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NARI OVERVIEW

The National Agricultural Research Institute (NARI) was established in 1993, by an act of parliament of the Republic of The Gambia. NARI evolved from the Department of Agricultural Research, of the then Ministry of Agriculture and Natural Resources of the 70s and 80s and today constitutes the major national agricultural research system (NARS) of The Gambia and a focal point for key regional and international research centers, i.e., IITA, ISRA, AfricaRice, CORAF/WECARD, CILLS, AGRA, AVRDC and other CGIAR members .

NARI is comprised of three main divisions, namely the research division which is the scientific wing of the institute; the finance & administration division and the technical or service division. The institute is governed by a board, the National Agricultural Research Board (NARB) which formulates and provides policy instruments and guidelines for the efficient administration of the institute as well as setting priorities for agricultural research to support national economic and social development policies of the country.

Cognizant of its mandate to address the constraints and challenges of producers, NARI conducts applied and adaptive research in all major agriculture and natural resources (ANR) sectors, i.e., crops (annuals, perennials and horticulture), livestock, fisheries/aquaculture, agro-forestry, rural economic resources) all of whose strategies and component arrangements are spelt out clearly in its (NARI's) research programs and research disciplines. NARI also carry out study and supervise and control the production of nucleus, foundation and certified seeds of all major food and cash crops grown in the country.

NARI maintains two major research stations, one at Sapu in the Central River Region (CRR) to cover research activities in the eastern half of the country, and the other at Yundum in the West Coast Region (WCR) to cover research activities in the western half of the country. In addition to these main stations, NARI operates and conducts research in key sub-stations and satellite stations in selected agro-ecological zones throughout the country. The Institute's headquarters in Brikama maintains four laboratories: i) pest management laboratory, ii) soil testing laboratory iii) seed technology laboratory and iv) aflotoxin/ food chemistry laboratory. The services offered includes: documentation centre, training, laboratory services (food chemistry, mycotoxin - aflatoxin, seed quality testing, soil analysis, planting materials, processing equipment (Threshers).

1. AGROFORESTRY/CROPPING SYSTEMS AND RESOURSE MANAGEMENT

1.1 Crop Residue Management and Nitrogen Fertilizer Effect on Maize Grain Yield and Yield Components in Agroforestry System

Introduction

Most of The Gambian soils are inheritably infertile because the nutrient capital are being fast depleted through in efficient crop residue management, irrigation and fallow management among others

This research aims to test combination of three crop residue management practices with four nitrogen fertilizer levels to restore natural soil fertility, organic matter build-up and improve maize production and productivity in The Gambia.

Objectives

- To identify easy and low cost increased maize production technologies.
- To increase maize production through sustainable use of crop residue.
- To explore efficient management of crop residue as an option for sustainable maintenance of the natural resource base.

Materials and Methods

The study was conducted at NARI experimental site III in 2013 for preliminary biomass resource access and the year 2013 provide preliminary residue response data. The trial was a split plot design with main plots assigned to residue management and sub-plots assigned to nitrogen fertilizer levels

Data was analyzed using MSTATC and means were compared at LSD of 5 %.

Main plot (Residue Managements - RM)

- RM1-maize Stover surface spread as farmer practice
- RM2 -maize Stover chop and incorporated in the plot
- RM3 – maize stover made into compost and applied

Sub-plots (N fertilizer levels)

- T1 –Control (0 kg N ha^{-1})

- T2 -Half recommended rate (100 kg N ha^{-1})
- T3 -Recommended rate (200 kg N ha^{-1})
- T4 -Twice recommended rate (400 kg N ha^{-1})

Data was analyzed using MSTATC and means were compared at LSD of 5 %.

Data collection

- Baseline soil sample,
- plant height,
- growth vigor
- Grain yield and yield components

Results and Discussions

Residue management two (residue chopped and incorporated after harvest) recorded the highest plant heights with a height of 160 cm. The lowest plant height was record with management one with a mean height of 100 cm. Nitrogen levels two, three and four in residue management one showed similar mean height of 140 cm. Similar heights were also obtained for N levels two and 3 in residue management 2 as well as for N levels three and four in residue management three (Figure 1).A linear increase in plant heights within residue management practices was observed as N levels were increased.

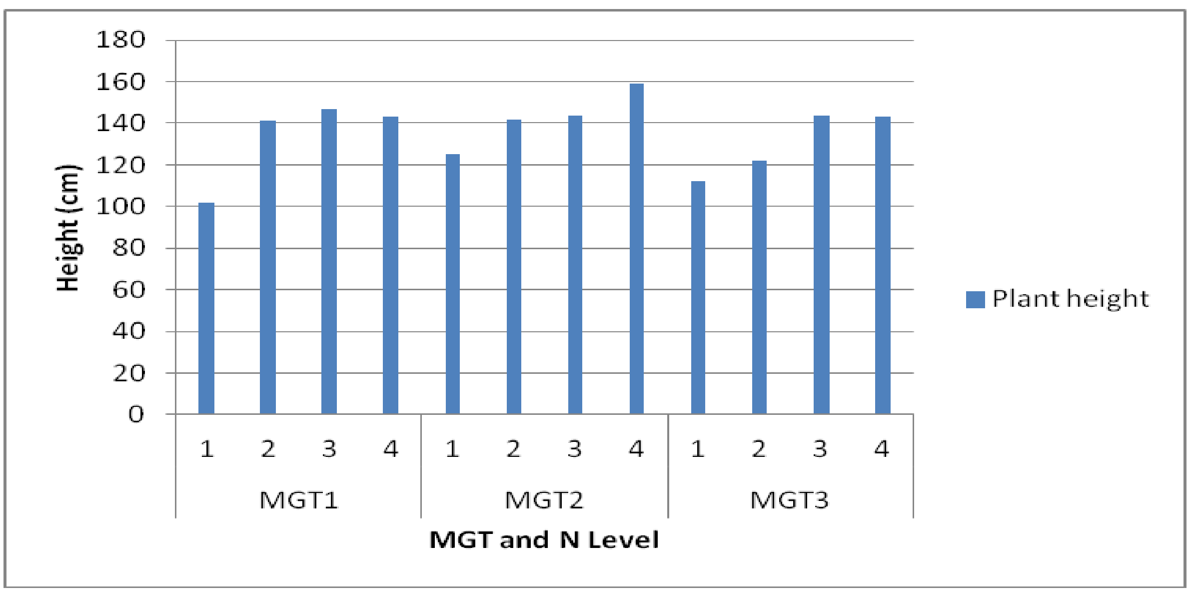

Figure 1. Plant height (cm) as influenced by soil amendments

It can be observed from Figure 2 that the highest mean number of cobs was recorded from residue management 2 with a mean of 50 but there is no significant difference between treatment four of residue management one and four of residue management two with means of 49 and 48 respectively. In residue managements two and three, mean number of cobs recorded in treatment 2 was above 40 which was not the case for the same treatment in residue management one, as it was less. Similarly, treatment four of management one and two scored more than a mean number of cobs of 45 as compared to treatment four of management three with a mean number of cobs of less than 30.

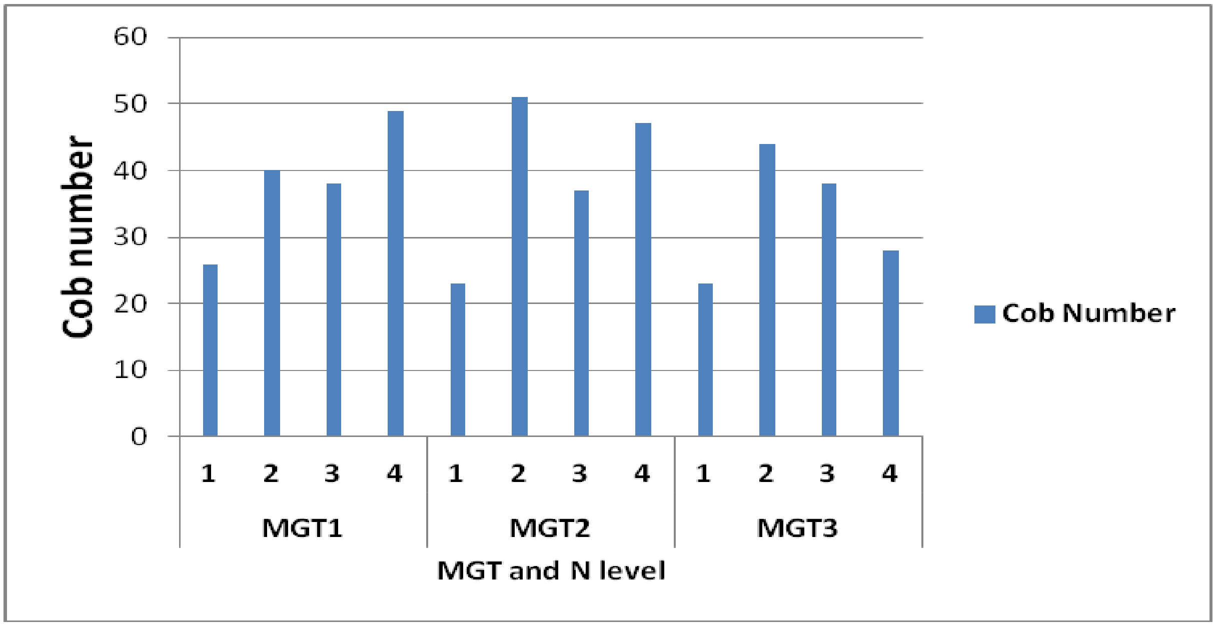

Figure 2. Effect of soil amendments on maize cobs produced per plot

The highest mean grain yield of 1.08 tons per hectare was recorded with residue management two in treatment four and the lowest mean yield of 0.3 tons per hectare was recorded in treatment four of management three. There were no significant differences between treatment four of residue management two, treatment three of management one and treatment three of residue management three recording means of 1089 kg, 967 kg and 844 kg respectively (figure 3).

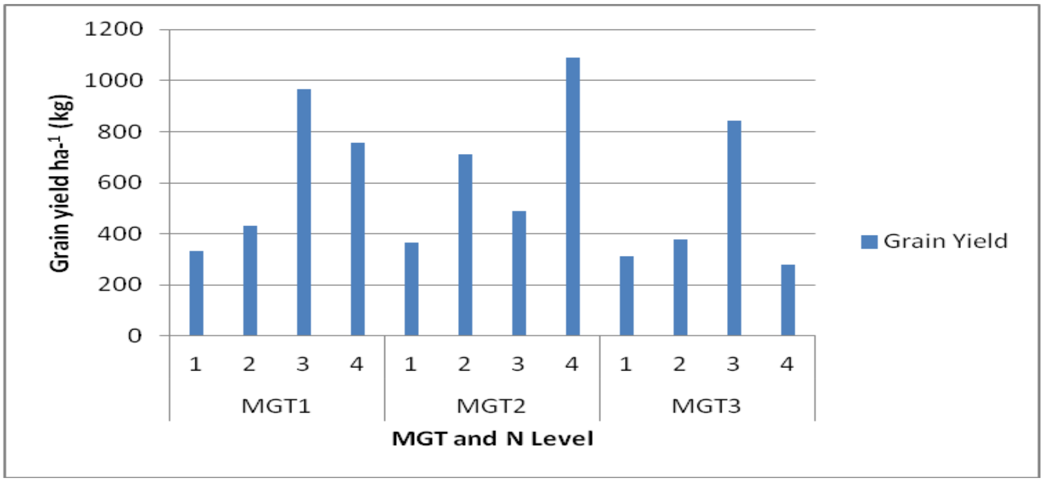

Figure 3. Effect of combining crop residue management with N fertilizer on yield of maize

In Figure 4, the highest 1000 mean grain weight was recorded in management two treatment two with a mean of 156 grams and the lowest was also recorded in management two treatment one with a mean of 106 grams. Across all three residue management practices, treatment three recorded a mean 1000 grain weight of approximately 140 grams. There was no significant difference between treatment three and four in all the management practices.

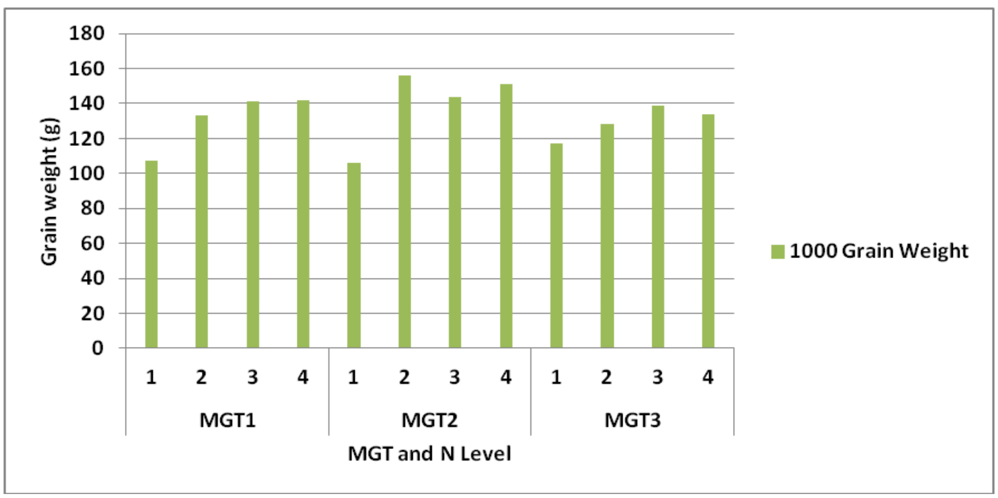

Figure 4. Influence of soil amendments on 1000 grain weight

Conclusion

From the three figures presented above, it could be confirmed that combining nitrogen fertilizer with residue management two (residue chopped and incorporated) had a more positive effect on plant height, number of cobs produced per plot and grain yield per hectare.

1.2 effect of nitrogen application rate on yield and yield components of six maize varieties in a free drained upland cropping system

Introduction

Rate of nitrogen fertilizer application is an important factor affecting efficient nitrogen utilization by maize crop. Nitrogen fertilizer is used more efficiently when the supply of available N in the soil match with the demand for N by the crop and maize is an outstanding candidate in this direction.

Nitrogen deficiency is a common occurrence in upland cropping systems particularly for a crop like maize, partly because of low N use efficiency due to N loss through processes such as leaching, denitrification and volatilization. In addition to optimizing crop returns, optimal crop utilization of applied N is also necessary to minimize the risk of environmental pollution.

Objective

- To determine optimal nitrogen fertilizer requirement of six maize varieties

Materials and Methods

A split plot design with main plots assigned to fertilizer levels and the sub plots assigned to maize genotypes was used.

Main plots (N levels in kg ha^{-1})

1. 0
2. 50
3. 100
4. 150
5. 200

Sub-plots (Maize varieties)

1. DMR Downy Mildew Resistant
2. Jeka
3. Swan 2
4. OBA Super 2
5. NCB
6. TZE-Y

Data was collected from, planting date, plant count at 21 days after emergence (DAE) and at harvest, plant height at 21, 28, 35 and 83 days after emergence (DAE), number of cobs, plant growth vigor (scale 1 – 5), grain yield and 1000 grain weight.

Results

In Figure 5, the highest number of cobs was obtained from varieties 1 (DMR-SR) and 2 (Jeka) in N level 5 whilst the lowest was recorded in N level one with varieties 4 (Ober Super), 5 (NCB) and 6 (TZE-Y) each scoring a mean number of 12 cobs respectively. The highest mean number of cobs attained by varieties 1 (DMR-SR) and 2 (Jeka) in N level five was not significantly different with mean number of cobs obtained from variety 2 (Jeka) in N level two. All varieties with the exception of variety 4 attained a mean number of cobs of more than 15 (figure 5).

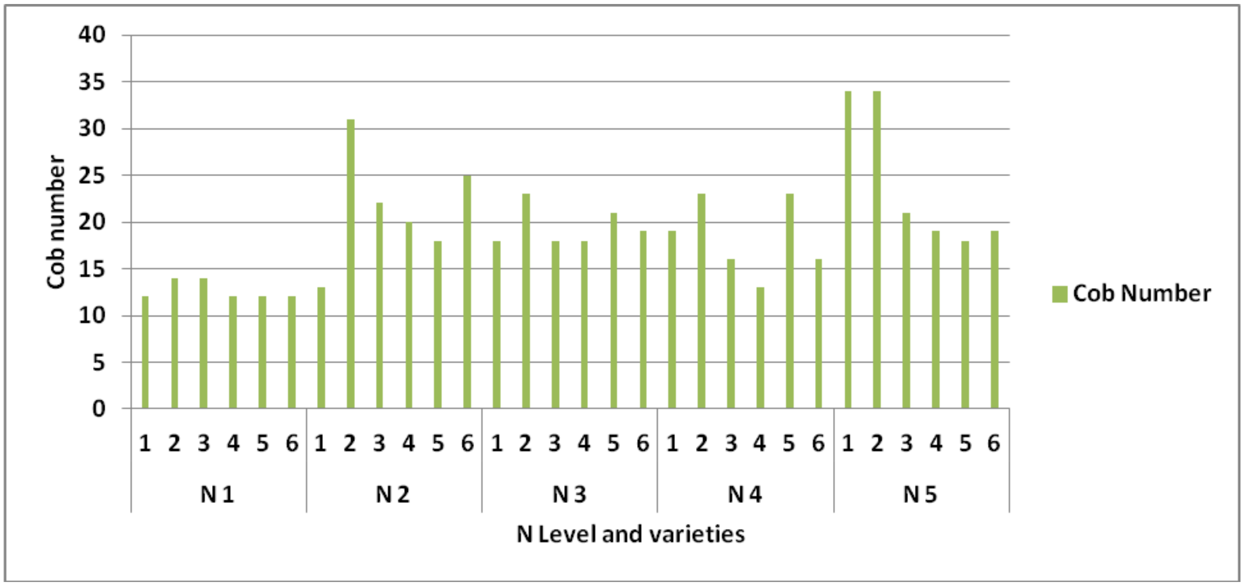

Figure 5. Effect of N levels on cobs produced by six maize genotypes

The highest grain yield was recorded from N level five with a mean grain yield of 0.5 tons ha^{-1} and the lowest was recorded in N level one with a mean grain yield of 0.08 tons ha-^{1}. Across all N levels, treatment three showed a linear increase in yield as N level increases with a mean yield ranging from 0.1 of N level one to 0.5 tons per hectare of N level five (figure 6). Similarly, treatment four also showed a linear response as N level increase, with yield ranging from a mean of 0.1 to 0.4 tons ha^{-1} across N levels.

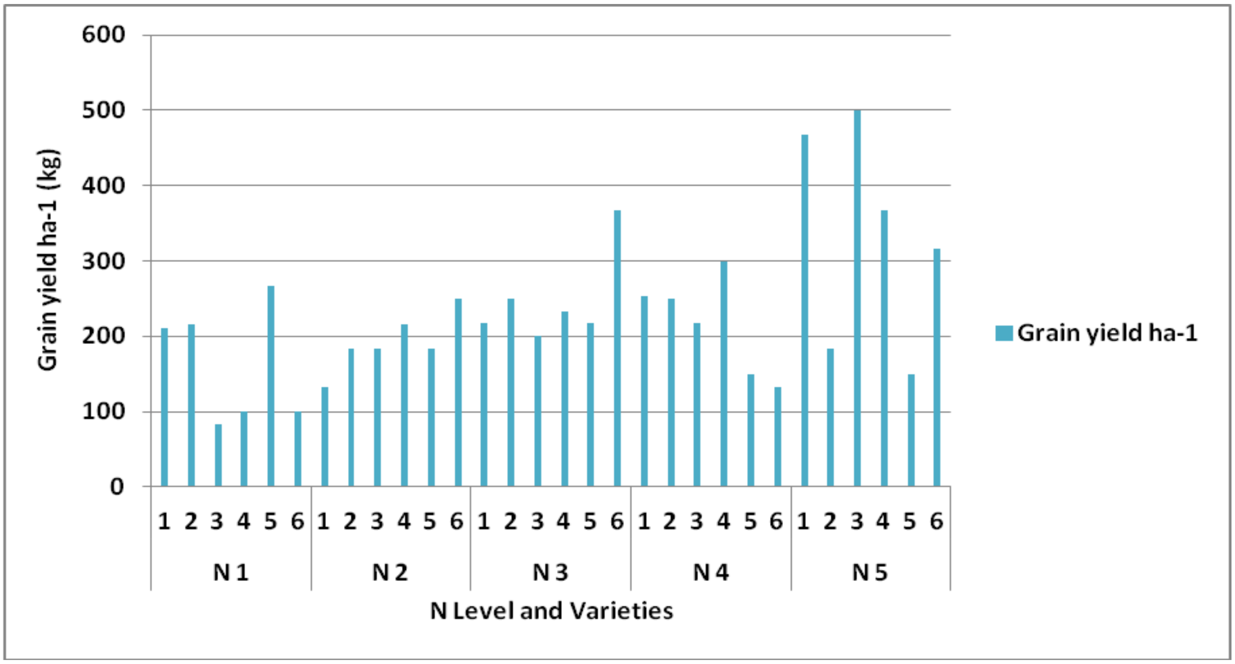

Figure 6. Grain yield of maize varieties as influenced by rate of N applied

Figure three indicated that the highest 1000 grain weight mean was obtained from varieties one, three and four in N level two and the lowest was recorded in N level five with a mean grain weight of 107 grams. All maize varieties, except variety six performed better at N level two than in N level five even though N level five treatments received the highest N rate.

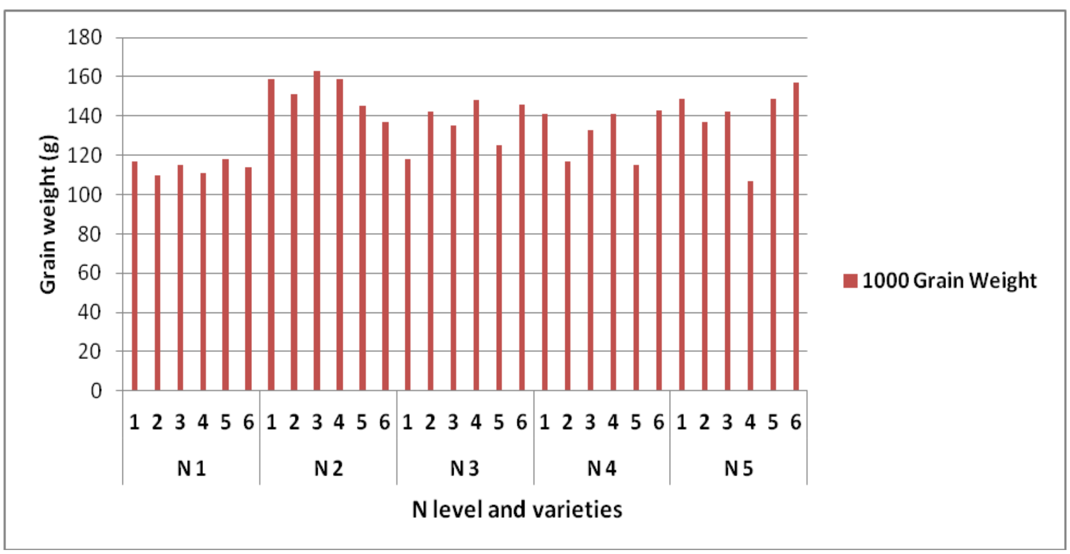

Figure 7. 1000 grain weight as influenced by nitrogen levels

1.3 AU-CRAP ACTIVITY

Introduction

The demand for land, seed and forest has become more intense in certain parts of the country. One of the reasons responsible for this is the high influx of farm families from the neighboring countries that are undergoing civil unrest, there is therefore a need to support the local countries that host people migrating from such conflict zones. In this regard, the Natural Resources Management program of NARI obtained a grant in collaboration with our Senegalese counterpart to run a project to help meet some of the domestic needs of the incoming refugees.

The main target of the project is to improve genetic quality and productivity of multipurpose tree spices and other planting materials including indigenous species in order to allow the diffusion of materials with vegetative stability and conformity with the needs of the communities.

As the sites are improving, more planting materials are needed to be supplied in the larger communities in order to help ease the bottlenecks faced by the local farm families. Most of the regeneration of the forests is ongoing and more expansion is being made to accelerate the seed requirement to meet the demand of the said communities.

Table 1. Villages and farmers involved in the activities

No.	Location	Name of Farmer	Crop	Remarks
1	Faraba Sutu	NyimandingDarboe	Cassava	The field is in progress with healthy plant of knee height
2	Kafuta	HenabaJarju	Cassava	Plants looking good but stunted in growth need to apply botanicals
3	Sibanor	FansuSanneh	Cassava	Aborted
4	Jiramba	Seedy Gibba	Maize and Rice	All crops failed due to erratic rainfall
5	Bantangjan	LambaTamba	Maize	Good harvest with cobs yet to be threshed
6	Aragallen	Amie Jarju	Findi	Very good harvest with three bags each weighing 55 to 60kg

Ongoing Activities

- Mangrove reforestation at Kalagi
- Forest regeneration at Sita
- Forest regeneration at Kafuta
- Forest regeneration at KaimoBintang
- Sweet potato at Ndemban
- Cassava at Sutusinjang
- Forest regeneration at Agarallen
- Forest regeneration at KaimoKaranai

Collaborative Agents

This project is being implemented by the Natural Resources Management program of NARI in collaboration with Horticulture program of NARI, Seed technology unit of NARI, Department of Agriculture, DOF and KomboFoni Forestry Association (KOMFORA).

2. PEST MANAGEMENT PROGRAM

2.1 Application of Aflasafe SNO1 in Gambian Fields

Introduction

Groundnut and maize are among the most important crops grown in The Gambia for cash, food and feed. Aflatoxin accumulation in groundnut and maize have been found to reach higher point in parts per billion (ppb), which if consumed can cause serious human health risks such as cancer. Apart from the health-related effects, aflatoxin contamination in The Gambian nuts has significantly resulted to the rejection of potential marketable groundnut and groundnut products.

The Gambia is the latest country to join twelve (12) others in Africa that have benefited in the implementation of this new project called ‘’Aflasafe Initiative’’. This project is been facilitated by ECOWAS Agricultural Commission and Partnership for Aflatoxin Control in Africa (PACA). In the Gambia, the National Agricultural Research Institute (NARI), the Department of Agriculture (DOA) and the Gambia Groundnut Cooperation (GGC) collaborated with international organisations such as IITA and Direction de la protection des vegetaux (DPV) in Senegal to commence the programme.

Objectives

- Enhance the quality of crop products through reducing aflatoxin contamination in groundnut and maize in The Gambia by 90%.
- Contribute to enhancing groundnut and maize marketing export trade for the Country
- Contribute to minimising health risks caused by aflatoxin contamination in The Gambia

Application Method

The villages that were selected in the first year of the Aflasafe initiative project were Fass Saho and Pakau Njogou in NBR, Sukuta, Chamen, and Bakadagy in CRR-N and Tambakunda Julafare and Sitanungu in WCR. The selection of the three regions was based on a survey carried out earlier on in all the regions to determine the aflatoxin endemic areas in the Country

The Aflasafe SNO1 product was applied on a total land field of 190 hectares in The Gambia. Trained men were then deeply involved in the application of the Aflasafe SNO1 product and the soil sampling in their respective fields with the involvement and supervision of the team from NARI, GGC, IITA and DPV.

Plate 1. Recruited young men applying aflasafe in CRR-S

Plate 2. Selected farmer holding the bio-product in NBR

The application rate was 10kg of the aflasafe per ha in all fields. The dimension of all treated fields and GPS coordinates of both treated and control fields were taken.

The groundnut and maize samples were all decorticated and shelling respectively at NARI and later all samples were transported to IITA laboratory in Nigeria via DPV of Senegal for analysis.

Expected outcome

It is expected that there will be low level aflatoxin contamination in Groundnut and Maize fields treated with the aflasafe product after all analysis are completed.

2.2 Integrated Pest Management (IPM) on Rice Blast disease under Upland rain-fed

Introduction

Rice blast is a serious disease in the upland ecologies and yield of up to 100% have been observed in some location. Environments providing frequent and prolonged dew periods with cool temperatures in daytime are more favourable to blast proliferation. The introduction of exotic rice varieties has resulted in a total replacement of the local land races. All aboveground parts of the rice plant are attacked by the fungus, for example (leaf, collar, neck, node, grain and panicle).

The Pest management program has screened several rice varieties for tolerance against blast disease and identified WAS 161-B-9-1-FKR1 to have the lowest percentage leaf incidence of 3%. The NERICA 1 had also shown the lowest percentage grain infection with moderate plant density. The introduction of the NERICAs and other varieties in the country must be investigated against rice blast, especially in the uplands, where the majority of farmers are growing most of these new varieties. However, further screening of these varieties in the lowland ecologies against blast will be an option for future research activities.

Objectives

- To screen blast tolerant varieties to upland farming communities
- Demonstrate to farmers the importance of Integrated Pest Management (IPM) in blast control

The research was an on-farm demonstration trial involving farmers, research and extension workers. The rice variety used was WAB105 and NERICA 1. The trial was conducted in two regions in The Gambia; West Coast Region (WCR) and Lower River Region (LRR). Two villages are selected in each region (Sibanorr and kaimoh in WCR and Kanni kunda and Jenoi in LRR). Parameters collected include: Leaf blast, Collar blast, Node blast, Panicle blast, grain blast and Farmers perception.

Treatments:

1. Treatment: Half dose of recommended Nitrogen fertilizer rate (110kg $ha^{-1}$of urea)
2. Seed priming- (1 kg of seed wash in 5 liter of water plus 20ml of sodium hydrochloride)
3. Farmer's own practice

Plate 3. A collaborative farmer at Kaimoh village in WCR

Results

The highest leaf incidence was recorded in Sibanor on farmer practice plot with 50.5% and lowest was recorded at kayomo on the primed plot (16.5%). It was also evident that highest and lowest percentage leaf blast in all the location expect for Jenoi were observed on the farmers practice plots and primed plots respectively as shown in table 1. This is results confirming the fact that rice seeds can be primed and wash to reduce blast disease.

Table 2. Percentage leaf blast incidence at vegetative stage of growth

Villages	Half Dose Urea	Primed	Farmers Practice
Sibanor	19	18.5	50.5
Kayamo	23.5	16.5	25
Kanikunda	71	60.5	77
Jenoi	30	34	13

Table 3 illustrates percentage blast severity in all the locations. The highest was observed in the primed treatment in kaimoh village with 38% and the lowest was observed in the half dose of urea in Kani kunda with 6%. Blast severity was evident in farmers' plots in Sibanor, Kanikunda and Jenoi.

Table 3. Percentage blast severity at vegetative stage of growth

Villages	Half Dose of urea (100 kg ha^{-1}	Primed	Farmers Practice
Sibanor	17	24	30
Kayamo	30	38	30
Kanikunda	6	7.5	30
Jenoi	6.5	4.5	11.5

As illustrated in table 4, panicle blast incidence was recorded in Kani kunda on farmers' practice than the other treatments. The lowest panicle blast incidence was observed at in both half dose of urea plot and primed plot.

Table 4. Percentage panicle blast incidence

Villages	Half Dose Urea	Primed	Farmers Practice
Sibanor	42	30	23
Kayamo	26	17	8
Kanikunda	53	30	67
Jenoi	13	13	33

Farmers' perception

All the collaborative farmers gave their perceptions with regards to the different treatments in all the locations. Interestingly all of them observed that the primed plots were the least affected by blast disease followed by half dose of urea plots. The farmers practice plots were therefore the most affected by the blast disease according to the farmers.

Conclusion

The research work has confirmed the effectiveness of some IPM approaches that can reduce blast disease in rice fields. Farmers are gradually becoming aware of the positive effects of priming seeds and the moderate use of urea in rice fields as practices that can reduce blast infestation.

Challenges

Long drought spelt in 2014 rainy season has seriously affects the trial during the wet season.

Recommendation

The work should be repeated in the coming rainy season so that all the needed data can be collected.

3. CEREALS PROGRAM OVERVIEW

The cereals program has the mandate to improve the genetic quality of cereal coarse grains cultivated in The Gambia. The approach to achieve its goal is through adaptive research, training and pre-extension (on-farm testing). The goal of the program is to increase farmers' productivity in the dry land and lowland cereals. The major function of the program includes germplasm collection and characterization, varietal screening, population improvement, on-farm testing and breeder seed production.

DRY LAND CEREAL COMPONENT

Maize

Introduction

Maize is the third most widely cultivated cereal in The Gambia after rice and millet. Maize is becoming a staple food rather than a hungry bridging food crop. With research and extension in the 1970s and 1980s, support from projects such as the Cereals Package Deal, Mixed farming and Resource Management Project and the Fertilizer use Project, maize was promoted to a national commercial crop and is now cultivated in outer fields. The popular varieties available in the past were NCB and Jeka which require 95-110 days to mature. With the erratic nature of the rains, reduction in total rainfall and frequent droughts, with different agro-ecological zones, it is dictating to screen for varieties for adaptation and adoption.

Objectives

- To evaluate and identify promising drought tolerant varieties of maize varieties for regional adaptation from National Agricultural Research Systems (NARS) and International Agricultural Research Centres (IARCs)
- To promote regional integration and exchange of germplasm materials from regional collaborators.

3.1 Evaluation of extra-early maturing maize trial

Results

The trial was carried out at Sapu Kerewan research field. Days to 50% flowering ranged from 44 to 52 days. The shortest days was recorded from variety 11(2008 TZEE-W STR) and the longest from varieties 1 (TZEE-W POP STR C4) and 12 (2008 TZEE-W STR). Days to silking was also recorded. Days to silking ranged from 48 to 56 days. The longest days was recorded from variety 1 (TZEE-W POP STR C4) and 12 (2008 TZEE-W STR) with mean of 56 days, while the shortest was recorded from variety 11 with 48 days to silking (Table 5).

Plant height ranged from 152.67 cm to 196.33 cm. The highest was recorded from variety 16 (2008 Syn EE – W DT STR) with a mean height of 196.33 cm and the shortest recorded from 13 (2009 TZEE-OR1 STR) with mean height of 152.67 cm (Table 5).

Grain yield ranged from 2.93 tons ha^{-1} to 5.69 tons ha^{-1}. From the results obtained, the highest yield was recorded from variety 13 with mean yield of 5.69 tons ha^{-1} and the lowest recorded from 4 (TZEE-Y POP STR C5) with mean yield of 2.93 tons ha^{-1} (Table 5). The most outstanding varieties in terms of grain yield ha^{-1} were 13 (2009 TZEE-OR1 STR), 6(TZEE-W SR BC5 (RE)), 16 (2008 Syn EE – W DT STR), 7 (TZEE-W POP STR QPM C0), 2(TZEE-Y POP STR X Z106), 8 (2000 Syn EE - W), and 11 (2008 TZEE-W STR) respectively (Table 5).

Conclusion

The most out yield entries from the trial will be selected for further testing for other agronomic and cultural practices such as fertilizer rates.

Table 5. Mean Agronomic traits and grain yield of Extra-early maize

Variety	Treatment	Days to 50% Flowering	Days to Silking	Plant height (cm)	Grain yield ha^{-1} (tons)
TZEE-W POP STR C4	1	52	56	178.00	3.29
TZEE-Y POP STR X Z106	2	51	55	181.67	4.18
TZEE-W POP STR C5	3	48	52	162.00	3.82
TZEE-Y POP STR C5	4	47	50	182.00	2.93
2000 Syn EE QPM C2	5	50	53	177.67	3.91
TZEE-W SR BC5 (RE)	6	47	51	165.00	4.80
TZEE-W POP STR QPM C0	7	48	51	187.67	4.44
2000 Syn EE - W	8	51	54	168.67	4.18
TZEE-Y POP STR QPM C0	9	48	51	182.33	3.96
2009 TZEE-OR2 STR QPM	10	48	52	175.33	3.56
2008 TZEE-W STR	11	44	48	192.00	4.00

2008 TZEE-W STR	12	52	56	190.00	3.02
2009 TZEE-OR1 STR	13	47	51	152.67	5.69
2004 TZEE-Y POP STR C4	14	47	49	186.00	4.22
2004 TZEE – W POP STR C4	15	50	53	162.00	2.98
2008 Syn EE – W DT STR	16	47	51	196.33	4.58
2008 SYN EE – Y DT STR	17	51	55	170.00	3.47
TZEE – W POP STR X Z 104	18	46	50	185.00	3.11
TZEE – W POP STR X Z 105	19	47	51	158.33	3.33
TZEE – W POP STR X Z 107	20	46	50	180.67	3.42
Lsd $_{(0.05)}$		**4.697**	**4.525**	**7.946**	**2.229**
P-value		**0.045**	**0.021**	**<0.001**	**0.677**

3.2 Evaluation of arly maturing maize Trial

Results

The trial was carried out at Sapu Kerewan research field. Days to 50% flowering ranged from 45 to 58 days. The shortest days was recorded from variety 8 (2009 TZE-W DT STR) and the longest from variety 13 (2008 DTMA-W STR). Days to silking was also recorded. Days to silking ranged from 48 to 61 days. The longest days was recorded from variety 13 (2008 DTMA-W STR) with mean of 61 days, while the shortest was recorded from variety 8(2009 TZE-W DT STR) with mean of 48 days to silking (Table 6).

Plant height ranged from 155.00 cm to 189.33 cm. The tallest was recorded from variety 19 (2008 DTMA-Y STR) with a mean height of 189.33 cm and the shortest recorded from 11 (2011 TZE-W DT STR synttetic) with mean height of 155.00 cm (Table 6).

Grain yield ranged from 1.33 tons ha^{-1} to 5.24 tons ha^{-1}. From the results obtained, the highest yield was recorded from variety 17(EV DT-Y 2008 STR) with mean yield of 5.69 tons ha^{-1} and the lowest recorded from 2(2011 TZE – Y DT STR Syn **C0**) with mean yield of 1.33 tons ha^{-1} (Table 6). The most outstanding early maturing varieties in terms of grain yield $ha-^{1}$ were 17 (EV DT-Y 2008 STR), 3 (TZE COMP 3 DT C2 F2 (RE)), 4 (2011 DTMA – W STR), 6 (2009 DTE – W STR), 9 (TZE-Y DT STR), 14 (Syn DTE STR-Y) and 20 (SW 123Q C1) respectively (Table 6).

Conclusion

The most out yield entries from the trial will be selected for further testing for other agronomic and cultural practices such as fertilizer rates.

Table 6. Mean Agronomic traits and grain yield

Designation	Treatment	Days to 50% flowering	Days to silking	Plant height (cm)	Grain yield ha^{-1}(tons)
2011 TZE – W DT STR Syn C0	1	53	57	158.33	3.16
2011 TZE – Y DT STR Syn C0	2	49	52	158.33	1.33
TZE COMP 3 DT C2 F2 (RE)	3	48	52	186.33	4.71
2011 DTMA – W STR	4	49	53	160.33	4.00
2011 DTMA – Y STR	5	50	54	180.67	2.36
2009 DTE – W STR	6	57	60	187.00	4.27
2009 DTE-W STR syn	7	53	57	164.00	2.04
2009 TZE-W DT STR	8	45	48	171.33	3.29
TZE-Y DT STR	9	52	56	180.67	4.27
TZE-W DT C4 STR C4	10	52	55	158.67	3.11
2011 TZE-W DT STR synttetic	11	56	60	155.00	1.60

TZE-Y DT C4 STR C4	12	49	53	158.67	2.76
2008 DTMA-W STR	13	58	61	188.33	1.60
Syn DTE STR-Y	14	54	58	166.33	4.40
Syn DTE STR- W	15	49	52	177.00	3.11
SY 123 Q C1	16	57	60	188.33	3.69
EV DT-Y 2008 STR	17	50	54	179.00	5.24
DT-W STR SYNTTETIC	18	52	55	179.33	3.38
2008 DTMA-Y STR	19	53	56	189.33	3.73
SW 123Q C1	20	49	53	184.67	4.09
2010 TZE-W DT STR	21	52	56	164.67	3.56
2011 TZE-Y DT STR synthetic	22	57	60	185.33	3.64
Lsd $_{(0.05)}$		**5.16**	**5.631**	**9.76**	**1.739**
P-value		**<0.001**	**0.001**	**<0.001**	**0.001**

3.3 Low soil nitrogen tolerance maize trial

Increased population pressure, inappropriate land management practices, reduced fallow or absence of fallow periods have caused a rapid decline in soil fertility in the Gambia, lowering agricultural productivity and increasing food insecurity. Low crop yields are due to many factors including: nutrient mining from the soil, low or no use of mineral and organic fertilizers in the farming system, and soil erosion resulting in severe degradation of agricultural lands. The decline in soil fertility and the serious land degradation problems facing the country demand an effort to focus on breeding plant types for low soil fertility levels. This research is focusing to introduce new maize genotypes that are tolerant to low soil nitrogen.

Objective:

- To evaluate and identify promising varieties of maize that can tolerate low soil nitrogen under low soil fertility for dissemination to farmers through on-farm trial for adaptability and adoption.

Results

Days to 50% flowering ranged from 49 to 59 days. The shortest days to flowering was recorded from variety 3 (TZPB -Y C 4) while the longest days to flowering was recorded from variety 6 (LA POTA SEQUTA C6). Days to silking ranged from 53 to 63 days. The shortest days to silking was recorded from variety 3 (TZPB -Y C 4) while the longest days was from variety 6 (LA POTA SEQUTA C6) (Table 7).

Plant height ranged from 144.25 to 177.00 cm. The tallest plant height was recorded from variety 7 (SINT MAR ZOCA LARGA) while the shortest was recorded from variety 1 (LNTP -Y C7) (Table 7).

Conclusion

The most out yielding varieties were 1 (LNTP -Y C 7), 3 (TZPB -Y C 4), 5 (TZL COMP /C6 LNC1) and 10 (NCB)

Table 7. Mean Agronomic traits and grain yield of low nitrogen trial

Variety	Treament	Days to 50% flw	Days to Silking	Plant height (cm)	Grain yield ha^{-1} (tons)
LNTP -Y C 7	1	53	56	177.00	3.07
LNTP - Y C 4	2	53	55	167.75	1.60
TZPB -Y C 4	3	49	53	158.75	2.10
BR 9928 - DMR SR LNC1	4	55	58	150.50	1.80
TZL COMP /C6 LNC1	5	56	59	164.00	2.00
LA POTA SEQUTA C6	6	59	61	160.25	0.60
SINT MAR ZOCA LARGA	7	57	60	144.25	1.33
BR99 TZL COMP 4 DMR SR	8	52	55	165.50	1.60
JEKA	9	54	57	166.00	1.53
NCB	10	57	60	166.25	2.17
Lsd $^{(0.05)}$		2.622	2.546	10.04	0.918
P-value		<0.001	<0.001	<0.001	0.002

3.4 Evaluation of early millet varieties for adaptation.

Justification

Millet occupies an important place in Gambian agriculture. Millet plays an important role as a food crop and the second most important cash crop in many parts of the country. Gambian farmers cultivate early millet depending on the region they come from. Despite these entire problems encounter during production, through the genetic improvement process of millet, the cereals programme must efficiently build-up germplasam collection and efficient strategies to improve the agronomic package of the new promising millet varieties to the farming community.

Objective

- To evaluate the agronomic performance and adaptation of elite early millet varieties for tolerance to biotic and abiotic stresses.

Results

Days to 50% flowering ranged from 54 to 82 days. The shortest days to flowering was recorded from variety 3 (Souna 3) with days of 54 while the longest days to flowering was recorded from variety 7(Majo) with 82 days. Days to maturity ranged from 78 to 110 days. The shortest days to maturity was recorded from variety 2 (Souna 2), 3 (Souna 3) while the longest days was from variety 7 (Majo) with 110 days (Table 8)

Plant height ranged from 81.05 to 96.75 cm. The tallest plant height was recorded from variety 4 (Kolonding 1) while the shortest was recorded from variety 7 (Majo). Head length is one of the components that determine yield of a particular variety. The longest head length was recorded from variety 2 (Souna 2) with mean length of 56.25 cm and the shortest was recorded from variety 5 (Kolonding 2) with mean length of 35.25 cm (Table 8).

Grain yield ranged from 0.688 tons 1.00 tons ha^{-1}. The highest yield was obtained from variety 3 (Souna 3) with yield of 1.00 tons and the lowest yield from variety 4 (Kolonding 1) with mean yield of 0.688 ton ha^{-1}(Table 8).

Table 8. Mean Agronomic traits and grain yield of early millet

Variety	Treatment	Days to 50% flowering	Days to Maturity	Plant height (cm)	Head length (cm)	Grain yield ha^{-1} (tons)
Souna 1	1	56	83	85.25	38.50	0.740
Souna 2	2	56	78	91.25	39.00	0.958
Souna 3	3	54	78	87.50	48.00	1.000
Kolonding 1	4	54	80	96.75	46.50	0.688
Kolonding 2	5	54	81	95.00	35.25	0.812

Chalack 2	6	54	80	90.00	56.25	0.979
Majo	7	82	110	81.05	39.75	0.841
komba	8	76	103	91.25	37.50	0.750
Lsd $_{(0.05)}$		**2.087**	**3.73**	**9.569**	**6.285**	**0.4243**
P-Value		**<0.001**	**<0.001**	**0.056**	**<0.001**	**0.667**

RICE BREEDING AND AGRONOMY

Introduction

The decline in area under rice cultivation is greater in the lowland ecology than in the upland. This is due to the reason that the mangrove swamp and rain-fed ecologies are critically affected by drought, rice yellow mottle virus, iron toxicity, salinity, and acidification. Production constraints differ as one move from rice ecology to another. In the mangrove swamp ecology, salinity, acidity and iron toxicity are the constraints affecting rice production. Other problems associated with the mangroves are the crabs and fish. These cause major yield losses by eating the young rice seedlings and by breaking earthen bunds built to protect rice plots from saline water in the tidal swamps.

Furthermore in the lowland rainfed areas and irrigated ecologies, challenges such as iron toxicity, rice yellow mottle virus, blast, and hippos affect rice production and they cause major yield losses in rice production. Considering these challenges, there is the need to come out with selection objectives dictated by environmental conditions.

Rice is a traditional staple food in many parts Africa. In recent years, the relative growth in demand for rice is faster in sub-Saharan Africa than anywhere in the world. Due to population growth, the demand for rice is increasing and there is a shift in consumer preference for rice especially in the urban areas. Rice production in Africa has been threatened by biotic and abiotic stresses as well as climate change.

Over the years, AfricaRice and other institutions have placed an emphasis on participatory research and development in order to provide technologies that are relevant to rice production systems and to ensure that they address the priority constraints. The primary approach has been to actively engage producers and other actors in rice research and development. Participatory breeding aims at eliminating the problems that come when breeders develop varieties without reference to the needs of farmers and other stakeholders in the rice value chain.

Participatory varietal selection (PVS) is applied as an addition to conventional breeding to address many of the production environments used by small-scale rice farmers and other varied quality demands of consumers. The PVS approach will allow farmers to select rice breeding lines that meet their requirements for cultivation and consumption. Furthermore, PVS trials allow breeders to identify key traits for varietal adoption by farmers and thus help them to better direct future breeding targets. To make high yielding varieties available through participatory varietal selection and subsequent adoption by farmers will significantly contribute to improve national and household food security.

Objectives

- To identify breeding lines adapted to Irrigated lowland ecologies having the following traits through evaluation for agronomic traits, resistance/tolerance to abiotic and biotic stresses and good grain quality.

- To identify salt tolerant lines and to check for their adaptability and reaction to ARGM, RYMV and bacterial blight and tolerance to salinity stress.

- To offer the farmers a chance of selecting from an elite group of salt tolerant/irrigated rice varieties that may perform better than the existing ones or their local varieties.

3.5 Participatory Evaluation Trial (PET) for Irrigated Lowland

The varieties used in this trial was those nominated by breeders from both International and national research Institutes for their high yield, tolerance to biotic and abiotic stresses. The trial composed of breeding lines developed by various institutions such as CIAT, IRRI, NARS, and AafricaRice which were subjected for evaluation. The trial consist of 34 improved varieties and one (1) local variety evaluated during 2014, wet season. Seeds were delivered on time and planting was done. Field visit was also carried out to access the perception of the farmers and other stakeholders along the rice value chain.

Data collected were days to 50% flowering, plant height, panicle number, panicle length, 1000 grains weight, grain yield and was subjected to analysis of variance using Genstat, adjusted means was calculated and compared for agronomic traits.

Plate 4. Data collection on Agronomic traits

Plate 5. Farmers selecting varieties of their choice

Results

Table 9 shows the results of the Participatory-Environment trial under Lowland Irrigated swamp at Sapu in the Central River Region in The Gambia. Days to 50% flowering ranged from 80 to 101 days. The highest number of days was recorded from variety 10 (IR 78581-12-3-2-2**)** with 101 days and lowest from variety 6 **(**IR 83141-B-19-B) with 80 days from sowing (Table 9).

Panicle length ranged from 22.62 cm to 25.49 cm. The longest panicle was recorded from variety 35 (IET 3137) with mean length of 25.49 cm and the shortest from variety 31 (HHZ 9-D7-SAL2-DT1) with mean length of 22.62 cm. Results of plant height ranged from 73.27 cm to 97.05 cm. The tallest plant height was recorded from variety 29 (WANXIAN 926) with mean of 97.05 cm and the shortest from variety 32 (Sahel 108) with 73.27cm (Table 9).

Grain yield ranged from 4.71 tons ha^{-1} to 7.53 tons ha^{-1}. The highest yield was obtained from variety 10 (IR 78581-12-3-2-2) with mean yield of 7.53 tons ha^{-1} and the lowest from variety 19 (PR 26703-3B-PJ 25) with mean yield of 4.71 tons ha^{-1}(Table 9). Results indicated that 20 varieties had yields higher than the local check (IET 3137).

Recommendation

In conclusion 20 varieties had yields higher than the local check. The selection for the next stage of the trial will be base on the yield, other agronomic trait and farmers' perception about the varieties base on their selection criteria.

Table 9. Agronomic Data and grain yield of Irrigated Lowland rice trial

Designation	TRT	50%FLW	Plant ht. (cm)	Panicle No.	Pan. Length (cm)	Grain yield tons ha^{-1}
IR 78581-12-3-2-2	10	101	89.49	13.99	24.63	7.53
IR 81363-86-2-3-2-2	16	91	82.31	13.96	24.45	7.00
Sahel 134	33	86	82.03	11.01	23.76	6.34
IR 71146-97-1-2-1-3	2	81	86.69	13.96	23.73	6.26
IR 82574-573-2-1	28	90	86.16	13.03	25.04	6.14
IR 78119-24-1-2-2-2	11	95	87.27	17.98	24.39	6.11
IR 83141-B-19-B	6	80	76.38	17.99	23.29	5.82
CHAITE 6	8	88	83.53	14.32	22.89	5.80
Sahel 108	32	85	73.27	14.34	23.89	5.79
IR 65192-4B-17-3	22	88	76.22	12.31	22.91	5.69
IR 80404-28-2-3-2	13	86	86.35	17.68	24.26	5.68
IR 82574-643-1-2	15	86	81.75	12.32	24.80	5.68
CT18148-10-4-2-3-4-1-M	5	85	90.66	13.62	24.69	5.65
WAB 2066-6-FKR 4-WAC 1-TGR 1-B-WAT-B9	24	93	89.20	13.04	23.73	5.65
HHZ 5-5-SAL 9-Y3-Y1	9	88	81.48	9.92	24.40	5.59
MR 255	27	95	80.41	12.66	24.79	5.58
HHZ 9-D7-SAL2-DT1	31	88	82.46	15.01	22.62	5.58
IR 81494-10-1-3-3-1	23	81	82.17	16.32	25.86	5.57
WAT-B9	25	95	84.09	11.66	22.69	5.54
IR 82635-B-B-145-1	14	92	81.21	15.37	24.08	5.50
IET 3137	35	86	86.13	14.43	25.49	5.49
HHZ 11-Y11-Y3-DT1	1	88	80.50	9.02	22.72	5.44
IR 73888-1-4-5	3	91	76.14	15.01	23.46	5.42
MR 254	12	91	87.00	14.69	23.96	5.38
BP234E-MR-11	4	81	81.93	12.05	24.46	5.35
WANXIAN 926	29	92	97.05	11.33	24.05	5.30
IR 78545-49-2-2-2	7	91	82.43	12.03	23.56	5.28
IR 78913-B-10-B-B-B	18	91	75.63	14.31	24.93	5.22
PCT 6\0\0\0>19-1-4-3-1-1-1-1-1-M	26	91	80.98	12.67	25.36	5.16
IR 62141-114-3-2-2-2	30	96	81.70	15.97	24.80	5.14
IR 77512-128-2-1-2	20	90	76.20	13.31	24.98	5.10
NSIC RC152	17	92	82.24	14.01	24.49	5.05
GANJAY(ACC 76349)	21	92	87.27	10.02	24.55	5.00
Sahel 201	34	98	78.30	16.96	22.76	4.86
PR 26703-3B-PJ 25	19	91	83.93	15.02	23.18	4.71
Sed		0.5097	4.190	0.2670	1.039	754.7

P-value		<0.001	<0.001	<0.001	0.151	0.392

Participatory Varietal selection (PVS)

A field visit was carried out at maturity for farmers to select varieties of their choice from the 35 varieties including the local variety. Farmers were asked to select the best 3 varieties they would like to grow in their fields. Results from the PVS revealed that varieties 7(IR 78545-49-2-2-2) , 9 (HHZ 5-5-SAL 9-Y3-Y1), 12 (MR 254), 13 (IR 80404-28-2-3-2), 16 (IR 81363-86-2-3-2-2), 21(GANJAY(ACC 76349)), 25 (WAT-B9), 26 (PCT 6\0\0\0>19-1-4-3-1-1-1-1-1-M), 29 (WANXIAN 926) and 31(HHZ 9-D7-SAL2-DT1) were selected by the famers (figure 8). The variety with the most turnout votes was variety 31(HHZ 9-D7-SAL2-DT1) with 16 votes follow by variety 9, 29 and 25 (figure 8).

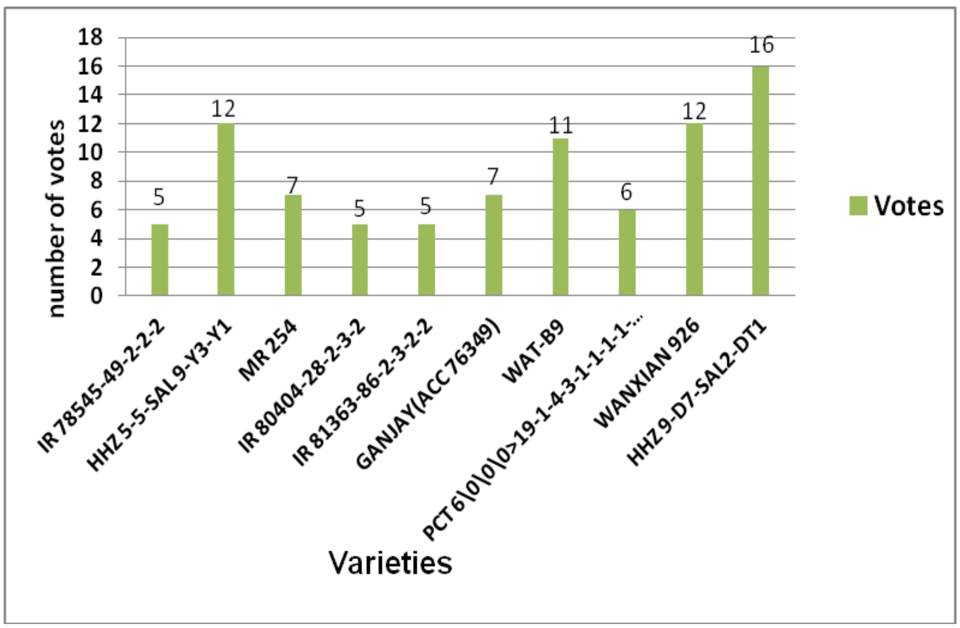

Figure 8. Number of votes during field visit (PVS)

3.6 Multi-environment trial (met) for salinity

Results

The trial consists of 56 varieties evaluated at Kaiaf in the Lower River Region in 2014 wet season in the mangrove ecology. From the results obtained days to 50% ranged from 98 days to109 days. The longest days was recorded from variety 51 (ARS14-210-RIL-78) and the lowest from variety 41 (ARS14-206-SPK-45) with 110 days (Table 10).

Panicle length plays a very important role in the mangrove where many farmers harvest by panicle picking method using knife. Panicle length ranged from 16.78 cm to 25.89 cm. The longest panicle was recorded from variety 53 (ARS14-210-RIL-89) with mean length of 25.89 cm and shortest from variety 32 (ARS14-204-RFL-36) with mean length of 16.78 cm (Table 10).

Results of plant height ranged from 50.44 cm to 100.56 cm. The tallest plant height was recorded from variety 50 (ARS14-208-RAM-76) and the shortest from variety 54 (ARS14-210-RIL-94). Grain yield ranged from 2.11 tons ha^{-1} to 3.28 tons ha^{-1}. The highest yield was obtained from variety 28 (ARS14-204-RFL-30) and the lowest from variety 35 (Aja Mano) (Table 10). Results indicated that 20 varieties out of 56 had yielded higher than the local check (Aja Mano) (Table 10).

Recommendation

Results have shown 20 promising varieties yielding higher than the local variety will be evaluated in 2015 wet season.

Table 10. Agronomic Data and grain yield of mangrove swamp rice trial

Designation	TRT	50% FLW (kg)	Plant Height (cm)	Panicle No.	Pan. Length (cm)	Grain yield tons ha^{-1}
ARS14-204-RFL-30	**28**	104	67.89	8.27	17.11	3.28
ARS14-204-RFL-19	**19**	103	65.00	7.75	18.56	2.67
ARS14-210-RIL-78	**51**	98	61.78	8.72	19.22	2.58
ARS14-206-SPK-40	**38**	103	68.56	9.70	18.89	2.55
ARS14-204-RFL-10	**10**	104	63.44	9.21	19.00	2.50
ARS14-210-RIL-89	**53**	105	91.00	14.85	22.89	2.48
ARS14-204-RFL-31	**29**	102	61.33	8.62	17.44	2.47
ARS14-204-RFL-34	**32**	100	65.78	11.44	18.78	2.46
ARS14-208-RAM-56	**45**	103	62.67	8.99	20.07	2.41

ARS14-210-RIL-94	**54**	102	50.44	9.51	20.00	2.41
ARS14-206-SPK-47	**43**	103	66.56	9.06	19.11	2.41
ARS14-204-RFL-39	**37**	104	55.00	10.68	17.89	2.41
ARS14-204-RFL-24	**23**	101	70.89	8.76	20.78	2.35
ARS14-204-RFL-13	**13**	101	65.56	10.46	18.00	2.34
ARS14-204-RFL-36	**34**	104	59.00	8.94	16.78	2.31
ARS14-206-SPK-45	**41**	109	52.33	11.58	19.44	2.28
ARS14-204-RFL-26	**25**	106	54.11	7.26	17.22	2.26
ARS14-204-RFL-8	**8**	104	66.56	9.46	18.56	2.22
ARS14-204-RFL-11	**11**	101	64.56	8.05	19.11	2.21
ARS14-208-RAM-76	**50**	103	100.56	12.30	22.67	2.17
ARS14-204-RFL-4	**4**	102	62.67	7.87	17.44	2.17
ARS14-210-RIL-88	**53**	103	64.56	9.27	19.33	2.16
ARS14-204-RFL-1	**1**	100	63.49	10.53	18.25	2.15
Aja Mano (Local Check)	**35**	103	62.97	9.76	18.24	2.11
P-value		<0.0001	<0.0001	<0.0001	<0.0001	0.1999

Figure 9 shows the EC level at Kaiaf. The results indicated that the highest EC level was recorded during harvesting with a value of 9.1 and the lowest before transplanting with a value of 2.8. It was observed that the EC level increases as the season progresses due to low amount of rainfall experienced in 2014 cropping season (figure 9)

Figure 10 shows the ph level at Kaiaf. The results indicated that the highest ph level was recorded after transplanting with a value of 6.6 and the lowest at transplanting with a value of 5.5.

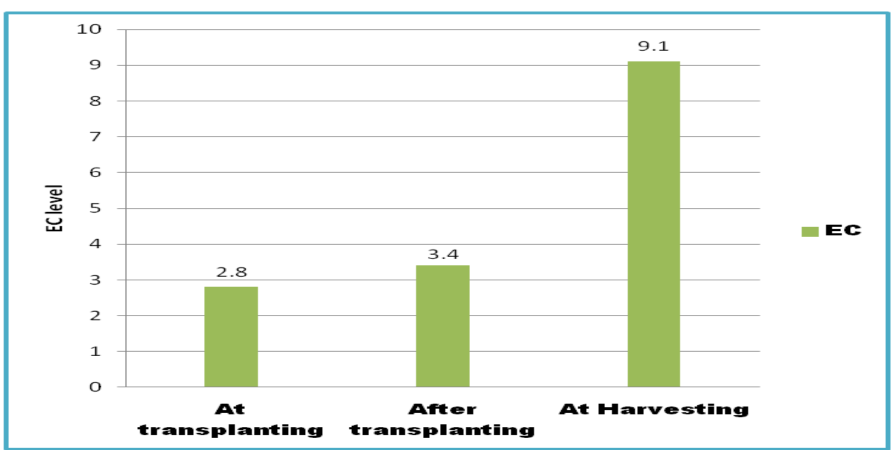

Figure 9. EC Level at Kaiaf

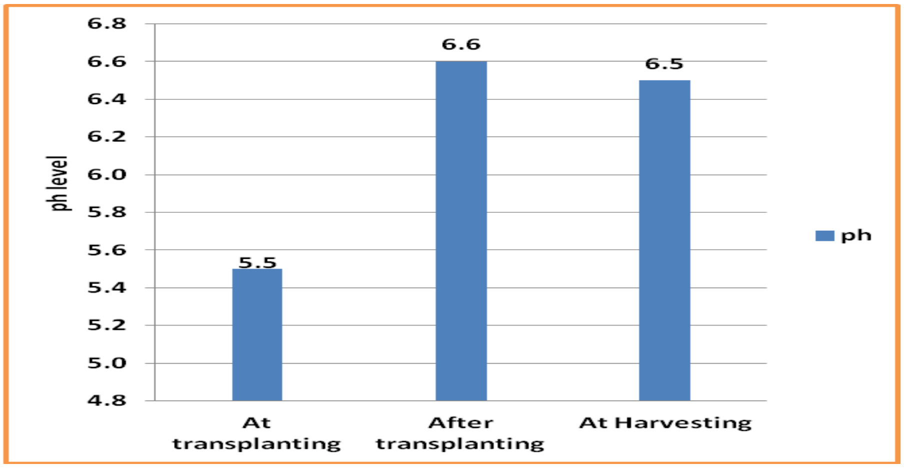

Figure 10. ph Level at Kaiaf

3.7 On-farm nutrient omission trials

Nutrient manager provides science-based principles for determining optimal N, P, and K fertilizer rates for a specific field with rice. With nutrient manager, N rates are determined based on a target yield, estimated crop response to fertilizer N, and a targeted agronomic efficiency for fertilizer N (kg increase in grain yield per kg applied N). The P and K rates are determined through a nutrient balance approach, which considers estimated P and K inputs from irrigation water and organic materials added during the crop; carryover of P and K in crop residues from the previous crop, removal of P and K in harvested grain, and estimated response of the crop to P fertilizer and to K fertilizer.

In the Gambia, the on-farm nutrient trial was carried out in HUB 2 (Central river region) with four treatments (-N, -P, -K, and NPK,) enables for a given location and for a targeted rice yield of 9tonnes/Ha, the estimation of:

1) Optimal N rate based on crop response to N,
2) P rate based on crop response to P and estimated P balance
3) K rate based on crop response to K and estimated K balance, and

The nutrient omission plot technique with four treatments was use across multiple locations with a diversity of soils, crop establishment methods, irrigation water sources, and crop residue management to develop and test principles for optimizing fertilizer rates to field-specific conditions. Nutrient omission trials represent research designed to facilitate the development of Nutrient Manager through which the need of a specific field for N, P and K can be estimated from the reply of a farmer to about 10 to 15 easy-to-answer questions about the management and characteristics of the field.

RESULTS AND DISCUSSION

Figure 11 shows that the lowest number of tillers was recorded from PK(i.e- N), followed by NK (-P) and NP (-K). The highest number of tillers was recorded from the combination of NPK. Results illustrated that the most important macro element that enhance plant height is Nitrogen (N), followed by Phosohorous (P) and then potassium (K).

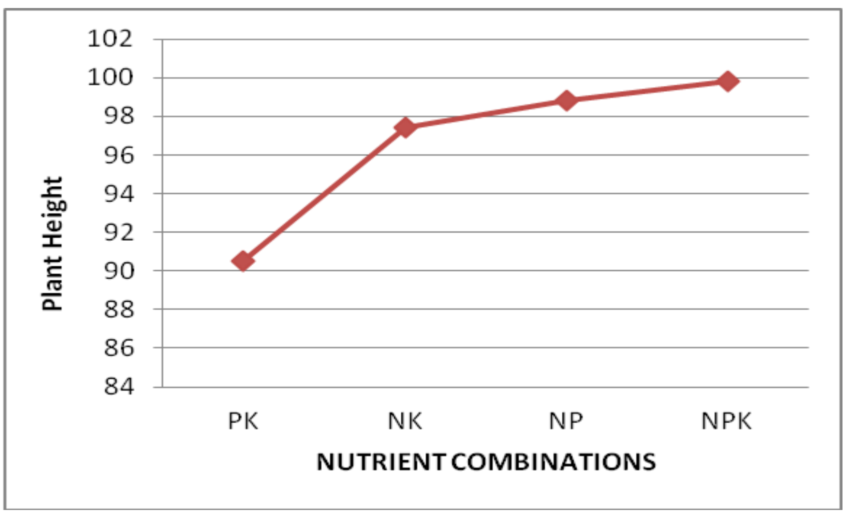

Figure 11. Plant height of the nutrient combinations at harvest

The highest tiller number was recorded from NK (-P) followed by NPK whilst the lowest tiller was recorded from PK (-N). This proves that N is an important component of improving plant's tillering ability. (Figure12).

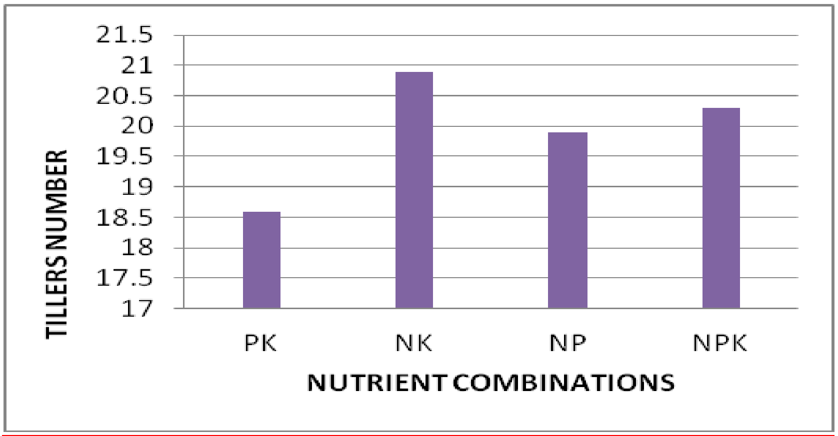

Figure 12. Tiller Numbers of the Nutrient combinations at Harvest

From figure 13, it can be observe that NK (-P) has the longest days to 50% maturity as compared to the other treatments. The results demonstrated that P deficient soil will have relatively longer days to maturity for rice when compared to N and K deficient soils.

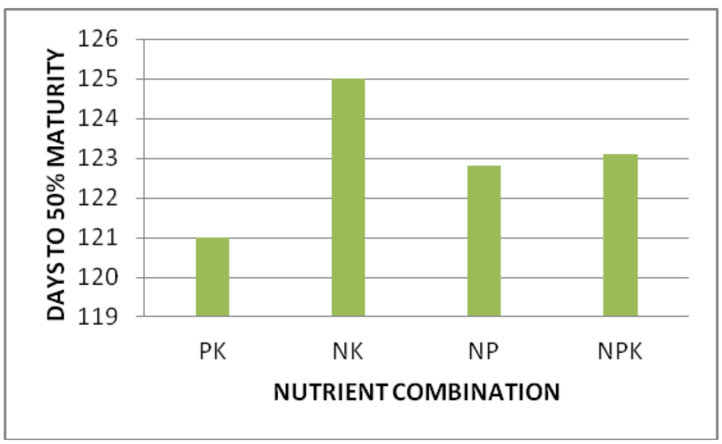

Figure 13. Days to 50% maturity of the nutrient combinations

Results from figure 14 shows that PK (-N) has the lowest yield with mean yield of 5000 kg ha^{-1}, followed by NK (-P) then NP (-K). A combination of the 3 nutrients has the highest yield with mean yield of 7000 kg ha^{-1}. The results indicated that the most important macro element that affects rice yield is N, followed by P and then K, though a combination of the three give superior yields.

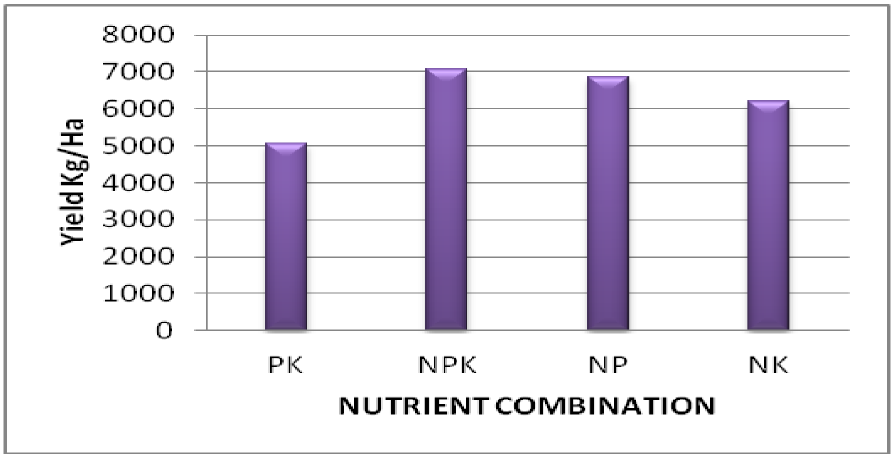

Figure 14. Yield kg/ha of the nutrient combinations

3.8 EMERGENCY RICE INITIATIVE (ERI)

This activity was carried out in 2014 cropping season a total of 15 hectares of seed production in was implemented targeting an average yield of 4 tons ha^{-1}, which will lead to 60 tons of quality seed per country that can be used in 2014 wet season. Each participating farmer in a Hub received 25 kg of certified seed.

Objective

- To support small holder rice farmers by providing them access to essential inputs such as seed, mineral fertilizer and knowledge with respect to good agricultural practices.

SEED DISTRIBUTION

The National Agricultural Research Institute in collaboration with Department of Agricultural Services had embarked on the distribution of 40 tons of Quality seed including NERICA and other upland varieties for key rice growing communities in West Coast Region (Hub 1). These activities are in accordance with the implementation of the project funded by People Republic of Japan through Africa Rice Centre. The key partners involved in this program were seed technology unit, Farmers platform in the Hubs, Catholic Relief Service and other local NGO's. The selected varieties include Nerica 6, Nerica 14, P163, IET 3137, IR 19746-26-2-3-3-1 and Tainung Sen 14.

Table 11. Seeds produced and quantity distributed in Hub 2 (CRR)

COMMUNITY	RICE VARIETY	QUANTITY PRODUCED (Tonnes)	QUANTITY DISTRIBUTED (Tonnes)
WELLINGARA	IET 3137	6	5
	P163	5	
	NERICA 6	7	6
	IR 19746-26-2-3-3-1	4	2
JAHALLY	IET 3137	7	6
	P163	6	5
	NERICA 6	8	9
	IR19746-26-2-3-3-1	7	5
SAPU RESEARCH FARM	NERICA 14	4	2
	TOTAL	**54**	**40**

A total of **1650** farmers (950 women & 700 men) in the upland ecology benefited from the seed distribution. Below are the communities and farmers from the respective villages in west coast Region who benefited from the seed distribution.

Table 12. Seed distributed in rice sector development hub 1

Community	Rice ecology/Hub	# of farmers	Quantity distributed (Tonnes)
Sintet	Upland Ecology	180 (80men & 100 women)	4.5
Dobong	Upland Ecology	100 (50men & 50 women)	2.5
Bwiam	Upland Ecology	110 (50men & 60 women)	2.75
Sibanor	Upland Ecology	50 (15 men & 35 women)	1.25
Gifanga	Upland Ecology	100 (40men & 60 women)	2.5
Ndemban	Upland Ecology	50 (20men & 30 women)	1.25
Killy	Upland Ecology	70 (35men & 35 women)	1.75
Kanilai	Upland Ecology	55 (15men & 40 women)	1.4
Sutusinjang	Upland Ecology	85 (30men & 55 women)	2.2
Kabokor	Upland Ecology	50 (25men & 25 women)	1.25
Sifoe	Upland Ecology	45 (20men & 25 women)	1.13
Gunjur	Upland Ecology	45 (15men & 30 women)	1.13
Kasangi	Upland Ecology	50 (15men & 35 women)	1.25
Somita	Upland Ecology	40 (20men & 20 women)	1
Block	Upland Ecology	50 (20men & 30women)	1.25
Tumani Tenda	Upland Ecology	85 (50men & 35 women)	2.13
Kitty	Upland Ecology	70 (30men & 40 women)	1.75
Jambur	Upland Ecology	130 (40men & 70 women)	3.25

Berefet	Upland Ecology	160 (60men & 100 women)	4.0
Medina	Upland Ecology	45 (10men & 35 women)	1.13
Wellingara	Upland Ecology	40 (20men & 20 women)	1
Kanlagie	Upland Ecology	40 (20men & 20 women)	1

4. GENDER TASK FORCE COMPONENT

4.1 Sensitization and provision of stress tolerant seeds to women farmers in the Rice Sector Development Hubs.

The National Agricultural Research Institute in collaboration with Africa Rice Centre are implementing the taskforce mechanism where rice research outputs are integrated across the rice value chain to achieve developmental outcomes and impact. These task forces activities are focused on the Rice sector development hubs: West Coast region (Jambur and Brefet) and Central River Region (Wellingara and Kerewan Samba Sera). The Gender Task Force is one of the task forces that focuses on training, sensitizing provision and distributing stress tolerant rice varieties to women farmers in the Rice Sector Development Hubs.

During the 2014 cropping season, 20 farmers were selected from the 2 hubs. These farmers were sensitized on the objective of the gender task force mechanism and how it will contribute to boost rice production and productivity in the Gambia through training women farmers in order to empower more women in agricultural activities by giving them the required inputs to boost their production. The seeds and fertilizer distribution was done by gender task force in collaboration with rice breeding task force member respectively. A baseline survey was carried out and results will be analyzed.

Plate 6. Fertilizer distribution to women farmers

Plate 7. Fertilizer distribution in Hub 2 (CRR)

Table 13. List of seeds distributed to women farmers

SN	Name of Farmer	Village	Gender	Hub Name	Varieties	Quantity (kg)
1	Maimuna Jabang	Jambur	Female	West Coast Region	NERICA 14	25kg/farmer
2	Sirra Bah	Jambur	Female	West Coast Region	NERICA 14	25kg/farmer
3	Jarra Bojang	Jambur	Female	West Coast Region	NERICA 14	25kg/farmer
4	Fatou Sarjor	Jambur	Female	West Coast Region	NERICA 14	25kg/farmer
5	Fatou Jallow	Jambur	Female	West Coast Region	NERICA 14	25kg/farmer
6	Adama Badjie	Berefet	Female	West Coast Region	P 163	25kg/farmer
7	Mariama Manneh	Berefet	Female	West Coast Region	P 163	25kg/farmer
8	Nyimanding Bajo	Berefet	Female	West Coast Region	P 163	25kg/farmer
9	Karafanding Badjie	Berefet	Female	West Coast Region	P 163	25kg/farmer
10	Arokey Ceesay	Berefet	Female	West Coast Region	P 163	25kg/farmer
11	Marang Jobe	Wellingara	Female	Central River Region	IR 19746-26-2-3-3-1	25kg/farmer
12	Mama Fatty	Wellingara	Female	Central River Region	IR 19746-26-2-3-3-1	25kg/farmer
13	Hawa Manneh	Wellingara	Female	Central River Region	IR 19746-26-2-3-3-1	25kg/farmer

14	Dady Jallow	Wellingara	Female	Central River Region	IR 19746-26-2-3-3-1	25kg/farmer
15	Buna Mankajang	Wellingara	Female	Central River Region	IR 19746-26-2-3-3-1	25kg/farmer
16	Fanta Jawla	Kerewan Mandinka	Female	Central River Region	IET 3137	25kg/farmer
17	Metta Baba	Kerewan Mandinka	Female	Central River Region	IET 3137	25kg/farmer
18	Aminata Mansally	Kereawn Mandinka	Female	Central River Region	IET 3137	25kg/farmer
19	Aja Suntunkung Jagne	Kerewan Mandinka	Female	Central River Region	IET 3137	25kg/farmer
20	Dandan Fatty	Kerewan Mandinka	Female	Central River Region	IET 3137	25kg/farmer

Challenges

During the monitoring visits it was observed that the farmers in Jambur had a total crop failure due to the drastic nature of the rains in 2014 cropping season.


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Plate 8. Rice field affected by drought in Jambur

5. SEED TECHNOLOGY UNIT (STU)

PROGRAM OVERVIEW

The mandate of the unit is to supply reasonable quantities of high quality seeds of the recommended crop varieties in the farming systems of the Gambia and to conduct trainings for stakeholders in seed quality and production techniques. Quality Control: Serve as the National seed certification Agency

Crop research undertaken by NARI has over the years, developed and released good crop varieties into the farming system basically for the major field crops, which farmers depend on for their year - in - year- out production. Inevitably, this results to continuous use of varieties which eventually leads to deterioration in genetic purity due to out-crossing and mechanical admixtures.

As there is no systematic conventional plant breeding undertaken by NARI currently, variety maintenance and purification by seasonal regeneration of released varieties for foundation seeds is the institute's strategic approach. The Unit ensures the availability of pure foundation seeds of the three major field crops of the country (Groundnut, Rice and Maize) for certified seeds production. As part of these efforts, the Seed Technology Unit (STU) of NARI embarked on foundation seeds production in Yundum site III and the three seed centres (Chamen, Sapu and Giroba kunda) for the 2014 cropping season.

Objective
To provide high quality foundation seeds of groundnuts, rice and maize to specialized seed producers (Individuals & Organizations).

5.1 FOUNDATION SEED PRODUCTION

During the 2014 cropping season, STU worked on the following crops: groundnuts maize, findo and rice in Yundum (Site III)and the three seed centers on an area of 8.75 ha for four sites

These activities implemented by the Seed Technology Unit in 2014 cropping season were as follows:

1. Foundation seed multiplication in Yundum (Site III), the 3 seed centers and at NARI Sapu Irrigated lowland Swamp.
2. Certified seed production of Maize with selected seed growers in the six Agricultural regions

Table 14. Foundation Seed Multiplication in Yundum (site 3) and 3 seed centers

Site	Crop	Variety	Area (ha)	Date of Planting
Yundun Site III	Groundnut	Ex-Dakar	1	24th July, 2014
	Maize	Tzee-y	1	27th July,2014
Chamen Seed Center	Groundnut	Ex-Dakar	1	2nd August, 2014
	Maize	SWAN-2	1	3rd August, 2014
Sapu Kerewan Field	Groundnut	Ex-Dakar	1	22nd July, 2014
	Maize	SWAN-2	1	22nd July, 2014
	Upland Rice	IR 19746	0.25	24th July, 2014
	Findo	Momo	0.25	25th July,2014
		Momo Sato	0.25	25th July, 2014
Giroba Seed Center	Maize	SWAN-2	2	25th July, 2014
Total			**8.75 ha**	

Table 15. Rice varieties produced for foundation seed

Site	Crop	Varieties	Area (ha)
Sapu Irrigated lowland Swamp	Rice	WAR 1, WAR 77, CK 73, ROK 5, Kumbandingo, IET 31-37, Jesmin 85, IR 19746, Sahel 134, Kanilai, ATM Sel 3, Taichung Sen 10, etc.	15

Table 16. Grain yield of Foundation Seed in Yundum (Site III) and the 3 seed centers

Site	Crop	Variety	Area (ha)	Grain yield (kg)
Yundun Site III	Groundnut	Ex-Dakar	1	25
	Maize	TZEE-Y	1	120
Chamen Seed Center	Groundnut	Ex-Dakar	1	1050
	Maize	SWAN 2	1	150
Sapu Kerewan Field	Groundnut	Ex-Dakar	1	300
	Maize	SWAN 2	1	150
	Upland Rice	IR 19746	0.25	No harvest
	Findo	Momo	0.25	30
		Momo Sato	0.25	30
Giroba Seed Center	Maize	SWAN 2	2	100
Total			**8.75**	**1955 kg**

Plate 9. Foundation seed fields at Physiological maturity

Results

An area of 15 ha was planted with different rice varieties. The quantities produced are shown in table17. From the results, 18.150 tons of seed was produced during the 2014 wet season (table 17).

Table 17. Grain yield of Foundation Seed of rice from Sapu Irrigated swamp

No	**Variety**	**Grain Yield (kg)**
1	**WAR 1**	3250
2	**WAR 77-3**	3500
3	**CK 73**	1250
4	**ROK 5**	250
5	**Kumbandingo**	3000
6	**Jasmine 85**	1000
7	**IR 19746-26-2-3-3-1**	1000
8	**Sahel 134**	1000
9	**ITA 212**	1000
10	**Tainung Sen 14**	1500
11	**Kanilai**	900
12	**IET 3137**	150
13	**WAB 105**	150
14	**BG 90-2**	100
15	**Tainung Sen 19**	100
Total		**18,150 kg**

5.2 Certified Seed production

The Seed Technology Unit of NARI was able to produce about 1.6 tons of maize foundation seed of two varieties (Tzee-y and SWAN-2) last cropping season of 2013. In order to build a sustainable seed system, the unit was able to initiate a maize certified seed production system with selected maize seed producers in the six agricultural regions of the country. The selection was based on the list of seed producers trained by STU in October, 2013 funded by WAAPP and was held in Chamen Seed Center.

In collaboration with Department of Agriculture (DOA), 1.2 tons of seeds was distributed to farmers out of which 0.4 tons was TZEE-Y and 0.8 ton was SWAN 2. A total of 60 seed producers were involved and each farmer received 20 kg of seed for an area of 1 ha. Field inspection forms part of seed certification process and three inspections were carried out during the cropping season.

Table 18. Certified Seed Production system with selected maize producers

Site	Crop	Variety	Area (ha)	Date of Planting
WCR	Maize	TZEE-Y	10	July/August
NBR	Maize	TZEE-Y	10	July/August
LRR	Maize	SWAN 2	10	July/August
CRRS	Maize	SWAN 2	10	July
CCRN	Maize	SWAN 2	10	July
URR	Maize	SWAN 2	10	July

Plate 10. Seed producer at Mamut Fana (CRR)

Plate 11. Seed producer at Pakau Njogu (NBR)

Results

The result of the certified seed production in 2014 is shown in (Table19). A total of 28.43 tons of certified seeds of maize was obtained in 2014 cropping season (Table 19)

Table 19. Grain Yield from Certified Maize Seed production

No	Name	Region	Variety	Area (ha)	Yield (kg)
1	Drammeh Sambou	WCR	TZEE-Y	1	1400
2	Lamin Jabang Bojang	WCR	TZEE-Y	1	700
3	Buba Jallow	WCR	TZEE-Y	1	1050
4	Alh. Modou Cham	WCR	TZEE-Y	1	210
5	Ebriama Joof	WCR	TZEE-Y	1	280

6	Ebriama Boye	WCR	TZEE-Y	1	210
7	Saikou Cham	LRR	SWAN 2	1	420
8	Ismaila Jobe	LRR	SWAN-2	1	2100
9	Alh. Yaya Jarjusey	LRR	SWAN 2	2	1050
10	Pa Ebou Jobe	NBR	SWAN 2	1	770
11	Abdou Aziz Secka	NBR	SWAN 2	1	2100
12	Omar Drammeh	NBR	SWAN 2	1	2100
13	Jim Fatima Jobe	NBR	SWAN 2	1	700
14	Amie Ceesay	NBR	SWAN 2	1	490
15	Alieu Kebbeh	NBR	SWAN 2	1	420
16	Alh. Katim Touray	NBR	SWAN 2	1	560
17	Momodou Jallow	CRR,N	SWAN 2	1	200
18	Alh. Meme Ceesay	CRR,N	SWAN 2	1	1400
19	Alh. Musa Bah	CRR,N	SWAN 2	1	300
20	Burama Mbye	CRR,N	SWAN 2	1	350
21	Jarga Jallow	CRR,N	SWAN 2	1	280
22	Famara Jallow	CRR,N	SWAN 2	1	1260
23	Buba Nyanko	CRR,N	SWAN 2	1	1050
24	Alh. Belly Jallow	CRR,N	SWAN 2	1	1400
25	Fatim Gaye	CRR,N	SWAN 2	1	210
26	Gass Ceesay	CRR,S	SWAN 2	1	420
27	Alh. Sedia Dukureh	CRR,S	SWAN 2	1	1400
28	Abdouraman Kanteh	CRR,S	SWAN 2	1	350
29	Amadou Sowe	CRR,S	SWAN 2	1	420
30	Hamat Bah	CRR,S	SWAN 2	1	420
31	Alh.Bosse Kebbeh	URR	SWAN 2	1	700
32	Mamadi Jawo	URR	SWAN 2	1	1260
33	Alh. Babasse Ceesay	URR	SWAN 2	1	420
34	Hojo Sowe	URR	SWAN 2	1	700
35	Muhamadou Baldeh	URR	SWAN 2	1	700
36	Fafa Jaiteh	URR	SWAN 2	1	210
37	Haji Jabbie	URR	SWAN 2	1	420
Total				**37**	**28,430 kg**

5.3 Seed Laboratory Services

During the period under review (1st January to 31st December, 2014), the Seed Technology Unit (STU) provided laboratory services to various institutions and individuals in the form of seed viability analysis (germination testing), moisture content tests, seed physical purity analysis etc. During this period, the Seed Technology Unit (STU) provided laboratory services to the following institutions and individuals.

Table 20. Samples received for quality Analysis

Institution	Crop	Number of Samples	Parameters		
			Germ (%)	MC (%)	Shriv (%)
WAAPP	Groundnut	28	X	X	X
	Maize	18	X	X	
	Rice	53	X	X	
AFET/FANDEMA	Groundnut	60	X	X	X
	Maize	60	X	X	
Kanilai Farms	Groundnut	1	X	X	X
VSO	Groundnut	1	X	X	X
Ministry of Agriculture	Groundnut	2	X	X	X
	Maize	2	X	X	
	Rice	8	X	X	

5.4 Short term in country training and overseas travel

During the period under review, the staff of the unit benefitted from in country training and overseas travel as shown in the table below.

Table 21. Overseas Networking

Name	Country/Institution	Duration	Purpose of Travel
Morro Manga	Togo	1 week	COASEM Meeting
	Bukina Faso	1 week	Lunching of Certified Seed Dissemination Project
	Zimbabwe	1 week	ARIPO Draft Protocol Meeting
	Senegal	1 week	Study tour on seed system development
Morro Bah	Senegal	1 week	Study tour on seed system development
Kenbugul Jaiteh	Benin/Africarice	1 week	Africarice Science Week

			Conference

Table 22. In-Country Short Term Training

Name	Type of Training	Duration	Venue
Morro Manga	Variety cataloguing	3 days	Baobab Hotel
Morro Bah	Variety cataloguing	3 days	Baobab Hotel
Kenbugul Jaiteh	Variety cataloguing	3 days	Baobab Hotel
Kalifa Ceesay	Variety cataloguing	3 days	Baobab Hotel
Salimatou Sabally	Variety cataloguing	3 days	Baobab Hotel
Kenbugul Jaiteh	Innovation Platform Mgt	5 days	Baobab Hotel
Morro Bah	Innovation Platform Mgt	5 days	Baobab Hotel
Morro Bah	Monitoring and Evaluation	3 days	Wellingara Model Farm

Conclusion

It is evident that the 2014 cropping season was below normal in terms of rainfall distribution and intensity. These abnormalities seriously affect crop production both upland and lowland nationwide and the expected results in terms of yield per hectare could not be met for all the crops concern. It was a successful year but a challenging year for the implementation of the planned activities due to the erratic and unpredictable nature of the rains

RECOMMENDATION/FUTURE PERSPECTIVES

1) As coordination of activities is done from NARI HQ, frequent monitoring and supervision of distant activities is important.

2) Frequent Program meetings put the Unit on track

3) The spirit of team work should remain the slogan of the program and embraced by all and sundry

4) Ground staff on distant activities should be report to their superior(s) all matters beyond their control for immediate action.

5) Now that the Seed quality control and marketing bill has been enacted by the National assembly, this will allow seed actors in the Gambia to be players in the seed trade in ECOWAS space. This will also pave way for the country to build a sustainable Seed system.

6. AGRICULTURAL ENGINEERING UNIT (AEU)

Introduction

Agricultural Engineering Unit has continued its strive to achieve the desired mandate of adaptive research in areas of pre-harvest to post-harvest operations (i.e. introduction of appropriate technologies) particularly animal traction that will help reduce drudgery and increase production capacity of farmers to alleviate poverty. The Unit also provides support services to other programs and institutions.

6.1 Efficiency evaluation of a single row manual rice drill on ploughed and unploughed land

Objectives

- To determine the most appropriate drill hole for rice
- To determine the operation time per hectare for each drill hole
- To determine the area sown in kg/ha for each drill hole
- To compare yields of different openings and of ploughed and unploughed fields

This trial was conducted at site III**.** Soil samples were collected for analysis. The land was ploughed and planted with Nerica rice. However, after emergence there was a heavy invasion army worms that destroyed the entire field. The destruction was so severe that we have to terminate it. The trial is going to be repeated in 2015 cropping season.

Plate 12. Using the seeder to plant

Plate13. Field invaded by army worm

6.2 On-farm demonstration of animal drawn ripper versus farmer practice

The demonstration was aimed at conservation agriculture where only the planted row is tilled. The area required was 25 m x 25 m for both demonstration and farmer practice from which yields was to be compared. Four sites were identified in each of the six agricultural region and soil samples were collected from all the sites. Each farmer identified was supplied with one animal drawn ripper. However, the activity could not be implemented due to the late arrival and supply of equipment to farmers. Preparations are being made to implement it in 2015 cropping season. Tables below show the details of selected farmers in each region.

Table 23. Selected farmers in Upper River Region

Farmer	**Village**	**Crop**	**Contact**
Sileh Baldeh	Mansajang Kunda,	Early Millet	7270258
Alhagie Ba Jainaba Juwara	Kumbija	Early Millet	9405925
Marie Sillah	Sabi	Maize	-
Mohamadou Baldeh	Giroba Kunda	Maize	-

Table 24. Selected farmers in Central River Region South

Farmer	**Village**	**Crop**	**Contact**
Yaya Jallow	Sare Saidou	Early Millet	779909/
Alhagie Babou Ceesay	Bati Njol	Early Millet	7297710/7268711/9802944
Bai Dam	Galleh Manda	Maize	3421674/7053672
Musa Cham	Daru	Early Millet	7183043/3529663

Table 25. Selected farmers in Central River Region North

Farmer	**Village**	**Crop**	**Contact**
Kebuteh Ceesay	Jarumeh koto	Early Millet	9360590
Kita Kongira	Kayai	Early Millet	6809276
Sarra Bah/Ali Bah	Kass Fula	Maize	760015/7427447
Lamin Sey	Njau Seykunda	Maize	7360393

Table 26. Selected farmers in North Bank Region

Farmer	**Village**	**Crop**	**Contact**
Modou Jawo	Waya Worr	Maize	770424/3884520
Alagie Jeng	Koli Kunda	Early Millet	7222952
Alahagie Katim Touray	Macca Farafenne	Early Millet	7066855
Katim Touray	Jerri Kau	Maize	7699388/6586176

Table 27. Selected farmers in Lower River Region

Farmer	Village	Crop	Contact
Lamin Sonko	Bambako	Early Millet	6269189
Landing Sanneh	Mandina (Kiang)	Maize	7552675
Wandifa Jawara	Jiffin	Early Millet	6900153/6464198
Alhagie TairuGikine	Jara Madina	Maize	6259423

Table 28. Selected farmers in West Coast Region

Farmer	Village	Crop	Contact
Kawsu Sanyang	Penyem	Late Millet	7239939
Ansumana Bojang	Bukock	Maize	7770705
Sulayman Beyai	Kanuma	Late Millet	7921157
Fabakary Camara	Kasagne	Late Millet	7325530

6.3 Testing of weeding technologies

Objective

- To allow farmers interact with the weeding technologies
- Record farmers' observation for possible improvement on the technologies

Two weeding technologies were tested in two villages; Berefet and Jambur at farmers' fields. The weeding technologies tested are the cono and ring weeder. This was done in collaboration with Socioeconomic and Cereals Programme.

The cono weeder has a floater, weeding cone, arm, frame and standard. It has a long handle with a T-end to enable proper handling during operations. It is used for wetland paddy field weeding in between rows. It is operated by one person through pushing and pulling during operation. A single row is weeded at a time.

The ring hoe is made up of a long wooden handle attached to a serrated cutting blade. It is operated in a similar way as the conventional West African short handle hoe. The difference between the two is the operator stands whiles weeding which makes it easier to operate and more effective. It works effectively when the weeds are tender and the ground moist.

Both men and women farmers were involved in the testing and were giving out their candid observations and suggestions about the two technologies, at the same time prompted to start comparing them to their conventional weeding technologies.

Results

Farmers' perceptions were recorded during the testing of the weeders. Results from farmers revealed that the weeders reduce drudgery because bending during weeding is eliminated which is one of their bottleneck. They also said that they are simple and easy to operate. They are faster compared to the conventional hoe (West African short handle hoe). They said that the cono weeder was very light.

Suggestions

- Increase the weight of the cono weeder and the blade of the ring hoe should be sharper.

7. GRAINLEGUMES AND OIL SEED PROGRAM

Program overview

Grain Legumes and Oil Seeds (GLOS) Program performs adaptive research at strategic locations around the country with emphasis on varietal screening for comparative yield performance and adaptability. This agronomic work includes moderate crop improvement efforts before handing over superior varieties to the NARI Seed Technology Unit for further multiplication and eventual adoption by farmers. Over the years, there has been a decline in the production of groundnut. The decline is due, in part, to cultivation of the traditional long-cycle variety particularly during drought years. However, over the past few years, the program has been able to screen a few improved, short-cycle varieties that are high-yielding and well adapted to The Gambian ecologies. The GLOS program covers: groundnut, sesame, cowpea, soya bean and bambara groundnut

7.1 Groundnut observation nursery

This activity was initially supposed to be conducted at site III experimental field but due to the drought period experienced during the season it was finally implemented at the Research and Innovation center at Yundum for supplementary irrigation.

The area was cleared, ploughed, demarcated and planted in August 2014, with plot sizes of 5m x 4.5 m^2 , covering an area size of 22.5m^2 with twelve varieties. The quantity of seeds produced is shown in Table 29.

Table 29. Groundnut Pod yield per plot

Variety	Plot size	Pod weight (g)
Bamako 3	5 m x4.5 m	626.84
Fleur II	5 m x4.5 m	186.72
Samnut 23	5 m x4.5 m	762.27
ICGV 86024	5 m x4.5 m	84.62
Samnut 10	5 m x4.5 m	324.47
55-33	5 m x 4.5 m	330.95
Samnut 11	5 m x 4.5 m	130.25
ICGV 7878	5 m x 4.5 m	873.04
Samnut 21	5 m x 4.5 m	431.42
LL34	5 m x 4.5 m	66.27
Samnut 22	5 m x4.5 m	496.05
S/28-206	5 m x4.5 m	96.0

7.2 Cowpea seed maintenance

The cowpea seed maintenance was conducted at Research and innovation Centre at Yundum using breeder seeds such as Mounge with an area of 11 m x 3.5 m, Pakaw with 11 m x 3 m and Dji Guiya with an area of 5 m x 2 m.

Table 30. Cowpea Grain yield kg per plot

VARIETY	PLOT SIZE	Grain weight kg per plot
Mounge	11 m x3.5 m	5.5
Pakaw	3 m x 6m	1.5
Dji Guiya	11 mx3 m	5.0

7.3 Sesame seed maintenance Yundum site III

Sesame seed maintenance was carried out in 2014 cropping season. Plot size of 20 m x20 m was planted using variety 32-15. This activity was incomplete due to poor rains experienced.

Recommendation

Due to the drought experienced during the cropping season it is therefore recommended for the trail to be repeated this coming season.

8. HORTICULTURE PROGRAM

Program overview

The Horticulture program is one of the commodity research programs of NARI. It conducts research on fruits, vegetables, plantation crops, roots and tubers. The research aims to promote production improvements that provide an economic advantage to the growers. It also conducts trials to compare varieties, fertilizer levels, planting densities, cultivation methods, and among others. Making such comparisons over time and across locations enables the program to make recommendations that guide growers, solve practical problems, improve yield and quality of crops and development of horticulture in The Gambia

8.1 Evaluation of different rates of organic, inorganic and combination on the yield of tomato (Mongal F_1)

Introduction

Most of the vegetable gardens in the Gambia are sandy loam but are generally poor in plant nutrients coupled with other factors like biotic and abiotic making vegetable producers obtain low yield. Small scale vegetable growers use small quantities or do not even use chemical fertilizers. Commercial fertilizers are becoming more expensive and in certain cases not affordable by farmers. Majority of the small scale vegetable growers use cow, goat or sheep dung to enrich their garden soils in order to maximize yield. In this vein therefore, the Program deems it necessary to find out which combination can be recommended to increase their yields.

Objectives

1. To evaluate the yield and yield components of different rates of organic (Farm Yard Manure) and inorganic (chemical Fertilizers) fertilizers on the yield of tomato variety Mongal F_1.
2. To provide farmers with the recommended rate of the fertilizer combination suitable for the production of tomato variety Mongal F1.

Materials and methods

Farm Yard Manure (was collected, heaped and watered once daily for the first 3 days and thoroughly turned to obtain a smooth mixture and spread it dry to reduce water before application. Type of inorganic fertilizer used was 15-15-15-4-40

Treatments

T1: 1 kg FYM, 200 g NPK and 100 g Urea

T2: 2 kg FYM, 100 g NPK and 100 g Urea

T3: 2.5 kg FYM, 100 g NPK and 100 g Urea

T4: 200 g NKP and 100 g Urea

T5: 3 kg FYM and 100 g NPK

T6: 5 kg FYM and 100 g NPK

8.2 Pine apple and Indian jujube

Pine Apple

Land area planted with pine apple was 35 m by 35 m which is equivalent to 1225 m^2. Land preparation was done by the power tiller on the and this was followed by fertilizer application, 1025 kg of chicken manure and 1 bag of 15-15-15 and incorporated into the soil using power tiller. Raised beds measuring 30 meters long by 1 meter wide and 30 cm high were used. Beds were later covered with plastic for weed suppression and planting was done on the. E ach variety was planted on four (4) beds and plantlets were dipped into benlate powder as a measure of protecting the transplants from termites and soil borne diseases. The following varieties were used in the production: -Tainung no. 3 Tainung no. 17 and Tainung no.20. Plantlets were spaced at 60 cm between rows and 50 cm between stands. Drip irrigation lines were laid on beds for efficient water supply to the plants. Three (3) tea spoonful of urea was dissolved in 30 liters of water to fertilize each bed once every month and the process will continue up to harvest.

The same Tainung no.17 was planted at Kanilai using the same cultural practices as that of Yundum. At the moment no pest or disease incident is noticed.

In continuation of the Fruit Test Planting, the National Agriculture Research Institute (NARI) has embarked on planting Grape Vine, Pine Apple and Jujube at Site III in Banjulunding during the 2014 wet season. It was meant to increase the diversity of fruit in the Gambia which were not in existence before notably Grape Vine and Indian Jujubee.

Indian Jujube

An area of 23m by 23m was planted for Indian Jujube (large fruit) was which is equivalent to 529 square meters. Planting holes were dug at 50 cm deep and 75 cm circumference and plants were spaced at 6 meters between rows and 6 meters between plants. Fertilizer was applied at the rate of 20 kg cow dung, 10 kg chicken manure and 100 g of 15-15-15 (NPK) in each hole prior to transplanting. Three (3) varieties were used namely- Tien-mi, Pinkuo and Tsui-mi was transplanted. Regular weeding was done as necessary and removal of flowers was done every two weeks to discourage early fruiting as recommended by Experts. Irrigation was done once a week during the dry periods.

Grape Vine

Planting holes were marked 3 meters between rows and 2 meters between plants and dug at 50 cm deep and 75 cm wide fertilizer was used at the rate of 20 kg cow dung, 10 kg chicken manure and 100 g of 15-15-15 (NPK). These holes were regularly watered one month before transplanting to allow further decomposition of organic manure. Transplanting was done on the 12th of September, 2011 using five varieties namely- Kyoho, Seedless, Red lady Black Queen and the Local.

Number of plants transplanted for each variety:- Kyoho (8 plants)**,** Seedless (4 plants)**,** Red Lady (2 plants), Black Queen only (1 plant survived), Local (4 plants)

8.3 cassava maintenance

Maintenance of cassava varieties was carried out at Site III in Banjulunding. The following cassava varieties were received from IITA, Nigeria in 2004 and they are currently planted for provision of planting materials for cassava growers and to serve a germplasm for future breeding: 92/0326, 96/4496, 98/0505, TME 14 and Tokumbo on .75ha. Plot

8.4 FAO cassava activity in collaborative with the National Agric. Research Institute (NARI)

Upon the request of Cassava variety resistant to Cassava Mosaic Virus (CMV) by His Excellency The President of the Republic of The Gambia from F.A.O, the Horticulture program and the Consultant from Ghana F.A.O Office for Africa, Madam Joyce received the cassava stalks from Gabon on Wednesday the 27th of August 2014 at about 9 am local time from DHL Office in Kanifing (Banjul).

These cassava stalks were obtained from Ms. NzueEyi from MBENG OSSI in northern Gabon. These planting materials were (**Lines 95/0528, 8061, 96/0304, 95/0528 and 8034)** were taken to NARI Research Station at Yundum for cutting them into 25 cm planting size recommended by International Root Crop Institutes. This exercise was accompanied by dipping the Cuttings into a Chemical Solution (SEEDOX) containing the following active ingredients: - imidachlorprid 10% + metalaxyl 10% + carbendazine 10 %. SEEDOX contains both fungicide and pesticide. As a wettable power one sachet of SEEDOX to one liter of water thoroughly stir before dipping cutting into the solution. Equipment used involved Hand Saws, Secateurs, Pliers, Gloves, Buckets and Nose Mask.

After dipping the cuttings into the chemical solution for 30 minutes,it was then removed and dried under the shade for air drying and packed for planting out in the field. Planting started with at Kanilai on the 28th of August 2014 and this was witnessed by the Consultant from Ghana, Madam Joyce, Perpetua, FAO Resident Representative in The Gambia, Njie Mariatou, FAO Gambia and Horticulture Staff of National Agricultural Research Institute (NARI) for the implementation of the program.

Planting was conducted at Site III Banjulunding on the 29th and Wellingara Horticulture Model Centre on the 30th August 2014. Things worked very well with logistic support rendered to us by F.A.O. Area of land cultivated in each Site: Kanilai 2400 meters square, Yundum 1114 meters square and Wellingara 936 meters square. Due to inadequate cassava stalk received, we could not meet the target area planned for all the sites.

Plate 14. Cassava material at DHL

9. FISHERIES AND AQUACULTURE PROGRAM

9.1 Fish and carrot integration

Fish (tilapia) and vegetable (*Daucus carota sub-species New kuroda*) were integrated (Jan – May 2014) as a trial using only organic manure as well as recycling aquaculture waste in a view to sustain productivity. Application of organic manures will aid in the improvement of soil textural class to become loamy. Loamy soils composed of sand, silt and clay in a relatively even concentration and are considered ideal for gardening and agricultural uses.

Objective: to determine the effects of fish pond water on carrot plants for their productivity

Results

An area of 77 m^2 was prepared was used bed size of 1 m x 4 m square. Carrot seeds were sowed on 27th January 2014. Treatments were fish pond water, tap water and combination of fish pond water and tap water. The results Figure… shows data collected. The results indicated that a combination of pond and tap water had a positive effect on plant height in the month of April compared to control (tap water only) and pond water. Whereas in March, control treatment (tap water) seem to perform better than other treatments with mean height of 76.3 but the difference is not significant.

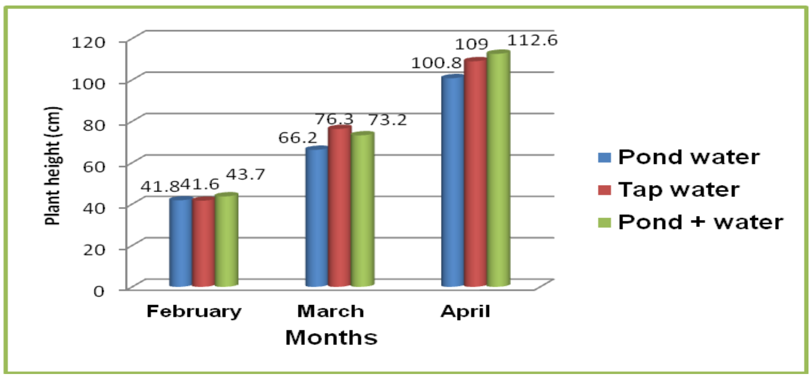

Figure 15. Mean plant height response to treatments

Challenges

Since the revitalization of the program in 2010, it has been a challenge to carry out a major project activity due to inadequate resources such as funds, research facilities and support staff.

Apart from on-station activities, aquaculture program needs a lot of field research requiring frequent movements – identifying culture species and potential sites, conducting surveys, transportation of fish and fingerlings, collection of feed ingredients, visiting and giving technical advices to aquaculture farmers throughout the country.

Conclusion

Fish effluent is a good additional nutrient supply for crops which is economical as compare to chemical fertilizer. It can be concluded that aquaculture play a pivoted role by supplying protein source to our diet thus improving the living standard of people for increase food security.

Recommendation

Conduct research on the biology and behavior of aquatic organisms to better manage our marine and freshwater ecosystems on a sustainable basis.

Expansion of research facilities including infrastructure, equipment, vehicle, development of aquaculture systems for collaborative research activities, integration of aquaculture with crops and livestock , networking in advance places, training in specialized areas and program in advance research (PhD).

Collaboration of external partners and strengthens partnership between the Gambian Aquaculture Farmers Association and NARI.

10. AGRICULTURAL PRODUCE CHEMISTRY LABORATORY (APCL)

The Laboratory has been rendering and continues to render support services to laboratory clientele and Scientific Officers. The services generally include routine chemical analysis for wholesomeness, quality for marketing and other research purposes. Laboratory Certificates are issued to its clientele and the results are used to support marketing/pricing of commodities. Laboratory clientele are sensitized and advised on how to collect samples such as weight/size and number of samples to be submitted for analysis.

In 2014 samples were received from the following laboratory clientele: Gambia Groundnut Corporation (GGC), Royal Enterprise, Abden Company Ltd./World Food Programmed (WFP), Reliance Enterprise, New-Nut Company [Gambia] Ltd, NAWFA, JV-KG, Afronut, Adama Jammeh & Co. Ltd, Saiko Waggeh, Smiling Enterprise .

The routine Chemical analyses carried out are as follows: aflatoxins, moisture content, insoluble impurities in fats and fatty oil, oil content and Free Fatty Acid (FFA). For the reporting period a total of two hundred and thirteen (213) samples were received (Table 31).

Table 31. Samples received for analysis at the APCL, January to December, 2014

Produce/Products	**Nº of Samples**
Decorticated groundnut (HPS)	170
Decorticated groundnut (FAQ)	6
Groundnut cake	8
Crude Groundnut oil	21

Soya Bean Oil	1
Palm Oil	1
Milled Rice	6
Total	**213 samples**

The routine Chemical analyses carried out are as follows: Aflatoxins, Moisture content, Insoluble Impurities in fats and fatty oil, Oil content and Free Fatty Acid (FFA).The laboratory results on samples received for 2013/2014 season are attached to this report.

Chemicals Purchased in Dakar Senegal:

Chemicals were purchased from the funds generated by the laboratory charges /fees. Worth of eight hundred and eighty thousand CFA(CFA 880,000),was received on the 11th of December 2014, equivalent to seventy five thousand six hundred and eighty dalasi (D75680) selling rate at the time for purchase of the following laboratory chemicals in Dakar, Senegal on 16th December 2014 according to the Performa invoice received.

1. Methanol 2.5L x 10 = (25L)
2. Methanol 4L x 6 = (24L)
3. n-Hexane 2.5LX 8 (120 liters)
4. Petroleum Spirit 40°- 60°C 2.5L X 2 (5 liters)

International Trade Center.

A consultant was hire in April by the International Trade Center (ITC) based in Geneva, through the Enhancement Integrated Framework (EIF) at the Ministry of Trade Regional Integration and Employment (MOTIE) to train Laboratory staff on the operation and maintenance of the High Performance Liquid Chromatography (HPLC) machine that was purchased by European Union (EU) since 2009, through the STABEX project. The machine since when bought was not in operational until the EIF project came and decided to make sure it is in operation. Training was conducted by the consultant but not completed. A second mission was planned, provided all necessary consumable recommended by the consultant base on his report are purchased and the laboratory refurbished. This had cause a delay on the consultant second mission until November when West Africa Agricultural Productivity Programme (WAAPP) came to our aid which was facilitated by the MOTIE and Ministry of Agriculture.

West Africa Agricultural Production and Productivity Programme [WAAPP]

WAAPP purchased 90% of the consumables being recommended by the consultant. They also take up the responsibility of renovating the laboratory, which will prepare it for accreditation.

Partnership for Aflatoxin Control in Africa {PACA]

The laboratory had also benefited from Partnership for Aflatoxin Control in Africa (PACA), through the Food Safety and Quality Authority a VICAM and other machine, together with other consumables for aflatoxins analysis. Laboratory staff also benefited from training on Africa Aflatoxin Management Information System (AfricaAIMS) and how to use VICAM machine together with other stake holders. The machine was bought purposely to collect samples, analyzed and generate data for Africa AIMS data base.

Activities proposed for next year January to 31st December, 2015

- Collection of samples of groundnut from the farm and secos, peanut butter from some local market/lumos, some local processing facilities, so as to determine the HACCP for aflatoxin production. Also start to implement PACA activities with the stakeholders involved.

- Sensitized the local community, mainly high groundnut producing areas on how to handle groundnuts from farm to the table to mitigate the level of mould growth which might lead to the production of mycotoxins particularly aflatoxins. Intervention and comprehensive network scheme for aflatoxin control in groundnuts and peanut butter is also necessary for groundnuts and other cereal farmers. This is based on the availability of funds to be implemented.

- Routine analysis of samples for aflatoxin, free fatty acid ,oil content and moisture content etc ,brought by clienteles for purpose of export, research and sometimes for domestic use.

- A memorandum of understanding be established between some advance Laboratories especially that of ITA Dakar, Senegal for training of laboratory staff on how to analyze aflatoxin using HPLC, so as to make best use of the HPLC equipment already purchased by the EU almost four years ago. Other short term trainings may also be necessary from time to time.

Standard of the Laboratory

It took many years of hard work to bring the standard of the laboratory to what it is today. It is strongly recommended that all laboratory staff to raise it higher or at least maintain its present condition/position.

Constraints/Bottleneck:

The Laboratory urgently needs functional Fume Cupboard/hood, and Electrical Grinder suitable for cereals and groundnut/Dickens Hammer Mill. The blenders presently used are not suitable and are very slow.

Recommendations:

- Specific account should be maintained for the laboratory charges and be accessible when needed. There is a great need to seek funds to upgrade the standard of laboratories in terms of chemicals, Glassware and other equipment as well as staff training. It is recommended that all laboratory chemicals, Glassware & Equipment requests be handled directly by NARI as it will be cheaper, faster and more reliable and not to be contracted to any Agent.
- Staff need to have networking/visits to other laboratories in Senegal/Sub-Region and developed /EU countries where possible to gain more experience.

- Laboratory equipment and methodologies are changing from time to time; therefore staffs need to be updated in the form of short/long term training.
- Management should consider paying risk allowances to Laboratory staff for handling Health Hazard Chemicals/ Mycotoxins through inhalation and skin contact.