Application of value chain analysis in understanding the wastes and losses of cassava in Vietnam

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ABSTRACT

To reduce post-harvest losses and foster development of cassava, it is necessary to evaluate the full range of activities required to bring fresh cassava root through different stages of production, processing, and marketing until it reaches the end-user. A Value Chain Analysis (VCA) provides the approach for such an understanding in that it is a process of tracing a product's flow from the point of production to the point of consumption along with tracing the roles and relationships of different actors and stakeholder at different points in the value chain. This paper provides an overview of the main cassava value chains in Vietnam, and the extent and nature of losses and wastes in those value chains.

Key words: cassava, value chain analysis, losses, wastes, post-harvest.

1. INTRODUCTION

Cassava is among the four most important food crops in Vietnam. It has always been considered a secondary crop even though it has played an important role in national food security. According to the report on the Vietnam's cassava situation in 2012, total cassava production of Vietnam is 9.87 million tonnes, grown on 559,800 ha[1]. In Vietnam, cassava is mostly used as fresh, chips and starch in which cassava starch and cassava chip are main products from cassava.

A main constraint with cassava is the amount of post-harvest losses generated[2]. Post-harvest losses are a problem because of their high perishability especially under tropical conditions (high temperatures) that accelerate the physiological process of deterioration. The reduction of post-harvest losses and the transformation of roots into various forms for food, feed, and industrial raw material has the potential to help improve food security, create additional value in rural settings, generate income and employment and develop a more favorable balance of trade.

To reduce post-harvest losses and foster development along the cassava value chain, it is necessary to understand the wastes and losses created during difference stages of cassava chain, i.e from farm to fork or from root production to final consumption. In doing so, value chain analysis (VCA), which analyses the full range of activities required to bring a product through different stages of production, processing, and marketing until it reaches the end-user has to be evaluated[3]. Value chain analysis therefore is an efficient tool to assess the wastes and losses generated along the cassava value chain. This paper tries to first and foremost provide an

overview of the main cassava value chains in Vietnam, and the extent and nature of losses and wastes in those value chains. It also provides some initial ideas to reduce physical and economic losses in the value chains.

2. METHODOLOGY

The VCAs have been carried out by a technical team who was in charge of gathering information (including by in-depth literature review), collecting data during field surveys, interviews with key-informants and analyzing the obtained data.

2.1. Selection of the study area

Three provinces were chosen where there is concentrated production or processing of cassava. In the North, we investigated cassava value chain at YenBai province (North East region) and peri-urban Hanoi (formerly HaTay province in the Red River region). In the South, TayNinh province in the South East region was chosen for this study.

2.2. Data collection methods

Two lists of guide questions have been prepared listing the key issues to be discussed with each actor of the cassava value chains. The list of guide questions covered core processes and flows for each of the actors in the value chains.

In addition to individual interviews of the various actor categories, group discussions were held for triangulation purposes. Furthermore, there was participant observation of production, processing and distribution activities to cross check information given by respondents. Data were recorded in field notebooks. After each day's field work, there was a regular team meeting to harmonize responses and initiate report writing. This helped with triangulation and validation of findings; gaps were identified and filled in subsequent interviews.

2.3. Data analysis

Descriptive analysis of both primary and secondary data collected was done. This basically involved confrontation and reflection of the existing practices by actors along the cassava value chain as well as back-and-forward triangulation and validation of data collected.

3. RESULTS AND DISCUSSIONS

3.1. Overall cassava value chain in Vietnam

The value chain for cassava in Vietnam differs from region to region in terms of characteristics of the actors and interactions among them. The regions differ in terms of climatic and socio-economic conditions, cultivation practice and organization, level of specialization, scale of the processing, etc. Figure 1 represents the principal actors and their roles in the cassava value chain in Vietnam. Key actors in the value chains include farmers, processors, labour (for specific activities such as harvesting and peeling) and traders (including agents, wholesalers and retailers). Others are catering and institutions as well as household consumers.

The cassava value chain can be divided into three sub-value chain namely (1) cassava dry starch sub-value chain, (2) cassava wet starch sub-value chain and (3) cassava chip sub-value chain.

In *dry starch sub-value chain*, farmer produces fresh cassava root (FCR) and often sells it to second actor, trader or collector. Processors buy FCRs from trader or directly from farmers who can bring cassava root to them. Some processors process fresh cassava roots into dry starch, especially industrial level-processors only produce dry starch. The other processors, most of whom are craft villagers, focuses on their production of dry starch from wet starch. The dried starch is then sold to another middleman or directly to starch-based industries, such as modified-starch processor, noodle, confectionery, MSG manufacturing, cardboard and plywood, pharmaceutical industries. Large part of the processed dry starch (70%) is sold to exporter or directly to importer from importing countries.

The production of the *cassava wet starch* occurs mainly at craft village level in the North of Vietnam. This sub-value chain is characterised by mirco/household and small processors. Wet starch processor is the primary processor of the chain. Wet starch can be stored in anaerobic condition for quite long time or sold to other secondary processors such as dry starch processor (60%), maltose dextrin, glucose producer or noddle and confectionary processor.

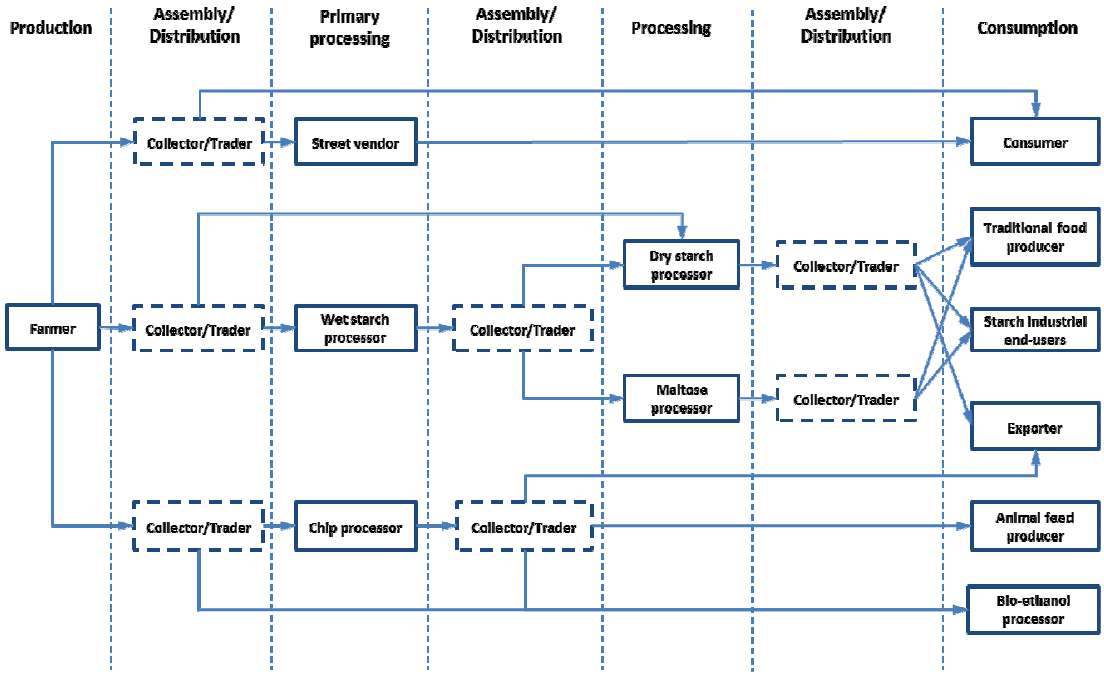

Figure 2. The overall cassava value chain in Vietnam

In the *cassava chip value chain*, farmer sells FCRs directly to cassava chip processor or through trader. Chip processor cuts the cassava roots into slides manually or by slicing machine. After chipping, fresh cassava chip is dried using natural solar radiation or in coal kiln. The cassava chips are sold directly to end-user such as animal feed producer, bio-ethanol processor, and exporter or through trader. Large quantity of cassava chip is exported mainly to China market.

3.2. Wastes and Losses in cassava value chain

Physical losses

Lost product for which there is not alternative use and residual value. It includes: (1) Product left behind in the field during harvesting (the whole root/tuber or part of it); (2) Spoiled or damaged

product that is thrown away (including at household level); (3) Product that disappears in one of the stage of the value chain (e.g., eaten by pests, stolen). The estimated volume of physical losses by stage of the sub-value chains is presented at Table 1. As far as the extent of physical losses at different stages of the sub-value chains is concerned, these can be estimated as follows:

On-farm physical losses: in the dry starch sub-chain cassava is usually purchased by the trader well before the harvest. Some losses occur in the wet starch and chip value-chains because often there is an intermediary that purchases the roots harvested by the individual farmer at the farm gate and transport them to the processing site. As such some physical losses may occur in the field in case of delays. These can be estimated at 0.5% for both sub-chains.

Losses during trading, transport and handling: during these phases some delays may occur and some roots can completely spoil and have to be thrown away. In the wet starch value chain, cassava has to be transported over considerable longer distances than the roots to be processed into dry starch and chips whose processing site are usually located nearby the cassava plantation area. Moreover, in the wet starch chain, it might take many hours to sell all the roots, which usually are delivered the day after the harvest. As such the physical losses were estimated at 2% for the wet starch chain and 0.5% for the dry starch and chip chains.

Losses during processing: good coordination of the actors exists in the dry starch chain. Some delays may occur and hence some physical losses estimated at 0.5%. In the wet starch and chip value chains in the North the considerably weaker coordination, the lower processing capacities and the higher humidity determine higher losses than in the South. These have been estimated at 1% and 5%, respectively.

Losses during distribution, retail and consumption: losses of dry starch and chips may exceptionally occur but these were estimated as negligible. Conversely some physical losses occur for wet starch when the block is exposed to aerobic conditions. In this case the outer part of the block has to be removed and thrown away and the inner part has to be immediately processed. These losses were estimated at up to 5%; 1% on average.

Table 1. Estimated volume of physical losses by stage of the sub-value chains

Sub-value chain	On farm (t)	Trading, transport & handling (t)	Processing - excl. on farm (t)	Retail and consumption (t root equivalent)	Total physical losses (t)	Share of used roots (%)	Share by sub-value chain (%)
Dry starch	0	27,154	27,018	0	54,172	1%	18%
Wet starch	2,455	9,772	4,788	4,740	21,755	4%	7%
Chips	19,248	19,152	190,565	0	228,965	6%	75%
Total	21,704	56,078	222,371	4,740	304,893	3%	100%
Share by stage of the chain (%)	7%	18%	73%	2%	100%		

The chip value chain is responsible for about 75% of overall physical losses. In this value chain around 6% of roots intended to be processed into chips are lost along the chain. The great majority of losses (75%) occur at the processing sites.

The dry starch sub-value chain incurs minimal losses in relative terms (1% of roots are lost) but, in absolute terms, they represent 18% of total physical losses in Vietnam. Conversely, the wet starch sub-value chain incurs significant losses in relative terms (6%) but, overall, they are just 7% of total losses in the country due to the low volume of roots processed in wet starch.

Economic losses

Product for which there is alternative use with discounted value such as: (1) spoiled or damaged product whose market price is discounted (e.g. cassava root sold at discounted price after one or more days from the harvest); and (2) spoiled or damaged product that cannot be used for what it was initially meant (e.g. a damaged root processed into lower value products or used as animal feed).

- The price of roots is determined by their quality. As rule of thumb, the "point system" mechanism reduces the price of roots by about 10% and 20% in the first and second day after harvest, respectively.

- In the dry starch and chip value chain it can be roughly estimated that 75% of roots are processed the day of harvest, 20% the day after and 5% two days after. In the wet starch value chain, due to the long distances and frequent delays previously described, it is estimated that only 10% of roots are processed the same day of the harvest. Around 80% are sold the following day and the remaining 10% the day after.

Wastes

Unlike losses that occur because of unexpected circumstances, lack of adequate infrastructures or mismanagement, waste is the deliberate disposal of any food substance, raw or cooked, which is discarded, or intended or required to be discarded. These food substances are not the primary focus of the production process. For the purpose of this study the term "waste" refers to: Stems and leaves of the plant, peels, other by-products of the processing: these include, but are not limited to, pulp (from starch extraction), dust (from chipping), waste water (from starch and ethanol production), distiller's dried grain with soluble-DDGS (from ethanol production). Table 2 shows the estimated amount and location of by-products along the cassava value chain.

In the selected sub-value chains the following by-products were found:

- Stems: these are found on farm. Part of them is used as planting material for the next season. Small volumes are used for the preparation of substrates for growing mushrooms. The rest is either left in the field as organic fertilizer or burnt.

- Leaves: these are found on farm and either left in the field as organic fertilizer or burnt.

- Dry peels: this is a by-product of the dry starch factories. They represent around 3% of root's weight and are usually given free of charge to farmers and used as fertilizer. Only negligible amount of chips are from peeled roots.

- Wet peels: this is a by-product of the dry starch factories and wet starch processors were they represent 2% and 3% of root's weight, respectively. They are also given to farmers to increase the organic matter content in the soil.

- Wet pulp: it represents between 25% and 28% of root's weight in the dry and wet starch sub-chains. At industrial level production of dry starch the wet pulp is usually dried by sun or tunnel using fuel, biogas or biomass. In wet starch processing the wet pulp is usually sold

to pulp collectors that sundry it and sell the dry pulp to animal feed processors, usually through specialized intermediaries.

- Black starch: this is a by-product of the processing of roots into wet starch processing only. Some black starch is also produced by the reprocessing of wet starch into dry starch at small scale level but this was not taken into account in the calculations. Currently this by-product is given free of charge or sold for animal feed (mainly pigs) at household level in the area nearby the craft villages.

- Waste water: it was estimated that around 6.3 m^3 and 3.5 m^3 of waste water are produced for each tonne of fresh root processed into dry starch and wet starch, respectively. All industrial processors of dry starch produce biogas by treating the waste water while wet starch processors discharge this by-product in the surrounding area.

Table 2. Estimated amount and location of by-products

	Parameters	On farm (t)	Dry starch processor (t)	Wet starch processor (t)	Total (t)
Stems (t)	10 t/Ha	5,542,160			5,542,160
Leaves (t)	9 t/Ha	4,987,944			4,987,944
Dry peels (t)	3% of FCR weight (dry starch)		161,299		161,299
Wet peels (t)	2% of FCR weight (dry starch) 3% of FCR weight (wet starch)		107,533	14,221	121,753
Wet pulp	25%-28% of FCR weight		1,505,461	118,504	1,623,966
Black starch	4.5% of FCR weight (wet starch)			21,331	21,331
Waste water (m3)	6.3 m^3/t FCR processed (dry starch) 3.5 m^3/t FCR processed (wet starch)		33,872,876	1,659,062	35,531,938

FCR: fresh cassava root

Conclusion

Vietnam cassava value chain is characterized by a number of intermediaries or middlemen due mainly to poor infrastructure for transportation and small land allocation for cassava production, especially in the mountainous areas. By using the value chain analysis approach, it is possible to trace the movement of cassava through different stages from farm to fork and understand the magnitude as well as causes of wastes and losses occurred at each stage. The results are also a benchmark for finding solutions to reduce post-harvest losses of cassava along the value chain.

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References

1. Booth, R.H. and Coursey, D.G. (1974) Storage of cassava roots and related post-harvest problems. In: Araullo, E.V., Nestel, B. and Campbell, M. Cassava processing and storage of an interdisciplinary workshop, IDRC, Ottawo, pp 43-49.
2. Department of Processing and Trade for Agro-forestry-Fisheries Products and Salt Production (MARD), Report on Cassava Sector, 2012.
3. Kaplinsky, R. and Morris, M. (2001) A Handbook for Value Chain Research; Prepared for the IDRC.