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Eligible are only university staff members of the respective sciences!

RESEARCH AND DEVELOPMENT

IN SUB-SAHARAN AFRICA

2010/1

UT SCIENTIIS
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New university clinics

Prof. Dr. Baldur Ed. Pfeiffer

Young universities in sub-Saharan Africa are increasingly interested in building a clinic at their campus for mainly two reasons: 1. University operated clinics offer adequate medical services to neighboring communities including staff and students. Approximately 5 - 10 percent of services are allocated to staff members and students and 90 percent to the neighboring population, who has limited access to basic medical care. 2. Universities recognize the urgent need to establish the health sciences. The inauguration of a nursing school may herald in this development succeeded by public health and eventually by medical sciences.

The preparatory phase of planning and financing a new clinic is a long enterprise. Often there already exists a small first aid center or a day clinic which demand an expansion. Meanwhile, universities have established the low investment sciences like business, education, humanities, social, and to some extent the natural sciences and are ready now for tackling the new challenge, which is the introduction of the more cost intensive health and medical sciences.

The clinic at Lukanga University (Dem. Repl. of Congo) under construction.

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This is the time when, as a co-partner, SUPPORT AFRICA INTERNATIONAL (SAI) provides assistance as soon as preparatory actions are completed, like the architect's plan and the permission for construction. Universities are invited to contact SAI for supplying medical equipments and clinic beds for their new clinics in case a co-operation is desired.

For economic reasons, universities often construct their clinics as a ground-floor building, thus avoiding the more expensive re-enforcement of the carrying walls obligatory for erecting a second floor. Also the actual budget requirements for administration, medical staff and medical services are impossible to predict at that early stage.

There is the optimistic view prevailing, that in case of any future expansions sufficient land would be available. However, there were inspiring cases of clinics fully utilizing the capacity, their expenditures sooner lessened than earlier expected. In less than ten years of operation further expansions became possible. To date, no collapse of a young university clinic has been reported.

Clinic of University of Lukango

Clinics supported by SUPPORT AFRICA

The decision for a ground-floor clinic has also advantages. This type of construction is less cost-intensive, because a ramp leading to the second floor is not required. Among the obstacles observed, the corridors and doors are sometimes too narrow for transferring beds from one room to the other. In some places no provisions are made for a clinic kitchen and a laundry due to the prevailing customs where food and laundry are taken care of by the respective families. If clinics provided room for kitchen and laundry, SAI would also supply equipment additionally. Optimized services rendered by relatives leads to improved hygienic conditions under less strain.

According to the co-operation agreement signed between SAI and universities, the latter mainly finance the construction of the building. The costs of a 30 bed clinic usually run up to 50.000 to 150.000 Euros depending on the strength of the local economy. Technical equipment provided by SAI amounts to an equal sum. The construction is an enormous investment and challenge for any university whose budgets mainly depend on fees and subsidies. Under these circumstances, universities very much appreciate the cost reductive solution offered by SAI. Only a few state universities have the capacity to invest beyond the amount mentioned, since they are expected to function as referral hospitals.

SAI is furnishing reconditioned medical equipment to meet the basic needs of general, surgical and dental medicine. Also included are gynecology, diagnostics and laboratory, besides 30 clinic beds and other hospital equipment needed. To start out with, this is a sufficient amount which can be upgraded as the demand develops later on.

SAI supports the idea of building a bridge of university clinics across the sub-Saharan African continent from East to West. The primary aims are the promotion of basic health care to satisfy the existing health needs of the population, but also for providing a basis for teaching health sciences at universities preparatory for medical studies. This strategy contributes to the provision of qualified health care and to the training of more medical and health personnel urgent needed in the future. New clinics and health sciences will emerge at sub-Saharan African universities as this process is escalating within the coming decade.

Adjunct university campuses

The university campuses in sub-Saharan Africa are usually larger than their European counterparts. This is due to the fact that the majority of them are located in rural way off the city centers to be reached only by motorized transportation. The founding fathers were in mapping out their campuses, that existed often of several hundreds of acres, generously.

The size of these huge campuses enabled the university planners of the first generation to give the campus a well planed functional and architectural shape, assigning the sites for the academic campus and the housing areas, adjunct by a farm, a restricted area for drinking water and somewhere at the edge maintaining a filter plant for the waste waters, etc.

But soon after the sciences had been established and the demands for more academic offerings were voiced, the countryside campus was suddenly faced by its limitations despite its huge areal. Down- town-university branches came now into the focus and were established in major cities. First lectures and seminars were offered in the evenings extended by specialized and follow-up courses until full academic programs emerged. Continuous education was promoted. But this move was not only promoted for educational reason, the precarious economic situation of the universities gave also birth to this new move. Next the university clinics moved also closer to the people and opened referral hospitals right down town. The university that first turned away from the city, returned now to the centers of population with an adjunct campus. University branches are very common in sub-Saharan Africa now-a-days. They are a result of their academic and economic expansion.

Finally, at the end of this process appear also the universities' industrial or productive centers, where the need of implementing the findings of the applied sciences is being felt or where financial considerations forced such measures to be taken. This move is not achieved without tensions. Some scientists feel that this is not part of their academic assignment while others argue in favor of their leadership obligation in promoting development in society.

There exists not a pre-prescribed pattern of this process. This phenomenon is a positive sign, demonstrating that universities are eager to serve their communities and strengthen their own economic status at the same time.

Neglected and under-utilized pulse legume crops as potential source of protein of Lamwa County, Kitgum District (Uganda)

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Introduction

Food insecurity remains one of the major problems of modern Africa, where famine continues to threaten peace and stability (Philip and Itodo, 2006). For thousands of years, Africans have depended mostly on their fruits, root/tuber, legumes and cereal crops for their subsistence. However, due to the decline and total neglect of their production on the continent, they are regarded as "neglected or under-uti1ized" crops of Africa.

According to Food and Agriculture Organization of the United Nations (FAO, 2004), 852 million people worldwide experience chronic hunger and it is estimated that 814 million live in developing countries, sub-Sahara Africa not being an exception. This finding illustrates the alarming state of malnutrition on the continent today. And the frightening truth of poverty and hunger are most evident in the developing regions of sub-Sahara Africa, where more than forty percent of the people are unable to obtain sufficient food on a daily basis (Mkandawire and Aguda, 2009).

Furthermore, hunger is also known not only to be a manifestation of poverty, but actually perpetuate it and, indeed, is the root cause of food insecurity (FAO, 1996a). In sub-Saharan Africa, millions of rural people suffer from chronic poverty, socio-economic marginalization, food insecurity and, most recently, the devastating impact of the climate change. Generally, the combined threat of food insecurity and the impact of climate change are leading to a rural development crisis, which requires integrated and multi-sectoral approach (FAO, 1988).

As it concerns climate change, the primary challenge for the agricultural sector is to mitigate the resultant impact on the agricultural systems that sustains the food security and livelihoods of the rural poor throughout sub-Saharan Africa. In poor rural households, climate change causes severe economic constraints that disrupt agricultural activities, aggravate food insecurity and undermine the prospects of rural development. The chronic poverty and food insecurity of African rural households becomes further aggravated, whereas the local capacity to overcome such crisis gradually weakens.

Nutrition status

Nutrition is an important factor in promoting health, preventing and treating disease and improving quality of life. The relationship between food, nutrition and health is one of the global challenges that we are facing today (Margetts, 2007). Nutrition for the venerable groups in African societies, for example, of the infants, children, pregnant, nursing women and elderly people should not be under looked. Our bodies, hair, and fingernails are made up mostly of different kinds of proteins that consist of varying combinations of amino acids. Some non-animal protein sources include legumes, nuts, seed and food yeast. Yeast foods provide the highest source of protein 50 percent (Gertjan, 2000).

Proteins are very large molecules made up of many amino acids linked together. Some amino acids are known as essential amino acids, because they can be synthesized in the body in large enough amount to meet the body's needs. The other amino acids are considered non-essential, because the body is unable to synthesize sufficient amounts when the amino groups are available (FAO, 2004). The sulfur containing amino acids, methionine and cystine are limiting in the proteins of these grain legumes. However, a favorable amino acid profile is easily obtained with the combined use of cereal grains in the diet. Food supplies available for direct human consumption have traditionally been gathered from wild despite their inherent flaws (Amuna, 2000). Dietary energy supply (DES) per capita which is simply the daily amount of food available for human consumption has subsequently been derived for countries from such national data.

The DES becomes the principal variable used by the FAO to generate estimates of the incidence of under-nutrition (FAO, l996b). Despite strong links between the DES of a country and the incidence of malnutrition, it is also true that even in industrialized countries with average DES in the region of 3,340kcals per capita/day (FAO, 1996c), there continue to be incidences of micro-nutrient under-nutrition, particularly iron deficiency in weanlings (Wharton, 1997).

The reasons for undernourishment are poverty and poor weaning practices. In the last decade, there has been renewed interest in food fortification, largely because it is generally recognized as being the most effective way to eliminate dietary micronutrient deficiencies (Amuna P., 2000). It is also thought to be socially acceptable, requiring neither a change in food habits nor a change in the characteristics of the food.

There are multitudes of factors leading to food insecurity, and these are: introduction of genetically modified crops, limited availability of arable land, inadequate water supply and other environmental disasters (FAO, 2003). Furthermore, diseases, conflicts, insufficient tools and inputs for successful agricultural production and transportation exacerbate the problem. In rural developing regions, farmers, who have limited resources to support a large proportion of the population, dominate agricultural production (Sumberg, et al., 2004).

Factors hindering food source diversification

Basing on a study conducted in southern Ethiopia on wild food plants, strong traditional beliefs and religious taboos obstruct people's psychological and mental willingness to domesticate and cultivate wild food plants (Guinand, et al., 2000).

Agricultural research and extension services are often disconnected from traditional agricultural systems of small-scale farmers, partly because they are designed from the top to the bottom, partly because they respond to policy considerations which are foreign to the local market trends and partly because they are tied to donor countries trends (Kroma, M. M., 2003). This is detrimental to many indigenous crops and varieties, leading to their neglect.

Additionally, the promotion of high yielding genetically modified crops excludes the crop diversity of farmer varieties and the potential of farmer-based crop improvements which could address the agro-ecological conditions, food needs and agricultural constraints of rural communities. Dominant modern and urban cultures despise many crops that the rural poor cultivate as 'indigenous' crops. This cultural discrimination results in the exclusion of these crops in policies, agricultural research, extension programs, market and rural development plans. Such cultural discrimination is so pervasive and often leads to the decline of the dignity and use of these crops and the rural people themselves, as they are persuaded or compelled to abandon their crops and varieties in order to become modern and achieve development.

Legumes suffer socio-economic exclusion

In this respect many indigenous pulse legumes suffer socio-economic exclusion, because they have a weak policy and programs support and very restricted access to market niches. Some indigenous neglected and under-utilized pulse legumes suffer technical constraints which impair their wide cultivation, consumption and marketing. For instance, some pulse legumes have a reduced market value due to consumer prejudices and lack of simple added value actions which could boost their marketing (FAO, 2004).

The deployment of appropriate technologies, commercialization of skills and policies may support rural people to overcome such technical constraints, thus optimizing the use of their crops for the goals of food security and income generation. Often an initial support is just needed that could boost the development of such crops.

Many traditional crops have received little research support to the point that their value and potential are poorly known, including their distinctive agro-ecological properties, nutritional quality and roles in local food habits (Jackson, et al., 2006). Consequently, such crops seem worthless for agriculture compared to other major crops whose features are well established and whose limitations are being addressed. This knowledge base leads to unawareness and impairs their further improvement and use. In addition, lack of formal research efforts on many indigenous pulse legume crops washes away technical, developmental and investment options to improve their cultivation and use. Pulse legumes are very ancient cultivation in both the old and new world. They are next importance to cereals as source of human food and contain more protein than any other plant product (Pulse glove, 1991).

Animal protein is still very rare in the diet of the vast numbers of the poorer people in the tropics and pulse legume often produce the chief and in some case the only source of protein. According to National Research Council 2006, Africa has more native legumes than any other continent. It has its own species of jack beans, pigeon peas, hyacinth beans and dozens of other legumes whose seeds are eaten from time to time. This food heritage has fed people for many generations stretching back to the origins of mankind. Largely bypassed in modern times by soybeans, local African legumes could not keep pace with foreign legumes, and the continent has slowly tilted away from its own ancient legumes wealth and embraced the newfound legumes from across the continents.

Nevertheless, these 'lost' plants have much to offer, not only to Africa but also to the entire world. They represent an exceptional cluster of legume biodiversity with particular promise for solving some of the greatest food-production problems of the twenty-first century. Africa's native legumes tend to tolerate extremes of agro ecological zone such as semi arid regions. They can thrive where introduced legumes produce inconsistently. Moreover, most can grow better than other legumes on relatively infertile soils. For thousands of years, they have yielded even where land preparation was minimal and management poor. They tend to be nutritious and better tasting than most of the world's well-known legumes.

Climate change is affecting the cropping patterns of many of the crops that people use and therefore it is extremely important to come back to some of the so-called "forgotten" and "under-utilized" plants, because many of them actually can withstand droughts or floods much better than the commercial crops. In addition, traits such as high yielding, tolerance to diseases and environmental stresses which are available in under-utilized or neglected traditional plants can be introduced through breeding efforts into other crops.

Endemic hunger from protein-energy malnutrition and transient hunger from drought, floods and other natural disaster are the realities of the day. However, scientists and biodiversity experts say that hunger can be tackled with an integrated strategy for conservation and sustainable and equitable use of agricultural biodiversity. Unlike animal protein, plant-based proteins source contain healthy fiber and complex carbohydrates. Animal products are often high in artery-clogging cholesterol and saturated fat, and the consumption of animal protein has been linked to some types of cancer. There is no need to eat animal products to maintain good health as studies about plant protein and nutrition show. The legumes are major sources of dietary protein and calories for human consumption in the world but of minor importance in sub-Sahara Africa.

The cool season food legumes range in protein content from about 22% for chickpeas to 28% for lentils (Edossa, et al., 2007). These legumes are popular in the developing countries of the Near East and North Africa. In addition, they are a dietary mainstay on the African continent, especially in regions where religious preferences discourage the consumption of animal protein. Some crops have received much attention as far as research is concerned and many institutes are devoted

to their development and promotion. However, many crops have been neglected by agricultural science hence neglecting their potential. International agricultural research has always promoted species and varieties of a limited number of crops and this has resulted in many people accustomed to a few crops.

Despite the high nutritional, medicinal and economic values, these under-utilized crops have been considered as minor crops and have received little funds for their promotion (Karl, et al., 2004). Furthermore, these crops have been neglected by researchers, development planners, even the international organizations. Most legumes are consumed as cooked seeds because of limited resources. For example cowpea is an important crop consumed by the many rural communities, while the surplus is traded as cash crop in local, national and regional markets.

Legumes are widely adapted group of crops that are generally under-utilized in cropping systems of East Africa. Prospects for expanded use in rotational systems with cereals depend on development of export markets and expanded domestic use for food and feed. Vigna mungo and Pisum sativum have potentials as protein supplements for animal feeding, while lentil and chickpea are produced for food because of their relatively high value.

Of the legume crops, pigeon pea, hyacinth bean and lima bean seem to have the greatest potential for expanded production. These pulse legumes are tolerant to dry conditions and can be used as fallow replacements in many areas of Eastern Uganda.

Photos by F. Olwari

Scientific name: Vigna mungo
Common name: Black gram

Description: Erect, hairy annual herb, about 90 cm tall. Stem diffusely branched from the base. Leaves: Alternate, trifoliate, petiole 5 to 20 cm long, leaflet ovate or rhombic-ovate, 4 to 10 cm long and 6 cm wide, entire and acuminate. Infloresence is with an axillary false raceme. Flower: Bisexual, papilion-aceous, small, bracteoles linear to lanceolate, exceeding the calyx, corolla yellow, standard 12 to 14 mm wide, wings approximately as long as standard. Fruit: Cylindrical pod, 6 cm long and 0.5cm, erect with hairs and short hooked beak, 4 to 8 seeded. Seed: ellipsoid, 5mm long, with squared ends and raised concave hilum, usually black, brown, cream or mottled or sometimes green (PROTA, 2006).

Over the years, legumes constituted subsidiary staple foods for the indigenous East Africans. Even in current traditional agricultural practices, legumes are commonly intercropped with tubers, cereals and other crops. They also supplement the main staple, for example cereal or tuber based. In their role of ensuring year round availability of food products, the food industry has failed to recognize the traditional complementary role of the legumes in the local diets. The cowpea, lima beans, and pigeon peas can be prepared in a variety of ways tested and practiced over millennia. However, like cereals, the potential of legumes as food sources has not been fully tapped. Only the 'introduced' soybeans, out of the list of locally available legumes, are used in the manufacture of baby foods. For instance in Nigeria, soybean was produced on 624,000 ha making it the largest producer in Africa (Williams, et al., 2001).

The shift from the consumption of millet, sorghum, maize, rice and wheat products has resulted in the reduction of the

General description and classification of wild crops which can be domesticated

Wild foods

The term 'wild food', though commonly used, is misleading because it implies the absence of human influence and management. In reality, there is a continuum resulting from the development of co-evolutionary relationships between humans and their environment (Bell, 1995). People have indirectly shaped many of the plants and some have been largely domesticated in home gardens and in the fields together with farmers' cultivated food crops and cash crops. Nevertheless, the term 'wild food' is used to describe all plant resources out-side of agricultural areas that are harvested or collected for the purpose of human consumption in forests, savanns and other bush land areas (Bell, 1995).

Wild foods are incorporated into the normal livelihood strategies of many rural people who are either pastoralists shift cultivators, continuous croppers or hunter-gatherers (Bell, l995). Wild food is usually considered as an additional farmers' daily food consumption pattern, generally based on their crop harvest, domestic livestock products and food purchases on local markets. Wild fruits and berries from a wide range of wild growing plants are typically referred to as 'wild foods'

Traditional crops

These are resources traditional in nature that are integrated and co-evolving with indigenous knowledge, agricultural practices, food habits and cultural dynamics of the rural communities and peoples that hold them. Many traditional crops are also considered as minor due to their little relevance in the global agricultural production and trade, as well as to their scant attention science, rural development programs and agricultural policies. They also include neglected and under-utilized crops (Eyzaguirre, et al., 1999).

Neglected crops

Crops, including their associated genetic variability that peasants cultivate in the centers of crop origin or diversity, include that are allegedly neglected by science and development. They play relevant roles in the agriculture, nutrition, livelihood and cultural dynamics of countless rural communities, but they are accordingly supported.

Under-utilized crops

These are crops that used to be widely cultivated but are rapidly diminishing, often as a result of socio economic, cultural, policy, agronomic or other forces. They often encompass advantageous traits and potential for food security, such as specific nutritional properties and ecological adaptation, but their cultivation and use are rapidly declining.

Methodology

Study area

Lamwa County is found in Kitgum District of Uganda between 32 degrees and 30 seconds to 38 degree East and 1 degree l8 seconds to 3 degrees 30 seconds north (Uganda districts, 2005). It covers an estimated area of approximately 1980 square kilometers. Lamwa has ten sub-counties viz. Agoro, Madi-Opei, Palonga, Padibe east, Padibe west, Lokung, Palabek-Kal, Palabekogil, Akwang and Layamo. Within each sub-county are several parishes, each made up of a number of villages.

The climate is generally warm and dry. Rainfall is bimodal and ranges between l000 - 1500 mm annually (Uganda Bureau of Statistics, 2004). This rainfall pattern results in two planting seasons. The soils of Lamwa are of low productivity. The natural vegetation is Savanna, the greater part of which is at present dominated by non uniform agriculture (67.4 percent (Langdale-Brown, 1959).

The county has an estimated population of 150,000 people and a population density of 140 people as per Uganda census of 2004 (Uganda Bureau of Statistics, 2006). Lamwa people are known as Luo or Acholi and they are an agricultural community. They practice subsistence crop agriculture as their main source of livelihood, growing mostly sweet potatoes, maize and finger millet, cassava, sorghum, groundnuts, cotton and fruit plants especially orange and mangoes. They practice fallow and permanent cultivation farming system. However, they also gather some food from the wild lands.

Methods

The reasons to initiate the study of 'wild food' plants, with emphasis on pulse legume plants, have a largely practical and pragmatic basis. The initial idea was to document indigenous knowledge on wild foods more particularly pulse legumes and identify and understand better their importance as a source of proteins in the survival strategies adopted by the rural people during time of food insecurity, and also promote the cultivation and consumption of pulse legumes. Besides the collection of secondary data, of which unfortunately very little exists of wild pulse legumes and related subjects concerning Lamwa County, informal interviews were conducted with selected key informants.

In the field, interviews and discussions were held with farmers, men, women, hunters and children. Bush and farm walks were undertaken for tracking down specific wild plants. The team was guided by local agricultural experts, who identified knowledgeable key informants and also acted as translator. Whenever possible, background information was collected on edible wild plants, a vernacular name of the plants and edible components were taken.

Using participatory pair wise ranking, the researchers collected, mounted, labeled and submitted twenty six different plant specimens to the national herbarium at Makerere University for identification and taxonomic classification.

Results and discussion

The families leguminosae and diosccoreacae have the highest diversity of neglected and under-utilized food crops. Other families include solanaceae, poaceae and convolulaceae. To determine the major legume pulse of Lamwa, the research calculated the familiarity index and set the lowest limit of familiarity to 26. Accordingly, ten species turned out to be routinely used. Six of the major legume pulses were introduced. Of these, three species are cultivated and the rest are either naturalized or semi-wild. Four of the major pulse legumes are eaten as staple food and they include: Vigna munga, Cajanus Cajan and Vigna unguiculata. Another three are eaten during period of food insecurity and these include: Acacia mellerifa, Tamarindus indica and Parkia bicolor.

Photo by F. Olwari

Scientific name: Cajanus cajan
Common name: Common pigeon

Description: A shrub: annual or perennial, 3 to 5 m. Leaves: alternate, trifoliate. Stem: erect, becoming woody with age. Bark brown, thick ribbed and densely hairy. Leaves: compound trifoliate, leaflets hairy, white below, 2 to 8 cm long, grooved above; rachis 0.5 to 4 cm long. Flowers: usually yellow in terminal group, the larger petal has red line outside, bud yellow. Fruit: sickle-shaped pod 2 to 10 cm long, hairy with 4 to 5 green to gray seeds. Seeds: globose to ellipsoid, 4 to 8 mm long and 4 mm wide, cream, brown, purplish, plain or mottled (Katende, et al., 1995; PROTA, 2006)

Photo by F. Olwari

Scientific name: Tamarindus indica
Common name: Tamarind

Description: A large tree, 30 m width, extensive dense crown, evergreen or deciduous in semi arid area. Bark rough, grey to brown. Leaves: compound, on hairy stalk to 15 cm, 10 to 18 pairs of leaflets, light green, 3 cm long, oblong, round at the tip and base, vein raised. Flowers: small, few-flower heads, buds red, petals gold with red veins. Fruit: pale brown sausage-like, pods, cracking when mature to reveal sticky brown pulp around 1 to 10 dark brown angular seed (Katende, et al., 1995; PROTA, 2006).

Further eight are eaten as snack and they include: Eriosema nutans, Acacia hockii, Parkia filicodea, Astragalus atropikisulus, Senna singueana, Cordia africana, Decorsea schlechteri and Acacia karroo.

The major legume pulse food crops of Lamwa are consumed locally while a few are traded. The preparation of legume pulse is 20% of the edible neglected or under-utilized plants. Reasons that have led to the neglect or under-utilization of these plants: According to the responses from the interviews, cultivated introduced legume pulse crops are more important than those collected from the wild. Yet the majority of the legume pulses are semi-wild. In addition, farmers also have a diversity of cultivated foods to choose from. Semi-wild legumes pulses are not readily available, because their habitats have been cleared for agriculture or settlement. Lastly, loss of traditional knowledge has also led to the neglect of these crops as the old are dying with this vital information or young people are spending most of their time at school.

Conclusion

Pulse legumes have a potential of providing enough protein to the ever increasing population of the poor people of Lamwa County, Uganda and sub-Sahara Africa in general. They are regarded as under-utilized due to the decline and total neglect of their cultivation. Several factors are responsible for their decline and these include: limited availability of arable land, inadequate water supply and other environmental disasters, diseases, conflicts, insufficient tools and inputs for successful agricultural production and transportation.

Pulse legume cultivation in East Africa and Lamwa in particular has to be promoted by researching into activities towards the solving of existing biological, agronomical, climatically, man-made constraints that hinder the cultivation and consumption of pulse legumes. Therefore, the importance of searching for new sources of proteins from pulse legumes cannot be overlooked for the present and the generations to come.

Recommendations

Since legume pulses are a rich source of protein for the poorer population who depend on them during periods of food insecurity, more efforts need to be taken to conserve their genetic diversity through the establishing of community based seed banks.

In addition, we need to document and disseminate the traditional knowledge to the young people before the people who hold it die away. More participatory studies need to be intensified involving community members who are the custodian of the plant resources. Also governments should promote research on how best to conserve these neglected or under-utilized plant resources before they become distinct.

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An appraisal of some seeds and vegetables as lesser known potential sources of non-animal protein in Northern Nigeria

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Introduction

In sub-Saharan Africa there are several thousand indigenous species of plants already selected for food production that still fall outside the ambit of modern research and economic development. These plants have been feeding people for ages and have become essential parts of the peoples' life, culture and farming systems (Okigbo, 1979; Smith, 1982; Uwaegbute, 1989; Olowu and Atu, 2001). Many thrive in the harsh conditions that Africans face daily. Some of them are exceptionally nutritious, yet none of them have received adequate scientific or institutional support. Many of these plants offer significant global potential as sources of various nutrients, including non-animal (vegetable) protein.

Plants are more popular as sources of vitamins, minerals and roughage and their parts are not traditionally consumed as sources of protein. However, some of them offer quantities of protein that are significant enough to make a difference in the otherwise dominantly carbohydrate based diets of many in sub-Saharan Africa. Many plants are used in this regard. Some of them grow wild and are harvested as such. Some are protected in home gardens or farmsteads. A few are cultivated to limited extents. Majority are shrubs, seeds, leaves and fruits of herbaceous plants, and trees. They all have in common the fact that they have received little or no scientific attention and/or attempts at developing their economic potential. They are therefore classified as under developed crops (Chweya and Eyzagurree, 1990; Adebooye et al., 2003). A recent assessment of plant resources of Tropical Africa (PROTA) on African vegetables highlighted those species of primary use as vegetables. However, several other perennial species that yield edible leaves as secondary products were scarcely mentioned (Grubben and Denton, 2004). This is in spite of the urgent need to meet the nutritional requirements of an ever increasing human population (Prakash and Misra, 1998). Many such plants have been identified. For example, up to 150 wild edible plants were identified in Botswana, while over 200 shrubs and trees of West African origin could yield products of high nutritional value (Abubakar, 2006; NRC, 2006). Similarly, seeds of Cassia laevigata and Tamarindus indica have been recommended for adoption as cheap sources of protein in India (Siddhuraju et al., 1995).

In Nigeria, there are many plant species that are indigenous, or naturalized, which can be exploited as sources of non-animal protein. A major reason for the low patronage enjoyed by lesser known plants as sources of protein for human consumption is the lack of knowledge of their nutritional potentials, as well as the suspicion of the presence of anti-nutritional factors in the parts that are potentially edible. The objective of this paper is therefore to present data available to the author on the potentials of indigenous and naturalized plant species as sources of non-animal protein as well as the present cultivation and utilization status of these species in northern Nigeria.

Methodology

The data presented is of two origins.

1. Primary Data

These were generated from research mainly conducted in the author's laboratory and other laboratories in the Department of Biological Sciences, Ahmadu Bello University, Zaria in northern Nigeria. These evaluations were done at various times and by various workers as acknowledged.

2. Secondary Data
These were data collected from published works of various authors as acknowledged.
3. Experimental
Parts of plants used for evaluation of protein contents, were collected fresh from the field, cleaned and air dried. They were subsequently dried in oven at 65-70° C till constant weight. Further processing involved grinding in an agate mortar and the resulting powder was analyzed for total nitrogen content. The methodology involved in these analyses for both primary and secondary data was the micro-Kjeldahl procedure (except where otherwise stated) for determination of percentage nitrogen (in dry matter) and multiplying the result by the nitrogen: protein conversion factor of 6.25 (AOAC, 1980). Anti-nutritional factors were similarly determined by standard methods (AOAC, 1980).

Results and Discussion

The protein contents previously reported for a wide range of seeds of various plants (mainly trees) as well as data generated from research in the author's laboratory is presented in table 1 and 2. Protein contents for seeds of most of the trees ranged from 11.24% (Detarium microcarpum) to as high as 40.19% (Moringa oleifera). Eight of the nine species reported were tree legumes. Interestingly however, the only non-legume reported had the highest protein content of 40.19%. Relatively high protein contents are expected in seeds of legumes, because of the ability of legumes to incorporate atmospheric nitrogen into ammonia and subsequently to amino acids and proteins. This they do through symbiotic nitrogen fixation in association with bacteria of the genus Rhizabia that live in the plants' root nodules. Seeds of legumes (also called beans, grain legumes or pulses) are second only to cereals as sources of human and animal food. The pulses are leading candidates to be considered for improvements of vegetable protein supply to malnourished areas. Many have protein contents of between 20 and 40%, while a few may range between 40 to 60% (NAS, 1979; Alais and Linden, 1999). Unfortunately, of the thousands of known legume species, less than 20 are extensively used as food sources at present. The remaining is little used and many of them remain almost unknown to science (NAS, 1979). Therefore, the increased use of food legumes should be encouraged by developing the potentials of the lesser known species.

Moringa olefeira, a non-legume whose seeds had a protein content of over 40% is well known as the planets most valuable undeveloped tree. Being well suited for growth in sub-Saharan soil, the tree yields at least four different edibles (pods, leaves, seeds, roots) that have impressive complements of protein, carbohydrates, oil, vitamins and minerals NRC, 2006). Another non-legume that expressed an appreciable level of protein content was Khaya senegalensis with a seed protein content of 17.63 (Table 2). This tree is not usually exploited as food tree. Rather it is known to yield high quality wood (West African Mahogany) and phyto-chemicals extensively used in ethno-medicine (Mann et al., 2003; Aliyu, 2006).

Seeds of a few of the legumes had relatively low protein contents. These included Delonix regia (4.25%) and Albizia lebbek (8.75%) (Table 2). Protein contents of such seeds can be significantly improved by simple processes such as fermentation (Ega, l986).

Table 3 presents protein contents in leaves of some indigenous and naturalized plant species in Northern Nigeria. Again, protein contents varied widely and went as high as 41.60% in Hibiscus sabdariffa var sabdariffa (Rosselle). Vegetable leaves are common sources of non-animal protein in Africa. However, many Africans have remained largely dependent on non-native food plants that have tended to displace local species. Long ago hundreds of leaves, roots, tubers corms, rhizomes, bulbs, shoots stems pods and flowers were eaten. However, across Africa today, the main vegetables are crops such as sweet potato, plantain, cassava, peanut, common bean, peppers, eggplant and cucumber. Out of the continents top vegetables today, only cowpea, yam and okra are African (NRC, 2006). This situation is clearly undesirable as it portend danger to the continued survival of indigenous species and also restricts natural resource utilization.

Tables 4 and 5 present the results of preliminary evaluations of the anti-nutritional factors in some of the plant species being assessed. A wide range of chemical substances with anti-nutritional capacities were detected. Phyto-chemicals are normal constituents of plant tissues. They are secondary metabolites produced as by-products of primary plant processes and are required to enhance plant adaptation and survival in the natural environment. Man exploits the presence of these chemicals as sources of raw materials in agriculture, industry and medicine. It is well known that

Table 1: Protein content in seeds of some indigenous and naturalized plant species in Northern Nigeria

Scientific Name	Common Name	Family	Protein Content(%)	Source of Data
Acacia senegal	Gum Arabic	Fab: Mimosoideae	38.89	Balogun & Fatuga, 1986
Bauhinia monandra	Orchid tree	Fab: Caesalpinioideae	24.68 26.20	Balogun & Fatuga, 1986 Omode *et al*; 1995
Bauhinia rufescens	Orchid bush	Fab: Caesalipinioideae	21.70	Omode *et al*; 1995
Caesalpinia pulcherrima	Pride of Barbados	Fab: Caesalpinioideae	26.60	Omode *et al*; 1995
Detarium microcarpum	Tallow tree	Fab: Caesalpinioideae	11.24	Ahwange *et al*; 2004
Moringa oleifera	Moringa/Horse radish tree	Moringaceae	40.19	Ahwange *et al*; 2004
Parkia biglobosa	Locust bean	Fab: Mimosoideae	28.20 29.40	Ega, 1986 Balogun & Fatuga, 1986
Prosopis africana	Mesquite	Fab: Mimosoideae	25.74	Balogun & Fatuga, 1986
Tamarindus indica	Tamarind	Fab: Caesalpinioideae	16.06 12.87	Ega, 1986 Balogun & Fatuga, 1986

Table 2: Protein content in seeds of some indigenous and naturalized plant species in Northern Nigeria

Scientific Name	Common Name	Family	Protein Content(%)	Source of Data
Albizia lebbek	Siris tree/East Indian Walnut/Woman's tongue tree	Fab: Mimosoideae	8.75	Present work
Bauhinia monandra	Orchid tree	Fab: Caesalpinioideae	21.00	Abubakar, 2006 (Author's laboratory)
Delonix regia	Flamboyant	Fab: Caesalpinioideae	4.25	Present work
Khaya senegalenis	West African Mahogany	Meliaceae	17.63	Present work
Lonchocarpus sericeus	Wild/African	Fab: Papilionoideae	22.60	Abubakar 2006 (Author's laboratory)
Mangifera indica	Mango	Anacardiaceae	7.63	Present work
Millettia thonningii	Thonning's Millettia	Fab: Papilionoideae	19.20	Abubakar, 2006 (Author's laboratory)
Mimosa pigra	Giant sensitive plant	Fab: Caesalpinioideae	38.70	Abubakar, 2006 (Author's laboratory)
Senna alata	Ringworm plant	Fab: Caesalpinioideae	5.25	Present work
Uvaria chamae	Bush banana	Annonaceae	15.00	Odoh, 2004

Table 3: Protein content in leaves of some indigenous and naturalized plantspecies in Nothern Nigeria

Scientific Name	Common Name	Family	Protein Content(%)	Source of Data
Gnetum africanum	Gnetum	Gnetaceae	14.06	Bealo, 1998 (Author's laboratory)
Hibiscus cannabinus	Kenaf	Malvaceae	37.76	Amadi, 2004
Hibiscus sabdariffa var altissima	Roselle	Malvaceae	40.30	Umar, 2006 (Author's laboratory)
Hibiscus sabdariffa var sabdariffa	Roselle	Malvaceae	41.60	Umar, 2006 (Author's laboratory)
Senna obtusifolia	Sickle pod/foetid cassia	Fab: Caesalpinioideae	24.53	Yakubu, 2008 (Author's laboratory)
Senna occidentalis	Coffee senna	Fab: Caesalpinioideae	19.50	Yakubu, 2008 (Author's laboratory)
Sesamum indicum	Sesame/beniseed	Pedaliaceae	9.38	Onaji, 2008

Table 4: Anti-nutritional in seeds of some indigenous and naturalized plant species is Northern Nigeria

Scientific Name	Common Name	Family	Anti-nutritional factors identified	Source of Date
Albizia lebbek	Siris tree/East India walnut/Woman's tongue tree	Fab: Mimosoideae	Oxalate, phytate, sapornin, tannin, cyanide	Present work
Bauhinia monandra	Orchid tree	Fab: Caesalpinioideae	Trypsin inhibitor phytate, tannins	Abubakar 2006 (Author's laboratory)
Delonix regia	Flamboyant	Fab: Caesalpinioideae	Trypsin inhibitor phytate, tannins	Abubakar 2006 (Author's laboratory)
Khaya senegalenis	West African Mahogany	Meliaceae	Trypsin inhibitor tannins phytate	Present work
Lonchocarpus sericeus	Wild/ African Indigo	Fab: Papilionoideae	Oxalate, phytate, sapornin, tannin, cyanide	Abakar 2006 (Author's laboratory)
Millettia thonninglii	Thonning's Millettia	Fab: Papilionoideae	Trypsin inhibitor phytate, tannin	Abubakar 2006 (Author's laboratory)
Mimosa pigra	Giant sensitive plant	Fab: Mimosoideae	Trypsin inhibitor inhibitor phytate, tannin	Abubakar 2006 (Author's laboratory)
Mangifera Indica	Mango	Anacardiaceae	Trypsin inhibitor phytate, tannin	Present work
Parkia biglobosa	Locusts bean tree	Fab: Mimosoideae	Tannin oxatate, saponin, cyanide.	Present work
Senna alata	Ringe worm plant	Fab: Caesalpinioidea	Saponin, tannin, cyanide, Phytate Oxalate.	Present work
Uvaria chamae	Bush banana	Annonaceae	Not determined	Odoh, 2004

the concentration of these phyto-chemicals varies between plant parts and also at various times during the growth of the plant. Therefore, any conclusions to be drawn from the presence of these phyto-chemicals must first assess the actual quantities of the various substances in the plant tissue, to ascertain the nutritional safety limits. In any case, it has been reported that simple processing operations such as boiling/cooking can reduce the levels of these substances considerably (Ahwange, et al., 2004).

Table 6 presents data on the current cultivation and utilization status of the various plant species in this study. The local names are given in Hausa language (except where specified otherwise), the most commonly spoken language in northern Nigeria. It clearly shows that a majority of these plants are better known for other uses than as food sources. Majority of the species are presently collected from the wild, or only partially cultivated. Some are merely protected on farmsteads as economic trees. Species like Acacia senegal, that was previously collected only in the wild is now under intensive cultivation as a source of gum Arabic.

Table 5: Anti-nutritional factors in leaves of some indigenous and naturalized plant species in Northern Nigeria

Scientific Name	Common Name	Family	Anti-nutritional factors identified	Source of Data
Gnetum africanum	Gnetum/Eru	Gnetaceae	Not Determined	Bealo, 1998
Hibiscus cannabinus	Kenaf	Malvaceae	Not Determined	Amadi, 2004
Hibiscus sabdariffa var altissima	Roselle	Malvaceae	Oxalate, cyanide phytate.	Umar, 2006 (Author's laboratory)
Hibiscus sabdariffa vor sabdariffa	Roselle	Malvaceae	Oxalate, cyanide phytate.	Umar, 2006 (Author's laboratory)
Senna obtusifolia	Sickle pod/foetid cassia	Fab: Caesalpinioideae	Phytate, trypsin inhibitor, cyanide, glycoside.	Yakubu, 2008 (Author's laboratory)
Senna occidentalis	Coffee senna	Fab: Caesalpinioideae	Phytate trypsin inhibitor, cyanide, glycoside.	Yakubu, 2008 (Author's laboratory)
Sesamum indicum	Sesame/beniseed	Pedaliaceae	Cyanide, phytate saponin, tannin.	Onaji, 2008
Uvaria chamae	Bush banana	Annonaceae	Not determined	Odoh, 2004

Further, species like Gnetum africanum, whose natural habitat is the tropical rain forests of southeastern Nigeria and forest outliers in northern Nigeria, is now under limited cultivation in home gardens in northern Nigeria. This should emphasize the possibility of developing the potentials of the various plants as food sources.

Conclusion

This study is by no means an exhaustive presentation of the great diversity of plant resources that are available for exploitation in this part of the country. It has, however, highlighted the potentials of indigenous plants as sources of food proteins that could be utilized to improve human nutrition in a predominantly low income population. It should also stimulate further research into food safety aspects, as well as commercial viability of the species with promise as crops for enhanced cultivation.

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*Co-winner of the Research Award of Sustainable Agriculture, 2008.

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Agrarian science for sustainable resource management in sub-Saharan Africa

Book report

Prof. Dr. Uche C. Amalu, Faculty of Agriculture, University of Calabar, Calabar

The twin problems of food and arable land shortages, resource scarcity, population growth, climate change, environmental degradation and exposure to natural disasters are at present among the greatest agricultural and rural development challenges facing countries of sub-Saharan Africa (SSA). Though several perspectives on overcoming hunger, poverty and environmental degradation have been very amply described and extensively discussed in the "THE UNFINISHED AGENDA", the 2001World Food Prize Winner book, by Per Pinstrup-Andersen and Rajul Pandya-Lorch, the extent and depth of the above problems at the turn of a new century and millennium remains unconscionable.

With a view to helping in stemming the above scourge and threatening situations enumerated above and in searching for feasible alternatives, the SUPPORT AFRICA INTERNATIONAL e. V. (SAI) and SCHWEISFURTH-FOUNDATION both of Germany encouraged African Scientists to conduct some researches aimed at developing and applying sustainable and regionally adaptable agricultural practices. Every year, the best scientific papers are rewarded with **Research Awards**, but more importantly, are published in SAI Serials "STUDIES IN SUB-SAHARAN AFRICA". **"Agrarian Science for Sustainable Resource Management in sub-Saharan Africa"** is a collection of the best scientific papers submitted by African Scholars in the SSA region.

The book highlights the importance of science in our global and regional efforts at tackling resource scarcity, and fashioning out alternative and applicable models for sustainable resource management in the SSA region. Several useful theoretical frameworks in agrarian and animal sciences, which can help in establishing and implementing practical solutions for resource management in the SSA region have been presented (in very simple and easy-to-read English language) in section one. Important issues of natural resources and natural resource conservation, including soils and water, animal, agro-forestry, agro-biodiversity, energy and human resources etc; have been discussed with an aim at achieving maximum conservation status and sustainability. The emerging facts that all the foregoing could only be achieved by implementation of sound resource-building policies by governments and employing holistic and participatory research approaches by responsible institutions were emphasized. But perhaps the more interesting fact is that all the above theoretical models and recommendations have been developed, based on day-to-day and on-the job experience of African Scholars of their own socio-cultural, economic, demographic agro-ecological and biophysical environment.

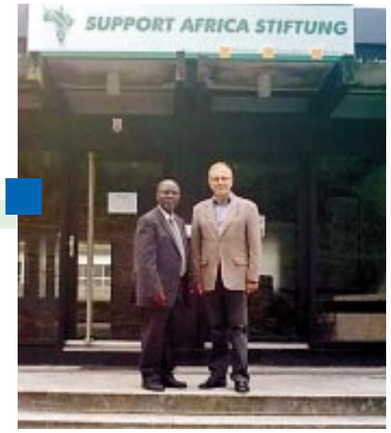
The book is not all theory, however. In section two are presented very good details of practical applications of the theories developed and propounded in the preceding section one. Contemporary and sensitive issues ranging from protection of rights to indigenous land resources and their management, fire wood fuel exploitation and land use practices, through employment of basic soil science principles in the management of land and mitigation of degradation of land were extensively discussed. An outstanding example of applications of different resource-sustaining methods aimed at reducing hunger and poverty, as well as improving health of rural households the application of organic farming for sustainable horticultural production in Kenya is showcased.

A special section was dedicated, at the end of the book , to some rather unusual, but very relevant subjects, fish and poultry nutrition, specifically centering on African Catfish (Clarias Griapillus (Burchell, 1822) and the exploitation of the biological and genetic potentials of poultry birds from administration of relatively cheap nutrients sources, which abound nearly everywhere in sub-Saharan Africa.

The book, like the earlier one in the series, is a fine and readable example of a new wave of thinking, **"Development of Tertiary Institutions across SSA"**, encouraged and promoted by SAI, which recognizes that the indigenous scholars (African Scholars) often knew best (all along) of their immediate environment. For scholars and agricultural practitioners who are eager to change their perceptions and approaches, this book is a great encouragement. The book succeeds in its purpose of providing new information, examples of best practices and sound analytical tools for those involved in and are affected by hunger, poverty and environmental degradation in SSA to take the best decisions. Subject-matter-specialists in the Ministries of Agricultural and related agencies will find the book very interesting and exciting.

NEWS

Vice-Chancellor of UEAB, Kenya, visited SAI



The Vice-Chancellor of the University of Eastern Africa Baraton, Prof. Dr. Nathanael Walemba, visited the head office of SUPPORT AFRICA INTERNATIONAL, Sept. 14 to 18, 2009. Further co-operations were discussed.

Agreement signed

Bugema University (Uganda) signed an agreement of co-operation for the development of its new clinic with SUPPORT AFRICA INTERNATIONAL, December 12, 2009. The picture shows l. to r. Mr. John Bazarra (Business Manager), Prof. Dr. B. Pfeiffer, Prof. Dr. Patrick Manu (Vice-Chancellor) and Mrs. D. Grebe.

Visit to the Inter-University Council for East Africa

Mrs. D. Grebe and Prof. Dr. B. Pfeiffer pay a visit to the Deputy Secretary of the Inter-University Council for East Africa, Prof. Moses L. Golola, in Kampala, January 20, 2010. The developing of clinics at universities in Eastern Africa was the center of discussion.

Tractors for university farms

University farms and horticultures are becoming of more significance to university economies. Their importance is not only due to agricultural research objectives but also to the incomes gained from meat and milk production and fruits, etc. They provides food for the cafeteria and sales to the community, it gives work opportunities to students and the community. It makes as such a significant contribution to the university economy. SUPPORT AFRICA INTERNATIONAL helps universities in obtaining new and reconditioned agricultural equipment. Reconditioned tractors such as INTERNATIONAL HARV 30 - 60 h. p.

Left: Continental Harv-IHC 383 with mowing device.
Right: Continental Harv-IHC 431with fork. Both tractors are helpful in small fields.

SUPPORT AFRICA INTERNATIONAL
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