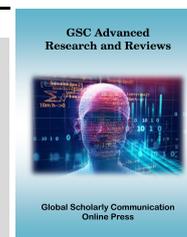




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(REVIEW ARTICLE)

Climate change, Sahel Savanna, gum arabic and biotechnology

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Abstract

The Sahel Savannah has witnessed increased aridity and expansion to the Sudan Savannah. This has affected livelihood including loss of water bodies. The natural tendency is to migrate or develop survival strategy. In both cases, there are severe environmental and social consequences. The gum arabic tree is well adapted to arid climate and the Sahel Savannah in particular. Biotechnology facilitates production of planting materials and genetic improvement, as gum arabic is amenable to application of biotechnology. This will facilitate response of gum arabic agroforestry to several aspects of the Sustainable Development Goals of the United Nations. The objective of this paper was to highlight the application of biotechnology to enhance the potential of gum arabic to address the degradation of the Sahel savannah.

Keywords: Climate Action; *Acacia senegal*; Biotechnology; Arid Land

1. Introduction

The Sustainable Development Goals (SDGs) of the United Nations succeeded the Millennium Development Goals and climate change is relevant to several aspects of the SDGs. In order of relevance and within the scope of agriculture, the climate change related aspects of the SDGs are Climate action (SDG 13), Life on land (SDG 15), Life below water (SDG 14), and Affordable and clean energy (SDG 7). These three areas also form significant part of climate smart agriculture advocated by the FAO [1].

In addressing the issues of climate change, the developing countries also characterized by low technology agriculture are considered vulnerable communities as their poor ability to adapt to changing weather conditions will be a major set-back to the global effort of adaption and mitigation of climate change. This will lead to serious humanitarian crises and high profile crimes, which is predicted, in a World Bank report, to attain severe levels by 2050 [2]. In the World Bank report, it was advised that government and funding agencies will need to focus on sustainable economic empowerment of the vulnerable communities as a preemptive measure to guide against migration and attendant social dislocation which is already witnessed especially in Africa [3, 4].

The Sahel Savanna was till the 1950s restricted to the extreme North Eastern Nigeria, but the entire extremes of North Central and North West have been taken over by the Sahel Savannah. This scenario is not different across the West African sudano-sahelian zone. This downward extension of the Sahel Savanna means loss of fertile land, loss of fodder, reduced crop and animal production. It is believed strongly that the farmer-herder clash is attributable to loss of fodder and hence the survival instinct to make use of what is available sometimes at the expense of the livelihood of others [5].

Some challenges are the southward trend of increased aridity associated with the increasing Sahel Savanna in Nigeria and the requirement of increased vegetation cover of the Sudano-Sahelian zone for sustainable food, fodder, environment and profit for the communities. Gum arabic (*Acacia senegal*) is an arid zone crop that can meet these

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multiple requirements [6]. The application of biotechnology is necessary to meet the target of gum arabic tree based climate action agroforestry. The objective of this paper therefore was to present the climate smart relevance of gum arabic and the application of biotechnology to enhance the production and productivity of gum arabic as an ecofriendly crop.

2. Gum arabic (*Acacia senegal*)

Gum arabic has the following advantages:

- i. Evergreen tree of the Sahel Savanna. It is green almost throughout the year providing forage for cattle, sheep and goats even during the dry season.
- ii. Source of foreign exchange: several countries with Sudan as typical case, derive their foreign exchange mainly from export of gum arabic.
- iii. Source of income: gum arabic is sometimes referred to as desert gold since it is an article of merchandise from farm-gate sale, through sorting/grading and sale by middlemen to international trade. It is a rich value chain.
- iv. Production of gum arabic powder as intermediate product between farm-gate and industrial use.
- v. Food value: it is a component of processed foods, confectionary and a number of canned/bottled drinks.
- vi. Medicinal value: as binder in many drugs.
- vii. Source of carbon sink: it is believed that the emergence of trees on the Geologic Time Scale has been a stabilizing factor in the concentration of atmospheric carbon. Marzocchi [7] and Omokhafa et al. [6] reported that in an era on the Geologic Time Scale, trees effectively reduced atmospheric carbon from 650ppm (v/v) to 100ppm (v/v). Gum arabic tree has the potential to reduce atmospheric carbon as suitable carbon sink. In recognition of the stable sinks provided by trees, Farglone et al [8] suggested land use allocation of grassland such that after making provision for urbanization, crop/livestock production and fodder, the balance will be planted to trees. In this regard, tree crop agroforestry was advocated, especially in developing countries to take advantage of tree culture and economic empowerment of resource-poor, low technology communities [9].

3. Biotechnology application in gum arabic

In view of the ecofriendly advantage of gum arabic tree, biotechnology can be used to improve the production and productivity of gum arabic as follows:

- i. Micropropagation: gum arabic is a tree crop producing seeds only once a year. This places restriction of the use of seeds for propagation. Micropropagation can enhance multiplication.
- ii. Multiplication of improved varieties: since the 1990s, new genetic materials of gum arabic are available rather than collection of unselected seeds from the wild. These improved materials require multiplication through tissue culture for faithful multiplication of improved genetic materials.
- iii. Molecular techniques for variety identification: this is necessary for identification of selected genotypes and to accelerate genetic improvement.

4. Suggested steps

- i. Collaboration among government agencies to pull resources together
- ii. Collaboration between government and non-governmental organisations in furtherance of private-public participation.
- iii. Collaboration between NGOs/private sector including local and external/international donor agencies

In this regard, government at various levels is expected to make a mark in climate action. Climate restoration agencies may mobilise funds to support investment in tree crop based agroforestry for multiple benefits of economic empowerment of resource-poor farmers (SDG 1), improved nutrition through agroforestry (SDG 2), carbon

sequestration (SDG 13), enhancement and conservation of biodiversity (SDG 15) under the Sustainable Development Goals of the UN [10]. Suitable proposals are necessary to attract support of government or donor agencies.

5. Conclusion

There are prospects of the use of gum arabic tree based agroforestry to respond to the challenges of climate change. This is necessary to avert humanitarian crises in low technology countries, as forecasted in a World Bank report. In this regard, gum arabic based climate smart agriculture is recommended. This will be facilitated by gum arabic biotechnology.

Compliance with ethical standards

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Disclosure of conflict of interest

Authors hereby state that there is no conflict of interest.

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