



Received: 01-05-2022

Accepted: 11-06-2022

## International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

### The significance of agricultural intensification on paddy productivity in Mbarali district, Tanzania

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#### Abstract

The growing literature on the importance of agricultural intensification on crop productivity is widely recognized. An increasing market demand for rice has promoted an increased use of farm inputs to improve its productivity. This raises the need to understand the role of agricultural intensification on paddy productivity in Mbarali district. Rice has emerged as a significant cash crop in Mbarali district and has encouraged high involvement in its production for both consumption and sale purposes so as to meet the growing market demand in both domestic and world-wide markets. Both the quantitative and qualitative methods were employed. Secondary data were collected through documentary review while primary data were collected through household interviews, focus group

discussions, key informant interviews and field observations. The quantitative data were analysed using SPSS and Microsoft Excel while the qualitative data were analysed by content analysis. A simple linear regression analysis was performed to understand the statistical relationship between agricultural intensification and paddy productivity. The results show that there was statistically positive significant relationship between agricultural intensification and paddy productivity. About 87% of respondents indicated that they have applied farm inputs that led to increased paddy productivity among households in Mbarali district. The government and the private sectors are encouraged to subsidize farm inputs to promote a more improved paddy production in the district.

**Keywords:** Agricultural Intensification, Paddy Productivity, Mbarali District, Tanzania

#### 1. Introduction

In recent years, agricultural intensification has emerged to be one of the strategies to improve rural livelihoods through increasing crop production to meet the growing global food demand caused by rapid population growth (Xie *et al.*, 2019; Kalinga, 2021)<sup>[39, 12]</sup>. It has been acknowledged that through access to farm inputs smallholder farmers have achieved a higher crop productivity which leads to improved wealth and reduced poverty situation that exist in the area (Graeub *et al.*, 2016); Lowder *et al.*, 2016)<sup>[18]</sup>. An appropriate land use based on improved land management practices such as the use of farm inputs like improved seeds, fertilizers, herbicides and insecticides is critical in achievement of improved crop productivity.

It is widely recognized that farmers have adopted intensified agriculture so as to enhance their crop productivity for achievement of improved livelihoods. For instance, in Ilambilole and Ikuwala Villages, Iringa region, Tanzania, farmers shifted their strategy from extensive to intensive land-use based practices where less land is used efficiently to improve their yields (Birch-Thomsen and Friis-Hansen, 2021)<sup>[2]</sup>. In Morogoro region, improvements in livelihoods among smallholder farmers was resulted from increased paddy production caused by increased use of agricultural inputs particularly fertilizers and improved seeds (Djurfeldt *et al.*, 2021; Kalinga *et al.*, 2022)<sup>[8, 11]</sup>. Also, in Arusha and Manyara Regions, Tanzania, farming households used improved seeds instead of the traditional ones. Also, they applied pesticides in controlling cutworm and stalk borers to improve their harvests (Snyder *et al.*, 2021)<sup>[29]</sup>. Further, in Mlali and Mgeta villages, Tanzania, an increased tomato productivity was resulted from both expansion and intensification of agriculture that led to improved household livelihoods in the area.

While various scholars have argued that agricultural intensification are important in achieving improved crop productivity (Xie *et al.*, 2019<sup>[39]</sup>; Graeub *et al.*, 2016); Lowder *et al.*, 2016<sup>[18]</sup>; Birch-Thomsen and Friis-Hansen, 2021<sup>[2]</sup>; Djurfeldt *et al.*, 2021<sup>[8]</sup>; Kalinga *et al.*, 2022<sup>[11]</sup>), others view market demand as the main driver for promoting increased crop productivity in various parts of the world (Coulson, 2015; Mussemal *et al.*, 2015; Labarta, 2015<sup>[16]</sup>; Ponte and Brockington, 2021<sup>[27]</sup>; Kalinga *et al.*, 2019)<sup>[13]</sup>. For instance, a study in Ethiopia reported that the growing market demand for crops, promoted increased crop production to improve household income (Mussemal *et al.*, 2015). Farmers adopted intensified agriculture including the use of

fertilizers and improved crop varieties to meet the market demand for food (Labarta, 2015) <sup>[16]</sup>. In Morogoro region, Tanzania, households concentrated on production of crops that matures earlier rather than the slow maturing crops to improve their income (Ponte and Brockington, 2021) <sup>[27]</sup>. The increased productivity crops like tomatoes, onions, and potatoes, maize and rice has been a response towards meeting the available market demand in urban areas (Coulson, 2015). The adoption of improved avocado species in Rungwe district, Mbeya region was resulted from its growing demand both on domestic and global markets (Kalinga *et al.*, 2019) <sup>[13]</sup>. With the rising of both paddy production and rice consumption, Tanzania has emerged the fourth largest rice producer among African countries (FAOSTAT, 2018).

The existing studies have reported on agricultural intensification with a less focus on the linkages between agricultural intensification and crop production. Despite the available wide literature on agricultural intensification, (Djurfeldt *et al.*, 2021 <sup>[8]</sup>; Snyder *et al.*, 2021 <sup>[29]</sup>; Graeb *et al.*, 2016; Lowder *et al.*, 2016 <sup>[18]</sup>; Birch-Thomsen and Friis-Hansen, 2021 <sup>[2]</sup>), yet have left unanswered questions on the relationship between agricultural intensification and rice production trend, which are addressed in this study. This paper makes an attempt in filling this knowledge gap through identifying the rice production trend and investigating the contribution of agricultural intensification on rice productivity in Mbarali district. This paper examines agricultural intensification as one of the strategies towards improved rice productivity which has implication on rural livelihoods improvement in Mbarali District, Tanzania.

Therefore, this paper addresses the questions of what is the production trend of rice in relation to area cultivated overtime from 2011 to 2021, and what is the contribution of agricultural intensification on rice productivity in Mbarali District. The paper contributes to existing theories particularly enriching the Boserupian theory on the role of agricultural intensification on food production. Also, the study adds to existing body of knowledge on the role of agricultural intensification on paddy production.

### 1.1 Theoretical framework

The study is guided by the Boserupian theory which supports that agricultural intensification and the adoption of new innovation and technologies promote improved crop production. An improved agricultural productivity is necessary because it helps to meet the food demand that arises from the growing global population over time. This study adopts this theory because it provides a guidance in assessing the significance of agricultural intensification on achievement of improved food production among rural societies.

The remaining part of this paper is organised as follows. Section 2 provides a description about the methodology used in this study. Section 3 presents about the results and discussion while in section 4 the paper provides a conclusion and the recommendations of the study.

## 2. Material and methods

The study was conducted in Ubaruku village, Mbarali District, Tanzania. Mbarali District was purposively selected because it is one of the districts in Mbeya region with great potential for rice production. The district officials helped in selecting the Ubaruku ward due to its involvement in

production and marketing of paddy. Through purposive sampling the ward officials helped to select Ubaruku Village because its households have intensified their paddy farming. The village has 966 households. therefore, to obtain the households sample size, the study applied the formula proposed by Israel (2009) <sup>[9]</sup>.

The given formula is;

$$n = \frac{N}{1+N(e)^2}$$

Where,

n = is the sample size,

N = is the population size, and

e = acceptable/standard error (is the level of precision)

The total number of households in Ubaruku village was 966.

$$\text{Therefore, } n = \frac{966}{1+966(0.1)^2} = \frac{966}{10.66} = 90.62$$

$$n = 90.62 \text{ approximately, } 91 \text{ households.}$$

Further, Israel (2009) <sup>[9]</sup> maintains that, 10% of the sample size is added to compensate for respondents who could not be contacted or for respondents with no response.

The 10% of the sample size:

$$n = \frac{10}{100} (90) = 9$$

$$n = 9+91=100 \text{ households.}$$

Therefore, a total of 100 household heads were interviewed for this study.

Both primary and secondary data were collected in this study. Secondary data were collected through a documentary review while the primary data were collected through household interviews, focus group discussions (FGDs), key informant interviews (KIIs) and field observations. In depth interviews were conducted with various key informants such as agricultural extension officers, owners of rice mills, leaders of CBOs, elders and religious leader. Also, the three focus group discussions (FGDs) were held separately with women, men, and youth. The use of KIIs and FGDs was important in gaining a general understanding about various forms of agricultural intensification that have occurred in the area.

The content analysis used to analyse the qualitative data while the Statistical Package and Social sciences (SPSS) and Microsoft Excel was applied in analyzing quantitative data. The simple linear regression analysis was applied to understand the existing relationship between agricultural intensification and rice productivity. The findings of the study were presented in different ways comprising of tables and graphs.

## 3. Results and discussion

### 3.1 An overview

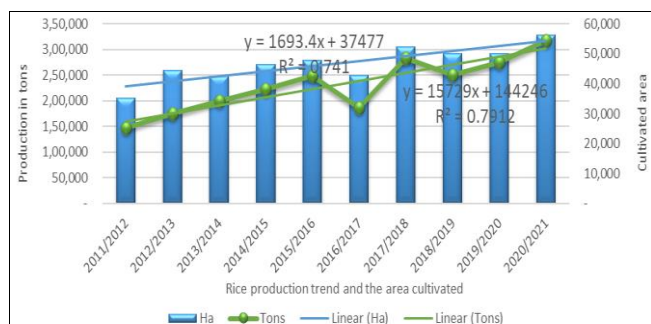
This paper presents an assessment of the significance of agricultural intensification on paddy productivity in Mbarali district. Paddy production has become one of the strategies to improve and sustain livelihoods of households in Mbarali district. Agricultural intensification has emerged to be one of the strategies to improve paddy production in the district.

In addition to agricultural intensification, expansion of cultivated land has also contributed to increased paddy production in the area.

The first part of this section provides a discussion on the role of agricultural intensification on paddy production in Mbarali district. The second section presents the production trend of rice in relation to the area cultivated overtime. The third section gives a simple linear regression analysis on the statistical relationship between agricultural intensification and paddy productivity in Mbarali district.

### 3.2 The production trend of rice in Mbarali district from 2011 to 2021

For improvement of productivity of any crop the use of farm inputs is inevitable. The use of various farm inputs and mechanization have been significant in improvement of paddy farming and have greatly contributed to the recognition of Mbarali district as one of the famous area for production and marketing of rice in Mbeya region. It was reported by KIIs that the use of farm inputs and the high involvement in paddy production by both residents and non-residents from various locations such as Dar es salaam, Iringa, Morogoro and Dodoma have contributed to increasing rice production trend over time. Fig 1 demonstrates the trend in rice production and the total area cultivated where by both the yield and the cultivated land have increased overtime from 2011/2012 to 2020/2021 with exception of 2016/2017 and 2018/2019 (Fig 1).



Source: Mbarali District Council (2021)

**Fig 1:** The paddy production and the area cultivated in Mbarali district

Further, the findings from linear regression analysis depicts a variation of both the paddy production and cultivated area overtime from 2011/2012 to 2020/2021. The results presented in (Fig 1) revealed different equations for each. The resulting equations are as follows:

$$y = 1693.4x + 37477, \text{ with } R^2 = 0.741 \text{ (Cultivated area in ha)}$$

$$y = 15729x + 144246, \text{ with } R^2 = 0.7912 \text{ (Production in tons)}$$

Results shown by the regression lines in Fig 1, demonstrate that the cultivated area increased by the rate of 0.741% ( $R^2 = 0.741$ ) while the paddy production increased by 0.7912 ( $R^2 = 0.7912$ ) for the whole period from 2021/2012 to 2020/2021. This indicates that both the cultivated area and paddy production statistically had a significant increase over time because the fitted line show that the  $R^2$  value which is the coefficient of determination was above 0.5. (Fig 1). This indicates that an increased paddy production has resulted

from both agricultural intensification and expansion of the cultivated land, which is an implication that both agricultural intensification and extension has occurred in the area.

Furthermore, it was emphasized through KIIs and FGDs that the use of farm inputs and expansion of area under paddy production are important because without farm input expansion of cultivated land alone could not lead to increased paddy productivity. Also, it was noted that improved rice production was contributed by an increased market demand for rice both in domestic and global markets which encouraged farmers to produce more of the crop to maximize profit through paddy cultivation for achievement of improved life.

### 3.3 Agricultural intensification and mechanization

The application of agricultural intensification and mechanization is necessary in achievement of improved agricultural crop productivity. This is because with the use of agricultural inputs such as fertilizers, herbicides, insecticides, and improved seeds as well as other new innovations enable rural famers to improve their livelihoods through the available potentials of profitability from crop production. In Mbarali district farmers are encouraged to use farm inputs and modern machines due to increased demand of rice caused by the growing populations particularly in urban areas.

The study revealed that 87% of respondents have applied farm inputs including fertilizers, herbicides, insecticides and improved seeds while 13% indicated that they have not used inputs because they could not afford their cost. It was also revealed that only 23% of respondents have used sufficient amount of fertilizers in paddy farming while 64% of respondents used insufficient amount due to their high prices. It was also reported by FGDs and KIIs that the use of farm inputs is necessary and that farmers are compelled to use them particularly, fertilizers because the soils have been exhausted due to practices of continuous cultivation without fallowing, therefore the use of fertilizers helps to improve land productivity and enhance paddy productivity in the area. One of the participants of FGD explained that;

“We are forced to use fertilizers because our land has become tired enough so that without fertilizers you end up with very little or no harvest at all, without paddy harvests no life in the village because paddy production is our main source of income”. (A male paddy producer aged 56 at Ubaruku, Village, November, 2021)

Also, the study revealed that there are improvements in farm implements used. For instance, farmers have applied improved farm implements such as power tillers, tractors and combined harvesters. About 37%, 15% and 7% of respondents have owned power tillers, tractors and combined harvesters respectively, while others (44%) access those implements through renting with some charges. The use of modern farm implements was important in simplifying farming activities because they accomplish paddy farming activities within a short period of time. This led to reduced unnecessary losses of crops and timely accomplishment of farming activities, which allow household members to have extra time for participation in other income generating activities such as trade, wage labour and driving.

### 3.4 Modelling the significance of agricultural intensification on paddy productivity using a simple linear regression

The simple linear regression is useful in estimating the relationship between one dependent variable and one independent variable through calculating the regression coefficient and regression equation (Saunders *et al.*, 2003). In this study a simple linear regression model was developed to find out whether agricultural intensification and crop productivity were significantly related or not, and to be able

to measure the strength of their relationship. Therefore, through SPSS the simple linear regression model was estimated. This allowed to ascertain the unique contribution of agricultural intensification to paddy productivity. The dependent variable (response) was paddy productivity while the independent variable was agricultural intensification.

The results indicates that there was statistically significant relationship between agricultural intensification and paddy productivity ( $b = 0.753, p = 0.000$ ) (Table 1).

**Table 1:** Coefficients for a simple linear regression analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
1 (Constant)	0.294	0.085		3.464	0.001	.126	.463
Agricultural intensification	0.753	0.071	.733	10.679	0.000	.613	.893

Dependent Variable: Paddy productivity

Table 1 demonstrates that there was a statistically significant relationship between agricultural intensification and paddy productivity. Further, Table 2 show that the statistical tests of the model indicates that the whole model was significant ( $p = 0.000$ ). Also, the model summary establishes that the R square value of the model was 0.564 (Table 3), which indicates that 56.4% of the changes in paddy productivity was resulted from the predictors in the model while the remaining percentage (43.6%) could be explained by other factors that were not involved in the model, such as increased market demand, improved infrastructures, improved livelihood asset, population growth and global forces.

Where,

$$Y (\text{paddy productivity}) = 0.294 (\text{constant}) + 0.753X (\text{agricultural intensification}) + E$$

Through this model, agricultural intensification ( $b = 0.753, p = 0.000$ ) (Table 1) had a positive relationship and was statistically significant, which means agricultural intensification was a significant predictor of variations in rice productivity. This implies that the more the agricultural intensification the higher the paddy productivity. This verifies that agricultural intensification is a significant factor to be considered in predicting change in paddy productivity in Mbarali district.

This study show that farmers perceives that the use of farm inputs is one of the strategies to improve their paddy productivity. Other studies have reported on the role of agricultural intensification in achievement of improved crop productivity. For instance, a study by Tilmana (2011) reported that the use of farm inputs is essential due to their significance in increasing crop production needed to meet the global food demand. Increased crop production can be resulted either from increased cultivated land that involves clearing additional land for crop cultivation or by intensification which is achieved through increased inputs and other new technologies. Similarly, an observation by Struik (2017) <sup>[30]</sup> indicate that the proper use of technological strategies ensures increased food production and guarantees access to food without degrading the status of land productivity. These results agree with Valenzuela (2016) <sup>[36]</sup> who reported that agricultural production must be transformed so as to achieve a green revolution that involves rapid development and the use of new technologies in food production. Smallholder farmer is considered to be the key actor in achievement of food security and the main actor in practices of agricultural intensification while looking for profit maximization from agricultural sector for livelihood improvements (Xie *et al.*, 2019) <sup>[39]</sup>. The emphasize is focused on land use management practices that involve high-yielding varieties and chemical fertilizers. Through the use of farm inputs and mechanization, paddy production has increased and became important food crop in urban markets (Mdoe and Mlay, 2001). A study by Djurfeldt, *et al.* (2021) <sup>[8]</sup> indicates that in Kilombero District, Tanzania, both the cultivated area and mechanization has led to improved paddy production aiming at meeting the rice demand caused by rapid population growth. In addition, a study in the North

**Table 2:** ANOVA for a simple linear regression analysis

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	7.228	1	7.228	114.036	0.000 <sup>b</sup>
Residual	6.212	98	0.063		
Total	13.440	99			

a. Dependent variable: Paddy productivity  
b. Independent variable (Predictors): Agricultural intensification

**Table 3:** The model summary for a simple linear regression analysis

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.751 <sup>a</sup>	0.564	0.559	0.25633

Predictors: (Constant): Agricultural intensification

Given the formula for a simple linear regression:

$$y = \beta_0 + \beta_1x + \epsilon$$

Where:

- Y = the dependent variable
- B0 = the Y intercept
- B1 = the change in Y for each one increment change of X
- X = an independent variable for which we predict the change in the value of Y
- E = the residual error, which is unmeasured variable

With coefficients from Table 1, the simple linear regression model can be given as:

$$Y = 0.294 + 0.753X + E$$

China Plain (NCP) indicated that the average crop yield from intensive double cropping of wheat and corn was higher than the yield from less intensive single cropping of corn (Pei *et al.*, 2015)<sup>[26]</sup>. A study in India suggested that the introduction, adaption and acceptance of new technologies results into improved crop productivity and resilience of farming systems (Khanam *et al.*, 2018)<sup>[14]</sup>.

Therefore, through existing literature it is evident that agricultural intensification is significant in improvement of food productivity so as to meet the growing populations which supports the theory of population by Boserup. The study adopted the Boserupian theory as a reference point for promoting rural transforming through agricultural intensification and mechanization for achievement of improved wealth among rural societies.

The study results suggest the Boserupian theory that agricultural intensification is very significant for meeting the food demand of the growing population. In Mbarali district households have applied not only intensifies agriculture but also increased cultivated land which consequently led to improved paddy productivity. Without application of agricultural inputs, the continued cultivation on the same area could result into land degradation and declining yield over time. This indicates that the use of farm inputs has promoted increased paddy productivity among rural households in Mbarali district (Khanam *et al.*, 2018<sup>[14]</sup>; Dejufert *et al.*, 2021).

Although these findings support that agricultural intensification results into increased crop production to meet the food demand resulting from the growing population in urban areas, the findings by Sokoni and Tilumanywa (2021) showed that agricultural intensification has not been realised in the Uporoto Highlands because poor families could not intensify their agriculture. Further, a study in Arusha and Manyara regions emphasised that farmers were not ready to adopt and use chemical fertilizers due to their local believe that chemical fertilizers destruct the natural fertility of the soils and that the use of chemical fertilizer is the main reason for decline in soil fertility (Snyder *et al.*, 2021)<sup>[29]</sup>.

Also, a study by Dejufert *et al.* (2021) indicates that the use of chemical fertilizer varies from one area to another depending on the nature of the available land. For example, in Idete village, farmers did not use chemical fertilizers since their land were still very fertile hence no need of fertilizers, while in Katurukila village households have used chemical fertilizer because their soils were infertile. This indicates that it is not always the case that rapid population growth results into agricultural intensification, as expected in Boserupian theory, it depends on various factors such as economic, social and cultural factors and varies from one situation to another as well as from one location to another.

In spite of the significant role played by agricultural intensification on increased paddy production, various challenges have faced farmers in Mbarali district including the high cost of farm inputs and inadequate finance to run their farming business smoothly. The high prices of inputs such as fertilizes, herbicides and insecticide has become a big challenge to rural farmers because they fail to apply the required amount on their farms. It was revealed through FGDs and KIIs that with subsidizes farm inputs farmers could achieve the more improved paddy productivity than the current yield. Also, the inadequate finance limit farmers to participate fully in paddy farming that limits the full utilization of the available potentials from paddy farming,

which consequently delays the process of poverty alleviation in the area.

#### 4. Conclusion

This study has assessed the linkages between agricultural intensification and paddy productivity in Mbarali district. Both agricultural intensification and land expansion have contributed to increased paddy production in Mbarali district. The study revealed that agricultural intensification has emerged as one of the strategies for achievement of improved paddy production in the area. this is because their farms have been continually cultivated year after year which deplete soil nutrients, therefore agricultural intensification is the key strategy for regeneration of soil fertility which has a positive implication not only on paddy production but also on land productivity.

The study show that agricultural intensification has a significant impact on paddy production because through a simple regression analysis the study showed that there is statistically significant relationship between agricultural intensification and paddy production. Also, the model indicates that agricultural intensification ( $b = 0.218$ ,  $p = 0.000$ ) has a positive relationship which implies that the use of farm inputs is important in crop production as it contributes to increased crop productivity which useful in improving and sustaining livelihoods of rural communities.

#### 5. Recommendations

Despite the efforts by farmers to increase paddy productivity through the use of farm inputs and expansion of land under paddy production, the high prices of farm inputs and inadequate finance were among the challenges that threaten their performance in farming activities. The government and the private sectors should subsidize farm inputs and provide financial support to rural farmers to enhance their ability and affordability on various cost of running paddy farming to ensure food security for both rural and urban societies in general.

#### 6. References

1. Barrett CB, Christiaensen L, Sheahan M, Shimeles A. On the Structural Transformation of Rural Africa. *Journal of African Economies*. AERC. 2017; 26(S1):11-35.
2. Birch-Thomsen T, Friis-Hansen E. Improved Livelihoods on Less Land: The Case of Ilambilole and Ikuwala Villages in Iringa Region, 1996-2017 In: *Prosperity in Rural Africa? Insights into Wealth, Assets, and Poverty from Longitudinal Studies in Tanzania*. Edited by: Dan Brockington and Christine Noe, Oxford University Press, 2021. Doi: 10.1093/oso/9780198865872.003.0015
3. Boserup E. *Population and technological change: A study of long-term trends*. University of Chicago Press, Chicago, 1981.
4. Brockington D. *The Sesame Seed Cash Injection: Commodity-Fuelled Asset Booms in Remote Rural Tanzania in: Prosperity in Rural Africa? Insights into Wealth, Assets, and Poverty from Longitudinal Studies in Tanzania*. Edited by: Dan Brockington and Christine Noe, Oxford University Press. © Dan Brockington, 2021. Doi: 10.1093/oso/9780198865872.003.0008
5. Brockington D, Noe C. *Assets, Prosperity, and Data in Rural Africa in: Prosperity in Rural Africa? Insights*

- into Wealth, Assets, and Poverty from Longitudinal Studies in Tanzania. In: Brockington, D. & Noe, C. (Eds.) *Prosperity in Rural Africa? Insights into Wealth, Assets, and Poverty from Longitudinal Studies in Tanzania*. Oxford University Press, 2021.  
Doi: 10.1093/oso/9780198865872.003.0002
6. Christiaensen L, Demery L, Kuhl J. The (Evolving) Role of Agriculture in Poverty Reduction, An Empirical Perspective. *Journal of Development Economics*. 2011; 96:239-254.
  7. Cosmas Sokoni, Verdiana Tilumanywa. Exploring Long-Term Changes in People's Welfare on the Uporoto Highlands, Mbeya District, Tanzania. In: *Prosperity in Rural Africa? Insights into Wealth, Assets, and Poverty from Longitudinal Studies in Tanzania*. Edited by: Dan Brockington and Christine Noe, Oxford University Press, 2006.  
Doi: 10.1093/oso/9780198865872.003.0014
  8. Djurfeldt AA, Hillbom E, Msuya E. Ricing Fortunes: Agricultural Growth, Farm Intensification, and Paddy Specialization in Two Tanzanian Villages In: *Prosperity in Rural Africa? Insights into Wealth, Assets, and Poverty from Longitudinal Studies in Tanzania*. Edited by: Dan Brockington and Christine Noe, Oxford University Press, 2021.  
Doi: 10.1093/oso/9780198865872.003.0011
  9. Israel GD. Determine the Sample Size, 2009. <http://www.edis.ifas.ed/pd006> Accessed 12<sup>th</sup> August 2021.
  10. Jayne TS, Chamberlin J, Benfica R. Africa's Unfolding Economic Transformation. *Journal of Development Studies*. 2018; 54(5):777-787.
  11. Kalinga AS, Kangelawe RYM, Lyimo JG. The Significance of the Diversification of Food Crops in Abating Impacts of Climate Variability: The Case of Rungwe District, Tanzania. *Journal of the Geographical Association of Tanzania*. 2022; 41(2):1-21.
  12. Kalinga AS. Market Availability and Food Security in Rungwe District. *African Journal of Accounting and Social Science Studies (Aajass)*. 2021; 3(2).
  13. Kalinga AS, Kangelawe RYM, Lyimo JG. Drivers of Livelihoods Diversification in Rungwe District. *Journal of Sustainable Development*. 2019; 12(4).
  14. Khanam R, Bhaduri D, Nayak AK. Crop diversification: an important way-out for doubling farmers' income", *Indian Farming*. 2018; 68(01):31-32.
  15. Knapp TR. Learning Statistics through Playing Cards, 2012. Available at: [www.statlit.org/Knapp](http://www.statlit.org/Knapp). retrieved on 26th March, 2021
  16. Labarta R. The Effectiveness of Potato and Sweet Potato Improvement Programmes from the Perspectives of Varietal Output and Adoption in Sub-Saharan Africa. In: Walker, T.S. & Alwang, J. (Eds.) *Crop Improvement, Adoption, and Impact of Improved Varieties in Food Crops in Sub-Saharan Africa*. CGIAR and CAB International, 2015.
  17. Lakhnan S, Kumar S, Bajiya R. Crop Diversification: An Option for Climate Change Resilience, *Journal of Trends in Biosciences*. 2017; 10(2):516-518.
  18. Lowder SK, Scoet J, Raney T. The Number, Size, and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide. *World Development*. 2016; 87:16-29.
  19. Mataia AB, Jesusa C, Beltran AC, Rowena G. Manalili, Betzaida M, *et al.* Rice Value Chain Analysis in the Philippines: Value Addition, Constraints, and Upgrading Strategies, *Asian Journal of Agriculture and Development (AJAD)*. 2020; 17(2):19-42.  
Doi: <https://doi.org/10.37801/ajad2020.17.2.2>
  20. Mdee A, Wostry A, Coulson A, Maro J. A Pathway to Inclusive Sustainable Intensification in Agriculture? Assessing Evidence on the Application of Agroecology in Tanzania. *Agroecology and Sustainable Food Systems*. 2018; 43(2):201-227.
  21. Mdoe NSY, Mlay GI. Agricultural commercialisation and the political economy of value chains: tanzania rice case study, Working Paper, WP 57, 2021.
  22. Mussema R, Kassa B, Alemu D, Shahidur R. Determinants of Crop Diversification in Ethiopia: Evidence from Oromia Region, Ethiop. *Journal of Agricultural Science*. 2015; 25(2):65-76.
  23. Nobuhito Sekiya N, Oizumi N, Kessy TT, Fimbo KMJ, Tomitaka M, Katsura K, *et al.* Importance of market-oriented research for rice production in Tanzania. A review. *Agronomy for Sustainable Development*. 2020; 40(7).  
Doi: <https://doi.org/10.1007/s13593-020-0611-1>
  24. Noonari S, Memon IN, Jatoi AA, Memon A, Wagan SA, Sethar AS, *et al.* Analysis of rice profitability and marketing chain: the case study of taluka pano akil district sukkur sindh Pakistan. *Global Journal of Agricultural Research*. 2016; 4(3):29-37.
  25. Ollenburger M, Crane T, Descheemaeker K, Giller KE. Are Farmers Searching for an African Green Revolution? Exploring the Solution Space for Agricultural Intensification in Southern Mali. *Experimental Agriculture*. 2019; 55(2):288-310.
  26. Pei H, Scanlon BR, Shen Y, Reedy RC, Long D, Liu C. Impacts of varying agricultural intensification on crop yield and groundwater resources: comparison of the North China Plain and US High Plains, *Environ. Res. Lett.* 2015; 10:044013.  
Doi:10.1088/1748-9326/10/4/044013
  27. Ponte S, Brockington D. Involution and Enterprise in Rural Areas: A Twenty-Year Perspective on Rural and Agricultural Change in Morogoro In: *Prosperity in Rural Africa? Insights into Wealth, Assets, and Poverty from Longitudinal Studies in Tanzania*. Edited by: Dan Brockington and Christine Noe, Oxford University Press, 2021.  
Doi: 10.1093/oso/9780198865872.003.0012
  28. Sedgwick PM. Snowball Sampling, *Clinical Research*, 2013. Doi: 10.1136/bmj.f7511
  29. Snyder KA, Sulle E, Massay DA, Petro A, Qamara P, Brockington D. 'Modern' Farming and the Transformation of Livelihoods in Rural Tanzania in: *Prosperity in Rural Africa? Insights into Wealth, Assets, and Poverty from Longitudinal Studies in Tanzania*. Edited by: Dan Brockington and Christine Noe, Oxford University Press, 2021.  
Doi: 10.1093/oso/9780198865872.003.0006
  30. Struik PC, Kuyper TW. Sustainable intensification in agriculture: the richer shade of green. A review Article, *Journal of Agron. Sustain. Dev.* 2017; 37:39.  
Doi 10.1007/s13593-017-0445-7
  31. Takele A. Determinants of Rice Production and Marketing in low Producer Farmers: The Case of Fogera Districts, North-Western Ethiopia. *International*

- Journal of Environment, Agriculture and Biotechnology. 2017; 2(5).  
Doi: <http://dx.doi.org/10.22161/ijeab/2.5.34>
32. Tilmana D, Balzerb C, Hillc J, Beforta BL. Global food demand and the sustainable intensification of agriculture, PNAS. 2011; 108(50):20261.
  33. United Republic of Tanzania (URT). National Rice Development Strategy Phase II (NRDS II) 2019-2030, Ministry of Agriculture, 2019.
  34. United Republic of Tanzania (URT). Mbarali District Council Socio-Economic Profile, Ministry of Finance and Planning, National Bureau of Statistics and Mbarali District Council, Tanzania, 2017.
  35. URT (The United Republic of Tanzania). National Agriculture Policy, Ministry of Agriculture Food Security and Cooperatives, Dar es Salaam, 2013.
  36. Valenzuela H. Agroecology: A global paradigm to challenge mainstream industrial agriculture. Horticulture. 2016; 2(2):2.  
Doi:10.3390/horticulturae2010002
  37. Wang C. An Analysis of Rural Household Livelihood Change and the Regional Effect in a Western Impoverished Mountainous Area of China, Journal of Sustainability. 2018; 10:1738. Doi:10.3390/su10061738
  38. Wilson RT, Lewis I. The rice value chain in Tanzania. A report from the Southern Highlands Food Systems Programme, FAO, 2015, 9.
  39. Xie H, Huang Y, Chen Q, Zhang Y, Wu Q. Prospects for Agricultural Sustainable Intensification: A Review of Research, Land Review Journal. 2019; 8(157).  
Doi:10.3390/land8110157