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CONTROVERSIAL ROLE OF THE *EUCALYPTUS* TREE SPECIES: A CHALLENGE ON GROUND WATER DEPLETION

Masimba Gwemende[1]

Mahusekwa Gvt High School Department of Agriculture and Crop Science, P Bag 3719, Marondera, Zimbabwe

[1]Ministry of Primary and Secondary Education, Harare, Zimbabwe

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***Abstract: Eucalyptus* trees, like any other forestry plants, play a pivotal role in sustaining the natural endowments of almost all bio – setups coupled with multi – economic benefits. An undisputable observatory survey made in some parts of Mashonaland East Province of Zimbabwe, manifests bio and economic benefits of the tree species, to include reclamation of waterlogged burdened arable lands, reclaiming gullies , reduction of open water source sedimentation and improvement of the general environmental outlook. Economically, the tree species nursed the nation through availing all by-products derived from it in particular the construction and the manufacturing industries. However, all benefits derived from the tree happened to be at a latent cost, which to date currently manifested its self through underground water depletion as evidenced by change of cropping patterns among farmers mostly the rural folk. Global campaigns in the upkeep of a health environment by tree establishment, attracted the Zimbabwean nationals into planting more trees dominated by the *eucalyptus* species, most of which in or along wetlands which to date has contributed to ground water sources depletion against high extraction costs. High extraction costs take cognisance of a situation where if people were to opt for borehole as an alternative measure. This study therefore ravels the tree species controversy with much inclination to socio economic rather than empirical evidence.**

***Keywords:* water depletion, *eucalyptus,* controversial, ground water, paradigm shift.**

I. INTRODUCTION

This study employed pragmatic world view coupled with mixed methodology design and research approach (Creswell, 2014). The main focus was on how the *eucalyptus* tree species impact ground water depletion. As the survey process progressed, it was noted that, a paradigm shift is needed in groundwater management, from technocratic approaches to use of collaborative, participatory knowledge systems. Groundwater users, technical specialists, scientists and policy makers need to work jointly with the support of facilitators, and backed by demonstration results, learning and communications. They should collaborate to align groundwater knowledge, governance reforms, economic incentives, investment and social organisation. Smith (2016), associates the tree's fast growth, adaptability to a wide range of environments and socio - economic roles it plays to its global support it has gained. Since 1980's International Monetary Fund (IMF) promoted tree plantations. In compliance to IMF's call most countries worldwide adapted to establishing plantations with the earth covered by forestry plantations which increased from 167 million to 277.9 million hectares from 1990 to 2015. Brazil, Argentina and Chile comprise the largest areas of forestry plantations in South America. Currently Brazil has about 7.8 million hectares of planted forests, mainly *eucalyptus* (5.7 million hectares) and *pinus* (1, 6) (Tiago Souza Mattos, 2019). As for the African region, forestry plantations were earmarked to meet increased demand for domestic industries, export, fuel wood and

charcoal, together with the demand for an array of non-wood products. Pressure has been exerted on natural forests as a result of urbanisation and above all human population growth. As such production levels are; 1.76 million in W. Africa, 0.15 in E. Africa, 0.05 in C. Africa and 2.2 million in Southern Africa (Chamshama and Nwonwu, 2004). While the above production levels were mainly inclined to meet economic targets, plantation forests could play ecological roles in buffering floods, increasing interception rates, decreasing surface runoff as well as contributing to an accumulation of soil organic matter (Bonnesoeur etal, 2019)

The purpose of this study is to alert farmers on the controversial impact paused by the *eucalyptus* tree species on ground water depletion, a phenomenon that seemed to be silent among the group of people and has led to diverting of the cropping programmes on certain lands as well as shifting farmers from old farming sites relocating themselves to new sites of favourable conditions. Targeted farmers in question seem to be a neglected group by most studies because of their farmland sizes and location. (Subsistence farmers) Most studies concentrated on big forestry plantations ignoring small forestry tree establishments (less than 1 hectare plantations).

Water depletion on ground water sources was mainly attributed to climate change, putting very little blame on other factors if not none at all except for experts in the area of hydrological studies. The study will demystify the dilemma of only associating ground water shortage to poor precipitation. Inclusion of this minority group in the study closes the gap left by most researchers.

Various studies based on forestry tree plantation concentrated much on the production side with less input on expatiating the negative impact paused by such plants in particular the *eucalyptus* species. Timberwatch Coalition and World Rainforest Movement (2016) concentrated on projects earmarked at exploiting all African patches with a potential to produce timber and to include countries falling within West, East, Central and Southern Africa. White etal (2916) consider *eucalyptus* as contributing to positive development through retention of soil in its natural state as well as providing wood-based products. Negatively however, note the trees as impacting the availability of underground water levels by excessively drawing it than what the soil should retain. Studies by Rotzer etal (2016) view forest trees as natural water balancing bodies regulated by climatic conditions variation in which losses can be restricted through stoma closure or emitted as stoma open and thus maintaining an uncompromised water balance. This Scientific view is shared with that of Braun etal (2004) where ground water levels are naturally regulated by forestry trees. Both studies indicate a reduction in underground water levels as plantations increase. The later studies associate reduction in underground water levels to short season water stresses in plants which force them to draw more water which under drought conditions is not compensated. Smith etal (2016) associate underground water depletion to more discharge than recharge activities and the underlying natural hydrological set ups and regard vegetation as contributing to the water recharging processes. Joshi and Palanisami (2011) regard *eucalyptus* tree species as one that has raised a lot of controversies. It has been adored worldwide due to it being a fast grower with disbursing and unswervingly supply industrial wood. The tree has been cheaply utilised to supply fuel wood, covering abandoned poor soil in arid and marginalised lands of the world. The essential roles of the tree have however, been engulfed by the negative impacts where it has evidently impaired growth of other plants through allelopathetic growth habits replacing other conventional forests as well exerting more thrust on food security. Its ability to utilise up to 90 litres of water per day depleting larger volumes of underground water has contributed much to the tree's loss of credibility which is the nerve centre of this study. This implies that continuous production of the tree species in drought threated regions would render the people into great food security risks.

II. STUDY METHODOLOGY

This study specifically used exploratory sequential mixed method approach where the researcher began with a qualitative research phase in exploring the views of 24 farmers selected from 52 Ward 20 villages of Cikomba District in the Mashonaland East province -Zimbabwe... The data was then analyzed, and the information used to build into a second, quantitative phase. The qualitative phase was used to construct the questionnaire instrument that best fits the sample under study (Creswell, 2014) The study used 3 ponds as a 3-year case study after prior observation of some water level changes in ponds and other areas that used to be marshy at certain times of the year but have totally changed as nearby eucalyptus tree canopy increased. The questionnaire contained the purpose of planting the tree, justification on the choice of the site; awareness on how the tree could impact ground water sources levels and views on action to take in getting rid of wrongly sited plantations. Concurrently observations were made to determine how the tree species impacted ground water levels. Questionnaire contents were schematised.

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III. RESULTS AND DISCUSSION

Table 1: Purpose of planting the eucalyptus tree

Purpose	Number	%
Poles and other home uses	7	29.2
Live fence	8	33.3
To drain excess water from own land	3	12.5
To economically utilise idle land	6	25
Totals	24	100

With reference to table 1, 33.3% the respondents planted trees around their cropping areas irregardless of where the farmland was situated and could not have been aware on how the trees could impact crop productivity which the trees later did as their canopies increased. 29% of the respondents aimed at establishing timber for general home use and tree establishment to them had to be anywhere as long as they managed to get timber for the intended purpose. 25% of those utilising idle land were also not site restrictive as they were targeting at open spaces. Draining excess water by 12.5% of the respondents was site specific on earmarking wetlands. Heterogeneous and egocentricity that existed among the respondents depicted how liberal the pattern of planting was, as evidenced randomised tree establishment.

Table 2: Justification on the choice of plantation site

Justification on the choice of the forestry plantation site	Number	%
To make the tree benefit from available moisture from wetland	10	41.7
To demarcate own farmland	8	33.3
The only available land for forestry plantation	6	25
Totals	24	100

Data in table depicts that the trees were planted in wetland constituting 41.7% of the respondents and the wetlands could be within the water course or near water sources where vegetable gardens could be located. 33.3 % of the demarcated farm land could be gardens near water sources (figure 1) at high water demanding *eucalyptus* trees which create a high water gradient and deplete underground water nearby. A 25% utilising of available land could in-discriminatorily included wetlands which have probabilities of being left out as unsuitably for cropping purposes and yet are an underground water source. Exposing *eucalyptus* to wetlands subjects the land to water depletion especially on sites with limited water supply as the case with the sites under study. Coining the results of the study to empirical findings by Joshi and Palasami (2011) where the tree said to draw as much as 90 litres of water per day. (Figure 2)

Table 3: Awareness on how *eucalyptus* could impact ground water sources

Awareness on the tree's impact on water depletion	Number	%
No knowledge of tree's high water demand	8	33.3
Linked water depletion to climate change and not to tree's high water demand	8	33.3
Not concerned because the site used was not a threat	4	16.7
Aware but no labour to remove the already grown trees	4	16.7
Totals	24	100

Table 3 reflects that 16.7% of the respondents were the only people who were aware that eucalyptus trees could deplete ground but could be the same people who did not plant trees on water depletion sites. 83.3% of the respondents could have wrongly sited their plantations (figure 1) due to ignorance and could be the group that could have benefited from the outcomes of the study.

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Table 4: Action to take on wrongly sited *eucalyptus* tree plantations.

Views of farmers	**Number**	**%**
To get rid of plantations outside one's field	4	16.7
Concerned with removal but face labour challenges	16	66.7
Support plantation existence to play economic and ecological roles.	4	16.7
Totals	24	100

Table 4 shows an 83.4% outweigh of those who felt the trees could remain on wrongly sited lands as long as they served anticipated social and economic roles constituted by 16.7%. The results could mean that, production of other basic crops outweighed benefits obtained from *eucalyptus* probably because economic benefits of the tree at small scale are not forthcoming.

Figure 1: Eucalyptus trees were planted as demarcating farm land behind the background and yet closer to the water source which is under threat of quick drying due to high water demand by eucalyptus trees nearby. The farmer even stopped the cropping programme on the land due to water shortage.

Figure 2: Eucalyptus trees above the water pond drew more water from the marshy area increasing the rate at which water is depleted from the pond

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Figure 3 shows a water depleted site, slightly behind the background water used to sustain for a longer period in the season before canopy development of the tree species which seemed to have drawn the water that used to seep through the underlying pervious parent rock...

IV. CONCLUSION

The advantages drawn from the study have showcased that;

- Commercial benefits derived from *eucalyptus* trees after manufacturing do not matter most at small scale production than what people could do without the tree.
- People's attitudes in the management of the water resource could change for the better.
- People could accept the tree be grown at commercially selected sites other than haphazard planting which tend to threaten underground water resource.
- Up to 90 litres of water discharged by the tree (Joshi and Palanisani 2011) in the dry season could be difficult to compensate under dry season conditions where rural people would need water most for watering their vegetable crops therefore its removal serves a lot of water.
- Small farm setups may not accommodate the production of the tree because once the tree colonises the area, reduction of space for basic crop production results aggravating famine and thus contributing to high social costs for governments.

In as much as the study has justified the need to discourage people from establishing eucalyptus trees in areas where land size and use might not permit, incorrect handling of the study outcomes might result in;

- Sedimentation of water sources due to complete removal of the tree where it could serve the purpose.
- Disruption of the hydrological cycle in areas which are naturally bare and a bit further from water sources where the tree could serve the purpose.
- Relocating the farmers threatened by depleted water sources in areas they were used to depend on available water could be a bit expensive as there is need to find alternatives like sinking costly boreholes for individual poor rural farmers.
- There are some challenges to convince people to get rid of their small plantations for the good of availing water for the farmer whose farming activities are situated at lower sites of the plantations.

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