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LAND USE FOR COCOYAM IN NIGERIA- IMPLICATIONS FOR COCOYAM RE-BIRTH.

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ABSTRACT: *Cocoyam (Colocasia esculenta {taro} and Xanthosoma mafafa {tannia}) is a neglected staple carbohydrate–based food in Nigeria, despite its higher nutritional advantages over competitor roots and tubers. The National Root Crops Research Institute, Umudike, Nigeria, launched cocoyam re-birth initiative (CRI) in 2007 to promote cocoyam research, production, marketing and consumption. Currently, about 34. 6 x 10^6 and 23. 4 x 10^6 million ha of the country's arable land are moderately suitable and highly suitable, respectively, for sustainable cocoyam production. However, 28. 2 x 10^6 and 4.7 x 10^6 million ha are marginally suitable and unsuitable, respectively. A combination of land area under highly suitable and moderately suitable, showed that 65.1 and 34. 9 % of it represent where cocoyam is relatively unimportant and very important, respectively. Cocoyam is also relatively unimportant on marginally suitable land (32.7 %) out of total suitable land area. To promote cocoyam production in the country through CRI, application of cocoyam re-birth mission ad extra where the crop is relatively unimportant and cocoyam re-birth mission ad intra where it is very important is recommended.*

KEYWORDS: Cocoyam; Cocoyam re-birth mission *ad extra*; Cocoyam re-birth mission *and intra*; Land use; Nigeria.

INTRODUCTION

In Nigeria, cocoyam (Figures 1a and b) refers collectively to *Colocasia esculenta* (taro) and *Xanthosoma mafafa* (tannia). They are tropical herbaceous tubers cultivated predominantly as annuals, mainly for their edible starchy storage underground stems called corms and cormels. Taro (*Colocasia esculenta*) is the fifth most harvested root crop in the world with production estimated at 9.0 million tonnes in 2011(1). Nigeria maintains the lead among cocoyam producing nations, with an annual production of 4.55 million metric tonnes in 2012, representing 61.2 and 43.1 % total production in West Africa and Africa, respectively (1).

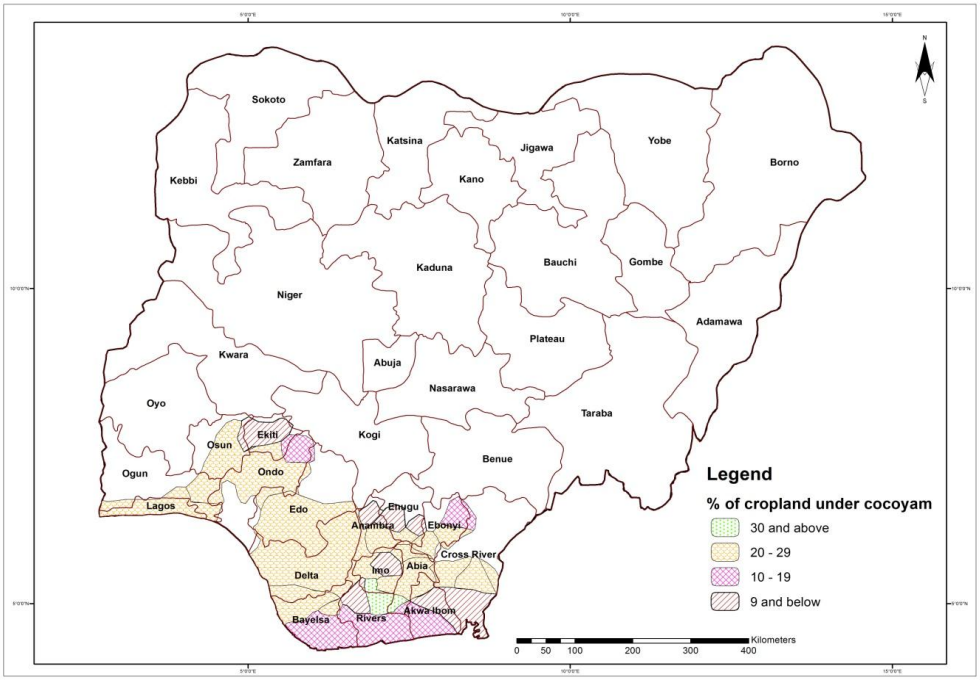
Figure 1a. *Xanthosoma mafafa* (tannia) plants and cormels of cultivar NXs 001

Figure 1b. *Colocasia esculenta* (taro) plants and cormels of cultivar NCe 001.

It also accounted for 34.3, 46.2 and 62.3 % of the cocoyam area in Africa and West Africa, respectively. In Nigeria, cocoyam ranks third after cassava and yam among staple root and tuber crops, in terms of importance, total output and production area. It has high economic potential, not only as food (main meal, snacks and adjunct in thickening soup) but as an agro-industrial raw material for pharmaceutical, confectionery, and livestock industries (2; 3). In Nigeria, the bulk of cocoyam produced is consumed as food, either as a primary product (corm, cormel, leaves and inflorescence) or as a secondary product (flour, cake, crisp, and chip) (4). It is of interest to note that among root and tuber crops in Nigeria, cocoyam is the only fully edible, because the corms and cormels are eaten in various food forms while the leaves and flowers are commonly used as spice to garnish and flavour food (5; 6). The corms are good sources of carbohydrates with easily digestible starch (7). Cocoyam is nutritionally superior to major competitor roots and tubers like cassava and yam, in terms of digestibility, contents of crude protein and essential minerals, such as Ca, Mg and P (2; 8; 9;10). In phytomedicine, a daily consumption of roasted cocoyam with palm oil for three months is recommended for diabetes treatment (11). Recently, (3) revealed its potential in the prevention of prostate and breast cancer. Increasing awareness and concern for environmental quality reveals that the small starch granules of cocoyam (1 – 4 µ) are better sources of raw starch for the production of biodegradable plastics than those from cassava (15 – 17 µ), yam (10 – 70 µ) and potato (50 µ) (12).

In the colonial era and up to 1970s, the rain forest belt was the major zone for root and tuber crops production in Nigeria. Land use under cocoyam then was studied by (13) who reported that the eastern states (Akwa Ibom, Anambra, Bayelsa, Cross River, Ebonyi, Enugu, Imo and Rivers States) was the major of its production from the pre-colonial era through the 1970s. The author delineated land use under cocoyam into four production areas (Figure 2) based on percentage of cropland occupied by cocoyam.

Figure 2. Land use under cocoyam in Nigeria in the 1970s. Adapted from: (13)



However, evidence from macro characterization of West African farming systems by (14), and perspectives in yam research in Africa by (15) revealed that root and tuber crop production has significantly moved from the forest to savanna ecosystems. The authors explained that yam cultivation has expanded into the savanna, which has become the new major growing area in West Africa, due to socio-cultural, agronomic and ecological factors such as preferences, culture, better temperature, higher soil fertility and moisture availability. Consequently, it is expected that with the expansion of root crop belt northwards, the cocoyam cultivation map of Nigeria produced about 25 years ago (13), should be updated to reflect the present situation. Land area under cocoyam production in Nigeria was modified by (16) who produced a land suitability classification map and delineated where cocoyam is an important crop into three categories, to reflect present reality, based on percentage of cropland under cocoyam, as in (13) thus: low = ≤ 9 % of cropland, moderate = 10 – 29 % of cropland and high = ≥ 30 % of cropland (Figure 3). However, the authors (16) failed to quantify the land area under each suitability class.

This gap in knowledge could limit the usefulness of the map as a project-planning tool by policy makers and other stakeholders to expand cocoyam production, in response to the increased interest stimulated by the aggressive campaign of the NRCRI, Umudike, through the CRI. The enlightenment campaign was so great that (17) remarked, "The re-birth programme from the NRCRI Umudike was initiated and the "*fire*" glows on".

Figure 3. Land suitability classification map for cocoyam and important cocoyam growing areas in Nigeria. Adapted from: (16).

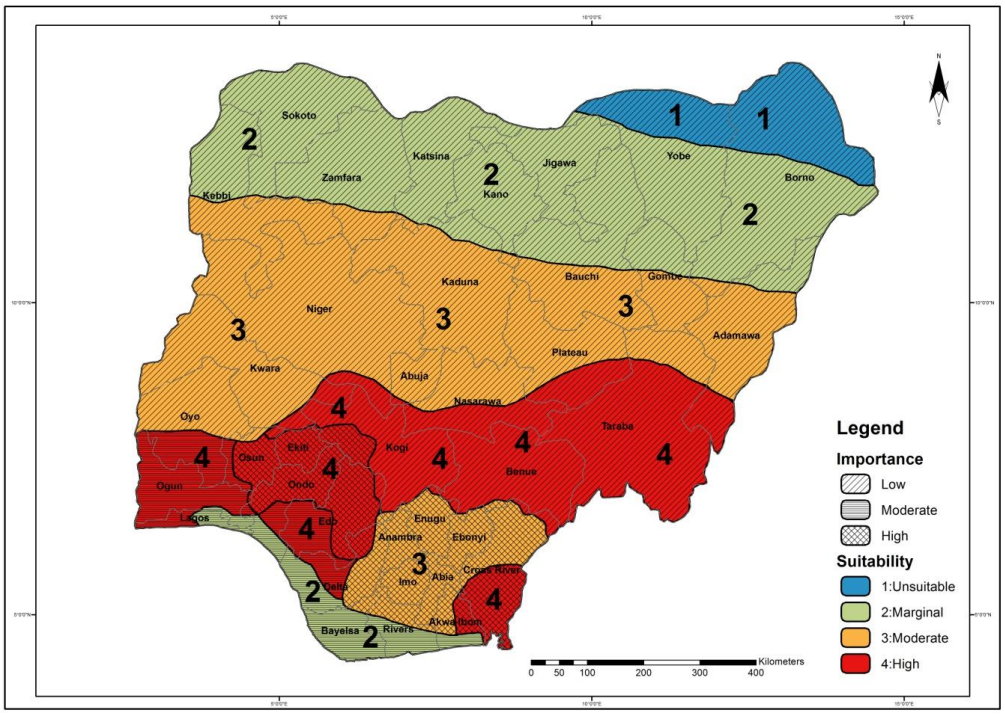


Table 1 has filled the gap in knowledge of 16 observed in Figure 3 by presenting the extent of each land suitability class. This will largely satisfy the increasingly interest on using soil data to answer practical questions on cocoyam production by increasing array of stakeholders. When the table is used in companion with the map (Figure 3), interaction between soil scientists and stakeholders (farmers, processors, marketers and policy makers) will be effective in terms of research negotiations, in which various approaches towards cocoyam transformation are defined, in terms of value chain to be evaluated by a cost/benefit analysis.

Table 1. Extent of land suitability classes for cocoyam in Nigeria.

Suitability class	**Extent (ha)**	**Percentage of total suitable land**
Highly suitable	23,449,877.210	27.2
Moderately suitable	34,619,669.099	40.1
Marginally suitable	28,204,497.573	32.7
Non suitable	4,785,072.458	-
Total suitable area	**86,274,043.882**	**100**
Total land area	**91,059,116.34**	

Table 1 shows that about 23. 4 x 10^6 and 34. 6 x 10^6 million ha of the country's arable land are highly suitable and moderately suitable, respectively, for sustainable cocoyam production. However, 28. 2 x 10^6 and 4.7 x 10^6 million ha are marginally suitable and unsuitable, respectively. From the table, it is gratifying to observe that only 5.25 % of the total land is unsuitable for cocoyam production while 94.75 % is suitabile, at various degrees, for cocoyam production, indicating that there is very high opportunity to expand cocoyam production in Nigeria. The suitability of the land area, in order of magnitude is moderately suitable > marginally suitable > highly suitable.

The National Root Crops Research Institute (NRCRI), Umudike, launched Cocoyam Re-birth Initiative (CRI) in 2007 to increase awareness on nutritional, health and economic importance of cocoyam. Cocoyam re-birth is a new holistic approach to the perception, research, production, utilization and marketing of cocoyam in Nigeria (18). The cocoyam re-birth slogan is: "Cocoyam Rebirth for Food Security and Empowerment". The CRI is a paradigm of strategies to reposition cocoyam as a major staple food and agro-industrial raw material in sub-Saharan Africa. It includes operational and conceptualized strategies such as advocacy, research and extension of improved cocoyam technologies, to enhance food security and socio-economic empowerment of farm families. Under the aegis of the re-birth, Dr. Godwin Chukwu, the coordinator of Cocoyam Research Programme, NRCRI, Umudike, formed a cultural troupe called "The Giant Crop Choir", and composed songs to eulogize cocoyam (Plate 1). Wearing of cocoyam rebirth t-shirts freely in different occasions and entertaining people with cocoyam songs in public and private gatherings are strategies to re-awaken peoples' consciousness and interest for the crop.

Plate 1. Dr. Chukwu leads the choir at a farmers' empowerment programme. (See a corm of cocoyam cultivar NXs 003 behind him that weighs 35 kg).

According to (18), Dr Godwin Chukwu introduced the following neologisms: cocoyam re-birth mission; cocoyam re-birth mission *ad intra*; cocoyam re-birth mission *ad extra*, and echoes of cocoyam rebirth in 2009. They became the basic concepts that defined the scope of cocoyam rebirth.

Cocoyam Re-birth Mission

Cocoyam re-birth mission is reactivating interest of stakeholders where cocoyam is an important crop or its introduction as a new crop to where it is relatively unknown, with a missionary zeal. Mission could refer to a particular work that you feel it is your duty to do. Cocoyam as a tuber crop falls within the mandate of the NRCRI, Umudike, Nigeria. Consequently, the NRCRI owes it as a duty to conduct research into genetic improvement, cultural management and production of cocoyam both under monocropping and under cocoyam-based farming systems. The Institute also tackles the challenges of farm-gate processing (value-addition), storage and marketing, as well as extension of the generated improved technologies to the end-users in the southeast agro-ecological zone of Nigeria.

Cocoyam Re-birth Mission Ad *Intra* (CRM *AI*).

Cocoyam rebirth mission *ad intra* (CRM *AI*) targets to increase interest of stakeholders in cocoyam where it is an important crop by strengthening the empowerment of those already involved in cocoyam business. How? CRM *AI* can manifest in a series of pragmatic activities organized at micro or macro level by any stakeholder or group of stakeholders or institutions. It includes upstream and downstream research, trainings, excursion visits, formation of cocoyam growers' co-operatives, and organization of cocoyam-based symposia, seminars, workshops and conferences. For instance, the giant crop family (members of the Cocoyam Research Programme) and the cocoyam re-birth missionaries (collaborator in cocoyam research) organized cocoyam consumption awareness campaign (COCAWAC) on 4 June 2009, within the NRCRI, Umudike and Michael Okpara University of Agriculture (MOUA), Umudike environments. Other activities included the formation of "Cormel Club," (Plate 2) as a variant of Young Farmers' Club based on CRI in primary schools in Abua Kingdom of Rivers State, Nigeria.

Plate 2. Members of the cormel club with Dr. Chukwu in a school cocoyam farm.

Showing empathy to cocoyam farmers through friendly visits to their farms, as well as prompt response to emergencies such as sudden epidemic, can have a tremendous positive impact on farmers. Training on various aspects of cocoyam production, storage and processing (value-addition) is to build capacity of the farmers and empower those already involved in cocoyam business. The graduated farmer trainees could be given planting materials to enable them practice what they learnt, as soon as possible, before what they learnt is forgotten. The farmers can be involved in farmer participatory research (FPR). The FPR has many advantages. It

enabled farmers to obtain planting materials at no financial cost, acquire skill in modern cocoyam production technologies, select varieties that are adaptable to their environment and enjoy the psychology of sharing knowledge and collective decision-making with scientists to solve farming problems.

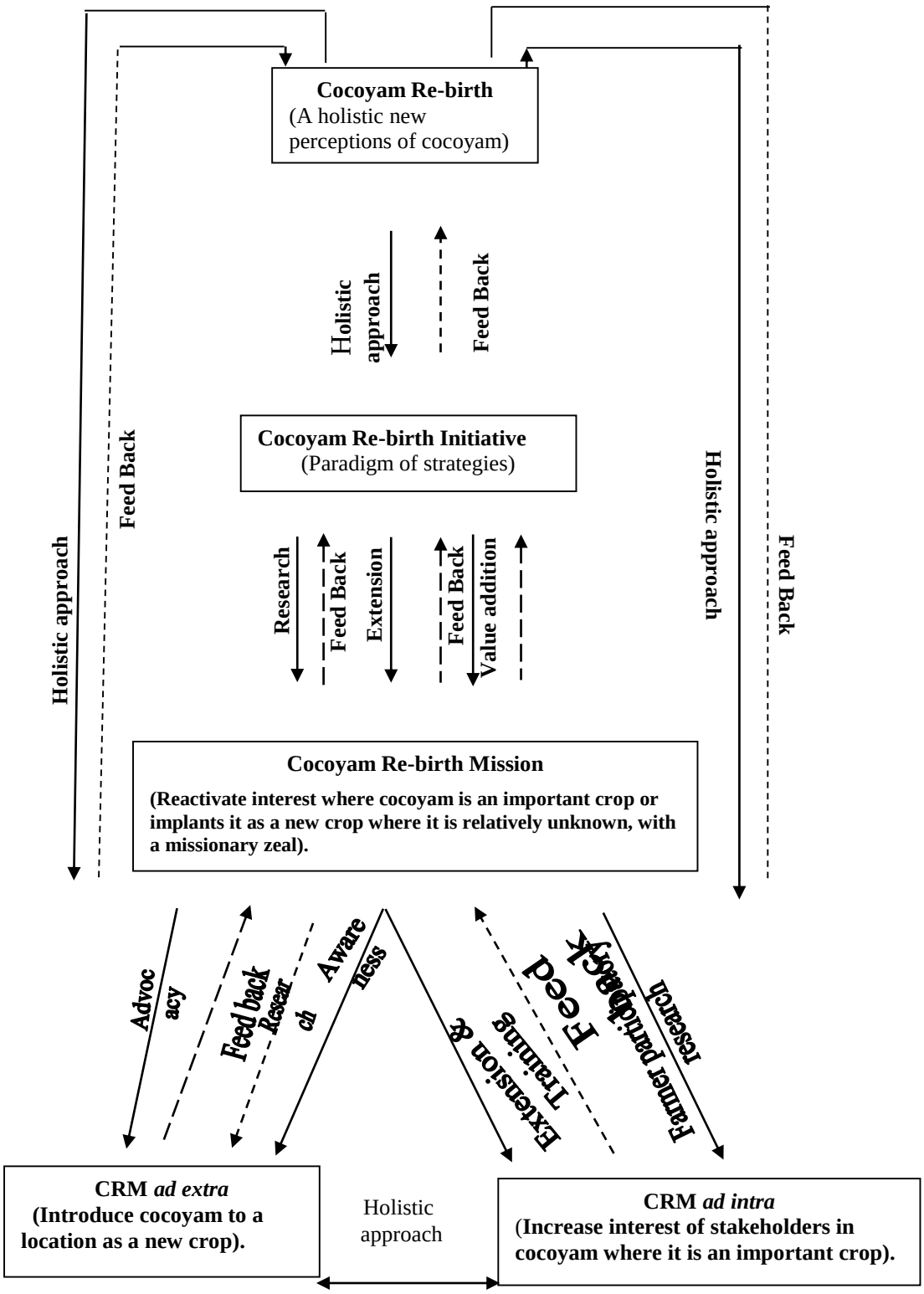
Cocoyam Rebirth Mission *Ad Extra* (CRM *AE*).

Cocoyam re-birth mission *ad extra* focuses on introducing cocoyam to a location or an area as a new crop. It includes popularizing its production, processing and consumption, where it is currently a minor or unimportant crop, provided the ecology is moderately or highly suitable for its cultivation. CRM *AE* relies heavily on the principle of crop introduction as a way of crop improvement. CRM *AE* takes a clue from the fact that many important staple food crops in Nigeria, such as rice, cassava, cowpea (beans), cotton, maize, millet, as well as cocoyam, were exotic and came mostly from Southeast Asia and South America. Differences in adaptability and adoptability of these crops by people in various agro-ecological zones depended largely on land suitability for their production and food preference.

Echoes of Cocoyam Re-birth (ECR).

This is interrelationships between cocoyam re-birth, operational and conceptualized strategies, targeted goals and roadmaps to keep the re-birth alive and make it effective (Figure 4).

Figure 4. Echoes of cocoyam re-birth. Source: (18)



The echo is effective when strategies formulated and implemented give expected results. A clue to ascertain the existence of the echoes is the achievement of project objectives. The

echoes show that challenges facing cocoyam are holistically addressed manner through core research, extension, physical value addition (cake, bread, chin chin) through post harvest processing of cocoyam corms and cormels into different food forms and agro-industrial raw material or psychological value addition through music, songs and dancing supplied by the giant crop choir. The echo can be observed as the application of missionary zeal in the implementation of strategies to increase interest of stakeholders where cocoyam is already an important crop (CRM *AI*) or introduce cocoyam to a place as a new crop (CRM *AE*) to achieve the objectives of the cocoyam project. In all these, there is a free flow of information among the basic concepts of cocoyam re-birth to keep the re-birth alive and effective. Therein lays the echo of cocoyam re-birth.

Table 2. Land Suitability Class, Extent, Relative Importance for Cocoyam and Implications for Cocoyam Re-birth in Nigeria.

Suitability Class	**Extent of Area (ha) (%)**		**Relative Importance of Cocoyam in the Area**		**Application of Cocoyam Re-birth Mission (CRM)**	
Highly + Moderately	37,823,594.22**	65.1**	Relatively Unimportant	-	CRM *Ad Extra*	-
Highly + Moderately	20,245952.09**	34.9**	-	Very Important	-	CRM *Ad Intra*
Marginally	28,204,497.57*	32.7*	Relatively unimportant	-	CRM *Ad Extra*	-

** = Extent relative to combined highly and moderately suitable land.

* = Extent relative to total suitable land.

- = Not applicable.

Table 2 shows that when the highly suitable class is combined with the moderately suitable class, more than half of the area (65.1 %) is currently, relatively unimportant for cocoyam, with land under crop of ≤ 9 %. Therefore, to popularize cocoyam production in the area CRM *AE* is recommended. Only 34.9 % of the highly and moderately suitable classes are where ≤ 30 % of cropland is under cocoyam, indicating that this area is very important for cocoyam production. The most appropriate CRI strategy needed in this area is cocoyam re-birth mission *ad intra*, 16 had discussed the factors that accounted for the differences in the suitability of the land classes. For instance, the semiarid and dry sub-humid regions typical of north of Maiduguri in Borno, Sokoto and Kano States and parts of the deltaic areas of Akwa Ibom, Bayelsa, Cross River, Edo, Lagos and Rivers States (19), constitute the 37.2 % marginally suitable area (Table 2). The northern end is characterised by aridic and torric moisture regimes, where soil moisture is at ≥ 1,500 KPa tension at least for 90 days out of 180 – 240 days of growth period for cocoyam (19). Similarly, total annual precipitation in these areas ranged from 400 – 1, 000 mm (19). This amount of rainfall (precipitation) cannot sustain cocoyam production without irrigation. In the above area, cocoyam is not an important crop. To popularize cocoyam in the area, CRM *AE* is the most appropriate strategy. Conversely, the deltaic area experience number of rainy days ranging from 300 – 360, where effective rainfall is likely to exceed evapotranspiration for nine months, out of 12 calendar months in a year.

Consequently, cocoyam cultivated within the area is likely to suffer moisture stress due to excessive moisture. Appreciable portions of the soils are Thionic Fluvisols (20) that suffer endosaturation (be saturated with water in all layers from the upper surface to a depth of 200 cm) (21) at the peak of rainy season. This will necessitate serious drainage and soil management to control sulphur acidity (Thionic Fluvisols) to upgrade the suitability. Other challenges include potential frequent flood hazards and presence of leach to limit access to the farm to carry out agronomic management timely. Despite these challenges, cocoyam is already an important crop in the area. Therefore, to sustain the interest of stakeholders in the area in cocoyam production, emphasis should be on CRM *AI.*

Areas around Kaduna, Bauchi, Plateau, Adamawa and Niger States and parts of Kogi, Kwara, Benue, Plateau and Federal Capital Territory are moderately suitable for cocoyam production. The soils are fertile with a base saturation ranging from 60 – 80 % (22). They are derived essentially from basement complex rocks and newer basalts and are naturally endowed with weatherable minerals, especially white mica (muscovite) which is a potassium aluminum silicate (23), the soils are less prone to accelerated soil erosion because of appreciable amounts of gravel and presence of occasional rock out crops (22, 23). All these confer higher structural stability to the soils of the zone. However, it is surprising to note that though all these areas are moderately suitable for cocoyam, yet ≤ 9 % of cropland is under cocoyam (Figure 2) evidencing its under utilization for cocoyam production. Similar observation was made by (24) in Ghana where they observed that a vast lowland ecology suitable for cocoyam production was not put to effective use. CRM *AE* is the most appropriate strategy to apply to harness the advantages of the favourable ecology. However, Oyo, Ondo and Cross Rivers States are highly suitable and belong to where ≥ 30 % of cropland is under cocoyam (Figure 3). CRM *AE* is needed to sustain and improve on the popularity cocoyam commands in the area.

Abia, Anambra, Ebonyi, Enugu and Imo States are important for cocoyam production (Figure 3). Cocoyam festival is among cultural ceremonies commonly celebrated in many communities in the area and women famous in cocoyam production were conferred with titles in the colonial days up to 1970s (18). However, because the area is underlain by acidic soils derived essentially from Coastal Plain Sands, Sandstone and Shale parent materials which are sedimentary products of earlier cycle of weathering and deposition, with low fertility status (base saturation) (19, 22, 25). CRM *AI* is the most appropriate cocoyam re-birth initiative in this area to sustain the people's interest through training, farmer participatory research and financial support.

CONCLUSION

Nigeria has 86.27 x 10^6 million ha of suitable arable land to massively increase cocoyam production under the agricultural transformation agenda. However, cocoyam is a very important crop in about 31.3 % of the suitable land area and remains a minor crop in about 68.7 % of the area. The tempo of cocoyam re-birth should not wane since it has proved to be a panacea to extinction threat looming against cocoyam in Nigeria and it is as an effective campaign strategy to increase interest of stakeholders to expand land area under the crop.

REFERENCES

ODNRI. (1989). *Nigeria profile of agricultural potential*. Overseas Development Natural Resources Institute, United Kingdom, 15 pp.

Agboola, S.A. (1979). *An agricultural atlas of Nigeria* Oxford University Press, Great

Ahn, P (1970). *West African Soils*. Oxford University Press, London, 332 pp.

Akomas, G.E.C., Mbanaso, E.N. and Akomas, O.EU. (1987). *Proc 1st National Workshop on Cocoyam*, NRCRI, Umudike, Nigeria, pp 187-195.

Akoroda, M. (2012). Better co-ordinated root crop systems for food and cash in Nigeria. In: Root and Tuber Crops Research for Food Security and Empowerment. Amadi, C.O. Ekwe, K.C, Chukwu, G.O, Olojede, A.O and Egesi, C.N. eds. *NRCRI, Umudike*, pp 3 - 32.

Britain, 248 pp.

Chukwu, G.**,** Okoye, B and Nwosu, K. (2012). Cocoyam rebirth in Nigeria. Lap-Lambert Academic Publishing, Germany, 100 pp.

Chukwu, G.O and I. Olafimihan. (2002). Management of Thionic Fluvisols of the Niger Delta for biodiversity conservation. In: The Status of conservation and Renewable Natural Resources in the Niger Delta Area of Nigeria. *Transactions of Nigeria Society for Biological Conservation, Special Edition.* Feb. 2002, pp 14–17.

Chukwu, G.O**.,** P. O. Nwosu and Onyekwere, I. N. (2014). Suitability evaluation of land resources zones of Nigeria for cocoyam production**.** US Open Soil Science Journal, 1 (1): 1 – 8.

Chukwu, G.O., Uwasomba, C, Okoye, B.C. and Onwubiko, O. (2011). Cocoyam re-birth: A crop model in rebranding Nigerian agriculture. In: *Root and Tuber Crops Research for Food Security and Empowerment.* Amadi, C.O., Ekwe, K .C.,.Chukwu, G.O., Olojede, A.O. and Egesi, C.N. (eds). NRCRI, Umudike, pp 287-300.

FAO. (1990). *Roots, Tubers, Plantains and Bananas in Nutrition*. FAO, Rome, Italy.

FAO. (1990). *Roots, Tubers, Plantains and Bananas in Nutrition*. FAO, Rome, Italy.

Federal Department of Agricultural Land Resources (FDALR) (2005). Soil map of southeastern Nigeria. *FDALR, Owerri*.

FMANR (Federal Ministry of Agriculture and Natural Resources) (1990). *Literature review on soil fertility investigations in Nigeria.* 5 (2): 92-95 and 5:252-261.

Food and Agriculture Organization of the United Nations (FAO). (2012). 18 Mar. 2013. ttp://faostat3. fao.org/home/index.html>.

Gooding, E.G. B. (1987) Tonnia (*Xanthosama spp)* and Taro (*Colocasia esculenta)* in : Root Crops second edition. Tropical Development and Research Institute, London pp 200 – 251.

Green, B.O. (2003). Taxonomic and nutritional analysis of certain tuber crops in the Niger Delta of Nigeria. *African Journal of Environmental Studies 4(1/2): 120-122*

Ilonzo, F.I.N. (1997). *You and your health with phytomedicine (healing remedies from plants).* The Centre for Psychic and Healing Administration. Nobel Publication, Enugu, Nigeria, 26 pp.

Kundu, N., Campbell, P., Hampton, B., Lin, C., Ma, X., Ambulos, N., Zhao, X. F., Goloubeva, O., Holt, D., Fulton, A. M. (2012). Antimetastatic activity isolated from *Colocasia esculenta* (taro). *Anti-Cancer Drugs* 2:200-211

Manyong, V. M., Smith, J, Weber, G, Jagtap, S.S and Oyewole, B. (1996). Macro characterization of agricultural systems in West Africa: An overwiew. *Resource and Crop Management Monograph,* No. 21, IITA, Ibadan.

Okwor, G. C. (2004). Perspectives in yam research in Africa. *Proc. 8th ISTRC-AB Symposium*, Ibadan, Nigeria, pp 5 – 8.

Oyenuga,V.A (1968). Nigeria's food and feeding stuff, their chemistry and nutritive value (3rd edition).*University press, Ibadan*, pp 31-35.

Plucknett, D.L., R.S. de la Pena, and F. Obrero. (1970). Taro (*Colocasia esculenta).* Field Crops Abstr. 23:413–426.

Sagoe, R., Ban, R., Manu-Adueing, J., Haleegoah, J., Dedzoe, D., Tetteh., J.P., Osei, J . K., Safo-Kantanka, O and MOFA Staff. (2004). improving taro cropping systemin Ghana: A participatory research - farmer- extension approach. *Proc. 8th ISTRC-AB Symposium*, Ibadan, Nigeria, pp 321 – 324.

Soil Survey Staff (2003). *Keys to soil taxonomy*. United States Department of Agriculture 9th edition, 332 pp.

Standal, B.R. (1983). Nutritive value, p. 141–147. In: Wang, J.K. (ed.). Taro: A review of *Colocasia esculenta* and its potentials. *University of Hawaii Press*, Honolulu, HI.