アフリカにおける米の生産: サハラ以南アフリカの食料安全保障を強化するためのキー
Rice Production in Africa: A Key to Promoting the Sub-Saharan Africa Food Security

ジョン・C・オニャンゴ　John C. Onyango
ケニア国立マセノ大学理学部長
名古屋大学農学国際教育協力研究センター客員教授*

Professor, Department of Botany and Horticulture, Dean of Faculty of Science,
Maseno University, Kenya
Visiting Professor, International Cooperation Center for Agricultural Education (ICCAE),
Nagoya University, Japan*

要　約

アフリカ全体そしてケニアにおいて、農村住民の 60%以上が貧困であると言われている。貧困は通常、健康不良と栄養失調として現れる。深刻な食糧不足に加えエイズの流行が多くの農村地域の状況をさらに悪化させている。

アフリカ稲（*Oryza glabberima*）とアジア稲（*Oryza sativa*）の交配種である New Rice for Africa（NERICA）の利用は貧困を削減する方策の一つとして期待されている。西ケニアで実施された NERICA 品種の適応性試験では、1ヘクタール当り5トン以上の収量が示され、ケニア国内の水稲の収量を上回った。マセノ大学、アルペ研究センター、および SACRED-Africa（ブンゴマ）の適応性試験圃場で開催された農民の見学会で農民がこれを目にしてその事実に気づき、自分達の農地で NERICA を栽培したいと種子に対する要望が上がった。このことから、西ケニアで今後 NERICA 種子の需要が増えることが予想され、種子提供システムを整える必要性があると言える。

NERICA には実際 3,000 以上の品種があるが、西アフリカでは現在、約 25 品種しか利用されていない。ケニアで入手できる NERICA はわずか 20 品種であり、西ケニアの農地で適応性があると判明しているのはそのうちわずか 6 品種である。これらの推奨品種には共通する栽培特性があり、アフリカ大陸の厳しい環境条件下で長年にわたり進化してきたアフリカ稲品種の特性を持つ NERICA は、水不足や病虫害などのストレスに対する耐性が優れている。NERICA は親品種のいずれよりも収量が高い。1穂粒数は、*Oryza glaberrima* が約 100 粒、*Oryza sativa* が約 250 粒である一方、NERICA の1穂粒数は約 400 粒と多く、これが高い収量をもたらしていると思われる。また、NERICA のタンパク質含量は 10～12％で、親品種の約 8～10％を上回る。

コメはアジアで最もよく知られている穀物であり、世界人口の半分以上が数世紀にわたり食べ続けてきている。1980 年代にアジアで起こった緑の革命は、コメ研究の成功に拠るところが大きく、その研究は現在も続いている。この事実は、アフリカの食糧事情を解決する方策を探るうえで刺激となるものである。1991 年から

* 2006 年 10 月講演当時。
At the time of presentation in October 2006.

数年を経て、NERICA は食糧保障および換金作物として西アフリカでよく知られるようになり、多くの農民女性グループが NERICA を主要穀物作物として栽培するようになった。食料生産と現金経済の観点から、NERICA が果たす役割は非常に大きいと考えられる。

　これらのことを踏まえて今回の発表では、サハラ以南アフリカの作物生産に影響を与える重要項目について述べる。また、その影響下にある人々に寄与するために、それらの課題をどのように推進していくべきかについても述べる。研究によって解決策を探るという観点から、研究グループが早急に注目すべき課題に次のようなものがある。

耐旱性、肥料の利用効率、雑草管理、保証種子の生産、過去の降雨パターンのコンピュータ解析、病害虫管理、間作・輪作システム、水稲用 NERICA 品種、ポストハーベスト加工、付加価値付与・精米・マーケティング戦略、女性農民による土地所有、低金利融資など。

Rice Production in Africa: A Key to Promoting the Sub-Saharan Africa Food Security

John C. Onyango
Professor, Department of Botany and Horticulture, Dean of Faculty of Science,
Maseno University, Kenya
Visiting Professor, International Cooperation Center for Agricultural Education (ICCAE),
Nagoya University, Japan

Abstract

High poverty levels of over 60% have been reported in rural communities in Africa in general and in Kenya in particular. Poverty levels normally manifest themselves in poor health and malnutrition. There are high levels of household food insecurity and in most rural areas the situation is aggravated by the prevalence of HIV/AIDS. Some of the strategies that could contribute to poverty alleviation, food security and wealth creation have not been given due attention. These strategies include the use of NEw RIce for AfriCA, code named NERICA, which was developed by crossing the African rice (*Oryza glabberima*) and the Asian rice (*Oryza sativa*). Adaptability trials for the NERICA varieties in Western Kenya showed a yield potential of over 5 tons per hectare which is higher than the yields obtained in Kenya for irrigated rice. Farmers field days conducted at Maseno University, Alupe Research Center and SACRED-Africa in Bungoma adaptability trials sites have created awareness to the rural farmers and they have put in request for seeds of NERICA varieties to try on their farms. This implies that, there is demand for seed and therefore a need to set up seed support systems for NERICA in Western Kenya as the demand is anticipated to rise. NERICA is not just one cultivar, but there are actually over 3,000 different NERICA varieties, although farmers in West Africa currently are using only about 25 cultivars. In Kenya only about 20 cultivars are available out of which 6 varieties have been identified as promising in Western Kenya agro-ecological region. The preferred varieties share some common features of the rice growth cultures. Reflecting the characteristics of African rice varieties that have evolved over centuries in the continent's difficult environmental conditions, NERICA is very hardy, resistant to stresses such as water deficit, common rice diseases and pests. NERICA produces significantly higher grain yields than the two parent varieties. Each panicle of the *Oryza glaberrima* has about 100 grains and each panicle of *Oryza sativa* has 250. But NERICAs' panicles hold an average of 400 grains and this explains the high harvest observed. Each grain of NERICA has more protein than either of the parents: while the parents have a protein content of about 8-10 per cent, NERICA can reach 10-12 per cent.

Rice is a cereal crop best known in Asia and has fed well over half of the world's population for centuries. The success of the crop research led to the green revolution in Asia in the 1980's and is still strong. This can provide an incentive in finding a better solution for the African problem. Over the years from 1991 NERICA has become a household name in West Africa in terms of food security and cash crop in the region. Many women group farmers have adopted NERICA as their main cereal crop. The role NERICA plays in food production and cash economy cannot be over emphasized. This presentation is therefore, aimed at addressing the pertinent issues that affect the crop production in Sub-Saharan Africa and how it can be accelerated for the benefit of the affected population. Some of the factors which require urgent attention by scientific community in terms of solution exploration through research are: drought tolerance; nutrient use efficiency; weed control; production of certified seeds; computation of historical rainfall pattern; pests and diseases control; inter- and relay cropping systems; development of lowland NERICA varieties and buffer crops; post-harvest processing; value addition, milling and marketing strategies; land ownership by women farmers and availability of low interest credit facilities, among others.

1.0 Introduction

Farmers in most Sub-Saharan Africa produced enough food commodities for the continent's populations up to 1960s at the time of independence for most countries. After attaining independence from the imperial powers the Africa population started growing at a faster rate than food production. By 1980s most countries were pleading to the developed world for food aids. By 1985-88 the late photo journalist Mohammed Amin brought the plight of dying Africans especially the horn of Africa to the world attention and something had to be done. In most African countries over 60% of the population live in the rural areas with Agriculture as their main survival activity both for food security and economic empowerment. However, most governments have either given agriculture and rural development a low priority or pursued impractical policies to protect their stay in power. Investments in improved roads network, input delivery, value addition to agricultural produce and grain marketing systems also in agricultural research, extension and general education have been woefully in adequate. Cheap food policies to appease the politically informed urban dwellers have greatly distorted production incentives for framers.

The major development problem in Africa is infrastructure that is roads, dams, electricity and communication. These are areas which were ignored by the colonial powers as opposed to the development pattern in Asia and Latin America before the de-colonization era in those regions. The emerging African governments have not done much either and some have even worsen the situation; take the case of Zimbabwe in the recent years. All these have resulted in negative agricultural development in the continent giving way to starvation and rampant poverty. A concerted effort is needed within the continent to correct this situation before it explodes to the detriment of human kind. Africa needs assistance from development partners and best practices from outside the continent, however, the African government must understand that any sustainable success to these measures must be home grown and have the political good will. Strong economies and high quality of life are all integral part of good and responsive governance in terms of economic and development policies. It is important to take note that perfection is a peacock the academics chase and never catch. As researchers and intellectual think tanks we must undertake our share of the responsibility apart from advocating ivory tower autonomy.

Rice is known to be staple food for half of the world's over 6.5 billion people (International 2006). It is the cereal of choice and is produced and consumed in Asia in large quantity. In Sub-Saharan Africa the demand is increasing and has surpassed production leading to importation of about 46% in order to meet the region's demand but this is a drain to foreign reserve which is valued at more than US$1.5 billion per annum to most countries in the region (WARDA 2006). Rice has become a major source of calories not only for the affluent, but also for the urban and rural poor in many parts of the continent. Its availability and price have become major determinants of the welfare of the poorest African consumers. The notion that rice was only consumed by the urban affluent population does not apply any more since the consumption is actually dictated by availability and affordability of the cereal. It is the preferred food for the rural communities as well especially in regions where the crop is grown and therefore market price is affordable. To reduce rice import and achieve self-sufficiency in rice in most countries, the production of the crop in the sub-region will have to be increased and the quality of local rice must be comparable to the imported rice in order to maintain the market parity. To enhance the quality of local rice and its preference, improvements in both varietals' and value addition aspects must be taken into consideration in packaging. The current trends in rice production, particularly in Asia which has been the global rice basket is worrying due to respective governments' restrictions in their local rice production. This will definitely affect the rice net importers from Africa in terms of food security for their nationals. To mitigate against the expected out come, the Sub-Saharan Africa region must align itself into the promotion of rice production within the region. This is where the achievements which have been made in NERICA development since 1991 come into play.

Rice has been grown in East Africa for several centuries. In Kenya the crop is grown in the Lake Victoria basin in Nyanza and Western Provinces, in Central Kenya at Mwea Schemes and along the Indian Ocean coastal marsh areas. Over this period of time the crop has been subject to selection by farmers for performance in the rather dry climate of East Africa. The main rice growing regions in

Tanzania include Mwanza, Shinyanga, Mara and Kagera regions, which produce almost one third of the country's rice demand. Shinyanga, Mwanza and Mara do produce about 25% of the Country's total rice production. The main rice growing regions in Uganda, include Jinja, Mukono, Kampala, Mayuge and Bugiri districts while the upland rice and NERICA research activities is concentrated at Namulonge and other NARO research Centers. In Uganda there is increasing interest in rainfed rice cultivation by farmers. This interest has mainly been stimulated by sensitizing farmers on the importance of rice as an income generating crop and food security. The rice production is mainly done by farmers in groups in order to lower the cost of production. Over 60% of land being cultivated is under upland rice at the moment causing high demand for seed rice since 2000, unlike in the past years when demand for seed rice from the District farm institutes was rather low. The difference in maturity of the varieties, water condition in the fields and labour availability of the households determines the length of harvesting season that ranges from 145-175 days (Zuma, 2004). The rice yields ranges from 500 kg to 3,500 kg depending on the moisture availability, cultivars used, soil fertility and timeliness of field operations. No other crops are planted after rice harvesting although these relatively wet fields could be used for short season crops such as vegetables and legumes. Local communities are not aware of the utilization of the residual moisture after harvesting rice, or other sources of water.

NERICA has become so popular in certain districts of Uganda that some farmers are even abandoning other crops to produce rice. This change in trend and awareness has been increased by the dissemination of research through extension activities and political good-will by Uganda government officials. The crop has been reported to yield up to 4-5 tones per hectare in farmers' fields, which translates to US$ 2000 in local markets in terms of income to the farmer. NERICA is preferred in East Africa because of its short duration to maturity – about 90 – 110 days.

Rice is a cereal crop best known in Asia and has fed over half of the world's population for centuries. The success of the crop research led to green revolution in Asia in the 1970's and is still strong. This can provide a more vigour in finding a better recipe for the African problem. Over the years from 1991 NERICA has become a household name in West Africa in terms of food security and cash crop in the region. Many women-group farmers have adopted NERICA as their main cereal crop. NERICA produces significantly higher grain yields than the two parent varieties. Each panicle of the *Oryza glaberrima* has about 100 grains and each panicle of *Oryza sativa* has 250. But NERICA's panicles hold an average of 400 grains and this explains the high harvest observed. Each grain of NERICA has more protein than either of the parents. While the parents have a protein content of about 8-10 per cent, NERICA can reach 10-12 per cent (Fujii *et al.*, 2004). NERICA matures considerably faster within a period of 90-100 day after planting. This not only ensures food security among the farming communities, but also reduces poverty levels through sales of excess produce (Onyango and Onyango 2006).

The role NERICA plays in food production and cash economy cannot be over emphasized. This presentation is therefore, aimed at addressing the pertinent issues that affect the crop production in Africa and how it can be accelerated to the benefit of the sub-Saharan Africa population. Initial studies carried out in Western Kenya at Maseno, Kisumu district; Alupe, Teso district and Siritanyi, Bungoma district from 2004 to 2006 have given promising results in production. Farmers in these regions are demanding seeds of the NERICA cultivars to grow on their farms, mostly small scale farmers. Rice as a crop is generally grown in small plots of about one hectare blocks. This is because of its labour requirements. It is only in the six rice growing states of U.S.A. where large commercial farmers are found due to mechanization (Onyango 2006). In Africa the target farmers shall be the small scale farmers with low capital base at the initial stage. During the adaptability trials six NERICA cultivars have been identified for seed multiplication (production) for release to demanding farmers. The cultivars are NERICAs N1, N4, N6, N8, N10, and N11. Seed bulking of the above cultivars have been achieved and enough seeds for multiplication can be provided from the University Botanic Garden, Maseno NERICA seed stock. Further more training of adaptability trial researchers and technicians on harmonization of research and production operations have been achieved for the pilot group.

1.1 Problem statement

The role of NERICA is not only improving the food situation in Africa but also improves the livelihoods and the economic situation of the rural and urban poor has not been exploited. There is need to sensitize the communities on NERICA cultivation in East Africa. Nonetheless, there is no established seed support system for NERICA resulting in lack of quality seed. Inadequate Agronomic and physiological studies have been carried out. Limited research done has not been fully disseminated to farming communities there is therefore need for up scaling the known technical information to the wider farming communities in the region.

1.2

NERICA has been identified as one of the Africa's "best practices" worth up scaling. The development of NERICA was heavily funded by the government of Japan and IFAD with ARC Scientists producing desired results (WARDA 1999). NERICA adaptation and production in West Africa has played a key role in reducing poverty and malnutrition in the region. The expansion of NERICA cultivation throughout Sub-Saharan Africa has been hailed by NEPAD member countries because of its adaptability and high productivity. The aim of this presentation is therefore, to explore how NERICA can be integrated into the existing varietals' portfolio for Sub-Saharan Africa farmers with complementary technologies to maximize production at minimal input level. This will spirally lead to better natural resource management practices and improved rice marketing and availability to rural communities. The findings from the research strategies and up-scaling of production technologies will also be a resource and attribute to the performance and implementation by various Ministry of Agriculture extension services in different countries in the region. If coordinated well then this will enhance the role of NERICA in food security and poverty reduction in Africa.

Detailed analysis of limiting factors

NERICA varieties were developed for rainfed or upland conditions; however, there is need to quantify the spectrum of several varieties in cultivation with regard to their water requirements for effective production. From previous experiments it has become clear that there are some NERICA lines that show high growth with low uptake of water and they seem to be appropriate for long periods of cultivation in low precipitation conditions (Fujii *et al.,* 2004). This is because high dry matter accumulation during drought by drought tolerance cultivars is due to their ability to absorb soil water. However, physiological characteristics of NERICA are not fully known and there is an urgent need to conduct research in NERICA physiological parameters geared to high productivity under limiting water availability. The trend of rice cultivation is going towards the upland production rather than irrigated. The kind of infrastructure which goes with the paddy rice production is rather expensive for most small holder farmers. Because of these problems, most farmers tend to go for upland rice production, based on rainfall but if there is any irrigation, it will be by gravity from rainfall harvested water or from small streams. The are three rice irrigation systems for lowland rice in Kenya which are situated in Ahero, West Kano and Bunyala in Western Kenya, Mwea Tabere in Central and Bura in North Eastern Kenya, but all of the are performing under capacity. In Western Kenya electricity is used to pump water and as the cost of electricity goes up, it becomes expensive to supply water while in Central and North Eastern Kenya, gravity irrigation is used but during droughts the level of rivers go down.

Establishing seed banks requires elaborate information on the ecophysiology of the donor plants, especially with regard to overcoming environmental constraints, since stress is a major limitation to crop production worldwide. This will ensure that well adapted germplasms are established, which are able to survive and achieve acceptable levels of bio-productivity. The Western parts of Kenya for example, are faced with intermittent dry spells accompanied with high rates of evapo-transpiration, more negative soil–water potentials and decreasing soil–water supply capacity to the plants. Plants in such environments must therefore, posse's adaptable strategies (Kramer 1980), which will enable them achieve their water requirements for maximum rates of shoot growth and transpiration, without undergoing cavitation (Sperry 2000). Such plants must attain a balance between shoot and root activities in order to ensure productivity without compromising survival (Otieno et al. in press). Understanding soil water uptake patterns by of the NERICA varieties and the associated shoot responses to water loss under limited water supply will help explain differences in productivity, survival and distribution among species and varieties as well as provide selection criteria for the preferred gene banks. Few studies exist on the eco-physiological responses of the NERICA varieties. This information is however required to further our understanding of their autecology in natural or agro-ecosystems. There is growing interest in identifying and selecting genotypes that will maintain growth and productivity under limited water conditions.

- Although the breeders credit NERICA with low nutrient demand, no results are available to quantify the requirement in the various African agro-ecological regions where the crop is grown. NERICA may need the shuttle breeding approach in order to produce varieties which are adaptive to several regions of different agro-ecological structures. Through this process varieties which can perform well in the Sub-Saharan Africa can be produced or selected within a short time, thereby reducing the breeding programme period. The fertilizer use has been in high debate for a very long time as a factor in improving crop production. Actually, even the Green Revolution in Asia that is, India and Pakistan, the fertilizer was a problem and so was the crop production. But I think the scientists who were dealing with the crop at that particular time made the governments realize that if the aim was to increase production then fertilizer had to be involved. If that (increased use of fertilizer) is going to be the case, even though the farmers are poor, they are ready to offer labor on their farms, so the government should come up with subsidy to bale them out to increase NERICA production. The problem with the fertilizer is still there as at now we also have environmentalists who are concerned with pollution factors caused by fertilizer run-off from farm lands. However, this can be mitigated by having buffer crops to take up run-off nutrient load before discharge into water bodies. Since the subsidy worked for Green Revolution it is possible to employ the same method to increase production. The countries affected with low rice production spends about US$ 1.5 billion to import rice, it follows that, if they spend a fraction of that money to access fertilizer for farmers then they can assist small holder producer increase production. The agricultural extension staff will also help with safe environmental management of fertilizer usage.

- Weed control has been identified as a factor, reducing NERICA production in East Africa, especially the *Striga hermonthica* which causes up to 70% loses in cereals. Identification of NERICA varieties that can withstand the weeds effect will be desirable to promote production. Striga is the main parasitic weed devastating NERICA production in Sub-Saharan African. Striga compensates for lack of its own root system by penetrating the roots of rice, diverting essential nutrients from them, and stunting their growth. Striga infests an estimated half of the 8.5 million hectares devoted to rice in Africa, resulting in crop losses of up to 60% among rice farmers. Striga is considered to be the main obstacle to sufficient food production in Africa. Most farmers have been using cultural method of weed control through crop rotation with cultivars that encourage suicidal germination of *striga* seeds but the methods is too slow for effective land use. Other modern method such as the use of Fungus (*Fusarium oxysporum*) is rather expensive to the target farmers (Ciotola *et al.,* 1995).

- In recent Africa Rice Congress (ARC) in Tanzania, it was realized that Sub-Saharan Africa has the lowest number of available scientific expertise which is about 83 scientists per million people, compared to 1100 scientist per million in industrialized countries and 785 per million in Asia. At this level of scientific expertise in Africa, it is paramount that capacity-building programme focusing on the development of a multi-disciplinary researchers and extension staff is urgently needed.

- Lack of certified seeds is the main draw back to releasing some of the high potential NERICA varieties in Kenya. Efforts are now being made to bulk the seeds of selected NERICA lines for release to farmers by 2008 long rains season but there is also a need to bring in private sector stakeholders in certified seed production and marketing. Sasakawa-Global 2000 has played the role of seed production successfully in Asia and Uganda. Their role lead to successful green revolution in Asia and rapid dissemination of NERICA production in both East and West Africa and involvement of selected farmers in the informal seed multiplication. African Rice Congress took the cognizance of the importance of NERICA seed production in Africa and recommended that farmers adoption of NERICA should be accelerated and other improved technologies, concerted action by partnership including governments, research institutions, the private sector, local, regional and international organizations are needed (ARC 2006).

- Intercropping NERICA with maize and sorghum is a common practice in upland cultures in Sub-Saharan Africa for various reasons. To enhance this practice we are investigating the intercropping or relay cropping NERICA with leguminous pulses for soil improvement at Maseno University. Good adaptive technology researchers must know how to implement the technologies themselves without relying on the technicians to do the work. It is more difficult to inculcate what one knows only in theory. The practical aspect is very important and should be master right from the laboratory and experimental field. Intercropping of NERICA with legumes is being experimented in Western Kenya (Maseno University) with the main purpose of replenishment of the soil nitrogen, because the two crops are legumes, hence good in nitrogen fixation at scientific level. But at community level, most farmers we are dealing with are already intercropping Soya beans and Bambara groundnuts with maize. Our experiments are therefore aimed at developing a package for technology transfer. We want to have enough information for this transfer so that we can win farmers' confidence in using rice instead of maize thereby increasing the production.

- Value addition and milling requires quick access to good quality mills to enhance profitability of the rice produce by farmers in contrast to the middle traders. Market surveys and identification of ready market for the produce will also entice more small-holder farmers to continue with rice production both for food security and cash crop. In Uganda farmers have earned up to Ush. 3,740,000 (about US$ 2,000) for NERICA production per hectare. This earning has enables NERICA farmers to meet several of their family obligations.

- Women have been identified to be key players in NERICA production in Africa and yet they do not own land. Sustainable production will therefore require a review of land tenure system in most countries to allow women to acquire and own land as a natural resource base for rice production. Actually the problem we have is that, it is the women who are actually more active in agriculture. The women according to our statutory set up do not own land. In other words you might have group of women who want to participate in NERICA cultivation. Since they don't have land, they have to get permission from their husbands.

Concluding remarks

It is a clear knowledge that the Japanese Government made a very strong promise to the African governments; this was at the World Summit on sustainable development in Johannesburg, South Africa in the year 2002 that was followed by NEPAD and the involvement in the NERICA production. I understand that the third TICAD is coming in two years time and we would like to learn about the success story on the Japanese government contribution in NERICA production in Africa. From the contributions presented in this Open Forum it is clear that there are several aspects of NERICA production, in Africa and all of them are geared towards sorting out food shortage in Africa. I think it is only the last presentation by Sasakawa 2000 which mentioned that in case of Uganda, NERICA is actually not being produced to sort out the food problem it is being produce as a cash crop, and if that is a case it is still a contribution because that will be alleviating the foreign currency balance from the Uganda government, therefore, we are still in the right direction.

In my prioritization brief we are talking of the upland conditions of rice production. When we talk of upland situation, it is soil moisture which keeps fluctuating and we need to arrest it. Most of us plant scientists are very quick at looking at what is happening above ground which everyone can observe. But what happens below ground which is being expressed by the above ground characters we don't know, this is where precipitation or water requirement under upland conditions comes in handy and we need to look at that. I would not like to go GMO direction, I would like to go through the conventional breeding if at all we can identify the markers which code for less water usage and that will definitely be tied to water use efficiency among the various NERICA. If we can identify this we will have made more or less 50 % contribution towards promotion of NERICA production in Africa, given the fact that agro-ecological situation is very fragile. That is my first line, looking at the water requirement and that will entail looking at below and above ground structures of NERICA varieties. One advantage we have is that there are several NERICA varieties and it seems that the regions in Africa have already identified which lines they want to use and therefore those lines should be investigated for desirable traits. The other aspect which came out very clearly is the question of availability of certified seed. The contribution of double naming of NERICAs' seeds in Uganda is real. There is a variety which is NERICA 4 which one commercial seed firm calls it Suparica 2 while National Agricultural Research Organization (NARO) also in Uganda calls it Naric 3. This creates confusion to farmers. They are growing same variety but depending on where they sourced the seed they think the varieties are different. Therefore we need to look at the seed aspect and harmonize it. This would ensure seed purity which is very fundamental in genotype research. From those two main points, there should be some socio-economic activities which prepare farmers at the farm level to receive some of the NERICA technology which can complement lack of greenhouses.

References

Abukutsa-Onyango, M.O., G.N. Mwai and J.C.Onyango, 2005. Studies on horticultural practices of some African Indigenous Vegetables at Maseno University. In: Abukutsa-Onyango. M.O., A.N. Muriithi, K.Ngamau, V.Anjichi, S.G. Agong, A. Fricke, B.Hau and H Stützel. 2005. Proceedings of the Third Horticulture Workshop on Sustainable Horticultural Production in the Tropics, 26th -29th November 2003. Maseno University, Maseno, Kenya.

AICAD (2003), "Overview of poverty situation in Kenya, Uganda and Tanzania" AICAD/JICA, Nairobi.

Chweya, J.A. and P.B. Eyzaguire, 1999. The biodiversity of traditional leafy vegetables. International Plant Genetic Resources Institute, Rome, Italy.

Ciotola, M., A.K. Watson and S.G. Hallet 1995. Discovery of an isolate of Fusarium oxysporum with potential to control Striga hermonthica in Afica. Weed research 35:(4) 303-309.

Fujii, M., C.Andoh and S. Ishihara 2004. Drought resistence of NERICA (New Rice for Africa) compared with Oryza sativa . and millet evaluated by stomatal conductance and soil water content. Proceedings of the 4th International Crop Science Congress, 26 Sep – 1 Oct 2004, Brisbane, Australia. ISBN 1 9200842 20 9

Hesser, L. 2006. The Man Who Fed the World. Nobel Peace Prize Laureate, Norman Borlaug and his battle to end World hunger. Durban House Publishing Company, Inc. Dallas, Texas. Pp 263.

International 2006. United States Census Bureau, International Data Base, August 2006 version.

Onyango, J.C. and M.O.A. Onyango (1999). Potentials for rainfed rice (Oryza sativa L.) production and germplasm development in Kenya in: Proceedings of the 6th KARI Conference, 9th to 13th, November, 1998 KARI Headquarters, Nairobi. Kenya. Pp. 562-566.

Onyango, J.C. and Onyango, M.O.A. (2000). Characteristics of root system and water uptake in two cultivars of rice (Oryza sativa L.). Maseno Journal of Education, Arts and Science 3(2): 138-149.

Onyango, J.C. 2006. Rice, a Crop for Wealth Creation: Productivity and Prospects in Kenya's Food Security. Professorial Inaugural Lecture Nr. 2 – Presented at Kisumu Hotel – Maseno University, 24 May 2006, Kisumu, Kenya.

Onyango, J.C. and Onyango, M.O.A. (2006). Adaptability trials of five NERICA cultivars at Maseno. Proceedings of NERICA workshop, 16-17 February 2006, AICAD, Nairobi, Kenya.

Schippers, R.R. 2000. African indigenous vegetables an overview of the cultivated species. Chatham, UK. Natural Resources Institute /ACP-EU Technical Centre for Agricultural and rural Cooperation.

WARDA, 1999. New Rice for Africa – NERICA development and release. WARDA Annual Report 1999, pp 9-15.

Zuma 2004. Production of rice and dissemination in Africa: in: Seminar on production and dissemination in Africa. AICAD, Nairobi, Kenya, February 10-11, 2004.

RICE PRODUCTION IN AFRICA:
A KEY TO PROMOTING THE SUB-SAHARAN AFRICA FOOD SECUTY

jconyango@yahoo.com

BY

J.C. ONYANGO

DEPARTMENT OF BOTANY AND HORTICULTURE
FACULTY OF SCIENCE, MASENO UNIVERSITY

AND VISITING PROFESSOR, ICCAE,
NAGOYA UNIVERSITY

7TH ICCAE OPEN FORUM AT NOYORI Memorial Conference Hall, NAGOYA UNIVERSITY
20TH OCTOBER 2006

1

KEYNOTE ADDRESS

Introduction

- Rice is a crop that is currently feeding over a half of the world's 6.5 million population and doubles as both subsistence and export cereals.
- Rice production is increasingly becoming a key issue in cereal growth and development in the Sub-Saharan Africa region.
- The increasing consumer preference has pushed rice into the list of most important crops that requires concerted effort in production.

2

Food Production by Independence

- Farmers in most Sub-Saharan Africa produced enough food commodities for the continent's populations up to 1960s at the time of independence for most countries.
- After attaining independence from the imperial powers the Africa population started growing at a faster rate than food production.
- By 1980s most countries were pleading to the developed world for food aids.

3

Infrastructure constraint

- The major development problem in Africa is infrastructure that is roads, dams, electricity and communication.
- These are areas which were ignored by the colonial powers as opposed to the development pattern in Asia and Latin America before the de-colonization era in those regions.

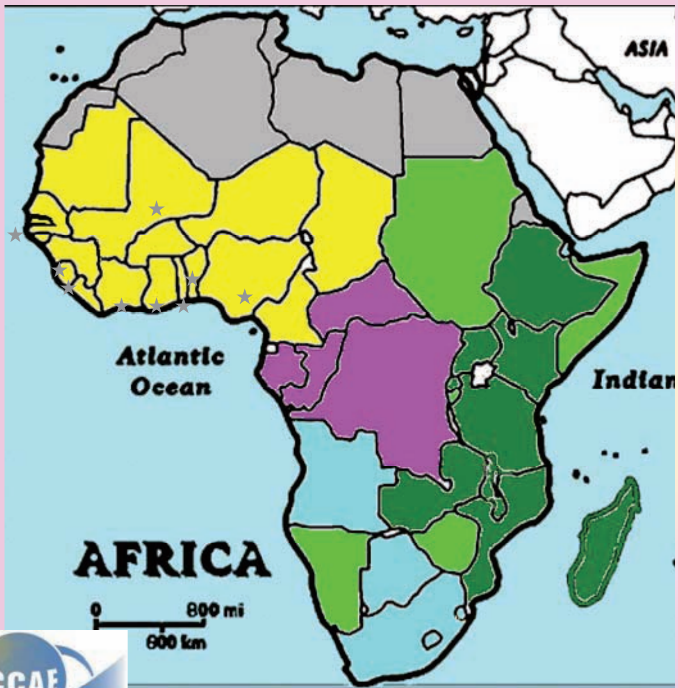
4

Governance and Development

- Strong economies and high quality of life are all integral part of good and responsive governance in terms of economic and development policies.
- It is important to take note that perfection is a peacock the academics chase and never catch.
- As researchers and intellectual think tank we must undertake our share of the responsibility apart from advocating academic freedom.

5

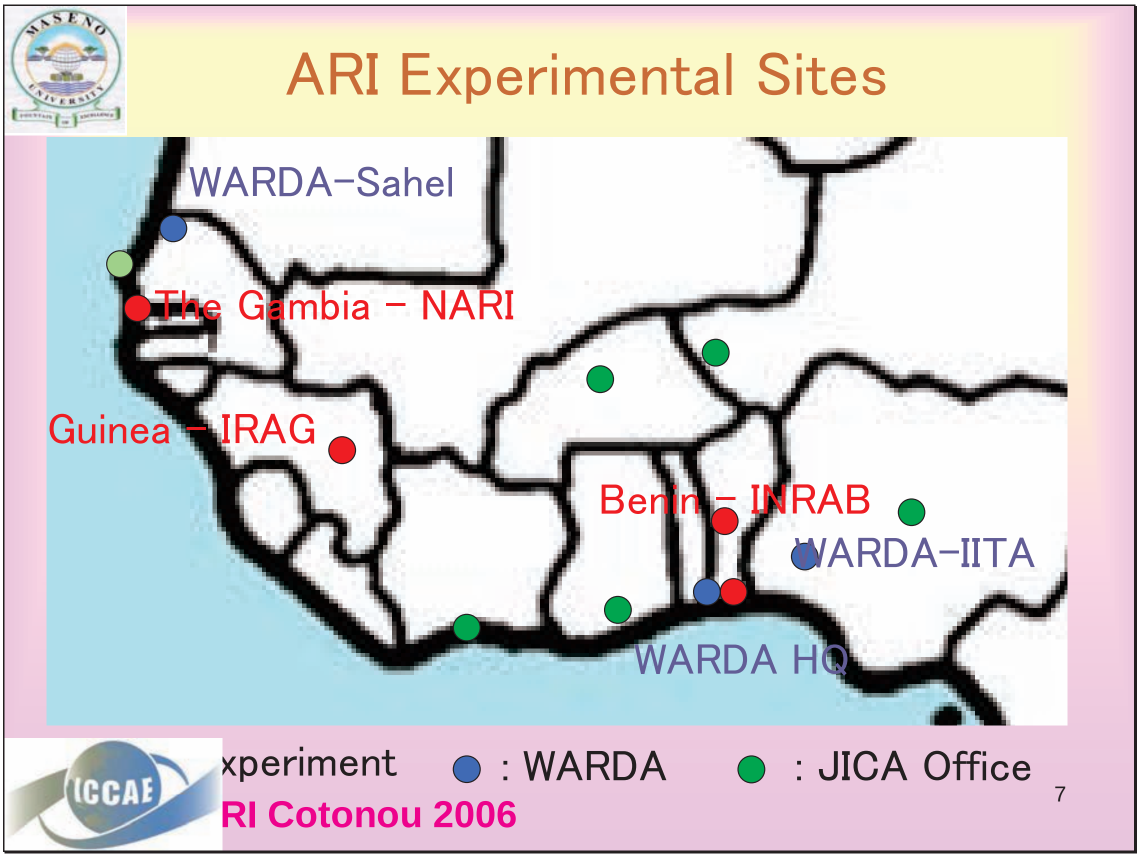
WARDA's involvement in Sub-Saharan Africa

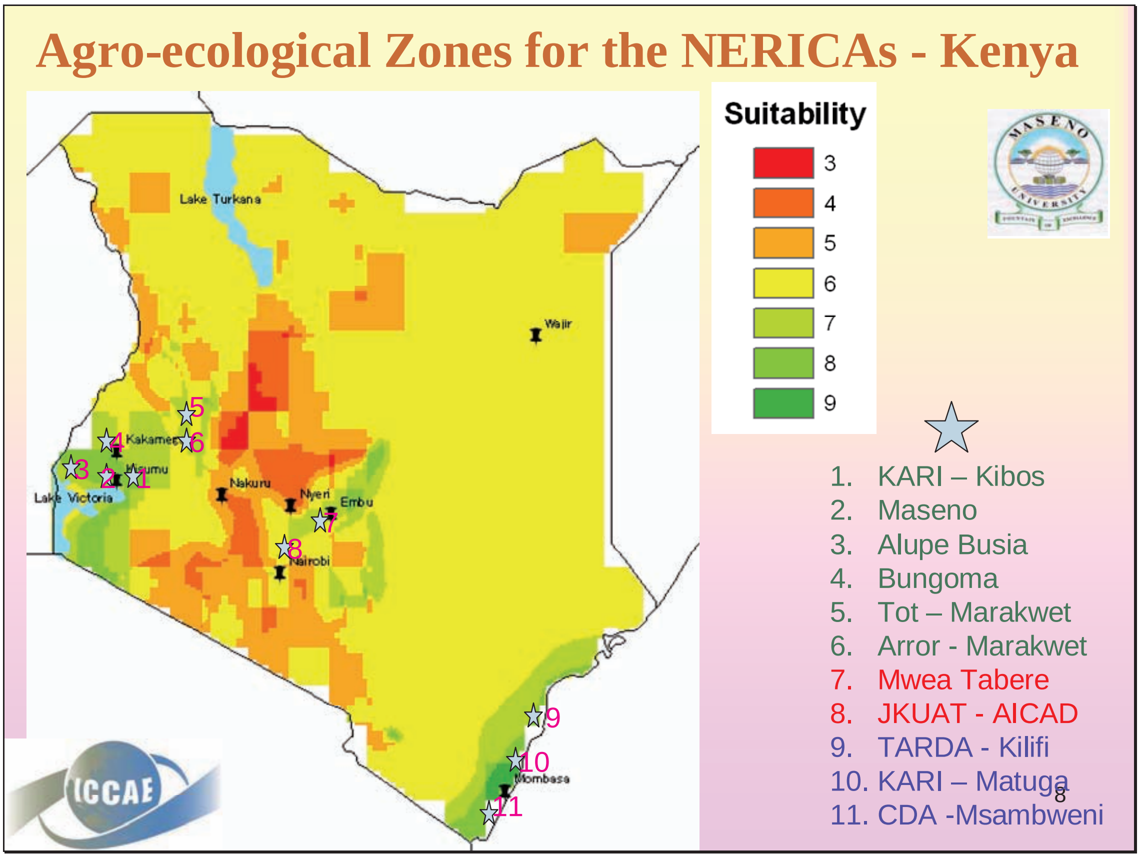


- WARDA Members States and ARI
- ★ : ARI pilot country
- ARI & INGER-Africa
- ROCARIZ & INGER-Africa
- INGER-AFRICA only
- Non-affiliated countries
- Others

Source, ARI Cotonou 2006

6


ARI Experimental Sites
WARDA–Sahel
The Gambia – NARI
Guinea – IRAG
Benin – INRAB
WARDA–IITA
WARDA HQ
xperiment
: WARDA
: JICA Office
RI Cotonou 2006
7


Agro-ecological Zones for the NERICAs - Kenya
Suitability
3
4
5
6
7
8
9
Lake Turkana
Wajir
Kakamega
Kisumu
Lake Victoria
Nakuru
Nyeri
Embu
Nairobi
Mombasa
1. KARI – Kibos
2. Maseno
3. Alupe Busia
4. Bungoma
5. Tot – Marakwet
6. Arror - Marakwet
7. Mwea Tabere
8. JKUAT - AICAD
9. TARDA - Kilifi
10. KARI – Matuga
11. CDA -Msambweni
8

NERICA Potential

- In Sub-Saharan Africa the demand for rice is increasing and has surpassed production leading to importation of about 46% in order to meet the region's demand.

- This is a drain to foreign reserve which is valued at more than US$1.5 billion per annum to most countries in the region.

9

Global Rice Production Trend

- The current trends in rice production, particularly in Asia which has been the global rice basket is worrying due to respective governments' restrictions in their local rice production.

- This will definitely affect the rice net importers from Africa in terms of food security for their nationals.

10

Hunger Alleviation in Africa

- To mitigate against the expected out come, the Sub-Saharan Africa region must align itself into the promotion of rice production within the region.
- This is where the achievements which have been made in NERICA development since 1991 come into play.

11

Rice Cultivation regions in East Africa

- Kenya: Nyanza and Western Provinces, Marakwet, Kirinyanga, Kilifi, Mombasa and Kwale.
- Tanzania: Mwanza, Shinyanga, Mara and Kagera regions.
- Uganda: Jinja, Mukono, Kampala, Mayuge and Bugiri districts.

12

NERICA Yields in East Africa

- The rice yields ranges from 1500 kg to 5,000 kg depending on the moisture availability, cultivars used, soil fertility and timeliness of field operations.
- No other crops are planted after rice harvesting although these relatively wet fields could be used for short season crops such as vegetables and legumes.
- NERICA has become so popular in certain districts of Uganda that some farmers are even abandoning other crops to produce rice.

13

NERICA Dissemination and Economy

- The change in trend and awareness has been increased by the dissemination of research through extension activities and political good-will by Uganda government officials.
- The crop has been reported to yield up to 4-5 tones per hectare in farmers' fields, which translates to US$ 2000 in local markets in terms of income to the farmer.
- NERICA is preferred in East Africa because of its short duration to maturity – about 90 – 110 days.

14

NERICA Best Practices

- NERICA has been identified as one of the Africa's "best practices" worth up scaling.
- The development of NERICA was heavily funded by the government of Japan and IFAD with ARC Scientists producing desired results.
- NERICA adaptation and production in West Africa has played a key role in reducing poverty and malnutrition in the region.

ICCAE

15

Need to Increase NERICA Production

- There is need to sensitize the communities on NERICA cultivation in East Africa. Nonetheless, there is no established seed support system for NERICA resulting in lack of quality seed.
- Inadequate Agronomic and physiological studies have been carried out.
- Limited research done has not been fully disseminated to farming communities therefore, there is need for up scaling the known technical information to the wider Farming communities in the region.

ICCAE

16

Role of Japan and NEPAD

- The expansion of NERICA cultivation throughout Sub-Saharan Africa has been hailed by the Government of Japan and NEPAD member countries because of its adaptability and high productivity.
- The aim of this presentation is therefore, to explore how NERICA can be integrated into the existing varietals' portfolio for Sub-Saharan Africa farmers with complementary technologies to maximize production at minimal input level.

17

Production Constraints in Ethiopia

- Introduction of breeding materials and commercial varieties for different rice ecosystems
- Variety development for different ecosystems
- Developing suitable agronomic practices for different ecosystems
- Post –harvest management
- Food science research
- Marketing channel
- Capacity building
- Creating strong linkage with International Rice Research Institutions, Private Investers, governmental and non-governmental organizations.

18

Rice Field Day in Ethiopia

- Farmers appreciated the candidate varieties (NERICA-3, NERICA-4 and Suparica-1 for their:

✓ early maturity
✓ ability to grow on drained soil and low water requirement.
✓ disease resistance
✓ non-shattering nature
✓ seed quality such as seed size, seed color
✓ Long panicle.

19

NERICA 4 SEED MULTIPLICATION PAWE ETHIOPIA, OCTOBER 2005

NERICA 4 AT 1200 masl = 110-120 DAYS TO MATURITY

20

Mozambique Rice Production

- Agriculture contributes 25.9% of total GDP.
- Rice is 6th main crop in Mozambique.
- Rice production areas - Central region – 62 %, North region – 31 % and South region – 7%.
- Rice is cultivated in 182,000 ha and production was 187,000 tons in 2005.
- Rice import is 340,000 tons at a value of US$70 million to meet a demand of 527,000 tons in 2005.
- Calories based consumption – Rice is 3rd - 234 calories, after Cassava-718 and Maize-534.

21

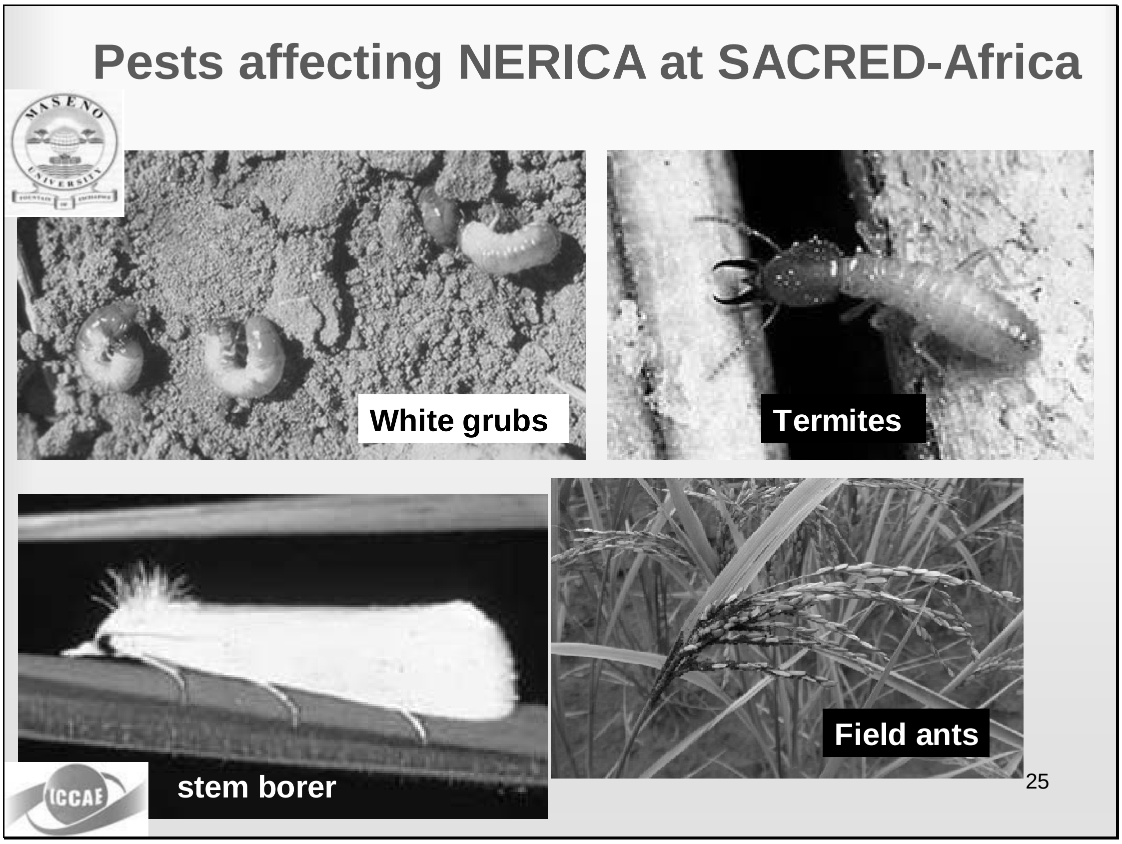
NERICA in Zambezia Region

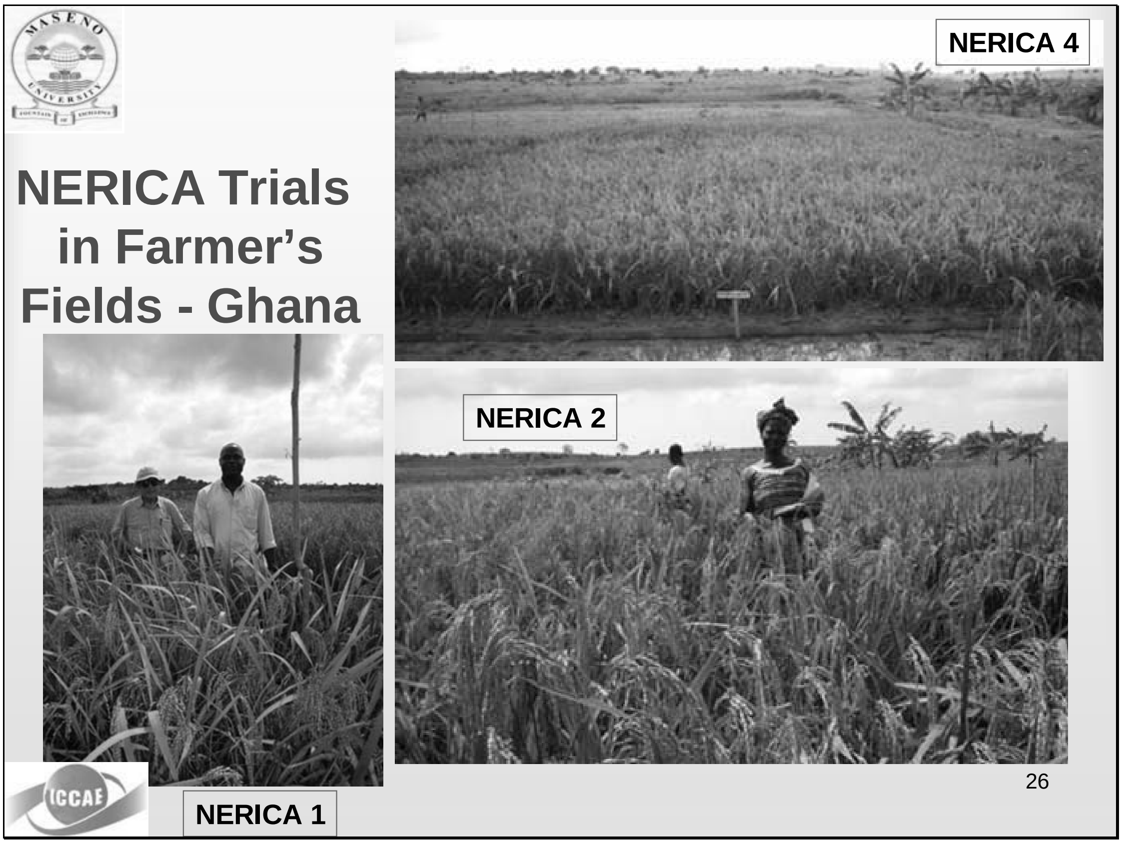
NERICA Growing under irregular rainfed
3 months after germination

NERICA 4 varieties – Different Stages
One Local variety – still Catching Up

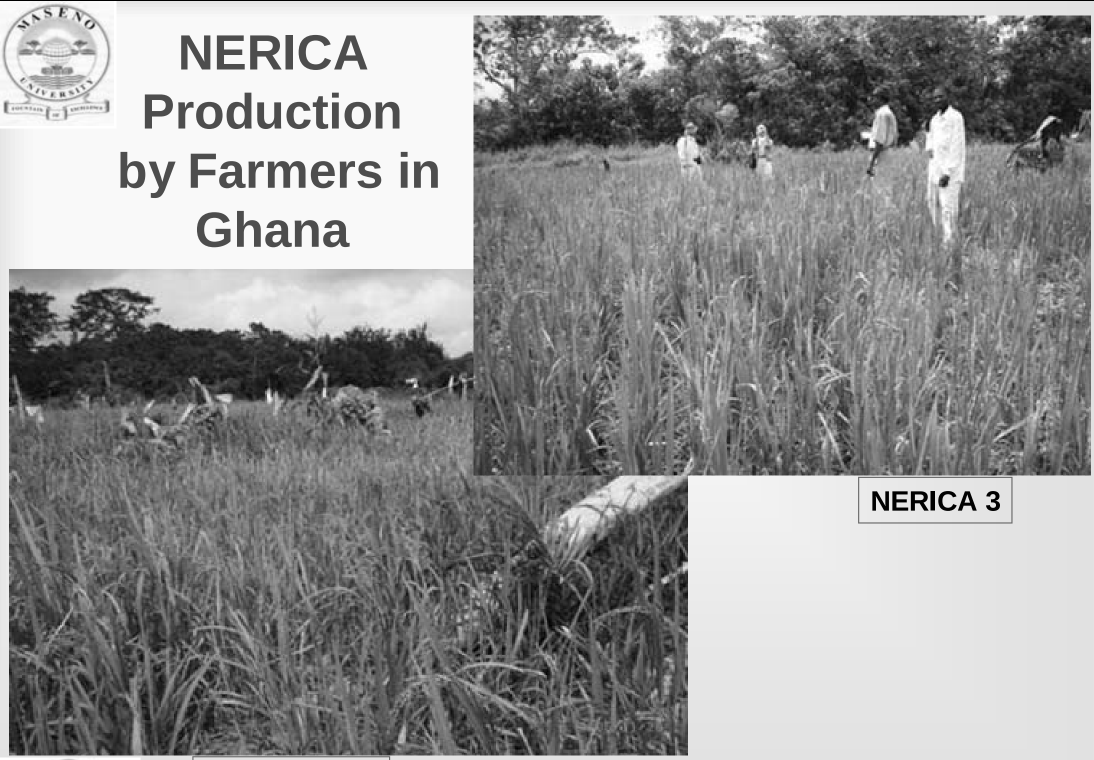

Insect Rice pests in Mozambique
23


Insect pests in rice field in Arror Marakwet, Kenya
24


Pests affecting NERICA at SACRED-Africa
White grubs
Termites
stem borer
Field ants
25


NERICA Trials in Farmer's Fields - Ghana
NERICA 4
NERICA 2
NERICA 1
26

NERICA Production by Farmers in Ghana



NERICA 3

NERICA 1

27

Grain Yield for some NERICAs in Ghana

Days from seeding to maturity

Variety	I	II	III	IV	Mean
N-1	118	106	106	115	111
N-4	118	106	106	115	111
N-6	122	111	111	117	115

Yield ($Kg.ha^{-1}$)

Variety	I	II	III	IV	Mean
N-1	2576	4982	3288	1235	3020
N-4	2531	3653	2384	1456	2506
N-6	3171	4955	3593	1951	3418

28

Rice seed multiplication field in Kilobero region, Tanzania

29

VARIETAL TRIAL NAMULONGE UGANDA

NERICA-5: HIGHEST YIELDING CULTIVAR

Maturity: 120 DAS
Yield t/ha: 4.42
Shatter habit: VD

30

Supplementary irrigation of varietal trials at the critical stage of booting

31

LONGTERM FERTILITY TRIAL

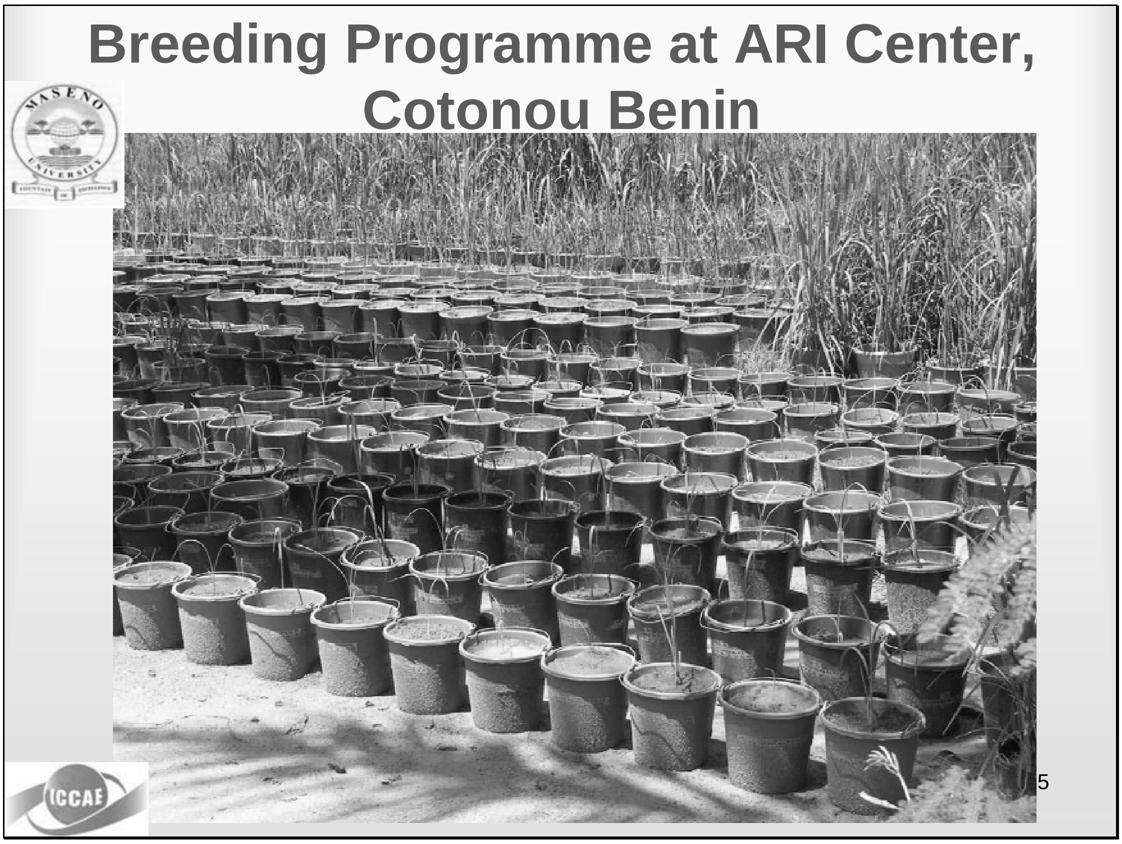
32

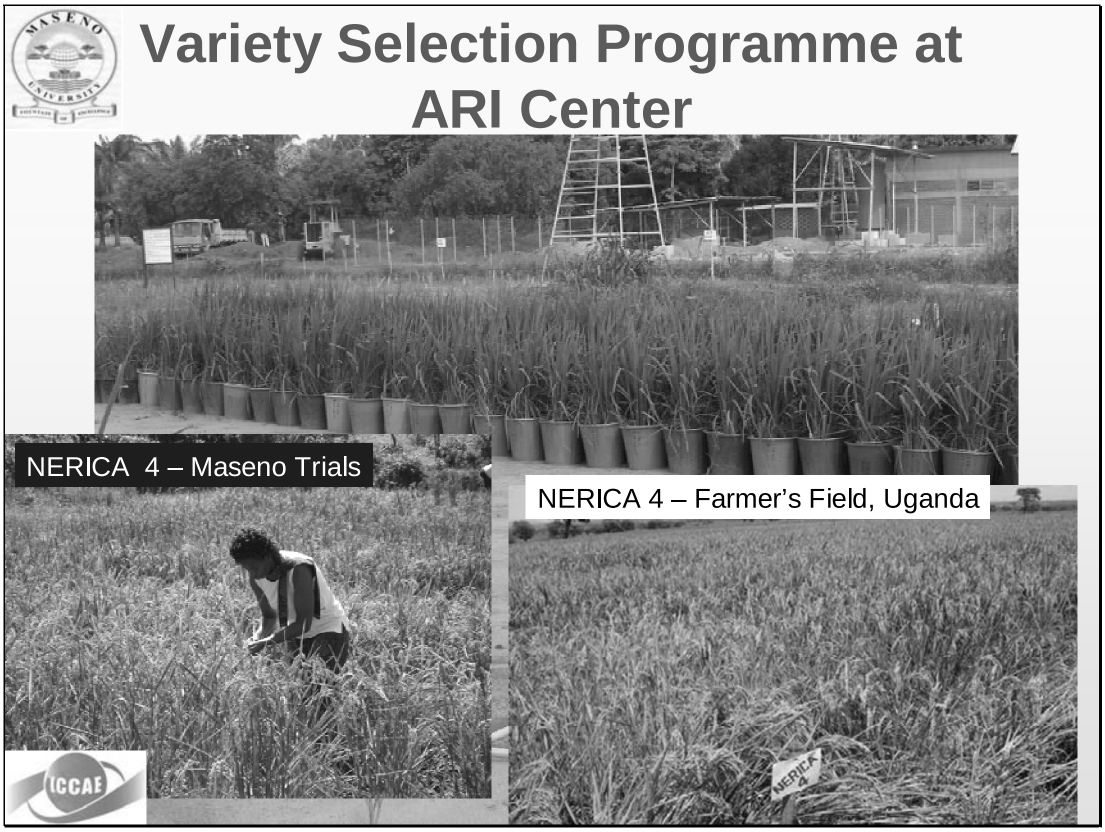
NERICA 4 in Farmer's Field Near Namulonge, Uganda

33

Drought Tolerance Trials at ARI Center

34


Breeding Programme at ARI Center, Cotonou Benin
5


Variety Selection Programme at ARI Center
NERICA 4 – Maseno Trials
NERICA 4 – Farmer’s Field, Uganda

NERICAs in Kenya

- NERICAs have been tried in Kenya for last three years.
- Yields obtained from the trials have been promising.
- The NERICAs have proved to be superior than the local varieties
- From the 3 years results: -NERICAs have been developed for various agro-ecological zones.

37

Research hypothesis to be tested

- Low and unstable yields of NERICA cultivars is caused by the unreliable rainfall in Sub-Saharan Africa's arable areas.
- Increased rice productivity will solve the problem of household food insecurity, wealth creation and poor natural resource management affected by increasing population.

38

Rain Water pool in NERICA Field

POT EXPERIMENTS FOR WATER REGIME EVALUATION

40

GREENHOUSE EXPERIMENTS: Some growth parameters

CULTIVARS	Height (cm)	Root Length (cm)	Panicle Length (cm)	Days to Harvest (dae)
T1	104bc	18b	25a	115bcd
T2	104bc	17bc	24abc	114cd
T3	102bc	14b-e	24abc	115bcd
T4	93bc	12de	23a-d	121a
T5	87c	18bc	25ab	113d
T6	106bc	14cde	25a	118a-d
T7	105bc	14b-e	24abc	119abc
T8	89	10e	21d	122a
T9	131	26a	25a	104e
T10	117	17bc	24abc	105e
T11	111bc	15bcd	22bcd	117a-d
T12	109bc	12de	22cd	120ab
LSD (0.05)	22.1	3.87	1.91	4.9
Standard Dev.	15.3	2.68	1.32	3.78
CV	14.6	17.27	5.6	2.93

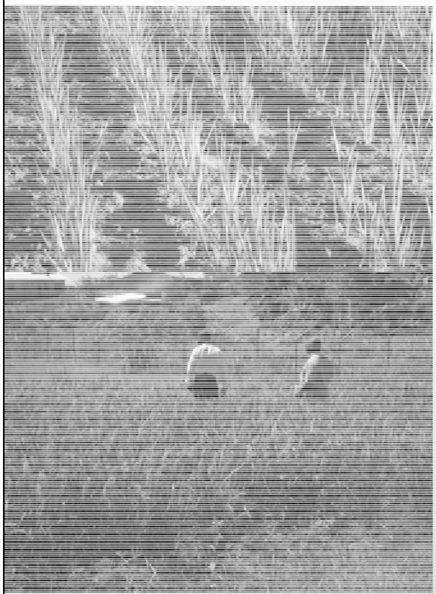
41

GREENHOUSE EXPERIMENTS: Some growth parameters

CULTIVARS	1000 Grain (g)	Filled Grain (%)	Yield 14% M.C. (Kg/ha)	Yield Component (Kg/ha)
T1	25.2cd	91a	610a	4069a
T2	24.8cde	88a	380b	2494bc
T3	24de	71c	272bc	1824bcd
T4	24de	71c	203cd	1501cde
T5	27bcd	91a	541a	3809a
T6	24.8cde	71c	356b	2380bcd
T7	26.9bcd	74bc	304bc	2031bcd
T8	21.5e	56d	123d	817e
T9	36.9a	85ab	641a	4285a
T10	34.7	80abc	380b	2551
T11	29.4b	56d	200cd	1385de
T12	27.8bc	42e	110d	736e
LSD (0.05)	3.22	11.5	119.3	899.2
Standard Dev.	2.23	7.97	82.6	622.8
CV	8.19	10.92	24.0	26.8

42

Rainfall and Temperature Data during NERICA Cultivars Trial – Short rains 2005



Months	Rainfall (mm)	Temperature (⁰C) Min.	Max
August	143	21	28
September	167	20	30
October	353	18	28
November	96	19	31
December	83	22	31
January	64	21	28

43

NERICA at Flowering – Maseno Site

44

NERICA 11 AT MATURITY

45

NERICA DISSEMINATION FIELD DAY AT BUNGOMA, KENYA

46

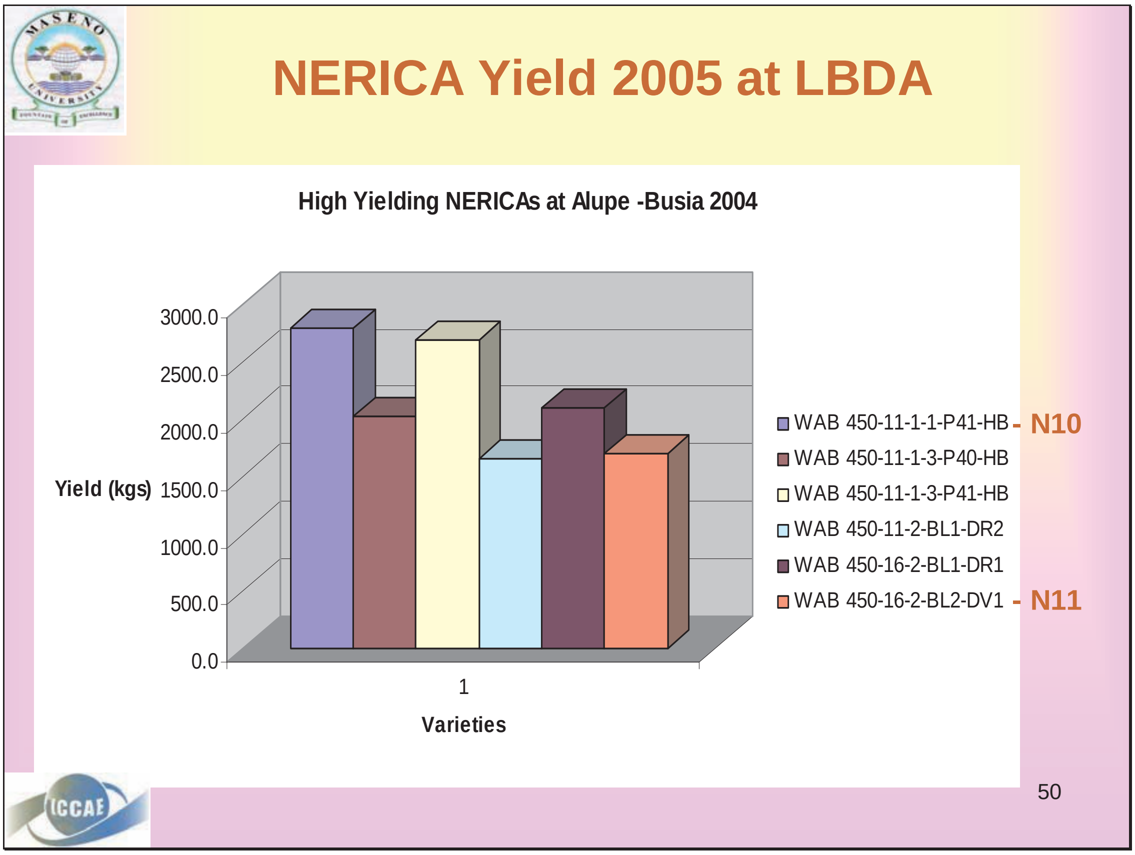
NERICA Growing in The Farmer Field in Bungoma, Panicle Harvesting

47

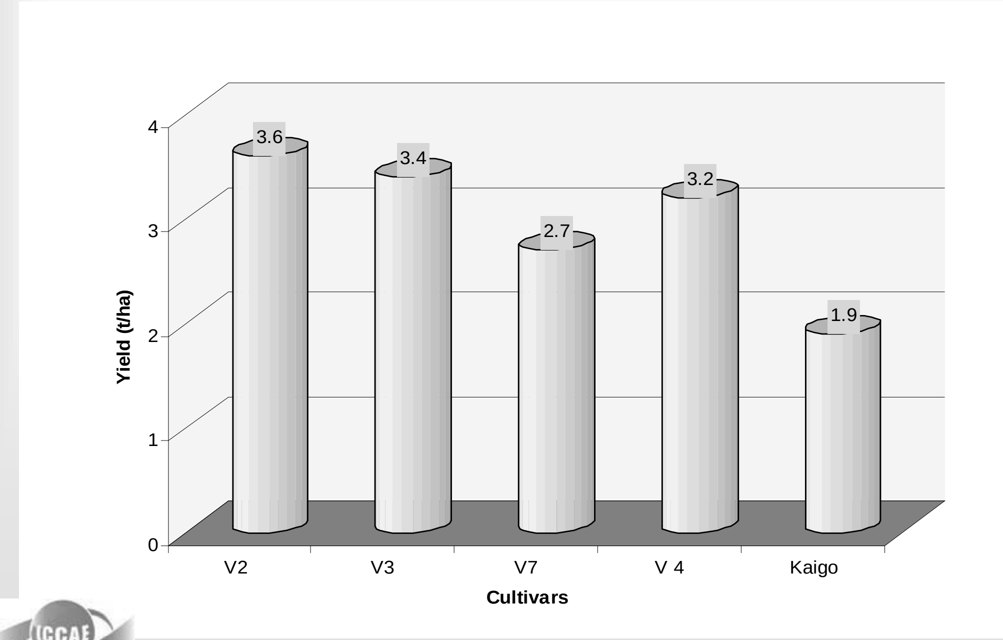
Response of NERICA Cultivars to Field Water Deficit

48


Grain filling during drought stress
ICCAE
49

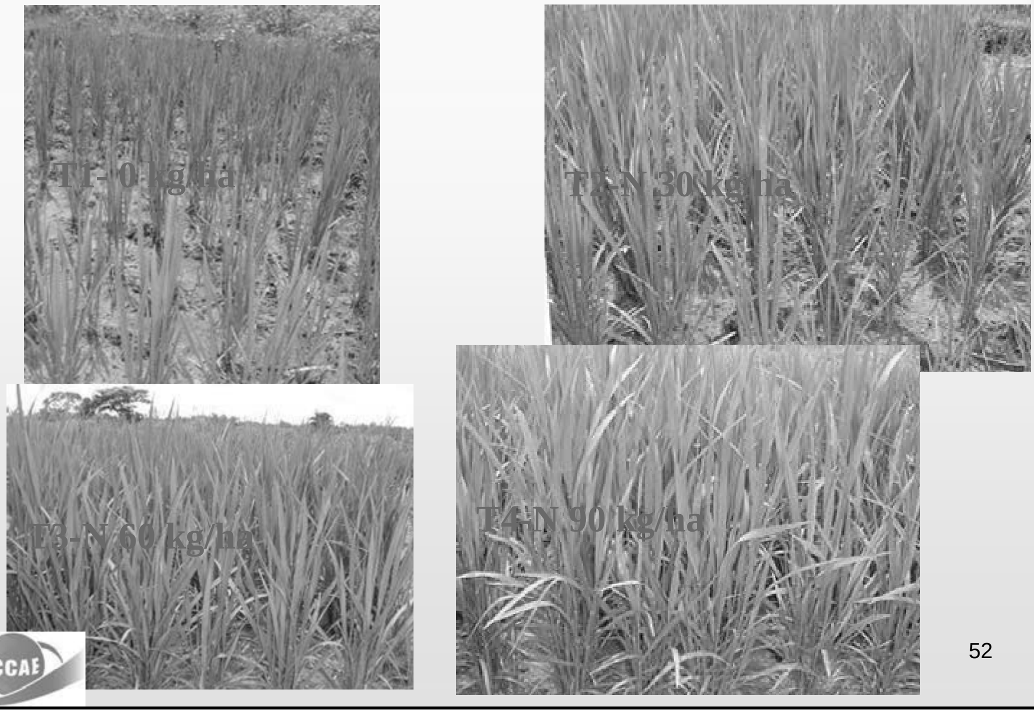

NERICA Yield 2005 at LBDA
High Yielding NERICAs at Alupe -Busia 2004
Yield (kgs)
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
1
Varieties
WAB 450-11-1-1-P41-HB - N10
WAB 450-11-1-3-P40-HB
WAB 450-11-1-3-P41-HB
WAB 450-11-2-BL1-DR2
WAB 450-16-2-BL1-DR1
WAB 450-16-2-BL2-DV1 - N11
ICCAE
50

Yield of the NERICAs at the Farmers Field in Teso District



51

NERICAs at 52 DASE at LBDA Alupe grown under different treatment of N



52

High Yielding NERICAs

Maturity – 100 days

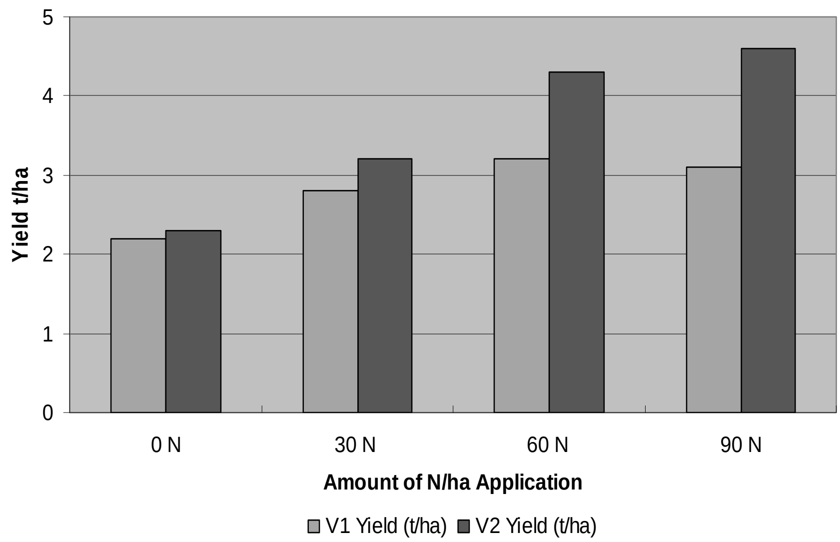
Yield – more than 4.0 t/ha

450-11-1-3-P40-HB

WAB 450-11-1-3-P41-HB

53

Effect of N on Yield - WAB 450-11-1-1-P41-HB (V1) and WAB-450-11-1-1-3-P40-HB (V2)



54

2006 Long rains trials

Experiments are on going in all the four sub-stations of the project, namely:

- Botanic Garden at Maseno University,
- Alupe field station of Lake Basin Development Authority,
- Kilombero Agricultural Training and Research Institute at Ifakara, Morogoro,
- Kenya Agricultural Research Institute, Kibos.
- Uganda, National Agricultural Research Organization – Ngeta.

55

Soya bean and Bambara Groundnut Intercrop with NERICA Rice 21 das

56

Soya bean and Bambara Groundnut Intercrop with NERICA Rice 42 das

57

NERICA - Alupe Experimental Plots - LBDA

58


NERICA Field Trials at Maseno 2006
ICCAE
59


NERICA Technical Review Team
Maseno Fields
ICCAE
60

NERICA 10 at Grain filling Stage, Maseno

61

GRAIN YIELD FOR SOME RAINFED RICE CULTIVARS [WESTERN KENYA]

Variety	Number of Panicles/M^2	Filled Grain Rippening Ratio (%)	1000 Grain Weight (g)	Yield (Kg/ha)
KAISO K23	452.5	77.0	20.3	2323.0
KR – 35	364.5	62.8	24.8	2527.0
KR - 108	379.6	67.8	27.7	2527.5
NERICA 1	235.6	85.7	30.0	3395.1
NERICA 4	259.6	85.7	27.3	2578.5
NERICA 10	205.4	92.8	26.7	3325.3
NERICA 11	296.9	86.5	30.2	4024.5
WAB 450-11-1-3-P41-HB	221.4	87.1	25.8	2898.1
WAB 450-11-2-BL1-DR1	193.8	82.2	31.8	3000.8
PAKISTAN R3	378.7	73.9	27.6	3104.0
PISHORI	459.6	67.8	26.8	2493.6
DOURADO	190.2	86.8	33.6	3035.9
CV	*17.40*	*8.32*	*7.51*	*23.54*
LSD 5%	*89.34*	*11.23*	*3.52*	*1170.43*
LSD 1%	*121.42*	*15.27*	*4.79*	*1590.86*

62

NUTRITIONAL QUALITY OF NERICAs

SAMPLE	TREATMENT	PROTEIN (%)
NERICAs	POLISHED VS PARBOILED	10.2 vs 10.7
NERICAs		10.0 vs 10.9
GUINEAN VARIETY		9.4 vs 10.7
IMPORTED VARIETY*		7.7
STANDARD REF. (USDA)		8.1

TAIWAN & CHINA*

Source, ARI 2006

63

Intervention Strategy 1

- NERICA varieties were developed for rainfed or upland conditions; however, there is need to quantify the spectrum of several varieties in cultivation with regard to their water requirements for effective production.
- However, physiological characteristics of NERICA are not fully known and there is an urgent need to conduct research in NERICA agronomic and physiological parameters geared to high productivity under limiting water availability.

64

Intervention Strategy 2

- Establishing seed banks requires elaborate information on the ecophysiology of the donor plants, especially with regard to overcoming environmental constraints, since stress is a major limitation to crop production worldwide.
- There is growing interest in identifying and selecting genotypes that will maintain growth and productivity under limited water conditions.

65

Intervention Strategy 3

- NERICA may need a shuttle adaptive research approach in order to select varieties which are adaptable to several regions of different agro-ecological structures.
- Through this process varieties which can perform well in the Sub-Saharan Africa can be produced or selected within a short time, thereby reducing the breeding programme period.

66

Intervention Strategy 4

- In Sub-Saharan Africa presently, the greatest need is to increase food production above the population growth rate.
- However, this will not be achieved unless fertilizer usage is increased and combined with higher yielding varieties and improved crop management practices.
- The realization of this target also depends on the improvement of the continent's infrastructure network.

67

Intervention Strategy 5

- Weed control has been identified as a factor, reducing NERICA production in East Africa, especially the *Striga hermonthica* which causes up to 70% loses in cereals.
- Identification of NERICA varieties that can withstand the weeds' effect will be desirable to promote production.
- Striga is the main parasitic weed devastating NERICA production in Sub-Saharan African.

68

Intervention Strategy 6

- In recent Africa Rice Congress (ARC) in Tanzania, it was realized that Sub-Saharan Africa has the lowest number of available scientific expertise which is about 83 scientists per million people, compared to 1100 scientist per million in industrialized countries and 785 per million in Asia.
- At this level of scientific expertise in Africa, it is paramount that capacity-building programme focusing on the development of a multi-disciplinary researchers and extension staff is urgently needed.

ICCAE

69

Intervention Strategy 7

Lack of certified seeds is the main draw back to releasing some of the high potential NERICA varieties in Kenya.

- Efforts are now being made to bulk the seeds of selected NERICA lines for release to farmers by 2008 long rains season but there is also a need to bring in private sector stakeholders in certified seed production and marketing.
- Sasakawa-Global 2000 has played the role of seed production successfully in Asia and Uganda, their experience is an asset in NERICA seed dissemination.

ICCAE

70

Intervention Strategy 8

- Pest and diseases evaluation in NERICA fields should be carried out and the results used to identify correct remedial measures and development of necessary pesticides and other crop protection chemicals relevant to NERICA rice production.

- Harvesting and post-harvesting techniques need to be surveyed and recommendation made on best practices on processing and storage.

71

Intervention Strategy 9

- Value addition and milling requires quick access to good quality mills to enhance profitability of the rice produce by farmers in contrast to the middle traders.
- Market surveys and identification of ready market for the produce will also entice more small-holder farmers to continue with rice production both for food security and cash crop.
- In Uganda farmers have earned up to Ush. 3,740,000 (about US$ 2,000) for NERICA production per hectare.
- This earning has enables NERICA farmers to meet several of their family obligations.

72

Post-harvest Activities Uganda

Rice Threshers

73

FINAL DESTINATION FOR RICE: THE MARKET & THE TABLE

74

Benefits to Farmers

- Benefits from rice growing have been proven to be greater for farmers working in groups than those working individually. Such benefits include sharing labour and information and also better marketing.

- On-farm water harvesting after heavy rains have also improved production to the farmers involved.

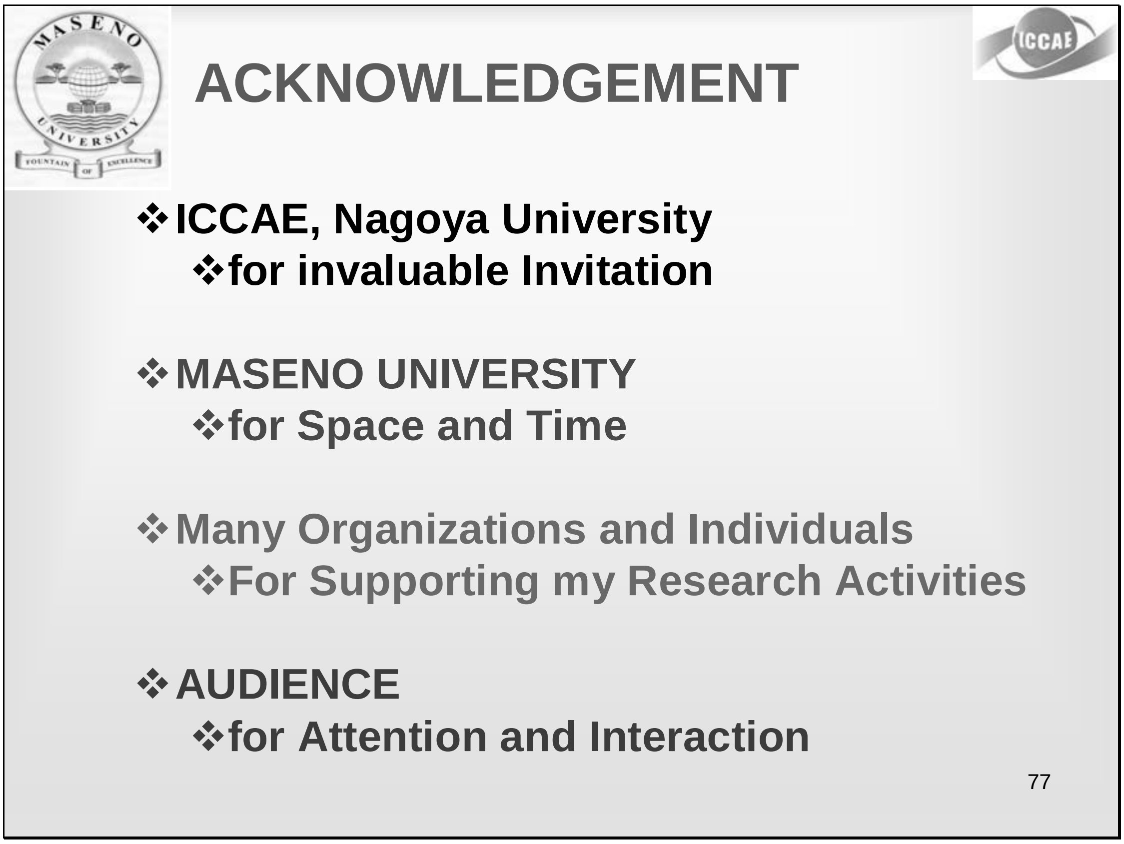
75

Conclusion

- The findings from the research strategies and up-scaling of production technologies will be a resource and attribute to the performance and implementation by various Ministry of Agriculture extension services in different countries in the region.
- This will spirally lead to better natural resource management practices and improved rice production, marketing and availability to rural and urban communities.

- If coordinated well, then this will enhance the role of NERICA in food security and poverty reduction in the Sub-Saharan Africa.

76


ACKNOWLEDGEMENT
❖ICCAE, Nagoya University
❖for invaluable Invitation
❖MASENO UNIVERSITY
❖for Space and Time
❖Many Organizations and Individuals
❖For Supporting my Research Activities
❖AUDIENCE
❖for Attention and Interaction
77


THANK YOU
FOR
LISTENING
ICCAE

質疑応答
Question and Answer Session

Rice Production in Africa: A Key to Promoting the Sub-Saharan Africa Food Security
アフリカにおける米の生産：サハラ以南アフリカの食料安全保障を強化するためのキー

John C. Onyango
Professor, Maseno University, Kenya
Visiting Professor, ICCAE, Nagoya University (at the time of presentation, October 2006)

司会：浅沼　修一
名古屋大学農学国際教育協力研究センター
Chair person: Shuichi Asanuma, Professor, ICCAE, Nagoya University

Asanuma, Chair:

Thank you very much for your general introduction of NERICA; on its production, problems, and dissemination in Africa.　I'm surprised to hear that NERICA has such a potential to grow its yield up to 3 tones/ha with the farmers skill.　As you said in the conclusion, coordinating them well would make it possible to improve the food security.　I think this is important.

We are behind the schedule.　Do you have any questions for Dr. Onyango?

Wakatsuki:

My name is Wakatsuki from Kinki University.　Thank you very much for your nice presentation.　I am also extremely impressed by your presentation and recognized, for realizing the green revolution in Africa, the basic infrastructure is necessary.

May I ask you about your target of NERICA dissemination?　Do you think fertilizer is the key?　If the yield of NERICA or of any other rice is less than 4 tons/ha in the farmers' fields, the use of fertilizer may not be productive. Normally at that level, fertilizer use cannot be sustained due to its high cost. The yield should be higher than 4 tons/ha.　So, in that case, do you think what strategy should be adopted to increase the yield at the farmers' fields?　I think that the green revolution would be possible when 4 tons or higher is realized in the farmers' yield, otherwise any fertilizer use can not be economic.　This is my opinion.　Could I have your comment about that?

Onyango:

Thank you very much for that question Dr. Wakatsuki.　I think the fertilizer use has been in high debate for a very long time.　That kind of thinking is not new.　Actually, even when we are talking about the Green Revolution in Asia that is, India and Pakistan, the fertilizer was a problem and so was the crop production.

But I think the scientists who were dealing with the crop at that particular time made the governments realize that if the aim was to increase production then fertilizer had to be involved. If that (increased use of fertilizer) is going to be the case, even though the farmers are poor, they are ready to offer labor on their farms, so the government should come up with subsidy to bale them out to increase NERICA production.

The problem with the fertilizer is still there as at now we also have environmentalists who are concerned with pollution factors caused by fertilizer run-off from farm lands. However, this can be mitigated by having buffer crops to take up run-off nutrient load before discharge into water bodies.

Since the subsidy worked for Green Revolution it is possible to employ the same method to increase production. The countries affected with low rice production spends about US$ 1.5 billion to import rice, it follows that, if they spend a fraction of that money to access fertilizer for farmers then they can assist small holder producer increase production. The agricultural extension staff will also help with safe environmental management of fertilizer usage.

Asanuma, Chair:

I will take one more question. No question? I have a question. You showed us in your slides regarding intercropping of NERICA with Soya beans and Bambara groundnuts. What is the purpose of the experiment in terms of farm management?

Onyango:

Thank you. The purpose of the experiment is to help with the replenishment of the soil nitrogen, because the two crops are legumes, hence good in nitrogen fixation at scientific level. But at community level, most farmers we are dealing with are already intercropping Soya beans and Bambara groundnuts with maize. Our experiments are therefore aimed at developing a package for technology transfer. We want to have enough information for this transfer so that we can win farmers' confidence in using rice instead of maize thereby increasing the production.

Asanuma, Chair:

If there is no other question, thank you very much, Professor Onyango.

Profile

ジョン・C・オニャンゴ John C. Onyango

マセノ大学理学部長・教授

Professor, Dean of Faculty of Science, Maseno University, Kenya

Contact: Department of Botany and Horticulture, Faculty of Science,
Maseno University
Address: Private Bag, 40705, Maseno, Kenya
Email: jconyango@yahoo.com

1986年ケニア・ナイロビ大学理学部植物学修士課程修了（植物生理学）、1989年英国サセックス大学博士課程修了（作物・植物生理学）。1986年から1991年までナイロビ大学教員、1992年から2001年までマセノ大学植物学科長。その後、同大学理学部植物生理学教授に就任し、現在に至る。2004年から2008年までマセノ大学理学部長を務め、2006年8月から12月まで名古屋大学農学国際教育協力研究センター客員教授を務め、名古屋大学山内章教授、浅沼修一教授とともに共同研究を実施。

1993年、1996年、2000年、2003年にはドイツ・バイロイト大学アーウィン・ベック教授、1995年にはロンドン大学デニス・ベイカー教授のもとで研究を行う。フルブライト・アフリカ上級研究者プログラムで米国ルイジアナ州の稲作研究試験場、リチャード・デュナン教授の下で9か月間にわたり研究を行う。

これまでドイツ・アフリカ学術交流（DAAD）、ドイツ国際技術協力（GTZ）、ドイツ研究財団（DFG）、アフリカ高地イニシアチブ（AHI）、ドイツ連邦教育研究省、ビクトリア湖研究イニシアチブ（Vic Res）（SIDA IUCEA）、日本の国際協力機構（JICA）、また、アフリカ人造り拠点（AICAD）などからも研究ファンドを得ている。

オニャンゴ教授が行った重要な研究の一つとして、ドイツ連邦教育研究省から研究費を受け BIOTA の下で実施した、コミュニティの資源有効活用に関する高価値植物の保全に関するプロジェクト『東アフリカ E12 プロジェクト：東アフリカ山林の植生、再生、民族植物学』が挙げられる。

現在は、AICAD と JICA とが行っている NERICA のケニア国内地域適応性試験において、特に、天水稲作、植物生理学、生物多様性に関する研究を意欲的に行っている。現在の研究は、ケニアにおける NERICA の適応試験、およびビクトリア湖地域におけるケニアの伝統的天水稲作法の普及研究。

Academic career

Professor Onyango obtained his Bachelor of Science and Master of Science in Botany (Plant Physiology) from the University of Nairobi, Kenya in 1982 and 1986 respectively. He later obtained his Ph.D. in Crop/Plant Physiology from the University of Sussex, United Kingdom in 1989.

Professional career

Professor Onyango has had an illustrious career in University teaching, research and administration since 1986 to date. He first taught at the University of Nairobi from 1986 to 1991. He then joined Maseno University in 1992 to become Chairman of Department of Botany up to 2001. He rose through the academic ranks to become a Professor of Plant Physiology in the Faculty of Science a position he serves until to date. Professor Onyango was also Dean of the Faculty of Science from 2004 to 2008 at the same university. He was a Visiting Professor from August to December 2006 at the International Center for Cooperation in Agricultural Education (ICCAE), Nagoya University conducting research with Professor S. Asanuma in Professor Akira Yamauchi's Laboratory.

Research Interests and Achievements

Professor Onyango in the past has been awarded several three-months research fellowship awards that enabled him to carry-out distinguished research in Professor Erwin Beck's Laboratory at the University of Bayreuth, Germany in 1993, 1996, 2000 and 2003; Professor Denis Baker's Laboratory at University of London 1995; Nine-months sabbatical leave research in Professor Richard Dunand's Laboratory at Rice Research Station, Crowley, at Louisiana State University, USA. Sponsored by Fulbright Senior African Scholars' Program.

Professor Onyango's outstanding research work is evidenced by his numerous publications in refereed journals and the many research grants he has been awarded by distinguished organizations, among the German Academic Exchange for Africa (DAAD), German International Technical Cooperation (GTZ), German Research Foundation (DFG) African Highland Initiative (AHI), German Federal Ministry of Education and Research, Lake Victoria Research Initiative – (Vic Res) (SIDA IUCEA), Japanese International Cooperation Agency, (JICA) and AICAD.

One important research initiatives he has undertaken is that of the conservation of high value plants for efficient community utilization of resources a project that was sponsored by the German Federal Ministry of Education and Research, under the BIOTA – East Africa, E12 project on Vegetation, Regeneration and Ethno-Botany of East African Mountain Forests.

Professor Onyango is currently an active researcher in the NERICA-rice research initiative promoted by Japanese International Cooperation Agency (JICA), and AICAD and his research work has focused on rain-fed rice and plant physiology and biodiversity in general. His current research is on Adaptability trials of NERICA in Kenya and Agronomic development of Kenya's traditional rain-fed rice in Lake Victoria region.