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# Drivers of arable production stagnation and policies to combat stagnation based on a systematic analysis of drivers and agents of arable production in Cameroon

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ABSTRACT

Reducing arable production stagnation in Cameroon is crucial because there are more and more people being faced with problems of food insecurity. As population growth increases, the pressure on food resources increases and if the drivers of arable production stagnation are not properly verified, inappropriate measures may be used and a vicious cycle can too easily be created. Current international efforts to reduce arable production stagnation should be associated with feasible, acceptable, efficient and effective country-specific policies. This study therefore attempts to analyse the drivers of arable production stagnation and the possible policies that can improve the arable production situation. The study uses a systematic approach which begins by identifying the drivers that are specific to Cameroon. The drivers are identified using the multiple linear regression approach. The other phases of our systematic approach are: a spatial analysis, a socio-economic analysis and the identification of specific policies to combat stagnation based on all the previous phases. This study demonstrates that population growth, forest area dynamics and arable production and permanant cropland are the main drivers of arable production stagnation in Cameroon. Also, it is argued that the best way to propose policies to combat arable production stagnation is by using the drivers that are responsible for the stagnation, in each country, this can be different. Some of the policies that are specific to the drivers are: bottom up population participation, financial mechanisms, diversification of livelihoods, renewable energies, penalties and pilot agro-ecology projects.

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## Introduction

Due to increasing global population, changes in dietary needs and an ever rising demand for green energies, global food supply has to be increased to match the current surges in global food demand. It has been estimated that there is currently a need for about a 70% increase in global food production (Schmidhuber and Tubiello, 2007). The global food production community is further challenged by the fact that patterns of land use change and or climate change are likely to render the needed projected food production targets unattainable (Schmidhuber and Tubiello, 2007; Battisti and Naylor, 2009). These polemics make food insecurity an urgent challenge that requires policy shifts and creative thinking at all scales.

Agriculture is very vital to mankind not just because people in all parts of the world need to be fed but because it also contributes on average about 50% to the GDP of the economies of most African countries (FAO and UNIDO, 2008). In most parts of sub-Saharan Africa, differences between actual production and projected needed arable production are often very wide because many of the arable farms are under production for subsistence purposes (Lobell et al., 2009). These farmers are poorly equipped as they have mainly rudimentary tools such as hoes and cutlasses. They depend on environmentally unfriendly methods such as slash and burn and shifting cultivation. Their use of agro-ecology farm inputs such as manure, natural nutrient cycling techniques, organic fertilizers and machine scale production methods are further hindered by ignorance and the inability of the farmers to obtain these inputs (Negin et al., 2009; Denning et al., 2009; Bezner-Kerr et al., 2007; Snapp et al., 2010; Epule et al., 2012a,b,c).

In Cameroon, the majority of farmers are small scale farmers and they are responsible for the production of 80% of the country's food crop. In the face of a rising population, low environmentally sustainable farm inputs, wide scale land use changes in the forestry

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sector and rising rainfall, crop production seems to be stagnant even as projected needed crop production is often above actual production (Beddington, 2010; Epule et al., 2012a,b,c). A study carried out in the drier north of Cameroon by Epule et al. (2012c) argued that between 1975 and 2005 there were 20 years during which actual cereal production was persistently below projected needed cereal production. Also, Yengoh (2012) focused on determining the effects of common land management practices and socio-cultural properties of small scale farmers that are associated with differences in crop yields. Epule et al. (2012a) verified vulnerability of experiencing food shortages along gender and poverty lines. Therefore, the hypothesis that arable crop production in Cameroon is stagnant is evident as seen in these studies cited above. However, the question of, what are the drivers of this stagnation and what policies could be used to combat such stagnation at a national scale in Cameroon, has not yet been delved into. Frequently, the task of saying this or that driver is responsible for a given outcome is daunting because often, land use change processes are fuelled by multiple stressors and this is the case of most food insecure regions (Folefack, 2008; Misselhorn et al., 2012). Presently, most policies to curb land use problems such as arable crop stagnation and deforestation in Cameroon are based on generalisations of what has been done elsewhere in Africa with little success (Denning et al., 2009; Armenteras et al., 2010).

This study employs a systematic approach in analysing the drivers of arable production and uses the most important drivers to determine case specific policies that can curb arable production stagnation in Cameroon. Unlike studies that are based on generalizations, the systematic approach is case specific as it considers only the specific realities of the country in question. The systematic approach was first used by Muller et al. (2013) and Epule et al. (2014) in proposing policies that could be used to curb deforestation in Bolivia and Cameroon respectively. To the best of our knowledge, this current study is perhaps only the third to use the approach globally, the second in Africa and this is the first time this approach has ever been used in proposing policies to curb crop production stagnation in the world. Our intention is therefore to use this study to identify, and verify the drivers of arable/crop production in Cameroon and to use this information to propose policies to curb arable production stagnation in Cameroon.

## Study area and methods

### *Study area*

Cameroon is located between latitude 2° N and 13° N of the equator. Longitudinally, the country is found between longitude 8° E and 15° E of the Greenwich meridian (Molua, 2006). Cameroon has a total surface area of 475,400 km$^2$ and a population of over 20.3 million people. Agriculture employs about 70–80% of the country's population (Mundex Dataset, 2012; CIA, 2014; Carr et al., 2006). Cameroon has an equatorial climate in the south with rainfall levels of between 1500 mm and 2000 mm per year and with an average annual temperature of about 25 °C. The country has a tropical climate in the north with annual rainfall amounts dropping to as low as 400 mm around the Lake Chad basin region and equally high temperatures of about 28 °C (Molua, 2006).

### *Data acquisition*

To verify the key drivers of the arable production per capita index in Cameroon, 12 time series data variables spanning the period 1961–2000 were collected from various sources. Specifically, rainfall data were culled from the climate database of the School of Geography and Environment at Oxford University and the United Nations Development Program (www.country-profiles.geog.ox.ac.uk, McSweeney et al., 2010a,b, and UNDP, 2014). The population data were collected from the World Bank, World Development Indicators database (www.google.com/publicdata). The following variables: arable production per capita index, arable production and permanent cropland, cattle stock, $CO_2$ emissions, fuel wood, forest area, trade in forest products and logging, fertilizers, tractors-import value, tractors-quantity imported were taken from the Food and Agricultural Organization's database (www.faostat.org, FAO, 2014) and the World Resources Institute's database (www.cait.wri.org, WRI, 2014).

In addition to the time series data on the drivers of arable production noted above, data on the socio-economic context and the spatial context of arable production per capita index in Cameroon were obtained from various official reports and peer review papers that have been presented in the results and discussion sections in this paper under the themes socio-economic and spatial context of the arable production per capita index. The maps for the spatial analysis were taken from Epule et al. (2014); http://www.wri.org/map/, www.bestcountryreports.com and http://www.fao.org/ag/.

### *Data analyses*

#### *The modified systematic approach*

The systematic approach was first used by Muller et al. (2013) when they examined specific policies that could be used to combat deforestation in Bolivia based on the key drivers of deforestation. To the best of our knowledge, the second use of the systematic approach was by Epule et al. (2014) when they also recommended specific deforestation reduction policies based on the key drivers of deforestation in Cameroon. The systematic approach is therefore a method that can be used in suggesting solutions to various land use problems. This current study modifies the existing frameworks and uses the approach to suggest various specific policies that can be used to reduce arable production stagnation in Cameroon. The stages in the modified systematic approach (MSA) proposed by this study are as follows (Fig. 1).

Stage one: This phase of the MSA is most likely the most important phase. This is because it involves an analysis that ends up defining specific drivers responsible for the problem under study. In the case of this current study, a multiple linear regression approach (MLR) is used to analyse the key drivers of arable production per capita index stagnation in Cameroon using SPSS. The equations used in fitting the initial (IM) and the final optimised (FOM) models are as follows:

$$Y_{\mathrm{APIM}} = \alpha_0 + \alpha_1 X_{Fa} + \alpha_2 X_{Apcl} + \alpha_3 X_P + \alpha_4 X_R + \alpha_5 X_{Cs} + \alpha_6 X_{Fw} + \alpha_7 X_{Tf} + \alpha_8 X_{\mathrm{CO_2}} + \alpha_9 X_{Ativ} + \alpha_{10} X_{Atqi} + \alpha_{11} X_F \quad (1)$$

$$Y_{\mathrm{APFOM}} = \alpha_0 + \alpha_1 X_{Fa} + \alpha_2 X_{Apcl} + \alpha_3 X_P \quad (2)$$

where $Y_{\mathrm{APIM}}$ is the arable production per capita index of the IM (dependent variable),$Y_{\mathrm{APFOM}}$ is the arable production per capita index of the FOM (dependent variable), $\alpha_0$ is the regression intercept, $\alpha_0 X_{Fa}$ is the partial regression coefficient and forest area, $\alpha_2 X_{Apcl}$ is the partial regression coefficient and the arable production and permanent cropland, $\alpha_3 X_P$ is the partial regression coefficient and population, $\alpha_4 X_R$ is the partial regression coefficient and rainfall, $\alpha_5 X_{Cs}$ is the partial regression coefficient and cattle stock, $\alpha_6 X_{Fw}$ is the partial regression coefficient and fuel wood, $\alpha_7 X_{Tf}$ is the partial regression coefficient and trade in forest products and logging, $\alpha_8 X_{\mathrm{CO_2}}$ is the partial regression coefficient and $CO_2$ emissions from land use, $\alpha_9 X_{Ativ}$ is the partial regression coefficient and agricultural tractors-import value, $\alpha_{10} X_{Atqi}$ is the partial

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