

論文の内容の要旨

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論文題目 Food Security in Ethiopia -Analysis of cereal demand and supply:
past trend and future prospect-

(エチオピアの食糧安全保障-穀物需要と供給の解析、過去の傾向と未来の予測-)

This thesis investigated food security challenges and potentials in Ethiopia using systems thinking methods in three parts. In the first part (Part I) comparative analysis of Ethiopian cereal supply was made in relation to other African countries. In the second part (Part II), meat consumption pattern in rural and urban Ethiopia was analyzed using cohort and econometric models. The third and final part (Part III) analyzed nitrogenous

fertilizer demand in cereal production in Ethiopia. The major data sources were the Food and Agriculture Organization, World Resource Institute, World Bank's World Development Indicators and Central Statistical Agency of Ethiopia.

In Part I, a system model was used to analyze and classify African countries based on level of cropping intensity. First, all countries were divided into three groups based on their level of cropping intensity (CI) which was calculated as a ratio of harvesting and arable land. This index helps to identify the potential of each country for further cropland expansion. Then the possible cereal supply options were discussed based on ratio of population-to-arable land, per capita GDP, water resources and past cereal yield. Countries that will face problem of cereal supply were ranked using combined index of the above variables. The result showed that between 1961 and 2003 most of the North African countries have made significant improvement in per capita cereal supply while decline has occurred in Central African countries, South Africa and East Africa. The future cereal supply prospect of the North Africa seems to rely more on cereal import and they will face no major problem. Central African countries were found to have sufficient potential arable land and water resource to expand cereal harvesting land. South African countries also will not face cereal supply problem because population growth rate has been low and they have the potential to improve cereal yield. On the other hand, most cereal production factors in East Africa showed that the region will continue to face large gap in demand and supply.

The future projection of cereal demand showed 60% of the countries in Africa will require cereal yield around 2 t/ha in 2030 to enable them contain further expansion of cereal harvesting land. Future supply of two of the most highly populated countries, Egypt and Nigeria will follow different options. While both countries will depend on cereal trade and cereal import, Nigeria will have better potential to improve its cereal yield because Egypt's cereal yield has reached near agronomic maximum.

The analysis of factors of available arable land, per capita income, cereal yield and available water resources showed Ethiopia, Eritrea, Rwanda and Burundi are among the countries that will face higher risk of food insecurity in 2030. Among these countries Ethiopia will face biggest challenge in supplying its large and rapidly growing population.

In Part II the result of analysis of household income, consumption and expenditure survey data of Ethiopia showed consumption of meat and its response to income change have had distinct pattern between urban and rural households. More than 40% of meat in

the country was consumed in urban areas. The per capita meat consumption in urban households changes more steeply with change in per capita income compared with rural households. The total national meat consumption made improvement between 1996 and 2000 as a result of improvement in response of rural household meat consumption to income gain. The result of economic analysis revealed that urbanization and income have positive and significant correlation with meat consumption in Ethiopia at 1% and 5 % significance level respectively. On the other hand, level of cereal production and price of meat did not have significant correlation with per capita meat consumption. Therefore, improvement in meat consumption in Ethiopia could occur only if rural consumption pattern changes or urbanization is accelerated and income level of urban households is improved. In the study, the result of comparison of meat data sources showed that FAO overestimated the per capita meat in Ethiopia by more than 100% compared to the CSA household survey result. This disparity seems to be caused by overestimation of rate of livestock utilization than number of livestock. Therefore, it is recommended to use CSA's household consumption data along with FAO's data for policy making and research on nutrition in Ethiopia.

In Part III a system model was used to project and analyze the requirement of nitrogen fertilizer needed to improve cereal yield and produce the future demand of cereals in Ethiopia up to 2030. The model considers three GDP growth scenarios with corresponding level of food consumption. GDP was projected using gross annual rate of 2.5, 5 and 10% growth. The total GDP was distributed to households based on level of education. Income for each household under certain level of education, residence (urban or rural) and sex was estimated from literature and was adjusted using total GDP. Population was projected using data on demographic variables from Demographic and Health Surveys and initial population from UN Population Prospect. Per capita food demand was estimated for different meat items, milk and cereals using lin-log models developed from household income and consumption data of HICE 2004. In the model the logarithm of income was taken as dependant variables. Cereal feed demand was projected from livestock demands and animal feed/livestock ratios. The result showed that total demand for cereal food and feed in 2030 will increase between 2.5 and 4 times the level in 2005 depending on rate of GDP growth. The cereal yield which was 1.2 t/ha in 2005, is required to grow to 3.6 – 5.7 t/ha in 2030 which in turn requires nitrogenous fertilizer use rate between 160 kg/ha and 290 kg/ha. Hence, in order to supply the cereal

demand for its growing population while checking expansion of agricultural lands, Ethiopia needs to dramatically increase the use of chemical fertilizer.