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State and outlook of land use and agriculture sector in Machinga district, Malawi

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ABSTRACT
Agriculture is the main economic activity for Malawi where people depend on natural resources like fertile soils. Thus, Government recognizes the need to conserve natural resources in its development plans. Following the adoption of the Decentralization Policy and the Local Government Act of 1998, such responsibility mainly rests with District Councils. This paper provides information about the environmental situation of the land and agriculture sector for Machinga district; and also demonstrates the outlook of the sector by the year 2020. The study used data from Machinga District Agriculture Development Office and the 2012 Machinga District State of Environment and Outlook Report. Basing on governance and economic growth, the districts future has four possible scenarios, with *Ikwenda Chenene* scenario being preferred. To achieve this scenario there is need for concerted efforts for the conservation and management of natural resources by all stakeholders. This case study of Machinga district provides useful insights for Malawi and indeed several other communities in geographical locations with similar environment challenges.

Key words: *Ikwenda Chenene*, land degradation, Machinga, Malawi

RÉSUMÉ
L'agriculture est la principale activité économique du Malawi où les populations dépendent des ressources naturelles telles que les sols fertiles. Par conséquent, le gouvernement reconnaît la nécessité de conserver les ressources naturelles dans ses plans de développement. Après l'adoption de la politique de décentralisation et du décret du gouvernement local datant de 1998, cette responsabilité incombe principalement aux conseils communaux. Ce document fournit des informations sur la situation environnementale du secteur agricole et des terres de la commune de Machinga; et démontre également les perspectives du secteur d'ici l'an 2020. L'étude a utilisé les données du Bureau de développement agricole de la commune de Machinga et celles du Rapport datant de 2012 sur l'état de l'Environnement de Machinga. En se basant sur la gouvernance et la croissance économique, l'avenir des districts a quatre scénarios possibles, celui d'Ikwenda *Chenene*, étant le plus préférable. Pour réaliser ce scénario, il est nécessaire de fournir des efforts concertés pour la conservation et la gestion des ressources naturelles par tous les acteurs. Cette étude de cas de la commune de Machinga fournit des indications utiles pour le Malawi et plusieurs autres communautés situées dans des milieux géographiques ayant des problèmes d'environnement similaires.

Mots clés: *Ikwenda Chenene*, dégradation des terres, Machinga, Malawi

INTRODUCTION
The role played by the environment and natural resources in the economy and livelihood support for an agriculture reliant country such as Malawi cannot be over emphasised (Atkinson *et al*., 2012). One such natural resource is the agriculture land that is characterised by fertile soils and abundant water. The agriculture sector is the main economic activity in all the districts of Malawi (GoM, 2008). Following the adoption of the Decentralization Policy and the Local Government Act of 1998, the GoM has devolved certain political, social and fiscal powers to local authorities whose responsibility is, among others, to promote economic development through formulation and execution of District Development Plans (DDPs) (GoM, 2011a). Thus Government recognises the need to conserve natural resources including agricultural land in all its development plans; and to ensure this, environmental issues are constantly reflected in the DDPs. To ensure this district councils are mandated

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by the Environmental Management Act (1996) to produce a District State of Environment and Outlook Report (DSEOR) every two years (GoM, 2012).

The DSEOR is a document that reports on the state of the environment. It acts as a monitoring tool that captures all environmental data and analyses the conditions and trends in the environment (GoM, 2012). The DSEOR is used by all stakeholders in the district for programming and implementation of their activities so that strides are made in mitigating environmental degradation and, as such, improve people's livelihoods. There is, however, limited use of the DSEOR beyond environmental concerns. This paper therefore intended to demonstrate the value of the DSEOR and shows how the environmental situation links to land and agriculture sector using Machinga district, located south of Malawi as the case study. The paper shows the link between environmental sector and the 2012 DSEOR for Machinga district that used environmental scenarios concept as a way of environmental reporting. Projections for 2020, based on the identified environmental drivers are discussed.

METHODOLOGY AND APPROACHES

The state of land use and agriculture development in Machinga was described by analysing the quarterly reports, for the period of July 2005 to June 2011. These reports were obtained from the Machinga District Agriculture Development Office (DADO). From the reports, data were obtained to determine the trend as well as the state of this sector. The Driver-Pressure–State-Impact-Response (DPSIR) framework was used in the development process of the Machinga DSEOR. The framework highlights the cause-effect linkages between human and natural actions (UNEP, 2008).

Using the drivers for environmental changes as observed from all the sectors in the district, an exploration of the future of Machinga District was used to build scenarios for the district. This scenario concept was used to illustrate possible alternatives of how Machinga would look like in the future, based on current trends and actions that influence the environment and development. The purpose of building scenarios in environmental reporting is to stimulate positive action by painting a positive future that can result from such actions. At the same time, negative scenarios serve to deter negative actions towards the environment by painting a negative outlook of the future with a view to facilitate remedial actions.

The scenarios for Machinga district were developed using a participatory scenario-building process where all stakeholders were involved to explore the future of the environment in the district. This was done at a workshop which comprised members from the District Environment Sub-Committee (DESC); the District Executive Committee (DEC) which is made up of heads of all government sectors and NGO representatives in the district; and the District Consultative Committee which is made up of Members of Parliament of the Government of Malawi and Traditional Authorities.

FINDINGS AND LESSONS

Crop production

Intercropping is the main cropping pattern practised in the district with maize (*Zea mays* L.) as the dorminant crop and it is inter-planted with crops such as cassava (Manihot *esculenta* Crantz), groundnuts (*Arachis hypogea)*, pigeon peas (*Cajanus cajan* L.), cowpeas (*Vigna unguiculata* L.), dorricus beans (*Dolichus lablab*), mucuna (*Mucuna pruriens*), millet (*Eleusine coracana* (L.) Gaertn) and beans (*Phaseolus vulgaris*). Production of local varieties is declining due to farmers shift to improved varieties being made available through safety net programmes. It is estimated that 85% of the farmers use improved maize varieties. Furthermore, adoption of other new technologies is estimated to be lower than 40% due to limited financial resources required for purchase of inputs such as fertilizers and seeds. Crop production in the district has suffered due to erratic rainfall regimes, poor soil fertility and pests and diseases.

Livestock production

Livestock in the district include cattle, sheep, goats, pigs, rabbits and chickens. Chickens are favoured class of livestock among farmers. The ratio of head of livestock over farm family is 0.05 for cattle and 0.6 for goats. Most cattle are held on communal land and most herds have a size of 12 to 20 cattle with a maximum of around 45. Animal grazing is done on grasslands and along the banks intensively. Animals are kept in closed kraals during the night and out during the day to allow free range feeding. Except in estates and commercial farms there is hardly stall feeding in the district. Animal production especially in cattle, goats and sheep is decreasing due to shortage of grazing land and diseases. Intensive grazing on communal land has resulted into most areas being left bare and exposed to rains. Most areas have been eroded leaving very few areas suitable for farming compounding the problem of shortage of grazing land.

Land use pattern

There is heavy land pressure in some areas due to overpopulation. The array of estates in the district leaves out very little opportunities for most farm families to access new land therefore, customary land absorbs the pressure. The district has a total of 163 estates covering 9135 hectares located in various Extension Planning Areas, with 128 estates having a total of 7801 hectares. Despite a lot of estates being dormant they

maintain their legal status and smallholder farmers have hardly accessed this land. Currently land holding size is 0.6 ha^{-1} farm family and maize production dominates on these agriculture lands. There is no idle land amongst the smallholders and rotation is insignificantly being practised.

Status of soil conservation/fertility mitigation measures

A number of technologies are being promoted and implemented in the district. These technologies are aimed at conserving soil or land resources and retaining and improving soil fertility. In soil and water conservation the district currently follows the communal catchment's conservation approach and there are over 64 catchments implementing various technologies with an average of 400 farmers in each catchment.

Irrigation development

Machinga district has a lot of potential, which is being fully exploited into development of irrigation farming. Apart from the streams found all over the district, lakes such as Chilwa and Chiuta have flood plains, which necessitate production of crops through irrigation throughout the year. The area along the Shire River also has a lot of potential for irrigation development. The introduction of winter targeted input programmes, new technologies such as treadle pumps and a heavy campaign in irrigation have not only increased irrigated land but have also increased abstraction levels of water.

Agricultural extension services

The main extension messages are soil and water conservation, improvement of soil fertility, crop production and livestock production. The focus of all the messages is mainly on food security and protection of the production base. These messages are disseminated in various ways however, the common methods include campaigns, demonstrations, trials and field days, which are facilitated by Agriculture Extension Development Officers (AEDOs). The district has a shortage of extension workers as there were 87 frontline extension workers pegging the extension worker to farm family's ratio at 1:2909.This is far from the UNDP recommended ratio of 1: 750 and the GoM ratio of 1: 800. In addition to their insufficient numbers there is a knowledge gap amongst existing extension workers due to the wide scope of areas in which they are expected to specialise. Except in few cases, most extension workers do not have bicycles to use when discharging their duties and this makes the problem worse.

Threats to land use and agricultural production

Soil erosion and loss of soil fertility

Soil erosion occurring in the district has resulted into significant reduction of yields and formation of gullies and floods. The grazing lands in the district are all punctuated with rills and, to some extent, gullies. Problems of erosion in the district have been accelerated by practices such as cultivation on steep slopes, river beds and river banks; poor cultivation practices; overgrazing; and monocroping.

Population density

Population density continues to grow although the land size remains the same. The increased population density over the years has resulted in land pressure for agricultural production. The situation has forced farmers to cultivate in marginal areas such as river banks and hilly areas leading to land degradation, river siltation, deforestation and loss of soil fertility.

Table 1: Soil fertility improvement and soil conservation technologies

Technology	Participation and adoption by farmers		
	Ha/length (km)	Farmers Involved	Percentage of farmers involved
Contour ridging	9345	3456	1.6
Ridge realignment	920.5	3456	1.6
Raised footpaths and boundaries	794	3020	1.4
Gully reclamation	9500	10801	5.1
Vertiver hedgerow planting	96.4	482	0.2
Under sowing	318	1590	0.75
Improved fallow	21	210	0.1
Mixed intercropping	70	400	0.19
Systematic interplanting	756	1890	0.9
Incorporation of crop residues	1050	2625	1.2
Compost manure application	60,000	20000	9.5
Stream bank protection	20	600	0.29
Conservation Agriculture	63.59	384	0.18

Climate shocks

Machinga district experiences climatic shocks which in turn affects the agricultural production. These shocks include: Floods and strong winds which sweep away crop fields, and as an adaptive measure farmers are advised to practice irrigation farming; but there are also erratic rains and unpredictable rainfall patterns such as those that have been experienced in the district during the 2011/2012 growing season.

Exploring Machinga's possible futures and their implications to land use and agriculture

The 2012 Machinga DSEOR used the DPSIR framework to identify environmental drivers in the district. These drivers refer to the overarching macro-level activities which apply pressure on the environment. The future of Machinga's environment is expected to depend on how these drivers behave now and in the future. According to the DPSIR framework, understanding such drivers in the district assists in understanding the main forces driving environmental change. Through the process, the two main drivers identified to be critically uncertain were governance of environment and natural resources and economic growth, which were drivers that responded to poverty levels in the district. Other drivers identified included demography, environmental change, technology availability, cultural beliefs and religion.

Governance and economic drivers were then used to build four possible futures (scenarios), shown in Figure 1, for Machinga district by the year 2020 depending on the choices that could be presently made. The resulting scenarios were assigned local names, in Yao, to attract the interest of the target audience and also contextualize the issues to the rural population.

The future of Machinga district is described using four scenarios namely *Ikwenda Chenene, Jwachangamu, Mwayiyoyo* and *Icholowene*. These scenarios describe what the district might become in 2020 depending on how current actions will unfold. The time horizon is aligned with Malawi's vision 2020, hence the choice for the year 2020. The following is a description of the possible scenarios for Machinga district and how they may affect the state of Land Use and Agriculture in the district. This scenario mapping can be extrapolated as contextualized to other locations within Malawi and elsewhere. As indicated in scenario mapping a tool for capturing a wide range of possibilities. By identifying basic trends and posibilities, it is possible to construct a series of scenarios (Schoemaker, 1995; Bowman, 2016)

Scenario 1: "*Ikwenda Chenene*"

Ikwenda Chenene scenario describes a situation where there is positive economic growth and good environmental governance in Machinga district. This scenario tells that for the economy of the district to grow, there is need to utilize natural resources and the environment sustainably. Consequently, when there is sustainable utilization of resources it will also result in the districts sustainable development and people's livelihoods will be promoted. Crop production from agriculture increases and living standards of people improve. This will be due to communities adopting appropriate farming technologies and improved soil fertility.

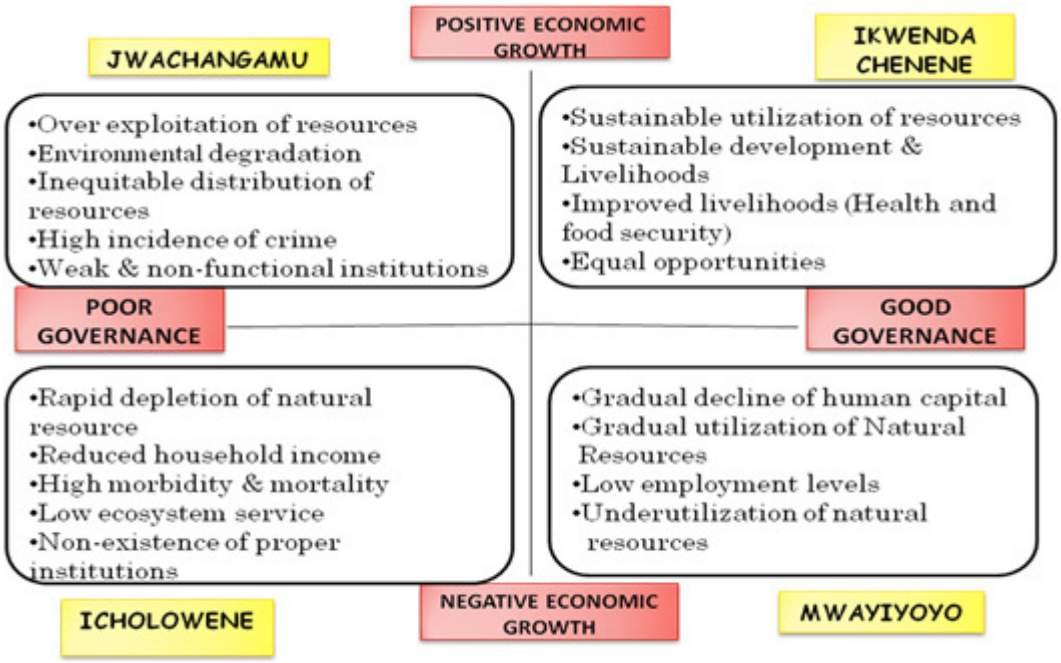

Figure 1: Diagram showing four possible scenarios for Machinga District (sourced from GoM, 2012)

Scenario 2: *"Jwachangamu"*

Jwachangamu describes a scenario where there is positive economic development while environmental governance is low. In this case, the resources are available to those who have finances. There is inequitable distribution of resources and as such, the gap between the rich and the poor widens. Ineffective institutional mechanisms fail to promote sustainable farming practices, resulting in a loss of soil fertility and a decrease in soil production. This would lead to a decline in agricultural production hence food insecurity, poverty, and high prices of crops due to low supply.

Scenario 3: *"Mwayiyoyo"*

Mwayiyoyo scenario describes a situation where there is good environmental governance and low economic development. In Machinga district, people depend on natural resources for their income and as such in this scenario for the economy to grow there is a large dependence on natural resources. In this case, the economy would grow slowly, and there would be a gradual decline of human capital. Natural resources would be under-utilised and this could result in only a gradual decrease of the resources. There is active participation in soil and water conservation measures in the short term, but gradually declines over time.

Scenario 4: *"Icholowene"*

Icholowene is a scenario that describes a situation where there is low environmental governance and negative economic development. There are no institutions to govern the utilization of the resources. The economic status of people in the district is low with an increase in the wealth gap and natural resources provide the most readily available option for survival. In this scenario there is widespread land degradation and high level of food insecurity.

CONCLUSION AND RECOMMENDATIONS FOR ACTION

Machinga district's agricultural production has and continues to depend on natural resources. If the natural resources continue to become degraded or depleted, both short and long term food security and sustainable socio-economic growth would be seriously compromised. Therefore, in order to promote agricultural productivity and sustainable management of land resources to achieve food security, increased incomes and ensure sustainable socio-economic growth and development, Machinga DADO has a big role to play. There is need for concerted efforts to be made for the conservation and management of land resources by the private sector, Non Governmental Organizations (NGOs), Community Based Organizations (CBOs) and local communities. Since poor governance will always be associated with degradation as well as other negative futures for the resource base even in the presence of positive economic growth, other specific recommendations include increasing the number of extension workers; intensifying training of lead farmers to help disseminate extension messages; use of improved crop varieties; formation of Cooperatives and Associations for small holder farmers to ensure effective marketing of agricultural produce; educating farmers on the need for them to develop a sense of ownership of agricultural programmes to ensure sustainability; instituting and implementing measures to curb cultivation on marginal lands in liaison with community leaders; and intensifying soil fertility improvement measures to increase crop production per unit area of land. There are issues that are on the Government of Malawi score-card but can be enhanced by scenario planning as observed by Shoemaker (1995) and Othman (2008). This will help on the governance aspect, as the communities and individual farmers in the long run will take responsibility for their own land and managing it; thereby, addressing the negative impact that may be brought by poor governance at district or national level.

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STATEMENT OF NO CONFLICT OF INTEREST

We the authors hereby declare that there are no competing interests in this publication.

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