Reducing the Farmers' Vulnerability through Conservation Agriculture Farming Practices for Livelihood Improvement in Myanmar

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Abstract: *This study investigates the current sesame farming practices in Myanmar and evaluates the impact of conservation agriculture (CA) techniques on the livelihood of farmers in the Central Dry Zone. Data were collected from 130 randomly selected farmers, and multiple regression analysis was conducted to determine the effects of CA farming on their income, expenditure, and wellbeing. The results highlight that while CA farming improves soil quality and reduces land degradation, it does not significantly enhance farmers income due to limited adoption of diversified crops.*

Keywords: Conservation agriculture, Myanmar, livelihoods, sesame farming, sustainable agriculture

1. Introduction

Myanmar boasts a predominantly agrarian landscape, encompassing an expansive landmass spanning 676, 577 square kilometers, and sustaining a populace of approximately 55 million. The agricultural sector is the backbone of its economy. The agricultural sectors includes crops, livestock and fishery subsectors which contribute 23.7% of GDP, 35.1% of total export earnings in 2020 - 2021. Labour force participation rate, in general, was 59.1% of the total labour force. The growth rate of the gross domestic product (GDP) from agriculture decreased from 46.5% to 23.7 % approximately 22.8 % from 1980 to 2021 (FAO, 2005; MOALI, 2021). Myanmar exhibits four noticeable agriculture zones, namely the delta, coastal region, arid region, and hilltop areas. These zones play a crucial role in shaping the country's agricultural landscape and demographic (Lambrecht et al., 2022).

The heart of Myanmar's agricultural production and population centers mainly lie in the floodplain area and arid region. The arid region which called the central dry zone (CDZ), encompassing roughly 60% of the nation's croplands, faces formidable challenges such as extreme heat, water scarcity, recurrent droughts. In contrast, the highland areas are distinguished by a more diverse agricultural landscape, featuring an abundance of shrubs and garden crops, along with cultivation of corn. Moving to southern seaside area, these areas exist frequently exposed to the menacing forces of tropical cyclones, floods, and storm surges. Notably, these environmental hazards also pose significant risks to the densely populated delta regions (MNREC, 2019).

As a result of climate variability throughout the country, Myanmar faces a multitude of challenges and obstacles. These include reduced crop yields, heightened yield reductions, hunger, undernourishment, these include diminished crop yields, increased crop losses, food insecurity, malnutrition, and increased level of poverty. To reduce the vulnerability of farmers' livelihoods in the agricultural area, it is crucial to outline the impacts of changing climate on farming and socio - economic status in rural areas. This entails a thorough examination of the primary barriers obstructing the adaptation of Climate Smart Agricultural practices, along with an understanding of the challenges involved in incorporating climate change adaptation policies to address agricultural farming methods. This paper aims to offer valuable insight that will aid stakeholders, including government and non - governmental organizations, researchers, and policymakers. By addressing farmers' vulnerability to climate change through the adoption of CA, it seeks to guide informed decision - making and effective interventions in the Republic of Union of Myanmar.

2. Material and Method

2.1 Study area

The arid area encompasses an expanse of roughly 87, 189 square kilometers, spanning across lower Sagaing, Mandalay, and Magway Divisions and encompassing a total of 57 townships. This region is home to approximately 12 million inhabitants, with an average population density of only nine individuals per square kilometer. A significant portion of the upland areas within the Dry Zone grapple with a range of land degradation issues, exacerbating environmental challenges in the area. The climate in this region is profoundly impacted by the south - west rainy season, which contributes to a two - phases precipitation pattern. The yearly precipitation in the Dry Zone averages less than 750 millimeters, underscoring the arid conditions that predominate (Kyaw and Routray, 2006). Worryingly, there has been a noticeable surge in the frequency of drought occurrences in recent times, posing a growing threat to the region's inhabitants and ecosystems.

Kyaukpadaung Township, located in the Dry Zone, experienced two years of drought from 2000 to 2006, leading to crop failures. The township, situated along the Mandalay - Magway - Yangon highway, is vulnerable and poor. With 196, 494 hectares, agricultural land dominates, with a significant rural population of 78%. The township shares borders with Bagan, a popular tourist destination (see in figure 1) (ADB, 2019). The study area has two primary cropping systems: sesame - based and rice - based. Sesame -

based farmers intercrop sesame and pigeon pea during the early monsoon season, followed by groundnut, pulses, or sorghum. Rice - based farmers cultivate rice during the monsoon season, then plant sunflowers or chickpea (Herridge et al., 2019a) (Herridge et al., 2019b) . Challenges faced by small - scale farmers included increased land degradation, increased susceptibility to diseases, improved soil quality, and the practice of mix - cropping to prevent land degradation.

2.2 Sampling and Procedure

The research area residents, encompassing SIN - TAT - KYIN, BIN - GA, and KYAUK - TA - GAR villages within the KYAUK - PA - DAUNG subregion, predominantly

depend on income, in addition livelihoods derived from inter - cropping and crop rotation farming practices. This categorizes them as inhabitants of the arid region in Myanmar, often referred to as dryland dwellers. Their agricultural methods are rooted in rainfed practices, shaped by their accumulated farming knowledge and adapted to the region's erratic weather conditions. In the year 2019, the total number of respondents within this area amounted to 130 households, comprising a population of 577 individuals. The determination of this sample size adhered to the methodology proposed by Yamane (1967: 886), ensuring that the chosen sample adequately represented the study's objectives and scope.
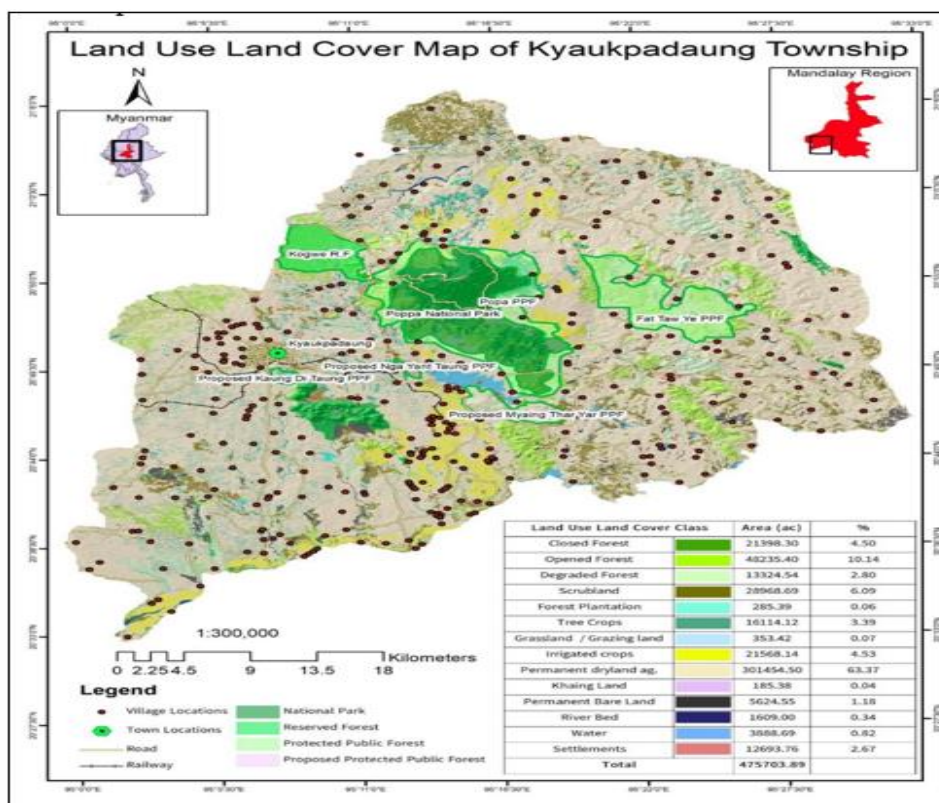

Figure 1: Map showing location of research site. Source; SLM - GEF (Myanmar)

The household survey employed a purposive sampling procedure. In the context of this purposive sampling, households were intentionally selected from the three villages under consideration. Among the 577 households engaged in CA practices within Kyaukpadaung Township, the distribution was as follows: 189 households were located in BIN - GA village, SIN - TAT - KYIN village which 192 total household, and KYAUK - TA - GAR village which 196 total household. Consequently, the sample for the study consisted of 47 households from BIN - GA village, 44 households from SIN - TAT - KYIN village, and 39 households from KYAUK - TA - GAR village.

Table 1: Sample size of each village

Area (Villages)	Population	Sample
Bin - Ga	189	47
Sin - ta - kyin	192	44
Kyauk - ta - gar	196	39
Total	577	130

Source; Author's field study

2.3 Data Analysis and Method

There is a notable disparity in the number of male and female household heads, primarily due to the fact that the majority of household heads are male, while female household heads often arise from widowhood. In our study, we observed that 82.3% of household heads were male, whereas 17.7% were female. To assess the level of farmers' adaptation in conservation agriculture, we considered it as the dependent variable. We conducted hypothesis testing to ascertain the relationship between the social, economic, and environmental factors influencing sesame farmers. In this study, we operated on the assumption that the dependent variable followed a linear function of the independent variables. Therefore, we employed regression analysis to estimate the extent to which variations in the dependent variable (farmers' adaptation level in sesame farming) were attributed to the independent variables, as determined through multiple regression analysis. The model used for this analysis was:

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$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 - - - - - - - \beta_n x_n + e \quad (1)$$

Where;

y = Famers' adaptation on conservation agriculture practices

β_0 = Intercept

$\beta_1, \beta_2, \beta_3, \beta_n$ = The estimation of coefficients

X_1 = Age

X_2 = Gender

X_3 = Household head education level

X_4 = Labor Cost

X_5 = Income from sesame

X_6 = Farmer debt

X_7 = Farming experiences

X_8 = Health

3. Results and Discussions

Table 2: Multiple regression analysis of effects on livelihood on adaptation conservation agriculture practices in the study area

Variables	Coefficient			
	B	Std. error	t	Sig
Constant	-23.151	2.947	-7.855	0
Debt	1.64	0.897	1.828	0.07
Income - Sesame	- 1.165E - 6	0	-1.89	0.061
Mix cropping	2.536	0.997	2.543	**0.012**
Crop rotation	0.307	0.838	0.366	0.715
Cover cropping	0.235	1.133	0.207	0.836
Agroforestry	2.858	2.152	1.328	0.187
Mulching	0.027	3.386	0.008	0.994
Age	1.034	0.034	30.196	**0**
Gender	-1.174	0.891	-1.317	0.191
Education	-0.392	0.412	-0.951	0.343
Health access	0.613	0.724	0.846	0.399
Labor Cost	0.001	0	1.877	0.063
Expenditure	- 3.082E - 8	0	-0.264	0.792

Source; Author's field study: Dependent variable: Farming Experiences (years); N=130, R²=.917

Table 3: Multiple regression analysis of income from sesame on effect livelihoods

Variables	Coefficient			
	B	Std. error	t	Sig
Constant	-231002.027	440275.885	-0.525	0.601
Inter cropping	-38933.899	73261.838	-0.531	0.596
Mix cropping	83515.567	152854.694	0.546	0.586
Crop rotation	-303320.866	125157.561	-2.424	**0.017**
Cover cropping	382.302	172307.238	0.002	0.998
Agroforestry	-64417.386	329342.888	-0.196	0.845
Mulching	449360.974	515653.257	0.871	0.385
Age	7348.411	5211.268	1.41	0.161
Gender	-19736.464	136585.31	-0.144	0.885
Education	13833.587	63202.976	0.219	0.827
Health	176677.875	108843.701	1.623	0.107
Labor Cost	191.893	62.074	3.091	**0.002**
Expenditure	-0.016	0.018	-0.901	0.37

Source; Authors' field study (2019): Dependent Variable: Income from Sesame (Kyat/year); R²=.232; N=130

The analysis unveiled a statistically significant relationship between farming experience, income from sesame cultivation, and several key factors: age, mixed cropping, labor costs, and crop rotation. These findings offer a valuable basis for the development of guidelines aimed at supporting CA farming practices among farmers. Moreover, they can inform the introduction of innovative and suitable technologies tailored to each farming area, thereby enhancing production efficiency while safeguarding natural resources and coping with the challenges presented by changing climate in the arid region. In particular, the study highlighted the strong correlation between farm experience and causes as household head age, as well as the current practices of mixed cropping and crop rotation. Notably, the majority of household heads fell within the middle - age group, comprising individuals aged between 41 and 60, accounting for 48.5% of the sample.

This was followed by the age group of 61 - 90, which constituted 42.3% of the sample, with the remaining 9.2% belonging to the 25 to 40 age group. Consequently, we concluded that individuals within the middle - age bracket possessed sufficient knowledge of CA practices. Furthermore, the adoption of CA practices by farmers was found to lead to a reduction in labor costs. Lastly, it was established that mixed cropping and crop rotation had a significant impact on farmers livelihoods, underscoring the importance of these practices in enhancing agricultural sustainability and income generation.

4. Conclusion

This study is significant because it explores the adoption of sustainable farming practices in a region that is highly vulnerable to climate variability and land degradation, providing insights for policy interventions and livelihood improvement. The results obtained from the multiple regression analysis revealed that several factors exerted significant influence on the adoption of CA practices. Among all the independent variables considered, four of them were notably impactful on CA practices. However, it's important to note that farmers who were practicing CA didn't experience significant effects on their income. This was primarily because they exclusively cultivated sesame crops in their CA systems, necessitating the purchase of rice for year - round daily consumption due to their limited income. Consequently, the working - age members of these households often migrated to other districts and even outside of Myanmar in search of better economic opportunities, posing a substantial challenge in the research area.

Additionally, it was observed that farmers who practiced crop rotation experienced an increase in income. Remarkably, a significant proportion of CA practitioners, amounting to 60.6%, engaged in crop rotation farming practices. Furthermore, the majority of farmers, approximately 85.6%, practiced intercropping as part of their agricultural activities. These findings shed light on the diverse strategies employed by farmers in the study area to enhance their agricultural productivity and income within the context of CA practices.

Farmers in the pursuit of increasing crop yields and enhancing household food security employ a combination of chemical and organic inputs, including fertilizers and pesticides. Remarkably, despite the financial challenges posed by the cost of these chemical inputs, which often exceed 125 kg/ha (as in the case of 15: 15: 8 compound fertilizer), the study found that a substantial majority, exceeding 80%, continue to utilize both chemical fertilizers and pesticides in their farming

practices. Approximately 81% of the respondents also acknowledged the use of organic fertilizers.

However, it's worth noting that the adoption of organic pesticides was comparatively lower, with only 23.7% of respondents indicating their usage. In addition to chemical inputs, many farmers rely on the application of organic materials such as farm manure, cow dung, and compost as their primary sources of organic fertilizers. Furthermore, a significant portion of farmers turn to neem pesticide, a locally sourced product from Myanmar, for their organic pest control needs. These findings underscore the diverse approaches employed by farmers to strike a balance between modern agricultural techniques and sustainable, organic practices in their quest for improved agricultural outcomes.

Due to the erratic and unpredictable weather conditions, farmers frequently encounter challenges related to pest infestations, diseases, and weed outbreaks. These issues can significantly contribute to reduced productivity and crop failures both before and after the harvest season. On average, farmers contend with two different types of pests, diseases, and weed outbreaks, respectively, compounding the complexities of their agricultural endeavors.

Certain sustainable practices serve a dual purpose for farmers by enabling them to not only promote long - term agricultural sustainability but also make short - term adjustments in response to immediate challenges. For instance, crop rotations represent a long - term strategy aimed at enhancing soil health. This strategy demands an investment of time in developing markets or establishing contacts for a diverse range of crops. It also requires investments in acquiring the requisite knowledge, equipment, and experience for cultivating various crops.

By implementing these long - term strategies and investments, farmers create a foundation that empowers them to make swift short - term adaptations. For instance, they can respond to challenges like drought by planting more drought - resistant crops or varieties without encountering major hurdles because they already possess the necessary equipment and agronomic knowledge. Enhancing farmers' adaptive capacity to address constraints can be achieved through education and the promotion of sustainable practices as a form of long - term adaptation, as exemplified by CA practices. This approach not only benefits the environment but also equips farmers with the tools and knowledge to navigate a range of challenges and uncertainties in their farming endeavors.

In conclusion, for CA to effectively enhance the livelihoods of farmers in Myanmar's vulnerable production regions, it is recommended that policies be designed with precision to target CA practices at the right categories of well - resourced farmers. Simultaneously, efforts should be directed towards empowering and supporting the economically disadvantaged groups of farmers. This balanced approach will ensure that CA not only contributes to sustainable agricultural practices but also addresses the specific needs and challenges faced by different segments of the farming community in these regions.

References

[1] ADB, 2019. MYA : Resilient Community Development Project.
[2] FAO, 2005. Myanmar Agricultural Sector Review Investment Strategy Volume 1 – Sector Review 1.
[3] Herridge, D. F., Win, M. M., Nwe, K. M. M., Kyu, K. L., Win, S. S., Shwe, T., Min, Y. Y., Denton, M. D., Cornish, P. S., 2019a. The cropping systems of the Central Dry Zone of Myanmar: Productivity constraints and possible solutions. Agric. Syst.169, 31–40. https://doi. org/10.1016/j. agsy.2018.12.001
[4] Herridge, D. F., Win, M. M., Nwe, K. M. M., Kyu, K. L., Win, S. S., Shwe, T., Min, Y. Y., Denton, M. D., Cornish, P. S., 2019b. The cropping systems of the Central Dry Zone of Myanmar: Productivity constraints and possible solutions. Agric. Syst.169, 31–40. https://doi. org/10.1016/j. agsy.2018.12.001
[5] Kyaw, D., Routray, J. K., 2006. Gender and rural poverty in myanmar: A micro level study in the dry zone. J. Agric. Rural Dev. Trop. Subtrop.107, 103–114.
[6] Lambrecht, I., Belton, B., Fang, P., Minten, B., Thandar, P., Naing, 2022. Agricultural land and crop production in Myanmar.
[7] MNREC, 2019. Myanmar climate change strategy (2018 - 2030).
[8] MOALI, 2021. Brief. pdf.

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