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Research Article

ADOPTABLE TECHNIQUE(S) FOR MANAGING GHANAIAN SALINE SOILS

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Abstract: Salinization of Ghanaian soils is on the rise. Organic matter application has not proved an effective and feasible technique for curbing this rise. Hence this paper seeks to review techniques that Ghana is using to manage its saline soils and further recommend a feasible, cost effective and beneficial technique for exhaustive research and possible adoption in the future. Halophytes appear to be the most feasible, cost effective and beneficial technique which could be adopted for the effective management of Ghanaian saline soils. But where halophytes are exotic, care must be taken to avoid competition with native species and allow preservation of agro-biodiversity.
Keywords: Halophytes, Organic matter, Salinity, Salinization,
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INTRODUCTION

Ghana's agriculture goes as far back as the 10th century when the first settlers from the old Mali Empire made entry (Stride and Ifeke, 1971) and now accounts for 33% of GDP (CIA World Fact book, 2011). Ghana with a total area of 23.8 million ha has only 13.6 million ha of arable land which is mostly rain-fed (Adiku *et al*., 1997) of which only 5.3 million ha is cultivated to produce sufficient food even at an annual population growth rate of 2.6% (FAO, 2000). With a growth in GDP of 5.2% in 2004 to 11.9% in 2008, agriculture's contribution to GDP is also expected to grow with it. Increased agriculture contribution cannot be realized without a conscious effort to grow crops year round. Year-round agricultural production is only achievable through increased irrigation. Nonetheless, irrigation is normally the major cause of salinization of soils (Rietz and Haynes, 2003). The more irrigation extends the more salinity of soils significantly alters (González-Núñez *et al.*, 2004 and Siadat, 1998). Therefore, it does not come as a surprise that from 1989 (Szabolcs in Choukr-Allah, 2004) to 2000 (FAO in Geressu and Gezaghegne, 2008), there has been an increase in the expanse of Ghanaian saline soils from 318,000ha to 790,000ha. This indicates that the techniques that Ghana is using for managing its saline soils are not very effective. Thus, the need to survey technique(s) that Ghana is using widely to manage its saline soils. Hence this paper seeks to survey technique(s) that Ghana is using widely to manage its saline soils and further recommend a most feasible, cost effective and beneficial technique for exploration and possible adoption in the future.

MATERIALS AND METHODS

Description of Ghana: Ghana is located on West Africa's Gulf of Guinea only a few degrees north of the Equator within latitude 5 degrees, 36 minutes north and longitude 0 degrees, 10 minutes east. Half of it lies less than 152 meters above sea level with the highest point being 883 meters. Its 537-kilometer coastline is mostly a low, sandy shore backed by plains & scrub and intersected by several rivers and streams. Its eastern coastal belt is warm and comparatively dry; the southwest corner, hot and humid; and the north, hot and dry. Southern Ghana experiences two distinct rainy seasons in May/June and August/September while northern Ghana experiences one distinct rainy season which starts April/May and ends September/October. In January and February, a dry northeasterly wind (the Harmattan) blows into Ghana. Ghana's annual rainfall averages < 750 to > 2000 mm. Its temperature varies slightly annually and daily with minimum temperature around 23°C (Runge-Metzger, 1993).

Saline Areas of Ghana: Majority of Ghana's saline soils occurs within the Coastal Savanna Agro-Ecological Zone of the southeastern corner. In this zone lies the coastal scrub, savannah and mangrove swamp of the Lower Volta Basin in the Greater Accra and Volta Regions within Accra-Ho-Keta Plains. Soils in these areas are highly salty, intolerable to crops, hydromorphic, heavy textured and poor in nutrients. Impenetrable sodium-saturated pan occurs in some of these soils (Agawtaw series) on the uplands. With only 760 mm of unreliable annual rainfall and high potential evapo-transpiration, there is a high water-salt imbalance in the Plains (FAO, 2000).

Natural Sources of Salinity in Ghanaian Soils: Salinity of Ghanaian soils basically originates from the seas, native rocks or artesian waters. On the coasts of Ghana, the process of evaporation could bring saline ground water from shallow water tables to the surface by capillary movement, leading to strong soil salinization. High and constant temperatures, low relative humidity and constant high wind velocity of the Plains are important factors in promoting upward salt movement into the exploitable volume of soils. Soils have become saline mostly because of seawater intrusion and inundation on low-lying tidal flats and flood Plains or from soils sprays blown overland from lagoons. Weathering of native rocks containing sodium minerals such as feldspars and amphiboles produces soluble sodium salts of carbonates, bicarbonates, sulfates, silicates and chlorides (FAO, 2000 and Aubert, 1983).

Characteristics of Ghanaian Saline Soils: 200,000ha and 118,000ha of Ghana's soils are Solonchaks and Alkaline respectively (Szabolcs, 1989) while 70, 000 ha and 600, 000 ha are Arenosols and Solonetzs respectively (FAO, 2000). Solonchaks (marine-originating) show decreasing salinity with depth; extend steadily outwards from sea and may show a weakly developed salt crust or a horizon of pseudo-sand (very fine aggregate of saline-alkali clay) five to six centimeters thick on the surface. Solonchaks have cations of sodium or calcium-magnesium complex in combination with anions of chlorine or sulfur (*Aubert, 1983*).

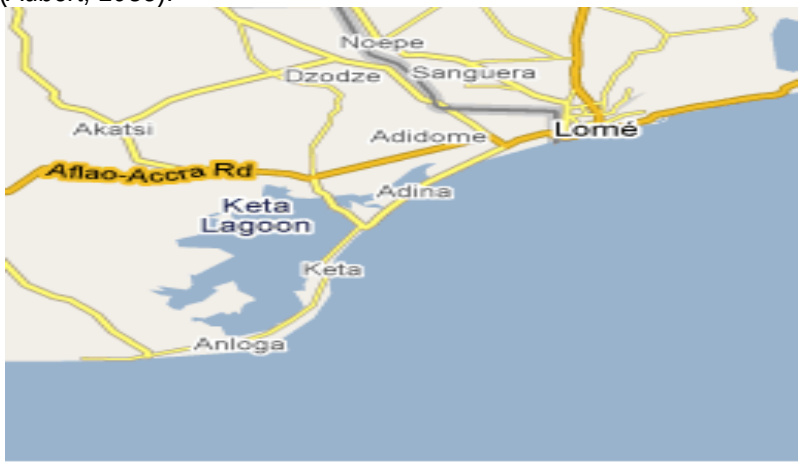

Plate 1: A map of particularly saline areas of Ghana.

Techniques in Use for Managing Saline Soils in Ghana: To identify technique(s) that Ghana is using to manage its saline soils, questionnaires were administered to one hundred rain-fed co-operatives-belonging small-scale multiple-crop local farmers from Anloga, Keta, Adina and Adidome (plate 1) along the coast in June 2008.

RESULTS AND DISCUSSION

Figure 1 shows the application of organic matter is the most widely used technique for managing saline soils in Ghana. Organic matter is widely used for managing Ghanaian saline soils because it is easily accessible, widely known and well documented. Lawson et al. (2004) investigated the effect of bark and Tenporon composts on the growth and nodulation of legumes under salt stress. Bark and Tenporon composts improved growth and nodulation of legumes alleviating the inhibitory effect of high concentrations of NaCl and Na_2SO_4. Nonetheless, organic residues are not readily available for use on saline soils in Ghana because they have many competing uses such as roofing, fuel, livestock feed and handicrafts depending on source (Fosu et al., 2004).

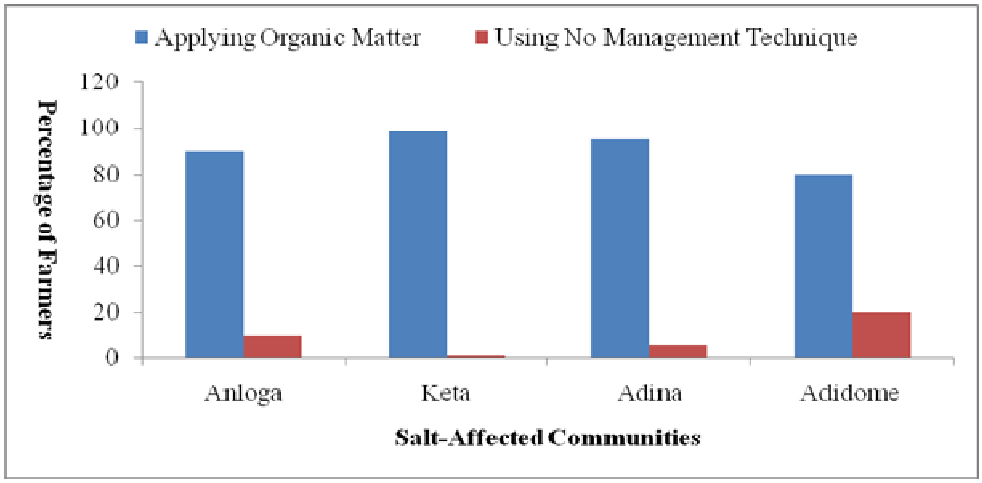

Figure 1: Technique(s) Used in Ghana to manage saline soils

Other Widely-Used Universal Techniques for Managing Saline Soils: Worldwide, saline soils are managed by drainage canals and field drainage systems; draining and planting; the use of salt-tolerant crops; leaching & drainage; anti-saline chemical application; improvement in genotypes of commonly grown field crops and halophytes (González-Núñez et al., 2004, Qureshi et al., 2007 and Choukr-Allah, 2004).

Techniques Adoptable for Managing Saline Soils in Ghana: As agriculture is the mainstay of Ghana, an alternative technique most likely to be adopted by Ghana for the management of its saline soils must be one that meet the broad needs of its developing economy. Ghana's industries would find immense use for fodder, forage, fuel, ornamentals and landscaping, essential oils, gums, resins, mulch, timber, pulp and fibre besides realizing the ultimate benefit of an effective technique for managing its saline soils to sequester a good amount of carbon. Worldwide, halophytes have proved to be excellent at delivering all of the above benefits and even more under highly stressing salt conditions (Aronson, 1985; O'Leary, 1988; Malcolm and Pol, 1986; Le Houérou, 1979, 1985 and 1986 and Choukr-Allah, 2004).

CONCLUSION

Though organic matter application for the management of saline soils is widely used in Ghana, it has not been successfully used to curb the rising salinization of soils because organic residues are not readily available. However, based on the needs of Ghanaian industries and the extent of research that has been done worldwide on the use of halophytes for managing saline soils, it appears halophytes would be the most feasible, cost effective and beneficial technique which could be adopted for the effective management of Ghanaian saline soils. Nonetheless, there is the need for exhaustive species, site and farmer-specific research to inform the kind of halophyte(s), native or exotic, to adopt. In adoption, care should be taken where halophytes are exotic so as to not introduce competition (aggressive colonizers) which cannot be matched by native species whose continued existence is essential to maintenance of agro-biodiversity.

REFERENCES

AAdiku, S. G. K., Dayananda, P. W. A., Rose, C. W.and Dowuona, G. N. N. (1997). An analysis of the within-season rainfall characteristics and simulation of the daily rainfall in two savanna zones in Ghana.Agricultural and Forest Meteorology.Vol 86. DOI: 10.1016/S0168-1923(96)02414-8

Aronson, J. (1989). HALOPH a Data Base of Salt Tolerant Plants of the World. Office of arid land studies, the Universityof Arizona, Tuscon, Arizona, USA.

Aubert, G. (1983). Map of Salty Soils of Africa.Office de la Recherche Scientifique et Technique Outre-Mer, Bondy, France. O.R.S.T.O.M. Fonds Documentaire. No. 3884. Cote B

Central Intelligence Agency World Factbook, (2011). http://www.theodora.com/wfbcurrent/ghana/ghana_economy.html

Choukr-Allah, R. (1997).The Potential of Salt-Tolerant Plants for Utilization of Saline Water.Options Méditerranéennes, Sér.A /n031, 1997 Séminaires Méditerranéens. Institut Agronomique et Vétérinaire Hassan II Agadìr, Morocco

FAO. (2000). Global Network on Integrated Soil Management for Sustainable Use of Salt-affected Soils. CountrySpecific Salinity Issues– Ghana: FAO. http://www.fao.org/ag/agl/agll/spush/degrad.asp?country=ghana

Fosu, M., Kuhne R. F. and P.L.G. Vlek. (2004). Improving Yield in the Guinea Savannah Zone with Leguminous Cover Crops and KP Fertilization. Journal of Agronomy. 3 (2): 115-121. ISSN 1680-8207.

González-Núñez, L.M., Tóth, T. and García, D. (2004). Integrated Management for the Sustainable Use of Salt-Affected Soils in Cuba.Vol 20.Numero 040- Universidad Juarez Autonoma de Tabasco, Villahermosa, Mexico, pp. 85-102

Lawson, I.Y.D., Hayatsu, M. and Nioh, I. (2004).Effects of Compost Application on Growth and Nodulation of Kidney Bean, Soybean and AlfafaUnder Salt Stress.West African Journal of Applied Ecology.Vol. 5. Ecological Laboratory, University of Ghana, Legon

Le Houérou, H.N.(1979). Ressources and Potential of the Native Flora for Fodder and Sown Pastures Production in the Arid and Semi-Arid Zones of North Afiica. In: J.R. Goodin and D.K. Northington (eds). Arid Land Plant Resources, ICASALS, Texas Tech. Univ., Lubbock, TX, pp. 3 84-40

Le Houérou, H.N.(1985). Salt-Tolerant Plants of Economic Value in the Mediterranean Basin. Reclamation and Revegetation Research

Le Houérou, H.N.1986. Salt Tolerant Plant of Economic value in the Mediterranean Basin. Reclamation and Revegetation Research 5: 319-341.

Malcolm, C.V. and J.E. Pol. (1986).Grazing and management of saltl and shrubs. Journal of Agriculture Western Australia 27:59-63.

O'Leary, J.W.(1988). Saline Environments and Halophytic Crops, In E.E. Whitehead, C.F. Hutchinson, B.N. Timmerman and R.G. Varady (ed), Arid Lands, Today and Tomorrow, West view Press, Boulder, Colorado, pp 773

Qureshi, A. S., Qadir, M., Heydari, N., Turral, H. and Javadi, A. (2007).A Review of Management Strategies for Salt-Prone Land and Water Resources in Iran.Colombo, Sri Lanka: International WaterManagement Institute. 30p. (IWMI Working Paper 125)

Rietz, D.N. and Haynes, R.J. (2003).Effects of Irrigation-Induced Salinity and Sodicity on Soil Microbial Activity.Soil Biology and Biochemistry – Elsevier.DOI:10.1016/S0038-0717(03)00125-1

Runge-Metzger A, (1993).Farm Household Systems in Northern Ghana.pp 31–170in: Runge-Metzger A and Diehl L (eds) Farm household systems in Northern Ghana – a case study in farming systems oriented research for the development of improved crop production systems. Verlag Josef Margraf, Weikersheim, Germany.

Siadat, H. (1998). Iranian Agriculture and Salinity. Soil & Water Research Institute of Iran. http://www.unu.edu/env/workshops/iran-1/02-Siadat%20Paper.doc

Stride, G.T. and Ifeka, C. (1971). Peoples and Empires of West Africa: West Africa in history, Africana Publishing Company. 1000-1800.

Szabolcs, I. (1989).Salt-Affected Soils. CRP Press, Boca Raton, F.I