ケニヤにおけるネリカ米普及に具備すべき社会経済的要素
Socioeconomic Factors Needed for NERICA Dissemination in Kenya

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要　約

ケニヤでは人口増加と都市化によりコメがここ数年、多くの世帯で急速に主食の一部を占めるようになってきている（Kennedy and Readon, 1994）。2002 年から 2003 年の間にコメの消費量は 35.2%の増加を示し、2005 年には生産が 8 万 5 千トン、消費が 31 万 1 千トンに達し、生産量と消費量の差は約 1 億 7 千万ドル分の輸入で補填しているとみられる（CBIK, 2005）。

コメの生産量が低い原因として、一方では耕作面積 0.5～2 エーカーの小規模農業経営、適切な作物栽培方法に関する知識不足、マーケティングの不足、低収量品種の利用、コメ以外の作物との競合、コスト的に効率を高める機材の不足が考えられる。他方では、陸稲として 40 万ヘクタール、低地・灌漑地として 65 万ヘクタールが栽培可能面積として賦存している一方、ケニヤ西部では天水で栽培される在来品種 Dourado Prococe（1.5 ton/ha）、および水稲栽培の IR2793-80-1（3.5 ton/ha）の低収量性、沿岸地域では、Kaiso K25 や Parkisan、KR22、KR25 などの在来品種の栽培も、低位な生産量の原因となっている（Atera 2006）。ケニヤ国立農業研究所（KARI）は協力機関と共同して、収量と旱魃耐性に関する NERICA の適応性試験を 11 か所で実施した。その結果、NERICA11 と NERICA4 が普及品種として選抜された。この 2 品種は旱魃耐性が高く、高収量を得られ、調理特性も優れている。収量は 2～3 ton/ha である。

今後の課題として、普及品種を農家に広く導入してもらうためにどんな条件を揃える必要があるのか分析することが必要となっている。技術普及段階に移行する時期は非常に重要である。この段階では社会経済的条件の影響を理解する必要がある。ブンゴマ地域で行われた戸別予備調査の結果は、NERICA 普及を促進する条件、あるいは妨げる条件が数多くあることを示唆している（Okech J N, Takeya H and Asanuma S, April 2006）。また、収量や、様々なストレスに対する耐性の高さ、味の良さといった NERICA の特性に関する情報が不足している場合に NERICA に対する関心が低くなるという結果も見られた。この他にも、生産コストの高さ、経験不足、適切な機材の不足（精米機）、ケニヤ国内市場における輸入米に劣る国産米の競争力、リスク嫌悪、といったことが要素として挙げられる。さらに、栽培面積の１位を占めるトウモロコシに対し、コメの場合は栽培面積で９位、収入額では３位である。予備調査ではこのほか、農家はコメの種子を主に近隣の農家から分けてもらう場合が多く、このことから組織的な種子生産システムが存在しないことも明らかになった。キスムとブシアで行われた戸別調査では、NERICA 普及に対する肯定的・否定的な考え方が、個人個人の場合と、グループの場合で違いがあることを考慮する必要性が浮かび上がった。また、NERICA と他の穀物との関係性（競合、補合、補完）を考慮する必要性も示唆された。

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Socioeconomic Factors Needed for NERICA Dissemination in Kenya

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Abstract

Rice has over the years rapidly increased to become a main food commodity in many Kenyan households due to increase in population and urbanization (Kennedy and Readon, 1994). A recent report indicates that between 2002 and 2003 rice consumption increased by 35.2%, and by 2005 production and consumption stood at 85,000 and 310,951 mts respectively, suggesting that the difference was imported amounting to about $170 million (CBIK, 2005).

The low rice production can be explained on the one hand by the small farm sizes ranging from 0.5 acres to 2acres that farmers cultivate, attributed to lack of knowledge on appropriate crop husbandry practices, poor marketing, low yielding varieties, competition from other food crops and lack of cost effective equipment. Yet there is a potential area of 400,000 and 650,000 ha for upland and lowland/irrigated ecosystems respectively, and on the other hand by low average yields of conventional varieties, Dourado Precoce (1.5 ton/ha) and IR2793-80-1(3.5tons/ha) under rainfed and irrigated cultures, respectively in West Kenya. In the coastal region the conventional varieties grown include Kaiso K25, Parkisan, KR22 and KR 25 (Atera 2006)

KARI and its partners have carried out NERICA adaptability tests focusing on yield and drought tolerance in 11 sites that resulted in selection of NERICA 11 and 4 that are being considered for release. Results have shown that the cultivars are drought tolerant, high yielding and have good cooking quality. The yields range from 2 to 3 tons per ha. Following the selection of NERICA 11 and 4, it is necessary to carry out analysis of the preconditions of diffusion as a strategy geared towards achieving high adoption rate.

Moving into technology dissemination phase is a crucial stage in which it is important to understand the influence of socio-economic conditions. Preliminary results of the household survey carried out in Bungoma district indicated that there are a number of preconditions that can promote or hinder NERICA diffusion (Okech J N, Takeya H and Asanuma S, April 2006). The results include low interest in NERICA which is attributed to lack of information on its characteristics such as yield, tolerance to various stresses and taste. Other factors identified were perceived high cost of production, lack of experience, lack of appropriate equipment (rice mill), low competitiveness of local rice against imported rice in the domestic market and high-risk aversion. In addition while rice is ranked 9th compared to maize which is ranked 1st in land allocation, it is ranked 3rd in income generation priority scale. The preliminary study further revealed farmers obtain rice seed mainly from neighbor's suggesting that there is no organized seed production system. Other preliminary results of the household survey in Kisumu and Busia indicated that we should consider differences between individual and group perception of constraints (opportunities) for dissemination of NERICA, and also think about the relation among NERICA and other crops.

1. Background Situation

Rice has over the years rapidly increased to become a main food commodity in many Kenyan households. As drawn at Fug.1, consumption of rice in Kenya started an increase since early 1990's and especially jumped up from 2000. The change was taken place by a new trend of consumption custom in urbanized people and young generation.

But the rice production in Kenya has not yet developed in 1990's and early 2000's. The gap of the production and consumption of rice subsequently become expanding very rapidly since 1993. The production and consumption of rice in 2005 in Kenya stood at 85,000 and 310,951mts, respectively. It resulted in import of rice and spending of valuable foreign money for the import. The deficit was imported about $170 million (CBIK, 2005).

The low level of rice production in Kenya can be explained on the one hand severe limitation of cultivated land with rice, especially irrigated farm land and on the other hand low yields of conventional varieties, Dourado Precocev (1.5ton/ha) under rainfed cultures. If farmers in Kenya use irrigated land and a variety of IR2793-80-1 (3.5tons/ha) which is already cultivated in some irrigated areas in Kenya, they can produce much more rice. There is a potential area of 400,000 and 650,000 ha for upland and lowland/irrigated environments, respectively in Kenya.

Most of Kenyan farms range from 0.5 ha to 2 ha under subsistent farming. They tend to have insufficient yield for their subsistence due to unstable climate condition. It is expected to develop rice production with favorite condition and new varieties. The issue must be clarified by research accompanied with field survey.

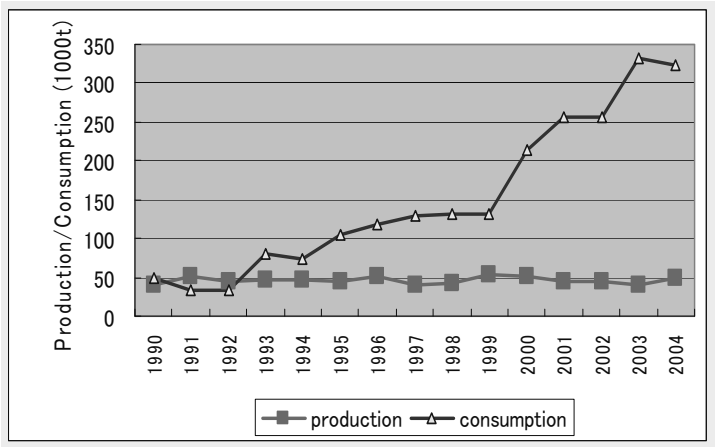

Fig. 1 Production and Consumption of Rice in Kenya

2. Necessary survey to clarify preconditions of NERICA diffusion

2-1. Where has the research of rice in Kenya come up to?

Rice research in Kenya was initiated in 1980's at Kibos and Mwea Tebere. The adaptive rainfed rice research conducted between 1991 and 1995 resulted in the evaluation and selection of 6 upland and 4 lowland rainfed cultivars for rice yield and cooking quality (Kouko *et al* 1995).

In a continued effort to develop high yielding rainfed rice varieties, NERICA was introduced from West Africa Rice Development Association (WARDA). The NERICA cultivars have the potential to increase rainfed rice yield to 3.5 tons/ha and irrigated rice yield to 6.0 tons/ha. KARI and its partners have carried out NERICA adaptability tests focusing on yield and drought tolerance in 11 sites, resulted in selection of NERICA 11 and 4 that were being considered for release in 2006.

2-2. Necessary survey

Following the selection of NERICA 11 and 4, it became necessary to carry out analysis of the preconditions of dissemination as a strategy geared towards achieving high adoption rate.

To get common understanding about the purpose of the survey, there are two points; one is to clarify the socio economic preconditions for NERICA

dissemination in Kenya at farm, community, and district levels, another is to find target farmers or groups, and target communities with positive characteristics and thinking. Based on such survey we can make a strategy of NERICA dissemination into target areas.

2-3. Referable information in Uganda

Factors with positive and significant effect on NERICA yield were pointed out by Y. Kijima, et al. (2005). Those are:

1) Experience in growing rice, especially NERICA
2) Farmers learn desirable cultivation practices from their own experience under less extension service
3) Maintenance of soil fertility through proper crop rotations (soil-nutrient responsive)
4) Timing of planting rice under rainwater shortage (large variations depending on the rainfall)
5) Favorable access to market and rice millers
6) Flat areas
7) Community based seed selection and propagation system

Regarding the factor 7th above-mentioned, the African Rice Center already developed a three-year process so that farmers could evaluate the NERICA varieties for themselves under their own climatic conditions. This consisted of establishing a rice garden in a respected farmer's village that compared many varieties of rice including NERICA. At the end of the season, this plot provided seed for farmers to try five varieties on their own acreages.

After the second growing season, farmers were asked to select only three varieties and to pay for the seed. Experiences were compared at harvest time and key learning about agronomic practices shared. By the third year, the superior characteristics of NERICA rice were appreciated and adopted from agronomic and economic perspectives.

In my survey in Aug. 11, 2005, a farmer told me “if somebody takes a good result, he goes to the farm quickly, and leans how to take it from the farming” in Busia near the boarder to Uganda. He was eager to have NERICA varieties.

2-4. Survey of objective conditions

The survey of objective conditions used to be composed of the followings:

1) Natural conditions in each area for possibility of growing NERICA: rainfall (volume and deficit seasons), soil (fertility of low, midst and high land), topography of farmlands (slope, flat), temperature (cultivation times, taste)
2) Technical factors of NERICA: input-output coefficient of each variety on natural conditions
3) Social conditions: extension activities, community based organization, availability to use micro credit
4) Infrastructural conditions: availability to purchase seeds, fertilizer, access to rice millers

2-5. Survey of farmers’ conditions

The survey also has to clarify farmers’ preconditions for NERICA dissemination:

1) Land ownership (paddy, upland, fallow, virgin; size, topography), borrow and lend of land
2) Times of land use per year, kinds of crops, crop rotation, purposes of production (self consumption or cash earning)
3) The number of family members and labors, working members in agriculture and outside jobs
4) Purchase and input production materials (seeds, fertilizer, insecticides, tools, machines), contract of works
5) Technological level（experience of rice and NERICA production, schooling years, yield of main crops）
6) Sales of agricultural products（city, town, rural market; middleman）
7) Business size (sales of products and purchase of materials in money, credits, risk management）
8) Collection of information（from whom, media）
9) Group or corporate activities（training, workshop, cooperative works, cooperative sales, rehabilitation of canals or roads）

2-6. Survey of farmer’s subjective conditions

Furthermore, the survey must to collect information of farmer’s knowledge and attitude concerned to NERICA. For example:

1) Interest: strong, moderate, nothing
2) Need for cash or self-consumption
3) Knowledge: soil-nutrient responsive, yield, cost
4) Technology: drill seeding, timing, water management, crop rotation

5) Crop relations: competitive, complement, supplement
6) Important matters for success: ranking on technology, seeds, fertilizer, water, miller, market should be collected by the survey

In addition, we should also survey on important constrains such as:

1) Less availability to purchase improved varieties
2) Lack of knowledge
3) Lack of technology
4) Lack of water management and conservation systems
5) Lack of low-cost equipment for land preparation, sowing, weeding, harvesting and threshing
6) Lack of extension services
7) Lack of rice miller
8) Lack of credit for farmers, Low price

We use a ranking method among these factors for evaluating constraints.

We need information of the competitiveness to imported rice in price or taste, too. Consumers do not necessarily buy domestic rice, if domestic rice has high price or less favorite taste comparing with imported rice in the market.

3. Results from one survey in Bungoma

3-1. One survey

One survey was done in April, 2006 in Bungoma and Busia to clarify the precondition of farmers for NERICA dissemination. The survey used a method of interview with questionnaire to farmers was implemented; around 6 young interviewers in each area were trained as enumerators through one day course. Then farmers were interviewed individually by the interviews including the authors. The number of farmers selected through random sampling method was both of 26 in Bungoma and Busia. Farmers' meeting was held for giving information of NERICA to them in each area. Here an analysis of those data in Bungoma was described.

3-2. Some features of paddy farmers

When interviewed farmers were divided into two categories in term of paddy farming; paddy farmers and non-paddy farmers, we can make their characteristics clear in Table 1. in this case, paddy means cultivable land for rice. When we observed actual paddy, it sure had small dikes but they have not maintained well as well as canal in that area. Those paddies have not had any water. In that sense, paddy seemed not to promise stable and high productivity of rice production in Bungoma.

Paddy farmers comparing with non-paddy farmers in Bungoma had have relatively small household members and adult family members.

The decision maker of paddy farmers was a little younger than non-paddy farmers and had taken high education. Paddy farmers also have relatively high rate of non-agricultural jobs. In other words, paddy farmers could take high education and consequently get high rate of non-agricultural jobs. Paddy farmers implemented paddy farming and subsequently suppose to obtain better conditions than non paddy farmers.

Table 1 Paddy and non-paddy farmers in Bungoma

	Household members	Adult family members	Age of decision maker	Male (%)	Secondary or higher education (%)	Non-agr. job (%)
Paddy Farmers	7.7	3.5	42.7	76.9	53.8	53.8
Non-Paddy Farmers	11.0	6.1	44.8	84.6	46.2	38.5

Source: Survey in April 2006.
Note: The number of Samples in case of paddy and non-paddy farmers is 13 and 13, respectively.

Paddy farmers have similar working days in one year to non-paddy farmers, as shown in Table 2. They have a little bit small working days in agriculture than non paddy farmers. But they have much more experience in agriculture and rice farming. They have gotten much more training, i.e., on the one hand 46% of paddy farmers had training and 1.4 times of such training, on the other 31% and 0.9 times in case of non paddy farmers. We can also notice that paddy farmers suppose to have better talent for farming and obtaining other jobs.

3-3. Cultivating areas of farmland by paddy farmers

Table 3 shows cultivating areas in 2006 in paddy farmers and non paddy farmers. Comparing those two types of farmers, we can understand size of their farming. Paddy farmers have averagely around twice of paddy comparing to non paddy farmers. Oppositely non paddy farmers have around twice areas of upland with midst and steep slope. Both of two types of farmers have similar size of fallow added with virgin farmland and subsequently paddy farmers have almost similar but a little bit large size of farmland in total with non paddy farmers, as shown in table 3. Depending on these data, we can think about the productivity of their farmland. Paddy farming in Kenya used to have relatively higher productivity and higher income than non-paddy farming in the same unit of farmland. If it is applicable to this analysis, we can estimate that paddy farmers have better production and income in agriculture than non paddy farmers, because paddy farmers have twice areas of paddy under the similar size of total farmland.

Bungoma is not better for rice production due to unstable rainfall even though farmers want to cultivate it. In this area maize is the most main crop and bean is the second main crop in acres. The allocated area for rice was the third position in both types of farmers, but rice did not contribute to cash earning in Bugoma. For cash earning, sugarcane, finger millet and tomatoes added to maize take more important position for paddy farmers, on the other ground nuts and sweet potatoes have significant for non paddy farmers. Total amount of products sales for both types of farmers are almost similar. But total income is higher for paddy farmers than non paddy farmers. That is 75, 615 KShs for paddy farmers, and 53,076 KShs for non paddy farmers.

Table 2 Period of agricultural experience and training in Bungoma

	Working days per year	Working days in agriculture	Agriculture engagement (Years)	Paddy rice (Years)	Upland rice (Years)	Non-agr. Job (%)	
Paddy Farmers	335	270	21.8	6.1	0.6	46.2	1.4
Non-Paddy Farmers	336	284	20.8	2.3	1.5	30.8	0.9

Source: Survey in April 2006

Table 3 Cultivating Areas of Farmland (acres)

Farmland		Paddy Farmer	Non-paddy Farmer
Paddy		1.77	0.85
Upland	Flat	0.31	0.31
	Midst	0.77	1.39
	Steep	0.00	0.10
Fallow		0.62	0.35
Virgin		0.04	0.35
Total		3.51	3.35
Crop rotation		100%	100%

Note: Paddy means cultivable land for rice

3-4. Factors of affecting farmer's decision to accept NERICA

What are factors to affect farmer's decision for accepting NERICA? A regression analysis was done for clarifying the factors, although the number of samples is not enough for statistics. According to table 5, a variable of interest has a positive and higher coefficient with 1% level of significance. Other variable of production cost has negative parameter with 1% level of significance. A factor of experience of rice farming has positive relation and another factor of age has highly negative regression coefficient with both of 5% level of significant respectively. In other words, young farmers having interest in NERICA and experience of rice production should become the target of extension at first when we try to disseminate NERICA to farmers. The factor of production cost needs to economize much more for farmers.

Table 4 Rank of each commodity based on areas and sales in Bungoma

Crop	Paddy Farmers				Non-Paddy Farmers			
	Areas (Acres)	Rank	Sales (KShs)	Rank	Area (Acres)	Rank	Sales (KShs)	Rank
Maize	2.90	1	14274	1	2.10	1	14885	1
Beans	0.71	2	2577	5	1.32	2	4008	2
Sorghum	0		0		0.17	6	2235	5
Sweet potatoes	0.15	6	1031	8	0.24	5	2882	4
Bananas	0.06	9	0		0.32	4	757	10
Soybean	0.15	6	0		0.17	6	1854	7
Finger millet	0.17	5	3585	3	0.13	9	2123	6
Tomatoes	0.21	4	3302	4	0.06	11	1731	2
Rice	0.47	3	1392	9	0.59	3	894	8
Cassava	0.13	8	1754	7	0.06	11	369	11
Groundnuts	0.06	9	1923	6	0.20	8	3396	3
Kales	0.04	12	346	10	0.09	10	885	9
Sugarcane	0.06	9	3842	2	0		0	
Cotton	0.02	13	47	11	0		0	

Source :compiled by authors

Table 5 Factors of affecting farmer's decision to accept NERICA

Variable	Coefficients
Interest	0.586***
Production Costs	−0.255***
Experience	0.260**
Age	−0.790**
Sex	0.420*
Education	0.002*

Note: ***: 1%, **: 5%, *10% with significant level

3-5. Important factors and major constraints for NERICA dissemination

Farmers were questioned what the important factors and major constraints for NERICA dissemination are?

Farmers thought about important factors shown the figures in table 6. The factor of skill was thought as the important factor by 10 informants among 13 ones. Selling price was the second important factor and milling machine maybe the third.

Concerning to the major constraints, knowledge was the most major constraint due to a new technology for the farmers in Bungoma. Farmers also thought skill and market for NERICA introduction were almost insufficient to them. It shows that the information and practice of NERICA have not been provided to farmers here yet so farmers want to know what is NERICA and how to cultivate it. Milling machine was also thought as a major constraint.

In this regard, let give a glance to ownership of equipment and machine here. Table 7 shows that all equipment and machines used to be hired when farmers use them for their farming. In this regard, to reduce of those hired cost must be expected for almost farmers. On the contrary, it should also notice that milling and threshing machine are owned with one quarter. The farmers who owned such machines maybe contact to treat relevant works with farmers who did not own them. Concerning to pumps, 35% of the farmers borrowed them from the neighbors. We should understand that when farmers in Bungoma implement rice production, they have to do under these conditions.

Table 6 Important Factors and Major Constraints for NERICA

Important Factor for NERICA	Number of High Ranking	Major Constraint	Number of High Ranking
Skill	10	Skill	7
Fertilizer	3	Knowledge	9
Water	0	Water Resource	2
Soil	3	Extension Service	2
Crop Rotation	2		
Threshing Mac.	3	Threshing Mach.	2
Milling Machine	4	Milling Machine	6
Credit	3	Credit	1
Selling Price	7	Market	7

Source: Survey in April 2006

Note: The numbers in the table show high ranked responds by interviewees who belong to the paddy farmers group with 13 samples. For example, 10 mean that 10 interviewees pointed the factor as important one.

Table 7 Percentage Response to Equipment Ownership

Ownership	Equipment and Machines (%)			
	Pumps	Milling	Threshing	Tractor
Self	11	23	23	0
Hired	54	65	58	85
Neighbor	35	12	19	15
Total	100	100	100	100

Source: Survey in April 2006

Current materials for rice production such as seeds and fertilizer were obtained by farmers in Bungoma as shown in table 8. Maize seed, chemical fertilizer and pesticide were bought by farmers generally. Manure used to take by themselves in most cases. On the other, rice seed obtained 50% from the neighbors and 20% by themselves. Farmers bought only 30% at market. When people try to disseminate NERICA technology, this kind of farmers' behavior should be thought about.

In addition, making good soil fertility contributes to better harvest in agriculture, as well known. Farmers in Bungoma used to feed livestock for tanking meat and manure shown in table 9.

Cattle feeding is very general for farmers. They use not only cattle's draft for their farming but also take meat, milk and manure. So farmers do not necessarily have manure the amount of manure maybe insufficient to increase rice yield or less developed skill for soil fertilization.

Table 8 Response to sources of farm inputs

Farm Input	Response (%)		
	Self	Buy	Neighbor
Maize Seed	15	81	4
Rice Seed	19	30	51
Chemical Fertilizer	-	85	15
Manure	73	12	5
Pesticide	1	96	3

Source: Survey in April 2006

Table 9 Type of livestock and their feeding purposes

Type of Livestock	Mean number Kept	Purpose for keeping livestock (○)				
		Meat	Milk	Eggs	Manure	Draft
Chicken	14	○		○	○	
Cattle	4	○	○		○	○
Goats	1	○			○	
Sheep	1	○			○	
Pigs	1	○			○	

Source: Survey in April 2006

4. Conclusions

1) An analysis of decision making regressed on selected variables indicated that interest, experience and sex can positively affect to acceptance of NERICA significantly, on the contrary age and production costs suppose to affect negatively efficient dissemination of NERICA technology.

2) Rice production in Bungoma has not been stable and high productivity comparing other crops, even though paddy farmers have positive attitude to rice farming. Rice production was considered as both food and cash crop with emphasis laid on self consumption.

3) Farmers obtain rice seed mainly from neighbors. It suggests that there is no organized seed production system.

4) Farmers have not yet understood NERICA technology in almost. They require skill, knowledge and market as well as milling machine. So to achieve effective diffusion of NERICA technology, there are needs not only to ensure availability of high quality seed, but also to provide sufficient workshops through extension works. Opportunities are available for increasing rice production through participatory and effective diffusion of NERICA technology.

5) To achieve these Governmental interventions is therefore necessary to address identified constraints which include lack of knowledge of NERICA, inadequate farmer support policies, high cost of farm inputs and lack of appropriate equipment.

Socioeconomic Factors Needed for NERICA Dissemination in Kenya

20th October, 2006
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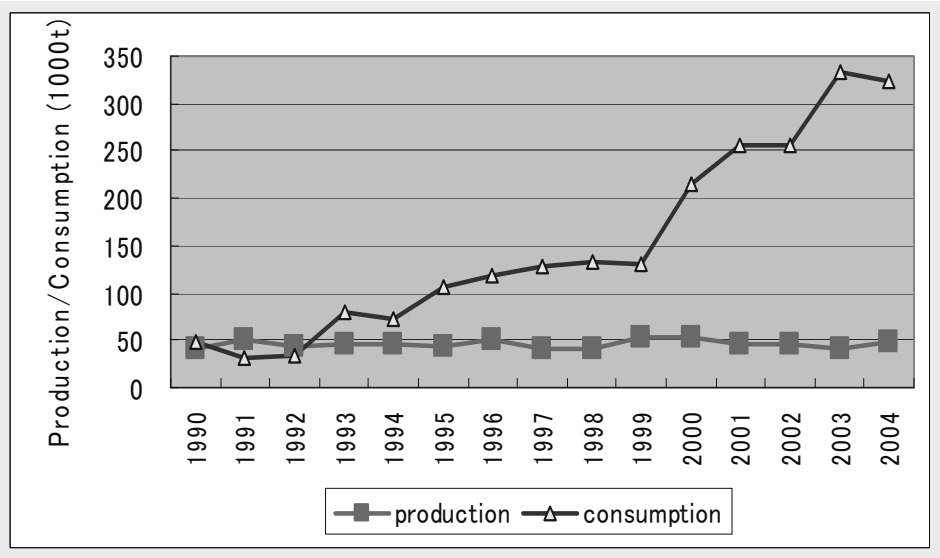
Fig. 1 Production and consumption of rice in Kenya



Rice production has rapidly increased for these years and become a main food commodity in many Kenyan households, due to its urbanization and increase in population.

1. Background situation

The production and consumption of rice in 2005 in Kenya stood at 85,000 and 310,951mts, respectively. The deficit of approximately $170 million (CBIK, 2005) was covered by import.

The low rice production can be explained on the one hand by the limited cultivated land for rice and on the other hand the low average yields of conventional varieties, Dourado Precoce (1.5 tons/ha) and IR2793-80-1(3.5tons/ha), under the rainfed and irrigated cultures, respectively.

There are potential areas of 400,000 and 650,000 ha, for upland and lowland/irrigated environments, respectively.

Most of Kenyan farms range from 0.5 ha to 2 ha under their subsistent farming.

2. Necessary survey to clarify preconditions of NERICA diffusion

2-1. Where has the research of rice in Kenya comes up to?

- Rice research in Kenya was initiated in 1980's at Kibos and Mwea Tebere. The adaptive rainfed rice research conducted between 1991 and 1995 resulted in the evaluation and selection of 6 upland and 4 lowland rainfed cultivars for grain yield and cooking quality (Kouko *et al* 1995).
- In a continued effort to develop high yielding rainfed rice varieties, NERICA was introduced from West Africa Rice Development Association (WARDA). The NERICA cultivars have the potential to increase rainfed rice yield to 3.5 tons/ha and irrigated rice yield to 6.0 tons/ha. KARI and its partners have carried out NERICA adaptability tests focusing on yield and drought tolerance in 11 sites, then resulted in selection of NERICA 11 and 4 that were being considered for release in 2006.

2-2. Necessary survey

Following the selection of NERICA 11 and 4, it became necessary to carry out analysis of the preconditions of diffusion as a strategy geared towards achieving high adoption rate.

2-3. To get common understanding about the purpose of the survey

- To clarify socioeconomic preconditions for NERICA dissemination in Kenya at farms, communities and in district levels.
- To find the target farmers/groups/communities with positive characteristics and thinking.
- To plan strategies for NERICA dissemination into the target areas.

2-4. Referable information in Uganda

Factors producing positive and significant effects on NERICA yields (Y. Kijima, et al. 2005)

- Experience in growing rice, especially in NERICA
- Farmers can learn about desirable cultivation practices from their own experience under less extension service.
- Maintenance of soil fertility through proper crop rotations (soil-nutrient responsive)
- Timing of planting rice under rainwater shortage (large variations depending on the rainfall)
- Favorable access to market and rice millers
- Flat areas

2-5. Referable information (continued)

Community-based seed system

- The African Rice Center developed a three-year process so that farmers could evaluate the NERICA varieties for themselves under their own climatic conditions. This consisted of establishing a rice garden in a respected farmer's village that compared many varieties of rice including NERICA. At the end of the season, this plot provided seed for farmers to try five varieties on their own acreages.

- After the second growing season, farmers were asked to select only three varieties and to pay for the seed. Their experience was compared during harvest time, and the key learning about agronomic practices were shared. By the third year, the superior characteristics of NERICA rice were appreciated and adopted from their agronomic and economic perspectives.

- A farmer told me "if somebody yields a good result, he goes, observes and learns quickly how to take it from the farmer's farming" in Busia. Aug. 11, 2005.

2-6. Objective conditions survey

1) Natural conditions in each area for possibility of growing NERICA
   - Rainfall: volume, deficit seasons
   - Soil: fertility in each land block (low, middle, high)
   - Topography of farmlands such as slope: flat
   - Temperature: cultivation times, taste
2) Technical factors of NERICA
   - Input-output coefficient on a variety of natural conditions
3) Social conditions
   - Extension activities, community-based organization, availability to micro credit
4) Infrastructural conditions
   - Availability of seeds and fertilizer, access to rice millers

2-7. Farmers' conditions survey

1) Land ownership (paddy, upland, fallow, virgin; size, topography), land borrowing and lending
2) Time period of land use per year, kinds of crops, crop rotation, purpose of production (self-consumption or to make cash)
3) The number of family members/labors, workforce members for agriculture and outside jobs
4) Purchase and input of production materials (seeds, fertilizer, insecticides, tools, machines), employment contracts
5) Technological level (experience in rice or NERICA production, schooling years, yields of main crops)
6) Sales channel of agricultural products (city, town, rural market, middleman, contract)
7) Business size (product sales and material purchase in money or credits, risk management)
8) Collection of information (from who/which media)
9) Group or corporate activities (training, workshops, cooperative works, cooperative sales, rehabilitation of canals/roads)

2-8. Farmer's subjective conditions survey

Concerning NERICA:

1) Interest: high, moderate, no-interest
2) Need for: cash, self-consumption
3) Knowledge: good, moderate, not good
   soil-nutrient responsive, yields, cost
4) Technology: high, moderate, low
   drill-seeding, timing, water management, crop rotation
5) Crop relations: competitive, complements, supplements
6) Important matters for success: ranking
   technology, seeds, fertilizer, water, millers, markets

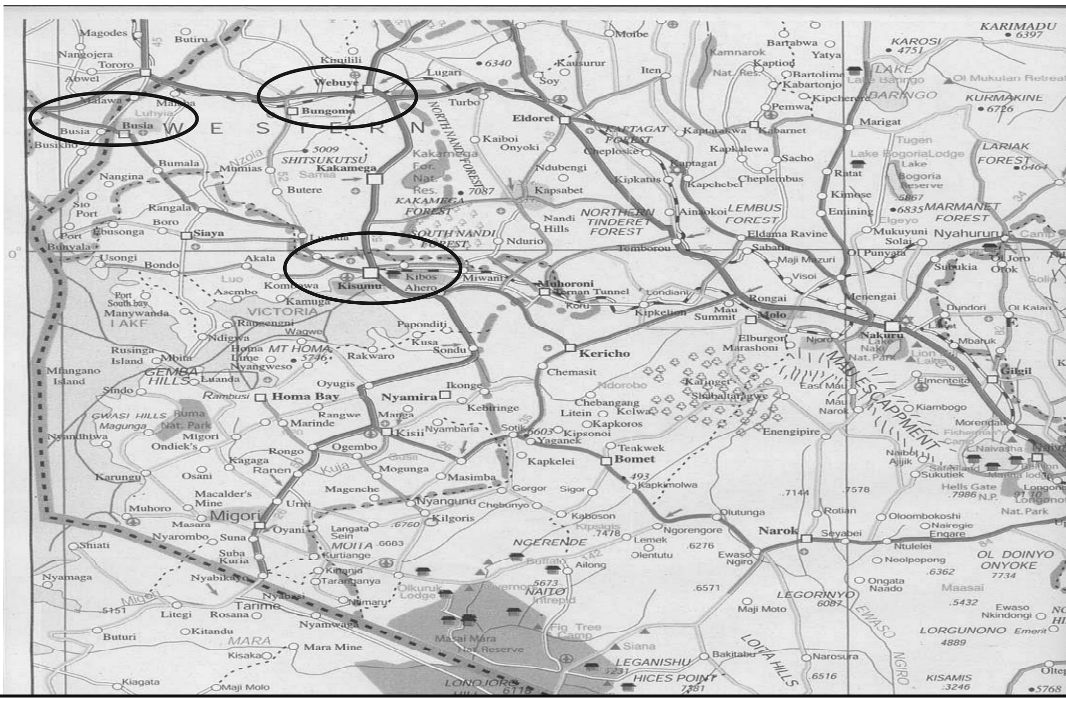
2-9. Farmer's subjective conditions (2)

Important constrains: ranking

- Less availability of improved varieties
- Lack of knowledge
- Lack of technology
- Lack of water management and conservation systems
- Lack of low-cost equipment for land preparation, sowing, weeding, harvesting, threshing.
- Lack of extension services
- Lack of rice millers
- Lack of credit for farmers
- Low price

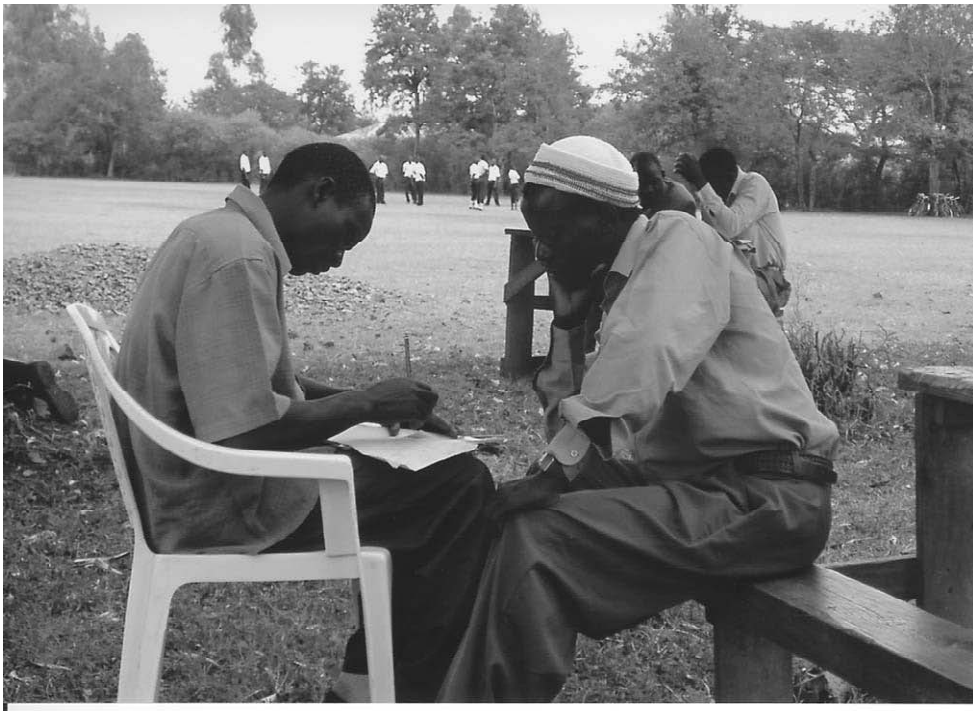
Competitiveness in the market: price or taste

3-1. Locations of survey areas: Bungoma, Kisumu, and Busia

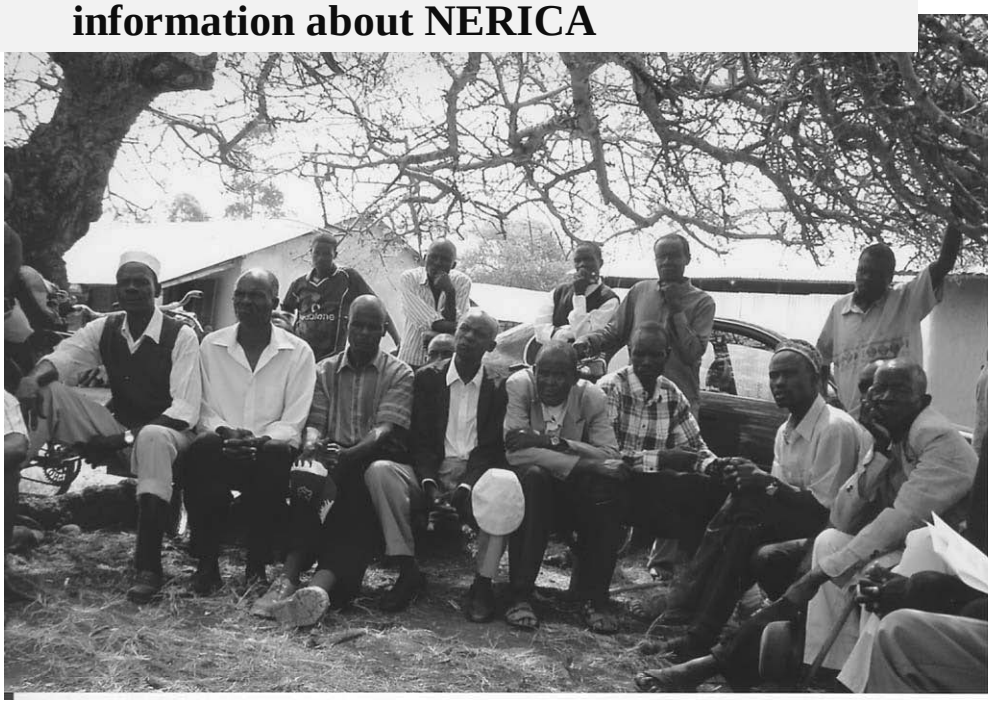


3-2. Training enumerators

3-3. Interviewing farmers



3-4. Farmers Meeting for exchanging information about NERICA



3-5. Data analysis

Table 1 Paddy and non-paddy farmers in Bungoma

	Household members	Adult family members	Age of decision maker	Male (%)	Secondary or higher education (%)	Non-agr. Job (%)
Paddy Farmers	7.7	3.5	42.7	76.9	53.8	53.8
Non-Paddy Farmers	11.0	6.1	44.8	84.6	46.2	38.5

Source: Survey in April 2006

Note: The number of samples: paddy and non-paddy farmers are 13 and 13 respectively.

Table 2 Time periods of agricultural experience and training in Bungoma

	Working days per year	Working days per year in agriculture	Agriculture (years)	Paddy rice (years)	Upland rice (years)	Training	
						(%)	(Times)
Paddy Farmers	335	270	21.8	6.1	0.6	46.2	1.4
Non-Paddy Farmers	336	284	20.8	2.3	1.5	30.8	0.9

Source: Survey in April 2006

Table 3 Farmland areas owned/managed by farmers

(acres)

Farmland		Paddy Farmer	Non-paddy Farmer
Paddy		1.77	0.85
Upland	Flat	0.31	0.31
	Middle	0.77	1.39
	Steep	0.00	0.10
Fallow		0.62	0.35
Virgin		0.04	0.35
Total		3.51	3.35
Crop rotation		100%	100%

Table 4 Ranking of commodity items based on the mean land allocations and associated mean gross-incomes in each areas

Crop	Mean land allocation (Acres)	Rank	Mean gross income (KShs)	Rank
Maize	2.5	1	14030	1
Beans	1.1	2	2853	4
Sorghum	0.5	3	1143	9
Sweet potatoes	0.2	4	1956	6
Bananas	0.19	5	378	13
Soybean	0.16	6	926	11
Finger millet	0.15	7	2659	5
Tomatoes	0.14	8	7708	2
Rice	0.13	9	3193	3
Cassava	0.1	10	1061	10
Groundnuts	0.09	11	1162	8
Kales	0.06	12	615	12
Sugarcane	0.03	13	1921	7
Cotton	0.01	14	23	14

Source: Complied by the researchers

Table 5 Maize production in Bungoma

	Maize Area (acres)	Maize production (t)	Maize yileds (t)	Home consumption	Sale		Channel (%)		
					(KSs)	(%)	town	middleman	consumer
Paddy Farmers	2.9	17.3	5.96	44	14,275	56	18	55	27
Non-Paddy Farmers	2.1	22.8	10.86	52	14,885	48	18	64	18

Source: Survey in April 2006

Table 6 Factors possibly affect farmer's decision-making to accept and adopt NERICA

Variable	Coefficients
Interest	0. 586***
Production Costs	−0. 255***
Experience	0. 260**
Age	−0. 790**
Sex	0. 420*
Education	0. 002*

Source: Survey in April 2006
Note: The significance levels are indicated as *** 1%, ** 5%, and * 10%.
Adj. R^2: 0.73

Table 7 Type of livestock and their feeding purposes

Type of Livestock	Mean number kept	Purpose				
		meat	milk	eggs	manure	draft
Chickens	14	*		*	*	
Cattle	4	*	*		*	*
Goats	1	*			*	
Sheep	1	*			*	
Pigs	1	*			*	

Source: Survey in April 2006
* Purpose of keeping livestock

Table 8 Response percentage on sources of farm inputs

Farm Input	Response percentage (%)		
	Self	Buy	Neighbors
Maize seed	15	81	4
Rice seed	19	30	51
Chemical fertilizer	-	85	15
Manure	73	12	5
Pesticide	1	96	3

Source: Survey in April 2006

Table 9 Response percentage on equipment ownership

Ownership	Equipment (%)			
	Pumps	Milling	Threshing	Tractor
Self	11	23	23	0
Hire	54	65	58	85
Neighbors	35	12	19	15
Total	100	100	100	100

Source: Survey in April 2006

Table 10 Important factors and major constraints regarding NERICA

Important factor for NERICA	Number of high ranking	Major constraint	Number of high ranking
Skill	10	Skill	7
Fertilizer	3	Knowledge	9
Water	0	Water resource	2
Soil	3	Extension service	2
Crop rotation	2		
Threshing machine	3	Threshing machine	2
Milling machine	4	Milling machine	6
Credit	3	Credit	1
Selling price	7	Market	7

Source: Survey in April 2006
Note: The numbers in this table indicate the high ranked responses from interviewees who belong to the paddy-farmers' group with 13 samples.

4. Conclusions

1) Factors regressing their decision making on the selected variables indicated: interest, experience, sex and education can positively affect their decision making to accept NERICA; and age and production costs can significantly and negatively affect that.

2) Rice is considered as a food and also a cash crop; their purpose in generating income is emphasized. Rice is ranked 9th and 3rd in terms of land use and income generation respectively.

3) Farmers can obtain the rice seeds mainly from neighbors; it is suggested that there is no organized seed production system.

4. Conclusions (continued)

4) In order to achieve effective diffusion of NERICA, it is required to ensure the availability of high quality seeds. Opportunities are available for increasing rice production through participatory and effective diffusion of NERICA.

5) Achieving these government interventions therefore needs to address identified constraints such as lack of knowledge about NERICA, inadequate farmer support policies, high cost of farm inputs, and lack of appropriate equipment.

5. Necessary analysis on marketing and competitiveness of rice sugarcane as a cash crop in the Migori district

質疑応答
Question and Answer Session

ケニヤにおけるネリカ米普及に具備すべき社会経済的要素
Socioeconomic Factors for NERICA Dissemination in Kenya

竹谷　裕之　　Hiroyuki Takeya
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Head, Socio Economics, Kenya Agricultural Research Institute (KARI) -Kibos Center, Kenya

司会：杉本　充邦　　Chair person: Mitsukuni Sugimoto
名古屋大学農学国際教育協力研究センター　准教授
Associate Professor, ICCAE, Nagoya University

Sugimoto, Chair:

Thank you very much Professor Takeya, about how the Kenyan farmers are introducing NERICA varieties. From the floor, are there any questions for Professor Takeya?

Ishii:

Your background situation, the Kenyan situation, you have potential areas of 0.4 million for upland and 0.65 million for lowland. My question is, though I know your target is NERICA dissemination, for sustainable rice production, how do you think about the priority when comparing the upland and lowland?

Takeya:

It's really difficult question for me, because this information comes from KARI Kibos and I'm not sure about the actual conditions of targeting areas with high possibility. I'm sorry for that. At least I can say that the staff of KARI Kibos which is the major research institution want to disseminate NERICA broadly not only into lowland but also upland. MAFF of Kenya has been thinking to disseminate NERICA to upland because NERICA can have high possibility to grow well even on upland.

Dr. Onyango, could you help me, if you have some ideas or information on this question?

Sugimoto, Chair:

Are there any questions or comments from other participants?

Yamauchi:

In Table 6, you showed us the results, how and what factors the farmers took when they accept NERICA varieties. The results of your survey showed that the factors such as lower cost, longer experience, and younger age would positively affect their decision making on selecting NERICA varieties. That

is how I understand. You also showed the factor of sex, men and women. Which are more interested in introducing NERICA?

Takeya:

For the factor of 'sex' which would affect farmer's decision as to whether or not they accept and adopt NERICA, we put '1' to men, and '0' to women. So, the results of this multi-regression analysis is read as: '0.42' means 'positive' effect on their adoption of NERICA cultivation with the coefficient of 0.42 when the decision maker in cultivation is a male farmer. When the decision maker is a female farmer, this calculation does not indicate anything. I should try another calculation putting '1' to women and '0' to men. But I am sorry I don't have such results here.

Yamauci:

I think the most important factor is their interest in NERICA. And my question is, what causes or what makes the farmers interested in NERICA? What is the factor that makes the farmers interested in it? What does the "interest" mean here?

Takeya:

Thank you for the important question. When we interviewed the farmers to question on NERICA cultivation, some farmers did not have much information about NERICA. But they have little information such as drought tolerance or early maturity. Even if they don't have such information, they would have keen interest in NERICA introduction. In our interviews to some farmers, they showed their interest in NERICA and asked us, 'What is NERICA?', 'What is the main characteristics of NERICA?' etc. Once they are given such information of NERICA characteristics, they would think they want to introduce NERICA as early as possible. So, if the farmer answered so, we put '1' to this factor, 'interest'. If they didn't have any interest even if they heard of such information, we put '0'. Then, we calculated like this result.

Sugimoto, Chair:

Any other questions? Regarding Professor Yamauchi's question, Professor Onyango will give us additional comments.

Onyango:

Thank you. I would like to make a comment about Prof. Yamauchi's comment about men and women. 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 groups of women who want to participate in NERICA cultivation. Since they don't have land, they have to get permission from their husbands. If you look at my abstract where I am talking about the land tenure system which needs to be changed, women can be empowered to own land. That's one of the major reasons, which is the land ownership and production. But NERICA activities are more active with women groups than men groups. Women are the main NERICA cultivators. The other question about the land acreage:

I think the trend 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 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 them are performing under capacity. In Western Kenya electricity if 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. In a nut shell, we are moving towards upland condition.

Sugimoto, Chair:

Thank you very much. Any other questions? Thank you very much, Professor Takeya.

Profile

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名古屋大学大学院生命農学研究科教授／農学国際教育協力研究センター長
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1973 年名古屋大学大学院農学研究科博士課程農学専攻満了。1973 年 4 月日本学術振興会奨励研究員になった後、1973 年 10 月名古屋大学農学部助手に採用され、都市化・工業化と農民層分解の研究で 1976 年農学博士(名古屋大学)を授与された。次いで農村労働市場と兼業農業の再編の研究、並びに農業・農村基盤整備投資の経済効果の研究に従事。1989 年 4 月名古屋大学農学部助教授に昇任し、水田農業の担い手研究などに従事。1992 年 4 月同学部教授に昇任した。1998 年 4 月から 2000 年 3 月名古屋大学評議員を務め、1999 年 4 月大学院重点化に伴い、名古屋大学大学院生命農学研究科教授となる。1999 年 4 月から 2007 年 3 月まで名古屋大学農学国際教育協力研究センター長を併任し、2009 年 3 月の定年退職後も精力的に研究活動に携わっている。専門分野は農業経済学・国際地域開発学、現在日本農業市場学会会長、日本農業経済学会副会長、日本国際地域開発学会副会長。

Academic career

Professor Hiroyuki Takeya received Ph.D. from Graduate School of Agriculture, Nagoya University, in 1976.

Professional career

Professor Hiroyuki Takeya was a research fellow of Japan Society for the Promotion of Science in 1973. In October of the same year, he started to work for School of Agriculture, Nagoya University, as Assistant Professor in agricultural economics. He studied developing processes of Japanese farming and mechanisms for capacity building of farmers, and on part-time farming related to development of Toyota Automobile Industry, etc. He was promoted to Associate Professor in 1989 and to Professor in 1992, School of Agriculture, Nagoya University, and Professor, Graduate School of Bioagricultural Sciences of the same university in 1999. Professor Takeya served as a council member of Nagoya University from 1998 to 2000. He supervised more than 19 Japanese and international students for their doctoral thesis since 1992. Professor Takeya assumed International Cooperation Center for Agricultural Education, ICCAE, as Director from 1999 to 2007. Even after his compulsory retirement in 2009, Professor Takeya has been actively working on his research fields and as an expert of policy making and evaluation for central and local governments in Japan.

Profile

ジョセフ・ニュートン・O・オケチ　Joseph Newton O. Okech

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オケチ氏は、1978 年、ケニア国立農業研究所（ナイロビ）に圃場試験指導監督技術補佐として採用された。1984 年同研究所に在籍しつつ、エジャートン大学農学部に入学、1987 年同学部を卒業、同年圃場管理主任に昇格し、圃場試験の技術面と資源有効利用の面から圃場管理運営を担当した。1990 年に社会経済学研究助手となり、1992 年、ケニアの主要稲作地帯にある同研究所キボス試験場に異動し、天水条件下における稲作適応研究の主任として 1996 年まで指導監督に当たった。1997 年から 1999 年まで、ギボス試験場の社会経済学研究に関わる立案・実施を指導し、2000 年には社会経済学研究部長に昇格した。この間、1997 年ロンドン大学大学院修士課程農業経済学コース入学、2002 年同コースを修了し、農業経済学修士を得ている。2001 年から現在まで、研究普及活動の統括者として、また農業技術・情報普及イニシアチブ・コーディネーターとして技術普及に携わり、現在に至っている。

Academic career

Mr. Joseph Newton O. Okech graduated from School of Agriculture, Egerton University of Kenya in 1987.

Professional career

Mr. Joseph Newton O. Okech joined KARI in 1978 as a technical assistant, before he pursuing his degree at the School of agriculture of Egerton University in 1984. After his graduation he was simultaneously promoted to a farm manager of KARI in 1987 where he ensured efficient resource allocation through development of farm plan for research and revenue generation activities. He became an officer in charge of on-farm rainfed rice trials in West Kenya in 1992; he then served as an assistant socio economist in 1997. He was again promoted to a coordinator at Agricultural Technology and Information Response Initiative (ATIRI) in 2001 and also worked in charge of research extension liaisons during 2001 to 2006. He has collaborated with ICCAE staff as a research fellow for technology dissemination research of NERICA in Kenya in 2006. Mr. Joseph Newton O. Okech is currently the head of Socio Economic Section in Kenya Agricultural Research Institute (KARI) Kibos Center where he is mainly facilitating priority setting for rice and cotton research and conducting impact assessment/adoption studies on cotton and rice technologies on farmers' fields.