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## ARTICLES

**Price competitiveness of smallholder rice farmers under cooperative irrigation schemes in Coast and Morogoro regions, Tanzania**  
Kangile, R. J. and Mpenda, Z. T.  
47

**Adaptive capacity of evicted agro-pastoralists from Ihefu Basin in Tanzania**  
Given Msigwa Msomba, Zebedayo K. Mvena and Kizito Mwajombe  
56

**Prioritizing needs assessment techniques for agricultural programs implementation: The case of Northern Region, Ghana**  
Abdul-Basit Tampuli ABUKARI, Burak ÖZTORNACI and Dilek Bostan BUDAK  
62
Price competitiveness of smallholder rice farmers under cooperative irrigation schemes in Coast and Morogoro regions, Tanzania

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Tanzanian produced rice is not competitive because of high production costs. To increase competitiveness will require improvements in production efficiency. This study was conducted to analyse production cost efficiency using cross sectional data (2013/2014 agricultural season) from 200 farmers that belong to four cooperative irrigation schemes in Coast and Morogoro regions. Two stage sampling and translog stochastic cost frontier were used for sampling and cost efficiency analysis, respectively. Production costs were estimated quantitatively using the enterprise budgeting technique. Study data suggest that total costs of production are US$315/MT. Rice output and prices for labour, fertilizer and irrigation water significantly affected costs of production. Unit cost of production were reduced by increasing rice productivity (p<0.05). Production efficiency was significantly influenced by farming experience, planting methods, frequency of weeding, degree of specialization and source of purchased inputs. These factors accounted for 82% of the variability in costs of production (p<0.05). A major conclusion is that production efficiency is reduced by high production costs relative to rice output produced, input prices, source of purchased inputs and other agricultural practices. Use of labour saving technologies, the purchase of inputs from irrigation scheme cooperatives and greater economies of scale resulting from increased specialization can increase profits.

Key words: Cooperative, cost efficiency, irrigation scheme, rice, smallholder farming.

INTRODUCTION

Rice in Tanzania is the second most important food crop after maize, being grown by 18% of the farming households and more marketed than maize (URT, 2013). The quantity of marketed rice is approximately 42% of the total production while that of maize is 28%, thus being more commercialized than maize contributing to 2.67% of the GDP (EUCORD, 2012). The average production in the country is lower than the actual rice demand,
evidenced by decreasing rice food supplies in the country. Rice milled equivalent kg/capita/year in 2010, 2011 and 2012 were 36.88; 31.71 and 25.29, respectively (MAFAP, 2013). Furthermore, the decision of the government of Tanzania in 2013 to exempt the Common External Tariff (CET) of 75% in importation of 60000MT of rice justifies the existence of the supply gap.

In irrigated rice production, smallholder farmers are the main driver with exception of few large scale producers (SAGCOT, 2012). Thus, smallholder irrigated rice production is imperative to the rice sector and the country in general. On the other hand, price competitiveness that is, the ability of locally produced rice to compete with imported rice in the market is also important for growth of the sector and smallholder rice farmers. Low price competitiveness of produced rice in Tanzania gives room for imported rice from various countries in the world by reducing profit margin to smallholder farmers and market for domestic produced rice. For example, milled rice from Pakistan is imported in Tanzania at a Cost Insurance and Freight price (CIF price) of US$390/MT and retailed at a price of US$500/MT, while domestic producers breaks even if they sell milled rice at US$605/MT (MAFAP, 2013).

Smallholder irrigated rice production is done in irrigation schemes which are managed either by irrigation scheme associations or cooperatives (cooperative irrigation schemes). Irrigation water is pumped using electrical and diesel engine pumps (pump-fed canal system). Some of the irrigation schemes are under flood recession and gravity-fed systems which does not necessarily need the pumps.

The irrigation scheme association is the group of farmers using water for irrigation in an irrigation scheme, having their own leadership and enforcing formal and informal rules such as social sanctions (URT, 2010). The irrigation scheme association is more concerned with allocation of water, operations and maintenance of the irrigation scheme with minimal or no involvement in marketing activities.

In cooperative irrigation schemes, the cooperative board manages the scheme on behalf of its members (farmers). Marketing activities are done in addition to maintenance, operation and management of the scheme. Marketing activities are usually done on the side of inputs. Available evidence indicates that, farmers rarely engage in collective marketing on the side of outputs. Farmers keeps their own stocks and does private marketing (Kilimo Trust, 2014; RCT, 2015). On the side of inputs, the cooperative board purchases in bulk and sells to members or facilitates on getting suppliers of inputs to members.

Underutilization of the cooperative irrigation schemes by smallholder farmers has been a concern of the government to an extent of either privatizing some of these irrigation schemes or running them in partnership with foreign investors (BMG, 2012; EUCORD, 2012).

Smallholder farmers in these cooperative irrigation schemes have been failing to contribute to the payments for irrigation water supply, thus left the fields to other farmers who may not necessarily be members of the irrigation scheme cooperatives.

This situation may be linked to high production costs which results into low profit margins as Zaal et al. (2012) associate high production cost leading to low price competitiveness in irrigated rice production with the capital intensive nature of irrigated rice production system. Smallholder farmers in cooperative irrigation schemes, are also capital intensive in their rice production system due to high use of capital inputs (purchased inputs).

The government claimed underutilization of the cooperative irrigation schemes and the failure of some smallholder farmers to pay for irrigation water supply may be due to the ascertained low price competitiveness of produced rice or any other factors at the cooperative management or smallholder farmer level.

The present study investigated smallholder farmers’ decision making level in cooperative irrigation schemes on use of production inputs whether follows the efficiency path of the farm production resources. Efficiency path shows the degree of achievement in the allocation of the available inputs and output produced in order to attain a high degree of efficiency in cost, revenue or profit. Literally, efficiency is the ability of a decision making unit to obtain the maximum output from a set of inputs (output orientation) or to produce an output using the lowest possible amount of inputs combination (input orientation) (Kumbhakar and Lovell, 2003). Dzeng and Wu (2013) recently defined efficiency as the goal oriented concept for determining the best scenario to use the lowest input or reach the highest output. The study focused on investigation of efficiency in cost. The inefficiency which is associated with the loss of productivity due to inability of farmers to use production inputs in their optimal proportions was also investigated.

The study also ascertains the level of production costs since the reported high production costs in irrigated rice production leading to low price competitiveness is not specific for this type of irrigation scheme management.

**METHODOLOGY**

**Description of the study area**

The study was conducted in Morogoro and Coast regions focusing on cooperative managed and rice specialized irrigation schemes. In Morogoro region, it was conducted in Mvomero district under irrigation schemes serving Dakawa and Mlali wards while for Coast region, the focus was in Bagamoyo district under irrigation schemes that serves Magomeni, Dunda and Vigwaza wards (Figure 1).

**Data collection, sampling procedures and sample size**

The study was cross sectional and involved collecting data from...
farmers in a single agricultural season, 2013/2014 using semi-structured questionnaire. A sample of farmers was drawn using a two stage sampling method. The first stage involved selection of four out of six irrigation schemes using probability proportional to size (PPS). The PPS method involved listing all rice specialized cooperative irrigation schemes, identifying the number of beneficiaries (population size), calculating the cumulative population in each irrigation scheme and calculating the sampling interval (SI) that is,

$$\text{Cumulative total population} = \frac{2311}{4} = 578,$$

and probability 1 and probability 2 of each irrigation scheme. Probability 1 is the likelihood of selection for each sampled irrigation scheme and probability 2 being the likelihood of selection for each individual farmer in each of the sampled irrigation schemes. Four clusters (number of irrigation schemes to be studied) were used. The last step of implementation of the PPS method was to generate random numbers and select the one which is equal or less than the SI, this is sometimes known as Random Start (RS). The random number selected was 275. The first irrigation scheme was then selected by looking for the irrigations scheme whose cumulative population size exceeds this random number in which CUMKI was selected. The second, third and the fourth irrigation schemes were selected using the same criterion by considering the SI that is; 275+578=853 for the second, 853+578=1431 for the third and 1431+578=2009 for the fourth in which UWAWAKUDA, TEGEMEO/BIDP and CHAURU irrigation schemes were respectively selected (Table 1). The second stage involved obtaining 50 smallholder farmers from each irrigation scheme sampled in first stage using Systematic Random Sampling (SRS) making a sample of 200.

**Analytical framework**

Quantification of costs of production was conducted using enterprise budgeting technique. The technique involved quantification of input costs such as irrigation water, seeds, fertilizer, herbicides, pesticides and labour. Land was not included in the quantification of the costs since farmers are given free by the irrigation scheme cooperative and the farmer has no direct decision on land thus cannot easily be allocated to an enterprise. The government land rent is paid by the cooperatives thus it is not a direct cost to farmers of the irrigation scheme cooperative.

Labour costs were quantified from rice production activities of
field clearing, ploughing, hallowing, planting, field water management, weeding, fertilizer application, herbicides application, and pesticides application, birds scaring, harvesting and bagging. In situations where family labour was used, equivalent wage cost of working off-farm for a wage was used. Other cost items were purchase of bagging materials and transport costs.

Number of people (labour unit) required to perform a particular amount of work was also estimated to enable the quantification of price of labour. The amount of work that can be done by one labour unit in one day is called man-day (one man day is equivalent to 8 working hours). Thus, the number of days spent on doing a particular activity in the field was estimated. The price of labour was then obtained by taking the total cost of labour divided by the number of days taken on that activity.

Farm level cost efficiency was determined using stochastic frontier analysis given its ability to decompose deviations from the efficient frontier into two components of inefficiency and error term (Aigner et al., 1977; Coelli, 1995; Kumbhakar and Lovell, 2003).

The production technology was implied by a Translog function forming a Translog stochastic cost frontier. It should be noted that, Translog stochastic cost frontier has three distinct terms; linear, quadratic and interaction terms. The stochastic cost frontier function was modelled in a four input framework as shown in Equation 1 with fertilizer, labour, irrigation water and rice seeds. Cost of production was measured in Tanzanian Shillings (TAS) per hectare (ha) and per metric ton (MT) of rice produced. Rice output was measured in MT/ha; average price of fertilizer of both basal application and top dressing applications used in one agricultural season in TAS/kg; price of seeds used in either transplanting, broadcasting or direct seeding in TAS/kg; price of irrigation water used in production paid to the irrigation scheme cooperative in TAS/ha and the price of labour was obtained by taking the total labour cost of an individual farmer divided by the total man days used in production (TAS/man day). One man day is the amount of work that can be done by one labour unit in one day (8 working hours).

\[
\ln C_i = \beta_0 + \beta_1 \ln Y_i + \beta_2 \sum_{m=1}^{4} \ln W_{mi} + 0.5 \beta_3 \left[ \ln Y_i \right]^2 + 0.5 \beta_4 \sum_{m=1}^{4} \sum_{n=1}^{4} \left[ \ln W_{ni} \right]^2 + \beta_5 \sum_{m=1}^{4} \ln W_{mi} \ln Y_i + \beta_6 \sum_{m=1}^{4} \ln W_{mi} + Vi + Ui \]

(1)

Cost efficiency frontier function is homogeneous of degree one in input prices such that \( C(Y_i, \lambda W_i; \beta) = \lambda C(Y_i, W_i; \beta) \), where \( \lambda > 0 \). The function has to be normalized by dividing the whole of Equation 1 except output by one of the input price (Morandi et al., 2013).

The cost efficiency frontier was thus normalized using the price of seeds and the model estimated is shown in Equation 2.

\[
\ln C_i = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln P_{\text{fert}} + \beta_3 \ln P_{\text{lab}} + \beta_4 \ln P_{\text{water}} + 0.5 \beta_5 \left[ \ln Y_i \right]^2 + 0.5 \beta_6 \left[ \ln P_{\text{fert}} \right]^2 + 0.5 \beta_7 \left[ \ln P_{\text{lab}} \right]^2 + 0.5 \beta_8 \left[ \ln P_{\text{water}} \right]^2 + \beta_9 \ln Y_i \ln P_{\text{fert}} + \beta_{10} \ln Y_i \ln P_{\text{lab}} + \beta_{11} \ln Y_i \ln P_{\text{water}} + \beta_{12} \ln P_{\text{fert}} \ln P_{\text{lab}} + \beta_{13} \ln P_{\text{fert}} \ln P_{\text{water}} + \beta_{14} \ln P_{\text{lab}} \ln P_{\text{water}}
\]

(2)

where \( \ln \) is natural logarithm; \( C_i \) is normalized total production cost incurred by a farmer; \( Y_i \) is rice output obtained by a farmer; \( P_{\text{fert}} \) is the normalized price of fertilizer; \( P_{\text{lab}} \) is the normalized price of labour; \( P_{\text{water}} \) is the normalized price of irrigation water and \( \beta_s \) are parameters to be estimated.

The above model was estimated by single step procedure using Frontier version 4.1 (Coelli, 1996). The single step procedure was used in order to avoid bias as the result of misspecification that is always brought by the use of two step procedure. Single step procedure estimates in a single equation the parameters for the efficiency model, cost efficiency scores, value of gamma and sources of inefficiency in the production system.

Cost efficiency scores ranges from 1 to infinity in a cost efficiency.

<table>
<thead>
<tr>
<th>Region</th>
<th>District</th>
<th>Irrigation scheme cooperative</th>
<th>Number of beneficiaries</th>
<th>Cumulative population size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Morogoro</td>
<td>Mvomero</td>
<td>Mkindo/Mgongola</td>
<td>102</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cumki*</td>
<td>130</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uwawakada*</td>
<td>471</td>
<td>371</td>
</tr>
<tr>
<td>Coast</td>
<td>Rufiji</td>
<td>Segeni</td>
<td>38</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Bagamoyo</td>
<td>Tegemoe/BIDP*</td>
<td>47</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chauru*</td>
<td>516</td>
<td>344</td>
</tr>
</tbody>
</table>

*Cooperative irrigation scheme selected.

Table 1. Rice specialized cooperative irrigation schemes in Coast and Morogoro regions (Ministry of Agriculture, Food Security and Cooperatives; Eastern Zone irrigation office).
frontier model. However, in case there is interest of showing cost efficiency ranging from 0 to 1, the approach is to take the reciprocal of the cost efficiency in cost frontier.

The value of Gamma (γ) indicates the level of inefficiency such that γ=0 implies that, deviations from the frontier are entirely due to noise as there is no evidence for presence of inefficiency effects. The value of γ=1 would mean that, all deviations from the frontier are due to inefficiency (inefficiency effects are highly significant in the production system). Furthermore, the likelihood ratio test (LR test) is used to compare the fitted model which includes inefficiency factors, to a corresponding model without inefficiency factors. The hypotheses being tested are there is no inefficiency implying that smallholder farmers are 100% efficient (Null hypothesis) and there is inefficiency implying that smallholder farmers are not 100% efficient (alternative hypothesis). Sources of inefficiency were determined through assumption on the inefficiency error component. The inefficiency error component $U_i$ was assumed to follow a truncated normal distribution (Equation 3) with a mean as a function of the hypothesized sources of inefficiency in production (Battese and Coelli, 1995).

$$U_i = \delta_0 + \sum_{m} \delta_m Z_m + \varepsilon_i \quad \text{ ............................................. (3)}$$

Empirically, the inefficiency model used was specified as shown in Equation 4;

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 \quad \text{ ............................................. (4)}$$

The value of $\delta_0,...,\delta_7 = 0$ implies that there is no inefficiency in the production system. The variables $Z_1,...,Z_7$ are given in Table 2 and $\delta_0,...,\delta_7$ were parameters to be estimated.

The negative expected sign shows a decrease of inefficiency (increasing cost efficiency) and the positive expected sign implies that a particular factor increases inefficiency (decreasing cost efficiency). Farming experience as measured by years of rice farming experience is expected to reduce the level of inefficiency in smallholder farmers’ production system. The more years a farmer spends in irrigated rice production the more skills are acquired in managing the production inputs, hence increasing efficiency.

Good Agricultural Practices (GAPs) are important in ensuring efficiency in any agricultural production system. Proper ways of harvesting, planting, weeding and use of quality seeds are vital for smallholder irrigated rice production in cooperative irrigation schemes. The use of combine harvester or motorized rice thresher as mechanization method in harvesting activity is expected to reduce inefficiency in harvesting activity, thus improving the cost efficiency. Manual harvesting is expected to be inefficient in terms of cost, quality of rice and time, hence can lead to inefficiency in the harvesting activity.

There are three main methods of planting rice; transplanting, broadcasting and direct seeding (dibbling). Transplanting method of planting allows the farmer to plan apriori the spacing, reduces weeds and leads to high yields. It is expected that, as farmers in irrigated rice production use transplanting method of planting, their cost efficiency increases through yield increase and reduced weeds and seeds for seedling. The increase in frequency of weeding (number of times weeding is done from planting to harvesting) increases cost efficiency due to reduced weed infestation in rice. Improved seeds also increase efficiency in production.

Degree of specialization,

$$\left[ \frac{\text{Total rice acreage}}{\text{Total acreage of all crops}} \right] \times 100\%.$$  

is the measure of economies of scale. Specialization allows farmers to enter into bulk markets as the average cost of production falls. Additionally, source of purchased inputs (whether a farmer

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Expected sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z_1$ = Farming experience</td>
<td>Years of rice farming experience</td>
<td>-</td>
</tr>
<tr>
<td>$Z_2$ = Harvesting methods (Dummy)</td>
<td>Combine harvester/motorized thresher Manual</td>
<td>- +</td>
</tr>
<tr>
<td>$Z_3$ = Planting methods (Dummy)</td>
<td>Transplanting Broadcasting and dibbling</td>
<td>+</td>
</tr>
<tr>
<td>$Z_4$ = Frequency of weeding</td>
<td>Number of times weeding is done from planting to harvesting</td>
<td>-</td>
</tr>
<tr>
<td>$Z_5$ = Seed variety planted(Dummy)</td>
<td>Improved variety Local variety</td>
<td>- +</td>
</tr>
<tr>
<td>$Z_6$ = Degree of production specialization</td>
<td>Measure of economies of scale (ratio of total rice acreage to total crop acreage)</td>
<td>-</td>
</tr>
<tr>
<td>$Z_7$ = Source of purchased inputs (Dummy)</td>
<td>Purchasing inputs through the cooperative Purchasing inputs from other input providers</td>
<td>- +</td>
</tr>
</tbody>
</table>

Table 2. Description of variables for inefficiency model.
purchases inputs through the cooperative or from other input providers) is expected to have influence on cost efficiency of the smallholder irrigated rice farmers in cooperative irrigation schemes. It is hypothesized that, purchasing inputs through the irrigation scheme cooperative increases cost efficiency in their production system.

RESULTS

Production activities and cost
Activities in irrigated rice production utilizing labour start from field clearing or ploughing to bagging as shown in Figure 2. Activities in which the farmer is incurring high average costs in descending order were weeding, harvesting, planting and bird scaring.

Furthermore, unit production cost was found to be TAS 504.43 kg⁻¹. According to Bank of Tanzania (BOT), the 2013 annual exchange rate was TAS 1599/USD, thus using this rate, this is equivalent to US$315.47/MT.

Production cost efficiency

Maximum likelihood estimates of the cost efficiency model
Cost efficiency frontier function was estimated through single step procedure and the results are shown in Table 3. All linear terms (normalized rice output, normalized fertilizer price, normalized price of labour, and normalized price of water) were significant (p<0.05) and positive.

Price of fertilizer was the most sensitive variable influencing the total cost of production followed by price of irrigation water charged by the irrigation scheme cooperative. A 1% increase in prices of fertilizer and irrigation water was found to increase 2.216 and 1.996% of the total production cost, respectively. Price of labour was the least variable in terms of sensitivity as a 1% increase in price of labour was found to increase 1.159% of the total production cost. Furthermore, cost elasticity of rice output evaluated at the mean was 0.917.

In quadratic (squared) terms, only normalized rice output was significant and positive, showing evidence of some economies of scale. All interaction terms were not significant, but some were positive showing complementarity of the variables. Rice output and labour, rice output and irrigation water and fertilizer and irrigation water are complements in smallholder irrigated rice production system, implying to have zero elasticity of substitution. The constant term was 8.444, positive and significant (p<0.05) and the value of gamma (γ) obtained was 0.8208 indicating high variability in costs of production.

Furthermore, the Likelihood Ratio (LR) test for one sided error testing the hypothesis that, smallholder farmers are not 100% efficient was supported (The test statistic LR Chi-square [χ²] was 27.63 which is greater than the critical LR χ² of 3.84 read from statistical tables).

Production cost efficiency distribution
All farmers had efficiency levels above 1 indicating that, they are operating above the cost frontier. Results indicate that, 64% of all farmers were below the mean cost efficiency level and 36% above the mean (Table 4).
Table 3. Maximum likelihood estimates of the cost efficiency model.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>8.4442**</td>
<td>3.18536</td>
<td>2.65094</td>
</tr>
<tr>
<td>LnY</td>
<td>0.7811*</td>
<td>0.31268</td>
<td>2.498081</td>
</tr>
<tr>
<td>LnP_fert</td>
<td>0.8802**</td>
<td>0.357296</td>
<td>2.463589</td>
</tr>
<tr>
<td>LnP_lab</td>
<td>1.6869**</td>
<td>0.747669</td>
<td>2.25619</td>
</tr>
<tr>
<td>LnP_water</td>
<td>0.49697**</td>
<td>0.25036</td>
<td>1.98505</td>
</tr>
<tr>
<td>(LnY)^2</td>
<td>0.06563*</td>
<td>0.024787</td>
<td>2.64785</td>
</tr>
<tr>
<td>(LnP_fert)^2</td>
<td>-0.037516</td>
<td>0.084911</td>
<td>-0.44183</td>
</tr>
<tr>
<td>(LnP_lab)^2</td>
<td>0.054087</td>
<td>0.11559</td>
<td>0.467917</td>
</tr>
<tr>
<td>(LnP_water)^2</td>
<td>-0.051839</td>
<td>0.059028</td>
<td>-0.878209</td>
</tr>
<tr>
<td>LnY* LnP_fert</td>
<td>-0.12789</td>
<td>0.042229</td>
<td>-3.02855</td>
</tr>
<tr>
<td>LnY* LnP_lab</td>
<td>0.080302</td>
<td>0.042555</td>
<td>1.88701</td>
</tr>
<tr>
<td>LnY* LnP_water</td>
<td>0.022939</td>
<td>0.015985</td>
<td>1.43504</td>
</tr>
<tr>
<td>LnP_fert* LnP_lab</td>
<td>-0.11635</td>
<td>0.097657</td>
<td>-0.11914</td>
</tr>
<tr>
<td>LnP_fert* LnP_water</td>
<td>0.66532</td>
<td>0.046151</td>
<td>1.44162</td>
</tr>
<tr>
<td>LnP_lab* LnP_water</td>
<td>-0.33225</td>
<td>0.047316</td>
<td>-0.70219</td>
</tr>
<tr>
<td>Sigma-squared(σ^2)</td>
<td>0.0053557**</td>
<td>0.0026994</td>
<td>1.98403</td>
</tr>
<tr>
<td>Gamma (γ)</td>
<td>0.820768*</td>
<td>0.1173288</td>
<td>6.995452</td>
</tr>
</tbody>
</table>

*Significant at 1% probability level; **Significant at 5% probability level.

Table 4. Cost efficiency distribution of smallholder irrigated rice farmers.

<table>
<thead>
<tr>
<th>Efficiency range</th>
<th>Frequency</th>
<th>Percentage</th>
<th>Efficiency level</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.139</td>
<td>128</td>
<td>64.0</td>
<td>Mean</td>
</tr>
<tr>
<td>1.139-1.177</td>
<td>55</td>
<td>27.5</td>
<td>Minimum (Min)</td>
</tr>
<tr>
<td>1.178-1.216</td>
<td>10</td>
<td>5.0</td>
<td>Maximum (Max)</td>
</tr>
<tr>
<td>&gt;1.216</td>
<td>7</td>
<td>3.5</td>
<td>Standard deviation</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

The average efficiency level was found to be 1.139 (87.80%) indicating that, 13.9% of costs of production in irrigated rice production can be avoided without affecting the level of rice output. In other words, the mean cost efficiency of 1.139 implies farmers to experience a cost saving of 13.9% if they happen to achieve cost efficiency. Likewise, cost saving by attaining the average cost efficiency level is 10.31%, that is,

\[
\left(1 - \frac{\text{Mean}}{\text{Max}}\right) \times 100\%,
\]

and for attaining the minimum efficiency level, smallholder farmers will save 12.76% of the production cost, that is,

\[
\left(1 - \frac{\text{Min}}{\text{Max}}\right) \times 100\%,
\]

respectively.

Inefficiencies in rice production under cooperative irrigation schemes

The inefficiency model results indicated that, farming experience, planting methods, frequency of weeding, degree of specialization and source of purchased inputs were significant (p<0.05). This implies that, they have a significant influence on cost efficiency. Type of rice seed variety planted and harvesting methods were not significant as shown in Table 5. All other variables except harvesting method variable had their expected signs. The positive sign indicate that, the variable under consideration increases the cost inefficiency in the production system, while the negative sign shows decrease in cost inefficiency (increasing cost efficiency).

DISCUSSION

Weeding was found to be the highest costing activity. The high cost on weeding is due to low level of mechanization.
on weeding. Smallholder farmers using herbicides for weeding were 34.5%, but as a supplement to manual weeding. The use of mechanized labour saving technologies in weeding is low. Similar result was obtained by Mdemu and Francis (2013) in their study in Kapunga irrigation scheme in Mbeya, Tanzania where weeding was the highest labour intensive activity due to low level of mechanization of this activity. High average cost of harvesting activity is due to 33% of smallholder farmers being using manual harvesting. Planting and bird scaring were 100% not mechanized.

Rice output, price of fertilizer, price of labour, and price of irrigation water were significant and positive indicating that, increasing these variables in irrigated rice production will increase the total cost of production. This implies that, costs of production in smallholder farming system under cooperative irrigation scheme are more sensitive to changes in input prices and rice productivity. Interestingly, the unit cost of production was found to decrease by increasing rice output. This is because the cost elasticity of rice output evaluated at the mean, was 0.917 implying that, a 1% increase in production in terms of rice output will increase 0.917% of the total production cost that is, increase in production are higher than increase in cost of production.

The constant term implied that, expense on fixed factors of production are incurred regardless of whether the production takes place or not. This includes all production fixed inputs especially farm implements as their costs are spread over a long period of time and contributions to the irrigation scheme cooperative for maintaining the membership status. This is in agreement with Ghosh and Raychaudhuri (2010) and Hidayah et al. (2013) in their study of cost efficiency in rice in India and Indonesia, respectively.

The model results indicated further that, 82% of the variability in the total cost of production that is not accounted by the function is influenced by inefficiency factors in irrigated rice production under cooperative irrigation schemes and only 18% being due to random factors that are beyond or outside smallholder farmers’ control. Furthermore, the LR test results indicated that smallholder farmers in cooperative irrigation schemes are not cost efficient.

Production cost efficiency distribution showed high efficiency level (87.8%) which is in agreement with Hidayah et al. (2013) who also obtained a high mean efficiency level (86.6%). The high mean efficiency level is due to high level of specialization allowing farmers to enjoy economies of scale as 56% of smallholder farmers in cooperative irrigation schemes use more than 50% of their land farming for rice production within which 40% are 100% farming rice only. Moradi et al. (2013) had similar reason for existence of economies of scale when found high cost efficiency levels for wheat production in Iran.

Farming experience had a negative influence on farmers’ cost inefficiency. It is true that, as smallholder irrigated rice farmers spend more years in rice farming their expertise in combining resources increase thus minimizing the wastage on the use of production inputs which increases production cost efficiency. Maganga et al. (2012) in his study of cost efficiency of Irish potato farmers in Malawi found farming experience to be highly influencing the cost efficiency of farmers. Likewise, Audu et al. (2013) obtained the same results in the study of cost efficiency in cassava production in Nigeria.

Planting and weeding are important GAPs in smallholder irrigated rice production under irrigation schemes. Planting methods, transplanting in particular and more frequency of weeding done by farmers, reduced inefficiency since had negative influence on cost inefficiency. The result on frequency of weeding being influencing cost efficiency, contradicts the result by Maganga et al. (2012) in his study of cost efficiency in Irish potato production in Malawi who found increase in weeding frequency not significantly influencing cost efficiency. This can be due to the nature of the rice production system being more susceptible to weeds.

Degree of specialization as the measure of economies of scale had a negative influence on cost efficiency. Specialization permit producers to enter into big markets.

### Table 5. Sources of inefficiencies in production.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.099955″</td>
<td>0.050915</td>
<td>1.96318</td>
</tr>
<tr>
<td>Farming experience</td>
<td>-0.0038275*</td>
<td>0.00090364</td>
<td>4.2357</td>
</tr>
<tr>
<td>Harvesting methods</td>
<td>0.024451</td>
<td>0.022724</td>
<td>1.07628</td>
</tr>
<tr>
<td>Planting methods</td>
<td>-0.084136*</td>
<td>0.033741</td>
<td>-2.49356</td>
</tr>
<tr>
<td>Frequency of weeding</td>
<td>-0.04152″</td>
<td>0.0161656</td>
<td>-2.568433</td>
</tr>
<tr>
<td>Seed variety planted</td>
<td>-0.027295</td>
<td>0.033884</td>
<td>0.810324</td>
</tr>
<tr>
<td>Degree of specialization</td>
<td>-0.046121″</td>
<td>0.022607</td>
<td>-2.040153</td>
</tr>
<tr>
<td>Source of purchased inputs</td>
<td>-0.10134027*</td>
<td>0.032792</td>
<td>-3.090425</td>
</tr>
</tbody>
</table>

*Significant at 1% probability level; **Significant at 5% probability level.
through expansion of output levels, spreading fixed costs which leads to reduced average cost per unit of output. Therefore, specialization in rice production increases cost efficiency of smallholder irrigated rice farmers. This is in agreement with Maganga et al. (2012) and Dzeng and Wu (2013). Maganga et al. (2012) found that, more specialized Irish potato farmers were more cost efficiency than their counterparts who were less specialized. Similarly, Dzeng and Wu (2013) in the study of construction industry in Taiwan found cost efficiency to be higher to firms focusing in building construction only than those are involved in civil and building construction. Furthermore, source of purchased inputs was found to influence cost inefficiency negatively. The situation of a cooperative member to purchase inputs through the irrigation scheme cooperative contributes to increasing efficiency in production that spurs cost efficiency due to reduced unit cost of input and accessibility of after purchase services offered through the irrigation scheme cooperative.

Conclusively, this study has revealed that, smallholder farmers’ costs of production stands at US$315/MT which is higher than the farm gate prices of rice in other countries especially Asian countries. Example; Kilimo Trust (2014) report that, farm gate prices of rice in Bangladesh and India are US$175/MT and US$169/MT respectively. Weeding, harvesting, transplanting and birds scaring are activities highly costing farmers. In order to lower cost and make these activities efficient, it is important to use herbicides in weeding; motorized rice thresher or combine harvester in harvesting and transplanter and direct rice seeder machine in planting.

Costs of production was found to be more sensitive to changes in prices of inputs and outputs but with unit cost of production being decreasing by increasing rice output. All farmers had efficiency levels above 1 indicating that are operating above the cost frontier and experiencing loss of efficiency in production, hence lowering rice price competitiveness. It is thus plausible to use labour saving technologies, purchasing inputs from irrigation scheme cooperatives and attaining greater economies of scale resulting from increased specialization to foster rice price competitiveness.

Conflict of interests

The authors have not declared any conflict of interests.

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REFERENCES


Adaptive capacity of evicted agro-pastoralists from Ihefu Basin in Tanzania

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This paper looks at the adaptive capacity of evicted agro-pastoralists who were evicted from Ihefu Basin in Mbarali District and forced to settle in new resettlement areas. Household questionnaires, life stories, and focused group discussions with a sample of 110 resettled agro-pastoralists was used to capture the data. Quantitative and qualitative data were analysed. The adaptive capacity index was used to determine the adaptive capacity of the resettled pastoralists. Findings revealed that the resettled pastoralists adopted different coping behaviors and livelihood strategies to adapt the resettlement areas. It was further observed that different livelihood capitals had different contributions on adaptive capacity among the resettled agro-pastoralists. Variations in the adaptive capacity of resettled agro-pastoralists were noted. For improving the adaptive capacity of resettled agro-pastoralists, the Government and other stakeholders should improve infrastructure such as rural roads, clean and safe water supply, schools, extension and veterinary services, reliable markets for agro and livestock products and marketing information.

Key words: Adaptive capacity, agro-pastoralists, impoverishment, livelihoods, resettlement

INTRODUCTION

Pastoralism often refers to extensive husbandry of herds of different animal species (cattle, sheep, goats, camelids, and equines) requiring periodic migration to access pasture. A commonly used definition in various literatures is that pastoralist households are those in which at least 50% of household gross revenue (including income and consumption) comes from livestock or livestock-related activities (Oxfam, 2008). Agro-pastoralism describes the coexistence of both agricultural and grazing activities, although there may be different degrees of integration of these activities, with specific consequences for land use. An economic definition is that agro-pastoralists derive more than 50% of household gross revenue from livestock and 10-50% from farming (Oxfam, 2008).

Pastoralists in Ihefu Basin in Mbarali District have stayed in the area for more than thirty years from 1972. The Ihefu Basin area was gazetted as a conservation
area in 1998 (SMUWC, 2001). Gazettlement of Ihefu Basin as a conservation area opened up processes for pastoralists’ eviction. As part of the move to safeguard the environment in Ihefu Basin, the Government issued a notice on 9th March 2006 banning all livestock keepers’ activities in Mbarali District. About 1,000 pastoralist households were evicted by the Government from Mbarali District. During the operation, an estimated 218,000 herds were actually relocated to various places (Walsh, 2007).

Various studies have shown that there is impoverishment and a change in livelihoods in pastoral societies following transformation in land use and ownership (Vangen, 2009; Brockington and Igoe, 2006). Cernea et al. (2003) examined how eviction affects people’s livelihoods in terms of major hardship risks, which include landlessness, joblessness, homelessness, marginalization, food insecurity, increased morbidity and mortality, loss of access to common property and social disempowerment and disruption to social institutions.

The eviction of agro-pastoralists from the Ihefu Wetlands and their definitive settlement was incited by a series of factors. The intention of the Government was to safeguard the environment and seen to have deteriorated affecting not only the Usangu plains and the Ihefu wetlands but also the Rufiji Basin ecosystem. Agro-pastoralists were taken as the major cause of severe water depletion leading to drying up of Mtera and Kidatu dams. During the 2006 dry season, the drying of Great Ruaha River forced Mtera Hydroelectric Plant to close and this measure reduced the Kidatu Hydroelectric Plant’s production of electricity by almost 50% (PINGOS, 2007; Walsh, 2007; Ngailo, 2011).

Eviction of agro-pastoralists from Ihefu to new areas of Tanzania has created some negative socio-economic impact on their livelihoods. However, there is little documentation on these adverse impacts. The exact nature and extent of these effects on the receiving or resettlement areas are not well known and documented, and in particular, the adaptive capacity of evicted pastoralists from Ihefu to new resettlement. The research questions addressed in this research includes; what livelihood strategies were undertaken by agro-pastoralists to sustain their livelihoods and what were the determining factors for the adaptive capacity of the agro-pastoralist in the resettlement areas. Therefore, this paper reveals the state of adaptive capacity and examines the livelihood strategies used by agro-pastoralists in the course of adapting in the resettlement areas.

CONCEPTUAL FRAMEWORK

The conceptual framework of this study was adopted by modifying some elements from the DFID’s Sustainable Livelihood Approach framework (SLA). Livelihood concerns the way people shape their lives by using material and non-material assets. The earlier livelihood definition was provided by Chambers and Conway (1992) who stated as follows: “A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living”. The livelihood framework is an analytical approach that puts people’s livelihoods, meaning their interaction with their environment at its centre. The framework incorporates five elements of analysis: context and policy analysis, analysis of livelihood resources, institutions and organizations, livelihood strategies and sustainable livelihood outcome. The core livelihood approach lies in analyzing different assets and capital upon which individuals or households draw to produce.

Adaptive capacity is the ability to design and implement effective adaptation strategies, or to react to evolving hazards and stresses to reduce the likelihood of the occurrence and/or the magnitude of harmful outcomes resulting from different hazards (Adger and Brooks, 2007). At the local level, the ability to adapt can be influenced by such factors as managerial ability, access to financial, technological and information resources, the institutional environment within which adaptation occurs, political influence and kinship networks (Kelly and Adger, 2000; Smith and Pilifosova, 2001; IPPC, 2007; Schipper and Burton, 2009). However, it is suggested that humans possess the ability to plan and manage adaptation (Schipper and Burton, 2009).

METHODOLOGY

This study was conducted in Mbarali, Chunya and Kilwa districts of Tanzania Mainland. Mbarali District was purposively included in this study because it was the area where agro-pastoralists were evicted from. Chunya and Kilwa were among eight districts where agro-pastoralists were eventually directed for resettlement after eviction from Ihefu Basin in Mbarali District. The study involved 110 respondents who were mainly affected by the eviction process.

Both primary and secondary data were collected. This involved qualitative and quantitative data collection methods. Quantitative data were gathered using questionnaire, while qualitative data were collected through key informant interviews, life histories and Focused Group Discussions. The quantitative data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 16.0 computer software, which provided descriptive and inferential statistics. In descriptive statistical analysis, frequencies, percentages, means and cross-tabulation were used to measure associations, while, inferential statistics, chi-square and t-test were used to measure variations in some variables in adaptive capacity. Qualitative data were analyzed by using content analysis. To examine the adaptive capacity of the agro-pastoralists resettled in Kilwa, Chunya and Mbarali districts an adaptive capacity index was developed.

An adaptive capacity index was used to determine the adaptive capacity of pastoralists resettled in Kilwa, Chunya and Mbarali districts. The index was developed using 25 indicators (Table 1). Based on the variables in the conceptual framework of this study, the measure of indicators for adaptive capacity was obtained by asking the respondents several questions and their answers were scored. The questions were based on ability of pastoralists to formulate their adaptive strategies, to access various forms of
Table 1. List of 25 adaptive capacity indicators.

<table>
<thead>
<tr>
<th>Capitals</th>
<th>Indicator</th>
<th>Maximum score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social aspects</td>
<td>Loss of kinship networks</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Maintaining kinship network through visiting each other</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Maintaining kinship network through mobile phone</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Maintaining kinship through joining together during special occasions</td>
<td>1</td>
</tr>
<tr>
<td>Economic aspect</td>
<td>Price of farm inputs</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Access to credit</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Selling of crops and animal products</td>
<td>1</td>
</tr>
<tr>
<td>Physical aspect</td>
<td>Access to dips</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Access to market</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Access to veterinary clinics</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Access to charcoal dam</td>
<td>1</td>
</tr>
<tr>
<td>Natural aspect</td>
<td>Access to good pasture</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Access to water</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Access to area free from disease</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Access to land for cultivation</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Access to forest and forest products</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Access to grazing land for animals</td>
<td>1</td>
</tr>
<tr>
<td>Human capital</td>
<td>Type of residence</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Procedure for acquiring land</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Type of housing</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Access to extension services</td>
<td>1</td>
</tr>
<tr>
<td>Transforming structures</td>
<td>Government support before eviction</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Government support for mitigating losses</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Government preparations for arrival in areas</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Link with different organizations</td>
<td>1</td>
</tr>
<tr>
<td>Total score</td>
<td></td>
<td>31</td>
</tr>
</tbody>
</table>

capital and to follow institutional processes. The respondents’ answers were scored based on the interval scale of a particular question. In this study, the social aspect of adaptive capacity (indicators 1 to 4) referred to respondents maintaining a kinship network. “Yes/No” questions were used to ask if they had maintained kinship networks. This implies that a respondent who reported “Yes” had lost the kinship network and so was given 0 but if “No” was given 1.

Economic aspects referred to their financial status measured by three indicators: price of farm inputs, access to credit, and the sale of crop and animal products (indicators 5 to 7). Physical aspects (indicators 8 to 11) referred to access to dips, market, veterinary clinics and charcoal dam. Natural aspects (indicators 12 to 17) referred to respondents’ access to good pasture, water, areas free from disease, land for cultivation, the forest and forest products and grazing land for animals.

Human aspects referred to the ability of the respondent to acquire a residence. If the respondent had a permanent residence he/she was given a score of 2, if it was semi-permanent he/she was given the score of 1 and if it was a temporary residence he/she was given the score of 0 (indicator 18), which implies that this person may not have decided to settle in that area, and so can decide to leave the area and move to another area. Regarding the acquisition of land, if the answer was by inheriting the score given was 1, if by renting the score was 2, if allocated by the government the score was 3, and if the land had been acquired by purchasing it the score
was 4, which implied that the respondent had the decision to resettle in that area and had the ability to purchase land (indicator 19). Other indicators were type of housing and access to extension services (indicators 20 and 21). Transforming structures referred to Government support before eviction, during the eviction process, preparation for arrival in areas and the respondents’ link with different organizations.

For all questions with a response of “Yes”/“No”, if the response was “Yes” they were given a score of 1 and if “No” they were given no score (0). The maximum score was 31. The total score for each respondent was divided by 31 so as to have a cumulative index ranging from 0 — 1 (0-100%). The adaptive capacity indices of respondents were put into three categories, such as poor adaptive capacity (adaptive capacity index score of 0.00 and less than 0.44), moderate adaptive capacity (adaptive capacity index score of 0.44 and less than 0.55) and good adaptive capacity (adaptive capacity index score of 0.55 and less than 1). The cut-off point for one standard deviation increase was zero + 1 std dev= poor; = 2 std dev = moderate; above + 2 std dev = good adaptive capacity.

### RESULT AND DISCUSSION

#### Adaptive capacity of resettled pastoralists

Table 2 shows the respondents adaptive capacity categories, which were poor adaptive capacity (adaptive capacity index score between 0.00 and less than 0.44), moderate adaptive capacity (adaptive capacity index score of 0.44 and less than 0.55) and good adaptive capacity (adaptive capacity index of 0.55 and less than 1). It was evident that respondents’ adaptive capacity was poor in Chunya District (82.2%). Good adaptive capacity was noted in pastoralists who resettled in Kilwa (45.2%) and Mbarali (53.2%).

A t-test was carried out to determine whether there was a significant difference in the adaptive capacity of respondents in Kilwa, Chunya and Mbarali districts. The test showed that there were highly (t=33.889, p=0.012) statistically significant differences between the adaptive capacity of pastoralists who had resettled in Kilwa and Chunya districts.

The results suggested that the observed difference could be attributed to the ability of respondents to apply different adaptive strategies by accessing several capitals and institutional processes e.g. village governments. For example, in the case of ‘poor adaptive category’, it means a maximum of 44% were capable of applying different adaptive strategies and accessing several capitals. Those with ‘good adaptive capacity’ of 55% and more were able to use different adaptive strategies and access several capitals.

#### State of adaptive capacity (human, social, economic, physical and natural capitals and transforming structures)

An ANOVA-F test was conducted to compare the contribution of different capitals to the adaptive capacity of resettled pastoralists in Kilwa, Chunya and Mbarali districts (Table 3). The attribute of human capital differed significantly between the three districts (F (2,107)=50.55, p=0.012). Human capital contributed less to adaptive capacity in Chunya District (M=0.23) and more to adaptive capacity in Kilwa and Mbarali districts (Ms= 0.31 and 0.36 respectively).

Based on the results of ANOVA-F test, means of economic adaptive capacity (F (2,107)=53.91, p=0.001), physical adaptive capacity (F (2,107)=123.46, p=0.025), natural adaptive capacity (F (2,107)=116.62, p=0.031) and transforming structures (F (2,107)=12.14, p=0.005) in the three districts had a very strong statistically significant difference.

Post hoc comparisons using the Fisher LSD test revealed that economic capital contributed more adaptive capacity in Mbarali than Kilwa and Chunya districts. During FGDs it was noted that in Mbarali District the majority of resettled pastoralists had access to financial institutions. Physical capital made a greater contribution to adaptive capacity in Mbarali and Kilwa districts but much less so in Chunya District (Table 3). Adaptive capacity was greatly contributed to by natural capital in Kilwa and Chunya districts. There was plenty of land for grazing and cultivating in these two districts, which increased their animal and plant productivity. Resettled pastoralists in Mbarali District had minimal access to cultivating and grazing land.

Regarding the contribution of social capital to adaptive capacity, the results showed that there was no statistical difference between the three districts (F (2,107) =1.08, p=0.172). From this finding it shows that even if agro-pastoralists were relocated to different areas, most of them were able to maintain their kinship networks. Social networks were very important for resettled pastoralists in

<table>
<thead>
<tr>
<th>Adaptive capacity categories</th>
<th>Kilwa (n=40)</th>
<th>Chunya (n=30)</th>
<th>Mbarali (n=40)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor adaptive capacity</td>
<td>1</td>
<td>14</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>Moderate adaptive capacity</td>
<td>11</td>
<td>15</td>
<td>5</td>
<td>31</td>
</tr>
<tr>
<td>Good adaptive capacity</td>
<td>28</td>
<td>1</td>
<td>33</td>
<td>62</td>
</tr>
</tbody>
</table>

Table 2. Adaptive capacity of resettled pastoralists.
the early days of resettlement. Through social networks they got financial support, market information and food from their relatives.

Adaptive strategies undertaken in new resettlement areas

Adaptive strategies are those that seek to spread the risk of failure in response to anticipated adverse trends. This may be by intensifying existing livelihood strategies or diversifying into new activities. Table 4 shows the adaptive strategies adopted by the evicted pastoralists. The majority of respondents (97%) reported that they had increased crop-farming areas, which caused agriculture to become an important economic activity. This enabled them to improve household food security and have a surplus for sale. Seventy-four respondents revealed that another strategy was to send members of the family to settle in different parts of the country. This also was narrated during FGDs. The study also revealed that during the eviction process, some families divided into different groups to minimize the risk of losing the entire herd if they all settled in one area. Such family division strategy enabled family members to engage in new activities, which improved their livelihoods through sharing their outcome. It was also noted that 23.5% of the respondents, especially in Chunya District, used another adaptive strategy that of growing cash crops, mainly tobacco.

It was further noted that 46.4% of the respondents opted to diversify their major livelihood activities. These included income-generating activities, such as petty trade and local transport services locally named “boda boda”, selling roasted meat “Nyama choma” and making local brew (especially by women in Mbarali District). A woman in Mbarali once stated that: “depending only on livestock does not ensure that I will be able to meet the needs of my family, especially when you consider the great loss we sustained during the eviction process, and so it was crucial to make use of all alternatives at our disposal”.

Other adaptive strategies used to improve livelihoods were reported. Twenty-nine percent of the respondents modified their herd composition and number of animals kept. This was reported mainly in Mbarali District (15.5%) (Table 4). The livestock keepers in Mbarali District decided to increase livestock breeds and adjust herd composition by reducing the number of grazing animals (cattle and sheep) and increasing the number of browsers (goats). This strategy was especially adopted in Mbarali District, where grazing land was shrinking and the quality of the pasture deteriorating. However, among the livestock only goats were able to browse and reproduce to generate income to meet family needs. The income generated from goat sales sometimes was used to generate other business activities such as petty trade. Similar observations of having more grazing animals than browsers have been reported. A study by CARE...
International in Longido District, following support by HPI Project, found that household members opted to raise camels (Richié et al., 2009). Through raising camels they could get more milk during the dry season unlike other households who refused the option. Camels can easily browse herbs and thorn bushes.

**Conclusion**

Resettled pastoralists had various ways of adopting different adaptive strategies and accessing several livelihood capitals. Such capabilities were considered to be good adaptive capacity. Availability of good pastures and water, organizations, different skills, culture and tradition were good drivers for pastoralists to adapt in resettlement areas. Government and its institutions were important in enhancing adaptive capacity of resettled pastoralists. For improving the adaptive capacity of resettled agro-pastoralists, the Government and other stakeholders should improve infrastructure such as rural roads, water supply, schools, extension and veterinary services, reliable markets and marketing information tailored to specific needs of pastoralists.

**Conflict of interests**

The authors have not declared any conflict of interests.

**ACKNOWLEDGEMENT**

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Prioritizing needs assessment techniques for agricultural programs implementation: The case of Northern Region, Ghana

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The Northern region is among the poorest in Ghana. The Southern regions possess a lot of natural resources, and at the same time viable for the production of cash crops. The Northern regions however, have agriculture as their most dependable source of livelihood. The proportion of people working as farmers in the region is 73%, making it the highest in the country. In the light of this, most developmental programs in the region are agriculture based. However, the impact of these programs is not being felt as farmers continue to experience lower harvest and productivity. We however blamed the situation on the absence or inappropriate Needs Assessment. We tried to establish from the farmers the programs they found successful. It was established that, an insignificant number of programs were adjudged successful. Reasons why they considered projects successful or otherwise were also investigated. Combining the results from the data and the practical application of the techniques in the study area, we prioritized these techniques. It was realized that individual group techniques were complements to group techniques in the context of the study area. A case is made for the prioritized techniques as well as further discussion on the highly prioritized ones.

Key words: Agricultural programs, needs assessment, need assessment techniques.

INTRODUCTION

Ghana’s economy is economically dependent on agriculture, not in terms of how much it contributes to gross domestic product (GDP) and economic growth but rather in terms how many people it employs. It is the least in terms of contribution to GDP, but the highest in terms of population employed. Agriculture, industry and services contribute 21.9, 28.6 and 49.5% respectively to GDP (Ghana Statistical Service, 2014a:5) and (World Bank Ghana Development Indicators, 2014). Agriculture however, employs 44.7% of the labor force as at October 2013 (Ghana Statistical Service, 2014b:51). The intricate nature of agriculture in rural setting makes implementation of agriculturally oriented programs very difficult. Unlike industrial farming which operates as an economic unit with higher efficiency and productivity, small scale farmers who comprise most of the world farmers simultaneously operate as an economic, social and cultural unit. This means, the implementation of any
program needs to strike a balance among these aspects of the rural community life. The regions in the Northern Ghana are typically less developed than those in the south where there are a lot natural resources and cash crop production. Apart from the fact that the countries mineral resources like gold, diamonds, bauxites, manganese and oil are found in the south, the production of Ghana's most important and precious cash crops; cocoa and coffee are viable only in the south. The Northern regions have only small scale agriculture as the only livelihood of most people. It is also the region with the highest proportion of its population as farmers; 73.11% (Ghana Statistical Service, 2012:76).

However, most of the agricultural outputs in the northern region especially food crops are below 50% of their potential productivity. These include important ones like maize, rice, cassava, yam, tomato, and cocoa (Ministry of Food and Agriculture, 2011:12). Furthermore, the productivity levels of some of the crops are not only below the national average, but are continuously declining over the years. For example, while the national productivity of cassava, yam, maize, rice and soybean improved from 2010 to 2013, that of Northern region for the same crops, with the exception of the tubers decreased from 2010 to 2014. For 2010, the national yield for cassava, yam, maize, rice and soybean were 15.4, 15.5, 1.9, 2.7 and 1.5 respectively, whiles that of 2013 were 18.3, 16.8, 1.7, 2.7 and 1.9. However, at the Northern regional level, the yields were 13.28, 12.53, 1.83, 2.95 and 1.97 for 2010, and 16.5, 17.2, 1.43, 2.16 and 1.96 for 2014 respectively. The unit of measurement is metric ton per hectare (Mt/ha) (MoFA, 2010 and 2013) and (FAOSTAT, 2015).

Even though Ghana as whole is improving in terms of poverty reduction, the source of this positive development is not from the agricultural sector but rather the service sector. This explains why poverty among the farmers in the northern region is rising. Between 1992 and 2006 for instance, the number of poor people in the southern regions deceased by 2.5 million while the northern regions experienced an additional 900,000 more poor people within the same time period (IFAD, 2012:5). The combined effect of poverty, falling agricultural productivity and some other factors force the youth in the north to migrate to the south to work as head potters, store keepers, maids, farm work etc.

In an effort to bridge this gap between the South and the North, agriculture has been the target of most development programs and policies in the Northern Region. Whiles some programs target yield improvement, others consider marketing. Others may attempt to solve problems along the entire agricultural value chain. The government of Ghana through the Ministry of Food and Agriculture (MoFA), private and non-governmental organizations implement programs aimed at fulfilling any or a combination of the above objectives. In this regard the Agricultural program implementers and extensionists play a major role. It has to be noted that almost all the government programs are supported by international organizations or a country that is a development partner. In some cases a Non-Governmental Organizations (NGOs) undertake a project with funding mostly from outside Ghana. This type of organizations has a little coordination with the MoFA and most time none with other partners working in the same districts with the same farmers. Sometimes too, development partners execute a project directly through some other official organizations within the country. The development partners who are directly or indirectly involved in executing agricultural projects in Ghana are African Development Bank (ADB), Alliance for Green Revolution for Africa (AGRA), Canadian International Development Agency, Food and Agriculture Organization (FAO), German Development Cooperation in Agriculture, International Fund for Agricultural Development – IFAD, United States Agency for International Development (USAID), Millennium Challenge Corporation, World Bank, World Food Program, Japan International Cooperation Agency and more (MoFA's website).

Most programs go into these communities with very good objectives and solution to a particular agricultural problem, but the problem has always been obstacles at the implementation stage. These obstacles include lack of community support, lack of corporation from participants, timing, funding, incompetent staff etc. These obstacles subsequently lead to agricultural programs that do not promote voluntary participation, adoption, and sustainable implementation of outcomes. Most of these obstacles could have been prevented if proper planning and consultations were done before the implementation. We therefore think that, the missing link in these project implementations is proper Needs Assessment (NA) and the appropriate NA techniques.

NA is basically the life line of every successful socially oriented project or program. This takes an objective overview of the current situation in the society and what it should have been. It is a multi-disciplinary concept so wide that its definition depends on the discipline, organization and focus of the researcher or the decision maker. This situation between the current state and the desired or targeted state is call the gap and the contributing factors to help close this gap is called needs (Watkins et al., 2012:19). However, a need is the same as a gap if the word 'need' is defined as a noun (Witkin and Altschud, 1995:9). The Gap forms the bases for any NA and any decision taken should be focus on addressing the gap. It tells where you are and where you intend to go.

**Why needs assessment**

For any gap in agriculture to be addressed the project implementer or the extensionists play a significant role.
The farmer is always at the center of all these and makes most of the decisions, hence whatever decision is to be taken about the program and its implementation, the farmer needs to be part of it and be well informed. NA is critical in the execution of any program. Agricultural programs and extension in general is required by statute to consider stakeholder input as part of the designs and delivery of programs (McCawley, 2009:4).

According to McCawley (2009:3), NA for agricultural programs and extension purposes is done by first learning what the audiences (in this case farmers) already know and thinks, so that an educational product and services can be designed to address their need. For example, if farmers want to increase productivity of wheat per acre in a particular community. So many needs might have accounted for low productivity but the researcher or the program formulator cannot just guess the ones really responsible. He or she must use any of the NA techniques. Sometimes it can be one particular need or a combination of more than one. These needs may include inadequate machinery, inadequate pesticide and weedicides, inadequate labor, the inappropriate use of equipment, and so on. Further scrutiny has to be made regarding this information gathered. For example, all the above may be adequate or enough in that particular community, but however the inappropriate use of pesticide, weedicides and machinery may be the problem. If the researcher finds out that there is a combined effect of three of the above listed problem, they must be prioritized, that is, which is more pressing or needed then the other to address the said goal (increasing productivity per acre).

Some authors stress the need to make distinction between a Need, Want and an Interest, as these terms are often confused and used interchangeably by program implementers, extensionists and farmers. “Needs refer to something considered necessary or required to accomplish a purpose. Wants, on the other hand, are considered desirable or useful, but not essential. Interests indicate an individual’s concern or curiosity about something” (Swanson et al., 1997). In the scenario above, the difference between want and need is exemplified by the fact that the farmers want to increase productivity, but they actually need education on the usage of farm equipment. When that equipment usage gap is reduced or closed, we can be sure that productivity will increase. This explains how suicidal it to execute agricultural programs in farming communities without NA.

In some cases, the buck does not stop at perfectly identifying the need. Some cultural and social lifestyle of the community may impede on the program implementation. Rural life in most part of Africa has a form of collective socialist behavior ingrained in them. They are ready to abandon anything that they think is not in the collective interest of their community especially their beliefs, customs and tradition. Some of their lifestyles however, are anemic to their development. In fact some of them prevent innovation, networking, technology, education and gender equality. It is rather the duty of the project implementers and the extensionists to be aware and well informed about them so as not to be obstructed by them in the implementation process. Since the primary aim of the agricultural program is not to change those lifestyles, it is prudent to avoid or managed them. A classic example is distributing a medicine whose structure or packaging looks like a cross to a Muslim dominated community, considering how Muslims abhor the cross. To some extent, NA can reveal the attitude the community will have towards the program when it is being implemented. This will give an expectation as to the pace of implementation. Lastly, knowledge about existing government policies as well as meeting other program implementers in the same communities is essential. Sometimes the objectives of the current policies or programs may be counter reactive or overlap with the one to be implemented.

It is in the light of these that we decided to evaluate the successes or otherwise of these agricultural programs from the farmers’ own perspective. It has to be noted that the farmers’ definition of success is more paramount to the programs definition of success in their reports. Using the results from the data gathered in addition to the practical applicability of each technique in our study area, we prioritized the techniques in order of importance.

**METHODOLOGY**

Numbers will not reveal the unquantifiable explanations behind the topic of discussion, whilst qualitative methods is not capable of giving a vivid picture of events. We therefore resorted to a mixed methodology, which is considered appropriate in a socially oriented research like this (Bryman, 2008). Qualitative research answers research questions from the perspective of the respondents. Therefore its application is paramount to this study because we seek to assess those programs directly from the farmers. This will enable us to calculate some quantitative results as well as give answers to the what, how and why questions. Considering the fact that the two methodologies have interviews as a common data collection instrument, we tend to have a face to face interview with each respondent. The difference being that, interviews for quantitative analysis will be less in-depth as compare to the qualitative (Trochim, 2000). The first part of the questionnaires would be structured, whereas the last part of it will be in-depth interviews.

What we requested as the main yardstick for success of a program was whether the program satisfied all or some of their needs as farmer. Reasons for the success or otherwise of programs were also investigated, ranked and discussed. Their knowledge about the project before implementation was also sort. We also enquired from them what their needs are. Their responses were ranked in order of frequency. From the responses we evaluated and established the NA techniques that were used for each successful project. The target respondents are Farmer Based Organizations’ (FBOs) leaders and members.

Descriptive statistics such as the mean mode and frequency tables will be used. Some of the analysis will also be done using the graphical representations such as the bars, lines and the dots.
Table 1. Selected FBOs.

<table>
<thead>
<tr>
<th>Districts</th>
<th>Number of FBOs</th>
<th>Total membership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chereponi</td>
<td>7</td>
<td>183</td>
</tr>
<tr>
<td>East Gonja</td>
<td>7</td>
<td>99</td>
</tr>
<tr>
<td>Gushegu</td>
<td>7</td>
<td>229</td>
</tr>
<tr>
<td>Savelugu Nanton</td>
<td>7</td>
<td>262</td>
</tr>
<tr>
<td>Saboba</td>
<td>7</td>
<td>108</td>
</tr>
</tbody>
</table>

Table 2. Number of successful projects.

<table>
<thead>
<tr>
<th>Districts</th>
<th>Total number of projects</th>
<th>Successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chereponi</td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td>East Gonja</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Gushegu</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>Savelugu Nanton</td>
<td>31</td>
<td>5</td>
</tr>
<tr>
<td>Saboba</td>
<td>30</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td>31</td>
</tr>
</tbody>
</table>

Based on the open ended questions asked, qualitative analysis would be made using direct responses from the farmers.

Data

The information is gathered on wide range of issues to assess the NA techniques used in the formulation of the agricultural programs. For any FBO, a member of the executive and a group member are interviewed. It is expected that the executives will have much information about the projects as well as their assessment of it. Information is gathered on the number of projects they participated, their knowledge about the projects before implementation, their assessments etc. A random sampling of 5 districts was chosen from among the total of 20 in the region. Out of which 7 FBOs were randomly selected from each of the 5 districts given a total of 35 FBOs. Since two members from each FBO are to be interviewed (an executive and a member), the total sample is 70 farmers (Table 1).

RESULTS

On the number of projects each group participated the number varied between the two respondents for the same FBO. We considered the report of the executive as right one because they have the records. The member may be new to the group and may not be aware of other projects that the group participated. The other thing worth mentioning was the fact that many of the members and some few executives could not identify projects by their specific names but by the country or the international organization that supported or a famous personality directly or indirectly involved the implementation of the project (Table 2).

As seen in Figure 1, the FBOs in Savelugu and Saboba implemented the most projects. However it has to be acknowledged that more than one FBO could be refereeing to the same project. This means that the results are aggregated at the district level. For example MiDA was a common name that came up in almost all the FBOs in the district in which it was implemented. The proportion of successful programs is indicated by the percentage figure above each bar.

It was also observed from further questioning that there were common names among the projects deemed successful. MiDA for example was considered successful for all FBOs that participated in it. It was implemented in five district of which Savelugu Nanton and Gushegu was part. In the Gushegu district, all the seven FBOs participated in it and considered it the only successful project they have participated. Only one considered an additional project a success. This additional program was a nucleus farmer. These are farmers who extend services to other farmers mostly on credit. They pay back the loan mostly in the form of harvested crop after the farming season. This makes a total of 8 (Table 2). In the case of Savelugu Nanton, only 5 FBOs participated in the MiDA program and it was considered the only successful program among all the programs they have participated. The other two think all the projects they have ever participated have not been successful or useful to them. Saboba and Cheriponi districts have the same explanation. In this case all the seven districts in both districts considered EPDRA program as the only successful project they have participated. The eighth successful project in the case of Chereponi was a project that provided the community with boreholes. They however could not identify the program by name. In East Gonja, one FBO referred to SEND Ghana project as the only successful project whiles another FBO mentioned...
SEND Ghana in addition to a project whose name they could not remember.

In all, out of about an average of four projects each FBO participated, an average of one was considered successful that is, 25% of total projects implemented. Considering the yardstick for a successful project and the results in Figure 1 we conclude that most of the programs did not meet the needs of the farmers.

Pre knowledge about projects

The FBOs in Savelugu Nanton and Gushegu Districts singled out MiDA project as the only projects they had information about before its implementation. According to them, there were stakeholder and consultative meetings at the district level to sensitize them about it. Their inputs and suggestions were taken but were not sure whether they were incorporated into the program. In the case of Saboba and Cherponi districts were EPDRA program was considered a success among all projects, it was revealed that EPDRA programs are continual. They work with them throughout the farming season and have meetings with them to plan for the coming season. Because of this, they have a permanent secretariat in those districts they are operating. This means that farmers are abreast with their activities before any farming season. The other issue has to do with the Nucleus farmers. According to them these business people inform them earlier and organize meetings to explain the modalities in what he or she is going to offer them. Because it is always in the form of credit and other services, those meetings are necessary for legal issues. Some of them are made to sign contracts to that effect. Other nucleus farmers make their transactions based on trust. These farmers are members in the community and they already know the package he or she is offering. They claim for all other projects, they are only informed about programs at the implementation stage. We therefore conclude no NA was conducted for most of the projects, and even if it was done, it was not properly done.

Why projects were successful

It was only logical to probe further to understand why they think some of the projects were considered successful. There were varied reasons given. We decided to arrange them in order of frequency.

1. The objectives were holistic
2. It addressed some of their needs
3. Continuity
4. Still benefiting from it.

The challenges in agriculture is spread across the various stages of the value chain: production, harvesting, processing, storage and marketing. Farmers would often like a project that seems to solve the various challenges
along the chain. For example a project or program that seeks to increase productivity by acquiring good seed variety and fertilizer, tractor and plough availability for timely production, processing equipment, storage facilities, good prices for their produce and most importantly credit of any form. MiDA for instance, strengthened the organizational structures of the FBOs, gave them technical training on good farming practices, linked them up with agro dealers, gave them loans, build storage facilities for them, provided tractor and implements, assigned buyers(aggregators) to the participating FBOs. The EPDRA program doesn’t as much as MiDA did but virtually assist farmers in most part of the production process. The package of some Nucleus farmers is also holistic; from production to marketing. They mostly act as aggregators of the produce of their clients. The holistic nature of these projects earned them the success tag from all the FBOs that participated in them.

According to them, some programs wasted their precious time. They were not just what they needed. Among the examples mentioned was a project that wanted to promote farm insurance, another one was teaching them precision agriculture, market linkage project etc. The holistic nature of the EPDRA and MiDA projects meant that some or all of their farming needs would have been addressed by those projects. Programs that are rolled out yearly are considered successful as compared with those that have a limited lifespan. Those types of programs are scanty. EPDRA programs in Saboba and Chereponi, and SEND Ghana program in East Gonja are good examples. Even though their activities vary, the fact that they are always around for the farmers to rely on every season make them important in the eyes of the FBOs. Lastly, they also attach importance to projects that have left an important impression on them even after it has folded up. Farmers in Gushegu district considered a project a success even though they could not identify its name. They pointed to a silo provided by the project for storage of their cereals. They could only identify the project as a German funded project and that there are other silos in other communities. The MiDA FBOs also added the presence of an Agribusiness Center (ABC). These centers were provided by the project to form as a meeting and learning place for the FBOs. It also harbors a tractor and its implements as well as rice mills for rice processing. They also mentioned of some roads that were constructed to link some communities to the main road, as well as the existence of the FBO itself. Most of the FBOs were formed purposely because of the MiDA program and they still exist four years after the end of the Project.

**Why projects were unsuccessful**

A lot of reasons were also given under this question.

Again the responses are ordered in terms of frequency.

1. The implementers were not serious
2. It was very complex
3. We lacked information
4. It was expensive to implement
5. Do not know
6. We did not need it
7. Our chiefs did not support it
8. FBO organizational problems
9. Ethnic unrest
10. No credit component
11. Apathy towards the implementation

Most of the farmers blamed the unsuccessful nature of some project to the nonseriousness the implementers attached to the project. They claim it often leads to the truncation of the project without any official communication from the implementers. Sometimes, the complexity of the project couple with lack of information makes it difficult for the farmers to identify with it. The farmers in the rural Northern region are mostly illiterates who find it difficult to identify with anything that is little complex. A farm insurance project was launched in the Savelugu Nanton district, which the farmers thought was too complex for them to understand not to talk of adopting it. Farmers did not turn up for the second meeting and that marked its demise. Farmers also alluded to the fact that some projects are not just feasible in terms of their financial situation. The implementation of those projects is expensive both in terms of time and money.

The case is worsened when those programs do not have a credit component. Examples were given of projects that came to promote a high yielding hybrid maize seed which require four times the fertilizer they normally use. The other common answer to our question was ‘I do not know’. This was mostly coming from FBO members. When a program is discontinued, the reasons are not normally communicated to the FBOs, hence this response. As mentioned earlier, the farmers thought some projects are just not important to them, that is, they do not need it. This normally leads to the abandoning of the project or it ends without making any impact.

In some cases, the traditional authorities impede on the implementation of certain projects. Even though Ghana has a constitution, the traditional authorities (Chiefs and kings) wield much power and authority especially in the rural setting. They have full control over all lands under their jurisdiction. In instances where they are not okay with the implementation of a certain project they have all what it takes to stop the project or impede it implementation. One sure way is by refusing to give out lands. Few farmers blame the truncation of some projects on the organizational structure of their FBOs. Sometimes organizational conflicts can crop up in the middle of a
project implementation. This normally arises out of distrust among members and executives of the FBO. There are sometimes ethnic conflicts in the region. Some farmers attributed the failure or the truncation of some projects to the emergence or start of a conflict between families or tribe within the district.

There was only one farmer who raised a very vital point that is worth mentioning. He explained there is general apathy towards projects if they do not have the credit component. Their main concern is what they will use to implement the recommendations of the programs on their farms. The last concern was a reason a farmer felt contributed to the general apathy towards agricultural programs. He said they are confused on what to do concerning good farming practices and other agricultural educational programs. For example, while some projects came to discourage them on the use of chemical fertilizer, others encouraged them to even apply more of it. The same contradiction is seen in the use of pesticides.

What are their needs?

About 95% of the reasons assigned to the failure of the projects would have been avoided if time was invested in conducting NA. Each respondent was asked to rank in order of importance, what they think their Needs are, as farmers. We also arranged their responses in order of frequency as seen below;

1. Tractors and plough
2. Credit of various forms
3. Irrigation
4. Wells and boreholes
5. Electricity
6. Roads

The availability of tractors is a major need according to the responses. If the land is not ploughed, nothing can be done in the farming season especially for cereals. Normally the Northern region has a single maxima rainfall pattern which lasts for about five months. However, the unpredictability of the rains forces farmers to wait till it starts before they can plough. When the rains finally set in, there is a mad rush for tractors to plough the land. The tractor operators take an advantage to exploit them by either charging them exorbitant prices or ploughing less than the required land size. A farmer in the East Gonja district explained that some members of their FBO could not cultivate their crops because it is always late by the time the tractors get to their turn. Those who are not able to plough on time will normally end up abandoning their farms or harvest very little. Even though they admitted an ownership of a tractor by the FBO would have been better, they just need it to be available when they need it. Credit was the second most important need according to the responses. They are of the view that, the availability of credit will help expand their scale. With the exception of a few, most of them use up their harvest before the next farming season. This is because, the size of the farm they are using commensurate the little capital they have for the farming season. The credit they said could be of any form; cash or rendering services on credit. According them the most common one is the rendering of agricultural services on credit. For example, the tractor operator can plough additional acres on credit, payable after harvest. Agro dealers can also extend more fertilizers and pesticides on credit. The mode of payment is mostly the harvest. For example, the supply of a bag of fertilizer on credit will attract one and half bags of maize. Irrigation facilities to them will not only help them cultivate in the dry season but will help augment the rains when it delays in starting. Even though the rains come in a short period, it is normally very heavy that most parts of the region get flooded. All what is needed is a technology to harvest this water during the raining season. Most parts of the region lack portable drinking water. They rely on the streams and dams which dry up in the dry season. Some part of the region is blessed with underground water, however extracting it has always been a problem. Though the need for wells and boreholes are not for agricultural purposes they still saw it as a necessity. This underground water also has the potential for irrigation in the dry season. The availability of electricity will help directly in the agro processing and other related agricultural activities. Roads will ease transportation and other related agricultural activities.

Needs assessment techniques

Watkins et al. (2012:83) outlined 7 techniques, Royse et al. (2009:44), Witkin and Altschud (1995:101) and Swanson et al. (1997) also outlined some techniques. Swanson et al. (1997) however went a little further to classify them into four major categories; individual, group, secondary source, and rapid rural appraisal techniques. With this categorization, we group all the techniques outlined by the above references in Table 3.

As observed earlier, there were some kind of NA conducted for the projects deemed successful; MiDA, EPDRA, SEND Ghana and the Nucleus farmers. We narrowed the discussion to these projects so as to identify the sort of NA technique or techniques that were used. The responses from those questions are matched with the NA techniques in Table 3 to determine what specific technique or category of techniques was used. We assume every project will one way or the other refers to some secondary source about the region. More so, the use of this technique cannot be verified from the farmers. We are therefore left with two groups since the fourth category is already a combination of the other three categories (Table 3).
of agricultural programs implementation. Secondly some of the techniques are structurally difficult if not impossible to be used in remote rural setting. Thirdly, some techniques do not promote the participatory extension being promoted by the FAO. Combining these three criterions with the empirical responses from the survey, we prioritized the techniques in order of importance in the context of northern region.

First of all, as can be seen from the results all the successful programs used the group or a combination of group and individual techniques. This goes to emphasize the fact theoretically and practically, individual NA techniques are compliments to group techniques when it comes to agricultural program which seeks to promote voluntary participation, adoption, and sustainable implementation of outcomes. Because of this we are inclined to those that have to do with grouping of farmers and stakeholders in agriculture. From our point of view, unlike other organizations where there is an organizational structure and levels of authority defined, agriculture is not like that. That is why farmers must be involved in every stage of activities leading to the decision making and outcomes. In a private company or government institutions, not everybody must accept a decision before it is implemented. Most people have to just obey and execute instructions. In the case of the farmers, their acceptance is key to the success of any project. Consider observation as a NA technique. When there is any need gap to be closed or solved in a company, observations can be used and recommendations made to the employees by the employers and it takes effect. Even though valuable NA data can be gathered especially through Informal Personal Observations (Swanson et al., 1997), recommendations thereof can be used for anything other than asking farmers and the community to implement them. This will sometimes see an outright rejection or it implementation will be a nine-day wonder.

It is in the light of these that we give less priority to Individual and Secondary techniques. In addition, structurally, telephone interviews will not be effective as few have access to telephones or mobile phones in the rural communities in the Northern region. Questionnaires

### Table 3. Needs assessment techniques.

<table>
<thead>
<tr>
<th>Individual</th>
<th>Group</th>
<th>Secondary source</th>
<th>Rapid rural appraisal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1). Face-to-Face Interviews.</td>
<td>1). Community forum</td>
<td>Document and Data Review can be done by using information from;</td>
<td>This method is a synthesis of the other 3 categories in a superficial way especially when the information is needed urgently. (Freudenberger, 1994)</td>
</tr>
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<td>2). Key Informant Interviews.</td>
<td>2). Focus group</td>
<td>1). Census Reports.</td>
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<td>3). Questionnaires.</td>
<td>3). Delphi</td>
<td>2). Previous Studies</td>
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<td>4). Informal personal observations.</td>
<td>4). Nominal group</td>
<td>3). Administrative Records and Reports</td>
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<td>5). Formal personal observations.</td>
<td>5). World Café</td>
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<td>6). Dual-Response Surveys.</td>
<td>6). Informal group</td>
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<td>7). Critical Incident technique.</td>
<td>7). Dacum process</td>
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**Prioritizing NA techniques**

With the multidisciplinary nature of NA, it is almost always impossible to define the most suitable method to be used in conducting it. Every need, targeted audience, organization and community is unique and hence depending on the practical feasibility and the researcher’s discretion, a suitable method or a combination of methods will be used. However in the area of agriculture that deals with the holistic rural community, the type of data being sort should be facts and not opinions. The data should be voluntarily given by the farmers and are well informed of its intent. Witkin and Altschud (1995:46) has it that there are two kinds of data collected for NA purposes; they are facts and opinions. Researchers should go for the facts and even when respondents mixed it up with opinions, they should be able to separate them. With this consideration, a lot of NA techniques fall short of the criterion to establish an agricultural program which seeks to promote voluntary participation, adoption, and sustainable implementation of outcomes. This does not close the doors on the use of the other techniques but just to emphasis that priority should be given in our opinion to some techniques more than others in the area of agricultural programs implementation. Secondly some of the techniques are structurally difficult if not impossible to be used in remote rural setting. Thirdly, some techniques do not promote the participatory extension being promoted by the FAO. Combining these three criterions with the empirical responses from the survey, we prioritized the techniques in order of importance in the context of northern region.

First of all, as can be seen from the results all the successful programs used the group or a combination of group and individual techniques. This goes to emphasize the fact theoretically and practically, individual NA techniques are compliments to group techniques when it comes to agricultural program which seeks to promote voluntary participation, adoption, and sustainable implementation of outcomes. Because of this we are inclined to those that have to do with grouping of farmers and stakeholders in agriculture. From our point of view, unlike other organizations where there is an organizational structure and levels of authority defined, agriculture is not like that. That is why farmers must be involved in every stage of activities leading to the decision making and outcomes. In a private company or government institutions, not everybody must accept a decision before it is implemented. Most people have to just obey and execute instructions. In the case of the farmers, their acceptance is key to the success of any project. Consider observation as a NA technique. When there is any need gap to be closed or solved in a company, observations can be used and recommendations made to the employees by the employers and it takes effect. Even though valuable NA data can be gathered especially through Informal Personal Observations (Swanson et al., 1997), recommendations thereof can be used for anything other than asking farmers and the community to implement them. This will sometimes see an outright rejection or it implementation will be a nine-day wonder.

It is in the light of these that we give less priority to Individual and Secondary techniques. In addition, structurally, telephone interviews will not be effective as few have access to telephones or mobile phones in the rural communities in the Northern region. Questionnaires
for NA purposes in agriculture are mainly used in developed countries (Swanson et al., 1997). Postal survey and Dual-Response Surveys will face the problem of high illiteracy and lack of postal addresses. Very poor record keeping will make Document or Data Review and Guided Expert Reviews techniques less effective. Secondary sources techniques generate data for future use with often unknown application. By it very nature, we do not prioritize it for NA technique for agricultural programs. Agriculture and rural development have ever changing challenges which requires current information and data to tackle them. It is no surprise that it is rarely used by Extension agents as a NA technique. This Sofranko and Khan (1988) attributed to its lack of straightforward application couple with the fact that extension staffs have little understanding about the role of secondary data.

The order

With the group techniques, there is still a need to prioritize them in terms of which technique ultimately promote the whole essence of agricultural programs; that is voluntary participation, adoption, and sustainable implementation. We consider the first four as highly prioritized and the rest less prioritized. In order of priority, they are; 1. Community forums, 2. Focus groups, 3. The World Café, 4. Nominal Group, 5. Delphi Technique, 6. Informal group, 7. Dacum process.

Starting from the bottom of the hierarchy, Dacum process as a group technique is very effective in identifying effective procedures built on a set of behavioral nature of the people involved, for a particular occupation (Witkin and Altschud, 1995:189). As the name suggests (DACUM stands for Developing a Curriculum), its final objective is to develop a curriculum which outlines the job descriptions and captures the best practices in that particular job or occupation. The question now is, is farming not a job? Yes it is and would have been better with such a curriculum. However the dynamic nature of farming does not make it attractive to the use of such curriculum. Farming as a job varies a lot within a particular community not to talk of regional and national levels. The unstructured nature of farming as a job makes its activities very diverse in terms of procedures even within one community. Again, per the procedures in conducting the Dacum Process, people who are successful and out-standing in that job constitute the group (Witkin and Altschud, 1995:189). In the case of farming that will require only successful farmers to form that group for the process. This form of discrimination will ultimately not enforce voluntary participation. Finally, the process itself is very complex and will require not only successful farmers, but highly technical ones who can do a lot of brainstorming on technical issues. In rural communities, this technique is disabled.

Informal groups as a technique in our opinion are not so much different from observation as a technique. According to Swanson et al. (1997), this form of information gathering is done at events which involve the grouping of people. It is believed that, prevailing discussions in those meeting reveal the unadulterated problems confronting the community which the extensionist or the researcher can easily capture. In rural setting, Social gatherings such as recreational, cultural, and religious occasions provide a platform for this, whiles in organizations, tea and coffee breaks provide the environment for this technique. Even though programs formulated from this technique are likely to reflect the authentic views of the people, they will not have confidence in its source. Like observation technique this will be good for structured organizations and public institutions.

The criticisms of Delphi survey technique come in three ways. First the faceless interaction of the participants does not augur well for a rural setting. Farmers do not have confidence in this form of interaction and will not identify their opinions in the final report even if it is captured. Secondly, it is biased towards literates. All contributions and discussions are expressed in writing, making it a privilege for those who can read and write. In rural setting, as researches have shown, the level of education of a farmer does not contribute positively to agricultural productivity (Alemdar and Oren, 2006). The educated farmer considers farming as a second job and does not pay much attention to their farms leading to lower productivity. The literate farmers in many cases may not be the right people to gather information from for NA purposes. Finally the medium with which it is conducted may as well not be appropriate for a rural setting. Most rural communities are so remote that mailed surveys will take a lot of time to reach there, couple with the fact that most of the rural farmers do not have mail addresses with which they can be reached.

The highly prioritized ones (Community forum, Focus Group Interview, World Café and Nominal Group Technique) appear to be more effective both in terms of empirical evidence above and practical application in the study setting. Even though they also have some disadvantages similar to the less prioritized ones, their advantages offset some of these disadvantages. For example, the Nominal group technique shares the second criticism of the Delphi technique; writing skills of participants. However, it is face to face and allows some degree of discussion and sharing ideas verbally. Community forum technique for instance has the advantage of announcing the presence of the program to a larger part of the community. All the four highly prioritized techniques tend to promote trust between the community and the researcher, which is very relevant in project implementation. With the exception of Nominal Group Technique, the rest do not limit participation of people in terms of literacy level. However, it is still worth mentioning that a combination of these group techniques...
can yield more effective results.

**Case for selected techniques**

In the words of Akridge (1992), it is very important to pick a niche in the development of an agricultural program. When the exact problem is not identified the program will end up not fitting anyone in the community. Different farmers will have different views about the same issues and problems. What is happening in one farm may not be exactly what is happening in the others farm. A Group NA method like community forums, nominal Group, focus group will not only help identify the exact problem, but will open up further discussions about the problem completely unknown to the researcher or the extensionist. Furthermore, these methods provide the implementer a quick, intensive picture of the real problem.

In any successful agricultural program, the trust and confidence of the community is very paramount (Oakley and Garforth, 1985; Petrović et al., 2010; Buck and Alwang, 2011). In outlining the problems in Agricultural programs and Extension Petrović (2010) and the colleagues identified farmers’ lack of trust in government, its institutions and as well as its agricultural policies. According to Buck and Alwang (2011), farmers’ lack of trust and interest in extension programs emanates from two sources; lack of trust and confidence in the extension agent or implementer and the source of the information. This situation can only be improved if there is a two way communication channel between the stakeholders involved. The group techniques can effectively build trust with the local citizens in planning, publicizing, moderating and evaluating of the program. These group techniques especially the highly prioritized ones has the potential to offset the two concerns raised by Buck and Alwang (2011). What these techniques do is to increase the interest of the farmers in three fronts; 1. When these methods are used in the NA stage, they get a better understanding into the program increasing their trust and confidence in it. Even when there are some grey areas, the researcher through meetings and discussions, takes care of that before the program starts. 2. The fact that the farmers are involved with the researcher and other experts through these techniques boosts the confidence and trust they impose on the extension agent or the implementer. 3. Some farmers especially the less educated who mostly constitute the large proportion of the target group finds confidence and trust neither in the agent or the source, but from their fellow farmers who they consider trust worthy and role models in the area of farming amongst them. These techniques create a situation where these role models form part of the interactions leading to the formulation of the program. Their trust in the program has a ripple effect in this situation. To sum up, the more farmers develop trust and confidence in the agent and source of information, the more they are willing to voluntary participate, adopt, and sustain implementation of outcomes of the agricultural program.

According to Ponniah et al. (2008:62), outlined four major factors for a successful agricultural extension program. First among the four factors is participation and empowerment of farmers and communities. The participation aspect of this has been dealt with in the preceding paragraph. Even though the concepts of participation and empowerment are the catch phrase of the current extension paradigm, their realization depend on the NA technique used. The group techniques ensure their empowerment at the NA stage where they understand and appreciate the whole program. It opens up a continual two-way communication between farmers and all stakeholders involved, which to Ponniah et al. (2008) is invaluable when it comes to fostering participation and empowerment of farmers through agricultural and extension programs. Linkage between farmer groups and institutions, innovative learning and communication and policy, and political influence are considered second, third and fourth factors respectively. With the exception of the fourth factor, the success of all of them is deeply rooted in the group techniques at the NA stage. The employment of any other NA techniques will not guarantee the positive outlook of these factors.

**Conclusion**

The ultimate aim of every agricultural and extension program is that farmers should voluntarily participate, adopt and implement the outcome in their farms. The greatest success is when this adoption is sustained over a long period of time. Agricultural and extension programs that promote participation and interactions between implementers or extensionists and farming communities should be encouraged. The NA that is conducted before these programs are rolled out goes a long way to ensure the above mentioned measure of success of any agricultural program. It could be seen that, all the unsuccessful programs did not conduct a NA or they used other techniques other than the group and the individual techniques. This accounted for the fact that the farmers had no knowledge of those programs until the implementation stage. All the reasons assigned to why those programs failed would have been avoided if a proper NA techniques was used. The availability of tractors, credit of any form and irrigation facilities are the most pressing needs of the farmers. If a program cannot be holistic like the case of MiDA, it can target any of these for effective impact on the farmers’ lives. Going through the prioritized techniques, the common trend that runs through them is the sense of ownership the farmers feel. This translates into whatever extension or agricultural program that comes out of it. As seen from responses of the FBOs and the discussion of the chosen techniques, the group techniques are complemented by
the individual techniques in the context of a rural agriculture. It could be seen that a combination of some group techniques complimented by individual techniques could even provide better results. In our opinion, apart from these group techniques, any other technique can be used with even higher rate of adoption, objective and relevant information gathered but sustainability and sense of ownership cannot be guaranteed which is very crucial to rural agricultural development.

Conflict of Interests

The authors have not declared any conflict of interest.

REFERENCES


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