FEDERAL MINISTRY OF AGRICULRURE AND RURAL DEVELOPMENT

NIGERIA POSITION PAPER ON ANIMAL FEED AND LIVESTOCK PRODUCTION 2014

1.0 INTRODUCTION

Nigeria is bordered by four countries on the west (Benin), north (Niger and Chad) and east (Cameroon). Its southern margin is formed by the 530 mile (853 km) coastline of the Gulf of Guinea. The country occupies 923,768 km^2, an area slightly larger than twice that of California. Nigeria is on the Gulf of Guinea in West Africa.

Income level: Lower middle income

GDP (current US$): $521.8 billion 2013

Population, total: 173.6 million 2013

Figure 1 POLITICAL MAP OF NIGERIA

1.1 GEOGRAPHY

Nigeria has a varied topography. Inland from the coast, the land rises steadily and merges into plateaus and hills that stretch northward across the country. Mountains in the southeast reach a height of nearly 8,000 feet (2,419 meters), the highest elevation in the country.

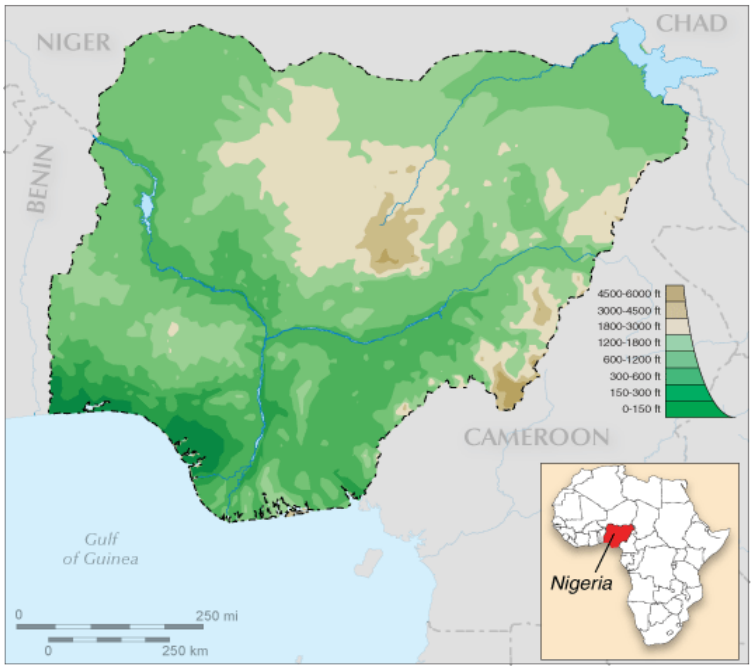


Figure 2 GEOGRAPHICAL MAP OF NIGERIA

1.2 HYDROLOGY

There are three major river systems cross Nigeria. Two have sources outside the country while the other arises in the central highlands. **Niger River** enters from Benin Republic (Northwest corner) and flows toward the center while **Benue River** originates in Cameroon and enters in the East-central region. It flows to center of Nigeria where it **converges with Niger**. The combined Niger River flows South through **Tropical Rain Forests** into the swamps of the **Niger River Delta.** It splits into a web of channels flowing into the Gulf of Guinea in the Delta.

Komadugu Gana River starts in the **central highlands** and flows **Northeast** through the arid northern part of Nigeria. **It empties into Lake Chad** on the NE border with Chad.

All three rivers are subject to periodic drought and flooding.

1.3 CLIMATE

Summer highs average 31^{o}C and Winter highs 6^{o}C. Nigeria's best weather is between September and November, when skies are clear and temperatures are mild. Rainy season begins in February in the South and continues through August in the north, bringing winds and rain.

1.4 AGRICULTURE

Nigeria's immense **agricultural potential** is a great asset for the nation and Africa, with promises for food security when fully harnessed. Only 40% of Nigeria's **84 million hectares of arable land** is **presently cultivated**. **263 billion cubic metres of water** from **two of the largest rivers in Africa**, is a great agricultural benefit. Livestock production contributes 6-8% of the Gross Domestic Products (GDP) and 20-25% of the Agricultural GDP.

Nigeria's livestock resources include **Cattle, Goats, Sheep, Donkeys, Horses, Poultry and pigs. Poultry** includes **chickens, guinea fowls, turkeys, ducks, etc.** The majority of the ruminants (**Cattle, Sheep** and **Goats**) are grazed **extensively on pasture**.

70% of the population (160 million) is engaged in one form of Agricultural Enterprise or the other. Livestock production provides essential food products – meat, milk, and other dairy products throughout the year. It sustains employment and income of millions of people in rural areas It generates **animal power** and **organic manure** for arable farming in the Ecological zones of the country.

2.0 NIGERIAN LIVESTOCK RESOURCES

2.1 LIVESTOCK POPULATION

Nigeria is one of the four leading livestock producers in Sub-Sahara Africa. In 2013, estimated domestic livestock population in Nigeria was put at;

- 19.3 million cattle,
- 71.1 million goats,
- 40.3 million sheep and
- pigs 6.6 million,
- poultry 161.1 million

TABLE 1: LIVESTOCK POPULATION ESTIMATES.

Species	2010	2011	2012	2013
Cattle	18,888,866	19,053,199	19,218,762	19,385,965
Goat	65,651,252	67,292,343	69,384,652	71,119,268

Sheep	**37,440,022**	**38,376,022**	**39,335,423**	**40,318,809**
Pig	**6,040,820**	**6,282,245**	**6,439,301**	**6,696,873**
Poultry	**139,218,636**	**146,179,568**	**153,488,546**	**161,162,973**
Camel	**277,727**	**278,005**	**278,283**	**278,561**
Horse	**101,509**	**101,611**	**101,713**	**101,715**
Donkey	**970,610**	**971,581**	**972,552**	**973,525**

Source: Estimates based on Report on National Agricultural Sample Survey (NASS 2011) by Federal Ministry of Agriculture & Rural Development and National Bureau of Statistics (NBS).

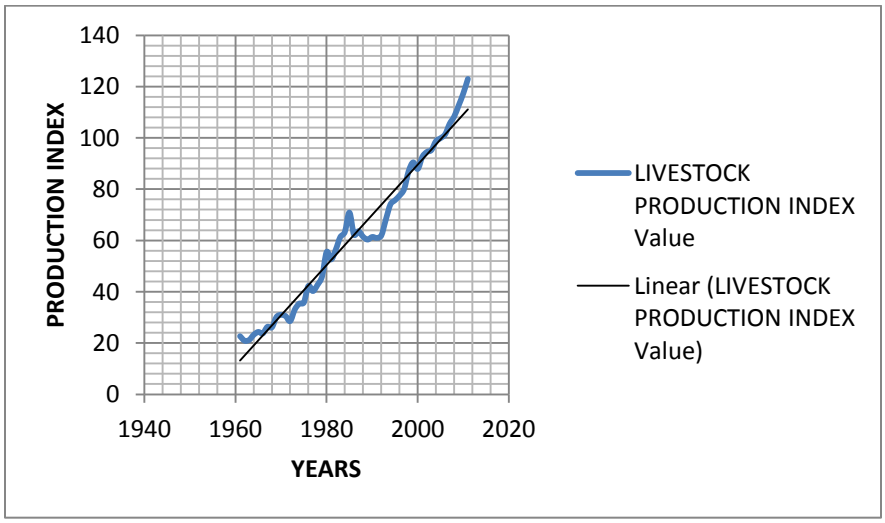
TABLE 2: PROPORTION OF EACH ANIMAL SPECIES BY COUNTRIES IN ECOWAS REGION (%), 2011.

Countries	Cattle	Sheep	Goat	Pig	Poultry
Benin	3.34	1	1.27	3.32	0.12
Burkina Faso	14.37	10.24	9.82	20.1	0.03
Cape Verde	0.08	0.02	0.18	2.1	
Côte d'Ivoire	2.66	2.05	1.05	3.04	0.03
Gambia	0.75	0.22	0.23	0.14	0.03
Ghana	0.34	4.69	3.97	5.11	0.04

Guinea	7.67		1.35		0.01
Guinea Bissau	1.05	0.55	0.56	4.19	0.001
Mali	15.39	15.03	13.4	0.7	0.03
Niger	15.47	12.09	10.32		
Nigeria*	**31.66**	**46.3**	**51.98**	**57.11**	**99.379**
Senegal	5.52	6.65	3.77	3.15	0.3
Sierra Leone	1.2	0.91	0.68	0.47	0.01
Togo	0.5	0.33	1.52	0.57	0.02
Total	100	100	**100**	**100**	**100**
Source: FAOSTAT, May, 2014.					

2.2 LIVESTOCK PRODUCTION

Nigeria Livestock production index (including meat and milk from all sources, dairy products such as cheese, and eggs, honey, raw silk, wool, and hides and skins) over the years is shown in the figure below



Over 90% of Cattle Production is owned by the traditional **Pastoralists** who depend solely **on tropical forages** characterized with **low protein content and high fiber.** Problem is

compounded with **long (5months) drier periods in the Northern parts** of Nigeria. **Animals migrate from the North to the South** in search of **maintenance forages and water**.

Compounded Commercial Ruminant Rations were for the first time introduced in some pilot states for Cattle and Ram fattening to ensure a minimum gain of 0.5kg/head/day, in 2013 under Agricultural Transformation Agenda (ATA). Practically few feed millers with limited capacities were available to meet farmers' needs. Wide window of **investment opportunities** in **Commercial Ruminant Rations** production exists. Many Conventional Feedmillers in 2014 have introduced Ruminant Feed lines into their production systems.

Crop residue processing, preservation and utilization was also introduced to farmers and pastoralists to stem down the incessant clashes and destruction of lives and properties. There is need for further **trainings and sensitization and empowerment of farmers to acquire shredding/crushing machines for ease of processing**.

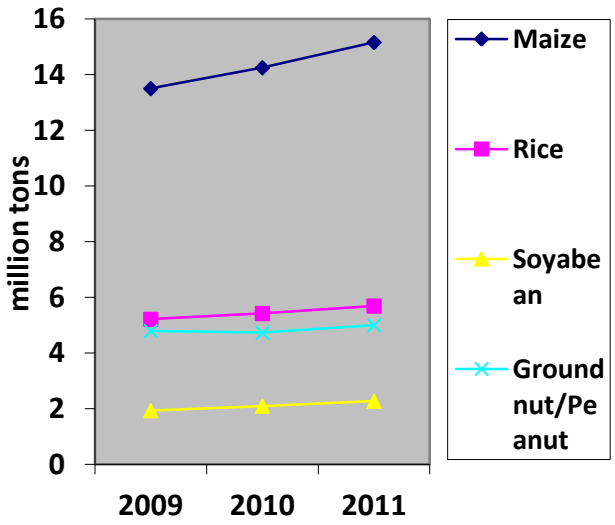
3.0 ANIMAL FEED INDUSTRY IN NIGERIA

The demand for feedstuffs in Nigeria is derived predominantly from livestock (especially poultry). Livestock feed requirement is met either by domestic production and/or imports. **Domestic supplies** to the feed industry are **dependent** upon **overall agricultural production, degree of industrialization and demand for refined food products**

TABLE 3: NATIONAL FOOD CROP PRODUCTION ESTIMATES, 2009 to 2011. (,000 Tonnes)

Item	Production (,000 Tonnes)		
	2009	2010	2011
aize	13,450.1	14,240.8	15,160.9
Rice	5,213.9	5,420.2	5,690.2
Soya bean	1,928.6	2,090.1	2,2707.7
Groundnut	4,489.2	4,728.5	4,999.4

Source: National Bureau of Statistics (Central Bank Nigeria Annual Report, 2011).



Formulated feeds account for the **major operating costs** in the semi-intensive and intensive pig and poultry industry. **Efficient feed industry** is **crucial** to the **sustainability of viable livestock and poultry production enterprises** in Nigeria.

Poultry feeds account for **over two-thirds** of all the manufactured animal feeds (Table 4). There are **few commercial sources of fish feeds,** and no pet food industries in Nigeria.

Table 4: **ANIMAL POPULATION AND FEED PRODUCTION IN NIGERIA (2000)**

	Management		**Population (millions)**	**Feed production**	
	Traditional	Commercial		Tonnes	Percent
Poultry	72.79	27.21	155.28	2 591 732	68.20
Pig	91.11	8.89	7.91	1 084 214	28.53
Rabbits	98.50	1.50	2.23	88 509	2.33
Fish	81.36	18.64	na	35 570	0.94
TOTAL				**3 800 025**	**100.00**
Source: (FAOSTAT 2005a)					

TABLE 5: EXPORTED FEED INGREDIENTS OF PLANT ORIGIN IN NIGERIA, 2009 TO 2011 (METRIC TONNES).

S/N	**Item**	**2009 (Metric tonnes)**	**2010 (Metric tonnes)**	**2011 (Metric tonnes)**
	Corn	NIL	NIL	44.60
	Cotton seed	NIL	135.46	279.7
	Soya bean cake	NIL	NIL	7.39
	Maize bran	NIL	3.25	NIL

	Wheat bran	157,030.9	88,048.59	50,729.85
	Cotton seed cake	391.01	4.73	NIL
	Palm kernel cake	16,872.9	24,500.15	23,171.27

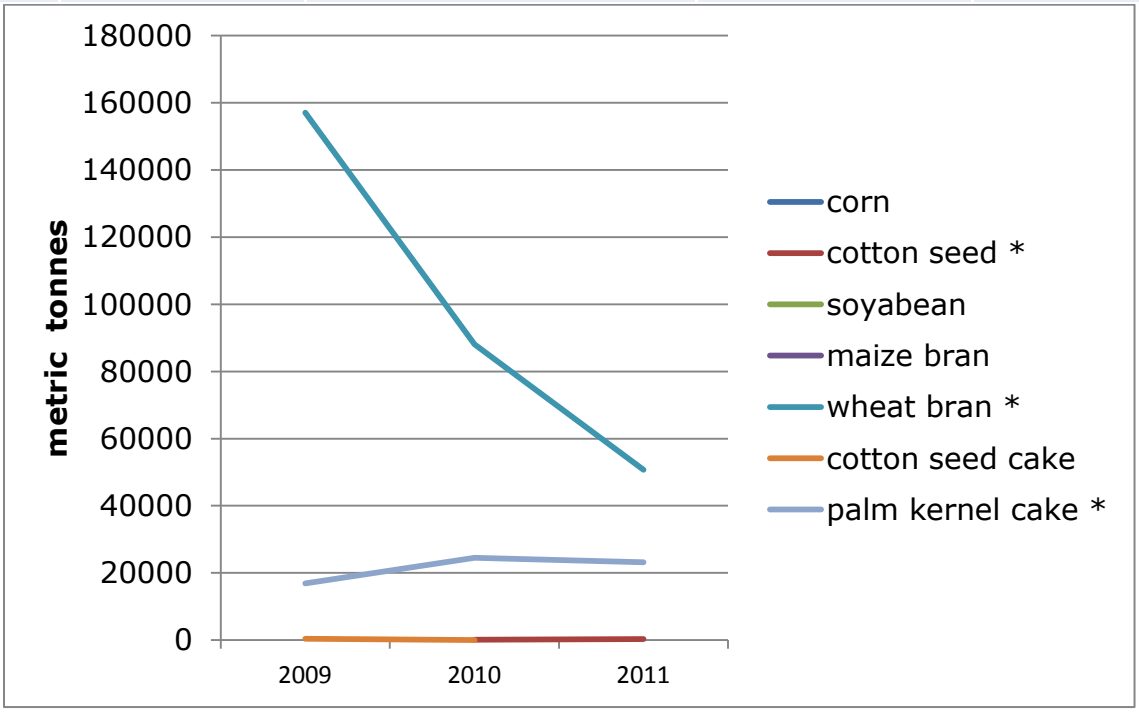


Figure 3 EXPORTED FEED INGREDIENTS OF PLANT ORIGIN IN NIGERIA, 2009 TO 2011

3.1 ESTIMATES OF FEED INGREDIENTS AVAILABILITY.

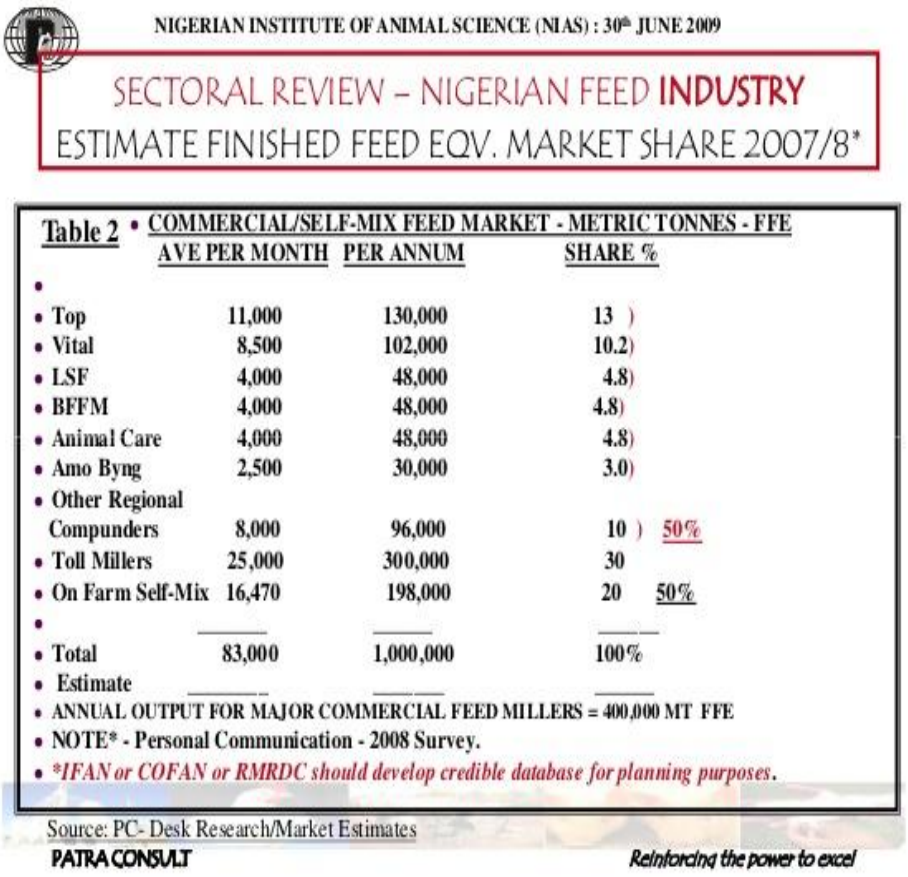
3.1.1 OIL SEEDCAKE/MEAL:

Soya bean cake (SBC). Part is locally produced while the rest is imported to meet up the demands. **1662.3 metric tonnes was imported in 2011. Groundnut Cake**: Partly for human consumption and animal feeds. Mostly locally produced. **Cotton Seed Cake**: Cotton seed is used by human and for animal feeds. Most of it is locally produced. In 2011, **279.7 metric tonnes were exported**. **Palm Kernel Cake/Meal**: All locally produced and for export. In 2011, **2317.27 metric tonnes exported**.

3.1.2 GRAINS BY-PRODUCTS:

Rice bran: All is used for animal feeds and all is locally produced. **Maize bran**: Mostly used for animal feed production. **2,601.84 metric tonnes imported** in 2011. **Wheat bran**: All is

locally produced. **50729.85 metric tonnes imported in 2011.**



NIGERIAN INSTITUTE OF ANIMAL SCIENCE (NIAS) : 30th JUNE 2009

SECTORAL REVIEW – NIGERIAN FEED INDUSTRY

ESTIMATE FINISHED FEED EQV. MARKET SHARE 2007/8*

Table 2 • COMMERCIAL/SELF-MIX FEED MARKET - METRIC TONNES - FFE

	AVE PER MONTH	PER ANNUM	SHARE %	
• Top	11,000	130,000	13)	
• Vital	8,500	102,000	10.2)	
• LSF	4,000	48,000	4.8)	
• BFFM	4,000	48,000	4.8)	
• Animal Care	4,000	48,000	4.8)	
• Amo Byng	2,500	30,000	3.0)	
• Other Regional Compunders	8,000	96,000	10)	50%
• Toll Millers	25,000	300,000	30	
• On Farm Self-Mix	16,470	198,000	20	50%
• Total	83,000	1,000,000	100%	
• Estimate				

• ANNUAL OUTPUT FOR MAJOR COMMERCIAL FEED MILLERS = 400,000 MT FFE

• NOTE* - Personal Communication - 2008 Survey.

• *IFAN or COFAN or RMRDC should develop credible database for planning purposes.*

Source: PC- Desk Research/Market Estimates

PATRA CONSULT

Reinforcing the power to excel

Figure 4: ESTIMATED FINISHED FEED EQV MARKET SHARE 2007/8

Nigeria has great resources for feed ingredients. There is **a high growing demand for feed ingredients** to enhance Livestock production to meet animal protein requirements for the teeming human **population**

Problems affecting feed ingredients supply include **insufficient production, poor quality and competitiveness with human consumption**. Increased crop production is increasing the availability of feed ingredients. Nigeria is establishing 14 Staple Crop Processing Zones (SCPZs) in the whole country. SCPZs will provide by-products (feed ingredients) for animal feeds. There is an arrangement for production of cassava grit as a substitute for maize. High cost of maize/competition between human consumption and feed production necessitated this development. Nigeria is currently working hard to conform to the Codex Alimentarius Code of Practice on Good Animal Feeding which is established as a Feed System for Livestock. This covers the whole food chain, taking into account relevant health issues and the environment in order to minimize risks to consumers' health.

A **strategy and experience sharing should be adopted and exploited** for **International quality standards and industry best practices.** There is need to **initiate, facilitate and develop capacities for the "Prioritization of National Feed Hazards"** to compliment the Agricultural Transformation Agenda in the **provision of safe food** and international trading standards. This will enable Nigeria comply with Animal Feed Safety.

3.2 POTENTIALS IN FEED INDUSTRY

Large quantities of residues are produced annually and are used as mulch; bedding, fuel, building materials, and large quantity decay after the animals have scavenged on them. It is expected that about 79,000mt each of Rice, Maize, and Sorghum straws estimated at about $14.8million will be produced in the current planting season, while 60,000mt of leguminous haulms from Soy Beans and Groundnut are expected to yield $7.5million creating jobs for the youth.

3.3 CASSAVA AS LIVESTOCK FEED IN NIGERIA

Nigeria is the world's largest producer of cassava producing over 40million mt annually. However, Nigeria continues to import nearly all of its flour, starch, sweeteners and animal feeds (GCP21, 2013). Few commercial feed mills have attempted using cassava flour for compounding feed. Some examples include Vital Feeds, Pfizer, Bendel Feeds and Flour Mills.

A new market for processing and utilization of cassava peel for cattle fattening in livestock Markets is now emerging. International Institute of Tropical Agriculture (IITA), International Livestock Research Institute (ILRI), CGIAR, Global Cassava Partnership for the 21st Century (GCP21) and Federal Ministry of Agriculture and Rural Development (FMARD) are working on Developing a Roadmap to a commercial reality for "**A Cassava-Based Feed System in Africa".**

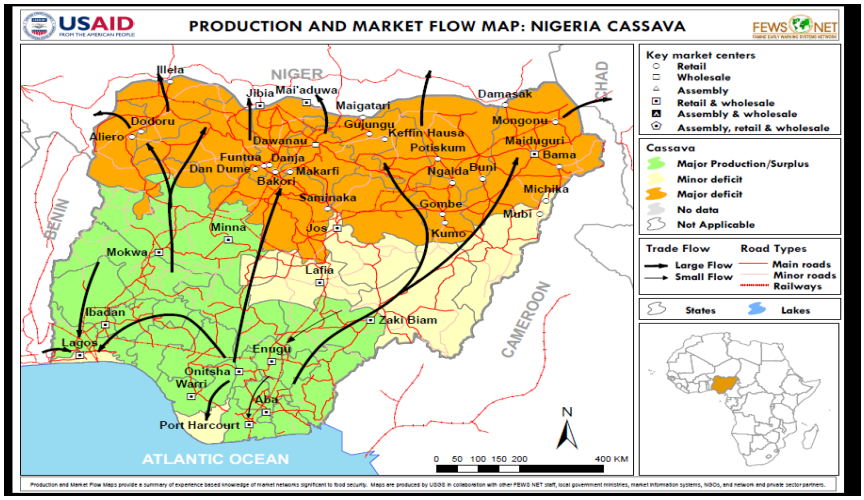
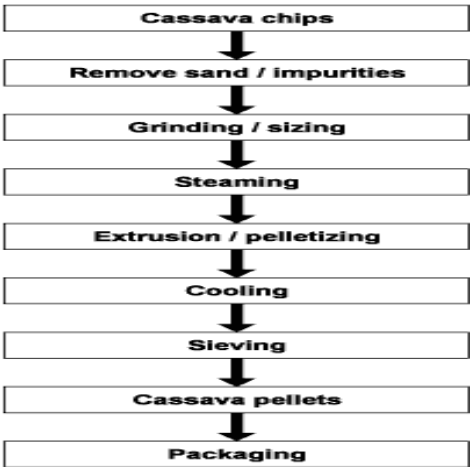


Figure 5:NIGERIAN CASSAVA PRODUCTION AND MARKET FLOW MAP

Cassava is used in various forms in Nigeria's Livestock industry. **Cassava chips and grits** are used in the industry at between 5 and 20% inclusion for **Layers and Growers feeds** respectively.

Cassava-based diets have the potential to bridge **feed supply gap** in **Pig** feeding on commercial and traditional systems**, Sheep and Goat** feeding in homesteads as energy supplement; Silage production in pig and small ruminant feeding

Figure 6: CASSAVA PROCESSING



In 2011 - the Ministry worked out and trained over 200 producers and processors to substitute maize with Cassava Grits at 20% inclusion rate. Producers were unable to meet the immediate demand of 1,130 mt of cassava grits, due to inadequate drying capacities - window for investors in this area. Opportunities for exploitation of cassava potentials in animal feed also abound in:

Cassava peels (estimated potential availability of 2.2 million MT DM/yr) is sun-dried for ruminant feeding targeting smallholders and Livestock markets. Value addition through ensiling particularly during the rainy season when solar radiation is low, Solid state fermentation to increase protein content; Carbohydrate characterization and enzymic supplementation to increase available energy.

Cassava bagasse (up to 30,000 MT DM/yr currently) is available for feeding pigs, beef and dairy cattle in its fresh form; Dewatering, drying and/or pelletizing for commercial Livestock feed millers; 1.7 million MT DM/yr of other cassava residues including cassava grits, stumps, and sieviates from traditional food processing of about are potentially available.

The establishment of 6 Staple Crop Processing Zones (SCPZ) under the ATA creates opportunities to fully develop the feed industry and reduce high cost and perennial feed scarcity. The feedstuffs used in the animal feed industry are derived from crop residues, by-products, food processing wastes and agro-industrial by-products.

Stagnant or diminishing output of certain traditional crops in the country's feedstuff means Nigeria has to rely heavily on imports to bridge the gap.

Figure 7: Site Location for Staple Crop Processing Zones

3.3.1 CASSAVA - ESTABLISHMENT OF A VIABLE GLOBAL CASSAVA-BASED FEED SYSTEM

Nigeria is world's top producer (assume 50 million MT/annum). Food and feed security for the large human and livestock populations remain a challenge just as cassava is useable by both.

Finding ways of reducing the competition for cassava between man and livestock is imperative, hence the focus on its residues (peels, under-size tubers at harvest, waste water during dewatering) It is alternatively used for monogastrics, it can replace 10% of maize in diets leading to the release of maize worth $864 million annually for human consumption. In practice, however, only an insignificant quantity of cassava residues is being used.

95% of the uses of cassava require peeling. Cassava peels constitute 15% or more of the fresh tuber meaning bout 7.5 million MT wet cassava peels. 2.4 million MT DM of cassava peels generated. At 9.4 MJME/kg DM, cassava peels and residues will provide the energy needs of 17.9 million TLU/annually at 10% supplementation. Processing of 250 tonnes is done by 1300 persons – (85% Female & 15% Male, further broken down to 70% adult female, 15% female child, 9% adult male and 6% male child)

Figure 8: MANUAL CASSAVA PEELING

70 vans bring in 1.3 tonnes of cassava & 20 pick-ups bring in 2.5 tonnes of cassava, twice daily amounting to approx. 250 tonnes daily for processing. When drying is 100% successful, 1.3 tonnes yields about 220 kg of dried peels. 4 persons peel a tonne/day @ N2000 (US$12.5)

Figure 9: CASSAVA PEELING

Figure 10: Drying of peels is on bare floor and is done over a 3-4 day period in the dry season

70 vans bring in 1.3 tonnes of cassava & 20 pick-ups bring in 2.5 tonnes of cassava, twice daily amounting to approx. 250 tonnes
When drying is 100% successful, one van load of wet tubers (1.3 tonnes) yields about 220 kg of dried peels (6 bags of the type in photo; about 36kg each)

Figure 11: VAN CONVEYING CASSAVA

Figure 12: WOMEN DRYING CASSAVA PEELS

but…..drying of peels is probably the biggest constraint. Even in the dry season, floor space for drying is a contributing factor.

Figure 13: CASSAVA PEELS DUMP SITE

Figure 14:CASSAVA PEELS DUMP SITE

Figure 15: CASSAVA PEELS INCINERATED

3.3.2 Expected long-term outcomes/impacts

- The simultaneous development of cassava R&D and value chains of cassava products
- The establishment of a viable global cassava-based feed system with strong markets in Nigeria and in Africa
- Complementary cassava value chains initiatives developed at the smallholder level considered for deployment in Africa
- The development ultimately of the cassava value-added chains involving the private sector in Africa

3.3.3 Strategies for Intervention

- Improve productivity
- Capacity building and Knowledge broadening
- Storage needs to be improved
- Structured linkages for end users and cassava productions
- Clusters and out-growers production units/ cooperatives
- Explore the possibility of guaranteed market price to farmers

3.3.4 COLLECTION (BULKING) STRATEGIES

1. Explore the idea of small village units to process
2. Motorized Semi-processing - Factory on wheels
3. Plantation model of operations
4. Improve infrastructure for rural transportation

3.3.5 FORMULATION, SOURCING THE PROTEIN COMPONENT

- nutritional analyses using NIRS at ILRI showed cassava peel pellets to compare favourably with common grains in terms of energy content measured in MJ/Kg DM
  - **cassava peel pellets (9.41),** sorghum grains (9.28), maize grains (9.71), soya-beans grains (10.88).
- Very low crude protein content compared to the same grains
  - **cassava peel pellets (39.81 mg/Kg DM),** sorghum grains (113.58), maize grains (113.40), and soya-beans grains (534.57).

Bottom line: availability of reliable protein sources could be a big constraint

4.0 INTERVENTION STRATEGIES ON CASSAVA PILOT PROJECTS TO INITIATE TAKE-OFF

4.1: OVERALL STRATEGIES FOR INTERVENTION

- Create **production units (farmers groups**), link them to **Garri processors** and in turn link them **animal feed producers** for collection of peels, t**o increase productivity, Semi processing, Transport**
- Government support to strengthen the system by **creating awareness, training and incentives for processing and production** units
- Access to credit needs to be strengthened

- Semi processing: On farm processing to increase storability and transportation with appropriate technology for moisture control
- Encourage **women in Garri processing** and **youth in on-farm processing** through credit and technology schemes
- Develop starch collection devices to mitigate the negative impacts of effluent on the environment.

4.2 UTILIZATION OF CASSAVA PEELS IN <u>POULTRY</u> FEEDS PROJECT:

Goals

- Pilot project to determine the inclusion level
- Pilot project to establish the level of oil inclusion in the diet
- Carry out a study with varying inclusion levels
  - 0, 2.5, 5.0, 7.5, 10.0 12.5, 15.0, 17.5 & 20.0% Cassava peels against Wheat offal, Rice bran, Maize offal, BDG, etc.

Main question: Are there any prospect for cassava peels in poultry feeding?

Answer : Yes

Prospects:

Cassava peels is fairly rich in energy, relatively cheaper when compared with offals. It is available but not in the form that is useful to the feed mill industries. Nuisance abatement (Enhances environmental wholesomeness)

Opportunities

Enzyme supplementation against constraint earlier mentioned (NSP enzymes can be introduced); The use of toxin binders should be encouraged; Enhancement of the protein content with enzymes such as protease enzymes e.g. cibenza DP 100; Use of anti-mould to improve shelf life; Dust abatement with soy bean oil is encouraged, this is because it provide linoleic and oleic acids which enhance feed quality

Experimental Design – 2 x 9 factorial
Growers mash 2.5% - mash; 5.0%; **Broiler** Grower and finisher 0 – 20%; **Cockerels** 0 – 25% inclusion With or without enzymes; **Male breeders** 0 – 10% With or without enzymes; **Quails** Same levels as growers 0 – 20 % With or without enzymes

4.2 OTHER PILOTS

4.2.3 PIG FEEDS

Figure 16: INITIAL RESULTS FROM PELLETING PEELS

sno	sample	dm	ash	nit	ndm	cpdm	cpdm/kg	fat	fatdm	fatdm/kg	gas24	me	ivomd
1	Defatted Cottone seed cake	88.98	4.96	3.73	4.20	26.22	262.22	7.96	8.95	89.45	39.61	11.49	65.36
2	Deaffated Sorghum garins	88.24	4.74	1.65	1.87	11.71	117.14	1.36	1.54	15.41	56.95	11.36	71.34
3	Deafatted Maize grains	90.65	1.18	1.82	2.01	12.57	125.70	8.26	9.11	91.12	52.68	12.40	67.60
4	Defatted Pigeonpea grains	90.86	7.09	1.94	2.14	13.35	133.46	1.05	1.16	11.56	29.99	7.20	49.96
5	Defatted Soyabean grains	91.19	3.58	8.11	8.89	55.58	555.82	0.99	1.09	10.86	44.14	12.93	86.41
6	Defatted Cotton cake	88.98	4.96	3.83	4.31	26.92	269.23	7.59	8.53	85.30	35.40	10.80	62.22
7	casava pellets	90.77	8.44	0.58	0.64	3.98	39.81				51.37	9.41	62.70
9	sorghum grains	88.24	4.74	1.60	1.82	11.36	113.58				47.31	9.28	62.99
11	maize grains	90.65	1.18	1.64	1.81	11.34	113.40				50.47	9.71	65.00
13	pigeonpea grains	90.86	7.09	1.92	2.11	13.17	131.74				29.44	6.95	49.39
15	soyabean grains	91.19	3.58	7.80	8.55	53.46	534.57				41.40	10.88	82.83

4.3 PALM KERNEL CAKE (PKC)

Palm kernel cake (a by-product of oil palm - *Elaeis guineansis*) has since become an important feed ingredient, as a filler to increase the bulkiness of feed while providing some protein, energy, minerals and vitamins. As a result of the ageing palm plantations and a reduction in processing capacity, palm oil production declined in the late 1980s. Nevertheless, the recent establishment of high nut-yielding oil palm plantations (imported from Malaysia) produces an annual crop of 774 000 tonnes of palm nuts.

These nuts yield over 396 000 tonnes of palm kernel cake for the animal feed industry. With the intervention of the Transformation Agenda, there has been an increase in the production and number of cottage oil palm processing industries in Nigeria, resulting in increased availability of PKC. However, there has been recent increase in the awareness to use agro-industrial by–products such as PKM either to supplement or replace out rightly, grains especially maize in livestock rations. This was because researchers have highlighted the nutritive values of agro-industrial by-products including PKM.

TABLE 3: NIGERIA PALM KERNEL MEAL PRODUCTION BY YEAR IN 1000 METRIC TONNES

TABLE 4: Oilseed cakes availability in Nigeria (2000)			
Product	**Quantity (tonnes)**	**Price (US$/tonne)**	**Availability**
Groundnut cake	**632 749**	**320**	**Adequate**
Cottonseed cake	**520 160**	**300**	**Adequate**
Palm kernel cake	**405 144**	**75**	**Adequate**
Soybean cake - local-import	**80 204208 746**	**480550**	**low adequate**
Sesame seed (Beniseed) cake	**39 825**	**100**	**Low**

4.0 ADVANCES IN THE FEED INDUSTRY

Research had been done in Nigeria on KPC/PKM as animal feed in the following areas:

- Utilization of Palm Kernel cake as a replacement for maize in Diet of Growing pigs;
- Effects on performance, Serum metabolites, Nutrient Digestibility and cost of feed conversion;
- Replacement Value of Palm Kernel Meal on Carcass Characteristic of Broiler Turkey;
- Replacement of groundnut cake by palm kernel meal in broiler diets;
- Growth performance and nutrient digestibility of growing pigs fed a mixture of palm kernel meal and cassava peel meal;
- Effect of Dietary palm Kernel Meal for maize meal on the Haematological and serum chemistry of Broiler Turkey;
- Energy and nutrient use of palm kernel meal and palm kernel oil in diets for growing pigs;
- The effectiveness of replacing Maize with Palm Kernel Cake in Broiler's starter Diet.

4.1 LEGISLATION AND GOVERNMENT POLICIES

In the absence of well-defined feed standard legislation, the government has harnessed other policy instruments designed to support the feed manufacturing industry.

Under the Nigerian Enterprises Promotion Act, integrated poultry production together with the manufacture of animal feeds, has been transferred from a Schedule II listing to a

Schedule III listing. This enables foreign investors to participate in the industry - either individually or in joint ventures with Nigerians.

Under the Industrial Development (Income Tax Relief) Act of 1971, the manufacture of animal feeds was placed on the list of pioneer industries.

This ensured a five-year tax holiday to new feed millers entering the industry.

These measures were aimed at stimulating investments in the animal feed mill industry.

- Nigerian feed resources had been in decline, because of the stagnant or diminishing output of certain traditional crops leading to heavy reliance on imports to meet the needs of the ever expanding livestock industry for feedstuffs.
- With the advent the current Transformation Agenda Nigeria has been exploiting the potential for expanding its feed resource base through improved production technologies and value addition.

5.0 ENCOURAGING PRIVATE SECTOR INVESTMENT (BOTH SMALLHOLDER AND LARGE PRODUCERS)

Considering the potential for substantial increases in cassava production and demand without undermining food security of the farming community. Further investment is required in the industrialization of cassava processing

Investment will need to expand to effectively use by-products of more industrialized cassava processing in livestock, poultry and aquaculture feed sectors

Develop end use markets for all the expanded cassava residue products

With roles for Government, the private sector, research communities & NGOs, etc.

5.1 ROLES OF GOVERNMENT IN FACILITATING PPP

- Tax advantages for investing in new production and processing technologies
- Import substitution policies that provide advantages for locally produced cassava
- Price supports to ensure stable and predictable pricing for the increasing
- Tax incentives/penalties to incentivize cassava processors to use by-products in productive uses (energy production, alternative ingredients for livestock, etc.)
- Support for research to develop the understanding required for successful implementation of production and use of cassava residues.

5.2 ROLES OF THE PRIVATE SECTOR

- **Private investment for inputs and optimization**

- **Development of inputs including shoots, fertilizer, harvest technologies etc.**
- **Investment in industrialized cassava processing plants**
- **Support (both funding and direct demonstration activities) for research to develop the understanding required for successful implementation of cassava-based feed production and use strategies.**

5.3 ROLES OF RESEARCH COMMUNITIES AND NGOS

- **Development and demonstration of new technologies to reduce implementation risk and support technology adoption.**
- **Characterization and potential applications for new product.**
- **Training and knowhow for implementing best practices.**

THE HALAL MEAT INDUSTRY IN NIGERIA

Halal Meat Industry is a new growth sector in Nigeria's Livestock sector yet to be tapped. It is an emerging market force that will attract all Nigerians because of its wholesome, hygienic and contamination-free principles of processing meat. Awareness and Interest in Halal products is steadily increasing.

Nigeria is the most populous nation in Africa with a significant Muslim population and a significant player in the economy of the ECOWAS sub-region. The National Agricultural Transformation Agenda (ATA) is aimed at fixing the structural gaps and strengthening the key activities along the value chains including marketing and trade. The reform envisages greater private sector participation in input delivery.

ATA is implementing a transformation of the entire meat industry. The transformation is to ensure movement of hygienically processed meat in well developed cold chain system instead of moving live animals. ATA is driving the Halal meat sector through the development of Livestock meat processing and packaging centres.

An intensive and focused diagnostic assessment of the industry was undertaken in 2013. The implementation of the outcome of the Study is key to the development of the Halal Meat sector of the Nigerian economy.

STATUS AND CHALLENGES OF THE LIVESTOCK INDUSTRY

About 90% of the cattle population pastoral under extensive system; 10% is under semi intensive and intensive systems. Borders are porous; 30% - 45% of the slaughter livestock in Nigeria are trade livestock coming in from Niger, Chad, Burkina faso and Benin Republic.

Livestock markets & marketing is driven by private entrepreneurs. Trade in livestock with neighbouring countries is largely informal. The quality of animals on offer varies and not monitored nor controlled and the value of animals is done by visual assessment which again causes difficulties in establishing prices and values.

MARKET OPPORTUNITIES FOR HALAL MEAT

Domestic market for Halal Meat is large and growing with demand expected to double by 2020 from 310,000mt to 650,000mt. The demand drivers include;

- **rapidly growing population (160 million),**
- **per capita income growth of 6%,**
- **large Muslim population**
- **increasing % of the middle class relative to others**
- **the demand for high, premium segments or cut**
- **growing consciousness for quality hygienic beef.**
- **increase in formal retail outlets by big supermarkets targeting the middle class.**
- **increasing domestic urban demand**

ANALYSIS OF MEAT TRADE IN NIGERIA

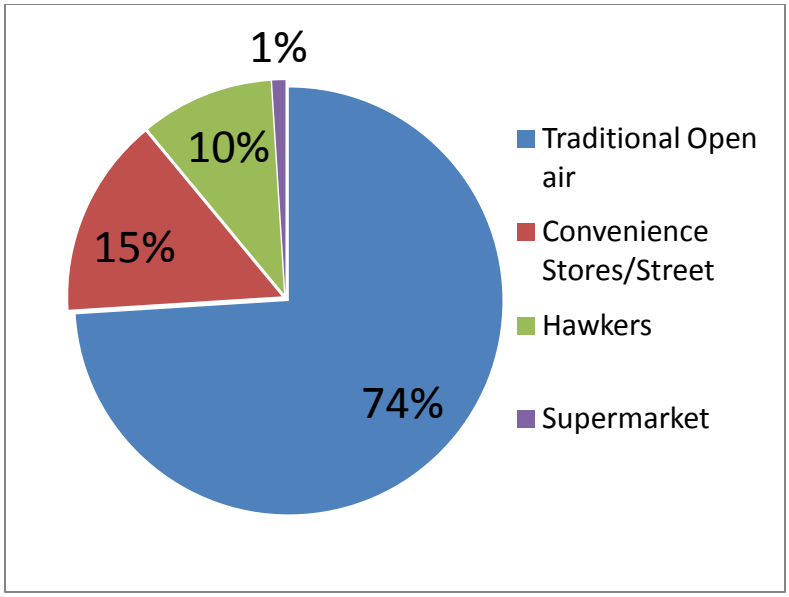
Traditional open air meat stalls dominate the red meat retail sector. Most meat and meat products are sold under un-hygienic condition and of course not acceptable under the current transformation dispensation. The concept of sale of meat in large shopping malls and supermarkets is just evolving in Nigeria compared with some other countries where they are well established.

GLOBAL HALAL MEAT TRADE

Halal Meat accounts for 16% of global trade in meat, none of the D-8 countries feature in the top 10 as exporters of Halal-beef even though they account for 60% of the population of Muslims. The size of the Halal meat industry is growing at the rate of over 4% annually, estimated at $625 Billion in 2012 but expected to rise to $ 2 trillion by 2013.

With the foregoing, there is need for the launch a major initiative around the Halal-meat industry development to take a major share of this rapidly growing industry.

DESCRIPTIVE REPRESENTATION OF MEAT TRADE IN NIGERIA



GOVERNMENT EFFORTS SO FAR IN THE DEVELOPMENT OF THE HALAL INDUSTRY

The Halal meat value chain is one of the priority values chains that government is taking clear steps to transform from end to end i.e. from production, processing marketing and distribution with linkages within the system.

A review of the study was made by the Ministry with DFID-GEMS 1 Project with recommendations made for the development of a focused halal meat industry with respect to:

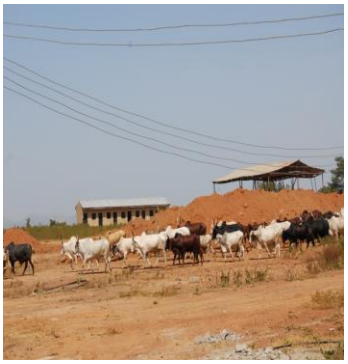
- ✓ **Feeder Cattle Selection**
- ✓ **Transportation and facilities**
- ✓ **Induction facilities,**
- ✓ **Feed Procurement**
- ✓ **Feedlot Design & Placement**
- ✓ **strengthening of industry Association for effective coordination of stakeholders.**

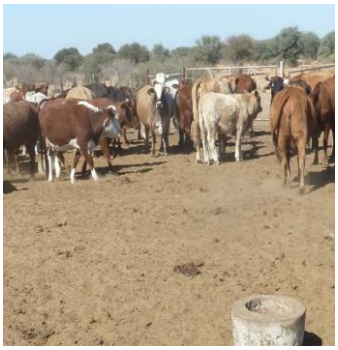
Key Components of a Sustainable Halal Meat Sector

- **Weaner Production**
  - **Organized process of producing calves between 210 – 270days of age for feedlots**
  - ***What are we doing?***

- **Establishing Staple Crop Processing Zones (SCPZs) for livestock; (Gombe /Sokoto)**
- **Sensitizing and wooing Investors**
- **Educating Pastoralists**
- **Learning from Botswana experience**

Kalahari weaner production facility





Weaner Production –Botswana Experience


ANIMAL HEALTH

Transboundary Animal Diseases (TADs) are real threat to feedlot operations. they include Footh and Mouth Disease (FMD), Contagious Bovine Pleuro Pneumonia (CBPP). Outbreak of these can result in huge losses. Porous Borders predispose Nigeria to disease introduction and Preventive vaccination regime is key.

WHAT ARE WE DOING?

Government in strengthening facilities in National Veterinary Research Institute (NVRI); Diagnostic Facilities; New BSL 3 lab built; Capacity Building, Twinning, technical coopertion and Restructuring the Institute), to cope with the new demands for feedlot operators.

Learning from Botswana experience - Heavily reliant on the beef export trade

Animal Health: Vaccine Institute in Botswana

FEEDLOTS

Feedlots are grounds/yards where animals are fattened for market. Essentials include; Requirements of the market; Market Specifications; Selection of Weaners and Animal Welfare.

What are we doing?

Developing SOPs for feedlot

- **Creating database on existing feedlots**
- **Advocacy on-going for Investors**
- **Govt. Incentives and support to be given to the investors**
- **Advocacy and Sensitization**
- **Private Sector driven**
- **Government intervention through SCPZs in Gombe**

FEEDLOTS – BOTSWANA EXPERIENCE






FEEDMILLS

Feedmills produce the feeds for the feedlots used for fattening animals for market. Care should be taken to avoid Moulds, high temp, Products with High fat, Foreign objects in feed

What are we doing?

- **Developing Standard Operating Procedures (SOPs) for our feedmills**
- **Creating database on existing feedmills**
- **Advocacy is on-going for Investors**
- **Government Incentives and support to be given to the investors**
- **Advocacy and Sensitization**
- **Private Sector driven**
- **Government intervention through Staple Crop Processing Zones (SCPZs) in Gombe**

ABATTOIRS

Abattoirs process live cattle into meat for domestic market; Halal method of slaughtering in place; Sanitary measures are adhered to; HACCP are met and Records are kept.

FAMAG-JAL FARMS, JIKOI, NIGERIA.

What are we doing?

- **Reviewing our legislation on meat slaughtering & handling**
- **Developing SOPs for abattoirs and slaughterhouses**
- **Creating database on existing abattoirs**
- **Advocacy for private Investors**
- **Govt. Incentives and support given to the investors**
- **Advocacy and Sensitization**
- **Private Sector driven**
- **Learning from the Botswana experience**

ABATTOIR – BOTSWANA EXPERIENCE



MARKET OUTLETS

- **Sales channels are largely informal with 70-90% via open air sales**
- **Consequence : Poor quality and few value added products**
- **Export Trade in Meat require compliance to WTO/OIE sanitary requirements.**
- **Demand for meat still far outweighs the supply**

What are we doing?

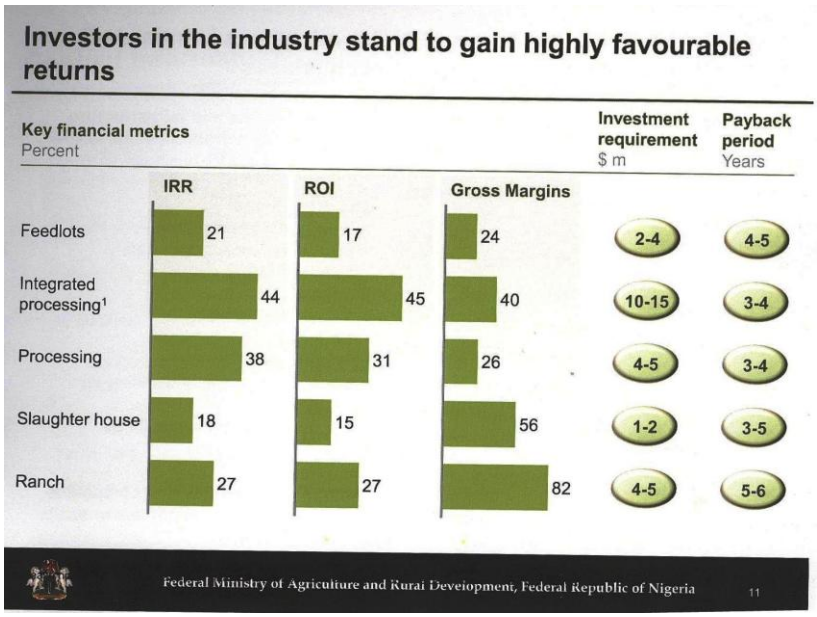
- **Reviewing our legislation.**
- **Developing SOPs to ensure compliance with WTO/OIE measures**
- **Encouraging establishment of meat outlets -Supermarkets, Meat Kiosks, butchery**
- **Advocacy for more investors in meat vending**
- **Advocacy and Sensitization of meat traders on export requirements**
- **Private Sector driven**
- **Strengthening Industry Associations**

INCENTIVES TO INVESTORS IN THE HALAL INDUSTRY

- ✓ **The financial incentives are being provided to reduce the start-up costs for the investors - financial incentives (single digit interest, 0% duties on equipment, interest buy back)**
- ✓ **NIRSAL, FAFIN , CACS**
- ✓ **Strict enforcement of regulation;**
- ✓ **Research and development (partnering with research institutes, establishment of AI centers etc);**
- ✓ **Infrastructural Development , Power, Communication, Water and Access roads.**
- ✓ **Policies to ensure a conducive business environment.**
- ✓ **Artificial Insemination (AI) Service Provision for improvement of local breeds**
- ✓ **Ensuring access to market through infrastructure development.**

BENEFITS TO INVESTORS IN THE HALAL INDUSTRY

Investors in the industry stand to gain favourable returns from investments in Feedlots, Processing, Slaughterhouses & Abattoirs, as well as Weaner production (ranching) starting with as little as $2 – $4 million. Government is also working on creating Staple Crop Processing Zones (SCPZs) that will have a standard offer that increases ease of setting up a halal meat business as an incentive.



REGULATORY POLICIES OF GOVERNMENT

We are currently reviewing are policies in the sector in the areas of; In country animal vaccination and disease control programs; Ante and post mortem inspection procedures; SOPs on Building and equipment standards; Hygiene standards; Product traceability requirements; Animal welfare standards; Enforcement of food safety standard ; Privatizing and Harmonizing Abattoir; Upgrading public slaughter houses and retail outlets; Set strict safety and environmental legislative and enforce standards; Provision of credit facilities to all players under a unit digit interest rate.

CONCLUSION

- The future developmental steps for efficient utilization of PKC in monogastric animal feeding requires strategic planning and effective implementation.
- The last few years have witnessed a considerable breakthrough for PKC inclusion in monogastric animal feeding in Nigeria; consequently, the interest for PKC utilization among farmers, nutritionists and feed manufacturers in the monogastric animal production sector is also growing as a result of various studies on the benefit of this by-product.
- After a period of almost total collapse of the livestock industry especially the poultry industry caused by the uneconomical cost of production, an appreciable relief is gradually in sight with the incorporation of PKC in monogastric animal feed formulation.
- Cassava-based diets have the potential to contribute towards bridging this feed supply gap.

- Introduction of Commercial Compounded Ruminant Feeds and fodder banking under the Agricultural Transformation Agenda, harnessing by-products from crop processing zones as well as the development of roadmap for Cassava–Based Feed System for Africa currently on-going, will definitely bring great dividends in our strive to ensure food security, especially if the abundant cassava wastes could be urgently turned into ruminant and fish feeds/meal on commercial basis.

- Experience and information sharing on standards and risk assessment in feed will go a long way in strengthening the feed industry and cooperation among members.

- Silage making in portable 35-50kg bags on commercial basis through the pilot project collaboration between Nigeria and Islamic Republic of Iran will definitely be one of the major measures of addressing Farmers/pastoralist clashes as well as provision of all year round feed for the pastoralists as well as stimulate commercial intensive ruminant production to bridge the animal protein demand gap

- Nigeria is keen to establish its capacity in the area of Halal certified meat industry. With a population of 19.2 million herds of cattle, mostly pastoral, there is need to encourage moving processed beef instead of animals to avoid farmer conflicts over grazing lands. The development of feedlots, animal fattening, integrated animal slaughter and meat processing and cold chain systems, will allow us to transit into modern beef industry.

- D-8 should therefore establish **Halal Meat Investment Commission** to drive the development of technical capacity, investments, certification, market and trade development towards strengthening the Halal Meat Sector in Nigeria.

PILOT PROJECT ON CASSAVA WASTE FERMENTATION TO PRODUCE HIGH QUALITY FEED IN NIGERIA

Duration: 36 months

Cost: $5.6M

Collaborators: FMARD, ILRI, World Fish, BioTork, Gainesville, Florida

Location of the pilot project: ILRI, on IITA Campus, Ibadan, Nigeria

Proposal summary:

Nigeria's population of roughly 160 million people is expected to swell to more than 400 million by 2050, putting enormous pressure on food production and natural resources management to feed these extra millions. Cassava, Nigeria’s main staple food, consumed as garri by 75% of the population, is not enough to meet this demand and ensure food security. Meat and fish are

increasingly part of a diversified diet, but there is a critical shortage of high-quality animal feed, most locally produced.

In Nigeria, large amounts of cassava and garri (54m MT and 9.4m MT, respectively) are being produced, generating some 14m MT of waste annually. Transforming polluting cassava waste into high-quality animal/fish feed would help to solve environmental issues while providing locally produced, high-quality feed at very affordable and competitive prices for livestock/fish growers to feed Nigeria's burgeoning population.

Under our initiative, cassava waste generated as a by-product of garri processing would be fermented with selected microorganisms (algae and fungi strains), to produce competitive, high-quality fish and animal feed. This would allow to create a new, commercially feasible business and income opportunities. Cassava producers, workers, entrepreneurs and consumers, all stand to benefit from developing and strengthening the value chain in this new sector:

(1) some 3.6 million cassava producers would sell cassava roots unfit for garri, realizing a new income source that would also spur cassava productivity;

(2) garri processors would enjoy new revenue from selling the waste produced on the garri markets, thereby cleaning up the environment and their work places as well as directly improving the well-being and work-site conditions of the million workers in the garri industry;

(3) the nascent fermentation business using cassava waste would attract investors, providing jobs in new factories and growing the economy;

(4) feed millers would gain both resources with cheaper, locally made animal and fish feed and a larger share of the market;

(5) animal and fish growers would have access to better and cheaper feed, lowering their operating costs while boosting the quality and quantity of animal produced; and

(6) consumers would benefit from buying more meat and fish at cheaper prices, thereby improving their health.

Key to the scale-up of the proposed project will be to involve stakeholders and technical specialists from the local private sector in the cassava-processing and in the feed mill industry, to ensure buy-in and a business perspective in project design. (Contacts have been made already with interested representatives of these two industries.) They will serve on the business steering committee, and in year 3 feed makers will participate in the feed evaluation studies. With technical experts advising investors on the feasibility of pilot-scale technologies. Their input will be solicited and considered throughout the process in order to make this new business profitable for everyone involved and ensure that small stakeholders and consumers will benefit, too. If the pilot project produces the expected data, private investors will be eager

to build the needed facilities to produce animal/fish feed as soon as possible and that those in the feed mill industry will buy the entire output from these facilities.

Enormous amounts of cassava waste are produced—and the demand in animal feed is so large and growing constantly—that the limiting factor will be the rate of return on investment and the time required to build the necessary facilities. (Our project time line assumes one year to build a factory processing 100 MT/day and one year to make it run at full capacity.) If the technology works the way we expect it to, there are no limits—not on the cassava waste side, on product sales, or on available investment.

Principle beneficiaries:

Roughly 10% of the total cassava roots produced by Nigeria's 3.6m cassava producers is not fit for the market because of their low dry matter content (DMC) or postharvest deterioration. In our project, these roots would gain a new market: fermenting factories would buy these substandard roots at ±$30/MT (i.e., 10% of 54m MT at $30 = $162m).

About 1 million people, 80% of whom are women and young children, are involved in gari processing. Facilities would buy the solid and liquid waste at $30/MT (36m MT x 30% at $30 = $324m) rather than allowing them to accumulate and rot. This would benefit the gari workers and improve their working conditions by replacing mounds of decaying cassava waste with trees and grass. With the increased incomes from cassava waste, processors could afford to mechanize some of the labor-intensive activities of cassava processing, allowing working children to return to school.

The fermentation industry would gain an estimated 18% of the sales, estimated to be at least $1,000/MT. Each factory processing 100 MT/day of cassava waste could realize $2m/year for a $10m investment. The gari system could support about 100 factories of this size and employ some 20,000 workers. The feedmill industry would gain on the higher quality of feed and save on other ingredients that are currently being used.

Fish producers could buy high-quality feed at $1,400/MT instead of today's $2,000/MT. At this price producers could produce 1 kg of fish/kg of feed, instead of at today's rate of 1 kg/4 kg (i.e., three cycles of fish production per year instead of two). This would increase production by 50% and allow them to meet demand more profitably.

Fish consumers now pay $3,000/MT, and although this price would probably not decrease because demand is outgrowing production, it would stabilize. Higher quality fish feed will improve the quality of the fish and dietary diversity for consumers.

Nigeria would realize savings from reduced dependency on importation of feed and fish meals and crops used to produce animal feed, such as soybean. A large quantity of food used in the feed could, instead, go back to the market for human consumption.

Development of a new market in Nigeria

There is virtually no market for cassava waste in Nigeria today. The very small fraction of peels are dried during the dry season and are sold at $40/MT to cattle growers. Our proposed project would compete neither for food nor other products. It is a brand-new market—value springing virtually from nothing. Cassava factories today are not using the waste, which is left in situ to pollute the environment through soils, groundwater, and other natural pathways. Investment costs to dispose of the waste properly is simply too costly for Nigeria (and Africa as a whole). Furthermore, removal of this waste would improve the work-sites of gari processors significantly. If cassava waste were used to make feed, it would solve the pollution problem that cassava factory managers currently have as well as be an additional source of income for a range of beneficiaries.

Activities proposed and expected results

1. Evaluate the quantity and quality of cassava waste at every step of the gari process. We expect 30% waste in weight of the total amount of cassava roots processed per day, with 46% DMC (Y1).

2. Evaluate practical/economical ways to collect about 100 MT/day solid and liquid wastes in a 25-km radius of the market in order to supply one fermentation factory (Y1).

3. Select strains of microorganisms to be used for the fermentation of cassava waste (algae and fungi) using BioTork technology. We expect to select microorganisms for two types of products—an algae to produce high protein content feed (55%) and a mixture of algae and fungi to produce high fatty acid content (30%) with a very high proportion of omega-3 fatty acids (4–9%)(Ys 1–2).

4. Scale-up the fermentation volume from 2 L to 5,000 L in four steps to produce meal cake and evaluate conversion rate from cassava to meal cake. We expect to reach a conversion rate of 60% or more on DMC basis (Ys 1–3).

5. Study all parameters for the fermentation at each step (e.g., temperature, solid density, nitrogen, inoculum concentration, cycle duration…) From this we will determine the best parameters for the highest conversion rate (Ys 1–3).

6. Analyze the composition of meal cakes obtained to verify high-quality feed expected from the results of the selection of microorganisms in activity 3 (Ys 1–3).

7. Perform nutrition studies on pigs and poultry with the high protein cake and fish with the high omega-3 product. We expect a very high nutrition performance for both (Y3).

8. Conduct economic feasibility studies, including cost of cassava waste and Nigerian production costs for a factory fermenting 100 MT/day. We expect production costs to be below $800/MT and a production capacity of 10,000 MT of meal cake/year/factory (Y3).

9. Manage the pilot project with a manager hired for the project's duration. Convene annual meetings of the scientific advisory committee and semi-annual of the business steering committee. Results will be reported every 6 months (Ys 1-3).

Proof of concept, effectiveness and scale-up of the pilot project

Proof of concept: BioTork has already established the proof of concept for selection of microorganisms to optimize fermentation on different substrates for different microorganisms (Ian et al., 2012; Crecy et al 2007; 2009), but not on cassava. Considering the composition of cassava waste, we expect similar results. Preliminary experiments on cassava will be performed before we begin the pilot project to ensure validity of the proposal. Rates of conversion previously obtained varied 59–85%; in our calculation models we use 59% to be conservative. Local conditions in Nigeria, such as water purity and temperature, may be factors and will be considered. Volume scale-up may cause technical issues that compromise an optimized fermentation (e.g., oxygenation, matter concentration, inoculum concentration, etc.). All of these parameters will have to be worked out at each step of the scale-up.

Cost effectiveness: Feasibility and cost-effectiveness calculations have been done using data obtained from other substrates. These calculations indicate that the process with a rate of conversion of 59% or higher should be very cost effective for fermentation units of 100 MT/day or larger. Considering the volume of cassava waste available and market demand for feed, we assume a factory model of 100 MT/day, though we may consider a larger size during the project. The larger the factory, the cheaper the production cost. In addition, we have already collected information in Nigeria for cost of energy, water, and manpower. Other costs such as land, buildings, equipment, and maintenance will have to be evaluated during the project to refine the overall production cost for Nigeria.

Pathway to scale: The last scale in the pilot project of fermenters of 5,000L is considered as pre-industrial, meaning that the fermentation parameters will not drastically change when scaling up to tanks of 100,000L or larger. Fermentation is a mature technology. The necessary equipment are readily available and do not present any unknowns or technical challenges. The private sector will be engaged to ensure transparency of the data collected and to involve them further in the project. They have already assured us that they would deploy the technology if pilot-scale results are as anticipated. The Ministry of Agriculture in Nigeria also supports the project.

Evaluation of the project

The proposal uses four major metrics:

(1) amount and quality of cassava waste on the gari markets,

(2) rate of conversion from cassava to feed meal,

(3) cost of production of this meal cake in Nigeria, and

(4) nutritive quality of the meal cake.

Metric 1 is already known and will be refined in the first 6 months of the project. Metric 2 will be assessed throughout the project as we scale up the volume and as new strains of microorganisms are selected by BioTork. Metric 3 has already been evaluated and will be refined in the final 12 months of the project, based on data obtained in the project. Metric 4 will be assessed in the final 12 months of the project when we produce enough meal cake from the pilot project. Every 6 months the business steering committee will meet to review all the data. We will build go-no-go milestones each year of the project so as not to overspend funds if the results do not support industrial deployment of the technology.

Operational and Financial Sustainability of the project

Innovation will be sustained and scaled up by the cassava-processing industry if they are interested in developing the proposed technology—we are confident that they will if our data are clear and convincing. We will constantly maintain communications with industry players to ensure transparency and motivation. Today, the cassava-processing industry is expanding, spurred by the need to produce 216,000 MT of high-quality cassava flour. All the major companies plan to build factories to process cassava, to take advantage of this lucrative market. They will themselves create an estimated 2m MT of waste; if our innovation is economically feasible, these companies will jump at the opportunity to use their own waste and buy more from the garri market. Capital investment does not seem a limitation in Nigeria, whose economy as a whole is expanding rapidly. In this industry access to cassava waste is widely available in large amounts, which should prevent any one business from dominating market share of the waste. On the other hand, the market for feed is exponentially increasing. And if the meal cakes have high quality, the feed millers will buy all the meal cakes produced.

Policymakers will have an important role in key elements such as the cost of cassava waste, the cost of meal cake, and the cost of animal feed through discussions and agreements with the association of cassava growers, processors and feed millers. Deployment of the innovation will be open to all interested industries, both for cassava processors and feed millers, to ensure competition and prevent a monopoly.

Although cassava processors and feed millers have opposing business concerns, we believe that they will naturally find a balance whereby both sides can benefit. There is much competition in the feed industry, and aquaculture represents a very promising market to provide them feed material: 0.5m MT today, 1. 5m MT by 2030! Cost effectiveness of the innovation will result

from all these factors, but the ultimate goal will be to ensure that the supply of healthy, affordable meat and fish meet consumer demand. Our innovation offers the potential of producing enormous amounts of high-quality feed at lower costs, and providing income for everybody along the value chain.

Lead organizations of the project

Three organizations will lead the project: the International Livestock Research Institute (ILRI) will implement the pilot project on the campus of the International Institute of Tropical Agriculture (IITA) in Nigeria; BioTork, which owns the technology used to select microorganisms, will select the required algae and fungi for the pilot project; and the Global Cassava Partnership for the 21st Century (GCP21), will coordinate the activities between the partners. ILRI, a CGIAR center, works to improve food security and reduce poverty in developing countries through research for better and more sustainable use of livestock. Founded in 2008, BioTork is a biotechnology company based in Gainesville, Florida. It focuses on the development of microbial strains that produce bio-based chemical commodities such as lipids, fuels, enzymes. Their optimized microorganisms provide the robustness needed for cost-effective industrial bioconversion processes. Founded in 2003, GCP21 is located at the International Center for Tropical Agriculture (CIAT), a CGIAR center. This unique global cassava partnership works synergistically with all the cassava organizations in the world. Its mission is to increase the productivity and use of cassava worldwide to alleviate poverty for hundreds of millions of people.

Composition of the project team

Key project personnel are centered around three leading experts in their fields. Dr. Iheanacho Okike, a Nigerian veterinarian and economist at ILRI, has been the country representative in Nigeria for nine years. Within the CRP on Livestock and Fish, he leads the flagship program on "Enabling Innovations for Value Chain Transformation and Scaling," in nine selected countries in the world. Dr. Okike's solid contacts in the country's public and private sectors will greatly facilitate partnering in the project pilot.

Mr. Eudes de Crecy is the founder/CEO of BioTork and Evolugate, two companies dedicated to improving the selection of microorganisms to optimize bioprocesses in order to produce a variety of compounds and products such as animal and fish feed from a variety of different waste products. http://www.biotork.com.

Dr. Claude Fauquet, the director and cofounder of GCP21, is a world cassava leader. He is now actively expanding the scope and activities of GCP21 globally. Prior to this engagement, Dr. Fauquet developed a cassava genetic engineering project for east Africa ("VIRCA"), with a budget of $30m (co-funded by USAID) over 10 years and operating in Kenya, Uganda, and the

United States. VIRCA is still under operation, and commercialization of its first products is scheduled for 2017.

Partner organizations

The proposed project has generated several potential partners with complementary expertise. World Fish, a CGIAR center located in Philippines, is interested in joining the team of the pilot project. It would contribute to the fish nutrition studies (Y3). Thai Farm Company is a private firm involved in cassava processing to produce high-quality cassava flour. It would join the team of the pilot project to advise in fermentation aspects in project scale-up. Animal Care is one of the most important feed millers in Nigeria. Located near Ibadan, it would participate in the poultry studies in the second phase of the project. Durante Feeds Co. is the largest local producer of fish feed and is eager to participate in the fish feeding studies in Y3.

PILOT PROJECT ON SILAGE PRODUCTION IN 35-50KG BAGS

Iran indicated interest in collaboration with Nigeria on Silage production in portable sacks of 35-50kg capacity.

ESTIMATED COST OF PRODUCING 35KG BAGGED MAIZE SILAGE PER LOCATION (1HA)				
S/N	**Recommended practices**		RATE	COST/HA
	Varieties of maize with high biomass: SHIMAZ and SAMMAZ 12-18 varieties			
1	Use 20kg/ha seeding rate		N150/kg	N3,000.00
2	Land preparation (Operations)			
	a	Ploughing		N5,000.00
	b	Harrowing		N6,000.00
	c	Ridging		N3,000.00
3	Planting of maize seeds with Planting machine (Planter)			N5,000.00
4	Weed management (Chemical herbicides)			
	a	Use Atrazine or Premextra gold @ 4Litres/Ha after sowing		N5,000.00
	b	Use the same herbicide @ 8weeks after planting (Ridging or Moulding)		N5,000.00
5	Fertilizer application			
	a	Use 2 bags of SSP @ Land preparation,	N6,000/bag	N18,000.00
	b	Use 4 bags of NPK @ 2-3 weeks after planting	N6500/bag	N26,000.00
6	Control of pests and diseases using *Cypermethrin + Dimethoate* @4l/ha (100-150ml/20l of water)		N1000 and 1200, respectively	N2, 200.00
7	Harvesting of maize materials @ glazing or dent stage with the use of Forage choppers			N20,000.00
	Procurement of Mobile Forage chopper/crushing machine			N400, 000.00
8	Transportation of maize materials with wagons			N10,000.00

	trucks to the storage site (silos)		
9	Storage of silage materials (bagged silage) with the use of plastic or polythene bags (Standard size 2.7m by 3.7m)		
	Total No. of silage bags per (35kg/bag content) required (from the yield of 35t/ha) = 35,000kg = 1000 bags 35kg	N250/polythene bag	N250,000.00
10	Cost of labour for bagging 1000bags	N1000/50bags	N20,000.00
11	Cost of 35kg bagged silage		N10,805.71
	Total Cost (1 -11)		**N378,200**
	COST FOR 10 IDENTIFIED LOCATIONS	**N378,200 X 10**	**N3,782,000.00 ($22,921)**
MONITORING AND SUPERVISION COST FOR 10 LOCATIONS			
	(a) TRANSPORT/FUELING AND VEHICLE MAINTENANCE	**$5,000/location**	**$50,000**
	(b) DAILY SUBSISTENCE ALLOWANCE		**$17,455**
	(c) INCIDENTAL COST/MICELLANEOUS		**$18,075**
	TOTAL	**N17,894,415 ($108,451.00)**	
1 bag of maize silage (35kg) will cost N10,805.71 ($65.50)			

Selected Ten Villages in Northern Nigeria are listed below:

(1) Damau (Kaduna State)
(2) Biya (")
(3) Giwa (")
(4) Kachia (")
(5) Marrabar Kankara (Katsina State)
(6) Kukar Ajara (Katsina State)
(7) Rgo (Kano State)
(8) Dambata (Kano State)
(9) Falgore (Kano State)
(10) Gidan Jaja (Zamfara State)

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