# Facilitating healthy seed yam entrepreneurship in the Niger River system in Nigeria

## The value of 'Research into Use'

Nora McNamara, Stephen Morse, Utiang P. Ugbe, Danny Coyne and Abiodun Claudius-Cole

***Abstract:*** *This paper explores the results of a programme designed to facilitate entrepreneurship centred on healthy seed yam (Dioscorea rotundata) production on the eastern bank of the River Niger. Ware yam farmers residing along the eastern bank, upstream of the Niger/Benue confluence, source their planting material from towns such as Ilushi in Edo state, which involves significant travel and expense. The project encouraged 10 ware yam farmers living in Edeke village (Idah local government, Kogi state) to specialize in healthy seed yam production by employing the adapted yam minisett technique (AYMT). This employs a sett size of around 80–100 g treated with a joint insecticide and fungicide dip. The treated setts are planted directly into the field, not first planted into a nursery as with the yam minisett technique (YMT). The Edeke farmers received a loan from the Diocesan Development Services (DDS) to employ the AYMT to produce healthy seed yams on a significant scale. However, while sales of seed yam by four of the farmers generated a significant and positive gross margin, six farmers opted to plant their seed yams in the subsequent season (2012) to produce ware yams. This paper presents some of the results, and discusses the decisions taken and the dilemmas faced by the farmers in the production of seed and ware yam and the possibility of initiating and developing new markets for seed yam in the Idah area.*

***Keywords:*** *healthy seed yam; agricultural entrepreneurship; Kogi state; Nigeria*

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It is well established that one of the key constraints to the production of white yam (*Dioscorea rotundata*) in West Africa is the availability of affordable and good quality planting material (Okoli and Akoroda, 1995). A series of research projects has sought to address this issue over the years, and answers have ranged from the use of small setts cut from ware yam to the use of vine cuttings (Akoroda and Okonmah, 1982). The success of these initiatives, including the yam minisett technique (YMT), has been limited. The YMT involves the division of a ware yam tuber into minisetts of between 10 and 80 g in size, with a recommended weight in Nigeria of 25 g (Kalu *et al*, 1989). Thus one ware yam tuber of 500 to 1,000 g should allow the creation of 20 to 40 minisetts of 25 g. The minisetts are dusted with a pesticide and a wood ash mixture, after which they are planted in a nursery for sprouting. Once sprouted, they are transplanted to the field at a density of 40,000 stands/ha and can yield about 13.6 tonnes/ha of seed yams for every tonne of minisett material planted (Okoli, 1986). However, despite being promoted in Nigeria since the mid-1980s (Chikwendu *et al*, 1995) the uptake of YMT by farmers has been relatively low (Agbaje and Oyegbami, 2005). The reasons for this may be myriad, but the economic performance of the YMT relative to other options available to farmers is no doubt an important consideration (Ezeh, 1991), although perhaps surprisingly this aspect has received relatively little attention within the scientific literature (Morse *et al*, 2009). Indeed, local systems of seed yam production have also been relatively underexplored in socioeconomic terms, including the various market processes linking growers with traders (Ibana *et al*, 2012).

A more recent initiative to encourage healthy (clean) seed yam production in Nigeria was funded by the UK Department for International Development (DFID) 'Research into Use' (RIU) programmes (Lenné, 2008; Ugbe, 2010; Hirvonen, 2011; website: www.researchintouse.com). That programme sought to build upon the DFID Renewable Natural Resources Research Strategy implemented between 1995 and 2006, which aimed to:

> 'accumulate and evaluate evidence to shape and share lessons on how best to enable innovation in the agricultural sector so as to achieve social and economic gains in diverse developing country settings.' (www.researchintouse.com)

While RIU was primarily a research programme, it aimed to 'put existing research products into use at scale' (www.researchintouse.com) and thus directly addressed a commonly perceived problem that research geared towards helping the poorest often ends up filling journal pages and shelves, with little development impact. It is what Hall *et al* (2010) have referred to as an example of a suite of more or less contemporary 'innovation-centric agricultural research and development programmes' put into place by a number of development and research agencies and designed to address this perceived problem of poor adoption.

Since 2007, RIU has established country programmes in six African countries (Malawi, Nigeria, Rwanda, Sierra Leone, Tanzania and Zambia) and a suite of 'Best Bet' (or opportunity-driven initiative) projects in Ghana, Kenya, Nigeria, Uganda and elsewhere, as part of experiments on promoting private sector-driven agricultural innovation. The goal of these interventions includes 'learning and disseminating lessons and evidences from the outcomes of multi-stakeholder agricultural research for development interventions through Innovation Platforms, to inform institutional learning and change as well as scaling up of successful trials' (Abalu *et al*, 2008). The Nigeria programme created three value chain innovation platforms (VCIPs) focusing on cassava, cowpea/soybean–livestock, and aquaculture. RIU interventions in each of these value chains aimed to increase farm production and productivity, increase and improve post-harvest value addition and contribute to institutional learning and change (that is, bring about supportive policies). The country programme portfolio included a range of strategies:

(1) field-level economic activities through the innovation platforms;
(2) engagement with policy makers to bring about institutional learning and change in support of the three value chains;
(3) training and other capacity-building assistance to national institutions and relevant but weak private sector stakeholders to enable them to participate in agricultural research for development (AR4D) activities; and
(4) inter-linkages and collaboration with other public sector and development programmes to impact on the assisted value chains.

The conditions that RIU Nigeria sought to change included the issue of poor uptake of outputs from the National Agricultural Research System (NARS) (Ugbe, 2010). There were various reasons in the Nigerian context that explain poor uptake of research, including a supply-driven approach to agricultural research and extension, combined with problems that arose from a top-down, state-run approach to the delivery of agricultural extension services. On top of this, there have been erratic and sometimes unsuitable agricultural policies, as well as poor incentives for, and inadequate involvement of, the private sector in agricultural research and development initiatives (Ugbe, 2010).

RIU has funded a number of projects in Nigeria, including the use of 'triple bagging' as a way of controlling weevils attacking grains such as cowpea (*Vigna unguiculata*) in storage. The use of 'triple bagging' creates an airtight space where insects cannot survive and hence reproduce and cause damage (Sanona *et al*, 2011). Thus it removes the need to apply storage insecticides and provides a relatively low-cost and reusable option for farmers to address this common problem. In addition, the Purdue Improved Cowpea Storage (PICS) technology was initially funded by the Bill and Melinda Gates Foundation and promoted by RIU via a range of media, including television and radio.

The 'triple-bagging' project sat firmly within the VCIP structure established by RIU. By way of contrast, the clean seed yam production initiative, funded by RIU between 2010 and 2012 as a 'Best Bet' project in Nigeria, was managed directly by the project holders, outside the terms

of the hosting arrangement under the RIU-ARCN Memorandum of Understanding. The RIU seed yam project followed on from a series of DFID-funded research projects (part of the Renewable Natural Resources Research Strategy) designed to look for ways in which clean yam planting material could be multiplied on an economically viable basis. Indeed, one of the contentious issues that farmers had often expressed about the YMT was the need to use a nursery stage, as minisetts were too small to plant directly in the field. The result of the DFID-funded research was an 'adapted' YMT that utilized a larger sett size (roughly 80–100 g, compared with the 25 g recommended in Nigeria for the YMT), which allowed for direct planting into the field, provided the setts were suitably treated with insecticide and fungicide (Coyne *et al*, 2010). Rather than use a pesticide-/wood ash-based dust, as with YMT, AYMT used a water-based 'dip' process in which setts were immersed in a pesticide suspension (Morse *et al*, 2009). The technical success of the AYMT, combined with it being regarded by farmers as more suited to their needs than YMT (Morse *et al*, 2009), made it a prime candidate for scaling up via the 'Best Bets' component of the RIU.

The RIU project sought to bring about scaling up of the AYMT by focusing on a number of key yet diverse locations in yam-growing areas of Nigeria: notably the Federal Capital Territory (FCT) of Abuja, where there is a highly developed seed and ware yam production system with associated credit provision and markets, and the eastern bank of the River Niger (Kogi state), which is a much more rural setting than Abuja without the same degree of market development and credit availability. In the Niger system, it was decided to focus on an area near Idah, for reasons to be detailed later. There are local yam markets in the Niger valley, but nothing like those geographically concentrated in Abuja (a city of approximately one million inhabitants and a density of 1,100 people per square kilometre). Similarly, while there are formal and informal credit supply systems in the Niger valley, in the authors' experience they do not appear to match the extent of availability in Abuja, which is the federal capital of the country. A further and outstanding difference concerns the agricultural extension services. The FCT has excellent resources, with good coverage by well trained and highly motivated extension staff who are also well resourced. In areas such as Kogi state, this expertise to support farmers is severely lacking. Despite this, the Niger-based yam production systems are sophisticated, with farmers travelling many miles and at significant cost to purchase seed yams at markets along the river, such as Ilushi in Edo state. In addition to these two main locations, a number of secondary schools and prison sites were selected to take part in the RIU project. In the former case, it was seen as a process of educating students within the agriculture curriculum, while in the latter it was seen as part of a process of rehabilitation of prisoners by providing them with usable skills as well as making them aware of business opportunities (as long as provision was made for inputs).

The demonstration plots established in the RIU project were managed by farmers, and involved a series of planned visits by other farmers in the locale. However, although the RIU project had demonstration sites spanning a number of locations in Nigeria, only the sites in the Niger system near Idah were observed in detail in terms of their agronomic and economic performance. This was largely because the farmers owning and managing these sites were members of a local Catholic Church-based NGO – the Diocesan Development Services (DDS) – which had a long history in the area (initiated in 1970). The services include a microfinance scheme. As part of the latter, DDS employed a business-plan approach to its dealings with farmers, with monitoring of plots as part of the conditions required. This provided an excellent opportunity to explore the performance of the Idah-based plots, and the objective of this paper is to present some of these results and how farmers responded. This study provides a number of important insights not only about the production of healthy planting material, but also how this might affect resource-poor farmers.

## Methodology

### *Site selection*

A collection of villages, referred to in the local language as 'Edeke' and located near Idah on the eastern bank of the River Niger, was selected for the RIU project largely because of its previous involvement in the DFID-funded seed yam research projects. Edeke is located within the geographical scope of DDS; it was one of the key partners in the RIU project and indeed was involved in a number of other DFID-funded research projects on yams. Edeke provides ideal conditions for yam production, and farmers living there specialize in the crop, as well as growing rice and some vegetables. While there is some marked spatial variability in characteristics, the Fluvial (Fle-VRgd-1; IUSS/FAO) soil is rich, heavy and experiences annual flooding, which helps replenish soil fertility while sanitizing it through the reduction of soil-borne pest and disease pressures. These conditions allow for a virtual monoculture of yam. Edeke has a population of approximately 4,072 people (1,894 male and 2,178 female), based on the 2006 official census (Federal Republic of Nigeria Official Gazette data for Edeke Ward; personal communication), including many migrants, some from the wider hinterland. Farmers purchase their seed yams from specialist producers further south along both banks of the Niger. Seed yams are expensive, not least because once purchased they need to be transported by powerboat back up the Niger to Edeke.

### *RIU project*

The intention of the RIU project was to encourage a group of farmers in Edeke to begin producing their own healthy material, rather than continuing their traditional approach of travelling long distances, at significant cost and risk, to markets on the Niger River, such as Ilushi on the western bank of the Niger in Edo state. The assumption was that if some farmers could begin producing their own seed yam, then it might be possible to supply their own needs plus those of other yam farmers in Edeke and beyond. For the RIU project, DDS supplied 1,200 ware yam tubers to each of 10 farmers on a loan basis. The tubers were provided as an 'in kind' loan in early 2011, and the intention was for the loan to be repaid in 2012 (with a small nominal

**Table 1**. Yields, costs, revenue and gross margins for the seed and ware yam plots of Edeke farmers.

| Farmer | Yield (kg/ha) | | Cost (N/ha) | | Revenue (N/ha) | | Gross margin (N/ha) | | Ratio of gross margin |
|---|---|---|---|---|---|---|---|---|---|
| | *Seed yam* | *Ware yam* | *Seed yam* | *Ware yam* | *Seed yam* | *Ware yam* | *Seed yam* | *Ware yam* | *Seed:ware* |
| 1 | 20,000 | 51,400 | 1,789,857 | 1,337,500 | 0 | 2,250,000 | 0 | 912,500 | |
| 2 | 47,200 | 38,845 | 1,755,776 | 1,594,072 | 0 | 1,546,392 | 0 | –47,680 | |
| 3 | 20,000 | 71,400 | 2,710,373 | 1,337,500 | 7,600,000 | 1,725,000 | 4,889,627 | 387,500 | 12.62 |
| 4 | 47,200 | 112,600 | 778,212 | 1,337,500 | 2,249,999 | 2,000,000 | 1,471,787 | 662,500 | 2.22 |
| 5 | 26,400 | 47,120 | 1,570,192 | 1,571,250 | 0 | 3,125,000 | 0 | 1,553,750 | |
| 6 | 46,826 | 67,020 | 1,158,186 | 1,625,000 | 0 | 3,750,000 | 0 | 2,125,000 | |
| 7 | 48,800 | 79,200 | 1,486,758 | 1,546,250 | 4,000,000 | 2,666,675 | 2,513,242 | 1,120,425 | 2.24 |
| 8 | 48,000 | 30,460 | 992,661 | 1,546,250 | 0 | 2,025,000 | 0 | 478,750 | |
| 9 | 30,877 | 71,400 | 1,623,260 | 1,030,833 | 2,604,801 | 1,423,533 | 981,541 | 392,700 | 2.5 |
| 10 | 16,000 | 34,780 | 5,393,333 | 481,982 | 0 | 1,025,000 | 0 | 543,018 | |

interest charge of 1% per annum) after harvesting and selling of the seed yams. The 10 farmers selected were asked to complete a business plan ahead of the enterprise, by first detailing what they thought would be their costs, revenues and hence gross margins. The farmers then recorded their 'realized' costs, revenues and gross margins during the season and at harvest. They were helped with this by DDS staff who visited the farmers on a regular basis.

### *Sett preparation*

The farmers were asked to use the AYMT for producing their setts. This involved cutting ware yam tubers into setts weighing approximately 80–100 g. The setts were dipped into a suspension comprising 150 ml of an endosulfan-based (35EC) insecticide and three sachets of 'Seed Plus 30WS' in 10 litres of water. 'Seed Plus 30WS' comprises 10% (by weight) of the pesticides Imidacioprid (insecticide), Metalaxyl (fungicide) and Carbendazim (fungicide). The setts were put aside to dry before planting at a spacing of approximately four per square metre in heaps, which were staked after germination. Farmers were trained on how to prepare the treatment and supported and supervised by DDS staff while doing it for the first time. Developing a business plan was an important component of the project. DDS staff underwent training for this and in turn helped and supported the 10 farmers with their business plans. During the growing season, all 10 Edeke farmers came together with DDS staff for a 'focus group' meeting in Idah where progress and issues arising from the use of the AYMT were discussed.

## Results

All 10 farmers opted to use the 'in kind' loan from DDS to plant ware yam alongside seed yam. The reason for this was to ensure that they would have sufficient funds to repay their loans (discussed later). Here we provide statistics for both seed and ware yam plots, but conveniently this provides the basis for a comparison between plots under entirely 'farmer-managed' conditions. Such comparisons between the economics of ware and seed yam production are rare in Nigeria.

Table 1 summarizes the yields, realized costs, revenues and gross margins for all plots (expressed per hectare). It was assumed that seed yams (for ware yam production) were planted at an average density of one per square metre and that four yam setts per square metre were employed for the seed yam plots. These figures are an approximation, but the 10 farmers were consistent in their spacing. Table 1 is complicated by the fact that only a few farmers opted to sell some of their seed yams, and hence the revenue figures for the seed yam plots are incomplete. For four farmers, the seed yams that were sold were used to extrapolate to a hectare-equivalent. Thus the seed yam revenues and gross margins are likely to be exaggerated. Most of the ware yams harvested by the farmers were sold, making the figures here more representative of the economics of production.

The yields and costs across the seed yam and ware yam plots are variable, with costs being generally higher for ware yam than seed yam. Yields can be highly variable both between and within farms in Edeke (Morse *et al*, 2009), often due to small-scale differences in soil quality and pest attack. For the costs, it should be noted that only those items – including some hired labour – for which farmers needed to pay are included. Excluded are items such as household labour, and the authors' experience suggests that this can vary significantly between households (Morse *et al*, 2009). The main cost for both seed and ware yam was planting material: seed yams (68% of total costs) in the case of ware yam, and ware yams (for setts, 78% of total costs) in the case of seed yam. The next major categories of cost were staking (9% and 12% for seed and ware yam respectively), land preparation (8% and 5% for seed and ware yam respectively) and harvesting (2% and 12% for seed and ware yam respectively). Weeding costs were relatively minor, at 2.5 to 3% for both plots, although this is partly a reflection of the use of herbicide (pre- and post-emergence) by some farmers, as well as household rather than paid labour by others. There are some significant differences in the 'cost profiles' for the seed and ware yam plots (t-tests used to make comparisons are provided in Table 2). Most notably, the harvesting costs for ware yam are significantly higher than for seed yam. This largely reflects the fact that ware yam tubers are bigger and extend deeper into the ground and thus have to be

**Table 2**. Comparison between the five main categories of cost for seed and ware yam.

| | Mean | SE mean | t-value (significance) |
|---|---|---|---|
| *(a) Land preparation* | | | |
| Seed yam | 11.54 | 0.37 | Not significant |
| Ware yam | 11.026 | 0.17 | |
| *(b) Planting material* | | | |
| Seed yam | 14.071 | 0.17 | 1.96 ns ($p$ = 0.069) |
| Ware yam | 13.676 | 0.11 | |
| *(c) Weeding* | | | |
| Seed yam | 10.539 | 0.22 | Not significant |
| Ware yam | 10.406 | 0.25 | |
| *(d) Staking* | | | |
| Seed yam | 11.850 | 0.21 | Not significant |
| Ware yam | 11.931 | 0.12 | |
| *(e) Harvesting* | | | |
| Seed yam | 10.389 | 0.13 | –6.3 ($p$ < 0.001) |
| Ware yam | 11.873 | 0.2 | |

*Note:* t-test performed on logarithm (base e) of costs/ha (variances not assumed to be equal). Means and standard errors are those for the transformed data.

excavated or 'bored' by specialist yam borers before they can be harvested. Indeed, harvesting ware yam in the fertile yet heavy soils of Edeke is difficult, and great care must be taken to avoid damage. Damaged tubers are more prone to pest and disease attack during storage, which ultimately can lower the market price. There is also an indication in the data that the cost of seed yam planting material (per ha) is higher than that for ware yam. The planting material for seed yam comprises setts cut from ware yams, and on average some 10 setts of approximately 100 g can be cut from a tuber. While ware yams are expensive, especially if they have to be purchased at the time of the year for planting setts, this may imply a relatively inexpensive method of producing planting material, but it should be remembered that they are planted at four times the density of the seed yams used to produce the ware yam.

It is interesting that for the four farmers who did sell some of their seed yams, the extrapolated revenues were higher than for ware yam, as were the gross margins. With the exception of farmer 3, who managed to obtain an exceptional price for some of his seed yams, the ratio between seed yam and ware yam gross margins was between 2.2 and 2.5. This is based upon an extrapolation from partial sales, as only 4 of the 10 farmers sold any of their seed yams. While there are no markets for seed yam near to Edeke, these farmers were apparently offered good prices and thus, as noted earlier, it seems reasonable to assume that the revenues and gross margins for the seed yam plots of these farmers is exaggerated. The results do nonetheless suggest that if the marketing is done well, then a profit from the production of clean seed yam is possible. This is encouraging for the future adoption and sustainability of the AYMT. However, the fact that farmers retained their seed yam as opposed to selling is in itself a possible indication of their perceived value by farmers in relation to their potential to produce ware yam.

**Table 3**. Labour input for the seed and ware yam plots.

| Farmer | Total labour (person hours/ha) | |
|---|---|---|
| | *Seed yam* | *Ware yam* |
| 1 | 4,607 | 5,575 |
| 2 | 4,211 | 4,407 |
| 3 | 6,407 | 9,675 |
| 4 | 2,439 | 10,350 |
| 5 | 5,490 | 9,838 |
| 6 | 4,854 | 8,950 |
| 7 | 5,087 | 6,600 |
| 8 | 2,361 | 7,075 |
| 9 | 2,684 | 5,117 |
| 10 | 9,400 | 2,198 |

**Table 4.** Division of labour between the main types of activity for seed and ware yam (figures represent an average of 10 plots).

| Activity | Labour (person hours/ha) | | | |
|---|---|---|---|---|
| | *Seed yam* | *% of total* | *Ware yam* | *% of total* |
| Land preparation | 2,671 | 56 | 2,937 | 42 |
| Weeding | 347 | 7 | 494 | 7 |
| Staking | 914 | 19 | 1,266 | 18 |
| Harvesting | 822 | 17 | 2,281 | 33 |
| *Total* | *4,754* | *99* | *6,979* | *100* |

Table 3 summarizes the labour input for seed and ware yam plots. It should be noted that the figures here include both household and paid labour. The values are generally higher for ware than for seed yam, and there are differences in the labour profile between the two types of yam, as indicated in Table 4. Here the activities are divided into four categories: land preparation and planting; weeding; staking; and harvesting (includes transportation to the store). Each of these categories comprises a number of activities (land preparation includes clearing, tilling and heap making), but they are commonly used to summarize the labour profile for yam. The major differences between the categories are in land preparation, which reflects the larger density of heaps for seed yam (although individual ware yam heaps are larger in size) and harvesting, as ware yams require a lot more effort, given the size of the tubers and the chances of damage. But harvesting is the only one that is statistically significant (Table 5). Given the skill required to harvest ware yam and not damage the tubers, it is unsurprising that the labour demand is higher.

The sample size (10 farmers) limits the statistical analyses that can be performed on the data, but Table 6 shows a regression analysis between yield and the categories of labour (all data have been transformed by taking logarithms to the base e). For seed yam there is no significant relationship between any of the categories and yield, but for ware yam there is a statistically significant regression. The coefficient of determination for the ware

**Table 5.** Comparison of the main categories of labour for seed and ware yam.

| | Mean | SE mean | t-value |
|---|---|---|---|
| *(a) Land preparation* | | | |
| Seed yam | 7.753 | 0.17 | Not significant |
| Ware yam | 7.801 | 0.24 | |
| *(b) Weeding* | | | |
| Seed yam | 5.739 | 0.16 | Not significant |
| Ware yam | 5.895 | 0.3 | |
| *(c) Staking* | | | |
| Seed yam | 6.664 | 0.19 | Not significant |
| Ware yam | 7.002 | 0.2 | |
| *(d) Harvesting* | | | |
| Seed yam | 6.560 | 0.19 | –4.28 *** |
| Ware yam | 7.633 | 0.16 | |

*Note:* t-test performed on logarithm (base e) of person hours/ha (variances not assumed to be equal). Means and standard errors (SE) are those for the transformed data.

**Table 6**. Regression analysis of yam yield and labour as dependent variables.

**(a) Seed yam plots**

| *Independent variables* | *Coefficient* | *SE* | *t-value and significance* |
|---|---|---|---|
| Constant | 14.644 | 2.325 | 14.644*** |
| Land preparation | –0.3647 | 0.2804 | –1.3 ns |
| Weeding | 0.1615 | 0.4345 | 0.37 ns |
| Staking | –0.4323 | 0.3666 | –1.18 ns |
| Harvesting | 0.0798 | 0.2216 | 0.36 ns |

$R^2$ (adjusted) = 32.8%.

**(b) Ware yam plots**

| *Independent variables* | *Coefficient* | *SE* | *t-value and significance* |
|---|---|---|---|
| Constant | 7.601 | 0.6571 | 11.57*** |
| Land preparation | –0.3278 | 0.1018 | –3.22* |
| Weeding | 0.61089 | 0.06866 | 8.9*** |
| Staking | –0.1437 | 0.1789 | –0.8 ns |
| Harvesting | 0.4316 | 0.1269 | 3.4* |

$R^2$ (adjusted) = 93.8%.

yam is high (94%). It is interesting to note that three of the categories for ware yam are statistically significant: land preparation, weeding and harvesting. The latter two are as expected, with the yield of ware yams increasing as weeding and harvesting labour increase. Labour invested in weeding, whether by herbicide use or manual removal of weeds, will reduce competition for vital resources and increase yield. Harvesting is also linked to yield: the more the effort employed in harvesting yams, the higher the yield. With land preparation, the coefficient is negative, suggesting that yield increases as land preparation labour declines. The reason for this is not clear and it may be due to various factors. For example, land that is more easily worked may also provide the best drainage and this will help increase yield as yam does not have a high tolerance of flooding. Thus the preparation labour may reflect the quality of the land, with less labour required to prepare better sites.

## Discussion

The results provide a number of insights. First, there are indications that clean seed yam production can be profitable – perhaps double that of ware yam – in the Edeke area, even without a specialized seed yam market existing nearby. Second, the farmers were reluctant to sell their seed yams, but preferred to retain them for sowing. These observations can be reconciled as the Edeke farmers are ware yam producers with no history of growing seed yam on a large scale, although a few do grow some of their own seed yam. Ware yams provide both sustenance and revenue in a market they know well. Seed yams are smaller and, although those produced in 2011 using the AYMT were healthier than many available elsewhere, there is no seed yam market in nearby towns such as Idah. During a farmers' meeting held in Idah in 2011, they stated clearly their concern about whether their seed yams would generate enough revenue to repay their loans. This highlighted concerns and uncertainty about the absence of a local market for their produce. But having assessed the relative risks involved in seed yam versus what they know well – ware yam – they concluded that their best option was to replant their seed yam to produce ware yam in 2012.

Only four of the Edeke farmers sold their seed yams, but they did manage to obtain good prices. As a result, when the gross margins were extrapolated to a 'per hectare' basis, they were notably higher than for ware yam. Extrapolating what the farmers would gain from the planting of the clean seed yams produced in 2011 is not necessary, and indeed could be misleading as it would depend upon 2012 prices. But there is no doubt that this revenue from ware yam in 2012 will exceed what is required for loan refunds. This is an encouraging development which is in contrast to the more economically marginal assessment by Morse *et al* (2009) based upon a series of farmer-managed trials, but working to a protocol set by researchers. Clearly, in Edeke there is potential for getting the marketing right with the seed yam system, and this can be lucrative. After all, successful markets do exist elsewhere in the Niger Basin (Ibana *et al*, 2012).

The situation in Edeke is uncertain and much depends upon the emergence of local seed yam markets, for which there is a great need. The fact that four of the farmers managed to find a market for some of their seed yams is encouraging and suggests that such markets could be further developed; the indicative gross margins for the seed crop are encouraging. There is possible potential to develop these further, and options will be pursued within a recently initiated yam production project in Nigeria and Ghana funded by the Bill and Melinda Gates Foundation (BMGF) and led by the International Institute of Tropical Agriculture (IITA). This timeline from early DFID support to RIU and now the BMGF shows an important contribution from international funders towards an important African crop.

The Edeke seed yam project is one of many initiatives of the DFID RIU programme in Nigeria, which ended in April 2012. The project provides an example of how RIU succeeded in facilitating an intervention in Nigeria within a relatively short time frame. Two key features which helped were trust and patience, as the project did not go entirely to plan, with farmers opting to use some of the loan to plant ware yam – resulting in seed yam plots being smaller than anticipated. An essential requirement for this trust and patience is the presence of a facilitating agent (DDS) that will be around long after the completion of time-bound programmes such as RIU.

The seed yam project also contrasts with other initiatives promoted by RIU in Nigeria such as the 'triple-bagging' approach adopted for cowpeas mentioned earlier (Sanona *et al*, 2011). Its origins were tied to DFID-funded research on yams over many years, and it requires a significant step change on the part of farmers rather than just the adoption of a new technology. The AYMT is a new approach in the sense of establishing different sett sizes and treatments compared with YMT, but it also requires significant changes in farm practices and marketing, which in turn result in extra costs and risks to the farmer. The farmer has limited resources in any one season, and the production of clean seed yam has to compete for those alongside other enterprises the farming household may wish to be involved in; decisions also involved a range of considerations about household needs and the expected returns and risks. An RIU programme can only go so far in such a complex situation, as it requires more than just the promotion/adoption of a single technology such as a 'triple bag' which can be readily promoted by the private sector. Thus, in the context of large step changes such as promotion of clean seed yam production, it is important for RIU to work through partners that can help facilitate change over the longer term.

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