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Knowledge Production Contest between Natural and Social Scientists with Regards to Land Degradation Assessment

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ABSTRACT

The paper interrogates the adequacy of natural scientific knowledge in the assessment of land degradation. On the one hand, it is argued that land is a biophysical resource; hence its degradation could be studied by only the natural scientists. On the other hand, the social scientists posited that land and its degradation could not be studied outside the cultural, historical and social context of the primary land users. Furthermore, the social scientists contend that knowledge production by natural science has been affected by political power, epistemological stances as well as insiders' or outsiders' culture and gender. Hence, natural scientific knowledge cannot be value free. Therefore, the continuous assessment of land degradation by only the natural scientists borders on social injustice in which there is the use of singular instead of plural perspective. The natural and social scientists discourse is elaborated on by the epistemologies of post-positivists and constructionists respectively. The paper concludes that although it is necessary to use natural scientific knowledge to assess land degradation, challenges posed by power relations, local knowledge as well as culture and gender make natural scientific knowledge insufficient for the purpose. Hence, the assessment of land degradation by natural scientific knowledge could be made good by incorporating social scientific knowledge.

Keywords

Land degradation, natural, social, scientific, knowledge, measurements, observation, culture, gender

INTRODCUTION

Research on land degradation has been concerned with improving on existing knowledge on the subject as well as finding solutions to the environmental challenge it poses. Signatories to the United Nations Convention to Combat Desertification (UNCCD) recognized the lack of information on nature, extent, severity, causes and remedial actions of land degradation. These countries expect the international scientific community to provide data and deepen knowledge on land degradation [1]. Knowledge is briefly defined as justified true belief [2]. Scientific knowledge is knowledge produced by science where science is a methodological process as involving how knowledge may be produced. Henceforward, scientific knowledge is knowledge that produces facts or fact-like statement which emerges from scientific activity emanating from work of scientific community [3].

Land degradation has been variously defined as:

"Reduction or loss of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical and biological or economic properties of soil; and (iii) long-term loss of natural vegetation" [4].

"The reduction or loss of the biological or economic productivity of [land]" [5:1].

"The reduction in the capacity of the land to provide ecosystem goods and services and assure its functions over a period of time for its beneficiaries" [6:31].

"The long-term loss of ecosystem function and productivity caused by disturbances from which land cannot recover unaided" [7:223].

"A change to land that makes it less useful for human beings" [8:49].

"A composite term; it has no single readily-identifiable feature, but instead describes how one or more of the land resources (soil, water, vegetation, rocks, air,

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climate, relief) has changed for the worse" [9:7].

"The progressive loss of the intrinsic or natural quality of the land" [10:18].

The various definitions of land degradation denote that the land is losing or reducing in some important qualities thereby changing from better to worse which makes the land incapable of rendering its usual functions to the people that depend on the land for sustenance.

The paper is divided into two major parts. It views scientific knowledge in two broad lens of post-positivist and constructionist approaches to science. The first part begins by explaining observation and measurement citing examples from land degradation assessment. The next sub-section discusses land degradation as a scientific construct, empirical weaknesses and strengths. Elaboration on theoretical dilemma ends the first major division of the paper. The second part deals with three challenges posed by social study of science. These challenges include power relations, usefulness of local knowledge as well as culture and gender.

Land degradation occurs in all the continents (excluding Antartica) affecting the livelihoods of millions of people as a result of demand outstripping supply of ecosystem services [5]. There is the increasing need to assess the magnitude of land degradation in order to aid investment in sustainable land management strategies that may engender global environmental benefits [11]. The assessment has been approached by two groups of scientist: natural and social, appropriately so because the causative factors of land degradation are underpinned by biophysical parameters (natural) and socioeconomic factors (social) [12]. In so doing, there is disproportionate sway towards natural scientific assessment. Natural scientists are called to address relationship between land degradation and climate change, international freshwater basin degradation and its linkages with terrestrial ecosystems as well as effects of land degradation on vegetation productivity and the knock-on effect on biodiversity. The only role assigned to social scientists is to assess the indirect impact of the natural environmental degradation on human society [11]. This paper argues that social scientists can do more.

The paper aims at contributing to the debate on natural and social scientists stakeholder participation in the provisioning of knowledge on land degradation. The paper relies heavily on literature review method introducing post-positivist and constructionist arguments into the debate. The stand of this paper would support earlier arguments by Forsyth [13] that integrating the two knowledge blocks borders on social justice. According to Blaikie et al. [14] natural and social knowledge synergy would give land degradation assessment a plural perspective. In addition, Reed et al. [15] posit that natural and social science knowledge show similar characteristics.

POSITIVISM OR POST-POSITIVISM

Post-positivism is offshoot of positivism which is synonymous with systematic scientific research approach, scientific method, quantitative research, empiricism or empirical research [16]. It deals with laws of cause and effect, order, universal laws and logical analysis [17]. Positivism was based on ontological objectivity, which is, an objective external reality in which there is subject and object distinction (dualistic in nature), value-free and the scientific goal or aim is to uncover the truth. However, post-positivist believes in fallibility of all observation, *prima facie* evidence, error-filled explanation (not value free) and questions the ability of science to know the truth about reality with certainty. Hence, the goal or aim of science under post-positivism is to get it right about reality even though that goal is impossible to achieve [18]. Post-positivism begins with observation and measurement [19].

OBSERVATION AND MEASUREMENT

The basic tenets of observation include seeing, listening and reasoning. During observation the scientists decide on important variable to note down and ascribe perceptual interpretation to it. It is carried out through the use of sound logical reasoning, instruments and techniques. Hence the outcome which is peer reviewed is described as empirical results. Therefore, observation is often used as the arbiter between science and pseudoscience. However, observation could be fallible due to perceptual illusion, hallucinations and other less dramatic perceptual errors [19].

Measurement incorporates observation, recording and evaluation [20]. It involves scaling and classification of the attributes, rules for assigning numbers to objects and representing quantities of attributes with numbers [21]. "The important point to be noted is simply that there is no a priori connection between phenomenal structure and number, and that to make a connection we must artificially associate a phenomenal criterion with numerical equality and a phenomenal operation with numerical addition" **[22].** "Numbers are central to the definition of measurement for several reasons: (a) numbers are standardized and allow communication in science, (b) numbers can be subjected to statistical analyses, and (c) numbers are precise" [21:2]. This author stresses the concern for accuracy and measurement error. Underlying measurement is the distinction between conceptual and operational definitions.

According to [21] the concept (conceptual definition) is different from the measure of concept (operational definition) and the latter is error-filled. For instance, the concept land degradation differs from how

land degradation is measured. Land degradation is not tangible, it remains a concept in the minds of people which is defined in relation to other concepts especially those relating to environmental degradation such as natural resource depletion. The operationalization of land degradation begins with identification of appropriate indicators. The indicators are not exactly the same as 'land degradation' rather the indicators are indicative of land degradation. Hence, the indicators are proxies or representations. Proxies are necessary in measuring land degradation as the concept is not directly detectable and monitored [8]. Examples of indicators of land degradation include soil loss, normalized difference vegetative index (NDVI) and net primary productivity (NPP). The calculation of soil loss, NDVI and NPP is not error free. Error is deviation from the true value even though the true value is hardly ever known [21]. The definition of error reinforces the goal of science as pursued by post-positivists. Science is to get it right although that goal can never be achieved. Science constructs land degradation by giving it conceptual and operational definitions.

LAND DEGRADATION AS A SCIENTIFIC CONSTRUCT

The origin of the term land degradation is difficult to trace and this has adversely affected its definition [23]. [24] described the term land degradation as pejorative. To [25] land degradation has generated misunderstanding in the scientific community. [26] and [27] complained about vague definitions. So far, every major research project has produced its own definition of land degradation despite the UNCCD's definition of 1996. For instance, the Millennium Ecosystem Assessment and Land Degradation Assessment in Dryland provided their own definitions. Individual researchers have defined land degradation based on their subject or discipline specific interest [26].

Nonetheless, scientific research on land degradation has proceeded in four areas: assessment of extent, severity and nature; physical processes; remedial actions; and, linkages with other environmental problems [28]. However, these research activities suffer from lack of historical data [26]. Many issues on nature, extent and severity of degradation remain unresolved and much of the scientific results on land degradation are seriously contested [24]. Even so, scientific knowledge claims build up through gradual process during which changes are permitted [28]. For instance, satellite imageries have shown to be false the notion of advancing deserts especially in the Sahel. "Such changes and shifts may, however, sit uneasily with the demands made on scientific inputs to addressing problems with a human dimension, while science may gain a reputation for inaccuracy and 'being wrong' when further scientific analyses lead to the revision of previous interpretations" [29:603]. It appears that much work is required to be done on the scientific construct of conceptual and operational definitions of land degradation. However, the natural science has succeeded in establishing land degradation as an environmental problem worth global attention. Natural science claims on land degradation have aroused the interest of social and political groups who are using and misusing available evidences to achieve their various agendas. "For example in the 1930s, the dust bowl soil erosion issue in the U.S.A. and the desire to get public funds devoted to relief efforts caused Dean Acheson, Secretary of State to advise President Trueman to take an alarmist stance in a forthcoming speech to Congress: 'Scare Hell out of them, Harry, or nothing will be done' (R. Simonson, pers. comm., 1995)" [28:604]. The exaggerated data is often cited in both grey and mainstream literature.

In addition, formulation of conceptual and operational definitions of land degradation follows different theoretical persuasions.

THEORETICAL DILEMMA

Two of such critical theoretical persuasions include equilibrium and non-equilibrium ecological theories. The two epistemological stances differ and affect the kind of scientific knowledge they produced. The equilibrium theory postulates a self-maintaining natural balance in the ecological system in which any disturbance produces resultant extinctions in order to restore stability. The non-equilibrium theory suggests that the ecological system is in the state of constant flux. Hence, reclamation or restoration of degraded land produces a new system and not a return to the previous pristine or climax state. The equilibrium theorists do not recognize indigenous knowledge but the non-equilibrium theorists do.

The equilibrium theorists argue from the standpoint of single physical reality based on balance of nature (ecological stability and equilibrium). Key tenet of their arguments is the environmental crisis concept which is explained and supported by theories such as neo-Malthusian population-environment nexus [30], carrying capacity [31], ecological threshold [32] and tragedy of the commons [33]. The equilibrium theorists identify severe land degradation crisis often attributed to human mismanagement of land; recommend immediate scientific remedial actions; and, plan implementation "through a combination of encouragement, persuasion, subtle threats sometimes backed by more coercive powers" [34:381]. For example, the crisis of land degradation in rangeland in southern Africa where equilibrium theorists explained that overstocking by local herders produced overgrazing which resulted in land

degradation. The proponents of the equilibrium theory prescribed drastic and immediate reduction in livestock numbers as well as decrease in livestock mobility. In this way the degraded rangeland would gain time to fallow [35]. A longer resting period gives the rangeland a better chance to return to the climax vegetation. [13] critiques that crisis concept blinds development experts (employees) and their institutions (employers) to the realities on the ground.

To the contrary, the non-equilibrium theorists rely on multiple realities and interpretations as well as the flux of nature (non-equilibrium). The advocates of non-equilibrium theory provide evidence of environmental improvements and counter-interpretations of population-environment relationship. Instead of livestock numbers, non-equilibrium theorists use climatic variability to explain rangeland degradation. Vegetation productivity is greatly influenced by rainfall and drought alternation. Hence, land degradation in the rangeland is caused by drought and not overgrazing [35]. The Machakos region of Kenya portrays another example of non-equilibrium theory where fewer people in the past suffered more severe soil erosion but the present increased human population has resulted in the use of terrace farming and subsequently less soil erosion [36]. The third example is the West African Savanna where the existing forest is now explained as not relics or leftover forest but rather cultivated forest since they are found only at previous human inhabited areas [37].

The proponents of non-equilibrium theory claim that some natural scientific explanations of land degradation were not observed and verified [38]. Hence, there is the need to de-construct the handed down explanations often referred to as narrative or orthodoxy and re-construct new explanation as done in the West African Savanna case.

CONSTRUCTIONISM

Constructionists' account of reality states that scientific knowledge is socially constructed. It involves the construction of worldly things, kinds and facts as well as beliefs about them [39]. Scientific knowledge is constructed through cooperative interactions of people and their artefacts rooted in their history and culture [40]. The nature of reality (ontology) of constructionism claims that the researcher and the research object are inseparable. There is rejection of realism (external reality independent of our experience of it) and acceptance of relativism (validity and subjectivity of all truths). In terms of research methods, constructionism uses qualitative approach, case study, ethnography, hermeneutics and phenomenology. The nature of inquiry is interpretive and the goal or aim of science is to gain insiders' view [41].

It is pertinent to add that the discourse on the science wars considers constructionism as academic or cultural left and also as anti-science [42]. Hence, the tendency to arrogate scientific knowledge to positivism/post-positivism is highly rife in land degradation research due to the biophysical nature of the land resources involved.

POWER RELATIONS

Social scientists contend that knowledge is socially constructed through the interplay of power relations [43; 44]. There is power relations between states and their bureaucracies, formal and informal sectors, civil society, local communities and local power groups, non-governmental organization (NGOs), businesses, households and individuals and the media which result in various environmental outcomes [44]. These outcomes exert consequential pressure on natural scientific knowledge. Hence, environmental policies as well as their scientific or technical bases are affected by democratic processes, public debate and political choices [45].

Land degradation, according to [43] was trumpeted in the mass media as environmental crisis long before global warming, deforestation and ozone depletion. Yet at United Nations Conference on Environment and Development held in 1992, land degradation was not place high on the agenda [46]. The Convention on Biological Diversity (CBD) rather was the main priority followed by United Nations Framework Convention on Climate Change (UNFCCC). The CBD and UNFCCC respectively started operating in 1993 and 1994. However, UNCCD entered into force in 1996, 90 days after the 50th ratification was received [4]. It was not until 2002 that the Global Environmental Facility expanded its mandate to include direct fight against land degradation by dedicating a focal area to land degradation [47]. This reflects the weak power position of the countries that advocated for the UNCCD.

Furthermore, "soil erosion in lesser developed countries will not be substantially reduced unless it seriously threatens the accumulation possibilities of the dominant classes (Blaikie, 1985:147)" [13:757].

Again, a power relation is visible in the discourse on the causes of land degradation. The recent usage of the term human-induced degradation implies blaming farmers, the direct or primary land users. However, in the 1960s and 1970s available scientific knowledge blamed land degradation on colonialism, climate change and drought. The reason for the shift of blame to farmers was the work of UNEP in the 1970s [48]. In terms of power, farmers particularly those in Africa are financially and academically weak. However, many of the local farmers possessed rich indigenous knowledge on their natural environment built over many years

through trial and error [49].

USEFULNESS OF LOCAL KNOWLEDGE

Local knowledge is synonymous with traditional or indigenous knowledge. It refers to knowledge rooted in history and culture of local people [49]. "Recent attempts to address land degradation have seen calls for greater integration of scientific expertise with local knowledge" [50:99]. The literature supports the hybrid knowledge with a number of reasons. [51] suggests that the two knowledge systems validates each other as exemplified by the Himalayan environmental degradation where local farmers provided the reasons behind the landslides. [50] stresses on the common characteristics of both knowledge claims. [14] acknowledge heterogeneity of knowledge and [13] emphasizes on social justice. [13] further holds that ecological knowledge is influenced by culture and gender.

CULTURE AND GENDER

The paper defines culture as everyday life activities of a people which portray unique traits and customs. Gender is understood as social construction of responsibilities and behaviour which culturally distinct male from female. Natural scientific knowledge is heavily embedded in western culture which has a characteristic tendency of imposing and suppressing other knowledge [52]. Western culture is entrenched in dualistic conception of the world such as "man/woman, reason/emotion, culture/nature, mind/body, activity/passivity, thought/matter, separate/connected, European/barbarian [and] human/animal" [53]. The human group refers to only males of certain races excluding all women as well as men of some racial background [53]. Such knowledge is flawed when applied outside its cultural/hermeneutic background [52].

In this context, land degradation research has particularly been influenced by culture and gender of the researcher and whether he or she is insider or outsider. Hence, reflexivity (researcher and research object bidirectional dynamics) cannot be overlooked in the production of scientific knowledge.

CONCLUSION

The paper has been interrogating the question as to whether natural scientific knowledge is adequate enough to assess land degradation. The paper confirms the opposite. Natural scientific knowledge was considered as an output of positivism or post-positivism, western culture and masculine which consider observation and measurement as the only acceptable means of knowing and as arbiter between science and non-science. However, social constructionists suggest that knowledge is produced by people and their interactions within culture and gender. Therefore, land degradation even though is largely biophysical process, its study and knowledge accumulation has been affected by political power, social systems, epistemological stances as well as insider or outsider researchers' culture and gender. The literature also depicted that local knowledge is useful in land degradation knowledge production. For these reasons this paper concludes that natural scientific knowledge even though necessary is inadequate for assessing land degradation. Hence, a blend of indigenous knowledge and scientific knowledge would give land degradation research plural perspective and ensures social justice.

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