Farming Related Factors Contributing To Agricultural Productivity In Smallholder Farmers In Dodoma Municipality. A Factor Analysis Approach

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Abstract: The study was conducted at Dodoma Municipal district in Dodoma region. The general objective of this study was to determine factors contributing to agricultural productivity in smallholder farmers. Purposively, three wards with periodic markets namely; Hombolo, Makutupora and Msalato, were selected in Dodoma municipality. The simple random sampling was used to select two mitaas in each Ward and 279 smallholder farmer households. Both the multiple response (scoring method) and factor analysis (maximum likelihood) was used to determine factors linked to agriculture productivity in the study area. Although Varimax and Quartimax are the two orthogonal approaches reporting on factor analysis method, the Varimax method is more conclusive as it minimizes the number of variables that have high weights on each factor. With Varimax rotation method, it has been revealed that climate (0.994), poor agriculture marketing (0.113) and degradation of natural resources (0.101) are the most important physical and economic factors affecting agriculture productivity in the study area have been. While climate plays a dominating role in agriculture production, good input – output markets precipitate increased agriculture production. Degradation of natural resources, such as land and water, undermines production capacity and threatens the sustainability of the natural ecosystem. Making appropriate technology available and accessible to smallholders farmers is suggested to go long way to improve agriculture productivity to smallholder farmers hence reducing rural poverty. Appropriate technology will enable farmers practice Climate Smart Agriculture, rehabilitate the land nutritional base, and managing land erosion. While good input markets will assure availability of agro input to small holder farmers, good output markets will ensure more income to small holders farmers. Tanzanian Government must increase her investments and spending in agriculture and technology development and dissemination.

Key Words: Farming factors, agricultural productivity, smallholder farmers, factor analysis

1.0 INTRODUCTION

The Tanzania Human Development Report 2014, showed that 64% of mainland Tanzanians are poor and 31.3% live in extreme poverty (UNDP & URT, 2014). The same report also declared that poverty is a rural phenomenon. In the same line, the Human Development Index ranked the country 159 out of 187 countries, and has classified Tanzania as a low human development country during 2014. The data simply shows Tanzania to be a poor country. The agriculture sector plays an important role in the Tanzanian economy and posses the potential to advance the country’s objectives of growth and poverty reduction. The performance of the overall Tanzanian economy has been driven by the performance of the agriculture sector, due to its large share in the economy. Tanzanian economy is heavily based on agriculture providing 85% of exports, accounting for half of employed work force, and contributing to 27.6% of the Gross Domestic Product (World Fact Book 2015; NBS 2013). Actually, in Tanzania, smallholder and subsistence farming dominates agricultural production, providing livelihood for the majority (69%) for the period between 2011 and 2015 (WB, 2016).

Poverty in Tanzania is related to low natural resource utilisation explained by extremely low land-labour ratios and low productivity. Despite the abundance of unutilised land, Tanzanian agriculture is dominated by small scale subsistance farming (MAFS, 2001). Smallholders operating between 0.2 and 2 hectares (Tulahi and Hingi, 2006) and traditional livestock holders who keep an
average of 50 heads of cattle utilise approximately 85% of the arable land (MAFS, 2001). Tulahi and Hingi (2006) also found that the major limitation on the size and utilisation of land holdings is the lack of access to modern farming methods and heavy reliance on the hand hoe as the main cultivating tool, 70% of farmers still used a hand hoe for tilling the land, 20% used animal draft ploughs and only 10% used tractors. Yields from smallholder farmers are relatively low despite high potential of the land to produce the same. Comparing harvests from farmers in Tanzania to other countries with similar natural resource endowments and climatic conditions, indicating inefficient use of the land available. A historical prolonged and deep urban bias has led to a distorted pattern of investment. Greater public and private capital was invested in urban areas than in rural areas, with too little capital directed towards raising rural productivity, such distortions have resulted in strikingly different marginal productivities of capital in urban and rural areas (Mnenwa and Maliti, 2010).

For decades, agriculture in developing countries including Tanzania has operated in a context of low global prices for food products coupled, in many countries, with unfavourable domestic environments. Low levels of investment in agriculture, inappropriate policies, thin and uncompetitive markets, weak rural infrastructure, inadequate production and financial services, and a deteriorating natural resource base have all contributed to creating environment in which it has frequently been risky and unprofitable for smallholders to participate in agricultural markets (Eskola, 2005).

Strong links to markets for poor rural producers are essential to increasing agricultural production, generating economic growth in rural areas and reducing hunger and poverty. Improving these links creates a virtuous circle by boosting productivity, increasing incomes and strengthening food security. Better access by small producers to domestic and international markets means that they can reliably sell more produce at higher prices. This in turn encourages farmers to invest in their own businesses and increase the quantity and quality of the goods they produce (Elkington, 2008).

2.0 PROBLEM STATEMENT AND JUSTIFICATION

There are a wide range of agricultural production methods currently in use throughout the world. These practices span a variety of techniques that rely on differing levels of land, water, labor, energy, capital and other inputs and are significantly defined by local climatic and agroecological conditions. The difference between current production paradigms may be concisely viewed as a spectrum of choices reflecting varying degrees of dependence on the use of industrialized, highly mechanized, high input farming techniques and smallholder farming operations that are characterized by a higher reliance on manual labor, draught animal power and the relatively low use of farm mechanization and fossil fuels, synthetic fertilizers and other agrochemical inputs. Lokina et al. (2011) who related smallholder farming to economic growth and poverty reduction in Tanzania during 1990s and 2000s realised that majority of households in Tanzanians earned their living from farming however, with worsening relative poverty as compared to non-farm households. Household survey data from 1991 to 2007 showed that there have been occupational shifts away from the agriculture sector, suggesting the sector to become less lucrative. Dodoma region has been noticed as among the poorest regions in Tanzania, characterised by low agriculture productivity, massive unemployment, increasing population density and malnutrition at levels that are higher than national averages (Mwakipesile, 2012). The Gogo, the natives in Dodoma Region, are basically agro-pastoralists. They are vulnerable to the vagaries of weather, which impacts on food supply (Matunga, 2012). Persisting food insecurity is related to low productivity in Dodoma region (Msaki et al. 2013)

Subsistence farming is dominant in Dodoma, and the main food crops are maize, sorghum, pearl millet and sweet potatoes (ibid.). Cash crops include sunflower, groundnuts, simsim, finger millet and peas. Livestock keeping occupies the second important position to farming, whereas cattle, goats, sheep and donkeys are kept (Mwamfupe, 2012). Vegetables are grown during rain seasons and in valleys during dry seasons (Maro et al. 2011).

Limited research has been undertaken on the contribution of farming related factors on agricultural productivity. Therefore, there has been lack of empirical data and information showing the role of farming related factors, the government and other development practitioners, in improving agriculture productivity and hence the overall development process of rural areas (WB, 2007; FAO, 2002). It is of this sense, this study addressed the farming related factors contributing in agricultural productivity in Msalato Ward, Makutupora Ward and Hombolo Ward in Dodoma Municipality.
3.0 METHODS AND PROCEDURES

3.1 Research procedure and design
Dodoma municipality is located in the middle of the country. It is boarded by Chamwino district in the East and Bahi district in the West. It lies between Latitudes 6.00° and 6.30° South, and Longitude 35.30° and 36.02° East. The municipality is characterized with both urban and rural qualities. Dodoma Municipality which is standing on broad upland plateau with an altitude ranging between 900-1000 meters above sea level, experiences long draughts and short rainfall seasons. Due to unreliable rainfall, the area has scanty vegetation such as shrubs, grasses as well as conspicuous baobab and acacias trees. The climate of Dodoma is semi-arid, characterized by a marked seasonal rainfall distribution with a long dry and short wet seasons, an average annual rainfall of about 550 – 600mm per year, which falls between December and April each year. The average temperature varies from 20°C in July to 30°C in November each year (Sakai 2012). While the original inhabitants of the Municipal are believed to be the Gogo and Rangi, but there are now a quite good number of mixed tribes from neighboring regions; this is due to trade and cultural relationships in the area.

The design of the study was cross-sectional design. Cross-sectional survey design allows collection of information at one point in time (Casley and Kumar, 1988). The study was designed to identify the way in which farmers perceive on the farming related factors that increase productivity and to show how those factors contribute in agricultural productivity in smallholder farmers in the study area.

Multistage sampling was employed in this study, involving purposive and randomly sampling techniques. The sampling procedure started with purposefully sampling (Reginard, 2013; Rwegoshora, 2006), where one district out of seven in Dodoma region were selected. Dodoma Urban District was selected for the study. The second stage also involved purposively sampling to select three Wards from the district. The criteria for selecting the ward was the presence of open periodic markets. Three wards of Dodoma Municipality namely; Msalato Ward, Makutupora Ward and Hombolo Ward were selected for the study. Hosting large periodic markets in Dodoma municipality was the reasons to select the areas (Wards) of the study. Choosing Wards with large periodic markets has been important to control for marketing factors which would otherwise influence the analysis. Hay (1971) reported benefits of periodic marketing may have one of three intentions: to achieve viability, to increase excess profits and to lower retail prices or raise producer prices as a move to forestall competition. Profitability in periodic markets is achieved by reducing the total over head costs which must be covered while using at a single market place. Periodic markets are convenient and assures profitability to farmers (Hay 1971; Stine 1969). Both the central place theory and location theory suggest the importance of periodic markets to rural smallholder farmers (Bromley and Good 1977; Hay 1971; Stine 1969; Christaller 1933)

Random sampling was employed to select two mitaa in each ward. The total of six mitaa were involved for the study. Lastly, representative farming households from the selected mitaa were selected randomly. The total of 279 farming households were involved in the study (see Table 1). Key informants were purposively selected with regards to their positions allowing them being able to explain changing scenarios linking agriculture productivity and various parameters of the involved community. The total of 9 Key Informants were involved for the study. The key Informants involved in the study were six mitaa leaders and three Ward Extension Officers.

3.2 Data collection methods
This study used a triangulation method whereby data from the same sample in the study area were collected using different techniques including; households’ heads interview using questionnaires, key informant interviews, and neighbourhood observations. Documentary review also formed part of the data collection methods. Under this method various published articles related to farming factors, agricultural marketing and agricultural productivity in the same context were reviewed.

3.3 Statistical analysis
The collected data were analysed qualitatively. The qualitative analysis used a multiple reponse (scoring method) in assessing the perception of farmers’ households towards farming related factors contributing in agricultural productivity. Factor analysis (ML) was used to assess the mostly likely farming related factors contributing in agricultural productivity in smallholder farmers households in Dodoma municipality.

3.4 Model specification
Principal Components Analysis (PCA) is the default method of extraction in many popular statistical software packages, including SPSS and
SAS, which likely contributes to its popularity. However, some argue for severely restricted use of components analysis in favor of a true factor analysis method (Bentler & Kano, 1990; Floyd & Widaman, 1995; Ford, MacCallum & Tait, 1986; Gorsuch, 1990; Loehlin, 1990; MacCallum & Tucker, 1991; Mulaik, 1990; Snook & Gorsuch, 1989; Widaman, 1990, 1993). Others disagree, and point out that there is almost no difference between principal components and factor analysis, or that PCA is preferable analysis (Arrindell & van der Ende, 1985; Guadagnoli and Velicer, 1988; Steiger, 1990; Velicer & Jackson, 1990).

PCA is becoming increasingly popular in the social sciences because it takes a hypothesis-testing rather than an exploratory approach to the analysis of data (Byrne 2001). A hypothesized model was tested statistically in a “simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data” (Byrne 2001:3). As Byrne (2001) argued that basing on knowledge of theory, empirical research, or both, [the researcher] postulates relations between observed measures and underlying factors a priori and then tests this hypothesized structure statistically…to determine the adequacy of its goodness of fit to the sample data. Factor analysis is a method for investigating whether a number of variables of interest \( Y_1, Y_2, \ldots, Y_n \) are linearly related to a smaller number of unobservable factors \( F_1, F_2, \ldots, F_k \).

Consider each observable variable for the farming related factors contributing in agricultural productivity is a linear function of independent factors and error terms, and can be written as;

\[
Y_i = \beta_{i0} + \beta_{i1}F_1 + \beta_{i2}F_2 + (1)\varepsilon_i
\]

The variance of \( Y_i \) can be calculated by applying the following formula:

\[
\text{Var} (Y_i) = \beta_{i1}^2\text{Var}(F_1) + \beta_{i2}^2\text{Var}(F_2) + (Var)\varepsilon_i
\]

\[
= \beta_{i1}^2 + \beta_{i2}^2 + \sigma_i^2
\]

The variance of \( Y_i \) consists of two parts; the communality and the specific variance. Communality of the variable (\( \beta_{i1}^2 \) and \( \beta_{i2}^2 \)) is the part that is explained by the common factors \( F_1 \) and \( F_2 \). The specific variance (\( \sigma_i^2 \)) is the part of the variance of \( Y_i \) that is not accounted by the common factors.

To calculate the covariance of any two observable variables, \( Y_i \) and \( Y_j \), the following formula was used:

\[
Y_i = \beta_{j0} + \beta_{j1}F_1 + \beta_{j2}F_2 + (1)\varepsilon_i + (0)\varepsilon_j; \text{ and}
\]

\[
Y_j = \beta_{i0} + \beta_{i1}F_1 + \beta_{i2}F_2 + (0)\varepsilon_i + (1)\varepsilon_j; \text{ Then,}
\]

\[
\text{Cov} (Y_i, Y_j) = \beta_{i1}\beta_{j1} \text{Var} (F_1) + \beta_{i2}\beta_{j2} \text{Var} (F_2) + (1)(0) \text{Var}(\varepsilon_i) + (0)(1) \text{Var}(\varepsilon_j)
\]

\[
= \beta_{i1}\beta_{j1} + \beta_{i2}\beta_{j2};
\]

The degree to which a given variable is associated with a particular factor is estimated by its "factor loading," a statistic analogous to a correlation which can range from -1.00 to +1.00. The closer the loading approaches -1.00 or +1.00, the greater the association between the variable and the factor.

Fabrigar et al., (1999) in their article argued that if data are relatively normally distributed, ML is the best choice because it allows for the computation of a wide range of indexes of the goodness of fit of the model and permits statistical significance testing of factor loadings and correlations among factors and the computation of confidence intervals. Other authors have argued that in specialized cases, or for particular applications, other extraction techniques (e.g., alpha extraction) are most appropriate, but the evidence of advantage is slim. In general, ML or principle axis factor (PAF) will give the best results, depending on whether your data are generally normally-distributed or significantly non-normal, respectively. This study is based on this idea in analysing the farming related factors contributing in alleviating poverty.

4.0 RESULTS AND DISCUSSION

4.1 Farming related factors influencing agricultural productivity

The first aim of this study was to examine the perception of smallholder farmers on farming related factors contributing in agricultural productivity in the study area. A multiple response analysis was carried out to address this objective. The results showed that most important physical and economic factors affecting agriculture productivity are: climate; land tenure; landscape/slope; market; transport facilities and government policies (see Table 2).
Table 2: Multiple response on farming related factors influencing productivity

<table>
<thead>
<tr>
<th>Factors</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate (Clim)</td>
<td>250</td>
</tr>
<tr>
<td>Agricultural market (AgrM)</td>
<td>241</td>
</tr>
<tr>
<td>Natural resource (NaRe)</td>
<td>187</td>
</tr>
<tr>
<td>Technology Advancement (Tech)</td>
<td>168</td>
</tr>
<tr>
<td>Landscape/slope (LaSc)</td>
<td>108</td>
</tr>
<tr>
<td>Farm size (FaSz)</td>
<td>60</td>
</tr>
</tbody>
</table>

4.1.1 Climate
The study showed 89.6% of respondents to declare climate as a major contributing factor to agriculture productivity in the study area (Table 2). This implies that climate plays a dominating role in agriculture. Plants require sufficient heat and moisture for their growth. Normally, regions having maximum temperature of less than 10°C are not suitable for plant growth. In the tropical regions, where temperature is high throughout the year, agriculture is successfully done (Schwartz, 1995). Dodoma Municipal is an arid land, hence such outputs were expected. Climate is a measure of the average pattern of variation in temperature, humidity, atmospheric pressure, wind, precipitation, atmospheric particle count and other meteorological variables in a given region over long periods of time. Climate Smart Agriculture can provide improvement in productivity in Dodoma Municipality.

4.1.2 Agricultural marketing
The study showed that, the majority (86.4%) respondents mentioned agricultural marketing as a contributing factor in reducing poverty in the study area (Table 2). The agricultural market is the second determining factors in production in all area of the study. This implied that interacting with good agricultural markets is thus an important aspect of the livelihood strategies of many rural households. Despite the availability of large periodic markets in Msalato Makutupora and Hombolo, the markets have been not useful to communities to enable them improve their productivity. Respondents reported that available markets have neither been able to supply required agro inputs nor providing good price for their produce. Administrators at periodic markets should consider the availability of input and output supplies with prices assuring profits to farming communities. Good agricultural markets are important economic factor to realise profits from agricultural produce. The distance from the market determines the cost of transportation. Agricultural crops like vegetables etc. are grown near the market. For any commercial farm to succeed there must be demand. If the demand for a crop drops then profits will fall, that crop will then be replaced by a more profitable one.

4.1.3 Degradation of Natural Resources
The proportion, (67.0%) of respondents mentioned degradation of natural resource to reduce agricultural productivity (Table 2). This factor was the third important factor determining production and hence contributing in agricultural productivity. This implies that natural resources are critical determinants of food supply. In fact that degradation of natural resources, such as land and water, undermines production capacity and threatens the sustainability of the natural ecosystem (Pinstrup and Pandya, 1998). Natural resources occur naturally within environments that exist relatively undisturbed by humanity, in a natural form. A natural resource is often characterized by amounts of biodiversity and geodiversity existent in various ecosystems. Natural resources are derived from the environment. Some of them are essential for our survival while most are used for satisfying our needs.

4.1.4 Poor Technology
As shown in Table 2, the proportion of respondents who mentioned the use of poor technology in agricultural production was 60.2%. Technological change increases agricultural productivity either by shifting the production frontier upward so that more measured output can be produced with the same amount of inputs or by moving closer to the production frontier so that the same amount of output can be produced with a smaller amount of inputs. Better organizational and management skills not only improve input-output combinations but enable producers to respond quickly to changing market circumstances as shown by Alston et al., (1995). The use of poor technology in agriculture production was the fourth most important factor in the study area determining
production. Technological change was recognized as one of the most important sources of productivity growth as also revealed by Antle and Capalbo (1988). In the current study, farmers declared that they lack technology to fight pest and diseases, mechanisation and technology which are climate smart.

4.1.5 Landscape/slope
The proportion (38.7 %) of farming households declared that landscape/slope in lands to be a contributing factor in low agricultural productivity (Table 2). The respondents reported that the sloping angle for their lands have been affecting the type, depth and moisture content of soil. Soil erosion has also been reported to prevail as the result of sloping lands in the surveyed areas. It will also affect the rate of soil erosion. The degree to which a farm can be mechanized is influenced by slope. Slopes at farming lands have been related to poor mechanisation, soil erosion and thereafter low crop productivity. Convenient technologies are suggested to curb the impact of landscapes leading to low productivity.

4.1.6 Farm size
Results showed that 21.5% of respondents mentioned farm sizes as a contributing factor to low productivity(Table 2), it was revealed that fertilizer use, irrigation, crop intensity, and technology declines with an increase in farm size lowering the size of holding. Obviously, the greater use of these factors would result in higher productivity, and those farm categories with the higher value of these factors are also expected to realize higher productivity. The findings in the current study tells that unaccessibility of farming inputs limits the size of the farm cultivated by smallholder farmers. In other words, the likelihood of farmers with larger farms to have low productivity is higher as compared to farmers with relative smaller farms.

4.2 Specific variances by farming related factors contributing to agricultural productivity
The study used maximum likelihood (ML) analysis to show the mostly likely farming related factors contributing to agricultural productivity in smallholder farmers households. In the area of factor analysis (FA) implementation, usually, the factors found by methods previously described, cannot be easily interpreted. Determining exactly the variables belonging to factor one, two and so on is difficult, as some variables have the tendency to load on some factors. Consequently, many factors can be interpreted by one variable. On contrary, the present paper aims at finding one factor to interpret one or more variables (Johnson and Wichern, 1982). Here in this paper, both Varimax and Quartimax rotation are involved.

Table 3: Specific variances by factor before and after rotation methods

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial Eigen values Total</th>
<th>% of Variance</th>
<th>Extraction Sums of Squared Loadings Total</th>
<th>% of Variance</th>
<th>Rotation Sums of Squared Loadings Total</th>
<th>% of Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>AgrM</td>
<td>1.290</td>
<td>21.506</td>
<td>0.999</td>
<td>16.652</td>
<td>0.968</td>
<td>16.137</td>
</tr>
<tr>
<td>NaRe</td>
<td>1.108</td>
<td>18.468</td>
<td>0.622</td>
<td>10.366</td>
<td>0.681</td>
<td>11.352</td>
</tr>
<tr>
<td>Tech</td>
<td>0.856</td>
<td>14.274</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LaSc</td>
<td>0.648</td>
<td>10.798</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FaSz</td>
<td>0.317</td>
<td>5.290</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Extraction Method: Maximum Likelihood.

Where:
- Clim  Climatic condition
- AgrM  Agricultural marketing
- NaRe  Natural resource available
- Tech  Technology advancement
- LaSc  Land Scape
- FaSz  Farm size

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Table 3 also presents the eigenvalues and percentage of variance explained. The middle part of the table shows the eigenvalues and percentage of variance explained for just the two factors of the initial solution that are regarded as important. Clearly the first factor (climate) is much more important than other factors. Whilst, taken together, the three rotated factors explain just the same amount of variance as the three factors of the initial solution, the division of importance between the three rotated factors is very different. The effect of rotation is to spread the importance more or less equally between the three rotated factors. It is noted in the table that the eigenvalues of the rotated factor are 1.449, 0.968 and 0.681, compared to 1.477, 0.999 and 0.622 in the initial solution. Table 4 presents factor loading matrix, before and after rotation.

### Table 4: Factor-loading matrix before and after rotation

<table>
<thead>
<tr>
<th>Related Factors</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climatic Condition</td>
<td>0.667</td>
<td>0.029</td>
<td>-0.192</td>
</tr>
<tr>
<td>Agricultural Marketing</td>
<td>0.993</td>
<td>-0.106</td>
<td>-0.035</td>
</tr>
<tr>
<td>Natural resource available</td>
<td>-0.064</td>
<td>-0.121</td>
<td>0.716</td>
</tr>
<tr>
<td>Technology advancement</td>
<td>0.107</td>
<td>-0.102</td>
<td>-0.190</td>
</tr>
<tr>
<td>Land Scape</td>
<td>0.020</td>
<td>0.901</td>
<td>0.284</td>
</tr>
<tr>
<td>Farm size</td>
<td>-0.037</td>
<td>0.346</td>
<td>-0.117</td>
</tr>
</tbody>
</table>

**Extraction Method:** Maximum Likelihood; **Rotation Method:** Varimax with Kaiser Normalization.

At last, the three rotated factors are just as good as the initial factors in explaining and reproducing the observed correlation matrix (see Table 5). In the rotated factors, climatic condition and agricultural marketing all have high positive loadings on the first factor (and low loadings on the second and third), whereas landscape have high positive loadings on the second factor (and low loadings on the first and third) and availability of natural resource have high positive loadings on the third factor (and low loadings on the first and second). Technology advancement and farm size have low loadings on both factors showing that they are not of great important as other factors.

### Table 5: Factor transformation matrix for mostly likely factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Clim</th>
<th>AgrM</th>
<th>NaRe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clim</td>
<td>0.994</td>
<td>-0.107</td>
<td>-0.036</td>
</tr>
<tr>
<td>AgrM</td>
<td>0.113</td>
<td>0.944</td>
<td>0.309</td>
</tr>
<tr>
<td>NaRe</td>
<td>0.001</td>
<td>-0.311</td>
<td>0.950</td>
</tr>
</tbody>
</table>

**Extraction Method:** Maximum Likelihood; **Rotation Method:** Varimax with Kaiser Normalization.

Table 5 gives information about the extent to which the factors have been rotated. In this case, the factors have been rotated through 6.3 degrees. (The angle can be calculated by treating the correlation coefficient as a cosine, the cosine of 6.3 degrees is 0.994).

### 5.0 CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

Factors, are estimated using mathematical model, where only the shared variance is analyzed. However, principal factors analysis is often preferred when the goal of the analysis is to detect structure. Varimax and Quartimax are the two orthogonal approaches, which are used to report on factor analysis method. The most commonly used orthogonal approach is the Varimax method, which aims to minimize the number of variables that have high weights on each factor.

The most important physical and economic factors affecting agriculture productivity in the study area have been climate, poor agriculture marketing and degradation of natural resources. While climate plays a dominating role in agriculture production, good input – output markets precipitate increased agriculture production. Degradation of natural resources, such as land and water, undermines...
production capacity and threatens the sustainability of the natural ecosystem.

5.2 Recommendations

If Tanzania is to break out of the vicious cycle of hunger and poverty, it needs to increase agricultural productivity. Making appropriate technology available and accessible to smallholders farmers will go long way to improve agriculture productivity to smallholder farmers hence reducing rural poverty. Appropriate technology will enable farmers being clever enough to practice Climate Smart Agriculture, rehabilitating the land nutritional base, and working out reducing land erosion and protecting hill side farming using rain water harvesting technologies. While good input markets will assure availability of agro input to small holder farmers, good output markets will ensure more income to small holders farmers. The Government must increase her investments and spending in agriculture and technology development and dissemination.

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