Preparing for a circular all-African cashew processing industry for Tanzania

Seedmoney project

Final presentation 09-12-2021, Johnny Cashew: Hayo de Feijter, WFBR: Anton Schultze-Jena, Wolter Elbersen

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JOHNNY CASHEW

THE PROBLEM

THIS NEEDS TO CHANGE AND HERE IS WHY:

PEOPLE IN EUROPE EAT MORE AND MORE CASHEW.
THAT'S GREAT!
UNFORTUNATELY,
THE TRADE CHAIN ISN'T!

12.500KMS
OF EXTRA TRAVEL

NO LOCAL PROCESSING

BITS AND PIECES

Optimize use of waste streams

THE SOLUTION

Johnny Cashew is the market maker for sustainable cashew, directly sourced from Tanzania and Mozambique containing the whole harvest.

Together on our way to
sustainable cashew that is:

- Carbon Free
- Waste Free
- Poverty Free

The work on the ground

Research question

- Partners want to develop cashew processing in East-Africa instead of shipping nuts for processing to Vietnam and India
- Adding value to cashew residues in Africa is necessary to be competitive and sustainable

Partners involved

- Johnny Cashew
- Listram Commodities in Tanzania
- Norges Vel
- Blue Crane
- Dutch Embassy in Tanzania/Kenia

Cashew data

- Worldwide ~750.000 tonnes of raw nuts per year
- East-Africa: Production characterized by smallholder farmers operating at subsistence level
- Trees productive after 4 year lag phase for > 25 years

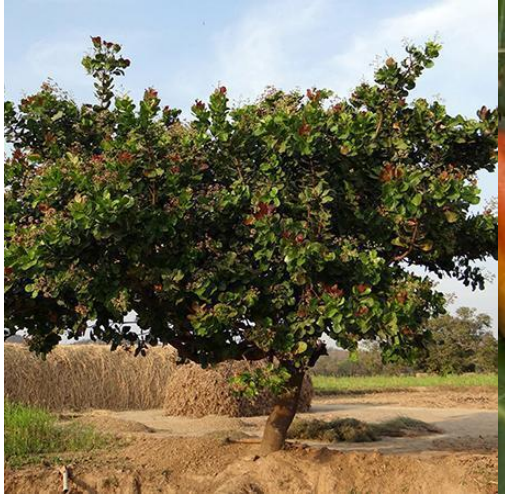
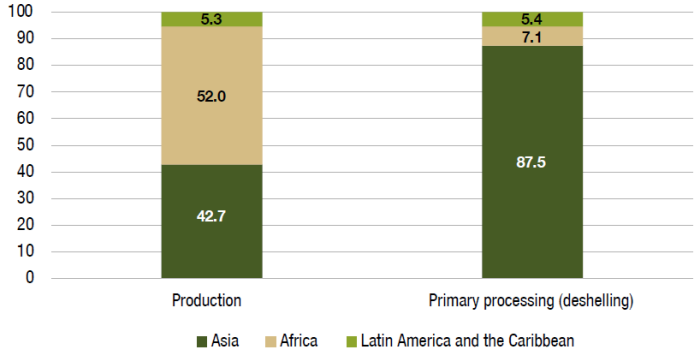
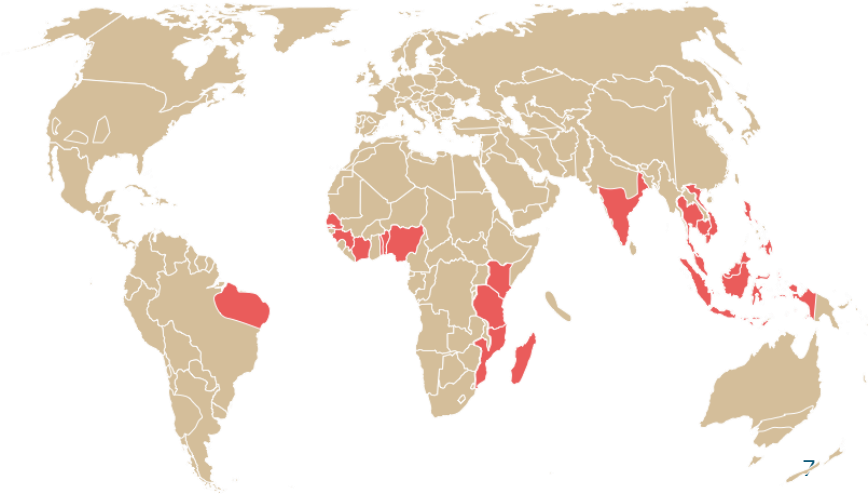


Figure 23
Shares in cashew production and primary processing by region, 2018
(Percentage)



Source: UNCTAD calculations, based on data from Comtrade, DCCD, FAOstat, the General Department of Viet Nam Customs and Viet Nam statistical yearbooks.



https://www.cashews.org/en/cashew-information
https://www.tanzaniainvest.com/cashew
UNCTAD - United Nations Conference on Trade and Development, "COMMODITIES AT A GLANCE - Special issue on cashew nuts."

Why are residues important?

- 84% of material produced is residue
- Cashew nut shell liquid has a high potential value though only part of potential is used
- Using both apple and nut together is difficult or impossible
- To competitively process raw nuts in Africa adding value to residues is essential, also for sustainability
- Establishing a local residue processing chain is necessary

Product	Total weight	Dry matter content	Dry weight
Apples	71%	10%	21%
Kernels	6%	97%	16%
Shell:			
Cashew nut shell cake (CNSC)	16%	90%	42%
Cashew nut shell liquid (CNSL)	5%	100%*	13%

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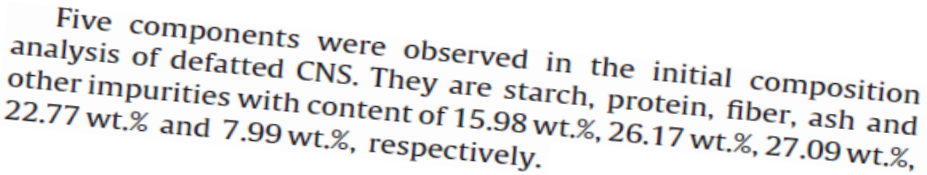
(Main) by-products current use

By-product	Characteristics	Current use
Cashew apple	High in sugar and vitamin C Astringent taste	Underutilized, majority (90%) left in the field Sometimes used to make alcoholic beverages. Little commercialization in Africa (Juice production in Brazil)
Cashew nut shell cake (roasted, opened nut shell after CNSL is pressed out)	Generally CNSL is pressed, leaving high residual CNSL	Underutilized, partially used at factory for energy Rest is often burned behind factory
Cashew nut shell liquid	High in phenolic content Caustic	A significant fraction is refined and used as starter material for a range of chemical products. Rest is burned or added to ships fuel

Decision not to travel → *PLAN B* = extended composition analysis & solving pellet production issues

"For understanding potential uses of residues, knowledge of composition is required"



Five components were observed in the initial composition analysis of defatted CNS. They are starch, protein, fiber, ash and other impurities with content of 15.98 wt.%, 26.17 wt.%, 27.09 wt.%, 22.77 wt.% and 7.99 wt.%, respectively.

"Literature is not complete and sometimes wrong about composition of cashew nut shell cake"

- We did amino acid analysis but protein content was less than 5% → Literature appears to be wrong!
  - ~~Protein 26 wt.%~~
- Norges Vel initialized testing of pelletization of cashew nut shell cake (with WFBR and company Zetadec)

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M. Yuliana, L. H. Huynh, Q. P. Ho, C. T. Truong, and Y. H. Ju, "Defatted cashew nut shell starch as renewable polymeric material: Isolation and characterization," *Carbohydr. Polym.*, vol. 87, no. 4, pp. 2576–2581, 2012.
M. Yuliana, C. T. Truong, L. H. Huynh, Q. P. Ho, and Y. H. Ju, "Isolation and characterization of protein isolated from defatted cashew nut shell: Influence of pH and NaCl on solubility and functional properties," *LWT - Food Sc*

Composition analysis → needs to be published!

	Cashew nut shell cake	Post ethanol extraction	Interpretation
Energy (Gross CV, bone dry) [MJ/kg]	23.54	19.74	High energy content
Ash (815°C) [% DW]	1.76	2.65	Low, positive for any application
Protein [% DW] (6.25*N)	3.97	5.06	Relatively low content, animal feed unlikely
Cellulose [% DW]	11.46	15.24	
Hemi-cellulose [% DW]	10.39	13.61	
Pectin [% DW]	1.34	1.88	Very low
Acid soluble lignin (ASL) [% DW]	2.76	3.92	High energy content, applications like activated charcoal or lignin products
Acid insoluble lignin (AIL) [% DW]	17.35	20.86	
Ash melting point DG ^{0}C	1290	1270	High, likely no ash agglomeration
Chlorine	0.052	0.052	Low, likely no problems with fouling and corrosion

Making quality pellets out of CNSC

- Partner Norges Vel commissioned Zetadec (Wageningen) to test pelletizing quality
- Pellets made from pressed CNSC and pressed + ethanol extracted CNSC
- Result shows that good pellet production is possible with few fines after (ethanol) extraction!
- CNSC contains caustic oil/liquid → low quality

1. Pressed CNSC

2. Ethanol extraction

3. Pelletizing

Conclusion on composition and potential

Co-product	Composition	Challenge to use to full potential
Cashew apple	High sugar and vitamin C content Potential food ingredient Fermentable sugars	Close to rotting when kernel is ripe – under utilized Logistics required to enable speedy processing Alternatively local stabilization (i.e. drying)
Cashew nut shell cake (roasted, opened nut shell after CNSL is pressed out)	Composition of good quality fuel, when CNSL is removed High lignin content makes it attractive for lignin products	Residual CNSL • Caustic to touch and ingestion • Creates caustic fumes when burned CNSL removal with pressing incomplete (extraction required)
Cashew nut shell liquid	Valuable chemical anacardic acid, cardanol, cardol	Logistics, bringing high quality CNSL together in large quantities Local processing, refinery in East-Africa

Conclusion on Cashew Nut Shell Cake pellets

- Norges Vel will now decide on buying pelletizer
- Once CNSL is extracted pellets have good quality
- Rel. high energy value

Other?

- Binderless board?
- Activated charcoal?

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Cashew nut shell liquid (CNSL)

- Application examples include:

Friction linings, paints and varnishes, laminating resins, rubber compounding resins, cashew cements, polyurethane based polymers, surfactants, epoxy resins, foundry chemicals and intermediates for chemical industry

- Large part not extracted / left in shell
- Large part used for low value factory fuel
- New option is Jetfuel → maybe next development?

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http://www.senesel.pl/en/applications/cnsl_applications

Next

CNSL extraction is necessary to produce product from CNSC

Solvent extraction of Cashew Nut Shell Cake should yield high quality CNSL

- Next steps:
  - Pellet production possible → Norges Vel
  - If CNSL is extracted on large scale a large market for chemicals and (jet) fuels is available → Johnny Cashew
- Publish Cashew Nut Shell Cake composition

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Johnny Cashew: Hayo de Feijter

WFBR: Anton Schultze-Jena, Wolter Elbersen

Input from

Zetadec: Marjanne Verhoeven

Norges Vel: Karsten Gjefle

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Sustainability and circularity considerations

- CNSL
  - Solvent extraction necessary for using the total potential and good quality
  - Extraction and refinery into products needs scale (no shipping of unrefined CNSL)
  - Applications for chemicals (existing), (shipping) fuels, jet fuels (HVO)
- CNSC (high lignin) based products
  - Binderless board?
  - Activated charcoal?
- CNSC fuel pellets (if oil removed)
  - Low circularity score in itself, but avoidance of deforestation is very important!