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## Design and Fabrication of Tapioca Planter

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**ABSTRACT:** The improved cultural practices in cassava root are such as time, method of plantation, weed control, fertilization, inter cropping and erosion control. The cassava yields may be reduced due to low rainfall or low temperature. The high and sustainable yields can be maintained either with animal manure or by chemical fertilizers. The improved cultural practices are effective ways to reduce soil erosion. The uses of chemical fertilizers, herbicides have been adopted in some countries such as India, Malaysia, Indonesia, Thailand, and Vietnam. The use of farmer participatory research methodologies are suggested to enhance the adoption of better practices that will contribute to increasing the income of cassava farmers and improving the productivity of the soil. Various kinds of experiments have been conducted to determine the best intercrops for cassava, planting arrangements and relative time of planting. Most of the farmers prefer to plant cassava in well prepared loose soil without any weeds. Cassava can be harvested at any time, but the roots are usually harvested between 6 to 18 months. Most of the countries use highly sophisticated cassava harvesting machine. Here an attempt have been made to mechanization of the plantation of the cassava root and physical working model have been developed and executed for trail run and also in the field work.

**KEYWORDS:** Planting, weeding, fertilization, intercropping

### I. INTRODUCTION

Tapioca is a starch extracted from cassava roots (*Manihot Esculenta*). In olden days manual peeling method is used for removing the peel. It is the most common method of peeling cassava roots tuber today, however, it is rather tedious, labor work consuming and still wasteful in terms of flesh loss. A manual cassava root tuber peeling rate of about 21.8 kg/h has been reported [1]. Ezekwe et al designed a spring loaded cassava peeling machine with 5spring loading points, equally spaced at 140 mm intervals and length of the knife assembly with a spring rate 2.193N/mm. The cassava was then introduced in various sizes and the average height of the bed to suit various tuber sizes. However the result obtained is 15% of broken tubers with peeling efficiency of 98.8 % [2][3]. In the design work carried out Odigboh designed three models of cassava peeling machine. In first model an oil drum was punched about 2/3<sup>rd</sup> mm diameter holes per square cm of its surface and eccentrically mounted on a shaft with a 200 mm by 150 mm opening load cassava inside the drum. Cassava tubers and a predetermined quantity of some inert materials, such as quariferous pebbles or pieces of 3.2 – 4.8 mm hard quarry stone are loaded into the drum which is then rotated at 40 rpm. The rubbing action removed the peels from cassava tubers, leading eventually to the complete and uniform peeling. Water is sprayed to wash away the finely abraded peels to prevent fouling and dulling of the abrasive surface. In second model balls of expandedmetals were used to replace pebbles. In third model 4cylinders of expanded metal mounted inside the main peeling drum driven by a planetary gear arrangement to rotate about their axes at 4times the rpm of the main drum, in addition to balls of expanded metals also loaded into the drum which is then rotated at 40rpm. In 2003, Adetan et al. reported that the tubers constitute the main storage area. Tubers are surrounded by a thin cambium layer and they are white or cream in color[4]. The cambium layer is covered by tuber peel, which consist of a corky ‘periderm’ on outside and cortex on inside. Asoegue in 1981 studied some breaking characteristics of cassava roots when subjected to bending loads. The rate of loading and root diameter were found to have significant effects on breaking strengths, deformation of roots, breaking energy[1] (Onwueme, 1978) and recent studies by Olukunle and Adesina, 2004; Olukunle, 2005; Olukunle et al., 2005 reported the various efforts at developing an effective peeler in China, Brazil and Nigeria.[5][6]

The review conducted jointly by IITA and FUTA in 2005 revealed that cassava peeling is still largely done manually. This is in agreement with Adetan et al. (2003) who also characterised some properties of cassava tubers as a scientific

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basis for the development of a cassava peeler. The results of their study showed that weight of peel in the roots (p) ranged from 10.6% to 21.5%; the root surface taper angle (ar) ranged from 0° to 22°; the root peel thickness (t) ranged from 1.20 to 4.15mm; the root diameter (d) ranged from 18.8 to 88.5mm; and the root peel penetration force per unit length of knife-edge (F) ranged from 0.54 to 2.30 N/mm. Nweke (2004) discussed the urgent need for an effective cassava peeler and concluded that if any cassava harvesting or peeling machine designed for smallholders can be identified anywhere in the world it should be urgently put to on-farm test in Africa with a view to adapt, fabricate, and diffuse it to farmers if confirmed suitable in the on-farm testing.[7]. Several researchers like Odigboh, 1983; Igbeka, 1984, 1985; Ezekwe, 1979 made appreciable attempts on the properties of cassava as well as in the design of cassava handling and processing equipment. Cassava and sweet potato are the most important root crops in the developing world, with a combined total annual production of around 300 million tones (Azan-Ali et al., 2003). However, cassava processing and in particular, cassava peeling has been identified as energy sapping and labour intensive. Several efforts have been made to develop effective cassava peeling machines in China, Brazil and in some parts of Africa (Odigboh, 1976, 1979; Sherrif et al.[9], 1995; Olukunle, 2005). At the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, the integrated cassava project initiated a search for an effective cassava peeler in 2005 in conjunction with the Federal University of Technology, Akure (FUTA), which started a conscious and desperate search for effective cassava peeling machines in July, 2004. This effort resulted in the production of commercial models of the single and double gang hand fed cassava-peeling machines. However, the machines require manual feeding and could only peel 2 to 5 tons of cassava per day depending on the variety, maturity, size of the tuber and the skill of the operator (Olukunle et al. 2005). Three models (i.e., A, B and C) of a self-fed cassava-peeling machine have also been developed in FUTA. Model A was first demonstrated in IITA and was also posted on the web in 2005. These models represented notable improvement on the hand fed models. Major advantages include elimination of manual intervention during the peeling process, overall reduction in drudgery and also increased in capacity. However, peeling efficiency is generally less than 80% and losses are more than 8%. The capacity of the machine is also less than the requirement of medium to large-scale industrialists. Fataroy and A&H local fabricators also make remarkable appearance at the cassava peeler search fair organised by the Integrated cassava project in IITA.

Cassava has virtually turned to pure gold for farmers. Less than five years ago, all the country was desperately looking for export market for the farm produce as a result of glut in the local market. But the situation has changed due to the trade promotion policy of the federal government (8). Nigeria grows more cassava than any other country in the world. The production of cassava is concentrated in the hands of numerous smallholder farmers located primarily in the south and central regions of Nigeria. A significant population of cassava growers in Nigeria has made the transition from traditional production systems to the use of high-yielding varieties and mechanization of processing activities (9). Table 1.1 indicates that in 2004, about 53 % of cassava in the world was produced in Africa, 30% in Asia, and only 17% in Latin America and the Caribbean.

**Table 1.1 Cassava Production, Area, and Yield in the World, the Continents and in various Countries in Asia in 2004**

	Production (‘000 tonnes)	Area (‘000 ha)	Yield (t/ha)
<b>World</b>	<b>203,618</b>	<b>18,475</b>	<b>11.02</b>
-Africa	108,470 (53%)	12,252	8.85
-LAC	34,727 (17%)	2,696	12.88
-Asia	60,245 (30%)	3,511	17.16
-Cambodia	362	23	16.09
-China	4,216	251	16.81
-India	6,700	240	27.92
-Indonesia	19,425	1,255	15.47
-Laos	56	8	6.81
-Malaysia	430	41	10.49
-Myanmar	139	12	11.30
-Philippines	1,640	206	7.97

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-Sri Lanka	221	23	9.54
-Thailand	21,440	1,057	20.28
-Timor-Leste	42	10	4.15
-Vietnam	5,573	384	14.53

The above Statistical records were taken between the periods of 1965 to 1995, shows the production trend of cassava in sub-Saharan Africa. It can be deduced that the total production of cassava increased from about 35 million tonnes in 1965 to over 80 million tonnes in 1995, an annual growth rate of 2.9 per cent, which was the same as the population growth rate, an indication that average per capita production has not increased. However, per capita production has increased during the last decade as total production has grown faster (3.8 per cent) than in the preceding decade (2.5 per cent).

Figure 1.1 shows that the five largest producers of cassava in sub-Saharan Africa have increased their share from about 70 to 80 per cent over the last two decades (FAOSTAT). The biggest increase has been in Nigeria which increased its share from 22 to 38 per cent and Ghana which increased its share from 4 to 8 per cent. The share of other producers has declined and Zaire has moved from being the largest to the second largest producer after Nigeria.

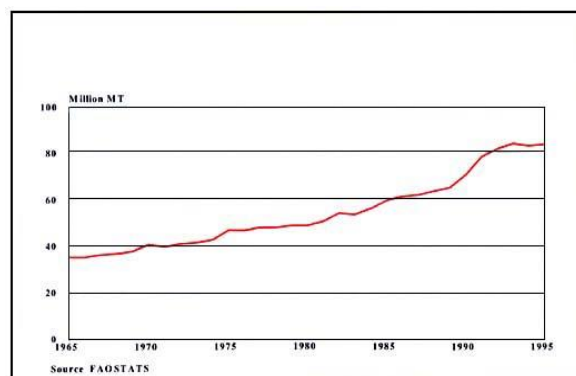


Fig 1 Trend in production of cassava in sub-Saharan Africa, 1965–95

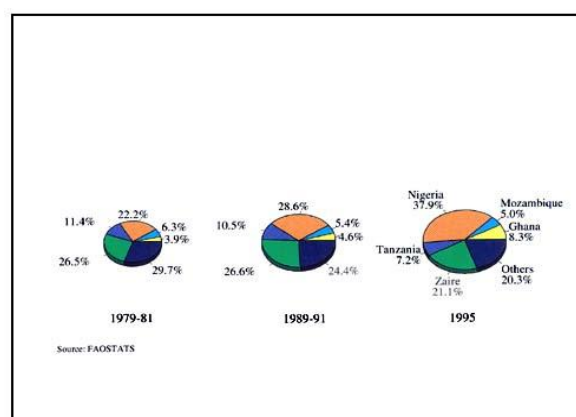


Figure 2 Proportion of cassava produced in selected African countries

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## II. MECHANIZATION OF CASSAVA PLANTING

Planting is majorly being carried out manually (i.e. using cutlass to lift the soil and insert the stem to about 10 cm into the soil and cutting off the rest from the buried stem). Mechanical planters available in the country are not yet fully developed to a level for them to be taken up by fabricators for commercialization. The National Centre for Agricultural Mechanization (NCAM) has in recent times made an in-road into the development of a mechanical planter which is about 75% completed. The conclusion on planting is that there is yet no commercially available mechanical planter for cassava planting in Nigeria (9). The NCAM-developed prototype cassava stem planter and in operation is shown in fig.3



Fig. 3 NCAM-developed prototype cassava stem planter.

Cassava is susceptible to early weed competition [6]. Slow initial development of sprouts from cassava cuttings makes all cassava cultivars susceptible to weed interference during the first three to four months after planting. In recent times, NCAM was able to come up with a long-handle hoe which is a better hand hoe than the traditional method being utilized. The long-handle hoe eliminates the bending posture required by the traditional hand hoe method (7).



Fig.4 NCAM-developed long Handle hoe



Fig.5 Experimental Setup- aerial view



Fig.6 Experimental Setup-eagle view

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## III. MECHANIZATION OF CASSAVA HARVESTING AND MODEL DEVELOPMENT

In Nigeria, an average manual cassava harvesting rate of about 100 m<sup>2</sup>/hr has been recorded (5). New mechanical technologies for cassava harvesting and processing are required to generate the rate of growth in cassava production realized in Nigeria from 1987 to 1992. Further improvement in yield-increasing technologies alone will not generate the same level of cassava production growth because genetic technologies which increase yield will only add to the existing labor bottlenecks at the harvesting and processing stages.

At NCAM, a manually operated prototype cassava root tuber lifter has been developed while research is on-going on a tractor mounted prototype tuber harvester that has attained over 80% harvesting efficiency (13).

1. Chose cuttings from plants that have dark green smooth leaves, and not from those with curled yellow leaves.
  2. Chose the cuttings in the old cassava field and cut the good ones ready there so that you do not have to carry the bad parts to the new fields.
  3. Cut off the soft green part of the stem near the leaves, and the bottom part of the stem as these may have more virus. These must be thrown away in the old field.
  4. Plant lengths of stem cut from the middle part.
  5. When the cuttings start to grow pull out those that have yellow, deformed leaves and replant with new cuttings.
- Plants with severe CMV will never give much yield if left and will spread the virus infection to others.

## IV. EXPERIMENTAL SETUP FOR CASSAVA FEEDER



Fig.6 Drive system



Fig.7 Drive system – chain type

## V. SMALL SCALE PROCESSING EQUIPMENT FOR VALUE ADDITION

IITA is currently collaborating value addition to cassava in Africa with National and International Agencies to promote innovativeness and utilization technologies to add value to cassava in Africa. IITA has recorded laudable achievements in the areas of value adding to cassava varieties, diversified industrial cassava products from flour and starch, and has engaged in the production of flyers, training manuals, books and monographs to stimulate the cassava industry at private level. IITA and other stakeholders are facilitating successful implementation of the policy on 10% cassava flour in bread from 2005. The policy had stimulated lots of attention and challenges to the cassava sub-sector. IITA is collaborating with National Agencies and Universities in developing glucose syrup from cassava starch (7).

As a result of adding value to cassava in Nigeria, NCAM as part of its mandates, has developed an array of cassava processing equipment that local processors could use to produce various cassava end-products at small-scale level. Available at NCAM are, cassava lifter, tractor-drawn cassava harvester, cassava peeling machine, cassava washing machine, cassava grater, cassava chipping machine, combined cassava grater-chipping machine, single and



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double dewatering press, cassava sifter, cassava sedimentation tank, hammer mill, batch and cabinet dryers and gari fryer.

## VI. CONCLUSION

We have implemented an automatic and improved cultural practices of cassava plantation that will enhance for the reduction of labour charge, time. Our developed model have successfully performed in the agricultural field. Further improvements can also be made regarding the angle of cutter used, drive system equipped, and so on.

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