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PrOpCom

Making Nigerian Agricultural Markets Work for the Poor

Monograph Series # 33

EMPIRICAL STUDY OF BIRD DAMAGE IN OFADA RICE PRODUCTION IN SOUTH WEST NIGERIA

By

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LIST OF ABBREVIATIONS AND ACRONYMS

ADP	**AGRICULTURAL DEVELOPMENT PROGRAMME**
RIFAN	**RICE FARMERS ASSOCIATION OF NIGERIA**
LGA	**LOCAL GOVERNMENT AREA**
GPS	**GLOBAL POSITIONING SYSTEMS**
PROPCOM	**PROMOTING PRO-POOR OPPORTUNITIES THROUGH COMMODITY AND SERVICE MARKETS**
NCRI	**NATIONAL CEREALS RESEARCH INSTITUTE**
DFID	**DEPARTMENT FOR INTERNATIONAL DEVELOPMENT**
AMREC	**AGRICULTURAL MEDIA RESOURCES AND EXTENSION CENTRE**
TOR	**TERMS OF REFERENCE**
IITA	**INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE**
FAO	**FOOD AND AGRICULTURAL ORGANISATION**
WARDA	**AFRICA RICE CENTER (WEST AFRICA RICE DEVELOPMENT ASSOCIATION)**
NERICA	**NEW RICE FOR AFRICA**
IPM	**INTEGRATED PEST MANAGEMENT**
UNAAB	**UNIVERSITY OF AGRICULTURE ABEOKUTA**

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EXECUTIVE SUMMARY

The PrOpCom Programme to improve the livelihoods of poor people in Nigeria is focusing initially on rice as a primary commodity and seeks to improve its production and profitability. Initial investigations by PrOpCom staff suggested that farmers considered birds as the major constraint in rice production, up to 75% of total output could be consumed by birds, and up to 50% of production costs went into bird scaring. To address this apparent problem, one international and one national consultant were employed to carry out a preliminary investigation from 28 January to 11 February 2007, and to recommend the best approach to bird pest problems in the South-Western States of Nigeria. The consultants also reviewed the activities of government institutions, private organizations, and individual farmers in attempting to prevent bird damage to rice. The consultants' survey in these states confirmed that farmers perceived bird damage as a serious constraint to Ofada rice production and noted bird scaring still followed the typical African pattern, with local variations in methodology. They recommended that an that empirical investigation of bird damage levels be carried out, training be provided to farmers in Integrated Pest Management approaches to bird pests and that trials should be conducted into the use of enclosure netting to protect the rice. The result of the investigations was reported at the stakeholders meeting on 9 March 2007. After the meeting, follow up action was agreed upon covering all three of the recommendations. The empirical study of bird damage levels was carried out from 10 July to 30 September 2007, under a contract from PrOpCom to the National Cereals Research Institute (NCRI), Niger State, Nigeria and is the subject of this report.

Five farms were selected for detailed study of the bird pest problem in two Local Government Areas (LGAs) in Ogun State and in one LGA in Ekiti, Osun, and Lagos States, a total of 25 farms. In the event, damage estimates could only be made in 22 of these farms. A further 10 farms were sampled in two other LGAs in Ogun State and one other LGA in Ekiti State, bringing the total sampled to 32 farms spread over 8 LGAs in 4 States. Four separate estimates were made per farm by four assessors in order to overcome variability. In Ogun State LGA1 estimated loss caused by birds ranged from 7 to 23%, in Ogun LGA2 8 to 18%, and Ogun transect surveyed farms 9 to 26%. In Lagos State, estimated loss by birds ranged from 13 to 15%, Osun 18 to 22%, Ekiti 4 to 16% and Ekiti transect surveyed farms 3 to 23%.

The overall damage level (range 3 to 26%) was lower than what the farmers had reported it to be, which is typical of bird damage in other places where it has been measured. The Village Weaver *Ploceus cucullatus was* the most abundant bird pest and probably the most important contributor to in-field Ofada rice damage. Other bird pests observed included the Black-and-White Mannikin *Spermestes bicolor,* Vieillot's Black Weaver *Ploceus nigerrimus*, Red-headed Quelea *Quelea erythrops,* Red-eyed Dove *Streptopelia semitorquata,* and Laughing Dove *Streptopelia senegalensis*. Our findings indicated that weaver birds would consume rice when available and plentiful but ate wild grass seeds and insects in similar proportions. This investigation was carried out during a 'good rain' year in which the pest birds had a plentiful natural food supply (wild grass seeds and insects). In drier years, bird pest pressure on Ofada rice might be higher. These results therefore provide a good estimate for years in which rain is plentiful. *P. cucullatus* were undoubtedly the principal bird pest of Ofada rice. This corroborated previous investigations in the same study area (Park 1974; Funmilayo and Akande, 1974, 1977).

Most of the Ofada farmers practiced shifting cultivation which may be good for regeneration of the land and probably reduce their dependence on expensive chemical fertilizers. It was observed that often they could not cope with the drudgery of manual land preparation. In the first year the land was often not well prepared and incompletely cleared, often by burning, without uprooting the tree stumps and the soil habitually lightly scraped by hoe. Consequently the stumps and bushes that quickly grew within the cropping area provided staging perches for the bird pests.

Based on labour input data collected from 10 farmers in 2 LGAs, labour for bird scaring accounted for half of the total quantity of labour required for rice production. About N15, 000 was required to scare birds from one hectare of rice. The rice fields protected with indigenous bird scaring juju were visited by farmers for surveillance, at an average of two hours a day for a period of 30-35 days. The average cost of each juju portion was N200, about five being required for one hectare of rice, giving a total cost of N1000/ha. Although farmers did not pay for surveillance, the cost when imputed for two hours of surveillance per day for 30 days would be N1, 250. The wage paid to bird scarers ranged from N200-N500 per 12-hour day, 2 hours for 30 days (i.e. 60 hours) would cost N1, 250. Thus the total amount required to protect one hectare of rice from bird pests using juju was N2, 250. Although juju cost only 15% of the cost of bird-scaring, it does not follow that it was effective. It was difficult to

distinguish between farms that were only protected by juju and 2hrs of checking by the farmer, from those that had juju and the farmer or bird scarer present all day.

Various practices can help to reduce bird damage. For example whenever possible it pays to avoid planting crops like maize, sorghum or cassava within and along the edges of a rice farm as practiced by most of the Ofada rice farmers, because they provided perches from which birds can launch attacks on the rice. Clearing and land preparation must involve, to the extent possible, the uprooting of tree stumps, logs of wood and bushes which serve as staging perches for the bird pests. Ofada rice has noticeably high weed problems, and weeding must be done early, partly to remove wild grass seed that may attract birds and partly to remove the weeds as staging perches.

Most of the Ofada farmers practiced shifting cultivation which may be good for regeneration of the land and probably reduce their dependence on expensive chemical fertilizers. It was observed that often they could not cope with the drudgery of manual land preparation. In the first year the land was often not well prepared and incompletely cleared, often by burning, without uprooting the tree stumps and the soil habitually lightly scraped by hoe. Consequently the stumps and bushes that quickly grew within the cropping area provided staging perches for the bird pests.

Ofada rice was expected to be grown in monoculture or in rotation with other crops as indicated by many farmers in the study area. They opined that the maize served as food or snack for the bird scarer who would be guarding the field for 30-35 days from dawn to dusk. The adverse effect of growing within the farm scattered stands of maize, sorghum, cassava, shrubs and scrubs was that it served as staging perches for the bird pest and this was acknowledged by farmers. Sorghum *Sorghum bicolor*, Maize *Zea mays*, Cassava (*Manihot esculenta*) intercrop with Ofada rice is not recommended for the study area. Some of the farms observed were situated on steep slopes which might be prone to erosion problems.

The conclusions consequent upon the results of our investigations are as follows:

- Village Weavers cause extensive damage to Ofada rice. Bird scaring by labourers remains the most effective control method.
- Bird scaring techniques could be improved at least marginally. An Integrated Pest Management approach, working with farmers to make their fields as unattractive to birds as possible would be an important approach towards reducing the damage; early

planting, good weeding, clean surrounds, better scaring, quick harvesting, would all contribute. Integrated Pest Management Training including the current novel bird netting trial will be helpful to farmers. The inclusion of IPM training is therefore crucial.

- The ecology/biology of bird damage in South West Nigeria suggests that the pest birds are unlikely to present good targets for lethal control as they are too dispersed and often establish colonies near human habitation making them unsuitable for aerial spraying or firebombs. Lethal control is not an option except for farmers to attack the breeding colonies of the Village Weavers, which might make the birds move further away from the rice fields.

1. INTRODUCTION

Most of the production of Ofada rice in South Western Nigeria is under upland rainfed conditions and Ofada rice is basically upland. However, some lowland Ofada is also grown in lowland habitats around Ise, Lagos State. Most of the upland growing areas are found in Ogun, Ekiti, Osun, Ondo, Kwara, Niger, Kano, Katsina, Borno, Kaduna, Edo, Benue and Plateau States. Since the mid-1970s, rice consumption in Nigeria has risen tremendously, at about 10% per annum, due to changing consumer preferences. Demand has also been increasing rapidly because of increasing population growth, higher income levels, rapid urbanization and associated changes in family job-related chores. The average Nigerian now consumes 24.8 kg of rice per year, representing 9% of total caloric intake (IRRI, 2001).

Rice is one of the five crops most frequently damaged by birds in the Western States of Nigeria (Funmilayo, 1973; Funmilayo and Akande 1974, 1977). Rice farmers in many parts of Nigeria suffer from sporadic damage to newly sown and maturing rice crops, caused by birds especially weaver birds. According to PrOpCom (Promoting Pro-Poor Opportunities through Commodity and Service Markets), birds were reported to consume up to 75% of total production in Ogun State, and bird scaring could account for as much as 50% of production costs. PrOpCom began an investigation of the impact of bird damage in Ofada rice-growing areas of South-Western Nigeria in early 2007. Previous studies had found that the Village Weaver *Ploceus cucullatus* was the most common avian pest of cereal crops in South-Western Nigeria (Funmilayo, 1973; Fumnilayo and Akande 1974).

In order to investigate the problem of the impact of bird damage on rice production, PrOpCom recruited one international and one national consultant to carry out a preliminary investigation from 28 January to 11 February 2007, and to recommend the best approach to bird pest problems in South Western Nigeria. The consultants reviewed the activities of government institutions, private organizations, and individual farmers in attempting to prevent bird damage to rice. This constituted the first part of the research project. The consultants' survey in these states confirmed that farmers perceived bird damage as a serious constraint to Ofada rice production and noted that bird scaring still followed the typical African pattern with local variations in methodology. They recommended that an empirical investigation of bird damage levels be carried out, training be provided to farmers in Integrated Pest Management (IPM) approach to bird pests and that trials should be conducted into the use of enclosure netting to protect the rice. The empirical study of bird damage levels, which was carried out from 10 July to 30 September 2007, represented the second phase of the investigation. It was carried out under a contract from PrOpCom to the National Cereals Research Institute (NCRI) Niger State. It focused on collecting empirical data on bird damage to rice and on evaluating the various bird control techniques farmers' use. It was envisaged that the outcome of the consultation would chart the direction towards alleviating bird pest damage, perceived by farmers as the most important constraint to rice production in the Ofada rice growing areas of South-Western Nigeria. There was considered to be an urgent need for an objective assessment and documentation of bird damage because there was a paucity of such information. It was important to put the bird pest problem into perspective, thereby providing a functional basis for developing cost-effective control techniques and crop protection strategies. Bird damage coupled with intensive cultivation without fallow and fertilizers was thought to affect Ofada rice production adversely.

Reliable estimates of damage and damage potential are important for understanding the impact of birds on crop yield and subsequent economic loss to farmers. This investigation aimed to sustain farmers' interest and ultimately to improve the profitability of Ofada rice production. The report of this study is intended to be part of a holistic effort to address the problem of bird damage in Ofada rice production, with the possibility that any solutions found may also be applicable to other rice-growing parts of the country. In this context, the role of quantitative empirical assessment of bird damage to Ofada rice becomes crucial.

Specific objectives

- To identify the pattern of bird damage to Ofada rice crop in the field.
- To provide an objective assessment of the average annual losses due to birds in per ha production and income; and costs to consumers in Ofada rice production areas.
- To develop a management strategy for the birds, which will reduce their impact to an acceptable level.

1.1 Study Area

PrOpCom decided to add Lagos State to the three States that were part of the preliminary investigation (Ogun, Osun, and Ekiti), and requested that five farms be selected for detailed investigation in two local government areas (LGAs) in Ogun State (Obafemi-Owode and Yewa North) and in one LGA in Osun (Oriade), Ekiti (Ido/Osi) and Lagos (Lekki). The general vegetation of the study area was secondary forest and the dominant vegetation was broad-leaved evergreen forest. Most farms in the villages were interspersed throughout the study area and were reachable, sometimes with difficulty, along lateritic and often dilapidated roads. The farms in Lagos State could be accessed only by canoe and then on foot.

2. METHODOLOGY

The field study began on 14 July 2007 at the height of the season when the Ofada rice crop was being cultivated by farmers and direct visual observations could be made. Twenty five rice farms representing 2 Local Government Areas (LGAs) in Ogun, and one each in Ekiti, Osun, and Lagos States were identified and selected in collaboration with RIFAN (Rice Farmers Association of Nigeria) officers, specifically for the empirical bird damage investigation The RIFAN officers assisted during the selection process by identifying suitable farmers and helping to obtain authorization to access the fields for data collection. For detailed investigation of the bird pest problem, five rice farms, each operated by an individual farmer, were selected in each of two rice-growing LGAs in Ogun State and preliminary observations made in them. Similarly, five rice farms were also selected in one LGA in Ekiti, Osun and Lagos States. A hand-held eTrex Legend Cx Global Positioning System (GPS) was used to record the coordinates and elevation of each of the farms and study sites. A pair of binoculars (Leica 8 x 32 and Bushnell 12 x 42) and a Nikon field scope (III A) were used to identify the bird pests, and to observe their foraging pattern within the farms and and in the agro-ecosystems. A list of all bird species occurring in the Ofada rice cropping system was also compiled. Photographs were taken with a Nikon (Coolpix 5000 optical zoom) digital camera. Farmers were interviewed on bird pest problems. Farmers' perceptions were

determined from their varying opinions expressed on series of specific questions (see Annex 1 for questions asked).

The ecology and biology of the bird species and per cent estimate loss due to bird damage were recorded.

On each rice farms visited, a 15 minute sampling interval of recording any bird species observed attacking rice was made. Weaver birds' activities within and in the vicinity of the rice farms were documented. Additional birds' species in the vicinity and others seen incidentally were recorded.

Point and strip transects counts for patch-scale ecological studies of terrestrial birds were combined to sample the birds (Bibby *et al*. 2000). A work plan was carefully drawn up against the Specific Tasks 1 to 10 as described in the Terms of Reference (TOR). The contract objectives were followed as closely as possible, although some tasks had to be conducted concurrently.

Damage estimates were made on ripening rice just before harvest or on the day harvest commenced. Four assessors were recruited locally on each selected rice farm to perform the damage assessment. Bias due to one assessor's differential figures was reduced by engaging four assessors per farm. On several occasions, the Coordinator or the Supervisory Consultant carried out their own assessments in the rice fields, so that comparisons could be made with the results obtained by the assessors.

Rice fields ready for harvest were sampled thus: Two bags were attached to the hips of each of four individuals (assessors), one marked ''Damaged and the other ''Undamaged''. They were instructed to move through the rice field on a zigzag path. Five (5) rice panicles were then cut at random every five to ten steps (depending on field size) at the level of the first node below the panicle. Panicles cut were examined to see if panicle was damaged or not and put in the appropriate bag. It was expected that about 200 panicles would be cut per person per field. The two bags were weighed, and then emptied out, and the bag re-weighed empty. The panicles were separated out and the exact number in each bag counted. Percent damage losses were then calculated, according to the formula:

$$\frac{\text{Mean wt. of damaged panicles}}{\text{Mean wt. of undamaged panicles}} \times \frac{\text{Number of damaged panicles}}{\text{Total no: of damaged + undamaged panicles}} \times 100$$

After the weights had been taken and the panicles had been counted the rice was given back to the farmer.

The various bird control methods used by farmers and their efficiency/replicability were documented, evaluating the skills of each category of bird scarers (children, hired labour, farmer). The morphological features of the rice plant and farm management practices within/around the rice crop that may affect bird attacks were noted. We used birds per minute of observation as the measurement unit for analyzing bird activity in the farms visited. A ‘’bird/min’’ was defined as the number of members of a species present in the farm during a 1-min observation period (Knutsen, 1998). The fixed-time spans employed for all sites were; 5-min point count, 15 min sampling interval, 15 min transect counts of weaver birds along the perimeter of the rice farm and along the path that led to the location of rice farm. By this method, the number of all bird species occurring in a given area at any one time was estimated. The sampling effort was standardised across all sites (Shields 1979; Ralph *et al*. 1995; Thompson 2002).

The software package IRRISTAT and SPSS 10.1 (SPSS, 2000) were used for statistical analyses. Data from all the 32 farmers was analysed as a single data set.

3. RESULTS

3.1. BIRD DAMAGE ESTIMATES

In Ogun State LGA1 estimated loss caused by birds ranged from 7 to 23%, in Ogun LGA2 8 to 18%, and Ogun transect surveyed farms 9 to 26%. In Lagos State, estimated loss by birds ranged from 13 to 15%, Osun 18 to 22%, Ekiti 4 to 16% and Ekiti transect surveyed farms 3 to 23%.

The results of our investigations indicated that estimated loss caused by birds to in-field Ofada rice in south western Nigeria ranged from 3 to 26 per cent. Damage occurred in all farms assessed though there was considerable evidence of variation, being low when pest density was low or farms were well guarded, or high when gregarious birds descended on susceptible farms.

Table 1. Estimated percent loss caused by birds in selected Ofada rice farms in Obafemi-Owode LGA of Ogun State.

Farm No & hectare	Farmer	Farm Location, Altitude & Coordinates	Damage Assessment Date. (2007)	Estimated per cent loss to birds. (%)
1 (Ofada), 3 ha	Mr Taofeek Soremi	Agbajege 437ft (133.20m) 06°59.514'N003°33.070'E	31 July	14
2 (Nerica), 10.2 ha	Pastor Adenekan	Moloko-Asipa 436ft (132.89m) 06°59.568'N003°33.977'E	20 September	23
3 (Ofada), 3.5 ha	Mr Sikiru Popoola	Lufoko 409ft (124.66m) 07°02.539'N003°24.108'E	25 August	14
4 (Ofada), 2.5 ha	Mr Sikiru Popoola	Lufoko 399ft (121.62m) 07°02.561'N003°24.185'E	25 August	10
5 (Ofada), 5 ha	Mr Nojimu Oguntola	Ayiwere 347ft (105.77m) 07°01.032'N003°24.538'E	8 September	7

In Table 1, the estimated percent loss caused by birds among the 5 farms at Obafemi-Owode were significantly ($P > 0.05$) different.

Mr Taofeek's Ofada rice farm was situated adjacent to the tarred road to Moloko-Asipa. According to him all farm operations such as land preparation, planting, weeding, bird scaring and harvesting were solely manual. Prior to the commencement of planting rice on this land, it had been fallow for 3 years. The rice was direct seeded by five hired labour from 10-12 April 2007. There were no fertilizer and pesticide application. Payment for land preparation and planting were usually negotiated at a price which ranged from □3,000 to □3,500 per hectare agreed in advance. He had cultivated the land for two consecutive years to Ofada rice and intended to plant water melon in September after the current rice to be followed by Ofada rice next year. The land has been cultivated for about five consecutive years to rice.

Flocks of 20-35 Village Weavers *Ploceus cucullatus* were noticed feeding on the rice panicles as early as 8.00am. More flocks, ranging from 30-55 *P. cucullatus,* flew directly into the ripening rice or perched on surrounding vegetation at very short intervals. Those that perched on nearby vegetation waited for few seconds to descend on the rice panicles at regular intervals. Although there were no colonies in the immediate vicinity of this farm, flocks of *P. cucullatus* on the farm had increased to about 2000 birds by 10.00am. An

assessment of the bird damage was conducted on 31 July 2007. Mr Taofeek commenced harvesting the rice on Monday 7 August 2007.

During a second visit (two weeks later, 14 August) to the farm with the second ornithologist though harvesting was in progress, about ¼ of the farm was not yet harvested. Further observations were recorded as the birds consistently raided the rice. The farm was visited at 6.30am before the weaver birds started flying around. The farm was weedy. Increased numbers of weaver birds (>40 birds attacking the rice) and two breeding colonies consisting approximately 45 nests about 300 metres from the feeding site were noticed. The birds used the tall broad leaf and grass weeds and scrubs within the rice as perches from which they moved onto the rice panicles to feed. A minimum population of 150 *P. cucullatus* was estimated, with a maximum population of 2,200 were attacking the rice. It was really tasking for the bird scarers to keep the birds away, because they were persistently raiding the farm from different directions. The farmer also acknowledged the Village Weaver as a very serious pest; he opined that they inflicted damage by plucking rice seeds from panicle and consuming them. Human bird scaring was the most effective method of control in his opinion. He did not apply 'juju' to deter birds from his field but engaged four human bird scarers for 35 days at the rate of N500/person/day. During that period the scarers should be on the field from 7am to 7pm. Catapult and slings were the prime equipment used to scare birds (Plate 1). Some other gadgets used included scarecrows, old video tapes tied to stakes, metal rod tied to a gong both fixed to a stake producing sound when windy. Rice lodging was observed in about 20% of the farm.

Plate 1. Bird scarer at Agbajege with a sling; equipment used in bird scaring. Old cassette wound around tall pole in the background is also used in bird scaring. Note the weedy farm.

Pastor' Adenekan's 10.2ha Nerica 1 farm at Moloko-Asipa was quite accessible from the main road. The land was left fallow since 1997 (i.e. 10 years fallow). He intends to grow rice there again for the 2008 cropping season. The farm is a family holding. Although he occasionally employed labourers whose pay was □500/day/person, land preparation was mechanized. The land was ploughed and harrowed twice though a tractor was not available promptly. He applied pre- and post-emergence herbicides, but the farm was overtaken by weeds. According to the staff, the herbicide used did not work properly. The most conspicuous and most perched on weed was *Panicum maximum.* Additionally, he recruited 5 labourers engaged in the maintenance of his farm for a period of eight months. The labourers were accommodated and fed. At the end of the eight month each labourer will be presented with a bicycle. In addition, eight bird scarers were engaged on the farm, fed and paid □200 daily. The total numbers of *P. cucullatus* persistently raiding this rice field was estimated at 278-2000 individuals. The birds perched on elephant grasses within the ripening rice and nearby trees and shrubs from where they alighted on the rice and damaged the grain. Damage by ''pinching'' (squeezing a grain with the beak to force the milky content into the mouth) was severe. There were six active breeding colonies on oil palms in the surrounding forest. There were many more oil palms, trees and shrubs which provided good nesting sites for the weavers as well as perches from which the birds repeatedly descended on the rice crop. It was very difficult for the scarers to chase the birds off the farm with shouts and catapult. Although the scarers did a lot of work chasing the birds from the rice farm the birds

persistently change direction to different parts of the farm when chased. The birds stopped attacking the rice during heavy rain, but resumed as soon as the rain stopped. A scarecrow was mounted on the farm. No juju was applied. Harvesting commenced on 25 September 2007.

Two Ofada rice farms owned by Mr Sikiru Popoola at Lufoko village were 3.5ha and 2.5 ha respectively (Table 1). He is a beneficiary of cultivated land allotments transmitted by inheritance. Both fields were planted during late April 2007. Planting was done by a gang of 18 labourers working for seven days from 24 August 2007. The labourers were his employees throughout the cropping season, accommodated and fed. Family members occasionally participate in important farm operations. Land preparation was mechanized, and herbicides, supplemented by manual weeding, were used. He applied fertilizers at maximum tillering and booting stages of the rice. The field was relatively clean, with few noticeable shrubs. Village Weavers were present in mixed breeding colonies with Vieillot's Black Weavers *Ploceus nigerrimus* on Oil Palm trees 50-100m away from the fields. A minimum population of 95 *P. cucullatus* was estimated, with a maximum population of 250 were attacking the rice persistently. Six bird scarers were engaged in chasing the birds on the 3.5 ha and four on the 2.5 ha. Because pebbles were scarce on this farm, bird scarers applied ingenuity by rolling clayey soil into balls and baking them. Once baked the balls became as hard as stone and were used in catapults to shoot birds foraging on the rice crop. A scarecrow was mounted in one of the farms. This was made by putting together pieces of wood into a human shape and mounting worn clothing on the structure to mimic the presence of a human being on the farm. A piece of metal was hung on a 1m peg driven into the ground in one corner of the farm. The sound produced by striking the metal temporarily scared the birds away. No juju was used.

Village Weavers and Vieillot's Black Weavers were observed causing damage at the maturity stage of the crop. Where five Vieillot's Black weavers were observed taking rice, large flocks of Village Weavers numbering 250 were observed taking rice on the farms. Black-and-White Mannikins *Spermestes bicolor* were observed taking rice at milky and soft dough stages. Damage assessments were conducted on the two farms on 25 August 2007 while harvesting started on 10 September 2007. Three mist nets installed early in the morning of 16 August 2007 caught four Village Weavers *Ploceus cucullatus*. Of the three males; two were adults of 39gms and 36gms respectively; the third was an immature male of 32gms. The one female was of 42gms. The mist net exercise ended after about two hours. One immature male Red-

headed Quelea *Quelea erythrops* was also caught in the mist net. The mist netting exercise enhanced identification and enabled the reproductive status of the birds to be assessed. The children were however disappointed that we released the birds after morphometric measurements. The birds according to them would have served as a small meal.

Mr Nojimu Oguntola's 5 ha farm was situated alongside the service road at Ayiwere village. His labour force included four men employed, accommodated and fed throughout the cropping season. Family members occasionally participated in crucial farm operations. Land preparation was mechanized, being ploughed and harrowed twice. Pre- and post-emergence herbicides plus supplemental manual weeding were used. He also applied fertilizers at maximum tillering and booting of the rice. He envisaged continuous Ofada rice planting on the same land. Planting by 8 men commenced on 17 May 2007 and was completed in two days. The farm had no noticeable shrubs or weeds growing among the rice, except for four old Oil Palms *Elaeis guineensis*. Eight more oil palms grew in the vicinity of the farm. Village Weavers regularly perched on the oil palms within the farm when chased off the rice. On 8 September 2007, 90 – 250 individual Village Weavers were raiding the farm persistently. Eight men armed with catapults had started scaring birds since 15 August. No juju was applied. Harvesting started on 14 September 2007. A colony of Village Weavers was located about 600 metres away at Mosunmore village.

Table 2. Estimated percent loss caused by birds in selected Ofada rice farms in Yewa North LGAs of Ogun State.

Farm No & hectare	Farmer	Farm Location, Altitude & Coordinates	Damage Assessment Date. (2007)	Estimated Per cent loss to birds. (%)
1 (Ofada), 2.0 ha	Alhj Rabiu Adesina	Iboro 422ft (128.6m) 07°06.746'N003°04.230'E	28 August	18
2 (Ofada), 2.2 ha	Mr Suleiman Tairu	Iboro 384ft (117.0m) 07°06.826'N003°03.872'E	28 August	13
3 (Ofada), 3.7 ha	Mr Jimoh Tairu	Iboro 332ft (102.2m) 07°07.834'N003°04.731'E	28 August	23
4 (Ofada), 9 ha	Mr Isaac Idowu	Agbanu 493ft (150.3m) 07°07.715'N003°05.220'E	31 July	20
5 (Ofada), 1.5 ha	Mr Lukuman Jimoh	Iwoye 324ft (98.8m) 07°07.797'N003°04.548'E	7 September	8

Alhaji Rabiu Adesina's 2ha farm was planted from 7 May 2007 for 3 days. Land preparation, weeding and other essential farm maintenance up to harvest were manual. No chemical fertilizers were used, and there was no herbicides application. Lots of shrubs were seen in the field during a visit to the farm on 15 July 2007. Fewer shrubs were present following weeding one month later (14 August). He applied juju and employed two guards to scare birds.

Mr Suleman Tairu's 2.2 ha farm was planted from 16 May 2007 for 7 days. Land preparation and farm maintenance were manual. There were no application of chemical fertilizers and herbicides. Rice was stunted, tillering was poor in about ¼ of his farm and there were many shrubs on his farm. Juju was used but he also personally guarded his field equipped with a catapult used to shoot stones at the birds. Two additional bird scarers were observed on the farm. The juju which appeared like a piece of cloth (brown-black) tied into a knot and fixed in between a slit in a four 0.5-0.9m sticks fixed to the ground at the four corners of the field and the fifth in the centre. According to Mr Suleiman Tairu, an enthusiastic proponent of juju, the juju should be applied at night (no moon light) before the rice started to boot. On his return from the field after installing the juju, he should sneak into his house and should not see or talk to anybody because members of his household should be in bed sleeping. There must be no cutting of wood, no shouting, no human defaecation, and no menstruating female working in the farm. He claimed the birds will overfly a juju protected farm because the juju stops them from seeing it. He said the total cost of materials for the juju was ₦2-3,000. He

inherited the juju preparations from his father. He usually prepares and installs the juju for his customers at a cost of ₦3, 500. A damage assessment was done on 28 August 2007.

Mr Jimoh Tairu's farm was planted from 7-10 May 2007 by manual labour. He paid ₦3, 800 for 6, 8, and 10 men for land preparation, planting, and weeding respectively. A portion of the land sloped gently down to a valley. Juju was installed at the four corners and one at the centre of the farm. Three men were observed scaring. Village Weavers were the prime culprits, flocks of up to 50 birds continually raiding the farm while it was being assessed for damage on 28 August 2007.

Mr Isaac Idowu's 9 ha farm situated at Agbanu village was planted by 16 individuals over a period of four days starting on 30 March. Land preparation was manual and the farmer did not apply juju, fertilizers or herbicides. The land had been left fallow for maximum of three years and there were still many shrubs and logs of wood not yet removed. Village Weavers were the most important bird pest. Large flocks of 50-150 birds were descending at regular intervals upon the maturing rice. Chased from one place by the six men birds scarers, the birds moved to another part of the same farm. Grass-cutter, a rodent pest of rice and a bush meat delicacy, was trapped by setting leg holding traps strategically around the periphery of his farm. He usually collected an average of one Grass-cutter per day, boosting his economic situation.

Mr Lukuman Jimoh's farm employed 4 men from 10-12 May 2007 to plant his farm at Iwoye village. The land preparation, planting and weeding were manual. No chemical fertilizers or herbicides. He applied juju and also guard the farm during ripening of rice.

Table 3. Estimated percent loss caused by birds in selected Ofada rice farms in Lekki LGAs of Lagos State.

Farm No & hectare	Farmer	Farm Location, Altitude & Coordinates	Damage Assessment Date. (2007)	Estimated Per cent loss to birds. (%)
1 (Ofada), 5 ha	Alhja Taibat Bakare	Ise 15ft (4.57m) 06°26.209'N004°12.055'E	19 August	13
2 (Ofada), 4 ha	Alhj Olatunji Balogun	Ise 15ft (4.57m) 06°26.373'N004°12.713'E	26 August	17
3 (Ofada), 3 ha	Mr Ganiyu Alabi	Ise 15ft (4.57m) 06°26.370'N004°12.618'E	26 August	15

The investigation left high ground of Ogun State and reached the coastal low land of Lagos State as indicated in the elevation figures (Tables 1 & 2 contrasted with Tables 3).

Planting of rice on Alhaja Taibat Bakare's farm was on 17 April 2007. This was preceded by manual slashing and tilling the soil. Land preparation was not thorough because most of the underbrush, and palms (oil and raphia palms) fronds cut down earlier were not removed from the farm. There was evidence of a power saw having been used to cut timber. The workforce was paid a lump sum for the whole season rather than on daily basis. Tree stumps, weeds shrubs and logs of wood provide perches from where birds descended on the rice. Many more also used the surrounding forest to roost and regularly forage from the farm. No juju was used. The estimated losses due to the birds in Farms 2 and 3 were each higher than Farm 1. However, bird damage level between the three farms was not significantly (>0.05) different at 5%.

Because of the difficulty of working in Lekki LGA, Lagos where farms had to be accessed by canoe, two out of the five farms which were earlier selected for damage assessment were missed.

Table 4. Estimated percent loss caused by birds in selected Ofada rice farms in Osun LGA: Osun State.

Farm No	Farmer	Farm Location, Altitude & Coordinates	Damage Assessment Date	Estimated Per cent loss to birds. (%)
1 (Ofada), 6 ha	Alhj Bisiriyu Olatunberu	Oriade ward 1 1088ft (331.62m) 07°33.106'N004°52.234'E	5 August	18
2 (Ofada), 3ha	Mrs Felicia Oni	Akola ward 1 987ft (300.84m) 07°31.195'N004°51.378'E	5 August	22
3 (Ofada), 2 ha	Mr Segun Fowowe	Odo-oni 914 ft (278.59m) 07°32.707'N004°53.552'E	5 August	20
4 (Ofada), 4 ha	Mr Oladeji Adeyekun	Okeoni 943 ft (287.42m) 07°32.180'N004°53.495'E	5 August	19
5 (Ofada), 1 ha	Mr Karimu Ayodele	Okeoni 988ft (301.14m) 07°31.129'N004°53.609'E	Not done	-

In Table 4 the estimated loss figures due to the birds in Farms 1, 2, 3 and 4 were not significantly different from one another at 5% level of probability

Farm 1 was very well maintained but a portion was intercropped with maize. Planting was accomplished from 22-25 April 2007 by average of eight men. Chemical fertilizers were applied There was very little scrub and the farm was adequately weeded. There were a few tree stumps and maize was planted within and around the periphery of the farm. Bird pests were present (48-85 Village Weavers), and bird damage were observed. Six old nests of Village Weavers were sighted on an oil palm and just before departure 2 Village Weavers flew over the old colony. No juju was applied but the farmer and his three children had been regularly on guard against the birds.

Farm 2 was sufficiently weeded and maintained but maize was planted within the rice and there were tree stumps. A sizeable area of maize had been interplanted with the rice. Chemical fertilizers were used. Village Weavers (55-123 individuals) were ubiquitous and continually raided the field. No juju was used.

In Farm 3 (Table 4) planting was done on 4 April by 6 men for a period of 11 days. Weeding and chemical fertilization were subsequently applied. The land had been fallow for 5 years.

Maize was also planted sparingly within the rice crop. Village Weavers were seen foraging within the rice farm. Bird scaring started in earnest from 3 July.

Mr Adeyekun's field employed 8 manual labourers working for 3 days to plant his farm from 15 May 2007. Maturing maize plants dotted his rice farm. He installed juju and also guarded his farm.

Damage assessment on Farm 5 (Table 4) could not be done because the Institute lawyers advised the survey team not to return to Osun State consequent upon the armed robbery attack which occurred during this contractual assignment with PrOpCom.

Table 5. Estimated percent loss caused by birds in selected Ofada rice farms in Ifaki-Ekiti and Igbemo : IDO/OSI LGA Ekiti State.

Farm No	Farmer	Farm Location, Altitude & Coordinates	Damage Assessment Date	Estimated Per cent loss to birds. (%)
1 (Nerica 1), 2 ha	Mr J. K. Ojo	Igboluwa Ifaki –Ekiti 1814 ft (552.91m) 07°45.233'N005°14.395'E	5 September	11
2 (Nerica 1), 2.5 ha	Mr Tayo Akinola	Igboluwa Ifaki –Ekiti 1772 ft (540.11m) 07°45.315'N005°14.300'E	5 September	16
3* (Nerica 1), 2.5 ha	Mr J. K. Ojo	Osunponri Ifaki –Ekiti 1793 ft (546.51m) 07°46.059'N005°14.476'E	Not done	Unripe
4* (Ofada), 0.6ha	Mr. S. A. Ojo	Osunpori Ifaki –Ekiti 1804 ft (549.86m) 07°45.670'N005°14.462'E	Not done	Unripe
5 (Ofada), 2 ha	Mr. Musa Lamidi	Igbemo Ijabo 1239 ft (377.65m) 07°40.698'N005°24.060'E	2 August	4
6 Ofada (ITA 50) 4 ha	Mrs Kalitumu Musa	Igbemo Ijabo 1342 ft (409.04m) 07°41.02'N005°24.469'E	2 August	11

Mr J. Kehinde Ojo's farm (Farm 1) planted during 10-17 May 2007 to Nerica1 at Igboluwa. The planting was done manually. He used folial fertilizer (Boost Extra) as well as pre- and post-emergence herbicides with supplemental hand weeding. He said Ofada rice was not common in his village. He used and displayed the most elaborate juju on his farm.

Ten persons planted manually for Mr Akinola (Farm 2) on the land he rented for □2,500. He applied a folial fertilizer (Boost Xtra). This was his first cultivation of Nerica 1. He said local varieties are good yielders but lodges. He did not apply juju to deter birds.

Mr S. A. Ojo's farm (Farm 4) and Mr J. K. Ojo's second farm (Farm 3) could not be done because when farms nearby were ripe and assessed both farms were not yet ripe. Additionally, organizing a return to his farm a third time presented an insurmountable logistical problem.

Mr Musa Lamidi's planted his farm on 28 April 2007. Sizeable number of maize interplanted with his rice farm. He started scaring birds on 5 July 2007. Flocks of *Q. erythrops* were sighted raiding his farm at 9.15am on 20 July 2007. He did not use juju.

Mrs Kalimutu Musa planted the field on 15 April with manual labour and started bird scaring on 15 June 2007. Maturing maize was observed in the farm.

3 .2 Transect Assessment Surveys

Table 6. Estimated percent loss caused by birds during Ofada rice Transect assessment survey at Ewekoro and Abeokuta North LGAs of Ogun State.

Farm No & hectare	Farmer	Farm Location & Coordinates	Damage Assessment Date. (2007)	Estimated Per cent loss to birds. (%)
1 (Ofada), 1.0 ha	Mr Bankole Bamgbopa	Abule Taiwo 480ft (146.30m) 07°08.349'N003°05.031'E	30 August	12.
2 (Ofada), 1.6 ha	Mr Gbenga Adewale	Abule Taiwo 471ft (143.6m) 07°08.559'N003°05.423'E	30 August	12
3 (Ofada), 2.0 ha	Mr Idowu Elegbede	Agbanla 243ft (74m) 07°05.204'N003°14.120'E	10 September	9
4 (Ofada), 2.0 ha	Mr Jimoh Olalekan	Agbanla 259ft (78.9m) 07°05.328'N003°13.905'E	17 September	15
5 (Ofada), 1.5 ha	Mr Sunday Sosah	Akinbiye 127ft (38.7m) 07°04.889'N003°15.145'E	19 September	26
6 (Ofada) 1.0	Mr Ganiyu Koku	Akinbiye 90ft (27.4m) 07°04.682'N003°15.243'E	19 September	15

Farm 1 cultivated by Mr Bankole Bamgbopa was family land which he had consecutively cropped for 3 years. He employed five men to plant manually on 15 May. No chemical fertilizers and herbicides application were made. He employed four men to guard the field

against birds. He denied using juju but the stakes with the juju attached was later discovered at the edges of the farm. According to him, because of lack of portable water in the village to process rice, farmers resorted to selling rice as paddy in basket. Last year the price was □7,000/basket of about 1.5kg and this year it was being sold for □- 5,000/basket. There were weeds and shrubs within the farm. He planted cassava along the edges of the farm on which Village Weavers were observed perched (Plate 2)

Plate 2. Farmer in his rice farm interplanted with cassava along the edges a staging perches for birds which attack his farm.

Mr Gbenga Adewale had been growing rice on his farm since 2004 but will shift next year. One week was expended on planting, as from 30 April. No applications of chemical fertilizers or herbicides were made. There were scattered shrubs and scrub within his farm. Three individuals scare birds and no juju was used. During discussions he retorted that his catapult was his juju.

The highlight of Mr Idowu Elegbede's farm was that sorghum was planted along the edges of his farm and harvesting had started. There were logs and scrub in the farm. Flocks of 15 Red-eyed Dove *Streptopelia semitorquata,* flew into the farm from surrounding forest.

It took several minutes of persuasion before Mr Sunday Sosah's farm (Farm 5) could be assessed. He had paid the sum of □12,000 to cultivate the 2.5ha out of which he cropped 1.5ha Ofada rice. He believed that some ''unknown forces'' adversely affected his farm. His farm just like many others was located far in the forest. He employed 13 individuals for 10 days to prepare the land and plant. There were scattered shrubs and logs within the farm and Village Weaver damage was evident. Characteristic ''pinching'' (squeezing a grain with the beak to force the milky content into the mouth) damage observed on the farm Many dark brown to greenish coloured rice empty glumes were observed on the farm.

Plate 3. Log of wood within farm often used by birds as perch to damage rice.

Note rice panicle very close to wood.

Table 7. Estimated percent loss caused by birds in Ofada Transect assessment survey in Ekiti LGA rice farms

Farm No	Farmer	Farm Location, Altitude & Coordinates	Damage Assessment Date	Estimated Per cent loss to birds. (%)
1 (Ofada), 2 ha	Mrs Alice Egunjobi	Ijabo-Ekiti-Igbemo 1346 ft (410.3m) 07°45.233'N005°14.395'E	2 September	3
2 (Nerica 1), 3 ha	Mrs Felicia Olakitan	Ifisin-Okeigbo –Ekiti 1885 ft (574.548m) 07°46.770'N005°12.266'E	5 September	19
3* (Nerica 1), 2.5 ha	Mr Falana Ibikunle	Alayere-Ekiti 1282ft (390.75m) 07°40.117'N005°25.900'E	17 August	16
4* (Ofada), 0.6ha	Mr. Dayo Egunjobi	Ijabo-Ekiti 1356 ft (413.3m) 07°41.423'N005°25.225'E	17 August	17
5 (Ofada), 1.2 ha	Mrs. Victoria Orebe	Ijabo-Ekiti 1323 ft (403.3m) 07°41.402'N005°25.198'E	17 August	23

Mrs Alice Egunjobi's farm was situated on a service road. The farm was manually planted by 6 men during the first week of April 2007 and few stumps dotted the farm. She engaged four of her family members to patrol the farm against birds. She applied juju. She interplanted maize with the rice. No noticeable bird activity was seen at the time of the visit.

The one way ANOVA performed indicated that the average estimated per cent loss to birds among the Farms 1-5 (Table 7) were significantly different ($P<0.05$). Furthermore, Farm 1 (Mrs Alice Egunjobi), the least damaged, differed significantly from the other farms.

Mrs Felicia Olakitan's was planted by an average of 7 hired labour working for 1 week. Oil palms growing within the farm made the attack on the farm more severe. Rice seed was collected from the ADP (Agricultural Development Project). Pre- and post-emergence herbicides and supplemental hand weeding were used. The land which was cultivated for the first time was incompletely cleared with tree stumps and shrubs competing with rice. Flocks of about 15 Black-and-White Mannikins *Spermestes bicolor* perched on twigs within the farm and descended on the rice panicles to feed. Another mixed flock of Bronze Mannikin (Spermestes cucullata) and Black-and-white Mannikin (*Spermestes bicolor)* was later sighted perched within the farm. The foraging activities of 85-1,200 Village Weavers on the farm

was most severe. Damage by ‘’pinching’’ was severe with dark-green colouration on some grains, probably as a result of bacterial or fungal infestations. She engaged two individuals (her son and his wife) to scare birds.

Plate 4. A colony of village weaver bird, when located within or near rice farm aggravates damage.

Mrs Victoria Orebe’s land was not well prepared, many tree stumps were not uprooted and all the edges of the farm were closely surrounded by forest. She engaged four bird scarers.

3. 3 Bird scaring efficiency

Table 8: Labour utilization for one hectare of Ofada rice farms in the study area

Activity	Quantity (mandays)	Wage Rate (N)	Cost (N)
Land preparation	10	300	3000
Planting	5	250	1250
Fertilizer application	2	250	500
Herbicide application	2	250	500
First weeding	8	350	2800
Second weeding	8	350	2800
Bird scaring	60	250	15000
Harvesting	10	200	2000
Threshing & winnowing	10	200	2000
Bagging & Transportation	5	200	1000
Total	120		30850

Source: Field Survey, 2007*

Based on the labour input data collected from 10 farmers in 2 States (Ekiti and Ogun), bird scaring is carried out for an average of 30 days from the flowering to harvest. This requires an average of two persons, working for 12 hours a day at a cost of N250 each per day per hectare that is N15, 000 is required for bird caring on one hectare. This means that labour for bird scaring accounts for half (60/120) of the total quantity of labour for rice production and contribute 49% (₦15000/₦30850 X 100) to the cost of labour per hectare of rice farm (Table 8).

Rice field protected with juju were visited by farmers for surveillance at an average of 2hrs a day for a period of thirty days. Since daily wage of 12 hours is N250, two hours of surveillance for 30 days (i.e. 60 hours) will cost N1,250. It should be noted that farmers do not pay for surveillance. The cost of local juju is N200.00 each, five of which is installed per hectare of rice farm. That is N1000.00 is required to protect one hectare. This brings the total sum required to N2, 250.00 to protect one hectare of rice farm.

Damage assessment data were completed on a total of 32 farms were across 2 Local Goverment Areas of Ogun, 1in Ekiti, Osun and Lagos States. Two farms were completed in the month of July, 19 farms in August and 11 in September. The estimated percent loss of Ofada rice to birds between the months of July, August and September did not differ significantly ($P > 0.05$). There was no evidence from our study to show that early planted fields suffered less damage than late planted ones.

Plate 5. Male and female village weaver birds: The most notorious bird on Ofada rice farms.

3.4 Birds observed in the rice farms

A total of 85 bird species belonging to 33 families were recorded in and around Ofada rice farms in the area (Annex 2).

Of these birds, some members of the family Ploceidae, namely, Village Weaver *Ploceus cucullatus*, Vieillot's Black Weaver *Ploceus nigerrimus* as well as one member of Estrildidae, Black and white Mannikin *Spermestes bicolor* were the birds that were observed feeding on the rice. One Red-headed Quelea *Quelea erythrops* were mist-netted in rice farm at Lufoko village, Obafemi-Owode LGA Ogun State, while eight Village Weavers *P. cucullatus* were mist-netted in the same site. One Red-headed Quelea *Quelea erythrops* was mist-netted while flying out from the same farm. *Quelea erythrops* has been implicated in literature to cause damage to rice but was not observed consuming rice except at Igbemo in Ekiti State.

The other birds, namely, Red-billed Firefinch *Lagonosticta senegala*, Orange-cheeked Waxbill *Estrilda melpoda* were seen in the rice farms but were not observed consuming rice. Tawny-flanked Prinia *Prinia subflava* were also recorded in rice farms but were not observed feeding on the rice. Helmeted Guineafowl *Numida meleagris* and Double-spurred Francolins *Francolinus bicalcaratus* were flushed out from a few farms but were also not observed feeding on the rice.

3.5 Bird scaring methods used for Ofada rice.

Bird scaring methods observed employed by Ofada rice farmers include:

Mechanical method: A piece of metal was hung on a 1m peg driven into the ground in one corner of the farm. The sound produced by striking the metal temporarily scared the birds away.

Use of catapult and sling: These are used to shoot stones at the birds. At a farm Ogun State where stones were scarce, young children were observed rolling clayey soil into balls and baking on fire the earth balls. Once baked, the balls became as hard as stone and were used in catapults to shoot birds foraging on the rice farm.

Plate 6. Moulding and baking clay used as missiles in catatapult against birds

Scarecrows: Scarecrows were mounted on farms. This was made by putting together pieces of wood into a human shape and mounting worn clothing on the human shaped structure to mimic the presence of a farmer on the farm.

Shouting and Clapping of hands: On most farms family members and bird scarers engaged in scaring the birds by going in and around the rice farm and shouting and clapping hands especially when flocks of weavers were seen flying on to the rice crop.

Use of waste videotapes

Some farmers tied old videotapes to stakes round the periphery and crisscross the farm. The videotape vibrated under the wind pressure and the humming sounds produced as a result of the vibration deter birds.

Use of juju: In addition to the scarers the farmers also employed the use of juju for scaring the birds away from the farms. A piece of cloth rolled and tied into a knot, fixed in between the slit at the end of a stick drilled into the ground at the four corners of the farm and one at the centre of the farm.

Plate 7. Juju stake in harvested farm protected for reuse during next cropping season

The height of the stick above the ground varies between 0.3-1.0m. The preparation and the installation of juju involve a number of outlined taboos. It was believed that the juju make the birds overlook and fly over the farm thus birds' won't forage in such farm.

3. 6 Rice morphology

Detecting morphological traits that may deter birds would be an exacting task in-field. Ofada rice observed lodging factor made it more susceptible to bird damage. It made damage easier for Pigeons and Doves whose weight prevent panicle feeding. Flag leaf which obstruct feeding access to the panicle probably for small birds, and persistent awn that could inhibit feeding could be a useful tool in crop protection but an uphill task with some adaptable bird pests.

The indigenous juju technique involved placing a stake ranging between 0.5m and 1.5m high at the centre and the four corners of rice field.

4. DISCUSSION

The results of our investigations indicated that estimated loss caused by birds to Ofada rice on the field ranged from 3 to 26 per cent. The two most important methods for preventing bird damage in the study area were scaring by individual scarers and the juju method.

The rice fields protected with indigenous bird scaring juju were visited by farmers for surveillance, at an average of two hours a day for a period of thirty days. The average cost of local juju portion was ₦200.00 each, about five of which is required for one hectare of rice field. This implies that about ₦1000.00 is required to protect one hectare of rice from bird. Although farmers do not pay for surveillance, the cost is imputed for two hours of surveillance per day for 30 days is ₦1,250 (since wage paid bird scarer per day of twelve hour is ₦250.00, 2 hours for 30 days (i.e. 60 hours) will cost ₦1,250.00). Thus total amount required to protect one hectare of rice from bird pests using juju was N2, 250.00. The implication was that ₦2, 250.00 was less than ₦15, 000.00 but did not contribute to effectiveness because it was difficult to identify a farmer that used only juju without supplementing human scaring. During this study the estimated bird damage loss in all farms where juju was used compared with where human bird scarers were engaged did not differ significantly ($P > 0.05$). The observed in-field scenario was that where juju was applied, farmers also deployed bird scarers full time. The imputed costs of such scarers were not included in pricing for juju use. In a field at Abule Taiwo, Ogun LGA where transect assessment survey was conducted, juju was used and bird scarers were observed on duty. This was the scenario in almost all the fields where juju was used. However, the main thrust in the present study is to develop a holistic strategy/technology acceptable to the majority of farmers and that will achieve improvements in the overall bird damage management/control

in small scale farmers. The cost of juju compared to brd scaring adds very little (15%) to the overall cost of bird scaring that it makes very little difference. If it makes farmers happier or more confident to use juju, and they know that they have to do bird scaring as well, it only marginally increases their costs.

This investigation was carried out during a 'good rain' year in which there would be a corresponding plentiful natural food supply (wild grass seeds and insects) for the bird pests. In drier year, bird pest pressure on Ofada rice might be higher. It is considered that the results obtained provide a good estimate for years in which rain is plentiful, but may not necessarily reflect the situation in other years. The Village Weaver was undoubtedly the principal bird pest of Ofada rice. This corroborated previous investigations in the same study area (Park, 1974; Funmilayo and Akande, 1974, 1976, 1977). Other potential bird pests included Black-and-White Mannikin, Vieillot's Black Weaver, Red-headed Quelea, and Red-eyed Dove. Flocks of 22-30 Black-and-White Mannikin were observed taking rice off panicle on two farms at Ekiti. One Red-headed Quelea was mist-netted in one farm at Lufoko Ogun State and a flock was seen attacking Ofada rice at Igbemo Ekiti State. Damage by Viellot's Black Weaver could be termed insignificant as the birds were observed taking the crop only once throughout the study period. Five Vieillot's Black weavers were observed taking rice on a farm. They were also recorded in mixed breeding colonies with Village Weavers by two farm boundaries in Ogun State but were not recorded taking the crop in those farms. The other species, namely, Red-billed Firefinch and Orange-cheeked Waxbill, were seen in the rice farms but were not observed taking any rice. Such bird species including Black-and-White Mannikin, damage the ripening crop by ''pinching grains'' (squeezing a grain with the beak to force the milky content into the mouth) in the milky stage, hulling grains in the dough stage and consuming the contents and breaking panicles by perching and feeding. During the damage assessments in a rice farm on 20 September 2007 at Moloko-Asipa, damage by pinching was severe. Plausible explanation would be that the bird during their search for *Panicum* spp wild grasses which had virtually overtaken parts of the rice farm diverted to rice. The birds thus responded to an abundant new food type in their habitat. Reaseach findings indicate that weaver birds would consume rice when available but consumed wild grass seeds and insects in similar proportions when rice was scarce (Bright and Oguyemi 2000). Double-spurred Francolins *Francolinus bicacaratus* were flushed out from a few farms but were also not observed feeding on the rice. These aforementioned species aside from *P. cucullatus* infrequently observed feeding or raiding Ofada rice farms are referred

here as potential pests, because of their relatively lower abundance and scattered distribution, With few exceptions, a major pest is one that is abundant, and the level of damage or depredation is a function of the larger population, which occurs during certain months of the year (Solomon, 1977).

Despite the logistical difficulties during these investigations such as accessibility to farms, reliability of assessors to effectively cover the entire farm and differentiate between bird damage and other damage, the estimated damage level should be considered to represent a reliable order of magnitude. For each field 4 assessors carried out the in-field damage assessment. Clive and Ephraim also carried out damage assessment simultaneously occassionaly with the 4 assessors to compare results. It is noteworthy that fewer farms were assessed in July. Perhaps if more farms had been assessed there would have been a better comparison. Farmers were quickly harvesting their rice during September. During our quest to assess late farms we turned down the request of three farmers to assess their farms at Abeokuta North and two at Ewekoro because rice harvest were virtually completed.

The largest populations of Village Weavers were seen during the study at Lufoko, Moloko-Asipa Ogun State and at Ifisin in Ekiti State. At Lufoko, there were breeding colonies in palm trees totalling about 600 nests. Assuming that all the nests were occupied, about 1,200 birds were involved. In the Red-billed Quelea *Quelea quelea*, it has been estimated (Elliott 1989) that each bird may be capable of destroying about 10g of rice per day (eaten and scattered on the ground). The Village Weaver, at about 40g, is about twice the weight of a Quelea (20g). It might be expected to be capable of destroying 20g/bird/day. If all the locally breeding birds fed on the field, they would be capable of destroying 1,200 X 20 = 24 kg/day. Given that the rice is vulnerable to bird attack for about 30 days, the weavers could theoretically damage 24 X 30 kg = 720 kg. The yield of the Lufoko field was expected to be about 2t/ha and the field was 3ha in size. The local bird population could therefore destroy about 12% of the expected crop, if there was no bird scaring. This indicated that farms that recorded > 12% are not effectively guarded

There are many assumptions in such a calculation. It would be most unlikely that the Village Weavers would only eat rice for the whole of 30 days. Some of the time, they will eat other food including insects. Some of the birds feeding in the fields may have come from colonies further away. The feeding of the birds in the fields is continually being disrupted by bird

scarers. One conclusion from these observations was that the numbers of birds seen in the fields were not sufficient to cause catastrophic damage, i.e. >50%.

The numbers of Village Weavers attacking the rice farm at Moloko-Asipa on 20 September 2007 was estimated to be about 2,000 birds. There seemed to be a congregation of birds that previously raided harvested farms in the vicinity such as farm at Agbajege. It was assumed that juveniles might have joined the population. Although it was raining intermittently, the birds resumed foraging each time the rains stopped. Earlier on 5 September about 1,500 village weaver bird and flocks of Bronze Mannikins and Black-and-White Mannikins persistently raided a farm at Ifisin- Ekiti.

Clearing during land preparation in this forest study area was most complex and tedious where the land must be cleared of forest before cropping can occur. The use of machete could only cut down few trees. Indeed, the few trees available were invariably spared to provide shade while some are economic trees. Such trees, tree and shrub stumps provided good staging perches and roosts from which the birds descended to damage the rice. In continuous cropping, the major land clearing is undertaken only once. This is not the case when most of the Ofada rice farmers continually shift for obvious reasons. The dimension and complexity were dependent on the native vegetation on the land. It is envisaged that as land pressure and technology improve more Ofada farmers would change from shifting cultivation to continuous cropping, and subsequently the importance of land clearing in Ofada rice farming and effect on bird damage would decrease. This would also encourage synchronized rice farming with its attendant advantages. That is, planting and harvesting would be available to the birds for a shorter period of time and the loss spread over a wider area.

A biological control observed in the field which could be exploited was whenever the predator approached a colony all the weaver birds were frightened off uttering distress call. Predator the weaver birds reacted to thus was the African Harrier-hawk *Polyboroides typus*. Man probably remains the most important predator. Young bird scarers that were quite proficient with the catapult often collected Village Weavers for the pot; a subtle population reduction method.

Ofada rice was expected to be grown in monoculture or in rotation with other crops as indicated by many farmers in the study area. They opined that the maize served as food or snack for the bird scarer who would be guarding the field for 30-35 days from dawn to dusk. The adverse effect of growing within the farm scattered stands of maize, sorghum, cassava,

shrubs and scrubs was that it served as staging perches for the bird pest and this was acknowledged by farmers. Sorghum *Sorghum bicolor*, Maize *Zea mays*, Cassava (*Manihot esculenta*) intercrop with Ofada rice is not recommended for the study area. Some of the farms observed were situated on steep slopes which might be prone to erosion problems.

A few farmers were convinced that juju worked well, and said their fields never needed any scaring. None of the farmers could explain adequately how it might work. At UNAAB, some observation of juju had been made but no experimental work on juju had been done in controlled conditions such as cage trials. Cage experiments could be carried out to test the ability of birds to detect the difference between a real juju and a placebo juju. Given that the cost of the juju is low relative to the other costs of production including bird scaring, farmers who wish to use juju should be free to do so, but should be encouraged to use bird scarers as well.

5. RECOMMENDATIONS

- In future studies, the same assessors should be used throughout the field trials instead of hiring different assessors at various farms. This would reduce further bias and error as well as enhance reliability.
- Whenever possible it pays to avoid planting close to established Village Weaver colonies.
- Total elimination of bird damage may become feasible. It is evident that correct proper use of enclosure netting will totally eliminate bird damage. In most situations observed during this study, bird damage can be further reduced by intensifying the effectiveness of the bird scarer. For instance the scarer on a platform pulling ropes with rattles installed crisscrossing the farm and armed with a catapult is likely to be a better threat to the bird pests. Such improvements need to be tested to confirm that they are more effective.
- Farms must be completely cleared of tree stumps, shrubs, logs of wood that provide suitable perches for bird pests from which they damage the rice growing on the farm.
- Train farmers in the technique of integrating/combing physical, cultural and acoustical methods against bird pest that are available but inadequately harnessed in the study area.
- Farmers should consider ‘synchronization of planting and harvesting’ so that the crops would be available to the birds for a shorter period of time and the damage spread over a wider area.

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ANNEX 1

Annex 1: Question format for farmers' interview schedule

Village: …….. LGA: …… State: ……

Name of farmer: ……..

Sex: Male [ ] Female [ ]

Rice farm size: ……. hectare

Variety planted: ……

Planting date: …… Expected Harvesting Date: ……..

Have you encountered bird pest problem on your rice field? Yes [ ] No [ ]

If yes, which stage of rice growth did you encounter severe bird damage?

…….

How did you protect your rice field from bird damage? …….……...……..
……

……

Did you use human beings to scare birds? Yes? Yes [ ] No [ ].

If yes, how many individuals/scarers did you engage on your farm and how much did you pay each individual?

How long did you engage them for? Days [ ] months [ ]

Did you have to supervise them? No [ ] Yes [ ]

Did you apply juju to prevent bird damage to your rice crop?

Which species of bird did you observe as most damaging? ……..

At what time of the year growth stage of rice did the birds commence attack and damage to your crop?

Is your farm a private or freehold property? Yes [ ] No [ ]

If No, how much did you lease/rent it for and for what period of time?

Did your farm lie fallow after some years of cultivation for land regeneration?

Did you cultivate this land on which you planted rice this year, last year?

Will you plant rice on this farm next year?

How many bags of paddy can you obtain from your rice field this year? ……

What is the current price of rice paddy in this area? ……. (Naira per bag)

What was the price immediately after harvest last year? …….. (Naira per bag)

Labour utilization

Activity	Number of persons employed	Number of days worked	Number of hours per day	Amount paid (Naira)
Land preparation Planting Fertilizer application Herbicide First weeding Second weeding **Bird scaring** Harvesting Threshing & winnowing Bagging & Transport Others (specify)				

Annex 2: Checklist of the bird species recorded during the empirical study of bird damage

PHALACROCORACIDAE

Long-tailed Cormorant *(Phalacrocorax africanus*)

ARDEIDAE

Cattle Egret (*Bubulcus ibis*)

Green -backed Heron (*Butorides striatus*)

ACCIPITRIDAE

African Cuckoo Hawk (*Aviceda cuculoides*)

Black-shouldered Kite (*Elanus caeruleus*)

Black Kite (*Milvus migrans*)

Palm-nut Vulture (*Gypohierax angolensis*)

African Harrier-hawk *(Polyboroides typus*)

Lizard Buzzard *(Kaupifalco monogrammicus)*

FALCONIDAE

Common Kestrel *(Falco tinnunculus)*

PHASIANIDAE

Scaly Francolin *(Francolinus squamatus)*

Double-spurred Francolin *(Francolinus bicalcaratus)*

Helmeted Guineafowl *(Numida meleagris)*

RALLIDAE

White-spotted Flufftail *(Sarothrura pulchra)*

COUMBIDAE

African Green-pigeon *(Treron calva*)

Bruce's Green-pigeon *(Treron waalia)*

Tambourine Dove *(Turtur tympanistria)*

Blue-spotted Wood-dove *(Turtur afer)*

Western Bronze-naped Pigeon *(Columba iriditorques*)

Red-eyed Dove *(Streptopelia semitorquata)*

Laughing Dove *(Streptopelia senegalensis)*

PSITTACIDAE

Grey Parrot *(Psittacus erithacus)*

MUSOPHAGIDAE

Green Turaco *Tauraco persa*

Western Grey Plantain-eater *(Crinifer piscator)*

CUCULIDAE

Black Cuckoo *(Cuculus clamosus)*

African Emerald Cuckoo *(Chrysococcyx cupreus)*

Klaas' Cuckoo *(Chrysococcyx klaas)*

Didric Cuckoo *(Chrysococcyx caprius)*

Senegal Coucal *(Centropus senegalensis)*

Blue-headed Coucal (*Centropus monachus)*

APODIDAE

African Palm-swift *(Cypsiurus parvus)*

COLIIDAE

Speckled Mousebird *(Colius striatus)*

ALCEDINIDAE

Grey-headed Kingfisher *(Halcyon leucocephala)*

Woodland Kingfisher *(Halcyon senegalensis)*

MEROPIDAE

Little Bee-eater *(Merops pusillus)*

CORACIIDAE

Broad-billed Roller *(Eurystomus glaucurus)*

BUCEROTIDAE

African Pied Hornbill *(Tockus fasciatus)*

Piping Hornbill *(Bycanistes fistulator)*

CAPITONIDAE

Naked-faced Barbet *(Gymnobucco calvus)*

Red-rumped Tinkerbird *(Pogoniulus atroflavus)*

Yellow-throated Tinkerbird *(Pogoniulus subsulphureus)*

Yellow-rumped Tinkerbird *(Pogoniulus bilineatus)*

Yellow-fronted Tinkerbird *(Pogoniulus chrysoconus)*

PICIDAE

Fire-bellied Woodpecker *(Dendropicos pyrrhogaster)*

HIRUNDINIDAE

Ethiopean Swallow *(Hirundo aethiopica)*

White-throated Blue Swallow *(Hirundo nigrita)*

MOTACILLIDAE

Yellow-throated Longclaw *(Macronyx croceus)*

PYCNONOTIDAE

Little Greenbul *(Andropadus virens)*

Slender-billed Greenbul *(Andropadus gracilirostris)*

Simple Greenbul *(Chlorocichla simplex)*

Swamp Palm Greenbul *(Thescelocichla leucopleura)*

Honeyguide Greenbul *(Baeopogon indicator)*

Common Bulbul *(Pycnonotus barbatus)*

Western Nicator *(Nicator chloris)*

TURDIDAE

African Thrush *(Turdus pelios*)

SYLVIIDAE

Red-faced Cisticola *(Cisticola erythrops)*

Whistling Cisticola *(Cisticola lateralis)*

Kemp's Longbill *(Macrosphenus kempi)*

Green Hylia *(Hylia prasina)*

Tawny-flanked Prinia *(Prinia subflava)*

Grey-backed Camaroptera *(Camaroptera brachyura)*

Yellow-browed Camaroptera *(Camaroptera superciliaris)*

MONARCHIDAE

African Paradise-flycatcher *(Terpsiphone viridis)*

NECTARINIIDAE

Variable Sunbird *(Cinnyris venustus)*

ORIOLIDAE

Black-winged Oriole *(Oriolus nigripennis)*

MALACONOTIDAE

Sabine's Puffback *(Dryoscopus sabini)*

Black-crowned Tchagra *(Tchagra senegala)*

CORVIDAE

Pied Crow *(Corvus albus)*

DICRURIDAE

Fork-tailed Drongo *(Dicrurus adsimilis)*

PASSERIDAE

Grey-headed Sparrow *(Passer griseus)*

PLOCEIDAE

Vieillot's Black Weaver *(Ploceus nigerrimus)*

Village Weaver *(Ploceus cucullatus)*

Yellow-mantled Weaver *(Ploceus tricolor)*

Blue-billed Malimbe *(Malimbus nitens)*

Crested Malimbe *(Malimbus malimbicus)*

Red-vented Malimbe *(Malimbus scutatus)*

Red-headed Malimbe *(Malimbus rubricollis)*

Red-headed Quelea *(Quelea erythrops)*

ESTRILDIDAE

Grey-crowned Negrofinch *(Nigrita canicapilla)*

Chestnut-breasted Negrofinch *(Nigrita bicolor)*

Pale-fronted Negrofinch *(Nigrita luteifrons)*

Red-billed Firefinch *(Lagonosticta senegala)*

Orange-cheeked Waxbill *(Estrilda* melpoda)

Bronze Mannikin (*Spermestes cucullata)*

Black-and-white Mannikin (*Spermestes bicolor)*

VIDUIDAE

Village Indigobird (*Vidua calybeate)*

Pin-tailed Whydah *(Vidua macroura)*

ANNEX 3

List of key informants and farmers in the Ofada rice producing areas who were met and helpful during the study.

S/n	Location	Contact	Phone	Activity
1	Ogun State Agric Dev.Programme Abeokuta	Pastor Bode Adenekan	08055284349	Chairman (RIFAN) Ogun State.
2	RIFAN Oshun State	Mrs Salawu	08032239192	Chairperson (RIFAN) Osun State.
3	ErinOke Osun State	Mrs Tawakalitu Adepetu	08066744977	Woman Leader, Osun State RIFAN
4	ErinOke Osun State	Mr E. Orogun Falase		RIFAN Secretary ErinOke Osun State
5	ErinOke Osun State	Mrs Nusiratu Oyinlola		RIFAN member ErinOke Osun State
6	Farmers' field at Ifaki	Mr. Joseph Kehinde Ojo	H55 Ilero St.	Farmer
7	Ifaki-Ekiti	Mr. S. A. Ojo	08028760001	RIFAN Chairman Ekiti
8	Farmers' village at Igbemo	Mr Oluyede Lere Samuel		Farmer, Financial Secretary RIFAN
9	UNAAB	Prof Akin Omotayo	08037223311	Director AMREC
10	Ise Lagos State	Mr Aro	08030983860	Farmer, Balogun, Ise Lagos State
11	Iboro, Ogun State	Mr. Adams Elegbede	08060173041	Farmer
12	Moloko-Asipa Ogun State	Mr G. F. Olonode	08037194135	Farmer

ANNEX 4

Year	Month	Day	State	Area	Farmer's name	Asses-sor	Dam-bag	DBag	Nodam-Pan	UND Bag	Udam+ bag	Nounda-pan	DWT	UNDWT	1DWT	1NDWT	TOTAL pan	Est%loss	
2007	7	31	Ogun	Agbajege	Mr Taofeek Soremi	1	220	75	126	60	450	68	145	390	1.150794	5.7352941	194	13.031989	
2007	7	31	Ogun	Agbajege	Mr Taofeek Soremi	2	185	60	62	124	810	132	125	686	2.01612903	5.1969697	194	12.398185	
2007	7	31	Ogun	Agbajege	Mr Taofeek Soremi	3	200	65	123	180	560	233	135	380	1.09756098	1.6309013	356	23.251774	
2007	7	31	Ogun	Agbajege	Mr Taofeek Soremi	4	200	60	44	120	1210	194	140	1090	3.18181818	5.6185567	238	10.469509	
Total									355			627	545	2546	1.53521127	4.0606061	982	13.66766	
Mean									88.75			156.75	136.25	636.5	1.53521127	4.0606061	245.5	13.66766	13.7
2007	7	31	Ogun	Agbanu	Mr Isaac Idowu	1	240	60	80	128	650	110	180	522	2.25	4.7454545	190	19.963702	
2007	7	31	Ogun	Agbanu	Mr Isaac Idowu	2	200	60	61	60	700	133	140	640	2.29508197	4.8120301	194	14.996778	
2007	7	31	Ogun	Agbanu	Mr Isaac Idowu	3	250	60	86	60	550	84	190	490	2.20930233	5.8333333	170	19.159664	
2007	7	31	Ogun	Agbanu	Mr Isaac Idowu	4	240	60	80	60	380	58	180	320	2.25	5.5172414	138	23.641304	
									307			385	690	1972	2.247557	5.1220779	692	19.466901	
									76.75			96.25	172.5	493	2.247557	5.1220779	173	19.466901	19.5
2007	8	2	Ekiti	Igbemo	Mr Musa Lamidi	1	80	65	3	240	2020	240	15	1780	5	7.4166667	243	0.832293	
2007	8	2	Ekiti	Igbemo	Mr Musa Lamidi	2	150	65	34	65	1500	202	85	1435	2.5	7.1039604	236	5.0699817	
2007	8	2	Ekiti	Igbemo	Mr Musa Lamidi	3	150	64	40	136	1040	134	86	904	2.15	6.7462687	174	7.3263147	
2007	8	2	Ekiti	Igbemo	Mr Musa Lamidi	4	100	65	16	67	500	64	35	433	2.1875	6.765625	80	6.4665127	
									93			640	221	4552	2.37634409	7.1125	733	4.2390254	
									23.25			160	55.25	1138	2.37634409	7.1125	183.3	4.2390254	4.2
2007	8	2	Ekiti	Igbemo	Mrs Musa Kalitumu	1	150	64	47	192	1890	240	86	1698	1.82978723	7.075	287	4.2353579	
2007	8	2	Ekiti	Igbemo	Mrs Musa Kalitumu	2	500	64	148	60	750	120	436	690	2.94594595	5.75	268	28.293316	
2007	8	2	Ekiti	Igbemo	Mrs Musa Kalitumu	3	150	64	58	120	1284	157	86	1164	1.48275862	7.4140127	215	5.395189	
2007	8	2	Ekiti	Igbemo	Mrs Musa Kalitumu	4	350	60	132	180	1772	207	290	1592	2.1969697	7.6908213	339	11.123093	
									385			724	898	5144	2.33246753	7.1049724	1109	11.396786	
									96.25			181	224.5	1286	2.33246753	7.1049724	277.3	11.396786	11.4

2007	8	2	Ekiti	Igbemo	Mrs Alice EgunjobiTR	1	70	62	5	120	1170	150	8	1050	1.6	7	155	0.7373272	
2007	8	2	Ekiti	Igbemo	Mrs Alice Egunjobi	2	100	65	10	60	930	147	35	870	3.5	5.9183673	157	3.7667472	
2007	8	2	Ekiti	Igbemo	Mrs Alice Egunjobi	3	70	64	2	30	1170	166	6	1140	3	6.8674699	168	0.5200501	
2007	8	2	Ekiti	Igbemo	Mrs Alice Egunjobi	4	150	62	15	189	1140	147	88	951	5.86666667	6.4693878	162	8.3966195	
Total									32			610	137	4011	4.28125	6.5754098	642	3.2453588	
Mean									8			152.5	34.25	1002.75	4.28125	6.5754098	160.5	3.2453588	3.2
2007	8	5	Osun	Erinoke	Alh Olatunberu	1	160	65	100	130	700	100	95	570	0.95	5.7	200	8.3333333	
2007	8	5	Osun	Erinoke	Alh Olatunberu	2	260	27	105	60	560	103	233	500	2.21904762	4.8543689	208	23.075962	
2007	8	5	Osun	Erinoke	Alh Olatunberu	3	230	24	102	65	520	98	206	455	2.01960784	4.6428571	200	22.184615	
2007	8	5	Osun	Erinoke	Alh Olatunberu	4	240	20	100	60	700	156	220	640	2.2	4.1025641	256	20.947266	
Total									407			457	754	2165	1.85257985	4.7374179	864	18.421115	
Mean									101.75			114.25	188.5	541.25	1.85257985	4.7374179	216	18.421115	18.4
2007	8	5	Osun	Erinoke	Mrs Felicia Oni	1	550	24	184	61	940	134	526	879	2.85869565	6.5597015	318	25.215904	
2007	8	5	Osun	Erinoke	Mrs Felicia Oni	2	300	22	109	57	800	99	278	743	2.55045872	7.5050505	208	17.808521	
2007	8	5	Osun	Erinoke	Mrs Felicia Oni	3	390	23	187	60	770	105	367	710	1.96256684	6.7619048	292	18.587208	
2007	8	5	Osun	Erinoke	Mrs Felicia Oni	4	400	25	115	130	900	137	375	770	3.26086957	5.620438	252	26.4765	
Total									595			475	1546	3102	2.59831933	6.5305263	1070	22.124707	
Mean									148.75			118.75	386.5	775.5	2.59831933	6.5305263	267.5	22.124707	22.1
2007	8	5	Osun	Erinoke	Mr Oladeji Adeyekun	1	190	25	101	138	610	110	165	472	1.63366337	4.2909091	211	18.224355	
2007	8	5	Osun	Erinoke	Mr Oladeji Adeyekun	2	300	25	205	67	590	99	275	523	1.34146341	5.2828283	304	17.123503	
2007	8	5	Osun	Erinoke	Mr Oladeji Adeyekun	3	450	30	250	70	690	127	420	620	1.68	4.8818898	377	22.820228	
2007	8	5	Osun	Erinoke	Mr Oladeji Adeyekun	4	190	29	112	77	690	133	161	613	1.4375	4.6090226	245	14.257749	
Total									668			469	1021	2228	1.52844311	4.750533	1137	18.90266	
Mean									167			117.25	255.25	557	1.52844311	4.750533	284.3	18.90266	18.9

2007	8	5	Osun	Erinoke	Mr Segun Fawowe	1	210	25	106	55	600	101	185	545	1.74528302	5.3960396	207	16.562514	
2007	8	5	Osun	Erinoke	Mr Segun Fawowe	2	530	23	186	60	690	120	507	630	2.72580645	5.25	306	31.55929	
2007	8	5	Osun	Erinoke	Mr Segun Fawowe	3	210	23	101	64	620	102	187	556	1.85148515	5.4509804	203	16.899387	
2007	8	5	Osun	Erinoke	Mr Segun Fawowe	4	270	30	125	73	890	122	240	817	1.92	6.6967213	247	14.509487	
Total									518			445	1119	2548	2.16023166	5.7258427	963	20.293847	
Mean									129.5			111.25	279.75	637	2.16023166	5.7258427	240.8	20.293847	20.3
2007	8	17	Ekiti	Alayere TR	Mr Falana Ibikunle	1	190	52	49	55	250	38	138	195	2.81632653	5.1315789	87	30.910698	
2007	8	17	Ekiti	Alayere TR	Mr Falana Ibikunle	2	190	52	123	57	780	103	138	723	1.12195122	7.0194175	226	8.6990049	
2007	8	17	Ekiti	Alayere TR	Mr Falana Ibikunle	3	340	49	78	54	850	108	291	796	3.73076923	7.3703704	186	21.227103	
2007	8	17	Ekiti	Alayere TR	Mr Falana Ibikunle	4	373	48	187	52	905	135	325	853	1.73796791	6.3185185	322	15.973947	
Total									437			384	892	2567	2.04118993	6.6848958	821	16.252757	
Mean									109.25			96	223	641.75	2.04118993	6.6848958	205.3	16.252757	16.3
2007	8	17	Ekiti	IjaboTR	Mrs Victoria Orebe	1	340	48	178	53	857	112	292	804	1.64044944	7.1785714	290	14.02642	
2007	8	17	Ekiti	IjaboTR	Mrs Victoria Orebe	2	510	45	140	47	930	175	465	883	3.32142857	5.0457143	315	29.256323	
2007	8	17	Ekiti	IjaboTR	Mrs Victoria Orebe	3	470	45	159	104	1150	208	425	1046	2.67295597	5.0288462	367	23.02791	
2007	8	17	Ekiti	IjaboTR	Mrs Victoria Orebe	4	290	46	98	46	490	105	244	444	2.48979592	4.2285714	203	28.424977	
Total									575			600	1426	3177	2.48	5.295	1175	22.920057	
Mean									143.75			150	356.5	794.25	2.48	5.295	293.8	22.920057	22.9
2007	8	17	Ekiti	IjaboTR	Mr Dayo Egunjobi	1	250	43	82	54	530	92	207	476	2.52439024	5.173913	174	22.993335	
2007	8	17	Ekiti	IjaboTR	Mr Dayo Egunjobi	2	260	48	178	50	730	119	212	680	1.19101124	5.7142857	297	12.491582	
2007	8	17	Ekiti	IjaboTR	Mr Dayo Egunjobi	3	330	44	131	46	780	146	286	734	2.18320611	5.0273973	277	20.537286	
2007	8	17	Ekiti	IjaboTR	Mr Dayo Egunjobi	4	340	48	137	51	950	115	292	899	2.13138686	7.8173913	252	14.822466	
Total									528			472	997	2789	1.88825758	5.9088983	1000	16.872858	
Mean									132			118	249.25	697.25	1.88825758	5.9088983	250	16.872858	16.8

2007	8	19	Lagos	Ise	Alhj Taibat Bakare	1	156	41	28	53	350	116	115	297	4.10714286	2.5603448	144	31.191545	
2007	8	19	Lagos	Ise	Alhj Taibat Bakare	2	151	45	106	45	530	110	106	485	1	4.4090909	216	11.130202	
2007	8	19	Lagos	Ise	Alhj Taibat Bakare	3	150	45	107	39	530	113	105	491	0.98130841	4.3451327	220	10.984077	
2007	8	19	Lagos	Ise	Alhj Taibat Bakare	4	99	52	105	51	420	111	47	369	0.44761905	3.3243243	216	6.5454682	
Total									346			450	373	1642	1.07803468	3.6488889	796	12.842073	
Mean									86.5			112.5	93.25	410.5	1.07803468	3.6488889	199	12.842073	12.8
2007	8	25	Ogun	Lufoko 1	Mr Popoola	1	260	43	43	82	1140	165	217	1058	5.04651163	6.4121212	208	16.270267	
2007	8	25	Ogun	Lufoko 1	Mr Popoola	2	100	44	14	104	1240	170	56	1136	4	6.6823529	184	4.5545009	
2007	8	25	Ogun	Lufoko 1	Mr Popoola	3	330	38	105	54	650	92	292	596	2.78095238	6.4782609	197	22.880114	
2007	8	25	Ogun	Lufoko 1	Mr Popoola	4	170	47	40	52	820	158	123	768	3.075	4.8607595	198	12.780145	
Total									202			585	688	3558	3.40594059	6.0820513	787	14.373536	
Mean									50.5			146.25	172	889.5	3.40594059	6.0820513	196.8	14.373536	14.4
2007	8	25	Ogun	Lufoko 2	Mr Popoola	1	99	47	17	82	1182	177	52	1100	3.05882353	6.2146893	194	4.3130272	
2007	8	25	Ogun	Lufoko 3	Mr Popoola	2	99	45	19	53	1098	186	54	1045	2.84210526	5.6182796	205	4.6885284	
2007	8	25	Ogun	Lufoko 4	Mr Popoola	3	99	45	25	48	660	163	54	612	2.16	3.7546012	188	7.6501877	
2007	8	25	Ogun	Lufoko 5	Mr Popoola	4	330	42	134	44	670	116	288	626	2.14925373	5.3965517	250	21.346965	
Total									195			642	448	3383	2.2974359	5.2694704	837	10.157471	
Mean									48.75			160.5	112	845.75	2.2974359	5.2694704	209.3	10.157471	10.2
2007	8	26	Lagos	Ise	Alhj Olatunji Balogun	1	310	47	101	52	620	102	263	568	2.6039604	5.5686275	203	23.265455	
2007	8	26	Lagos	Ise	Alhj Olatunji Balogun	2	320	57	101	49	570	100	263	521	2.6039604	5.21	201	25.114351	
2007	8	26	Lagos	Ise	Alhj Olatunji Balogun	3	250	50	101	51	830	100	200	779	1.98019802	7.79	201	12.773105	
2007	8	26	Lagos	Ise	Alhj Olatunji Balogun	4	300	86	112	120	970	105	214	850	1.91071429	8.0952381	217	12.182163	

Total									415			407	940	2718	2.26506024	6.6781327	822	17.123833	
Mean									103.75			101.75	235	679.5	2.26506024	6.6781327	205.5	17.123833	17.1
2007	8	26	Lagos	Ise	Mr Gani Alabi	1	210	52	102	52	610	102	158	558	1.54901961	5.4705882	204	14.157706	
2007	8	26	Lagos	Ise	Mr Gani Alabi	2	250	51	101	70	652	102	199	582	1.97029703	5.7058824	203	17.180438	
2007	8	26	Lagos	Ise	Mr Gani Alabi	3	290	58	101	58	590	101	232	532	2.2970297	5.2673267	202	21.804511	
2007	8	26	Lagos	Ise	Mr Gani Alabi	4	230	59	102	51	880	102	171	829	1.67647059	8.127451	204	10.313631	
Total									406			407	760	2501	1.87192118	6.1449631	813	15.212611	
Mean									101.5			101.75	190	625.25	1.87192118	6.1449631	203.3	15.212611	15.2
2007	8	28	Ogun	Iboro	Alhj Rabiu Adesina	1	160	58	25	126	1390	190	102	1264	4.08	6.6526316	215	7.1312923	
2007	8	28	Ogun	Iboro	Alhj Rabiu Adesina	2	500	72	75	64	870	108	428	806	5.70666667	7.462963	183	31.33873	
2007	8	28	Ogun	Iboro	Alhj Rabiu Adesina	3	100	61	12	213	1910	345	39	1697	3.25	4.9188406	357	2.2209237	
2007	8	28	Ogun	Iboro	Alhj Rabiu Adesina	4	540	52	73	61	950	132	488	889	6.68493151	6.7348485	205	35.345826	
Total									185			775	1057	4656	5.71351351	6.0077419	960	18.327047	
Mean									46.25			193.75	264.25	1164	5.71351351	6.0077419	240	18.327047	18.3
2007	8	28	Ogun	Iboro	Mr Suleiman Tairu	1	140	46	38	46	790	183	94	744	2.47368421	4.0655738	221	10.461976	
2007	8	28	Ogun	Iboro	Mr Suleiman Tairu	2	110	50	35	90	1440	374	60	1350	1.71428571	3.6096257	409	4.064113	
2007	8	28	Ogun	Iboro	Mr Suleiman Tairu	3	360	43	123	49	540	153	317	491	2.57723577	3.2091503	276	35.78987	
2007	8	28	Ogun	Iboro	Mr Suleiman Tairu	4	170	59	63	47	910	292	111	863	1.76190476	2.9554795	355	10.579537	
Total									259			1002	582	3448	2.24710425	3.4411178	1261	13.412458	
Mean									64.75			250.5	145.5	862	2.24710425	3.4411178	315.3	13.412458	13.4
2007	8	28	Ogun	Iboro	Mr Jimoh Tairu	1	220	47	57	45	640	92	173	595	3.03508772	6.4673913	149	17.952738	
2007	8	28	Ogun	Iboro	Mr Jimoh Tairu	2	450	52	114	49	560	94	398	511	3.49122807	5.4361702	208	35.198705	
2007	8	28	Ogun	Iboro	Mr Jimoh Tairu	3	260	55	50	49	610	83	205	561	4.1	6.7590361	133	22.804337	
2007	8	28	Ogun	Iboro	Mr Jimoh Tairu	4	250	60	83	48	800	145	190	752	2.28915663	5.1862069	228	16.068262	
Total									304			414	966	2419	3.17763158	5.8429952	718	23.025929	
Mean									76			103.5	241.5	604.75	3.17763158	5.8429952	179.5	23.025929	23

									64.75									
2007	8	30	OgunTR1	AbuleTaiwo	Mr Bankole Bamgbopa	1	170	45	102	47	820	102	125	773	1.2254902	7.5784314	204	8.0853816	
2007	8	30	OgunTR1	AbuleTaiwo	Mr Bankole Bamgbopa	2	220	50	154	53	760	130	170	707	1.1038961	5.4384615	284	11.006634	
2007	8	30	OgunTR1	AbuleTaiwo	Mr Bankole Bamgbopa	3	260	53	114	51	650	107	207	599	1.81578947	5.5981308	221	16.731506	
2007	8	30	OgunTR1	AbuleTaiwo	Mr Bankole Bamgbopa	4	260	53	180	47	550	90	207	503	1.15	5.5888889	270	13.717694	
Total									550			429	709	2582	1.28909091	6.018648	979	12.032742	
Mean									137.5			107.25	177.25	645.5	1.28909091	6.018648	244.8	12.032742	12
2007	8	30	OgunTR2	AbuleTaiwo	Mr G Adewale	1	280	52	123	51	440	65	228	389	1.85365854	5.9846154	188	20.264727	
2007	8	30	OgunTR2	AbuleTaiwo	Mr G Adewale	2	140	56	57	43	470	63	84	427	1.47368421	6.7777778	120	10.327869	
2007	8	30	OgunTR2	AbuleTaiwo	Mr G Adewale	3	260	46	170	49	710	101	214	661	1.25882353	6.5445545	271	12.06603	
2007	8	30	OgunTR2	AbuleTaiwo	Mr G Adewale	4	230	50	199	45	690	93	180	645	0.90452261	6.9354839	292	8.8881809	
Total									549			322	706	2122	1.2859745	6.5900621	871	12.299771	
Mean									137.25			80.5	176.5	530.5	1.2859745	6.5900621	217.8	12.299771	12.3
2007	9	5	Ekiti	Ifaki,Igboluwa	Mr J.Kehinde Ojo	1	170	50	22	138	1490	191	120	1352	5.45454545	7.078534	213	7.9589966	
2007	9	5	Ekiti	Ifaki,Igboluwa	Mr J.Kehinde Ojo	2	330	90	62	82	925	129	240	843	3.87096774	6.5348837	191	19.228261	
2007	9	5	Ekiti	Ifaki,Igboluwa	Mr J.Kehinde Ojo	3	72	62	2	71	1090	144	10	1019	5	7.0763889	146	0.9679111	
2007	9	5	Ekiti	Ifaki,Igboluwa	Mr J.Kehinde Ojo	4	330	76	70	67	940	131	254	940	3.62857143	7.1755725	201	17.610882	
Total									156			595	624	4154	4	6.9815126	751	11.90132	
Mean									39			148.75	156	1038.5	4	6.9815126	187.8	11.90132	11.9
2007	9	5	Ekiti	Ifaki,Igboluwa	Mr Tayo Akinola	1	270	51	69	71	1000	152	219	929	3.17391304	6.1118421	221	16.21361	
2007	9	5	Ekiti	Ifaki,Igboluwa	Mr Tayo Akinola	2	220	81	32	64	860	148	139	796	4.34375	5.3783784	180	14.357901	
2007	9	5	Ekiti	Ifaki,Igboluwa	Mr Tayo Akinola	3	230	47	37	138	1620	243	183	1482	4.94594595	6.0987654	280	10.716455	
2007	9	5	Ekiti	Ifaki,Igboluwa	Mr Tayo Akinola	4	370	80	87	67	710	119	290	643	3.33333333	5.4033613	206	26.053541	
Total									225			662	831	3850	3.69333333	5.81571	887	16.109226	
Mean									56.25			165.5	207.75	962.5	3.69333333	5.81571	221.8	16.109226	16.1
2007	9	5	Ekiti	Ifisin-Ekiti,Okeigbo	Mrs Felicia OlakitanTR	1	230	46	81	130	1670	262	184	1540	2.27160494	5.8778626	343	9.1265003	

2007	9	5	Ekiti	Ifisin-Ekiti,Okeigbo	Mrs Felicia OlakitanTR	2	160	92	50	49	500	84	68	451	1.36	5.3690476	134	9.4516332	
2007	9	5	Ekiti	Ifisin-Ekiti,Okeigbo	Mrs Felicia OlakitanTR	3	500	70	119	69	750	142	430	681	3.61344538	4.7957746	261	34.353357	
2007	9	5	Ekiti	Ifisin-Ekiti,Okeigbo	Mrs Felicia OlakitanTR	4	410	50	112	56	815	139	360	759	3.21428571	5.4604317	251	26.266476	
Total									362			627	1042	3431	2.87845304	5.4720893	989	19.25388	
Mean									90.5			156.75	260.5	857.75	2.87845304	5.4720893	247.3	19.25388	19.3
2007	9	7	Ogun	Iwoye Yewa North	Mr Lukman Jimoh	1	90	61	15	61	745	73	29	684	1.93333333	9.369863	88	3.5170787	
2007	9	7	Ogun	Iwoye Yewa North	Mr Lukman Jimoh	2	110	49	20	49	680	67	61	631	3.05	9.4179104	87	7.4448513	
2007	9	7	Ogun	Iwoye Yewa North	Mr Lukman Jimoh	3	155	51	50	51	618	55	104	567	2.08	10.309091	105	9.6077937	
2007	9	7	Ogun	Iwoye Yewa North	Mr Lukman Jimoh	4	160	52	30	52	950	110	108	898	3.6	8.1636364	140	9.4495705	
Total									115			305	302	2780	2.62608696	9.1147541	420	7.8888318	
Mean									28.75			76.25	75.5	695	2.62608696	9.1147541	105	7.8888318	7.9
2007	9	8	Ogun	Ayiwere Obafemi Owoade	Mr Nojimu Oguntola	1	120	48	31	48	900	173	72	852	2.32258065	4.9248555	204	7.1665286	
2007	9	8	Ogun	Ayiwere Obafemi Owoade	Mr Nojimu Oguntola	2	160	47	47	53	630	129	113	577	2.40425532	4.4728682	176	14.354222	
2007	9	8	Ogun	Ayiwere Obafemi Owoade	Mr Nojimu Oguntola	3	64	59	6	47	900	201	5	853	0.83333333	4.2437811	207	0.5691761	
2007	9	8	Ogun	Ayiwere Obafemi Owoade	Mr Nojimu Oguntola	4	110	62	21	54	870	175	48	816	2.28571429	4.6628571	196	5.2521008	
Total									105			678	238	3098	2.26666667	4.5693215	783	6.6521721	
Mean									26.25			169.5	59.5	774.5	2.26666667	4.5693215	195.8	6.6521721	6.7
2007	9	10	Ogun	Agbanla Abkt North	Mr Idowu Elegbede	1	150	50	46	46	860	170	100	814	2.17391304	4.7882353	216	9.6687597	
2007	9	10	Ogun	Agbanla Abkt North	Mr Idowu Elegbede	2	120	60	41	96	1430	243	60	1334	1.46341463	5.4897119	284	3.8484279	
2007	9	10	Ogun	Agbanla Abkt North	Mr Idowu Elegbede	3	310	56	106	47	740	166	254	693	2.39622642	4.1746988	272	22.368644	
2007	9	10	Ogun	Agbanla Abkt North	Mr Idowu Elegbede	4	110	57	123	48	900	185	53	852	0.43089431	4.6054054	308	3.7364338	
Total									316			764	467	3693	1.4778481	4.8337696	1080	8.9455526	
Mean									79			191	116.75	923.25	1.4778481	4.8337696	270	8.9455526	8.9
2007	9	17	Ogun	Agbanla Abkt North TR	Mr Jimoh Olalekan	1	320	54	38	144	1930	228	266	1786	7	7.8333333	266	12.765957	

2007	9	17	Ogun	Agbanla Abkt North	Mr Jimoh Olalekan	2	120	49	16	153	1730	217	71	1577	4.4375	7.2672811	233	4.1930541	
2007	9	17	Ogun	Agbanla Abkt North	Mr Jimoh Olalekan	3	420	59	87	104	1130	171	361	1026	4.14942529	6	258	23.320413	
2007	9	17	Ogun	Agbanla Abkt North	Mr Jimoh Olalekan	4	390	51	59	110	1080	153	339	970	5.74576271	6.3398693	212	25.222233	
Total									200			769	1037	5359	5.185	6.9687906	969	15.356688	
Mean									50			192.25	259.25	1339.75	5.185	6.9687906	242.3	15.356688	15.4
2007	9	19	Ogun	Ewekoro LGA Abule Akinbiye	Mr Sunday SosahTR	1	300	49	47	63	890	114	251	827	5.34042553	7.254386	161	21.490533	
2007	9	19	Ogun	Ewekoro LGA Abule Akinbiye	Mr Sunday Sosah	2	310	59	63	98	1170	173	251	1072	3.98412698	6.1965318	236	17.163784	
2007	9	19	Ogun	Ewekoro LGA Abule Akinbiye	Mr Sunday Sosah	3	430	49	83	43	740	111	381	697	4.59036145	6.2792793	194	31.276161	
2007	9	19	Ogun	Ewekoro LGA Abule Akinbiye	Mr Sunday Sosah	4	600	53	98	57	980	115	547	923	5.58163265	8.026087	213	31.996602	
Total									291			513	1430	3519	4.91408935	6.8596491	804	25.928541	25.9
Mean									72.75			128.25	357.5	879.75	4.91408935	6.8596491	201	25.928541	
2007	9	19	Ogun	Ewekoro LGA Abule Akinbiye	Mr Ganiyu KokuTR	1	160	49	37	104	1170	182	111	1066	3	5.8571429	219	8.6535249	
2007	9	19	Ogun	Ewekoro LGA Abule Akinbiye	Mr Ganiyu Koku	2	250	48	42	86	1070	142	202	984	4.80952381	6.9295775	184	15.842612	
2007	9	19	Ogun	Ewekoro LGA Abule Akinbiye	Mr Ganiyu Koku	3	190	52	42	47	680	157	138	633	3.28571429	4.0318471	199	17.199743	
2007	9	19	Ogun	Ewekoro LGA Abule Akinbiye	Mr Ganiyu Koku	4	390	57	82	108	1340	170	333	1232	4.06097561	7.2470588	252	18.233998	
Total									203			651	784	3915	3.86206897	6.0138249	854	15.265373	15.3
Mean									50.75			162.75	196	978.75	3.86206897	6.0138249	213.5	15.265373	
2007	9		Ogun	Obafemi-Owode LGA Moko-Asipa	Pastor Bode Adenekan	1	230	74	40	82	910	156	156	828	3.9	5.3076923	196	14.995563	
2007	9		Ogun	Obafemi-Owode LGA Moko-Asipa	Pastor Bode Adenekan	2	450	63	113	72	430	80	387	358	3.42477876	4.475	193	44.808522	

2007	9	Ogun	Obafemi-Owode LGA Moko-Asipa	Pastor Bode Adenekan	3	260	100	68	80	630	126	160	550	2.35294118	4.3650794	194	18.894096	
2007	9	Ogun	Obafemi-Owode LGA Moko-Asipa	Pastor Bode Adenekan	4	400	130	78	160	1140	202	270	980	3.46153846	4.8514851	280	19.876093	
								299			564	973	2716	3.2541806	4.8156028	863	23.412694	23.4
								74.75			141	243.25	679	3.2541806	4.8156028	215.8	23.412694	

		Av wt(g)of damaged panicle		X		No of damaged panicle		X		100								
	%loss	Av wt(g) of undamaged panicle				Total No of sampld panicle												
Lufoko		Popoola	CLIVE	189	43	32	47	923	144	146	876	4.5625	6.0833333	176	13.636364			
Iboro		Suleman Tairu	CLIVE	110	55	11	166	1272	163	55	1106	5	6.7852761	174	4.6584981			
Agbanla Abkt North		Mr Jimoh Olalekan	Ephraim	596	56	98	49	970	189	540	1321	5.5102041	6.989418	287	26.919739			
Ewekoro LGA Abule Akinbiye		Mr Sunday Sosah	Ephraim	860	41	135	60	680	102	819	1243	6.0666667	12.186275	237	28.357282			
Ewekoro LGA Abule Akinbiye		Mr Ganiyu Koku	Ephraim	410	57	58	46	570	83	353	1024	6.0862069	12.337349	141	20.292415			
Obafemi-Owode LGA Molko-Asipa		Pastor Bode Adenekan	Ephraim	290	120	44	80	670	118	170	590	3.8636364	5	162	20.987654			
%EstDamge																		

Important to know

REPORT TO PROPCOM

VISIT TO NIGERIA

21 JULY- 4 SEPTEMBER 2007

Clive Elliott

Deliverable 3. Supervise data collection and progress achieved under the NCRI contract and advise on any necessary amendments on program of study.

CALENDAR OF ACTIVITIES:

- Arrived Lagos: evening of 21 August;
- Travelled to Abeokuta 22 August; meeting with PrOpCom agronomist Dr.Olu Osiname, and WARDA team: Director Dr. Ajayi, Mrs. Oladimeji Oyin, and Ms. Blessing Athansa. Some preliminary information was provided on the progress made by WARDA on the enclosure netting contract, including the source of the netting and some of the costs of installation. A visit was then made to Pastor Adenekan's farm where the first net had been installed. The Coordinator of the NCRI contract, Mr. Ephraim Bright, arrived in the evening.
- 23 August: Discussion with Ephraim and Olu on the immediate work plan; visited Lufoko farms in Obafemi-Owode LGA, where WARDA were in the process of installing the second net.
- 24 August: returned to Lufoko farms with Ephraim, Olu and ornithologist Dr. Manu to observe the pest birds and attempted to catch and photograph them.
- 25 August: damage assessments in two of the selected farms in Lufoko in the morning; departed for Lagos in the afternoon.

- 26 August: damage assessments and bird observations in two selected farms at the village of Ise, Lekki LGA; returned to Lagos late in the evening.
- 27 August – 1 September inclusive: returned to Abeokuta; damage assessments of selected and 'transect' fields around Iboro, Yewa North LGA; observations of bird pests in Iboro, and Moloko-Asipa; advice to Ephraim on Section B of his first report, and on the Progress Report for 24 August; discussion and agreement on the standard calculation for damage assessments and the methodology; planning of the activities for the last part of the NCRI contract.
- 2 September: from Abeokuta to Lagos by car; Lagos to Abuja by air.
- 3 September: Discussions with PrOpCom staff; preparation of report.
- 4 September: return journey – Abuja/London/Oxford.

RESULTS:

The planned activities of the NCRI, as determined during the reporter's visit in July, are reviewed below:-

1. **Specific Task 1:**
   Prepare/reach agreement with the Supervisory Consultant on a detailed Work Plan:

   Agreement between the NCRI Coordinator and the supervisory consultant was completed during the previous mission.

2. **Specific Task 2:**
   Identify and select rice fields and farmers for observation:

   This Task was successfully completed in all the four states (Ogun, Osun, Ekiti and Lagos), as tabulated in Ephraim Bright's progress report of 10 August.

3. **Specific Task 3(part) and 4:**
   Determine nature of bird damage at different growth stages of Ofada rice and identify the bird species responsible for it.

   The nature of the bird damage and the species responsible were to be determined by the Coordinator as an ornithologist and by the second ornithologist recruited to assist him, Dr. Manu. There is no mystery about the nature of the damage which consists of the nipping of rice grains when they are milky, principally by the Mannikins *Lonchura* spp., and the eating of the whole grain or pieces of the grain from soft dough stage until harvest, mainly by Weavers *Ploceus* spp. The ornithologists had obtained this information by observation and by using a telescope to observe the actions of the birds in detail. Dr. Manu was particularly competent at species identification. The reporter was unable to provide detailed comment at this stage on the Task, because Dr. Manu's report was not yet available and the progress reports prepared by Ephraim did not give full quantification.

   Discussions suggested that the Task was essentially completed, but it was possible that additional information would be collected by Ephraim during the last weeks of the NCRI study, particularly on whether the nature of the bird damage and/or the species composition will change for late planted crops. The reporter noted that the Black-and-White Mannikin *L. bicolor* also fed on ripe rice grains. No Red-headed Quelea *Quelea erythrops* were observed by the reporter. *Q. erythrops* was observed by the ornithologists only in Ekiti, except for a single bird caught in a mist-net in Ogun. Unless *erythrops* arrives late in the season in Ogun and Lagos, the likely conclusion is that it

is not an important contributor to damage in South-West Nigeria as a whole and the Village Weaver *P. cucullatus* is the principal bird pest of Ofada rice. The reporter also noted that the numbers of Village Weavers in the rice fields was low. The largest flock seen in the fields was about 200 birds. It will be interesting to read what Ephraim and Manu have to say about the numbers of pest birds

4. **Specific Task 5:**
Document the ecology and biology of the bird species identified.

As explained in my July report, information on the ecology and biology of the bird pests involved in causing damage to Ofada rice is available in published literature. The extent to which the Task is covered by NCRI will become apparent only when the reports of the Coordinator and of Dr. Manu are received. It is unlikely that observations made by the ornithologists will include elements which are specific to Ofada rice. Most likely they will confirm what is already generally known about the pest species.

5. **Specific Task 3(part) and 6:**
Estimate approximate grain loss at harvest (in volume and value terms) due to bird damage; provide an objective assessment of the average level of damage and of the total loss caused by birds in each of the 4 States.

The main way in which estimates of bird damage were made was by cutting random samples of rice panicles from the farms selected for special observation and comparing the weight of damaged panicles with undamaged ones. Of the 25 selected farms in the four states, by end August 16 farms had been assessed. Because of the difficulty of working in Lekki LGA, Lagos state, where fields had to be accessed by canoe, two farms were missed. In Ogun state, one farm was missed because the Coordinator was advised not to return there for legal reasons. The target total was therefore revised to 22. During the week beginning 3 September, it was expected that four more selected farms would be assessed in Ekiti state, and the last two, in Ogun would be done during the last week of September. The 22 selected farms will then all have been assessed and, for each field, four, sometimes five, assessors will have taken samples, giving a sample size of at least 90. This is a good achievement.

It was expected that in addition to the selected farms, transect assessments would be made across other LGAs in which Ofada was grown. The intention was to stop every 5 or 10 km and assess the nearest rice field. Such transect surveys of bird damage have been successfully carried out in other parts of Africa, mainly on sorghum crops (Jaeger and Erickson 1980). For Ofada rice, transect counts proved not to be practical. First, the fields were usually not visible from the road, but hidden by tall vegetation or were up to several km off the road. Second, because assessing rice requires that samples be cut, albeit that once cut, weighed, and counted, the panicles are handed back to the farmer, the permission of the owner must be obtained. The bird scarers guarding the fields usually do not have the authority to agree to damage assessments. Third, because many of the Ofada fields are not visible and/or some way off the road, only the local farmers know where most of them are whereas the RIFAN Chairman often does not. Instead, the Coordinator took the initiative to sample other rice farms in order to increase the sample size. The reporter considers this to be a correct decision. These farms were identified by the village chairman on the basis that they were about to be harvested. Up to end August, at least six extra farms had been assessed for damage. It was expected that up to about 18 additional farms would be measured in Ekiti and

Ogun states, where possible in LGAs not covered by the selected farms. This will about double the number of rice fields sampled to about 40, and the number of assessments to >160.

It should be noted that arranging and carrying out damage assessments is a time-consuming activity. During the reporter's visit, the maximum number of assessments that was achieved in one day was three, each in a different locality. If fields are close to each other, it might be possible to do four. If a total of about 40 fields is sampled, the reporter considers that this will be sufficient to give a reasonable estimate of the levels of bird damage in 2007. Nevertheless it should be remembered that 2007 seems to have been a 'good rain' year, in which there was probably a large supply of natural food (wild grass seeds and insects) available for the pest birds. In a dryer year, bird pest pressure on Ofada rice might be higher. The results obtained in 2007 may not be representative of all climatic conditions, but the reporter considers that they provide a good estimate for years in which rain is plentiful.

6. **Specific Tasks 7 and 8:**
Document various methods of bird scaring used, assess their efficiency/replicability, and evaluate the bird scaring skills of each category of bird scarers (children, hired labour, farmers).

There is not a great variety in the methods of bird scaring, assuming that the selected fields were representative of the four states. The Coordinator and another staff member from NCRI, Mr. Tiamiyu, Agro-Economist, have obtained data on bird scaring, including its economics. The reporter considers that the time allocation and sample size of six farms covered by the Agro-Economist was insufficient to draw firm conclusions. On the other hand, given the many other activities and the limitation on transport, this input gave sufficient general data and some measure of the costs involved. The expectation, as specified in the Task, that the scaring skills of each category of bird scarer could be evaluated was unrealistic. Such an evaluation accompanied by quantification would require a full-time study by one competent observer for a whole season. NCRI should not be penalised for not carrying out this evaluation in detail.

The observations made by the reporter suggest that the key to successful bird-scaring is first that it is properly supervised by the owner of the field, second that it covers the whole day from first light to dusk, and third that at least one scarer is used for each hectare of rice. In several cases, the reporter noted that the bird damage on the side of the field where the bird scarers made their camp was usually very light, whereas at the point furthest from this camp, the damage tended to be more significant. The reporter also considers that the technique of bird scaring could be improved if raised platforms were built and ropes with rattles placed across the field. This technique is used in other parts of Africa, with some success. The scarer on the platform still has to be armed with a catapult, as it is most important that the scarer also provides a physical threat to the pest birds as well as simply scaring them with noise/rattles.

7. **Specific Task 9:**
List any morphological features of rice varieties that may deter birds.

As expected, no morphological features in rice panicles were detected that deterred birds. The main pest, the Village Weaver, is a versatile bird able to feed on a variety of different foods including caterpillars, grasshoppers, small beetles, winged termites taken in flight, grass seeds, fruits, the epicarp of oil-palm nuts, stamens of flowers and flower nectar. As a result, its ability to feed on different morphological varieties of rice is not surprising. The chances of finding a morphological variety that would be resistant to bird attack is minimal.

8. **Specific Task 10:**
Document farm management practices within/around the rice crop that may prevent or deter bird attacks.

The Coordinator and the other staff recruited by NCRI had collected data on farm management practices. The analysis of these data will only be completed in the final report. The main finding is likely to be that farms that were well cleared of weeds, bushes and trees that provide suitable perches for the pest birds from which they attack the rice, were less attractive to pest birds. The other major management practice is to determine if there is any advantage to early planting and harvesting. Logically it would be expected that rice fields that are harvested early would be less damaged than those harvested late. The reason would be that late harvested fields are likely to suffer damage from the new generation of young weavers that will have fledged and will be looking for easy sources of food.

9. **Specific Tasks 11 and 12:**
Use the information obtained to prepare a draft report.

The reporter suggested to PrOpCom staff that the due date for this draft report should be delayed until the end of September, because of the hiatus caused by the theft of the project vehicle, some difficulties with the replacement transport, delays caused by rain and in order to complete damage assessments on late planted rice field. Some fields were not due to be harvested until the last week of September. Including these in the report is important because they may indicate whether or not late harvested fields suffer higher damage than early harvested ones.

10. **Specific Task 13:**
Prepare a final report with inputs from stakeholders and the Supervisory Consultant.

This Task will only be completed after the stakeholders meeting at which the Coordinator will present the findings, and after inputs from the reporter. A date was suggested to PrOpCom of a due date for the final report of about 4 October. It was mentioned that the reporter will only be able to provide his input to the draft report in the first days of October, because of his absence abroad.

ADDITIONAL COMMENTS ON NCRI CONTRACT IMPLEMENTATION:

Damage Assessments:

In discussions with the Coordinator, it was agreed to standardise the method of calculation of damage using the formula given by Otis (1989):

$$\text{Percentage damage} = \frac{\text{Mean wt. damaged panicles}}{\text{Mean wt. undamaged panicles}} \times \frac{\text{No. damaged panicles}}{\text{Total no. panicles}} \times 100$$

The method of estimation arranged by the Coordinator was to hire four local people, equip each with two large plastic bags tied round their waists, one bag for undamaged panicles on one hip and one for damaged panicles on the other hip. Each person was expected to walk through the field on a zig-zag pathway stopping every 5 or 10 m and collecting randomly five panicles of rice at each stopping point. The samples were collected by cutting them with a knife just below the first node. Each person was expected to collect about 200 panicles by the time they reached the far side of the field.

The reporter observed the sampling method on several occasions. On two of them, the reporter carried out his own estimate to see how it compared with the other four assessors. The reporter's estimate in Lufoko gave 13.7% damage, and the other four assessors gave 12.8, 23.0, 4.5 and 16.1. The mean for all five estimates was 14.3%. On the second occasion, the reporter's estimate in Iboro was 4.6%, and the other four were 21.4, 31.1, 2.2, and 35.6. The mean for all five estimates was 16.1%. The teams were different in the two cases. In both of them, the Coordinator and the reporter made a rough visual estimate of the amount of damage, agreeing that the damage level was in the range of 5-10%. In the first case, it was felt that given human variability, the results of the four assessors were reasonably close to the reporter's. In the second, one result was close but the others were consistently high. The mean of the five estimates at 16.1% was also thought to be high, but the margin of error was probably only of the order of 5 or 10%. The problem with the technique is that the panicles must be selected randomly and the second team had probably over-selected the damaged panicles. It was also noted by the reporter that the assessors had not followed a zigzag pathway right across the field and back again, but had followed straight lines with only a small zigzag. The danger of this is that if the assessor stays mainly on the edge of the field, he will tend to collect more damaged panicles as the damage is often restricted to the edge. If his pathway follows the centre of the field, more undamaged panicles would be collected than reflect reality.

On another occasion, in the lowland rice at Lekki LGA, Lagos state, the Coordinator did not supervise the teams because of the difficulty of accessing the fields by canoe and the shortage of life-jackets. The reporter observed that the teams did not follow the correct pathway across the field but were collecting their samples from one area only. The reporter attempted to correct them, and afterwards the samples were collected better.

In discussion with the Coordinator, it was concluded that more explanation had to be given to the assessors before they started their work, to encourage them to sample randomly and not to choose damaged panicles, nor to choose large undamaged panicles, but simply to take an unselected sample of what was in each stopping place. It was also decided always to make a visual assessment of the field, so that if results came in which were enormously different, the source of the difference could be checked. Finally it was agreed that the Coordinator should always supervise the collection of the samples and provide guidance to the assessors if they did not move along the correct pathway and did not stop at the proscribed intervals. Furthermore the Coordinator was encouraged to collect his own sample from time to time, so that his result could be compared with those of the other four. In general, the Coordinator's decision to use four assessors in each field, although time consuming, was thought to be a good idea as it was likely to average out any assessor biases.

<u>The use of juju:</u>

In more than half of the fields visited by the reporter juju had been applied, usually on short 0.5m sticks at the four corners of the field and one in the centre. According to Mr. Tiamiyu, in Ekiti the juju was placed on tall poles up to 3m high. In most cases where juju was used, farmers also deployed bird scarers. This suggests that they did not have full confidence that the juju would work, but they did not want to exclude it. In other words, they could be said to be "hedging their bets". The final report of Mr. Taimiyu will analyse the differences between fields that had been protected only by juju and those that had been protected only by bird scarers. The indication is that damage levels in the juju protected fields were higher than in the bird scarer fields. However the juju is much cheaper than bird scaring. Taimiyu's sample size is, in the reporter's opinion, too small for firm conclusions. The reporter's view is that the juju most probably does not have any more effect on the level of damage than a scarecrow would. Cage experiments could be carried out to test the ability of birds to detect the difference between a real juju and a placebo juju. Given that the cost of the juju is low relative to the other costs of production including bird scaring, the reporter considers that farmers who wish to use juju

should be free to do so, but should be encouraged to use bird scarers as well. Further investigation into the efficacy of juju is unlikely to reveal that it is a genuine solution to solving bird damage problems.

Bird Populations:

The largest populations of Village Weaver that were seen by the reporter were at Lufoko and at Moloko-Asipa. At Lufoko, there were breeding colonies in palm trees totalling about 600 nests. Assuming that all the nests were occupied, about 1,200 birds were involved. In the Red-billed Quelea *Quelea quelea*, it has been estimated (Elliott1989) that the each bird may be capable of destroying about 10g of rice per day (eaten and scattered on the ground). The Village Weaver, at about 40g, is about twice the weight of a Quelea (20g). It might be expected to be capable of destroying 20g/bird/day. If all the locally breeding birds fed on the field, they would be capable of destroying 1,200 X 20 = 24 kg/day. Given that the rice is vulnerable to bird attack for about 30 days, the weavers could theoretically damage 24 X 30 kg = 720 kg. The yield of the Lufoko field was expected to be about 2t/ha and the field was 3ha in size. The local bird population could therefore destroy about 12% of the expected crop, if there was no bird scaring.

There are many assumptions in such a calculation. It would be most unlikely that the Village Weavers would only eat rice for the whole of 30 days. Some of the time, they will eat other food including insects. Some of the birds feeding in the fields may have come from colonies further away. The feeding of the birds in the fields is continually being disrupted by bird scarers. One conclusion from these observations was that the numbers of birds seen in the fields were not sufficient to cause catastrophic damage, i.e. >50%. The numbers of birds later in the rice season need to be monitored in case they should increase significantly once the new generation of young birds joins the population. If such an increase should occur, the impact on damage may increase. Up to the end of August 2007, the numbers of birds seen and the damage levels found of about 15% on average were compatible.

OBSERVATIONS ON THE WARDA NETTING TRIALS

The reporter was given the opportunity to visit the three netting trials established by WARDA, one at Pastor Adenekan's farm at Moloko-Asipa, one at Lufoko and one at Iboro. The following notes were made:

- The netting being used was manufactured locally by a company 'Golden Sea Fishing Net & Twine'. The thread was 0.28 mm and the mesh size was about 2cm square. The material was nylon. The colour was pale green. The net was supported by bamboo posts dug into the ground and about 2m high, spread out at 5m intervals. Plastic bags were wound round the top of each post to prevent it tearing the netting and the posts were linked by plastic twine or ordinary string.
- The installation of the net was carried out under the supervision of WARDA staff using about ten labourers. Some of the posts were guyed to maintain the tension in the net.
- The area covered by the nets was: Adenekan's farm 5,500m², Lufoko 3,200m², Iboro 2,800m².

My comments on the netting:-

- In general, I felt that the installation of the nets was remarkably well done in that it was completed without tearing the nets and was reasonably strongly constructed. I was disappointed that in the Lofoko and Iboro farms, the area covered did not reach the O.5ha specified in the contract.
- The material of the net itself was, in the reporter's opinion, not strong enough and I was concerned that it might rip especially where the posts had sharp ends. More effort could have been made to smooth the top ends of the posts. The tops of the posts were covered with plastic bags and this seemed to be successful in preventing any tendency to rip. I suggested that tyre inner tubes could be used to make the tops of the poles even smoother.

- When the nets were checked about one week after installation, the reporter was pleased to find that there had been no ripping at the top of the posts. The system used appeared to be effective, albeit that it could probably be improved.
- The Adenekan net was checked by the reporter on 28 August, having been installed on 21 August. It was found to have 15 holes varying in size from 40 X 20 cm to 4 X 4 cm. The holes were tied up with plastic string. WARDA did not appear to be monitoring the state of the net in order to make these repairs themselves.The Iboro net was visited on 1 September, having been installed on 23 August. It was found to have six holes which again were tied with string. The conclusion was that the material of the net was not strong enough. It was not clear what had caused the breakage but the most likely reason appeared to be that the tension on the net may have caused it to rip. According to the bird scarers in the vicinity, the pest birds had not tried to get into the net, but simply flew over the net to areas that were not netted. Despite the holes no pest birds had got into any of the three nets. Pastor Adenekan reported that he had seen one small bird going through the roof of the net and out again. From his description, I think this may have been a small insectivorous warbler (*Cisticola*) which may have been nesting in the field.
- The bottom of the net was not systematically attached to the ground with sections of bamboo or tufts of vegetation. In some places it was attached and in others not. In some places there was a gap through which small mammals could enter. One of the guards at Iboro reported that a hare had entered and could not find its way out. When the net was visited one week later, the hare could not be found, so it may have found its way out or ended up in a cooking pot. At least one snake was reported to have been tangled in the bottom of the net and to have been killed.
- The holes in the 0.28 mm monofilament suggest that the netting will not last for very many re-usages. It was pointed out by Dr.Manu that farmers could use the net first on early planted rice and then it could be transferred to late planted rice in the same season, to obtain a double benefit from it in the same season. The cost-effectiveness of the netting will depend in part on how many times it can be re-used and for how many years it will last. Information needs also to be obtained on what effect UV radiation has on the filament and whether it will make it more brittle after a certain period of exposure. It is possible that the next heavier thread size might be strong enough not to develop holes. The reporter also feels that cross-strings between the poles might allow the netting to be supported without sagging onto the rice and allowing it to be installed without using too much tension. This might reduce the tendency to form holes.
- In general, the use of locally manufactured netting, poles cut from the forest, and locally available plastic twine, suggest that the netting is a practical option for rice farmers, but the crucial element is the cost/benefit.

  The netting that was installed by WARDA was certainly succeeding in protecting 100% of the rice it enclosed, at least up to 1 September. The advantage of netting is its 100% effectiveness and that it is almost totally environmentally friendly. Further investigation of the materials, the design and the cost/benefit is warranted, together with the possibility of Government or State subsidy or support from donors to allow its widespread use by farmers in Ofada rice production.

WORK PLAN FOR THE END PERIOD OF THE NCRI CONTRACT

In discussion with the Coordinator, the tentative Work Plan for the last weeks of the NCRI contract was developed (see Annex 1).

CONCLUSION

The data collection and progress achieved under the NCRI contract as at the end of August 2007 was considered by the reporter to be satisfactory. It was a credit to the hard work and conscientiousness,

sometimes under difficult circumstances, of the Coordinator Mr. Ephraim Bright. There were some shortcomings in the details of the data collection and the supervision which could be corrected. It is expected that given some small flexibility in the completion date, the field work on the selected farms will be completed and a number of additional damage assessments in other Local Government Areas will also be carried out. Data, albeit limited in scope and sample size, will have been collected on the economics of bird scaring and more comprehensive information on the bird pest species, their numbers and behaviour in the study areas will have been obtained. The results will of course apply to the particular rainfall pattern and amount that fell in the agricultural season of 2007. There might be differences in other years, for example in a year with poor rainfall, but the information from 2007 can be used to gauge the importance of the bird pest problem.

The final report, once it has been appropriately improved and polished, should be an important contribution to the efforts of PrOpCom towards improving the livelihoods of poor farmers who produce Ofada rice.

ANNEX 1 : WORK PLAN FOR THE END PERIOD OF THE NCRI CONTRACT

Monday 3 September	Travel to Ekiti
Tuesday 4 September	Damage assessments (DA)
	2x selected farms, Ekiti
Wednesday 5 September	DA 2x selected farms, Ekiti
Thursday 6 September	back to Abeokuta: DA
	1x selected farm Ogun/Yewa North
Friday 7 September	DA 'transect' farms, new LGA
Saturday 8 September	DA transect farms, new LGA
Monday 10 September	Final report writing, Bida
Tuesday 11 September	-------ditto----------
Wednesday 12 September	-------ditto----------
Thursday 13 September	Travel to Abeokuta
Friday 14 September	DA selected farm Ayiwere
Saturday 15 September	Report writing, Abeokuta
Monday 17 September	Report writing, Abeokuta
Tuesday 18 September	--------ditto----------
Wednesday 19 September	DA transect farms, new LGA
Thursday 20 September	--------ditto----------
Friday 21 September	--------ditto----------
Saturday 22 September	--------ditto----------
Monday 24 September	DA selected farm Adenekan
Tuesday 25 September	Return to Bida
Wednesday 26 September	Report writing
Thursday 27 September	------ditto------
Friday 28 September	-------ditto-----
Saturday 29 September	submit draft report to CE for comments

Monday	2 October	CE's comments sent
Tuesday	3 October	Make amendments/corrections
Wednesday	4 October	Submit final report to PrOpCom