African Agriculture through Innovation from planting to harvesting: A case study of Cassava

Prof. Emmanuel Y.H. Bobobee, PhD
Kwame Nkrumah University of Science & Technology (KNUST), Kumasi. Ghana.

emmanuel.bobobee@gmail.com
url:tekcassavaharvester.com
Outline

- **Challenges to mechanised cassava production in Ghana and Africa**
  - Low farm power & drudgery in agriculture
  - Aging agricultural labour force
  - Slow progress in agriculture mechanisation
  - Low level of mechanised cassava production

- **Innovations developed to address some challenges by Bobobee et al.**
  - The TEK Mechanical cassava harvester and others
  - Durable digging blade
  - Double-row disc ridger
Global Agricultural Mechanization Progress

1 Kings 19:19

19th Century to date (Industry 1.0)

Drudgery

Productivity

Adam & Eve Time
In Gen 2-3

Time
Global Farm Power Typology and Hunger Map

Farm power typology – Developing Countries (L Clarke)
Cassava distribution

Grows between 30°N and 30°S latitude mostly in areas marginal for most others crops
Global Distribution of Cassava

Cassava output in 2005 shown as a percentage of the top producer (Nigeria – 41,565,000 tonnes)

- Africa: 56%
- SE Asia: 30%
- South America: 14%

(FAOSTAT 2017)
Production quantity ('000 Mt)

Country
- Nigeria: 57134
- Thailand: 31161
- Brazil: 21083
- Indonesia: 20745
- Ghana: 17798
- DR. Congo: 14678
- Vietnam: 11045
- Cambodia: 10207
- Angola: 9981
- Mozambique: 9100
- Tanzania: 5575
- Cameroon: 5502

Africa: 56%
SE Asia: 30%
South America: 14%

(FAOSTAT 2017)
The challenge to mechanised & commercial cassava production

• Small-scale producers dominate agriculture in Ghana and SSA
• Cassava is planted randomly/haphazardly/disorderly
• Apart from ploughing, there is little mechanisation by cassava growers
• Agricultural labour is aging in Ghana & Africa
• Agriculture is a way of life not treated as a business
• The youth are not interested to use manual tools in agriculture
• Manual cassava harvesting is a painful activity full of drudgery,
• Until recently, there are no commercial mechanical cassava harvesters developed in Africa.
Cassava production by task and days per ha in the Congo, Côte d'Ivoire, Ghana, Nigeria, Tanzania and Uganda *(Source: Nweke et al 2001)*

<table>
<thead>
<tr>
<th>Task</th>
<th>DR Congo</th>
<th>Côte d'Ivoire</th>
<th>Ghana</th>
<th>Nigeria</th>
<th>Tanzania</th>
<th>Uganda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land preparation (manual)</td>
<td>66</td>
<td>53</td>
<td>44</td>
<td>49</td>
<td>54</td>
<td>45</td>
</tr>
<tr>
<td>Seedbed preparation</td>
<td>21</td>
<td>29</td>
<td>31</td>
<td>41</td>
<td>27</td>
<td>31</td>
</tr>
<tr>
<td>Planting</td>
<td>39</td>
<td>22</td>
<td>28</td>
<td>32</td>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>Weeding</td>
<td>27</td>
<td>28</td>
<td>34</td>
<td>38</td>
<td>28</td>
<td>32</td>
</tr>
<tr>
<td><strong>Harvesting</strong></td>
<td><strong>48</strong></td>
<td><strong>44</strong></td>
<td><strong>53</strong></td>
<td><strong>62</strong></td>
<td><strong>46</strong></td>
<td><strong>52</strong></td>
</tr>
<tr>
<td><strong>Total days</strong></td>
<td><strong>201</strong></td>
<td><strong>173</strong></td>
<td><strong>191</strong></td>
<td><strong>222</strong></td>
<td><strong>182</strong></td>
<td><strong>187</strong></td>
</tr>
</tbody>
</table>
Painful manual harvesting methods
Manual Cassava harvesting in NIJILUCAS Farm, Nigeria, 2018
Heart rate profiles of manual cassava harvester on Niji Lucas farm, Nigeria, October 2018

- **Rest**
- **Harvesting**
- **Recovery**

**Heart rate (bpm)**

**Time (x 5s)**

- Fatimatu
- Farm Manager
HR profiles of two women for manual harvesting 10 Nkabom Cassava plants together on 01 July 11

Cassava harvesting
Loading
Unloading

Rest before work
recovery
Recovery after work
Recovery

Time (x 5s)

0 200 400 600 800 1000 1200 1400

HR (bpm)

Mawuto
Rose
• An efficient TEK mechanical cassava harvester invented and patented at KNUST (*OAPI patent 17219*).

• Harvester takes 1 sec/plant to dig out compared with 5 - 10 mins/plant manually.

• 50 prototypes manufactured and 30 deployed in Ghana, South Africa, Nigeria & Jamaica.

• Capacity exists to manufacture to satisfy continental demands.
Mechanical Harvesting Demo Video Clips
Drudgery evaluation of manual and mechanical cassava harvesting in RSA, 2015

![Graph showing heart rate (HR) over time for different harvesting methods: Tractor Op disk, Tractor Op harv, Regina hand, and Emily hand.]
Some Industrial Cassava Products

- Artificial Rice
- Alcohol
- Animal Feed
- Cassava Chip
- Paper
- Food
- Confectionery
- Monosodium Glutamate
- Sweetener
- Textile factory
- Bio-plastic
- Adhesives
- Medicines
After mechanical harvesting, the field is ploughed, conserving fuel, time and money.
DURABLE BLADES – THE ONLY SPARE PART
Tedious Manual Cassava Peeling
The future is planting on ridges

Ridges must accommodate trackwidth of the tractor
RIDGING & CA BENEFITS OF RIDGING FOR CASSAVA (SDG 13)
KNUST Cassava farm planted on ridges to facilitate mechanical operations
Drone view of KNUST Cassava Farm planted to 22 elite varieties
Commercial Cassava Farm on Ridges in Ghana
Recommended inter-row and intra-row spacings of mechanised cassava production
KNUST PROTOTYPE RIDGER
Inspecting mechanically harvested cassava at UNIVEN, RSA in 2014
Demonstrating Mechanised Cassava Harvesting in UNIVEN, South Africa, 2014
Demonstrating mechanical cassava harvesting and root damage assessment at University of Venda, RSA, 2014
Displaying mechanically harvested cassava at University of Venda, Limpopo, RSA, 2014.
Mechanical cassava harvest demonstration in Nelspruit, South Africa, June 2015
Displaying mechanically harvested cassava
Cassava Harvesting Demonstration in Nigeria, October 2018

Prof Bobobee
VISIT BY FAO DELEGATIONS TO KNUST CASSAVA FARM 2017
Ghana Vice President and Minister of Agric at my Exhibition stand at 33rd National Farmers’ Day in Dec. 2017

Ghana Minister of Agric Hon Kofi Humado (MP) commissioned harvesters in 2013
Conclusion

• First and reliable commercial mechanical cassava harvester developed at KNUST for Ghana and Africa

• Africa must develop cassava from food security crop to industrial & export crop.

• Well developed cassava value chain represents a multi- $billion market.

• The TEK Mechanical Cassava Harvester will unlock the huge potential of the crop on the continent

• Research team needs support to train farmers and tractor operators to adopt the modern cassava production methodology to reduce drudgery in sub-Saharan Africa.

• Cassava farmers and tractor operators should be supported by donors, development partners and policy makers to adopt the new methodology of growing cassava.
Concluding Remarks

Africa has the land (9 m ha) and the people (1.2 bn) and must adopt agricultural mechanisation technologies to attract the youth and turn agriculture into a multi $trillion industry on the continent.
THANK YOU!

Email: emmanuel.bobobee@gmail.com

url: www.tekcassavaharvester.com