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Smallholder farmers’ access to improved groundnut production and value addition technologies in Eastern Uganda

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Received 10 December, 2014; Accepted 23 July, 2015

Groundnuts are a key crop in Uganda, both as a source of nutrition and income. However, lack of knowledge and information on progressive practices along the groundnut value chain is a key contributor to the poor performance of the sub-sector. This study envisages establishing baseline knowledge on key aspects of groundnut production, processing and marketing with a view to identifying areas and gaps for capacity building interventions. A total of 155 farmers were randomly selected and primary data collected in early 2013 from three districts in Eastern Uganda namely; Bukedea, Mbale and Tororo. Results indicate that farmers were aware of most recommended pre and post harvest technologies/practices including knowledge on improved groundnut varieties, superior agronomic practices, proper drying and cleaning, long-life storage, grading, sorting and packaging. However, even though most farmers had knowledge of the progressive technologies; quite a substantial number of them did not use these technologies in groundnut production and value addition. This finding points to presence of constraining factors that may hinder access and application of known technologies. Therefore, capacity building efforts to increase both access and utilization of value-enhancing groundnut technologies will eliminate the gap between awareness and use of these technologies for improved livelihoods.

Key words: Awareness, groundnut, knowledge, technology utilization, Uganda.

INTRODUCTION

Uganda like many Sub-Saharan African (SSA) countries’ economies depends largely on agriculture from which the majority of the rural populations derive their livelihoods and incomes. The agricultural sector in Uganda employs 73% of the population (aged 10 years and above), the majority of whom (over 80%) dwell in rural areas. It contributes over 20% to the national Gross Domestic Product (GDP) and supplies agro-based industries with...
raw materials (UBOS, 2008; MAAIF, 2010; NEMA, 2010). Due to the importance of the agricultural sector, the Government of Uganda has put renewed emphasis on this sector. This is supported by many policy documents including the Development Strategy and Investment Plan (DSIP) (MAAIF, 2010). However, agriculture remains largely at a subsistence level (Dijkstra, 2001; UBOS and MAAIF, 2011), is characterized by low agricultural productivity, partly due to high land degradation, nutrient mining and soil fertility depletion (Nkonya et al., 2005; Isabirye et al., 2007; NEMA, 2009), limited investment in soil improving technologies, lack of appropriate information and low adoption of available technologies due to inadequate incentives. Soil fertility has continued to decline to levels that are currently prohibitive to profitable agriculture.

Originally fertile lands have been degraded with cereal crop yields of less than 1 ton ha\(^{-1}\) becoming common (Sanchez and Leakey, 1997; Sanchez, 2002). Similar decline in yields have been observed in groundnut production. Okello et al. (2010) reported that while yields of over 2.5 t/ha have been achieved in experimental plots, farm level data show averages of 0.75 t/ha.

Increasing land productivity and being able to contribute to profitable agriculture requires among other things, addressing the major biophysical factors on land through technologies on soil enhancement, prevention of nutrient loss, and conserving available nutrients either individually or in technology combinations. In light of this, the Uganda National Development Plan (NDP) also seeks to facilitate the availability and access to critical production inputs, especially in agriculture and industry, as well as the promotion of science, technology and innovation (UBOS and MAAIF, 2011).

In the case of groundnuts, research and innovation has led to a number of technologies that have been disseminated to farmers. These technologies include: Resistant groundnut varieties such as Serenut 2 and 4, optimal spacing, motorized shelling machines, peanut grinding machines among others. Some of these technologies are low cost and thus expected to be affordable by a majority of small-scale farmers. However, this requires that the intended user, the promoter and the suppliers be aware and knowledgeable about the benefits of each technology.

This is because knowledge and awareness is the critical first step in using a technology. Awareness helps to create perceptions, attitudes and beliefs about a technology that lead to an agent’s decision to adopt or not adopt the technology (Rogers, 1995). Unfortunately there is limited knowledge on what farmers currently know about the technology, their sources of information about the technologies, the method of information gathering and the factors that determine technology awareness. Knowledge of this is important for a number of reasons: First, it helps researchers to understand the potential usage of the disseminated technologies and this information acts as a check on impact of the researchers’ effort. Second, it helps to compare what they know and what they utilize which is important to understand the constraints in employing technologies that they know but do not use. Thirdly, knowing what farmers know about a technology is important in order to design ways of improving knowledge transfer to intended users. It is therefore important to know the level of farmers’ awareness of land improvement technologies, the networks that farmers join to access that information and the barriers to technology access and utilization (Duff et al., 1992; Tucker and Napier, 2002).

The major thrust of this paper is to analyze the determinants of awareness of soil fertility improvement technologies in the three districts of Bukedea, Mbale and Tororo. The specific objectives include: Understanding the level of awareness of integrated soil fertility management (ISFM) technologies in the area, identifying challenges faced by groundnut farmers in accessing soil fertility improvement technologies and to determine the factors that drive awareness of ISFM technologies by groundnut farmers.

**MATERIALS AND METHODS**

The study was carried out as part of a project in view to upscale ISFM technologies in East and Central Africa. In Uganda, purposive selection of survey respondents was conducted using a multi-stage sampling procedure. First, the districts of Bukedea, Tororo and Mbale were selected based on past involvement under Phase 1 of the ISFM project (for Mbale) and also based on the importance of the project enterprises in the districts (Tororo and Bukedea for Groundnuts). The second stage of sampling involved sampling of sub-counties based on their share of production of groundnuts in the district. The third stage of sampling involved random selection of farmers from the selected sub-counties. Lists of farmers obtained from the sub counts were used as sampling frames and a total of 50 farmers were randomly sampled from each district, making a total 150 groundnut farmers in the three districts.

Data collection was by use of direct face-to-face interviews with the aid of questionnaires. The questionnaire captured data on socio-demographic characteristics of the respondents, production data, knowledge and awareness of technologies used in production, post-harvest handling and value addition in groundnuts in the selected districts and sub-counties. Data analysis was performed using SPSS v16 and STATA version 12.0. Descriptive statistics of selected socio-economic characteristics (means, standard deviations, frequencies and percentages) were generated and are presented in Table 1 along with the sampled areas.

The present study uses descriptive statistics (frequencies, coefficient of variation, means and standard deviation) to analyze the farmers’ level of awareness of integrated soil fertility management (ISFM) technologies and the challenges faced by groundnut farmers in accessing soil fertility improvement technologies. The ordered logit model is used to analyze the determinants of farmers’ awareness of ISFM groundnut technologies using extension staff as their source of information.

**The ordered logit model**

The Ordered Logit Model is used when the response variable is...
Table 1. Selected Socio-economic characteristics of respondents in Taroro, Mbale and Bukedea.

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distribution (n=155)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tororo</td>
<td>53</td>
<td>34.2</td>
</tr>
<tr>
<td>Mbale</td>
<td>52</td>
<td>33.5</td>
</tr>
<tr>
<td>Bukedea</td>
<td>50</td>
<td>32.3</td>
</tr>
<tr>
<td><strong>Gender (n=155)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>77</td>
<td>49.7</td>
</tr>
<tr>
<td>Female</td>
<td>78</td>
<td>50.3</td>
</tr>
<tr>
<td><strong>Marital status (152)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>123</td>
<td>80.9</td>
</tr>
<tr>
<td>Single</td>
<td>7</td>
<td>4.6</td>
</tr>
<tr>
<td>Other</td>
<td>24</td>
<td>14.5</td>
</tr>
<tr>
<td><strong>Household head (n=112)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>101</td>
<td>90.1</td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>8.9</td>
</tr>
<tr>
<td>*<em>Main occupation</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staple food production</td>
<td>144</td>
<td>46.8</td>
</tr>
<tr>
<td>Fruits and vegetable growing</td>
<td>62</td>
<td>30.1</td>
</tr>
<tr>
<td>Livestock rearing</td>
<td>47</td>
<td>27.8</td>
</tr>
<tr>
<td>Others</td>
<td>18</td>
<td>5.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement unit</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>43.2</td>
<td>14.3</td>
</tr>
<tr>
<td>Education</td>
<td>7.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Farming experience</td>
<td>22.7</td>
<td>14.1</td>
</tr>
<tr>
<td>Total household size</td>
<td>5.2</td>
<td>6.4</td>
</tr>
<tr>
<td>Number of dependents</td>
<td>4.2</td>
<td></td>
</tr>
<tr>
<td>Land size</td>
<td>5.2</td>
<td>8.8</td>
</tr>
<tr>
<td>Cultivated land</td>
<td>3.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Land allocated to groundnuts</td>
<td>1.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Land allocated to maize</td>
<td>1.1</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Consider an index model for a single latent variable $y^*$ where:

$$y_i^* = x_i' \beta + u_i$$  \hspace{1cm} (i)

$$y_i = j \text{ if } a_{j-1} < y_i^* \leq a_j$$  \hspace{1cm} (ii)

The probability that observation $y_i$ will select alternative $j$ is:

$$p_j = p(y_i = j) = p(a_{j-1} < y_i^* \leq a_j) = F(a_j - x_i' \beta) - F(a_{j-1} - x_i' \beta)$$  \hspace{1cm} (iii)

The ordered choice model generalizes the notion of multiple thresholds. In a sense, we cannot observe $y^*$ directly but only the range with which it falls. The observed choice might reveal only an individual’s relative preference.

For the ordered logit, $F$ is the logistic cumulative density function given as:

$$F(z) = \frac{e^z}{1 + e^z}$$  \hspace{1cm} (iv)

The parameters to be estimated are a set of coefficients $\beta$ corresponding to the explanatory factors in $x_i$, as well as a set of $(J-1)$ threshold values $\alpha$ corresponding to the $J$ alternatives. In the interpretation of the estimators in ordered logit, actual values of the response variable (in this case; rating the use of extension personnel) are not relevant. Larger values are taken to correspond to higher outcomes. If there are $J$ possible outcomes, a set of threshold coefficients or cut points $\{\alpha_1, \alpha_2, \ldots, \alpha_{J-1}\}$ is defined where $\alpha_0 = -\infty$ and $\alpha_J = \infty$. The ordered logit model with $J$ alternatives will have one set of coefficients with $(J-1)$ intercepts. You can recognize an ordered choice model by the multiple intercepts. In the interpretation of the coefficients, the sign
of the parameters shows whether the latent variable $y^*$ increases with the regressor. The ordered logit model with $j$ alternatives will have $j$ sets of marginal effects. The marginal effect of an increase in a regressor on the probability of selecting alternative $j$ is:

$$
\frac{\partial p_{ij}}{\partial x_i} = \left[ F(\alpha_{j-1} - x_i \beta) - F(\alpha_j - x_i \beta) \right] \beta_j
$$

Where, the marginal effects of each variable on the different alternatives sum up to zero. The interpretation of the marginal effects is such that each unit increase in the dependent variable increases/decreases the probability of selecting alternative $j$ by the marginal effect expressed as a percent relative to the base category.

The reduced form equation that was estimated in this paper is given as:

$$
\text{EXTENSION} = \alpha + \beta_1 \text{AGE} + \beta_2 \text{SEX} + \beta_3 \text{EDUC} + \beta_4 \text{EXP} + \beta_5 \text{STAPLEINCOME} + \beta_6 \text{CHEMICAL} + \beta_7 \text{IPM} + \beta_8 \text{HHSIZE}.
$$

The definition of the variables used in the reduced form equation and their measurement is given in Table 2.

### RESULTS AND DISCUSSION

#### Challenges in using improved soil fertility enhancing technologies by smallholder farmers

All the respondents (100%) reported that the high cost of chemical fertilizer was the major reason inhibiting its usage. Other reasons included lack of knowledge about the technology. About 50% of the respondents believed that fertilizers destroy the land and 48% of the sampled respondents reported that fertilizers were unavailable (Table 3). About 40% of the farmers did not use chemical fertilizers because these particular farmers perceived their farms to be fertile hence without need for application of chemical fertilizers.

The results in Table 3 show that the biggest challenges to adoption of chemical fertilizer included high cost of fertilizer (expensive), lack of technical knowledge regarding use of the technology and unavailability of fertilizers. This implies that if increased use of this technology is to be realized, these three factors must be considered.

As shown in Table 4, farmers were examined for their knowledge on the average yield of crops with and without chemical fertilizer use. The average yields of maize, groundnuts, rice, millet and beans in kilogram per hectare were 1013, 484, 962, 527 and 600 kg/ha respectively without fertilizer use. However, the coefficient of variation for the crop yields in the three districts was high due to a number of reasons. First, yield differences may be due to differences in soil fertility with some farmers realizing better yields because of good soils while others realize low yields due to infertile soils. Another reason is attributed to the differences in the types of crop varieties planted and differences in managerial abilities of the different farmers in the three districts. In addition, a given crop variety may yield differently in different geographical locations.

The results in Table 4 indicate that with application of chemical fertilizers the average yields for maize, groundnuts, millet, banana, cassava, rice and sweet potato were: 1089, 1106, 1503, 6740, 1607, 1950 and 1393 kg/ha, respectively. Comparing the results of average yields with and without chemical fertilizers, it is observed that that with exception of maize yield, there is higher margin between average yields without chemical fertilizers and those with chemical fertilizers implying that farmers can realize higher crop yields with fertilizer use. The coefficients of variation for average yields with chemical fertilizers are more consistent compared to those without application of chemical fertilizers (Table 4).
Table 3. Possible reasons hindering wide usage of Chemical Fertilizers in Tororo, Mbale and Bukedea districts.

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percentage of responses</th>
<th>Percentage of sample*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unavailability</td>
<td>74</td>
<td>13.1</td>
<td>48.1</td>
</tr>
<tr>
<td>Unaffordable/too expensive</td>
<td>154</td>
<td>27.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Destroy land</td>
<td>79</td>
<td>14.0</td>
<td>51.3</td>
</tr>
<tr>
<td>Do not work (no response)</td>
<td>38</td>
<td>6.7</td>
<td>24.7</td>
</tr>
<tr>
<td>Not needed/farms are fertile</td>
<td>61</td>
<td>10.8</td>
<td>39.6</td>
</tr>
<tr>
<td>Do not know how to use</td>
<td>121</td>
<td>21.5</td>
<td>78.6</td>
</tr>
<tr>
<td>Not profitable</td>
<td>36</td>
<td>6.4</td>
<td>23.4</td>
</tr>
<tr>
<td>Total</td>
<td>563</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

*Multiple responses.

Table 4. Average yield obtained in kg/ha with and without chemical fertilizer of various crops.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Without fertilizer</th>
<th>With fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (N=155)</td>
<td>Std dev</td>
</tr>
<tr>
<td>Maize</td>
<td>1,013.2</td>
<td>2445.6</td>
</tr>
<tr>
<td>Beans</td>
<td>600</td>
<td>1411.6</td>
</tr>
<tr>
<td>Sorghum</td>
<td>385.6</td>
<td>802</td>
</tr>
<tr>
<td>Grain amaranths</td>
<td>205</td>
<td>275.8</td>
</tr>
<tr>
<td>Groundnuts</td>
<td>484</td>
<td>1,051.4</td>
</tr>
<tr>
<td>Banana</td>
<td>120.4</td>
<td>1643.2</td>
</tr>
<tr>
<td>Coffee</td>
<td>156</td>
<td>1,339</td>
</tr>
<tr>
<td>Millet</td>
<td>1526.8</td>
<td>792.4</td>
</tr>
<tr>
<td>Cassava</td>
<td>1123.7</td>
<td>888.8</td>
</tr>
<tr>
<td>Rice</td>
<td>962.5</td>
<td>863.5</td>
</tr>
<tr>
<td>Soybean</td>
<td>71.7</td>
<td>25.7</td>
</tr>
<tr>
<td>Sweet potato</td>
<td>1139.3</td>
<td>1181.6</td>
</tr>
</tbody>
</table>

The finding that farmers realized higher yields with the use of chemical fertilizers compared to non-use is an indication that use of improved technologies enhances agricultural productivity. This implies that efforts taken to address the challenges in the use of improved technologies shall be instrumental in changing the status quo; from subsistent to commercialized agriculture. Such efforts should focus on improving accessibility and affordability of the superior technologies (such as improved seed and fertilizers) and farmers’ technical knowledge.

Awareness and use of soil improvement technologies

The results in Table 5 show levels of awareness of soil improvement technologies. In order of decreasing importance, awareness was highest for crop rotation (96%) intercropping (95%) and farm yard manure (90%) whereas seventy two percent of all the farmers were aware of chemical fertilizers and optimal plant populations. Technologies that were least known as soil enhancing technologies included green manure, soil bands, contouring, terracing, agro-forestry and minimum tillage. Terracing and contouring are technologies most applicable to hilly terrain. The terrain in most of the study area (with the exception of Mbale) was relatively flat and hence these two technologies would be least expected to be practiced.

In the overall sample 67% of the farmers had adopted farm yard manure as a soil fertility improvement technology. It is important to note that the 48 farmers that used chemicals applied them on multiple crops. From the findings, the fact that 67% of the farmers applied farm yard manure in agricultural production implies efforts by farmers to intensify agricultural production. In addition, 31% of farmers used fertilizer as an agricultural input in their production, which corresponds to 43% of those who were aware of chemical fertilizers. The fact that 43% of those who had heard about chemical fertilizer actually used them is an indication of high adoption potential of

\[\text{Percentage of sample} = \frac{\text{Number of farmers using fertilizer}}{\text{Total number of farmers}} \times 100\]
ISFM technologies. As depicted in Table 5, about 54% of the farmers were aware about soil fertility improvement technologies using green manure and out of these, 64% had used green manure. This gives a difference of 36% who had not adopted green manure and yet they were aware about it. The reason underlying this behavior may be due to farmers’ perceptions about green manure as a technology that is bulky to apply hence labor intensive; therefore some farmers may not adopt it.

Close to 96% of the respondents were aware about crop rotation and 94% of all farmers had adopted the technology. Crop rotation plays a major role in conserving soil fertility in that it reduces the depletion of soil nutrients. Additionally, crop rotation is important in the control of crop pests by breaking the cycle of pest and disease-causing organisms thereby minimizing the risk of yield losses. Therefore the high adoption of crop rotation is important for crop production in Eastern Uganda. A number of reasons can be given for its wide adoption. First, farmers in Eastern Uganda (with exception of Mbale) have relatively large acreages which can allow for rotation. Secondly, crop rotation is not a capital intensive technology, that is, farmers do not need very high investment to adopt it.

The results in Table 5 also show that intercropping is widely known and used by farmers. As with crop rotation, intercropping does not require much capital to be used by the farmers. It is an efficient land resource utilization cropping system for the smallholder farmers who lack access to land resources. This is therefore the reason as to why 95 and 89% of the farmers knew about it and used it respectively. About 43% of the farmers were not aware of soil bands while close to 57% of the farmers had knowledge about it. Overall, 56% of the farmers did not adopt (most of whom did not know about the technology) while about 78% of the respondents who knew about the technology were using it. Soil bands were mostly used on maize, beans and sorghum in that order.

### Awareness of other technologies

Table 6 shows farmers’ awareness about the key practices/activities used in crop enterprise pre and post harvest handling. Results show that the majority of the farmers were aware about the key activities/practices that were asked by the research team. Over 90% of the farmers were aware about value addition, improved planting materials, better agronomic practices, timely harvesting, proper drying/cleaning, proper storage, and grading/sorting; while over 80% of the farmers expressed their awareness about packaging or bagging, promotion and measuring/weighting. Over 50% of the farmers were aware about processing and preservation. On the other hand, the majority of the farmers were unaware about branding, labeling and display/weighting.

### Sources of information on ISFM technologies

Farmers gave various sources of information for various technologies. With regard to chemical fertilizer, about 72% of the entire sample of farmers (30% of all responses) reported that extension staff/NAADS were the major source of information on chemical fertilizer while 63, 36 and 34% of the entire sample (or 26, 15 and 14% of all responses) said that fellow farmers, agro-dealers and media were the major sources of information for chemical fertilizer use. NGOs, development partners or research projects were insignificant sources of information on chemical fertilizer usage (Table 7).
Table 6. Awareness of improved technologies by farmers in Tororo, Mbale and Bukedea districts (n=155).

<table>
<thead>
<tr>
<th>Awareness</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value Addition</td>
<td>147</td>
<td>94.8</td>
</tr>
<tr>
<td>Improved planting material</td>
<td>148</td>
<td>95.5</td>
</tr>
<tr>
<td>Better agronomic practices</td>
<td>149</td>
<td>96.1</td>
</tr>
<tr>
<td>Timely Harvesting</td>
<td>153</td>
<td>97.8</td>
</tr>
<tr>
<td>Proper drying/cleaning</td>
<td>153</td>
<td>97.8</td>
</tr>
<tr>
<td>Proper storage</td>
<td>150</td>
<td>96.8</td>
</tr>
<tr>
<td>Grading and sorting</td>
<td>145</td>
<td>93.5</td>
</tr>
<tr>
<td>Processing</td>
<td>104</td>
<td>67.1</td>
</tr>
<tr>
<td>Packaging or bagging</td>
<td>123</td>
<td>80.9</td>
</tr>
<tr>
<td>Labeling</td>
<td>53</td>
<td>34.2</td>
</tr>
<tr>
<td>Branding</td>
<td>33</td>
<td>21.3</td>
</tr>
<tr>
<td>Promotion</td>
<td>124</td>
<td>80</td>
</tr>
<tr>
<td>Preservation</td>
<td>85</td>
<td>54.8</td>
</tr>
<tr>
<td>Display/lighting</td>
<td>49</td>
<td>31.6</td>
</tr>
<tr>
<td>Measuring/weighting</td>
<td>136</td>
<td>87.7</td>
</tr>
</tbody>
</table>

Table 7. Sources of information on chemical fertilizer in Tororo, Mbale and Bukedea districts.

<table>
<thead>
<tr>
<th>Response</th>
<th>Frequency</th>
<th>Percent of responses (n=378)</th>
<th>Percent of sample (n=155)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension staff/NAADS</td>
<td>112</td>
<td>29.6</td>
<td>72.3</td>
</tr>
<tr>
<td>Agro-dealers</td>
<td>55</td>
<td>14.6</td>
<td>35.5</td>
</tr>
<tr>
<td>Research projects</td>
<td>26</td>
<td>6.9</td>
<td>16.8</td>
</tr>
<tr>
<td>Fellow farmers</td>
<td>98</td>
<td>25.9</td>
<td>63.2</td>
</tr>
<tr>
<td>Media</td>
<td>53</td>
<td>14.0</td>
<td>34.2</td>
</tr>
<tr>
<td>NGOs and development partners</td>
<td>34</td>
<td>9.0</td>
<td>21.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>378</strong></td>
<td><strong>100.0</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Multiple responses.

Table 8. Importance of extension staff as a source of information for farmers in Tororo, Mbale and Bukedea districts.

<table>
<thead>
<tr>
<th>Importance of extension staff</th>
<th>Frequency</th>
<th>Percent of responses (n=109)</th>
<th>Percent of sample (n=155)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major source</td>
<td>72</td>
<td>66.1</td>
<td>46.5</td>
</tr>
<tr>
<td>Important source</td>
<td>24</td>
<td>22.0</td>
<td>15.5</td>
</tr>
<tr>
<td>Secondary source</td>
<td>13</td>
<td>11.9</td>
<td>8.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>109</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

The finding that extension staff are the major source of farmers’ agricultural information implies that interventions that are focused towards strengthening and enhancing the extension system shall be better placed in enhancing farmers access to information on ISFM technologies and ultimately enhance the adoption of superior agricultural technologies. Farmers were told to rank the importance of extension staff as a choice of information. The responses in Table 8 show that about 66% of respondents rank extension as a major source of information while 22 and 12% said that extension staff was an important and secondary source of information respectively. This indicates that agricultural research and extension policies should foster interventions that can...
Table 9. Determinants of the use of extension staff as a source of information for ISFM technologies in Tororo, Mbale and Bukedea districts.

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Coefficient</th>
<th>dy/dx for extension as a major source of information (outcome 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>-0.0385854 (0.055492)</td>
<td>-0.0062065 (.00961)</td>
</tr>
<tr>
<td>SEX</td>
<td>-2.370379** (0.93611)</td>
<td>-0.3890574** (0.15925)</td>
</tr>
<tr>
<td>EDUC</td>
<td>-0.3886394** (0.1835)</td>
<td>-0.0625134*** (0.03684)</td>
</tr>
<tr>
<td>EXP</td>
<td>0.1219867** (0.05744)</td>
<td>0.0196218 (0.01198)</td>
</tr>
<tr>
<td>STAPLEINCOME</td>
<td>1.11e-06 (8.11e-07)</td>
<td>1.78e-07** (0.00000)</td>
</tr>
<tr>
<td>CHEMICAL</td>
<td>-0.0625494 (0.052427)</td>
<td>-0.0100612 (0.00912)</td>
</tr>
<tr>
<td>IPM</td>
<td>4.40661** (1.704933)</td>
<td>0.7709153 (0.12992)</td>
</tr>
<tr>
<td>HHSIZE</td>
<td>0.1782079 (0.1336869)</td>
<td>0.0286651 (0.0248)</td>
</tr>
<tr>
<td>/cut1</td>
<td>1.777202 (1.916261)</td>
<td></td>
</tr>
<tr>
<td>/cut2</td>
<td>3.989325 (2.025511)</td>
<td></td>
</tr>
</tbody>
</table>

Log likelihood: -30.855661
Number of observations: 50
LR chi²(8): 26.55*
Pseudo R²: 0.3008
Testparm: 13.49***

***, ** and * 1, 5 and 10% level of significance. Figures in parentheses are standard errors.

enhance the development of an effective and efficient agricultural technology transfer policy for information dissemination to farmers.

**Importance of other information sources for farmers in Tororo, Mbale and Bukedea districts**

About 48% of the farmers reported that agro-dealers were an important source of information while 27 and 25% ranked agro-dealers as a major and secondary source of information respectively. In addition, a large number of farmers (82 out of the entire sample) ranked fellow farmers as a source of information. Of these, 37% ranked fellow farmers as a major source of information while 40% and 23% of the farmers ranked fellow farmers as an important and secondary source of information respectively. This implies that the farmer-to-farmer linkage formed a strong platform for information sharing amongst groundnut producers. From such informal platforms, farmers actively gather information from fellow farmers to enhance their knowledge characterized by pooling information or observing the behavior of others and imitating it (Katungi et al., 2008).

Therefore, policies should target and encourage informal sources as important sources of agricultural information for smallholder farmers. Ordered Logit Regression results (Table 9) show the determinants of extension as an important source of agricultural information by farmers. From these findings, sex of respondent is positively (coeff. = 2.37 P > |z| = 0.011) related to choosing extension as a choice of agricultural information source. Male farmers are more inclined to seek agricultural information from extension agents. This results has been arrived at by various researchers in different settings (Mbaga-Semgalawe and Folmer, 2000; Bayard et al., 2007; Tiwari et al., 2008; Mugisha et al., 2012).

In addition, the level of education was positively related to choosing extension agents while the farmer's experience was negatively related to choosing extension. This is because educated individuals tend to use formal channels of information access because they believe that the formal channels provide the right kind of information hence the reason as to why education is positively related to choosing extension. This result is in line with findings of others like Sidibe (2005) and Mugonola et al. (2013). On the other hand, experience is negatively related to choice of extension as a major information source because experienced individuals tend to know much about their farming activities hence may not require or seek additional information from any formal sources.

Use of improved planting materials is negatively related to choice of extension (coeff. = -4.41 P > |z| = 0.01). This may be attributed to the fact that most farmers access improved planting materials through farmer-to-farmer exchange rather than through extension agents therefore use of improved planting materials is likely to lead to choice of extension as a less important source of information by the farmers.

These results show that those who sought the services of extension service did so for purposes of obtaining other advice but not planting materials.

**Model fitness**

The test of whether the variables showing preferences for
extension staff should be in the model (Table 9) showed
that the included variables were significant at the 10%
level ($\chi^2 (8) = 13.49, \text{Prob} > \chi^2 = 0.0962$) implying that
without the included variables in the model, the
categories of the dependent variable would not be
significant. Marginal effects for the 3 outcome categories
of the dependent variable presented in Table 9 are a test
of the effect of a change of dummy variable from 0 to 1
for each category. The marginal effects in the two end-
groups ($\text{Import}_{\text{ext staff}} = 1$ and $\text{Import}_{\text{ext staff}} = 2$) are
highly significant.

By contrast, only two of the marginal effects in the last
group are significant at the 10% significance level. This
implies that, when a particular variable changes (say, age
increases by 1 unit), the number of people moving from
group 1 to group 2 is not more or less the same as the
number of people moving out of group 2 into group 3, so
that the probability of being in group 3 may significantly
change.

Conclusions

The study used baseline survey data collected in the
districts of Bukedea, Mbane and Tororo. Descriptive
statistics were generated using SPSS v16 and detailed
data analysis was performed using STATA v-12. This
paper discusses the study results using percentages,
means, frequencies and standard deviations presented in
Tables 3 to 7. Results revealed that the biggest
challenges include un-affordability, lack of technical
knowledge regarding use of the technology and
unavailability of fertilizers. This implies that if increased
use of chemical fertilizers in groundnut production is to be
realized, these three factors will have to be addressed.

In order of decreasing importance, awareness was
highest for crop rotation (96%), intercropping (95%) and
farm yard manure (90%). Seventy two percent of all the
farmers were aware of chemical fertilizers and optimal
plant population. Technologies that were least known as
soil enhancing technologies included green manure, soil
bands, contouring, terracing, agro-forestry and minimum
tillage. For all ISFM technologies, there was a disparity
between awareness and utilization implying that not all
the farmers who knew about a given technology applied
it. This suggests a potential for the project’s interventions
in increasing utilization of ISFM technologies.

Farmers had access to varied sources of information.
Many farmers obtained farming advice from extension
personnel and from fellow farmers. The least responses
were for research projects, NGOs, the media and agro-
dealers as important information sources. The fact that
extension service providers were the biggest contributors
to information on chemical fertilizers for the sample
implies that interventions in the area can leverage on this
already existing establishment if they are to reach a wider
coverage of farmers. In addition, the finding that farmers
are a significant source of information for their fellow
farmers suggests that to improve the quality of the shared
information, training of these farmers should be
conducted so as to create a hub of (technical) information
to support other farmers within a farmers’ group. Another
reason could be that formal sources of information (such
as extension agents, NGOs and agro-dealers) may not be
accessible such that farmers rely more on their peers
than technical service providers. This latter case requires
that efforts be put in place to make technical agricultural
services more accessible.

Conflict of Interest

The authors have not declared any conflict of interest.

ACKNOWLEDGEMENT

This research was conducted with support from the
Association for Strengthening Agricultural Research in

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Evaluation of biomass yield of selected fodder species in relation to frequency of harvest alongside defoliation heights in Western Kenya

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Received 11 June, 2015; Accepted 23 July 2015

Napier grass (Pennisetum purpureum Schumach), the most preferred fodder species for dairy production in East and Central Africa, is under threat from stunt disease caused by Candidatus Phytoplasma oryzae (Ns-phytoplasma). The disease reduces forage yield by 40 to 90%. Two alternative fodder grasses, Guinea grass (Panicum maximum Jacq) and Guatemala grass (Tripsacum laxum Scrib and Merr) and a new stunt disease tolerant Napier cv Ouma 3 were studied to determine their biomass production potential when subjected to three intervals harvest (4, 8, 12 weeks) alongside three basal heights of defoliations (5, 10 and 15 cm). The study was conducted at KARI, Kakamega (high rainfall zone) and KARI, Alupe (low rainfall zone) in Kenya. A split-split plot design with 3×3 factorial treatment arrangements was used. A 4-weekly interval of harvesting alongside defoliation heights of 10 and 15 cm significantly increased biomass yield in Napier cv Ouma (38.47 and 33.90 T/ha/year respectively) compared to Guatemala grass and Panicum maximum which yielded 23.3 and 27.4 T/ha/year respectively. There is appositive correlation between yield and morphological parameters with canopy diameter, plant height and number of leaves highly correlating in biomass yield.

Key words: Frequency of harvest, alternative species, defoliation height, biomass yield, fodder species.

INTRODUCTION

In Sub-Saharan Africa improved grasses and legumes have been recommended for livestock production due to their high dry matter yield as well as nutritive value (Onyeonagu and Asiegbu, 2013). Napier grass (Pennisetum purpureum Schumach) is the most preferred fodder species for dairy production in East and Central Africa. It can provide a continual supply of green forage throughout the year and it fits in intensive small-scale farming. It is the dominant grass in zero-grazing systems and can out-yield many other grasses such as Guinea grass (Panicum maximum) and Rhodes grass (Chloris gayana) (Orodho, 2006). It can withstand repeated cutting, and four to six cuts is able to yield 50 to 150 tons per hectare per year (Orodho, 2006). It is the main feed

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for dairy cows supplemented by crop residues in western Kenya (ICRAF, 1997). However, the threat of Napier Stunt Disease against Napier grass in western Kenya inspired the development of Napier cultivars that is tolerant to the disease hence the need to understand its physiological response to defoliation stress and biomass productivity compared with selected alternative fodder species.

The selected alternative fodder species have been found to be tolerant to Stunt disease (Wamalwa, 2013) but their adoption in the dairy farming system of Western Kenya is little understood, possibly because of greater emphasis previously placed on Napier grass. *Andropogon gayanus, chloris gayana, Sorghum almum, Panicum maximum* and *Guatemala tripsacum* are viewed as potential alternative fodder grasses to Napier grass in the dairy industry in Western Kenya (Orodho, 2006). *Tripsacum laxum* and *Panicum maximum* have the potential of producing up to 18 to 22 tons/ha/year and 9 to 10 t/ha/year respectively with protein concentration of 7 to 10% (Sebastian et al., 2013).

Harvesting of forages without due consideration of frequency of harvest and defoliation height may affect the regrowth of the remaining stubble residues. Studies have shown variation in species tolerance to frequency of harvest and intensity of defoliation arising from differences in growth habits and root systems (Onyeonagu and Asiegbu, 2013) Scanty information exist in Western Kenya regarding the relation between biomass yield, frequency of harvest and defoliation height for Guatemala and Panicum species (Orodho, 2006) as well as newly identified stunt disease tolerant *Napier cv Ouma*.

Furthermore, knowledge on stage of harvest as well as frequency of harvest is important because the quality and quantity of forage species for animal feed is partially contributed by these factors (Ball et al., 2001). The objective of the study was to determine biomass production of the alternative fodder species and *Napier cv Ouma* in relation to frequencies of harvest alongside defoliation heights in western Kenya.

**MATERIALS AND METHODS**

The study was conducted at KALRO Kakamega and Alupe sites of western region of Kenya (Figure 1). Kakamega and Alupe sites represent the Low Midlands 2 (LM 2) and Low Midlands 3 (LM 3) respectively with an altitude of approximately 1430 m and 1330 asl respectively (Jaetzold et al., 2005). The amount of rainfall received during the study period in 2012 LR and 2012 SR was 548
mm and 186 mm (Total 891.1 mm) at Kakamega and 186 mm and 460 mm (Total 646 mm) at Alupe. In 2013, Kakamega recorded 1064.3 in LR and 634.6 in SR (total 1698.9mm) while Alupe recorded 1190 in LR and 515 in SR (total 1705mm).” More than 75% of the precipitation was received in long rain season (March-August).

Mean annual minimum temperature was 13°C while corresponding maximum temperature was 29.6°C at Kakamega site and Alupe site the minimum was 15.3°C and maximum 31.4°C. The general soil texture for Kakamega site was sandy loam while at Alupe site it was sandy clay loam soil. The soil pH for Kakamega and Alupe sites were 5.1 and 4.94, respectively which were classified as slightly acidic based on the critical value levels (Okalebo et al., 2002). The organic carbon levels of soils at Kakamega and Alupe sites were 3.4 and 2.5% respectively which were classified as moderate (Okalebo et al. 2002). Nitrogen content in the soil at Kakamega site was 0.2% while Alupe was 0.12%. The two sites contain moderate levels of Nitrogen content in the soil as classified by Okalebo et al. (2002).

The experimental design was randomized complete block design arranged in a split-split with three replications (blocks). This was a three-factor experiment where three levels of precision were required for the various effects (Gomez and Gomez, 1984). The main-plot factor was the frequency of harvest and the sub-plot factor was defoliation height while the sub-sub-plot factor was the species. There were 27 treatments replicated three times, which consisted of three frequencies of harvest (4, 8 and 12-weekly interval of harvest), three defoliation heights (5, 10 and 15 cm) and three fodder species (Panicum maximum Schum), Guatemala tripacum and Napier grass cv Ouma).

Three rooted-splits of Panicum maximum and Guatemala grass and one rooted split of Napier cv Ouma (Ramadhian et al., 2012) were uprooted from the parent field and planted in prepared holes of 15 cm depth on a plot size of 2×2 m at 0.5 to 0.5 m spacing for Panicum and Guatemala grass while Napier grass was 1 to 1 m to maintain optimum plant density (Muia et al., 1999). Fertilizer was applied at the rate of 60 kg/ha of N and 9.3% of P top-traced with 100 kg of CAN immediately after defoliation to minimize the local soil nutrients influence on the performance of the fodder species. Biomass yield was determined by hand clipping three and nine internal stools of Napier grass and Panicum and Guatemala respectively at their respective defoliation heights and frequency harvest. At 4-weekly interval of harvest, three defoliation heights of 5, 10 and 15 cm for each forage grass were clipped manually using secateurs and field weights measured using electronic balance. The clipped samples were chopped into small pieces (about 3 cm lengths) weighing about 500 g. The samples were oven dried at 60°C for 48 h to determine percentage dry matter. The same procedure was conducted for samples harvested at 8-weekly and 12 weekly intervals. Statistical analysis was done using the statistical analysis system (SAS). The data were subjected to analysis of variance (ANOVA) and the means were separated using Duncan’s Multiple Range Test (DMRT) at the 5% level of significance. Dry matter yield was calculated using the following formula:

\[
\text{Sample dry weight (kg)} \times 100
\]

\[
\frac{\text{Whole field weight (kg)}}{1 \text{ ha} \times \% \text{Sample dry matter (tons)}} \times \text{Sampled area (ha)}
\]

**Table 1.** Interaction between frequency of harvest, defoliation height and species on cumulative dry matter yield at Kakamega site.

<table>
<thead>
<tr>
<th>Frequency of harvest (weeks)</th>
<th>Defoliation height (cm)</th>
<th>Dry matter yield t/ha/year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Guatemala</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>16.6(^a)</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>23.3(^a)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>20.7(^i)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>14.9(^i)</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td>15(^i)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>14.5(^i)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>8.5(^n)</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
<td>12.2(^c)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>12.7(^{kl})</td>
</tr>
</tbody>
</table>

DMRT\(_{0.05} = 1.66; CV\% = 5.34; NoMeans marked by different letters are significantly different at p<0.05 significance level.

**FINDINGS AND RECOMMENDATIONS**

Significant interactions (p≤0.05) between frequency of harvest, defoliation heights and fodder species were observed in cumulative biomass yield at Kakamega and Alupe sites. Napier grass cv Ouma significantly (p≤0.05) out-yielded Guatemala and Panicum when harvested at 4-weekly interval alongside defoliation height of 10 cm above the ground followed by the same species harvested at 4-weekly interval but defoliated at 15 cm stubble height (34 T/ha/year) at both Kakamega and Alupe sites (38.5 and 34 t/ha/year respectively) (Table 1 and 2). The result is in agreement with results of
Muyekho et al. (2003), where dry matter yield of recommended Napier grass varieties (Bana grass, French Cameroon and Clone out-yielded Guatemala grass when harvested at 4-weekly interval along with defoliation height of 10 cm above the ground. This could be explained by cumulative biomass yield after several repeated harvests (12 times) for the 4-weekly intervals compared to 8-weekly interval which was repeatedly harvested 6 times and 12-weekly intervals which had three repeated harvests within the experimental period of two years.

The trend of increased dry matter yield with interval of harvest in this study is in agreement with the findings of Saddul et al. (2004) who obtained increased biomass yield with increased intervals of harvest. Furthermore, Hsu et al. (2005) established that forage yield and quality of Nile grass (Acroceras macrum Stapf) and Pangola grass (Digitaria eriantha Steud) increased yield with increased frequencies of cutting. Conversely extended interval of harvest similar to 12-weekly and 8-weekly interval yielded low mainly because there was less re-growth and tillering in our present study.

This result is in agreement of Hoglind et al. (2005) who reported that more frequent harvest promoted re-growth and tillering in fodder grasses than less frequent harvesting. Ruiz et al. (2012) attributed to less biomass yield as a result of longer intervals between the harvests to the aging of the leaves and a great number of them fall down due to senescence. Njarui et al. (2008) found Napier grass yielding more than P. maximum due differences tillering ability during re-growth after defoliation.

Stichler and Bade (2002) found the stage of plant growth important in determining the biomass yield. In his research on frequency and cutting heights on biomass production of Tithonia diversifolia, Hsu et al. (2005) reported that plants cut at 5 cm and more frequent

<table>
<thead>
<tr>
<th>Frequency of harvest weeks</th>
<th>Cutting height (cm)</th>
<th>Dry matter yield t/ha/year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Guatemala</td>
<td>Napier cv Ouma</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>12.9&lt;sup&gt;i&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>19.7&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>14.3&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>12&lt;sup&gt;k&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>13.7&lt;sup&gt;zi&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>13.0&lt;sup&gt;i&lt;/sup&gt;</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>9.3&lt;sup&gt;no&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>8.6&lt;sup&gt;qo&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>10.7&lt;sup&gt;mn&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

DMRT<sub>0.05</sub> = 1.07; CV% = 3.56. Means marked by different letters are significantly different at p≤0.05 significance level using DMRT.

The findings in this current study suggest Panicum has a potential of being an alternative fodder to Napier grass cv Ouma in western Kenya when harvested at 4-weekly interval alongside defoliation basal height of 10 cm. Apart from high yielding when forage is harvested at the frequency of 4-weeks, Stichler and Bade (2002) observed that the forage is more palatable and large quantities is used by grazing animals. Although Napier grass cultivar Ouma is more tolerant to stunt disease (Khan personal communication), this study has shown that the biomass yield is comparable with other Napier species that are susceptible to stunt and smut diseases (Wamalwa, 2013; Muyekho et al., 2006). However, at Alupe site Napier grass harvested at 4-weekly interval along with defoliation height of 10 cm above the ground yielded the highest biomass (34.98 t/ha/year). This was below the yield observed at Kakamega site. This could be attributed to variation in climatic conditions between Alupe and Kakamega. Saddul et al. (2004) reported similar findings of forage yields variations between locations due to differences in climatic patterns.

In the current study, Kakamega site experienced relatively high cumulative rainfall (1294.99 mm/year) compared to 1175 mm/year in Alupe and therefore may have stimulated vigorous tillering ability, leaf numbers, wider canopy formation and stool diameter as is demonstrated in the highly positive correlation between these parameters and biomass yield (Tables 3, 4 and 5). Breshears and Bainers (1999) reported similar findings that biomass yield of a plant progresses with available soil moisture and diminishes with the fall of moisture below field capacity and ceases at the permanent wilting percentage. Cameron (2001) further reported that soil
Correlation coefficient (r) between biomass yield and yield components for Guatemala species.

<table>
<thead>
<tr>
<th></th>
<th>Canopy diameter</th>
<th>Plant height</th>
<th>No. of tiller</th>
<th>Leaf length</th>
<th>Stool diameter</th>
<th>No. of leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM yield</td>
<td>0.82*</td>
<td>0.90*</td>
<td>0.79*</td>
<td>0.78*</td>
<td>0.46*</td>
<td>0.74*</td>
</tr>
</tbody>
</table>

*Significant at α = 0.05.

Correlation coefficient (r) between biomass yield and yield components for Napier species.

<table>
<thead>
<tr>
<th></th>
<th>Canopy diameter</th>
<th>Plant height</th>
<th>No. of tiller</th>
<th>Leaf length</th>
<th>Stool diameter</th>
<th>No. of leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM yield</td>
<td>0.9*</td>
<td>0.9*</td>
<td>0.50*</td>
<td>0.8*</td>
<td>0.51*</td>
<td>0.8*</td>
</tr>
</tbody>
</table>

*Significant at α = 0.05.

Correlation coefficient (r) between biomass yield and yield components for Panicum species.

<table>
<thead>
<tr>
<th></th>
<th>Canopy diameter</th>
<th>Plant height</th>
<th>No. of tiller</th>
<th>Leaf length</th>
<th>Stool diameter</th>
<th>No. of leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM yield</td>
<td>0.8*</td>
<td>0.73*</td>
<td>0.7*</td>
<td>0.5*</td>
<td>0.4*</td>
<td>0.8*</td>
</tr>
</tbody>
</table>

*Significant at α = 0.05.

water stress may lead to limited leaf area development and consequently reduce dry matter yield.

Conclusion

The study has demonstrated that Napier cultivar cv Ouma yielded significantly higher DM than Panicum and Guatemala at all the three frequencies of harvesting alongside defoliation heights. However, Panicum harvested at 4-weekly interval alongside defoliation height of 10 cm above the ground produced the highest DM yield that was not significantly different from Napier cv Ouma harvested at the frequency of 4-weeks relative with 10 cm defoliation height. This finding demonstrated that Panicum species out yielded Guatemala in western Kenya and therefore, is a potential candidate of alternative fodder grasses in the event that a solution for stunt disease on Napier cv Ouma is delayed. Furthermore, fodder species harvested at 4-weekly interval cumulatively alongside defoliation height of 10 cm above the ground yielded highest dry matter compared to other intervals of harvest along with basal heights of 5 and 15 cm across the experimental sites.

Conflict of Interest

The authors have not declared any conflict of interest.

ACKNOWLEDGMENT

The authors appreciate KARI director through EAAPP Project for funding the activity. Further appreciation goes to Director KARI Kakamega and University of Eldoret for facilitating the activity. We also appreciate Mr. Mudeheri, biometrician for assisting in data analysis.

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Identifying the gap between the views of extension officers and members of farmers’ groups towards promoting sustained agricultural success in Trinidad, West Indies

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Successful farmers’ groups can play a major role in the rural development and food security needs of Caribbean communities. The lack of permanency of these groups, however, has provided the basis for numerous challenges with respect to their effectiveness in promoting sustainable agriculture in the Caribbean. This study attempts to identify what may be one barrier to farmers’ group stability in Trinidad, namely a ‘disconnection’ between the thinking of group members and that of the extension officers who serve them. Two focus group sessions and two structured survey instruments, administered by the researchers, were used to capture the perceptions related to farmers’ groups from extension officers (N=123) and farmers’ group members (N=293) in Trinidad. The structured survey instruments captured responses on an interval scale which returned scores at 1-unit intervals from ‘0’ (no agreement) to ‘5’ (full agreement) for the intensity of a respondent’s agreement with several item statements. The study revealed that there are gaps between the levels and types of service extension officers believe they provide to farmers’ groups and the support and interaction farmers feel they receive from agricultural extension in Trinidad.

Key words: Extension officers, farmers, agricultural extension, group dynamics, focus groups, structured surveys.

INTRODUCTION

The Republic of Trinidad and Tobago had its classification as a developing country in the Caribbean region removed only recently, becoming a developed country in October 2011 (International Monetary Fund, World Economic Outlook, 2012). Agriculture in Trinidad and Tobago is confined generally to rural areas and is a primary source of revenue for farmers and agricultural laborers in rural households (Rosen, 2008). The
agricultural sector has performed relatively weakly in many countries as a result of constraints on productivity due to small scale operations, limited public and private investment and natural disasters (Bourne, 2008). Domestic food production has consistently been inadequate to satisfy domestic demand and, as a consequence, the Caribbean countries have grown increasingly dependent on food imports over time (Walter and Jones, 2012). The gap between domestic consumption and domestic production is quite significant, with consumption two to nearly four times greater than production (Mendoza and Machado, 2009).

Food and nutrition security are now important items on political agendas in the Caribbean region. The region must seek to find sustainable solutions to the challenges in the food and agriculture sector. Farmers in Trinidad and other Caribbean islands are becoming more collaborative in their farming activities and are organizing themselves into groups. This organization of farmers into groups, with the support from respective Caribbean governments, can possibly increase the food production potential of the Caribbean region, thereby reducing their reliance on food imports. Government support to farmers and farmers’ groups in Trinidad is conveyed currently through agricultural extension services.

There are several challenges faced by the extension services in attempts to support the sustainable development of farmers’ groups in the Caribbean. In Trinidad, it is estimated that an average of 568 farmers are assigned to one Extension Officer in an environment where there exists limited support for Extension work (Kissonsingh, 2005). There is a need to find ways in which the limited number of extension officers can serve a larger group of farmers with optimal results (Lwoga et al., 2011).

The formation of farmers’ groups is one such means of addressing the high farmer to extension officer ratio in Trinidad (The sister island of Tobago operates under a different structure). Farmers’ groups could release some of the strain of providing individual Extension support for so many, resulting possibly in more effective and better managed services.

Farmers’ groups are social structures and successful collective action initiatives are influenced by group asset configurations, composition, and characteristics (Barham and Chitemi, 2009). According to Markelova et al. (2009), collective action is defined as the “voluntary action taken by a group of individuals who invest time and energy to pursue shared objectives”.

The relationship between social capital and collective action among farmers has been well documented in the literature (Svendsen and Svendsen, 2000; Uphoff and Wijayaratna, 2000; Chloupkova et al., 2003; Megyesi et al., 2010; Mishra et al., 2013). The literature empirically supports that building social capital through farmers’ groups can help enable and sustain collective action. It has been postulated that groups with relatively high social capital will be more effective and efficient than those with low social capital (Gilson, 2003). Krishna and Uphoff (1999) assess the collective actions aspect as the benefits flowing from social capital. Social capital through group formation is not only useful for agricultural development but also for the holistic development of the rural communities (Aref, 2011).

Social networks throughout rural communities have been shown to play an indirect role in increasing agricultural productivity through knowledge sharing via networks (Liverpool and Winter-Nelson, 2010). According to Allahdadi (2011), this has been emphasized in the case of technology options such as watersheds, irrigation management, and integrated pest management strategies.

Agrawal (2001), in his review, identified several conditions required for the successful outcomes of collective action, inclusive of: small group size, clearly defined boundaries, shared norms, past successful experiences, appropriate leadership, interdependence among group members, membership with different material worth but common identities and interests, and low levels of poverty.

Challenges to farmers’ groups have made them prone to failure. Danida (2004) reported that such challenges existed due to: (a) Capacity building of farmers’ groups being a slow and uneven process, with outcomes often determined as much by factors of social behaviour and cultural norms as by economic logic; and (b) Farmers’ groups susceptibility to problems concerning the accountability of their leaders, as well as the group’s legitimacy as representative or membership organizations for poorer farmers, rural women, and other marginalized groups among the farming population. Therefore, the lack of success of farmers’ groups suggests that there is a need to better understand the conditions under which collective action is useful and viable (Markelova et al., 2009; Poulton et al., 2010). Additionally, it has been suggested by Liverpool-Tasie (2012) that the extents (both the nature and the intensity) of the impacts of intra-group dynamics have not been properly researched in developing countries and this lack of understanding may account for the failure of some groups. This is true of Trinidad, where the interest in the creation of farmers’ groups is not new.

Over time, many farmers’ groups have been formed in the Caribbean. However, they exist only for a short time, going out of existence for a host of reasons. Literature searches have not revealed any studies which have fully investigated this problem in the region. Some actions are being taken, however, to promote the sustainability of farmers’ organizations. Francis (2010) reported that the Caribbean Farmers Network (CAFan), the Technical Centre for Agriculture and Rural Cooperation (CTA) and the Caribbean Agricultural Research and Development Institute (CARDI) are working to build and sustain farmers’ groups and to establish clusters, a form of
farmers’ organization, for the sustainable development of agriculture. The Inter-American Institute for the Cooperation on Agriculture (IICA) is also working to promote the sustainable development of farmers’ groups in the Caribbean.

Study objectives

The study was conducted to investigate several key areas of farmers’ group sustainability in Trinidad, as perceived by both farmers and extension officers. The study investigates the divergent and convergent views between the extension officer work-force and the farmers they serve in an attempt to propose recommendations for moving forward to close this gap between the two groups. It is felt that this must be one of the first steps in promoting farmers’ group stability.

METHODOLOGY

Research approach

The information presented in this paper was gathered from two Focus Group (FG) sessions, one each conducted with extension officers and with farmers, and two structured survey instruments, one each administered to extension officers and to farmers. The research is rooted in a study of the make-up of farmers’ groups. The instruments are constructed to explore farmers’ group dynamics, as observed/perceived by both extension officers and farmers themselves, including the reasons why farmers join groups, the benefits they receive, and the challenges they face as members. Information is also collected on the group members’ perceptions of their leadership, of the support received from and the operation of Extension services, of their satisfaction with group membership, and, most importantly, of the possibilities for the survival of their farmers’ group. Extension officers are also polled about what they believe they contribute to farmers’ groups.

Focus groups

The first Focus Group (FG 1) consisted of nine extension officers from selected Caribbean islands, including Trinidad, Grenada, and St Vincent while the second Focus Group session (FG 2) included eight farmers who belonged to farmers’ groups in Trinidad. The potential participants were either visited or telephoned to determine if they would be willing to participate in a Focus Group exercise. The non-Trinidadian extension officers who participated in the first Focus Group happened to be in Trinidad at the time, sent here for training in Agriculture by their respective Governments. The participants from Trinidad were extension officers who were involved in Extension services support to farmers’ groups.

Participation in both Focus Groups was voluntary. The recruitment strategy for participants incorporated both informal oral screening for eligibility and relevant background checks of the participants’ employment particulars and farming activities. To ensure participation, potential Focus Group members were contacted, again after the first time, via phone calls, e-mail messages, and/or personal visits prior to the date of the actual exercise.

Both focus group sessions (FG 1 and FG2) were conducted during a morning period at the main conference room of the Eastern Caribbean Institute of Agriculture and Forestry (ECIAF) campus of the University of Trinidad and Tobago. The site was selected because of its accessibility to participants. The room was comfortably air conditioned and conducive to discussion. The circular nature of the table allowed all participants to see, hear, and interact with each other. There were two note-takers, one of whom recorded the non-verbal expressions of the participants during the ½ to 2 h of the meeting. Additionally, the entire session was audio recorded (Olympus Digital Voice Recorder). Verbatim notes were taken throughout the session as a back-up to the audio recording. Participants completed a data capture form to provide basic demographic details. They were all informed that their anonymity would be preserved with the use of pseudonyms. They were reminded that their participation was strictly voluntary and that, at any point, if they felt uncomfortable they could discontinue their involvement with the exercise. It was emphasized too that there were no right or wrong answers and that each should feel free to express his/her own opinion.

Refreshments were provided for all participants after the session. The note-takers and facilitator met immediately after each Focus Group session to review the notes and compile and summarize the three streams of information. This promoted a more reliable extraction of main and sub-themes from the information collected during the session. The Focus Group sessions elucidated several themes which were built into the structured surveys, later administered to extension officers and farmers.

Samples of survey respondents

The number of extension officers (123) surveyed was almost (93%) the entire population of those who service farmers throughout Trinidad. The survey was a cross-sectional study of extension officers in Trinidad (as of April 2012). The survey took on average fifteen minutes to complete.

The formation of farmers’ groups in Trinidad and Tobago is based either on geographic proximity or on the main agricultural commodity of the group members. The sample of farmers used was obtained from the membership of a cross section of these groups, extracted from a list provided by the Agricultural Society of Trinidad and Tobago.

For the farmers’ survey, some 293 farmers overall were randomly selected, using proportional stratified sampling. It should be noted that, although members can belong to more than one farmers’ group, none of the respondents in this sample did. The decision to use 20% from each of 22 farmer’s group across Trinidad was based on expediency not on probability theory, although the percentage is above that demanded by basic sample size calculations, which really cannot rigorously estimate the correct sample size for a quantitative survey of 133 questions, each with its own unknown variance.

Data was collected through face-to-face administration and telephone interviews. When respondents could not fill out the survey on their own, the researcher administered it. The farmers’ survey required an average of twenty-five minutes to be completed. Data collection, for this instrument, was effected during the period August 28th 2012 to December 19th 2012.

Survey instruments

The extension officers’ survey instrument was designed with two scale components. The first scale was meant to capture the views of the extensions officers on farmers’ groups and the second scale explored the perceived extent of the extension officers’ group development efforts with farmers’ groups in Trinidad.
The first scale in the extension officer survey comprised twenty-two statements requiring closed responses. It utilized an interval data scale to score the intensity of agreement (with each statement) from '0' (no agreement) through to '5' (total agreement). On this scale, only the two ends of the scale are given levels of 'agreement'. The scores in-between (1,2,3,4) are not identified by named levels of agreement so that the respondents are left to split the entire range from '0' to '5' into equal intervals and to return an answer in the form of the appropriate numerical score to match the intensity of their agreements. Because of the absolute '0', the scale is actually stronger than an ordinary interval scale (in which intervals are equal and known, as they are here, but there is no absolute zero) and is closer to the ratio scale. It was developed by one of this study's authors to produce a measure which allows parametric statistical tests of significance to be used without defying the assumptions of the matrix algebra underpinning those tests. The scale uses numerical scores, given by the respondents themselves, to represent from none to maximum their intensity of emotion (agreement, satisfaction, usefulness, functionality, appeal, effectiveness, importance etc.). It differs from the Likert scale in 2 important ways: (a) It is interval and not nominal or ordinal and (b) It does not have negative and positive scores as are used by some researchers to code the categories of the Likert scale. It has been used in data-gathering instruments developed at UTT since 2010 and first appeared in publication in 2012 (Ali, 2012).

The second scale, Group Development, in the extension officer's survey instrument consists of nine (9) closed-ended questions used to capture the frequency with which extension officers believe they carry out certain actions/tasks. The responses required for the statements on this component are designated as “Never”, “Once a year”, “Every 5 to 6 months”, “Every 2 to 3 months”, “Once per month” and “As needed”. (Note, though, that the frequency of “As needed” is indeterminate. Without this category, the scale becomes essentially interval or even higher order, having a true zero in “Never”). Means were not calculated for the responses to the Group Development statements. In addition to the standard demographics, the farmers’ instrument was designed with 8 interval and 2 nominal scales (Table 1). The interval scales were meant to capture the respondents’ perceptions about certain aspects of farmers’ group dynamics, namely the respondents’ General Beliefs and Reasons for Joining; the quality of the Leadership, Member’s Values; the Trust members have in each other; their Satisfaction with membership; the Benefits they receive from membership; the Potential for Group Survival; and the role and contribution of the Extension Services they receive. The Reasons for Joining scale was meant to capture the initial motivation for pursuing membership. This, along with the General Beliefs scale, focuses on the qualities of the individual member. Both scales show considerable variability and, in fact, the Reasons for Joining scale statements should probably be considered as forming a list of options rather than being illustrative of a single latent construct. This is discussed later, when the results of reliability analysis of the scales are given.

The Trust, Group Benefits, perception of Leadership scales cover the internal Group Dynamics, while the interval Extension Services Support and the categorical External Linkages scales describe the dynamics of the Group’s outreach. Individual member Satisfaction and the perception of potential Group Survival map the results or outcomes of group membership and the associated interactions which forge the views of existing members.

**Table 1. Scales used in the farmers’ survey instrument (N= 293).**

<table>
<thead>
<tr>
<th>S/N</th>
<th>Interval scales (perceptions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Your general beliefs (11 Items) Interval agreement scale</td>
</tr>
<tr>
<td>2</td>
<td>Why you joined your Farmers’ Group? (10 items) Interval agreement scale</td>
</tr>
<tr>
<td>3</td>
<td>Your satisfaction with your Farmers’ Group,( 15 items) Interval agreement scale</td>
</tr>
<tr>
<td>4</td>
<td>How do you see the continued survival of your group? (19 Items) Interval agreement scale</td>
</tr>
<tr>
<td>5</td>
<td>How much trust is there between group members? (11 Items) Interval agreement scale</td>
</tr>
<tr>
<td>6</td>
<td>Leadership (19 items) Interval agreement scale</td>
</tr>
<tr>
<td>7</td>
<td>Extension Support (10 Items) Interval agreement scale</td>
</tr>
<tr>
<td>8</td>
<td>Benefits (14 Items) Interval agreement scale</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal scales (factual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>2</td>
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</tbody>
</table>

**Data analysis**

The themes built into the discussions of the Focus Groups and the structure of the surveys (closed categories of responses) to provide insight into the perceptions of extension officers and farmers are summarized in Table 2. Thematic Analysis of the information from FG1 and FG2 gave the broad views of the two groups in these areas. These views are concretized by the results of the statistical analysis of the survey data. This was carried out using the Statistical Package for the Social Sciences (SPSS), Version 17. Responses to scale questions are summarized using statistics (means and standard deviations). Each mean reflects the respondents’ average intensity of agreement to each question on a scale. The bigger the mean, the better is the consensus of the overall sample with the scale statement. The standard deviation, on the other hand, measures the level of consensus among the respondents in their responses to each scale statement. The smaller this value, the better is the consensus.

The Cronbach alpha value was estimated for each interval scale as a measure of its internal consistency. Exploratory Factor Analysis (EFA), with Principal Components extraction of factors (eigen values >1.0), followed by Varimax rotation, was used to obtain the latent multidimensional themes underpinning the respondents’ manifest responses to the survey interval scale items. Correlations between demographics and outcomes from the nominal scale were estimated by chi square tests and those between scale items or scales themselves by Pearson Product Moment correlation coefficients. The impacts of demographic variables are explored in ‘t’ and ANOVA tests in which they are used as grouping variables for the scale scores and/or the scale.
factor scores, when applicable. The step-wise linear regression analysis routine of SPSS, V.17 is used to fit a model for Potential for Group Survival from the scores of the other interval scales.

**RESULTS AND DISCUSSION**

**Extension officers’ demographics and perceptions**

The survey was administered to 123 individuals, all of whom had direct interactions with farmers’ groups in Trinidad. Most respondents were male (89%) and within the age range of 30 to 50 years (55%). Officers from The Ministry of Food Production constituted the highest percentage of respondents (80%) in the survey sample. Some 54% of all respondents had greater than 10 years service as an extension officer.

The extension officers in the sample serviced the North (33%), Central (20%), and South (41%) of Trinidad, with a small percentage (6%) covering the entire island. Most of the respondents were qualified up to the Diploma (53%) or the Bachelor’s (29 %) level. A substantial percentage (33%) of the officers in the sample interacted with more than 3 farmers’ groups.

The extension officers’ large interval scale of 22 items had a Cronbach alpha value of 0.71, suggesting that it is capturing a single complex construct. The strongest agreement (highest item mean values) were noted with statements about the farmers’ groups as political tools (mean =4.04); the need for monitoring the operations (3.90) and performance (3.90) of farmers’ groups; poor leadership styles in farmers’ groups (3.90); and the reality of members reaping disproportionate benefits (3.90), all of which had mean agreements of approximately 4.0 out of a possible 5.0. The statement that “farmers’ groups exist only for existence sake” elicited the least agreement (mean =1.8).

In the Group Development scale, most extension officers sampled seem to believe that helping farmers’ groups get organized (68%), updating their own technical skills (68%), and arranging meetings with farmers’ groups( 67%) were the efforts most necessary to do ‘as needed’.

The latent orthogonal multidimensional themes obtained by Factor Analysis of the extension officers’ survey scales support what had been observed with their Focus group discussion. These included themes of ‘politics, conflict, and competition’ in farmers’ groups; of ‘dictatorial or poor leadership’ in whom members place no ‘trust’; of ‘disproportionate member benefits’; of the need for ‘monitoring’ performance and operations (as seen too with the high means); and of the ‘satisfaction’ of the extension officers with farmers’ groups.

The statement items (not themes) of ‘satisfaction’ and ‘dictatorial leadership style’ show some significant correlations. ‘Satisfaction’ of the extension officers with farmers’ groups is significantly and directly correlated with all of the positive items on the scale- namely, the beneficial impacts of farmers’ groups on agriculture, on food security, and agricultural extension itself – and indirectly correlated with perceptions of member selfishness or indolence. The view on ‘dictatorial leadership style’ trends directly with 12 of the most negative items on the scale – namely, those reflecting lack of trust, selfishness, conflict, competition, politics, opportunistic behaviour, and member inertia. Perceptions of the abilities of the farmers’ groups to improve food security, agriculture, and extension services are all tied in with each other and with the perception that farmers in farmer’ groups assist each other.

**Farmer’s demographics**

The extension officers’ study allowed an external, but experienced, view of the dynamics of farmers’ groups. These officers, however, cannot identify as clearly as the
farmers themselves do the elements of group interactions which are important to members' satisfaction and which could sustain the group and so promote its survival. The Focus Group elucidated several themes which were built into the structured survey administered to farmers. As outlined before, this instrument, with its 9 scales - 8 of which are interval, with one categorical - was designed to follow all the phases from the time of the individual's joining the group along the progression to a mature member.

The farmers surveyed were predominantly male (73%), between 31 and 50 years old (52%), with most of the sample individuals belonging to geographic groups (64%), especially in the North (29%). The majority of the respondents belonged to farmers' groups of 51 to 100 members (70%), which had been in existence for 10 years or less (61%), although many respondents were members for 5 years or less (52%). The group membership was usually closed (98%), with crop farming (71%) being the main farming activity. Most groups met once per month (66%) and the members mostly attended about 50% of the meetings called (31%).

**Reliability analysis**

All interval scales were subjected to reliability analysis, by estimating the Cronbach alpha measure of internal consistency and the alpha values if each item, one at a time, is deleted from the scale. This latter step reveals if a particular item is harming the scale (the alpha value increases after deletion of the item). In Table 3 are given the alpha values for the farmers' survey interval scales. It can be seen that two scales, *Reasons for Joining* and *Perception of Extension Support*, have very low alpha values.

These have little internal consistency because they are actually lists. For example, with the 10-item *Reasons for joining* scale, there are numerous (10!) ways in which a respondent can prioritize these reasons. No two respondents need have the same priority list so it is not possible to get consistency (Note that this does not prevent EFA from being applied to these two scales, along with the others).

**Farmers' Perceptions**

Farmers appear to join groups principally 'to improve the agricultural sector' (mean = 4.94), believing that 'it is better to work together than to compete against each other' (mean = 4.93). Additional prevalent reasons for this sample are to get benefits, such as better organized ways of selling their products (mean = 4.87), and to protect their land rights (mean = 3.02). Most farmers were encouraged to join the group by other farmers (mean = 4.91) and not by Extension Officers (mean = 1.94).

The relative magnitudes of the mean agreement (of all respondents) to the statements on each of the *General Beliefs, Trust, Group Benefits*, and *Leadership* scales give the initial clues as to what obtains internally in farmers' groups. Farmers continue to believe, once they are in the Group, that one of the reasons why they joined is still valid - namely that they can increase food production (via collective action) - mean = 4.66. They believe too that 'farmers' groups can be used as a political force' (mean = 4.53), that members obtain disproportionate benefits (mean = 3.97), and that there is a need for some 'external monitoring mechanism' (4.49). Although they agree little that 'members willingly share resources' (mean = 1.74), they trust that group members will 'work together without competition' (mean = 2.58), that both members (mean = 3.65) and the group leader (mean = 3.72) are “interested in each member’s success”. They perceive the group leader as both assertive (mean = 4.29) and beneficial to the group (mean = 3.39), communicating respectfully with members (mean = 3.23) and sharing knowledge with them (mean = 3.22).

They expect that members would act as a network (mean = 4.62) via which benefits could be obtained such as shared knowledge, access to discounted resources (mean = 3.47) and to markets, and protection in the event of threats to their land rights (mean = 3.07). Finally, a sense of security, of belonging, and of importance (means = 3.29 to 3.57) all form part of what leads to 'member satisfaction'. Potential group survival is

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**Table 3. Cronbach alpha values for interval scales on farmers' survey**

<table>
<thead>
<tr>
<th>Scale</th>
<th>No. of items on scale</th>
<th>Cronbach alpha</th>
<th>Alpha if one item is deleted from scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>General beliefs</td>
<td>11</td>
<td>0.65</td>
<td>0.71 for 10 items</td>
</tr>
<tr>
<td>Reasons for joining</td>
<td>10</td>
<td>0.25</td>
<td>0.37 for 9 items</td>
</tr>
<tr>
<td>Member satisfaction</td>
<td>15</td>
<td>0.97</td>
<td>No large change</td>
</tr>
<tr>
<td>Group survival</td>
<td>19</td>
<td>0.93</td>
<td>No large change</td>
</tr>
<tr>
<td>Trust</td>
<td>11</td>
<td>0.89</td>
<td>No large change</td>
</tr>
<tr>
<td>Perception of leadership</td>
<td>19</td>
<td>0.93</td>
<td>No large change</td>
</tr>
<tr>
<td>Group benefits</td>
<td>14</td>
<td>0.66</td>
<td>0.68 for 13 items</td>
</tr>
<tr>
<td>Perception of extension support</td>
<td>10</td>
<td>0.18</td>
<td>0.26 for 9 items</td>
</tr>
</tbody>
</table>
perceived to be contingent on the group’s having as members enough experienced farmers (mean = 4.77) to guide and enough young farmers to sustain group development and ensure continuity.

Extension services support is not rated highly in general by farmers. The farmers believe that they themselves can ‘improve delivery of Extension services’ to the farming community (mean = 4.55). They prefer to receive advice from other farmers than from extension officers (mean = 3.89) and they do not think that these officers are genuinely interested in them (mean = 0.70), support them with training (mean = 0.09), or that they attend enough (mean = 0.58) or participate sufficiently (mean = 0.32) in group meetings. These last opinions comment on the services provided by extension officers and diverge considerably from what the extension officers perceive they provide.

Correlations

Several significant correlations are found between the demographics of farmers’ groups and the External Linkages forged by these groups. Whether or not the group has a permanent meeting venue or has a constitution, or links with Research and Development Organizations are three (3) Group ‘behavioural features’ which correlate with all the standard group demographics such as location, type of farmers’ group, years in existence, category of farming, and the size of the Group, among others. Groups associated with the Agricultural Society of Trinidad and Tobago (ASTT) seem to be disproportionately smaller, younger, and of the geographic type.

Individual and group impacts

Scale scores for every individual respondent were obtained from a weighted average of factor scores using the variance explained by the factors as the weights. These scale scores were used as dependent variables in the ‘t’ and ANOVA tests conducted to estimate individual and group impacts.

The demographics (such as sex, age, education, years farming) of individual group members had little or no impact on the scale scores for any of the 8 interval scales. Almost every group demographic, however, impacted significantly (as estimated via ‘t’ or ANOVA tests) significantly on the value of the General Beliefs scale score, on the feelings of Trust and Member Satisfaction and on the perceptions of Leadership, Group Benefits, and potential Group Survival. In every case the commodity-specific farmers’ groups, those which engaged in livestock farming, and those with members who attend meetings ‘usually or always’ had significantly higher means on all scales than the geographic groups, than those who carried out mixed or crop farming, and than those whose members did not attend meetings as often.

Whenever ‘Location’ was significant (as with its impact on the Trust, Member Satisfaction, and Group Survival scale scores), groups from the North had the highest means. Groups which were in existence > 20 years showed the highest means on the four (4) scales for which there were significant tests with this demographic (impacts on Group Survival and Leadership were not significant). Larger groups showed higher means (than those with ≤ 50 members) for 5 of the 6 scales on which group size impacted significantly (The effect on the Member Satisfaction scale was not significant). Groups which meet every 2 to 3 months have significantly higher mean values (than both those which meet less regularly and those which meet every month) for every scale except Member Satisfaction.

The perceived potential for group survival is estimated from a regression model in which the Group Survival scale scores are values of the dependent variable with the other scales used as predictors. Using the step-wise linear regression analysis routine of SPSS, V.17, the model obtained had 4 significant predictors - Group Benefits, General Beliefs, Member Satisfaction, and Leadership.

This model, whose development was one of the main objectives of the research, met all the regression assumptions (of multivariate normality, little collinearity, homoscedastic residual and predictors) and explained a substantial 72% of the variance in the scores on the Group Survival scale (R² = 0.72). (Possibly here too some group demographic impacts may explain the rest). The Group Benefits scale is the main predictor of Group Survival, with a relatively large beta value (0.583). It is important to note that the Extension Services Support scale, which captures the farmers’ perceptions of benefits supplied to farmers’ groups by Agricultural Extension, does not impact on the potential for Group Survival in any way whatsoever. This is perhaps the strongest evidence that farmers’ group members do not perceive Extension, in its current form, as important to their group survival.

Convergent and divergent views of extension officers and farmers

This research was designed not just to assess and map the landscape of Extension Services in Trinidad and Tobago and its importance to farmers’ group development and support but to give projections for the future based on the information garnered from the data collected. To this end, an initial comparison is made between what extension officers believe they bring to the relationship (Group Development scale in extension officers’ survey) and how members of farmers’ groups view the Extension Services Support (specific scale in the
This discussion will focus on those scales of the farmers’ survey which represent elements of farmers' group existence on which the quality and nature of Extension services may impact. These are the Group Survival, Satisfaction, and Group Benefits scales. The assessment of important statements in these scales should give insight into what farmers believe is/is not important to the sustainability of farmers’ groups.

The Extension Services Support scale in the farmers’ survey is separated into independent multivariate themes by Factor Analysis. The main theme of this scale, labeled “Extension Officers’ Presence and Support”, is a wish list for the Extension services farmers probably want or need. These services are captured by statements which relate to extension officers (i) showing interest in farmers' groups (ii) attending and (iii) actively participating in group meetings, while (iv) offering group training. The means of agreement with these statements are indicators of whether there is agreement among the respondents that these services are currently being provided. The actual mean values (whose possible maximum is 5.0) are all extremely low, ranging from 0.09 for the statement on ‘Training’ to 0.58 for extension officers attending group meetings regularly. This suggests that farmers do not believe that extension officers are delivering the named services.

In the area of statements reflecting the theme “Extension Officer - Farmer Interaction”, two statements stand out. These are “I prefer to interact with extension officers one-on-one” and ‘Farmers’ groups can improve delivery of Extension Services to farmers’. The means for the statements are 4.29 and 4.55 respectively. These confirm that farmers believe that their input into the services they receive will improve the quality of what they receive. They also seem to be calling for more individual versus group attention, perhaps the other side of the coin to what the extension officers consider “as needed” or ad hoc service (This is obtained from the Group Development scale on the extension officers’ survey). The sample mean of agreement (1.88) for the statement in the factor ‘Conflict Resolution’, which pertains to the extension officers’ role, suggests that farmers do not agree very much that extension officers provide any service or have any real role in conflict resolution.

The Group Development scale in the extension officer’s survey incorporates several statements about extensions officers’ efforts, similar to those above in the parallel scale from the farmers’ survey. The theme includes statements on the extension officers’ role in ‘arranging meetings with farmers’; ‘attending meetings’; ‘participating actively in meetings’; ‘training farmers’ groups on good governance’; and ‘actively working to resolve conflicts’. Obviously then, the main areas of communal thought with regard to Extension services are essentially the same for farmers and for extension officers. However, there is a distinct perception gap between the two.

The Group Development scale is not based on fully interval data so no means are calculated. In lieu of means, it can be argued, however, that a good indication of how extension officers view the quality of the services they provide to farmers’ groups can be given by the frequencies of the “as needed” category. For each of the statements on this scale, the ‘as needed’ category has the largest percent frequency. These are 67% (arranging meetings), 63% (attending meetings), 61% (actively participating in meetings), and 59% (resolving conflicts). The very activities/services which extension officers believe they provide to farmers, farmers do not agree that they receive. There is a striking disparity between the views of these two stakeholders which needs to be reduced or eliminated.

The services which dominate the thinking of both groups are the same but the divergence in evaluation between the benefits provided and the benefits received must be reduced if extension services are to provide optimum value to farmers.

CONCLUSION AND RECOMMENDATIONS

Two issues stand out from the information and data gathered from the extension officers and farmers in Trinidad. These are issues related to group survival/failure and to leadership. Both sets of participants felt that issues such as mistrust of leaders; associated greed; the inexperience of leaders; the aged membership; members’ perceptions of corruption and bias existing among leaders; lack of transparency in procedures; poor communication; and the prevailing expectation of entitlement by group founders are some of the major reasons that set groups at serious risk of failure.

Issues such as lack of transparency and accountability require some re-organization of governing principles as well as training. Perceptions of corruption and bias can be treated with monitoring mechanisms. Inexperience can be addressed through directed continuous training. The aged membership suggests that there is the need to promote group development much more among the emerging cadre of young farmers. Extension would have an important role in this regard since a prime role of Extension is group development. Communication would have to be improved and technology introduced and/or updated and utilized if younger persons are to be encouraged to join groups. The way meetings are conducted should be modernized to appeal to young farmers.

The sense of entitlement by group founders has to be addressed if young persons are to become active members of the group. The introduction of pathways for participation in the group decision-making process could go a long way toward lessening the hold of the older...
members while at the same time giving more active roles to the younger members.

The entire group governance process needs attention. This may require government intervention or even external assistance to reorganize governance procedures and make them up to date with modern best agricultural extension practices from around the world.

Concerns were articulated regarding the strength of the group leaders, the extent of the training in governance they receive, whether the leader is an active farmer or not, the role of the leader under the constitution, and the assigned powers of the leader. Leadership makes or breaks an organization. As such, clear roles and responsibilities must guide leadership.

For the proper governance of groups, leaders must be trained in correct procedures and management. The strength and power vested in leaders must be rationalized. There should be opportunities to provide management training to leaders and communication skills must be an important module in such training. It is highly recommended that training should be provided to agricultural extension officers in the area of farmers’ group formation.

This training should be done pre-service as part of their formal agricultural extension training at the University of the West Indies and at the University of Trinidad and Tobago. Additionally, in-service training in good governance practices, negotiation and conflict resolution, group training, and public speaking among other areas should be incorporated as a component of a programme for the continuous training and development of extension staff.

Conflict of Interest

The authors have declared no conflict of interests.

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