A Multi-Criteria GIS Site Selection for Sustainable Cocoa Development in West Africa:
A Case Study of Nigeria

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ABSTRACT

Cocoa occupies 6 million hectares in humid coastal West Africa where 70% of the world supply is grown, 90% of which is produced on 2 million family farms of 2 hectares or less. Here, at least 16 million people depend on cocoa but earn only $100/person/year from the crop. There is need to optimize the farming system, minimize the environmental impact of technologies, and improve socio-economic dynamics. This study identifies areas with potential for intensified cocoa farming and where maximum impact to household income could be achieved without deforestation. The selection involves defining suitability criteria, preparing an inventory of available data, determining suitability based on identified criteria, and combining suitability into hierarchical preferences based on weights proposed by local experts. GIS and Multi-Criteria land Evaluation technique using biophysical, socioeconomic, and demographic variables were employed in selection. Nineteen administrative units were selected in Nigeria where the intervention project could be implemented.

Keywords: Cocoa, GIS, Land Suitability, Multi-Criteria, Nigeria, Sustainable Development

INTRODUCTION

Cocoa (*Theobroma cacao*) is one of the most important perennial crops worldwide, with an estimated world production of 2.8 million tonnes (t) in 2002 (Food and Agriculture Organization [FAO], 2003). It is especially a most significant crop in West Africa where it occupies between 5 and 6 million ha in the coastal humid zone. Nearly 70% of the world cocoa supply is produced in West Africa (International Cocoa Organization [ICCO], 2010), 90% of which is grown on nearly 2 million small family farms, the majority with land holdings of 2 ha or less. It is estimated that at least 16 million people depend on cocoa for the majority of their cash income (International Institute of Tropical Agriculture [IITA], 2005a).

The average cocoa farming family in West Africa earns US$100 per person per year from cocoa (IITA, 2002; ICCO, 2007). The long-term social and economic well-being of these families and their communities depends upon the viability and sustainability of the West African cocoa sector. The sector is also vital to national economies with cocoa among the top three agricultural export products in each target country (Bastide & Perret, 2007). To ensure this, cocoa farming needs to become a profitable, income-generating profession that allows farmers, both women and men, to provide adequately for their families.

West African cocoa farmers face numerous challenges such as production and marketing inefficiencies as well as stagnant technological development. For instance, the majority of farmers sell their cocoa individually, a few bags at a time, to itinerant buyers without access to market information and this reduces their earnings relative to the market price.

In Nigeria, like the rest of West Africa, cocoa cultivation has witnessed significant changes in the last few decades due to factors such as variations in international demand, prices, and policy measures implemented by both the Federal and State governments (Cocoa Research Institute of Nigeria [CRIN], 2008). Cocoa was the most important agricultural export crop during the 1960-1970 period, earning a significant percentage of the foreign exchange income (Mustapha, 1999). The production increased gradually to a maximum of 308,000 t in 1970-1971 but dropped drastically to 110,000 t in 1990-1991. This was because of the diversion of government policy during the First, Second and Third Development plan periods (1970-1985) into petroleum and food production, and the poor price policy of the Marketing Board which resulted in the abandonment of cocoa farms (Mustapha, 1999).

In view of the undulating nature of the cocoa sector as a result of factors such as socio-economics, government policies, management practices, and declining natural resources (Bastide & Perret, 2007), it is necessary to seek a viable and sustainable cocoa production system in West Africa.

It is therefore important to carefully target the program's intervention in the cocoa sector of the West and Central African countries to ensure maximum program impact and conformity with national agricultural sector priorities. This will include the identification and selection of communities through systematic spatial targeting that meets multiple criteria. World Cocoa Foundation (WCF) has asked IITA Sustainable Tree Crop Program (STCP) to lead the process of site selection, building on its recent experience in conducting a similar multi-criteria and multi-stage systematic selection of target districts/communities for a multi-sectoral project in Cote d'Ivoire and Ghana in collaboration with local expertise.

In view of the complexity involved in the process of decision making, the method of multi-criteria land evaluation (MCE) is adopted in this study (Khoi & Murayama, 2010). MCE is the process of determining the fitness of a given parcel of land for a defined use (Stainer, 1991). An MCE involves the selection of the biophysical or socio-economic factors, or both, of an area; the combination of the selected factors with the decision-makers preferences allows one to create a composite suitability index (Sui, 1993). The MCE is an effective tool for multiple criteria decision-making issues (Malcewski, 2006). The purpose of the MCE is to investigate a number of choice possibilities in the light of multiple criteria and multiple objectives (Cover, 1991). Integration of the MCE and GIS (GIS-MCE) can help land-use planners and managers to improve decision-making processes (Malcewski, 1999). GIS allows the computation of assessment factors and MCE aggregates them into a land suitability index.

This paper aims to identify potential land suitability for cocoa, based not only on biophysical but also socioeconomic and infrastructural variables in accordance with the framework for land evaluation developed by the Food Agriculture Organization of the United Nations (FAO, 1976) using GIS, a decision support system

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