CONSERVATION AGRICULTURE (CA) ON SMALLHOLDER FARMS IN ZIMBABWE: FACTORS OF ADOPTION AND POSSIBLE SUSTAINABILITY IMPACTS

（ジンバブエのビンドゥラにおける小規模農家での保全農業:導入要因と持続可能性への影響）

SIBANDA SPENCER, GPSS-GLI, STUDENT I.D. 47-176803

Advisor: Associate Professor: Alexandros Gasparatos

Co-Advisor: Associate Professor: Hirotaka Matsuda

ABSTRACT

This study assesses the impact of conservation agriculture (CA) as a sustainable farming method introduced in Zimbabwe; to address the challenges of food security, poverty, low agricultural productivity and deteriorating soil quality of farmlands. The sustainability science framework was adopted to determine the performance of CA as compared to CT practices. Primary data was gathered from a sample of 91 respondents, consisting of 30 CA farmers, 31 Conventional Tillage (CT), and 30 farmers using both (CA) and (CT). Snowballing and simple random sampling techniques were used to identify respondents. The data was gathered through household surveys using structured questionnaires, participant observation techniques and soil analysis. This study attempts to:

- Review the state of CA in Zimbabwe, identifying the drivers and barriers of adoption, and the main sustainability impacts, through a literature review.
- Assess the possible local social, economic and environmental impacts of CA in Zimbabwe through household surveys and soil analysis.
- Develop policy recommendations that can aid in the implementation of CA in Zimbabwe and enhance its positive sustainability impacts.

The first part of the thesis reviewed the determinants of CA adoption and the impacts of adoption in Africa, through a literature review and document analysis. From the financial point

of view, this study identified profitability (increased farm yields) as the dominant driver for conservation agriculture adoption. Other important reasons farmers choose to adopt CA were time savings, reduced farm labour costs, policy instruments, extension services and training. The second part of the thesis aimed to establish differences in farmers' food security, poverty, profitability, and soil quality among CA, CT, and CA+CT farmers. To assess the food security situation of farmers, the Food Consumption Score (FCS), Household Food Insecurity Access Scale (HFIAS) and Coping Strategy Index (CSI) of each household were calculated, and then t-test was conducted to validate the differences. Poverty status of farmers was measured using the Multidimensional Poverty Index (MPI) to establish the poverty difference between farmers involved in CA, CT and CA+CT practices. Soil quality was assessed through laboratory analysis of soil bulk density, fertility (NPK) and soil organic carbon (SOC). The evaluations show that CA tends to have a higher impact on food security compared to both CT and CA+CT practices. The analysis of farmer's perception further supported the findings. The Multidimensional Poverty Index (MPI) for both CA and CT farmers was below the provincial and national poverty levels. The cost of production and labour demands for CA farmers lower compared to CT and CA+CT practices. This shows that implementing CA affords farmers more time to engage in extra income generating activities or spend time with family and friends. The mean gross margin per ha for CA+CT was the highest at $USD 6,767.60, compared to $USD 4,636.30 for CA farmers and $USD 3,389.70 CT farmers respectively. In effect CA farmers have higher gross margins compared to CT farmers, which is statistically significant. CA+CT farmers obtained higher gross margins because of the additional higher incomes obtained from cultivating cash crops that cannot be cultivated under CA. CA practices significantly improved soil fertility as compared to CT. CA practices significantly increased soil mineral N, pH, Potassium, Calcium and Magnesium by at least 48 %, 0.3 pH units, 11 %, 34 % and 31 % respectively as compared to CT across all farmers. However, effects on soil fertility were not

significantly different ($p > 0.05$) except for mineral N where direct seeding increased mineral N by a significant 8.4 % ($P < 0.01$). Generally, the study recommends for policymakers that CA practices have the potential to improve the farm income, livelihood and soil quality of farmers and therefore should be promoted by Non-Governmental Organizations and Government Institutions.

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The evaluations show that CA tends to have a higher impact on food security compared to both CT and CA+CT practices. The analysis of farmer's perception further supported the findings. The multidimensional poverty index (MPI) for both CA and CT farmers was below the provincial and national poverty levels. The cost of production and labour demands for CA farmers were lower compared to CT and CA+CT practices. This shows that implementing CA affords farmers more time to engage in extra income generating activities or spend time with family and friends. The gross margin per ha for CA+CT was the highest at $USD 6,767.60,

compared to $USD 4,636.30 for CA farmers and $USD 3,389.70 CT farmers respectively. In effect CA farmers have higher gross margins compared to CT farmers, which is statistically significant. CA+CT farmers obtained higher gross margins because of the additional higher incomes obtained from cultivating cash crops that cannot be cultivated under CA.

CA practices significantly improved soil fertility as compared to CT. CA practices significantly increased soil mineral N, pH, Potassium, Calcium and Magnesium by at least 48 %, 0.3 pH units, 11 %, 34 % and 31 % respectively as compared to conventional tillage across all farmers. However, effects on soil fertility were not significantly different ($p > 0.05$) except for mineral N where direct seeding increased mineral N by a significant 8.4 % ($P < 0.01$). Generally, the study recommends for policymakers that CA practices have the potential to improve the farm income, livelihood and soil quality of farmers and therefore should be promoted by Non-Governmental Organizations and Government Institutions.

KEY WORDS: *Conservation agriculture, impact assessment, food security, adoption, soil quality, profitability, smallholder farmer.*