to reclaim more unused sloping land. Future demand for Mộc Châu corn seems secure, driven by the rapid expansion of Vietnamese meat

consumption[3] and of the correlated animal feed industry[4]. But it may be challenged by possible changes in import quota policies related to, for example, the future Trans-Pacific Partnership agreement, and by quality issues. Indeed, as mentioned by traders interviewed for this study, Mộc Châu maize is mostly marketed to feed mills in the Red river delta, mostly in Hung Yen province; while the large feed mill operated by CP company in near-by Hoa Binh province prefers to buy higher-quality, dryer maize from other Son La districts, such as Mai Son. Last but not least, the rapid expansion of maize in Mộc Châu also causes the environmental risk of soil erosion in sloping land and questions the sustainability of the cropping system[3].

Figure 5: Mộc Châu marketing lines spatial configuration



44. Chayote production in Mộc Châu in 2012 represents an estimated area of 271.6 ha and a volume of between 3,000 and 4,000 tons of chayote fruits. Chayote leaves are also on demand, but produced on a much smaller scale. Chayote collectors played a major role in the development of this crop in specific villages since 2005, by directly supporting investment in wood or concrete trellis, seeds and chemical inputs, giving technical guidance and ensuring market access. From our survey it is estimated that about 85% of total chayote production is marketed through wholesalers to Hanoi and surrounding provinces in the Red river delta. Harvesting time, from April to November with a peak production between July and September is counter seasonal to Red river delta production. This ensures high demand and a profitable price. The main challenges for Mộc Châu chayote are the sustainability of the intensive cropping system, and the market competition from other off-season production areas such as Hoa Binh and Tam Dao.

[3] According to FAOSTAT, the daily meat consumption per capita in Vietnam rose from 72g in 2000-2002 to 100g in 2005-2007 (+44%). See Nguyen et al. (2012).

[4] Vietnam's animal feed industry output rose from 10.6 million tonnes in 2010 to over 12.7 million tons in 2012 (Nguyen K., 2013).

3.2 Analysis : Transport performance and connectivity

45. The analysis of the cost structure aims at assessing the extent to which transportation may represent a major constraint for linking farmers located in remote areas to end-users in urban areas. The limited number of lines for which a consolidated budget was developed did not allow for robust and definitive conclusions about the relations between the configuration of the lines and the transportation costs. However, the comparison between these cases provides a sound framework to put this issue into perspective and to deliberate about the rationale and the nature of the interactions between transportation cost and the marketing of the agricultural product.

3.2.1 Marketing lines are financially viable

46. The cost structure, total income and profit generated by each marketing line are shown below (Table 3 and Figure 6). The consolidated budgets show that these lines are financially viable with a positive profit, under the price system adopted (Table 3) and in spite of the additional transport costs generated by the remoteness of producers' location. The profit share represents more than half the value of the total output for the whole line, and the returns to total cost (i.e., the amount of VND received for 1 VND invested in the lines) are well above 100%.

Table 3 : Price system adopted for each line: selling price for each player in VND/KG

Players	Product	KN Maize 1	KN Maize 2	KN Maize 3	KN Maize 4	MC Chayote 1	MC Maize 4	MC Maize 5	MC Maize 6
Producer	Maize on the cob						3000	2800	
	Fresh maize grain	3500		4000					3400
	Dried maize grain		5700		3700				
	Chayote					2100			
Village collector	Fresh maize grain	3800							
	Chayote					2400			
Commune collector	Maize on the cob						3300	3300	
	Fresh maize grain	4200		4400	4300				3600
	Dried maize grain		6300						
District collector	Fresh maize grain								4300
Dyer	Dried maize grain	6300		6500			6200	6200	6200
Wholesaler	Dried maize grain	7000	6700	7000	5800		6600	6600	6600
	Chayote					3600			

47. This positive level of profitability is due to several factors. It should be kept in mind that we did not input the opportunity cost of labor and land at the farm level, which explains why, as detailed below, farmers receive the highest share of the profit generated in each line. Also worth considering, some cost items may have been overlooked during the interview which may lead to an underestimation of the total cost, because most of the attention was focused on the estimation of transportation cost. Finally, it is necessary point out that the estimation of the income is determined by the price level declared by the players which may lead to an overestimation of the income generated by each line.

48. The detailed analysis by category of players below shows that the omission of the opportunity cost of labor and land at the farm level explains to a large extent the perceived high level of profitability. Taking into account these limitations, the consolidated budgets indicate, however, that agricultural production in upland areas can be viably marketed since there is a margin for absorbing output price changes or cost increases. According to prices reported since 2010 in USDA reports on grains in Vietnam (USDA, 2013), maize price varies from 5000 VND up to 7500 VND/kg. While this rather high price level is generated by the prevailing tensions on the international cereals market since 2007, the computation of the break-even price for each line reported in the last lines of five shows that maize systems as a whole would remain profitable with a 50% decrease in the maize price. This break-even price only indicates the magnitude of the price change that the each line can absorb, as it is likely that producers may not maintain their maize production with only a limited return.

49. The scope of the study focusing on the relation between transportation cost and the configuration of the marketing lines does not allow to conclude definitively on the competitiveness of Mộc Châu and Krông Nô producers on the maize and chayote Vietnamese market, as we cannot compare the financial performances of these lines with other lines supplying maize and chayote from other origins (other upland or lowland producing areas). For the same reasons, it is not possible to compare the respective profitability of the various cropping options for farmers in each location and therefore to estimate the threshold under which farmer would not crop anymore maize or chayote. But Table 4 shows that the return to farmer family labour for maize would remain within an acceptable level (around 100,000 VND/day) when prices of the final output decrease, i.e. at the feed factory. If we assume that farmers could get a daily income of 80,000 VND from off-farm jobs, it means that maize production would still remain a competitive income opportunity for farmers when maize price are in the lower range of 4000 to 5000 VND/kg, except in the case of KN1 line, where the return to farmer labour decreases significantly when maize price goes down below 5500 VND/kg.

Table 4. Simulation of changes in Profit and Return per day of farm labour, according to maize price

Maize	Marketing lines: KN 1		KN 4		MC4		MC6	
Price	Profit	Return to Labour	Profit	Return to Labour	Profit	Return to Labour	Profit	Return to Labour
VND/kg	VND/kg	VND/Day	VND/kg	VND/Day	VND/kg	VND/Day	VND/kg	VND/Day
3 000	116	7 170	1 199	81 599	1 038	32 149	969	43 018
3 500	616	21 188	1 699	104 883	1 538	47 604	1 469	61 571
4 000	1 116	35 205	2 199	128 168	2 038	63 058	1 969	80 123
4 500	1 616	49 222	2 699	151 452	2 538	78 513	2 469	98 676
5 000	2 116	63 239	3 199	174 737	3 038	93 967	2 969	117 229
5 500	2 616	77 256	***3 699***	***198 021***	3 538	109 422	3 469	135 782
6 000	3 116	91 273	4 199	221 306	4 038	124 876	3 969	154 335
6 500	3 616	105 290	4 699	244 590	**4 538**	**140 331**	***4 469***	***172 888***
7 000	***4 116***	***119 307***	5 199	267 875	5 038	155 785	4 969	191 441
7 500	4 616	133 324	5 699	291 159	5 538	171 240	5 469	209 994
8 000	5 116	147 341	6 199	314 444	6 038	186 694	5 969	228 546
8 500	5 616	161 358	6 699	337 728	6 538	202 149	6 469	247 099

50. Keeping these limits in mind, the profitability computed for each line concurs with the expansion of maize production observed in each study site.

51. In terms of cost structure (see Figure 6 on page 22), the purchase of the material inputs and services represent on average more than 75% of the total cost, while paid labor and equipment represent 11% and 12% respectively. This cost structure corresponds to the expected cost structure of an agro-food marketing line with limited raw material processing. Since most of the labor is computed as family labor at the farm level, the intensity of paid labor is rather low in the remaining part of the lines. Comparing the two regions, we observe that marketing lines in Mộc Châu are more capital intensive that in Krông Nô. The difference comes from the higher level of technology used for drying maize and less reliance on existing drying facilities, which would otherwise lead to a higher cost per kilogram of maize dried. According to the information gathered from dryers interviewed in Mộc Châu this lower utilization of drying facilities results from recent investment in drying capacity in the district because local entrepreneurs have been attracted by the high profitability of this activity.

52. Considering the distribution or profit among the players, the largest share (from 55% to 90% in the case of short marketing channels) remains with the farmers, while processing activities retain the second largest, around 14% on average, and traders receive on average less than 10% of the total profit per kilogram traded (Table 5). These distributions should be taken as orders of magnitude, given the price variability that prevails at each point of transaction from one player to another.

Table 5 : Distribution of profit among players per marketing line

Line: Players	KN Maize 1	KN Maize 2	KN Maize 3	KN Maize 4	MC Chayote 1	MC Maize 4	MC Maize 5	MC Maize 6
Farmer	74%	91%	80%	67%	79%	61%	54%	66%
Village collector	4%	n.a.	n.a.	n.a.	12%	n.a.	n.a.	5%.
Commune collector	7%	7%	5%	22%	n.a.	6%	12%	12%
Dryer	10%	n.a	10%	n.a	n.a.	29%	30%	16%
Wholesaler	5%	1%	4%	10%	10%	4%	3%	3%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

53. The higher share of profit going to collectors compared to the wholesalers illustrates the lower level of competition that may prevail among collectors compared to the downstream part of the chain. The high share of profit captured by the dryers in MC L4 and MC L5 (respectively 29% and 30% of total profit) is partially due to the fact that they are producing dried maize grain directly from fresh maize on cob, while the other dryers in our study are drying fresh maize grain. The higher share of profit obtained by the MC L4 and MC L5 dryers corresponds to the remuneration of a higher value created along the line, value (for maize grain shelling) which is created by farmers in the other lines. Conversely, this higher profit may also be related to a low level of market power for farmers selling fresh maize on the cob, resulting in a lower price and consequently a lower share of the total profit generated by these lines. Wholesalers' share of the total profit is much lower, 5% on average. This lower share of the total profit per kilogram of final output retained by the wholesalers compared to the other segments of the lines upstream is due to the higher productivity of these players who are handling very large volumes of products compared to the others. It may also indicate that competition prevails in this downstream segment of the line, preventing the creation of rent.

54. The return to cost computed for the different categories of players confirms the viability of the lines in financial terms (see Table 6). The high ratios of return to cost for farmers result from the non-inclusion of the opportunity cost for family labor and land use. As discussed above, the level of return to family labor (farmer's profit/total man-days of labor) is commensurate or above the custom rate applied for wage labor in the selected areas according to the experts involved in the study: The return to family labor is estimated between 118,000 and 180,000 VND/ day (see Table 4), while in comparison the remuneration of on-farm day-labor in rural areas of North-West and Central Highlands regions is estimated between 80,000 and 100,000 VND/ day, and these rural labor opportunities are not always available in remote areas. Hence, in spite of distances and transportations costs, farmers are incited to produce these crops, and maize in particular.

55. As mentioned earlier the profitability of processors is higher in Mộc Châu compared to Krông Nô. Trading activities record the lowest return to cost ratios, indicating that players linking farmers to market are most likely not taking advantage of their strategic position in linking farmers to market. The higher remuneration for the money invested in collecting the goods from the farm compared to wholesale trade may reflect a lower level of competition at this stage. This is in line with the information collected during the interviews with the study's players, mentioning that collectors often focus on only one specific procurement area. This geographical specialization might be necessary to ensure a volume of trade high enough to cover the collection cost; it would not be financially viable to have three or four traders operating with small five ton trucks to collect six to seven tons of maize in one village during a week. The higher return recorded at the collection stage compared to the wholesaler can also be explained by a higher level of risk faced by collectors in performing their operation (uneven supply of product in the procurement area, road hazards such as quagmires and landslides), while wholesalers benefit from a more stable or less uncertain environment (the bulking process being done up-stream) and have to face strong competition from other suppliers down-stream. Finally, these results are in line with the hypothesis that more remote areas have less intense trade competition and higher risks. The costs incurred by remote rural areas due to connectivity limitations therefore seem to reflect not just mere transportation costs, but also accrued logistic risks and reduced trading competition.

Table 6 : Return to cost per player per marketing line

Marketing Line: / Players	KN Maize 1	KN Maize 2	KN Maize 3	KN Maize 4	MC Chayote 1	MC Maize 4	MC Maize 5	MC Maize 6
Farmer	155%	146%	143%	153%	210%	261%	156%	259%
Return to family labor (VND/day)	*118,000*	*160,000*	*144,000*	*161,000*	*180,000*	*146,500*	*121,000*	*177,073*
Village collector	3%				10%			6%
Commune collector	5%	5%	4%	18%		7%	13%	12%
Dryer	7%		6%			28%	26%	13%
Wholesaler	3%	1%	3%	6%	5%	3%	2%	2%

56. In order to further explore interactions between output price and main costs changes on the profitability of the lines, a sensitivity analysis was carried out for four maize lines (Table 7). The

analysis modeled on the Monte-Carlo procedure[5] takes into account the effect on total profit of the line and return to farmer labour of a simultaneous variation of +/-25% around the initial value of maize final price, agricultural inputs and fuel costs. For all lines, maize price variation is the variable that causes the higher effect on the total profitability of each line and on the return to farmer labour, far above the impact of agricultural inputs and fuel costs variation. Agricultural inputs have a slightly higher impact on the return to farmers' labour as they directly affect the profitability of agricultural production, but the main driver of the farmers level of income remains the maize price itself. The impact of transport cost on the profitability of the lines is to some extent underestimated as we take into account fuel cost only, which does not represent the total costs associated with transportation; it does however represent approximately 50% of the total transport cost. Given the marginal contribution of transport cost variations to the outcome of the simulation, compared to the large effect of maize price, it is clear that the profitability of the selected lines is primarily determined by the level of the maize price. This confirms that transport cost is not the first driver of agricultural production profitability in the selected areas.

Table 7: Sensitivity analysis of Profit and Return to farmer labour, to +/-25% changes in maize, agricultural input and fuel prices

Lines:	KN1		KN4		MC4		MC6	
Variables	Correlation	Contribution	Correlation	Contribution	Correlation	Contribution	Correlation	Contribution
Profit per kg of maize delivered at the factory								
Maize price	0.9712	0.9576	0.9905	0.9877	0.9901	0.9707	0.9888	0.9805
Agricultural inputs	-0.2042	0.0423	-0.0541	0.0029	-0.1720	0.0293	-0.1286	0.0166
Transport cost	-0.0088	0.0001	**-0.0966**	0.0094	-0.0017	0.0000	-0.0539	0.0029
Return to farmer day of labour								
Maize price	0.9434	0.9183	0.9898	0.9858	0.9739	0.9364	0.9729	0.9550
Agricultural inputs	-0.2797	0.0807	-0.0835	0.0070	-0.2538	0.0636	-0.2107	0.0448
Transport cost	0.0313	0.0010	**-0.0847**	0.0072	-0.0025	0.0000	-0.0157	0.0002

57. The financial performances of the lines, and of each category of players, was verified for consistency and reliability of the data collected. The orders of magnitude of the indicators computed are reasonable and indicate that all the lines are financially viable in the Vietnamese market under the current price and cost environment even though the sample of players interviewed is not exhaustive.

3.2.2 Transportation cost depends upon the configuration of the supply lines

58. The financial viability of the selected lines has been established in the previous section of the report. The following section will describe to what extent transportation contributes positively to competitiveness, and whether investing in transportation can pay off.

[5] The Monte Carlo procedure consists in defining a range and a profile of variation around an observed value. In this case the distribution applied was of triangular form as it was not possible to further specify the most relevant distribution (standard, Poisson….). The Sim module of Xlstat® software generated the defined distribution through 1000 iterations for each determinant of the cost simultaneously and computed the % of total cost value that can be attributed to this change.

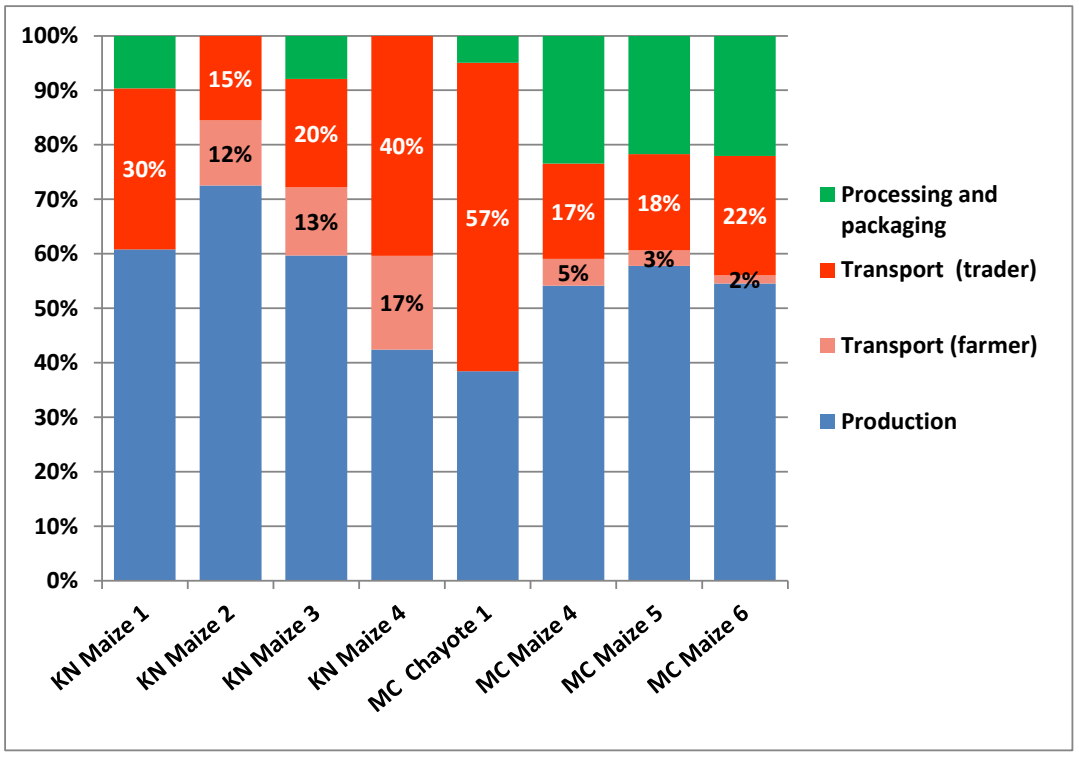
3.2.2.1 Transportation cost and distance

59. Looking at the structure of the total aggregated costs per line (Figure 6) broken down according to the three main functions fulfilled by agro-food value chains (i.e., production, transportation, and processing and marketing), we found that the production of the crop at the farm level represents on average 56% of the total aggregated total costs per selected lines, while processing and packaging represent on average only 11%; this was expected as we considered only the up-stream part of the value chains, where limited transformation of the product occurs. In addition, in the case of the lines KN L2 and KN L4, the maize is directly dried and shelled by the farmers and therefore these costs are compounded in the production cost.

60. The remaining share of the total aggregated total costs per line is for transportation costs, which represent on average 33% of the total aggregated cost per line. For the six cases where farmers have to assume part of the transportation costs by shipping their product to the collection point, transportation cost represent on average 26% of the total cost.

61. Comparing across the lines, transportation costs take a significant share of the total cost for the marketing of chayote in Mộc Châu district (57 % in MC L1) and for the marketing of dried maize grain in the case of the Line 4 in Krông Nô (40% of total retail price) (see Figure 7). On the other hand, transportation costs represent only around 20% of the aggregated total costs in the case of maize marketing in Mộc Châu district, and in Line 2 of Krông Nô district. For the latter one (KN L2) the limited share of the cost due to transportation could be explained by the short distance of this line which targets an animal feed industry in neighboring Buon Me Thuot district, 70 km away. Similarly, the higher share of transport cost for fourth line in Krông Nô (KN L4) with a comparable configuration (marketing of dried maize grain targeting the feed mills in Dong Nai, 300 km South) can be explained by the longer marketing distance.

Figure 6 : Total line cost distribution, per main function (in % of total aggregated cost)



62. In the context of Mộc Châu, the share of transportation cost in the total aggregated cost is higher for the Chayote line than for maize lines. This is because of the limited role of processing/packaging function for chayote, which automatically increases the relative share of transport cost. On the other hand, processing costs are higher for maize which is mechanically dried. These differences in the relative weight of transport in total costs may also be due to a lower productivity of the transport technique or organization in the case of the Chayote line, which uses smaller trucks in order to ensure quicker market delivery of this perishable product, as seen in the previous section. These hypotheses will be further explored, putting into perspective the transportation costs with the distance covered by each player at each step of the marketing line.

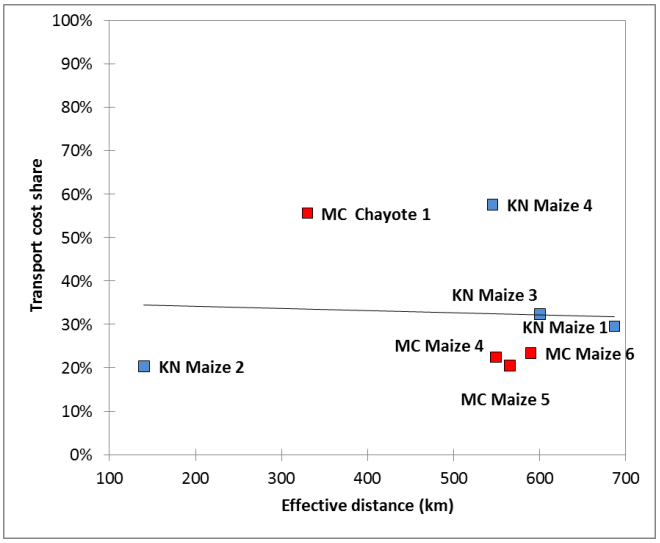
63. Table 8 presents the detailed data about transport costs extracted from the budget of each economic player. These data include the total transportation cost per kilogram of product delivered at the end of each line, the effective distance in kilometers, and the cost for shipping one kilogram of product per kilometer. By effective distance we refer to not only the distance covered by the selected product, but also the distance to be covered without any load, at any moment back or forth to complete the trading cycle.

Table 8 : Transportation cost per kilogram of final product and distance covered

Stages	Items	KN Maize 1	KN Maize 2	KN Maize 3	KN Maize 4	MC Chayote 1	MC Maize 4	MC Maize 5	MC Maize 6
Total	Transport cost	911	783	992	1433	998	421	492	476
	Effective distance	687	140	600	545	330	549	565	590
	Distance within district	8.5	7.0	33.0	**10.0**	**0.0**	4.0	12.0	24.0
	Trp cost VND/kg/km	1.3	4.1	1.7	2.6	3.0	0.8	0.9	0.8
	Transport cost share	30%	20%	32%	**58%**	**56%**	22%	20%	23%
Farmer	Transport cost		343	383	429		92	68	31
	Effective distance		9	10	10		4	10	4
	Trp cost VND/kg/km		38	38	42		23	7	8
	Transport cost share		6%	17%	29%		8%	5%	3%
Village collector	Transport cost	140				0			0
	Effective distance	16				0			0
	Trp cost VND/kg/km	8.8				0			0
Commune collector	Transport cost	265	173	285	354		102	160	181
	Effective distance	5	5	54	10		4	12	44
	Trp cost VND/kg/km	52.9	17.9	3.2	35.4		17.6	13.3	4.1
Wholesaler	Transport cost	506	267	323	650	998	226	264	264
	Effective distance	666	126	540	525	330	541	541	542
	Trp cost VND/kg/km	0.76	2.12	0.60	1.24	3.02	0.40	0.50	0.49

64. Considering the whole line, Figure 7 shows that there is not a straightforward relationship between the share of the transport cost in total cost and the effective distance covered along the line. In other words, the share of transport cost does not necessary increase with the effective distance travelled by the players. This is rational since, as expected, there are economies of scale, or more precisely economies of distance, in transportation.

Figure 7 : Relation between effective distance of the line (two-way) and the transportation cost share



65. This relation is displayed in Figure 8 with a linear inverse relation between the effective distance and the transportation cost expressed in Vietnam Dông per kilogram and per kilometre of product transported. In others words, the increase in transportation cost generated by a longer distance covered is more than equally compensated by the higher productivity of the transportation organization on long distance transportation. However, the benefit of this increasing productivity of transportation with the distance only has a slight positive impact on the profitability of the line as displayed in Figure 9. We note that, while the lines with the highest ratio of return to total cost are on the right hand side of the graph covering an effective distance of 600 km, there are also lines covering this distance with a much lower ratio of return to total cost, below 150%, comparable with the performances of the lines covering less than 350 km. Thus, while short to medium distance lines are not associated with the highest level of return to cost, the opposite is not true either, because long distance lines are not synonymous to highly profitable lines. The performances of the lines are determined by several other factors such as the productivity of the production and processing functions (production yield, processing recovery rate….) and the price level on the market.

Figure 8: Relation between effective distance and transportation cost

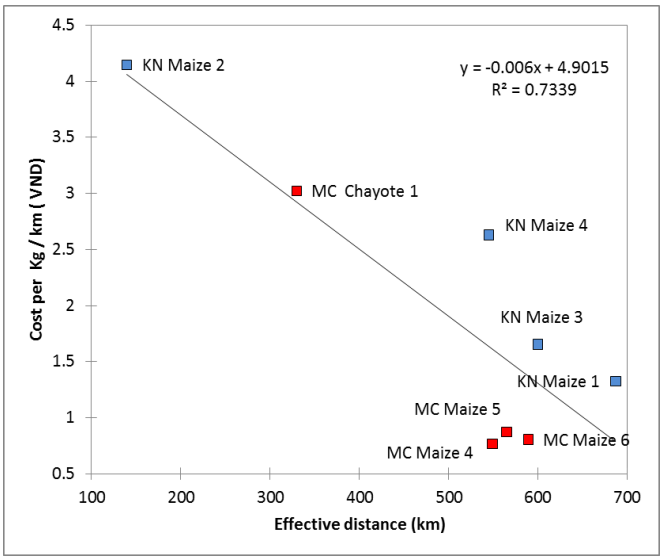
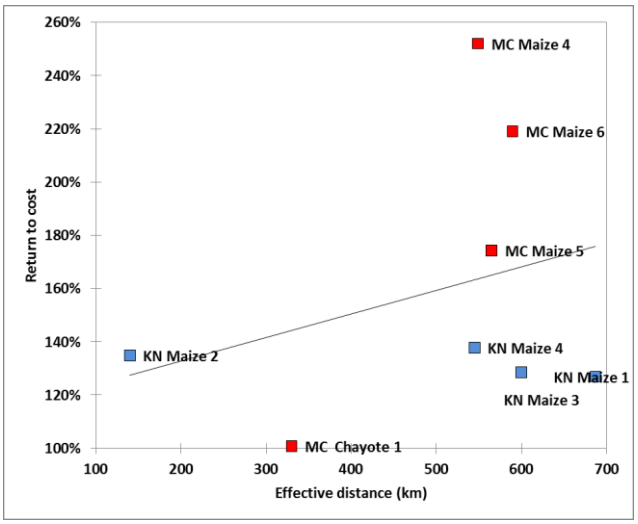


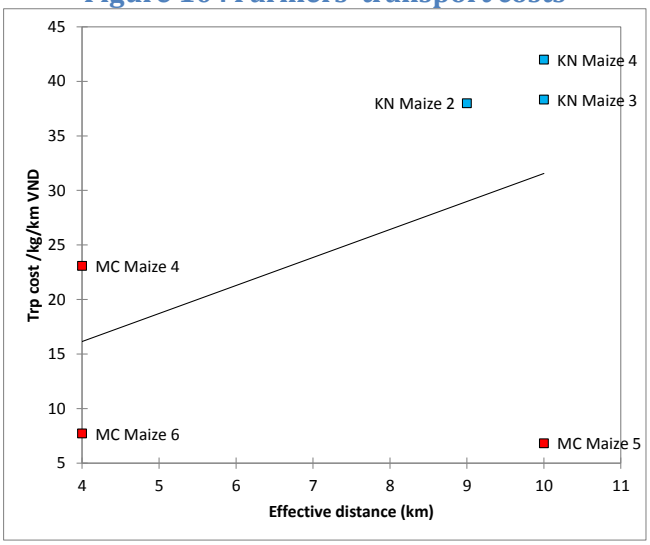
Figure 9 : Relation between effective distance and return to cost



66. Comparing across lines and geographical settings for the relations between effective distance and profitability, we found the following: Maize lines in Mộc Châu have the highest return to cost, while the maize lines in Krông Nô have a lower ratio of return to cost for an equal distance (Figure 9). While, as mentioned above, transportation costs are not the only determining factors of line profitability, it should be noted that transportation costs are higher in the case of Krông Nô lines compared to Mộc Châu for lines covering between 500 km to 700 km of effective two-way distance (Figure 8). This may imply a less efficient organization of Krông Nô compared to Mộc Châu. It may also reflect the particular isolation of the selected maize survey villages in Krong Nô. The situation in the most remote maize-oriented villages is indeed not representative of the whole Krông Nô district, where villages usually enjoy good connectivity for export crops such as coffee, cashew and rubber.

67. Looking at the cost of transportation per category of players provides additional insights into the impact of transportation cost on market accessibility for remote farmers. Comparing the relation between the transportation costs and the effective distance covered for the shipment managed by farmers (either with their own means of transportation or by purchasing transport services) we note that transport cost per kilogram tends to increase with the distance (Figure 10). Farmers' transport costs are determined by other factors than distance such as tracks or roads conditions but overall we found that there is limited scope for an "economy of distance" at this stage.

Figure 10 : Farmers' transport costs



68. The case for collectors (Figure 11) shows an opposite trend. There is a sharp decrease of the cost per unit of volume when the covered distance is over 10 km, while below this distance transportation costs are in the same range as the one observed for farmers. Finally, in the case of wholesalers (Figure 12), the relation between the effective distance and the transport cost per unit is decreasing along an almost linear trend. This shows that gains in transport productivity are mainly located at these downstream stages of the line.

Figure 11: Collectors' transport costs

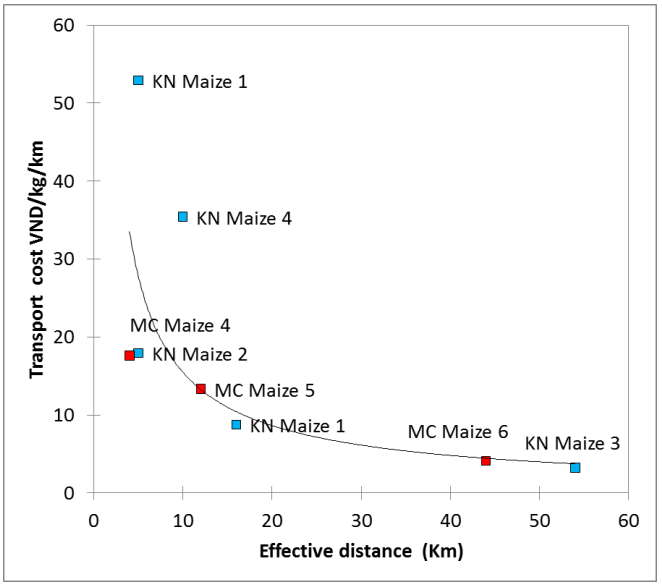
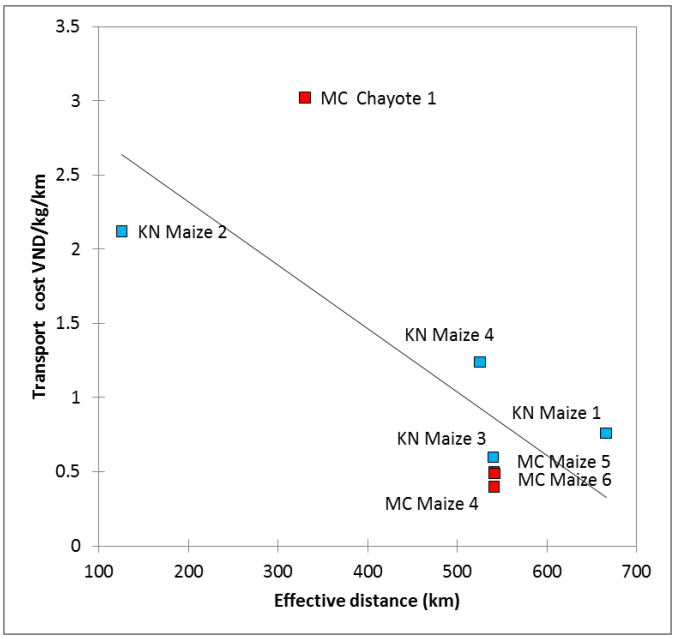


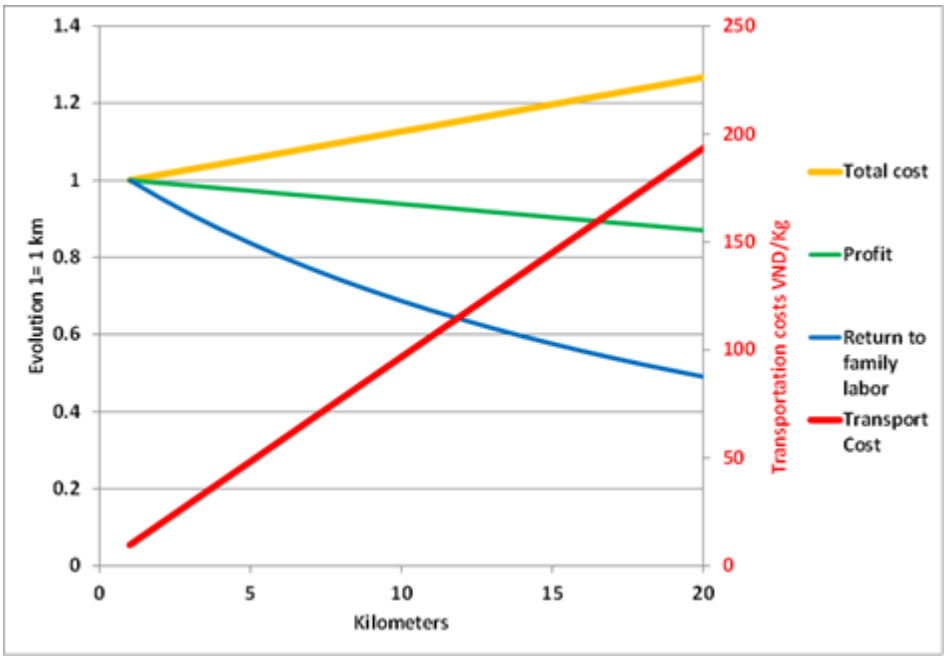
Figure 12: Wholesalers' transport costs



69. Given recent improvements in the tracks that connect the chayote producing area in Mộc Châu to the main transit road that crosses the district, it was difficult in the survey to characterize a situation whereby chayote producers had to cover the cost for the shipment of production to a collection point. Currently, the renovated tracks can be used by chayote wholesalers who come

directly with their trucks into the producing areas, several kilometers away from the main paved road. These arrangements reduce bulk breaking points along the line and increase the profitability of the system. For farmers who ship their production themselves, a simulation was run based on the data collected within the district to assess the impact on the farmer's profit for the distance between production site and collection point. In the simulation presented in Figure 13 we assume that a farmer would use his motorbike to bring his chayote production to the collection point; the cost for running the motorbike has been derived from the cost recorded for maize lines in the same district (MC L4 and MC L6). The average transportation cost would be around 10 VND per kilogram per kilometer with a capacity of 150 kg per trip and 15 minutes of farmer's time used per kilometer of transportation.

Figure 13 : Simulation of transport costs impact on a remote chayote producer



70. We observe that a producer located 20 km away from the collecting point would have to deduct up to 200 VND from the selling price per kilogram of chayote sold at the collecting point, i.e. around 10% of the selling price. This would increase the total farmer's cost by a factor of 1.2, compared with a farmer situated next to the collecting point, and would reduce his profit by 20%. While this decrease of farmer's profit could not be considered as a strong disincentive to produce chayote far away from the collection point, it is worth noting that the decrease in the return to family labor is much higher. If the road conditions do not allow using a large capacity vehicle such as a small truck, the time needed to bring the production to market increases dramatically. For example, for a farmer located 20 km away from the collection point 95 days would be needed to ship the same volume as the one produced in the case of MC L1 (28 tons); this would represents about one third of the total family labor. Since it is not viable to invest 90 days of transportation into selling a perishable crop this configuration is highly unlikely, of course, yet this hypothetical case illustrates that the transportation cost is one dimension of the accessibility issue for the farmer. There are other technical thresholds that also have to be taken into account. In the case of perishable crops, production in remote location would have to be limited for logistical reasons, unless, like in Mộc Châu, local authorities invest on improved roads conditions.

3.2.2.2 Transportation cost according to the means of transport

71. A wide range of means of transportation were recorded during the field interviews. At the farm level, farmers may use manual labor to bring their product to the first point of transaction. This was not explicitly recorded in the survey as it is limited to a very short distance; just for bringing and gathering the harvest out of the fields. This task was generally included in the volume of manual work days allocated to harvest. For shipping the product to longer distance (more than 500m), farmers may use motorbikes or animal traction (horses, buffalos). In the 8 lines recorded, motorbikes are the only means of transportation used by farmers (Lines MC4 and MC6), otherwise they pay for transportation services. In Krông Nô district the two-wheel motorized trailer (công nong) is the usual mean of transportation rented by farmers (Line KN L2, KN L3 and KN L4) while in the case of Mộc Châu district line MC L5, the farmer pays for renting horses to dispatch his harvest from field to farm.

72. Collectors use small, 3 to 6 ton capacity trucks to collect the product from the farms or from the first transaction point when the farmer handles part of the transport. In Krông Nô district, the village collector who is operating within a limited, 5 to 10 km range area (line KN L1) owns a công nong, a two-wheel tractor with 2 ton capacity trailer. In Mộc Châu, the utilization of 4 wheel-drive trucks allows the collectors to expand their procurement areas to remote places in spite of bad road conditions. In some cases a trader may use a 10 ton capacity truck which allows him to diversify the activity from the collection stage within the district to the delivery of product outside the district for long distance.

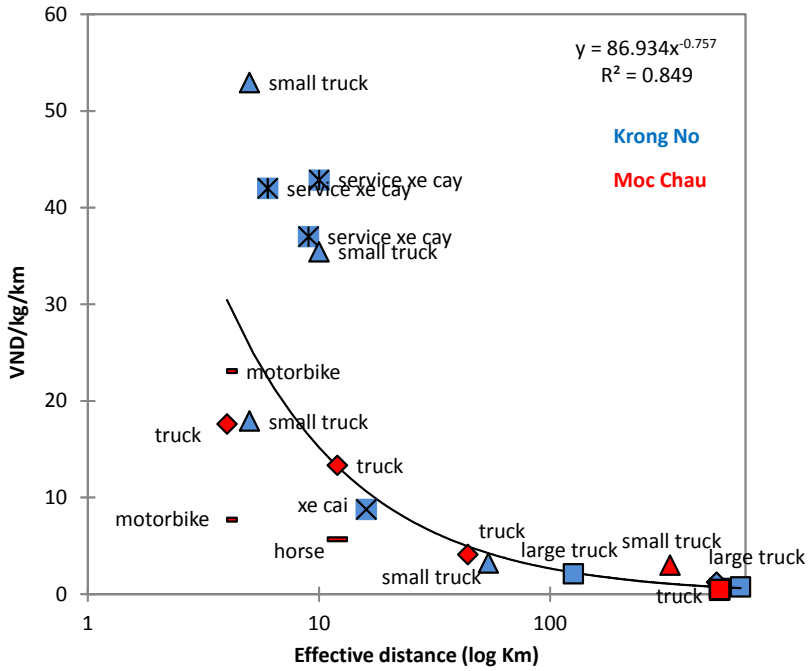
73. Wholesalers usually ship the product using large, 30 to 40 ton capacity trucks, especially in Mộc Châu district where they are able to purchase a large volume from the dryers at one time. There are wholesalers who may use trucks with a lower capacity, as mentioned in the case of KN L4. In the case of chayote, the wholesaler directly picks up the load from the village collector's warehouse and ships it to Hanoi market with a small truck. This type of vehicle is most-likely used because it responds better to the trader's requirements and because it allows a shorter rotation time between Mộc Châu and Hanoi which limits product spoilage. It is important to always keep in mind that trading and shipping are joint functions.

74. Figure 14 displays the cost per unit, per kilometer, for the various types of means of transportation identified during the field survey. It confirms that the "*return to distance*" has a major impact on the transportation cost, whatever the type of vehicle used. For long distance shipments by wholesalers, large, medium or small trucks used for distances over 100 kilometers result in different costs per kilometer. As displayed above in Table 8, this cost varies from 0.50 VND to 3 VND to per kilogram per kilometre. But these differences are much smaller than the differences recorded among vehicles used for shorter distance shipments in the up-stream segment of the line. For distances from field or farm to commune collector covering around 10 km, the cost of transportation computed displayed a much broader range of variation: a ten-fold factor ranging from 4-5 VND per kilogram per kilometre up to 55 VND.

75. The distribution of the transport cost, per type of transportation, also shows that transport cost is higher in Krông Nô. This is particularly the case for farmers who are paying for transport services, their costs being around 40 VND per kilogram per kilometre, whereas the costs for a collector

operating his own tractor are estimated at only 10 VND per kilogram per kilometre. This gap illustrates the additional costs supported by farmers who are located in a place that cannot be reached directly by collector, and have to bear higher transport costs. It also points out a divide among producers in Krông Nô who own a công nong, leading to reduced costs and increased choice in marketing strategies, and those who do not.

Figure 14: Transport costs per type of means of transportation and distance covered



76. This steep difference between the price paid for renting the services of a carrier with a công nong and the cost for directly operating the same vehicle, may also be an indication of the tension that could prevail on the transport market in Krông Nô in favor of the suppliers of transport services. More generally speaking, it should be underscored that the traders interviewed in these regions are consistently also the owners of the vehicle used for shipping the product traded. Some big traders even own a fleet of vehicles. In other words, the volume of operations generated by agricultural trade within these remote districts, and between these districts and the rest of the country, is not high enough to pave the way for a higher specialization of players and a division of tasks between the trading and the shipping activities.

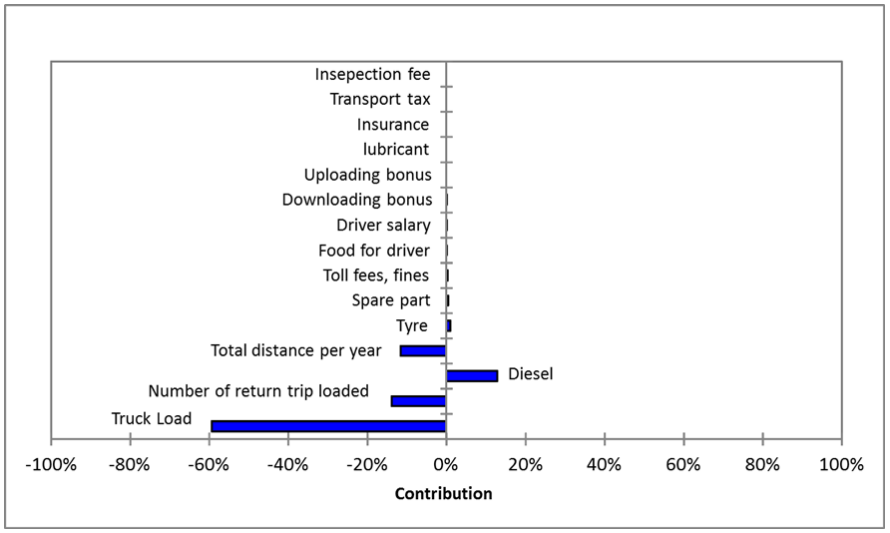
3.2.2.3 Transport cost sensitivity to trading practices

77. A sensitivity analysis, based on a Monte Carlo procedure[6] was carried out to further identify the determining factors that affect the total value of transportation cost. Taking the case of the wholesaler budget of the Line 4 in Mộc Châu, we have tested the selectiveness of the total transport cost to a variation of -/+ 20% of all the cost items. The test also includes the level of utilization of the capacity, that load carried out by the truck, the total distance covered in one year and the number of

[6] See footnote 5 above.

loaded back trip per rotation. Figure 15 below presents the outcome of the sensitivity analysis.

Figure 15 : Sensitivity analysis of transport cost (Wholesaler budget, Mộc Châu line 4)



78. Transportation costs are sensitive to four determinants. The first determinant is the level of utilization of the truck load capacity. The analysis indicates that when all the variables vary within 20% around the observed value, the level of truck capacity will contribute to 60% of the total cost variations. The negative sign corresponds to an inverse relation between the level of capacity utilization and the total cost of transportation (i.e., an increase in the utilization of the truckload capacity translates into a reduction of transportation cost). This is consistent with the practices observed on the field, where traders tend to routinely overload their vehicles in order to increase the profitability of each rotation; an additional profit that is not significantly reduced by the fines paid to the police on the road. This result also underscores the crucial importance of the bulking process upstream. An efficient mechanism for gathering the agricultural outputs into large batches is necessary to reduce as much as possible transport cost and thus to strengthen the competitiveness of the local producers. In the case of perishable crops, the time needed for gathering a large volume may increase the losses. It is therefore justified to limit the size of the batch traded at the wholesale level even though it translates into higher transportations costs. Based on traders' experience, the cost of the losses might be higher than the reduction of the transport costs if perishables were traded in large volume.

79. The second most important determinant of the transportation cost level is the number of fully-loaded return trips. Each fully-loaded return trip actually corresponds to a reduction of the total distance covered, since the cost of the return trip is not imputed to the transportation cost of the selected product. This outcome emphasizes the importance for the wholesaler to have loads for the in-bound trips back into the districts, as they generally contribute to the reduction of the transport cost for the out-bound trips and thus improve the competitiveness for the crops produced by farmers in these remote areas.

80. An important element at the wholesaler stage is that the development of the local demand for "imported" goods contributes to the reduction of transportation costs for "exported" commodities. The ratio of loaded in-bound trips per loaded out-bound trips varies from one wholesaler to another; from 10% of the trips in the case of the maize lines in Mộc Châu (MC L4, MC L5, MC L6), to 50% of the

trips in the case of the chayote line in Mộc Châu and of the fourth maize line in Krông Nô. Imported products include consumer goods such as rice, but they also include bulky commodities such as agricultural inputs (fertilizers), coal or cement. The capacity of a trader to find in-bound return loads depends primarily on the volume of demand in the remote district. Regardless, given the bulky nature of the agricultural products marketed against the lower volume of goods imported for an equal value, this asymmetry cannot be eliminated.

81. Is it possible to increase freight for purchases in order to reduce overall transport costs ? Rice produced in the deltas could be an important in-bound product for upland rural areas that are specializing into other commodities. The survey was not conclusive about the data collected on "imported" rice lines. In Mộc Châu, most surveyed farmer families purchase rice seasonally, mostly in the months of March-April and August-September, for an estimated 0,2 T per family per year. Interesting to note is that we found that the rice supply chain to Mộc Châu was mainly from wholesalers in Nam Dinh and Thai Binh provinces in the South-East Red River Delta, where several feed mills are also located. The second rice purchasing season in August-September fits with the beginning of the maize marketing season on Mộc Châu. This could be favorable to the combination of paralel in-bound rice cargos with out-bound maize sales to the feed mills. In Krông Nô, rice purchased by rural families has a much closer origin; it is imported from rice-orientated communes within the district itself such as Buon Choah, or from bordering Krong Ana district in Dak Lak province. In this case, maize and rice market itineraries do not run paralel.

82. At the local collector's stage, there were no indications of a return load, which contributes to the lower productivity of commune level transport between the farmer and the wholesaler. This may be due to a stronger dissociation between the out-bound lines for marketing agricultural outputs and in-bound line for retailing consumer goods. Farmers may also decide to purchase their goods at the commune level. Another reason may be that the in-bound flows for delivering fertilizer and other agricultural inputs and the out-bound flows for collecting agricultural output do not happen at the same time.

83. In the future, the trend towards crop specialization according to basic comparative advantages (i.e., selling maize and buying rice) will be pursued gradually. To mitigate the risks in terms of food security, planners and local authorities can continue focusing attention on "category 3" communes and villages which are those that may require food security strategies to cope in particular with seasonal shortages and inaccessibility. It is also essential that development projects and planners pay more attention to return loads, which are a critical factor in order to develop an efficient transportation and market access system connecting remote districts and central economic areas.

84. The two remaining determinants impacting transportation costs, according to this sensitivity analysis displayed in Figure 15, are i) the diesel cost, which does not depend upon local strategies ; and ii) the total distance run per year per truck.

3.2.2.4 Marketing only, or marketing and processing ?

85. Farmers who do not benefit from good accessibility to a trade hub, like in the case of Lines 2 and 4 in Krông Nô, have to bear high transportation costs during the rainy season when tracks are in very bad condition. While the customary rate for shipping one 70 kg bag of maize is around 25,000 VND during the driest period of the year, this price can reach about 40,000 VND to 50,000 VND during

the rainy season. Because of this increase in cost, farmers are incited to limit their maize production during the rainy season as it is difficult for them to ship out the fresh maize grain out of the farm. Investing in the improvement of tracks that link remote production sites to trade hubs, and thus benefit from a lower transportation cost, is one option for supporting the expansion of maize production. However, the economic viability of this option might not be achieved given the rather low density of farmer settlement in this district, which would limit the effective utilization of these improved roads. Likewise, it might not be desirable to expand new roads in some remote areas because of environment protection laws. Until the density of settlement increases to justify public investment in roads, an alternative option might be pursued by remote farmers. This alternative option for supporting the expansion of maize production during the rainy season consists in drying fresh maize grain at harvest time and to store it until the dry season when farmers have a better accessibility to the market.

86. The outcomes of these options have been compared using the farmer budget established for the Line 2 in Krông Nô. Three scenarios are compared in Table 9.

Table 9 : Marketing fresh maize grain versus dried maize grain at the farm level

Scenarios:	Baseline	Improved road		Maize Processing	
Items		**Value**	***Changes to baseline***	**Value**	***Changes to baseline***
Season	Rainy season	Rainy season		Dry season	
Output	Fresh maize grain	Fresh grain		Dried maize grain	
Volume	5343	5343		4500	
Output price VND/kg	3500	3500		5700	
Transport cost VND/Bag 70kg	60000	20000		20000	
Profit VND/kg	1151	1723	*1.5*	3656	*3.1*
Return to total cost	49%	97%	*2.0*	179%	*3.6*
Return to family labor (VND/day)	69348	102277	*1.5*	171000	*2.4*

The conversion ratio between dried maize and fresh maize at the farm level has been adjusted to 1.20 instead of 1.33, the rate used for an industrial dryer, on the basis of the price differences for the dried maize produced by the dryer in KN L1 and the dried maize paid to the farmer in KN L2 . In other words, we assumed that 4500 kg of dried maize produced by the farmer requires 5400 kg of fresh maize. High transport cost paid during the rainy season significantly reduces the profitability of maize production at the farm level. Investing in roads to improve accessibility would increase profit by a factor of 1.5 and the return to cost will double. If the potential number of farmers and the volume of the flow of agricultural products that may benefit from road improvement do not justify an investment, the second option could be considered as well. The incremental benefit accrued from drying fresh maize grain at harvest, and shipping during the dry season when transport is cheaper, is even higher than in the "road improvement" scenario. Profit per kilogram of maize increases by 3.1 and the return to total cost by 3.6. The incremental effect on the return to family labor is smaller because drying requires additional labor compared to the two other scenarios. The preferable option

would need to be decided locally, according to the development plans of the communes with consideration for the budget available for road improvements, and the local trade-off between developing new agricultural areas vs. preserving the environment.

87. Thus, investing in drying technology at the farm level should be considered as a possible answer for farmers that may not benefit from a good accessibility to a trading hub. At the same time, the viability of such an option depends on parameters that were beyond the scope of this simulation yet should be considered. Drying maize during the rainy season, and storing it properly, certainly requires investing in adapted technology; farmers would not be able to dry maize using drying pavement and current in-house drying process used in Krông Nô is not satisfactory. To what extent the potential benefit provided by selling dried maize would cover these costs remains to be seen. Cash management is another issue since it is a major constraint for small holders. Unless farmers could benefit from a credit mechanism that would allow them to wait for marketing their maize in the dry season drying maize might not be an option. In such a context, designing a program for improving market accessibility would have to assess beforehand whether it is easier to invest in infrastructure or, alternatively, in technology dissemination and a rural finance system.

4 - Lessons learned and key issues for promoting inclusive markets

88. This study provides several lessons about the impact of accessibility and logistical issues on the upland and highland farmers' capacity to market their production efficiently, from which priorities areas can be identified for empowering farmers into markets.

89. Firstly, it is important to note that according to the eight marketing lines analyzed, upland and highland farmers can compete on the Vietnamese market in spite of the 33% (on average) share of the total costs allocated to transportation. The consolidated budgets of the lines show a profit share higher than half the value of the total output of the whole line, and returns to total cost are well above 100%. These profits do not factor for the cost of labor, but calculations demonstrate that on-farm labour remuneration is consistently higher than the local labour opportunity costs. Transportation costs do hamper the competitiveness of these highland areas, but this is compensated by other factors, as illustrated by the case of maize. In spite of competition from international markets and serious environmental pitfalls due to cultivation on sloping land, maize did, under current circumstances represent an economically successful economic diversification strategy in both Central Highlands and North-West mountains survey sites. This occurred for three sets of reasons: First, upland maize farmers benefited from the dynamic demand for grain driven by the animal feed industry and the rapid increase in meat consumption, prompted by a production schedule different than that of lowlands, and by the lowland competition of maize with higher value crops. Second, technological factors boosted the considerable maize expansion in highlands and uplands; genetic yield improvement, and more importantly the widespread use of herbicides in the 2000's which enabled farmers to reduce weed management, increase labor productivity and cultivate larger areas. Third, maize wholesalers are actively investing in transport and drying facilities. In the context of highly competitive land use in Vietnam, the highland and upland context is favorable for traders who aim to organize their collection areas and increase their economic scale. As observed in Mộc Châu, some traders also invest in improving or maintaining road access to maize fields and in supplying hybrid

seed and chemical fertilizers to farmers, with the aim of gaining a dominant role in product collection from these fields[7]. Middlemen appear therefore as active drivers of the current transformations, as shown by Reardon et al. (2012) who draw attention to the role of these players in the "quiet revolution in staple food value chains in Asia". How environmental concerns will be addressed, especially in Mộc Châu given the intensive use of sloping land, remains an open-ended question. [8]

90. Our study shows that half of transportation costs, on average, are borne by the wholesaler for "exporting" the product outside of the district. While this segment of the marketing system uses a significant share of the resources allocated to transport within each line, it records the lowest cost of transportation per unit of volume and kilometer, as it benefits from important economies of scale. Furthermore, the low share of the total profit that is taken by wholesalers across all the lines (5% on average) indicates that this function is fulfilled cost-efficiently with the current context, and that competition may prevail within this category of players.

91. The picture is different for the remaining half of the transportation costs allocated to the bulking process linking the farmers to the wholesalers. This function bears a higher cost for moving one unit of product per kilometer than in in the case of the wholesaler, and we notice that these in-district collectors take a larger share of the total profit generated in each line. This is the "first mile paradox": the more remote the area, the costlier the kilometer transported. The lower efficiency of collectors is explained by their smaller scale of operation, using powered trailers and small trucks, combined with a higher level of risks : These two factors are both partially generated by the road conditions. It may also be partially attributed to a lower level of competition among the players at this stage, but this would need to be investigated further. When farmers themselves carry out the shipment of their production to the next player downstream the costs are comparable, or even higher, than the ones attributed to collectors, except for remote areas in Krông Nô. The relatively higher margins of collectors are also likely to reveal a tightened supply chain on the transport market in these areas; in most of the cases traders own their means of transportation; marketing and transporting being to a certain extent a joint service. It is therefore rather difficult for farmers to rent the services of a "specialized carrier" and most likely they have to rent the vehicle from another player who does not need it temporarily.

92. Various options exist for enhancing the cost-effectiveness of transport on this up-stream segment of the lines. One option is improving the rural road or track conditions as it reduces the risk and cost for the shipment within the commune (less fuel consumption, less vehicle failures, faster rotations). Both districts in Mộc Châu and Krông Nô districts, and their respective provinces, are implementing public investment plans to gradually improve rural roads. Some improvement schemes by Dak Nong province (Krông Nô) also involve community participation in labor and in cash. However, the construction of roads *per se* may not always be a priority if the issue of the supply of transport services is not simultaneously addressed. Transport service providers play a major role in enhancing transport cost-effectiveness. Several observations have been collected during the survey in Mộc Châu regarding private initiatives taken by local traders to maintain tracks in acceptable conditions that allow them to reach their customers located in remote areas. In Mộc Châu also, collectors have partially released the accessibility constraint by using four-wheel trucks. (However, this practice might not be maintained in the coming years as all these vehicles are old models and it is uncertain

[7] They also play an important role in stimulating cross-border maize trade with Laos.

[8] The government policy aims to limit maize expansion in mountainous areas. Associating maize with food legumes or agroforestry anti-erosion rows can be a pragmatic step towards for soil conservation.

whether this type of robust rural vehicles and rural transportation services will continue to be available in the future.)

93. To reduce transportation costs, increasing the transportation capacity within the current level of infrastructure may be more effective in the short term, than initially investing in infrastructure. Therefore, another option that should be considered for improving farmers' access to the market is to strengthen the local supply of transportation services within the commune's boundaries. This option would consist in supporting the dissemination and maintenance of adapted rural vehicles : Công nong and xe cay (two and four wheel tractors), four wheel trucks or pick-ups. This would require specific investment schemes.

94. Increasing the value retrieved at the farm level through the promotion of high value crops (such as vegetables) or through the processing of the harvested raw material is yet another option. The situation in Krông Nô and Mộc Châu shows that promoting high-value crops for supplying the urban market might not necessarily be a viable option in remote areas for reducing transportation cost per unit of product traded and, thus, improving market accessibility for remote locations. In Krông Nô, perennial crops such as coffee and rubber production are major vectors for market linkages, while vegetables and perishables still play a very minor role, but maize provides opportunities to implement actions for improving market accessibility through the dissemination of processing technology. The case of the chayote line in Mộc Châu illustrates that vegetables are not adapted to a bulking process involving multiple players between the farmer and the wholesaler, because the marketing of perishable products pushes for a reduced number of bulk-breaking spots along the lines and puts emphasis on short rotation with smaller vehicles to reduce losses.

95. The scope of the accessibility issue is not only limited to the cost-effectiveness of transport functions and logistics. Any option will have to take into account the implications of institutional arrangements and coordination between players. This was illustrated above in the case of the dried maize grain marketed by farmers in Krông Nô. "Group marketing" is another potential institutional arrangement. It has not been addressed extensively during the study because there are limited if not any examples of such institutional body recorded during the survey. This type of organization might not fit well to the situation where farmers are scattered. This type of institutional arrangement might be more viable in a context where the supply of means of transportation (specialized carriers) is less problematic than in Krông Nô and Mộc Châu.

96. Credit has been identified as one of the constraints faced by farmers. Because of distance, risks and oligopsony, remote farmers not only receive discounted prices but also have to pay higher private interest rates for inputs. For example, oral contracts for credit payment of maize seeds in Mộc Châu were found to be 75% more expensive than payment in cash, and 63% for NPK fertilizer. Besides, credit for agricultural inputs is often linked to an exclusive right of the traders on the marketing of the output. These arrangements reduce farmers' market power. The provision of alternative sources of credit may therefore release farmers' dependency to their money lender. As introduced in the case of the dried maize in Mộc Châu, the provision of credit mechanisms at harvest, such as warehouse receipt system were farmers can use their harvest as collateral, may also enhance farmers' capacity in choosing the best time to market their product. A market information system could also play a critical role in assisting farmers in marketing decision making; there are a few initiatives in this field but they are still limited in scope.

97. Specialization of production is already happening in the survey sites, albeit with certain limitations concerning some isolated villages and ethnic social groups where the priority may be to ensure food self-sufficiency and overcome severe seasonal credit restrictions. In some cases, investments in roads may even be unjustifiable because of insufficient production, or be undesirable because of environmental conservation. Beyond roads, connectivity can be improved by other tools reducing seasonal price and income instability through post-harvest technology, credit facilitation, or diversification towards nonperishable products. While specialization can and will develop further in Central Highlands and North-West mountains, it is essential that development projects take into account the optimization of return loads in order to decrease the overall transport costs, as well as the need to target productions that count with long term competitive advantages. The current success of maize is undeniable; but increased investment in its production should be held with caution considering its fragility if faced with a future liberalization of import quotas and its serious environmental pitfalls. It would be more practical to anticipate future changes by stimulating other commercial orientations including high quality animal production and perennial crops.

98. Our study shows that the shipment of agricultural products out of remote upland districts is a serious constraint, but does not constitute the major limitation for farmers' inclusion into agro-food markets. In both study sites, local private entrepreneurs have developed marketing systems that provide outlets to most of the local producers. These marketing services are provided at reasonable costs, considering the current level of infrastructure. They do not adversely affect the competitiveness of agricultural production in both districts. They may not be inclusive enough, yet they do constitute a starting point from which specific and complementary actions can be formulated aiming at improving the connection of the most disadvantaged farmers.

99. To put it in a nutshell, in order to develop rural connectivity for sustainable market-based income generation, infrastructures and road access are needed; but they are not sufficient. Value chain services are also essential; namely, input provision, credit, and transport services.

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Appendix: Data sheet

The Appendix presents, for each of the eight selected marketing lines, the consolidation data sheet that aggregates the budget of the whole marketing line.

Individual data sheet describing the general characteristics and operating budget of each agent taking part in the marketing lines (producer, collector, dryer, wholesaler…) are not included in this appendix. They are available from the authors on request.

Krông Nô Line 1	**Maize from Phu Xuan village to Dong Nai Province** Agents : Producer → Village collector → Commune collector → Dryer → Wholesaler	KN L1
Krông Nô Line 2	**Maize from Xuyen Tan village to Buon Me Thuot city** Agents : Producer → Commune collector → Wholesaler	KN L2
Krông Nô Line 3	**Maize from Dak Luu village to Dong Nai** Agents : Producer → Collector → Dryer → Wholesaler	KN L3
Krông Nô Line 4	**Maize from Bon Choi village to Dong Nai** Agents : Producer → Commune collector (cob) → Wholesaler	KN L4
Mộc Châu Line 1	**Chayote, from Tu Nhien village to Hà Noi** Agents : Producer → Village collector → Wholesaler → Distributor → Retailer	MC L1
Mộc Châu Line 4	**Maize from Ban Men village to Hung Yên Province** Agents : Producer → Village collector → Dryer → Wholesaler	MC L4
Mộc Châu Line 5	**Maize from Che Den village to Hung Yên** Agents : Producer → Village collector → Dryer → Wholesaler	MC L5
Mộc Châu Line 6	**Maize from Quang Minh commune to Hung Yên** Agents : Producer → Village collector → Commune collector → Dryer → Wholesaler	MC L6

Consolidation sheet : Krong No Maize line 1 - Synthesis

Krông Nô Line 1 KN L1	**Maize,** from **Phu Xuan** village (Quang Phu commune) **to Dong Nai** Province
Agents :	• **Producer** • **Village collector** • **Commune collector** • **Dryer** • **Wholesaler**

Line:	**KN Maize 1**					
Final output:	**Dry maize in grain**					
Unit:	VnD / kg					
	Agent					
Agent: **Item:**	**Producer**	**Village collector**	**Commune collector**	**Dryer**	**Wholesaler**	**System (Total)**
Fixed cost	66	37	9	30	38	180
Commodity in process	0	4 786	5 067	5 600	6 300	
Material inputs	1 674	67	4	93	202	2 040
Services	137	36	116	0	126	415
Labour	0	0	131	133	141	405
Other cost	0	0	5	40	0	45
Total cost	1 876	4 927	5 331	5 897	6 806	3 085
Total output	4 786	5 067	5 600	6 300	7 000	7 000
Profit	2 910	140	269	403	194	3 915
Cost structure by agent /system						
Commodity in process	0%	97%	95%	95%	93%	0%
Cost structure out of Commodity in process						
Fixed cost	3%	26%	3%	10%	8%	6%
	0%					
Material inputs	89%	48%	1%	31%	40%	66%
Services	7%	26%	44%	0%	25%	13%
Labour	0%	0%	49%	45%	28%	13%
Other cost	0%	0%	2%	13%	0%	1%
Cost share of ouput	39%	97%	95%	94%	97%	44%
Return to capital invested	155%	3%	5%	7%	3%	127%
Profit distribution	74%	4%	7%	10%	5%	100%
Transport cost analysis						
Effective distance	0	16	5	0	666	
Transport cost	0	140	265		506	
Volume	5000	1950	12000	7500	40000	
		8.8	52.9		0.8	

Consolidation sheet : Krong No Maize line 2 - Synthesis

Krông Nô Line 2 KN L2	Maize, from Xuyen Tan village (Duc Xuyen commune) to Buon Me Thuot city (Dak Lak province)
Agents :	• Producer • Commune collector • Wholesaler

Line:	KN Maize 2					
Final output	Dry maize in grain					
Unit	Kg					
	Agent					
Item	Producer of dried maize	Collector of maize on cob	Wholesaler			System (Total)
Fixed cost	74	22	68			164
Commodity in process	0	5 920	6 380			
Material input	1 711	24	32			1 767
Services	480	44	29			553
Labour	138	83	141			362
Other cost	0	0	6			6
Total cost	2 403	6 093	6 657			6 657
Total output	5 920	6 380	6 700			0
Profit	3 517	287	43			3 847
Cost structure by agent and system						
Commodity in process	0%	97%	96%			0%
Cost structure out of Comm in process						
Fixed cost	3%	13%	25%			2%
	0%					
Material input	71%	14%	12%			27%
Services	20%	25%	11%			8%
Labour	6%	48%	51%			5%
Other cost	0%	0%	2%			0%
Cost share of ouput	41%	96%	99%			
Return to capital investe	146%	5%	1%			58%
Profit distribution	91%	7%	1%			100%
Transport cost analysis						
Effective distance	9	5	126			
Transport cost	480	173	267			
Volume	4500	3900	39500			
	53.3	34.5	2.1			

Consolidation sheet : Krong No Maize line 3 – Synthesis

Krông Nô Line 3 KN L3	**Maize, from Dak Luu village (Tan Thanh commune) to Dong Nai (Dong Nai province)**
Agents :	• **Producer** • **Collector** • **Dryer** • **Wholesaler**

Line:	KN Maize 3					
Final output	Dry maize in grain					
Unit	kg					
	Agent					
Item	Farmer	Collector	Dryer	Wholesaler		System (Total)
Fixed cost	35	57	26	15		134
Commodity in process	0	5 367	5 867	6 500		
Material input	1 657	93	82	137		1 969
Services	518	28	0	45		591
Labour	0	107	133	122		363
Other cost	0	0	0	8		8
Total cost	2 210	5 652	6 108	6 828		3 064
Total output	5 367	5 867	6 500	7 000		7 000
Profit	3 157	215	392	172		3 936
Cost structure by agent and system						
Commodity in process	0%	95%	96%	95%		0%
Cost structure out of Comm in process						
Fixed cost	2%	20%	11%	5%		4%
	0%					
Material input	75%	33%	34%	42%		64%
Services	23%	10%	0%	14%		19%
Labour	0%	38%	55%	37%		12%
Other cost	0%	0%	0%	2%		0%
Cost share of ouput	41%	96%	94%	98%		44%
Return to capital investe	143%	4%	6%	3%		128%
Profit distribution	80%	5%	10%	4%		100%
Transport cost analysis						
Effective distance	6	54		540		
Transport cost	383	285		323		
Volume	12000	7950		50000		
	63.9	5.3		0.6		

Consolidation sheet : Krong No Maize line 4 – Synthesis

Krông Nô Line 4 KN L4	**Maize, from Bon Choi village (Duc Xuyen commune) to Dong Nai (Dong Nai province)**
Agents :	• **Producer** • **Commune collector (maize in cob)** • **Wholesaler**

Line:	KN Maize 4					
Final output	Dry maize in grain					
Unit	0					
	Agent					
Item	Farmer	Collector of maize on cob	Wholesaler			System (Total)
Fixed cost	44	135	75			254
Commodity in process	0	3 700	4 800			
Material input	963	31	278			1 272
Services	429	5	113			546
Labour	0	183	153			336
Other cost	0	0	32			32
Total cost	1 435	4 054	5 450			2 440
Total output	3 700	4 800	5 800			5 800
Profit	2 265	746	350			3 360
Cost structure by agent and system						
Commodity in process	0%	91%	88%			0%
Cost structure out of Comm in process						
Fixed cost	3%	38%	12%			10%
	0%					
Material input	67%	9%	43%			52%
Services	30%	1%	17%			22%
Labour	0%	52%	24%			14%
Other cost	0%	0%	5%			1%
Cost share of ouput	39%	84%	94%			42%
Return to capital investe	158%	18%	6%			138%
Profit distribution	67%	22%	10%			100%
Transport cost analysis						
Effective distance	10	10	525			
Transport cost	429	354	650			
Volume	10000	150000	12500			
	42.9	35.4	1.2			

Consolidation sheet : Môc Châu Chayote Line 1 – Synthesis

Mộc Châu Line 1 MC L1	**Chayote, from Tu Nhien village (Dong Sang commune) to Hanoi city**
Agents :	• **Producer** • **Village collector** • **Wholesaler** • **Distributor** • **Retailer**

Line:	MC Chayote 1					
Final output	Chayote					
Unit	kg					
	Agent					
Item	Farmer	Village collector	Wholesaler	Distributor	Retailer	System (Total)
Fixed cost	193	72	63			328
Commodity in process	0	2 100	2 400			
Material input	380	0	792			1 171
Services	0	15	0			15
Labour	105	0	143			249
Other cost	0	0	30			30
Total cost	678	2 187	3 428			1 793
Total output	2 100	2 400	3 600			3 600
Profit	1 422	213	173			1 807
Cost structure by agent and system						
Commodity in process	0%	96%	70%			0%
Cost structure out of Comm in process						
Fixed cost	29%	83%	6%			18%
	0%					
Material input	56%	0%	77%			65%
Services	0%	17%	0%			1%
Labour	16%	0%	14%			14%
Other cost	0%	0%	3%			2%
Cost share of ouput	32%	91%	95%			50%
Return to capital investe	210%	10%	5%			101%
Profit distribution	79%	12%	10%	0%	0%	100%
Transport cost analysis						
Effective distance	0	0	330			
Transport cost	0	0	998			
Volume	28500	2000	6000			
			3.0			

Consolidation sheet : Môc Châu maize line 4 – Synthesis

Mộc Châu Line 4 MC L4	Maize, from Ban Men village (To Mua commune) to Hung Yên province
Agents :	• Producer • Village collector • Dryer • Wholesaler

Line:	MC Maize 4					
Final output	Dry maize in grain					
Unit	0					
	Agent					
Item	Producer	Village collector	Dryer	Wholesaler		System (Total)
Fixed cost	94	51	225	27		397
Commodity in process	0	4 000	4 400	6 200		
Material input	933	20	142	141		1 236
Services	80	0	0	0		80
Labour	0	32	80	41		152
Other cost	0	0	0	17		17
Total cost	1 108	4 102	4 846	6 426		1 882
Total output	4 000	4 400	6 200	6 600		6 600
Profit	2 892	298	1 354	174		4 718
Cost structure by agent and system						
Commodity in process	0%	98%	91%	96%		0%
Cost structure out of Comm in process						
Fixed cost	9%	50%	50%	12%		21%
	0%					
Material input	84%	19%	32%	62%		66%
Services	7%	0%	0%	0%		4%
Labour	0%	31%	18%	18%		8%
Other cost	0%	0%	0%	8%		1%
Cost share of ouput	28%	93%	78%	97%		29%
Return to capital investe	261%	7%	28%	3%		251%
Profit distribution	61%	6%	29%	4%		100%
Transport cost analysis						
Effective distance	4	4	0	541.5		
Transport cost	92	102	0	226		
Volume	5000	10000	15000	50000		
	23.1	25.5		0.4		

Consolidation sheet : Môc Châu Maize line 5 – Synthesis

Mộc Châu Line 5 MC L5	**Maize, from Che Den village (Moc Chau farm town) to Hung Yên province**
Agents :	• **Producer** • **Village collector** • **Dryer** • **Wholesaler**

Line:	MC Maize 5					
Final output	Dried maize grain					
Unit	kg					
	Agent					
Item	Producer	Village collector	Dryer	Wholesaler		System (Total)
Fixed cost	33	60	217	27		338
Commodity in process	0	3 733	4 400	6 200		
Material input	1 358	59	225	179		1 821
Services	68	0	0	0		68
Labour	0	42	80	41		162
Other cost	0	0	0	17		17
Total cost	1 459	3 893	4 922	6 464		2 406
Total output	3 733	4 400	6 200	6 600		6 600
Profit	2 274	507	1 278	136		4 194
Cost structure by agent and system						
Commodity in process	0%	96%	89%	96%		0%
Cost structure out of Comm in process						
Fixed cost	2%	37%	42%	10%		14%
	0%					
Material input	93%	37%	43%	68%		76%
Services	5%	0%	0%	0%		3%
Labour	0%	26%	15%	15%		7%
Other cost	0%	0%	0%	6%		1%
Cost share of ouput	39%	88%	79%	98%		36%
Return to capital investe	156%	13%	26%	2%		174%
Profit distribution	54%	12%	30%	3%		100%
Transport cost analysis						
Effective distance	12	12	0	541.5		
Transport cost	68	160	0	264		
Volume	4400	10000	15000	50000		
	5.7	13.3		0.5		

Consolidation sheet: Mộc Châu maize Line 6 – Synthesis

Mộc Châu Line 6 C L6	Maize, from Quang Minh commune to Hung Yên province
Agents :	• **Producer** • **Village collector** • **Commune collector** • **Dryer** • **Wholesaler**

Line:	MC Maize 6					
Final output	Dry maize in grain					
Unit	kg					
	Agent					
Item	Producer	Village collector	Commune collector	Dryer	Wholesaler	System (Total)
Fixed cost	141	0	70	173	27	411
Commodity in process	0	4 082	4 322	5 059	6 200	
Material input	998	0	87	201	179	1 464
Services	0	0	0	0	0	0
Labour	0	0	24	74	41	139
Other cost	0	0	0	0	17	17
		0	0	0	0	
Total cost	1 138	4 082	4 503	5 506	6 464	2 031
Total output	4 082	4 322	5 059	6 200	6 600	6 200
Profit	2 943	240	556	694	136	4 569
Cost structure by agent and system						
Commodity in process	0%	100%	96%	92%	96%	0%
Cost structure out of Comm in process						
Fixed cost	12%	100%	39%	39%	10%	20%
	0%					
Material input	88%	0%	48%	45%	68%	72%
Services	0%	0%	0%	0%	0%	0%
Labour	0%	0%	13%	17%	15%	7%
Other cost	0%	0%	0%	0%	6%	1%
Cost share of ouput	28%	94%	89%	89%	98%	33%
Return to capital investe	259%	6%	12%	13%	2%	225%
Profit distribution	64%	5%	12%	15%	3%	100%
Transport cost analysis						
Effective distance	4	0	44	0	541.5	
Transport cost	31	0	181	0	264	
Volume	13000	800000	10000	20000	50000	
	7.7		4.1		0.5	