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Game Meat Quality

Southern Guinea Savanna

Highlights

Hand-Dug Wells in Ibadan

Crop and Livestock Productivity

Discovering Thoughts, Inventing Future

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Impact of Gender and Age on Game Meat Quality

By Reka Stefan, I. Bud, M. Botha & Daniela Ladoși

Abstract - The environmental conditions become more “civilized” during the time and implicit less favorable in general for the game. It came into sight some trace regarding the qualitative and also the quantitative regress of the products and subproducts from this domain. The analysis of the causal relations of the determinant factors and of the game population dynamic during the years showed that the actual situation is a consequence of some complex releasers factors (biotic and atrophic factors). We named the following from these factors: the environmental conditions of the game (climate, relief, temperature, humidity, the shelter, and the quit of this), the specie, the age, the gender of the game, the game fatten, the feed supplement, the stress before slaughter, the type of the used arms, electrocution of the game or other methods witch the game became unconsciously. Another category of factors refers to the treatment conditions after slaughter, respectively: the time to disembowel the game, the removal of the males’ testicles, the cooling and the correct manipulation during transportation of the game carcass, and the adequate storage of these carcasses for aging. In this paper we present some of these factors: age and gender which affect the game meat quality. In this paper we describe the influence of gender and the age on game meat quality. The results of the experiences showed that the male’s carcasses have higher contents in muscular and osseous tissue, comparative to the female’s carcasses. The female’s carcasses have higher contents in fat and conjunctive tissue, comparative to male’s carcasses. Also, these results point out that younger game have a soft meat, comparative to the adult game meat.

Keywords : game meat, quality, age, gender.

GJSFR-D Classification : FOR Code: 670102, 670102



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Impact of Gender and Age on Game Meat Quality

Reka Stefan^α, I. Bud^σ, M. Botha^ρ & Daniela Ladoși^ω

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Keywords : game meat, quality, age, gender.

I. INTRODUCTION

The physical and geographical conditions specify to Harghita district has favored some pedogenetical process, which determined the apparition of some different types of soils. These physical and geographical conditions assure adequate development of some game species (bear, wild boar, and deer). Cinegetic administration point of view, Harghita district is divided in 66 hunting territories. In present these hunting territories include the following species: common buck - 1278 examples, deer-690 examples, chamois-60 examples, bear-271 examples, wild boar-441 examples, partridge-465 examples, grouse-552 examples, wolf - 53 examples, rabbit-1195 examples, and lynx-56 examples (Miercurea-Ciuc Silvic Direction).

The total forest surface in Harghita district represents 231494 ha, and it is situated exclusively in the mountain area, excepting the south-west region which belongs to the hill region. From the total forest surface, 212905 ha (93%) belongs to Romsilva, and 15709 ha (7%) belongs to private persons.

The forest is constituted preponderant by resinous species, 73% from the total forest surface, and the deciduous species represents only 27% (Miercurea-Ciuc Silvic Direction).

The buck has gain the quality of emblem of Romanian hunting, like a food source, one hand and for his imposing trophy, one the other hand.

For majority of the hunters the deer remains the main hunting specie.

In this paper we present some of the factors, which affecting game meat quality: the age and gender of the animals. The aim of this paper is to compare the differences between the carcasses of males and females, and also, between the carcasses compositions of the adult and the younger animals.

II. MATERIAL AND METHODS

The results which were processing statistically proceed from the personal experiences, based on some results from the forest administration of Harghita district, and also from literatures. We made qualitative and quantitative analysis of the game meat. The game proceeded from Harghita district, and all the animals were slaughtered according to meat industry standard. In present, the results of statistics point out high variation of the game effectives, during the time, with alarming decrease of some species, for this reason we appreciated that is opportune to study these aspects. Are many responsible reasons for the effectives decrease, which can be diminish this decrease.

In this paper we approach the following aspects: the influence of age and gender towards to game meat quality.

III. RESULTS AND DISCUSSIONS

The environmental conditions become more "civilized" during the time and implicit less favorable in general for the game. It came into sight some trace regarding the qualitative and also the quantitative regress of the products and subproducts from this domain.

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The analysis of the causal relations of the determinant factors and of the game population dynamic during the years showed that the actual situation is a consequence of some complex releasers factors (biotic and atrophic factors). We named the following from these factors: the environmental conditions of the game (climate, relief, temperature, humidity, the shelter, and the quit of this), the specie, the age, the gender of the game, the game fatten, the feed supplement, the stress before slaughter, the type of the used arms, electrocution of the game or other methods witch the game became unconsciously. Another category of factors refers to the treatment

conditions after slaughter, respectively: the time to disembowel the game, the removal of the males' testicles, the cooling and the correct manipulation during transportation of the game carcass, and the adequate storage of these carcasses for aging. Follow-up we will describe some of these factors.

The game meat quality is influenced by the gender of the animals. In the case of males, the first step after slaughtering is representing by the remove of the testicles because these can imprint a strange taste to the meat.

The following table presents some differences between deer males and females carcasses:

Table 1 : Differences between deer males and females carcasses (Reka Stefan, 2007)

Carcass compositions	Male	Female	Differences %
Muscular tissue, %	60.51 $\pm$ 0.43	56.64 $\pm$ 0.97	3.87
Osseous tissue, %	18.37 $\pm$ 0.81	15.98 $\pm$ 0.84	2.39
Fat tissue, %	6.21 $\pm$ 0.19	9.46 $\pm$ 0.09	-3.25
Intermuscular fat tissue, %	2.23 $\pm$ 0.35	3.28 $\pm$ 0.09	-1.05
Conjunctive tissue, %	11.8 $\pm$ 0.26	13.87 $\pm$ 0.02	-2.07

This table shows that there are some differences between the males and females carcasses. In the case of the males, the percent of muscular tissue is higher than in female's cases, and this tissue represent 60.51 $\pm$ 0.43 from the total carcass weight. In the case of the females, the percent of the muscular tissue is 56.64 $\pm$ 0.97, the difference between females and males carcasses is 3.87.

In the males case the osseous tissue percent is 18.37 $\pm$ 0.81 from the total carcass weight. In the females case this percent is 15.98 $\pm$ 0.84, and the

difference is 2.39. There are also significant differences between the fat percent of males, comparative to female's carcasses.

Also, the difference between the percent of conjunctive tissue of the two genders is 2.07, in the favor of females.

Another factor which affects the game meat quality is the age of the animal. The younger have a soft meat, comparative to the meat of the adult animals, at it is showed in the following table:

Table 2 : Chemical composition of the different game meat species, depending on age (Reka Stefan, 2007)

Game species	Water, %	Protein %	Fat, %	Minerals, %	Dry substance, %
Adult deer	75.2	20.9	2.8	1.1	24.8
Young deer	79.8	17.7	1.8	0.7	20.2
Adult wild boar	72.09	20.5	6.4	1.01	27.91
Young wild boar	78.9	16.3	4.3	0.5	21.1
Adult bear	75.9	19.7	3.3	1.1	24.01
Young bear	79.5	17.4	2.5	0.6	20.5

This table shows that there are some differences between the adult game animals and the younger. The meat of the younger is soft, with a higher water percent comparative to the adult game meat. Also, the adult game meat has a higher protein, minerals and fat percent, comparative to the younger game meat. It is necessary to aging the both types of game meat for being softly.

IV. CONCLUSIONS

The analysis of the causal relations of the determinant factors and of the game population

dynamic during the years showed that the actual situation is a consequence of some complex releasers factors (biotic and atrophic factors). The main conclusions are the following:

1. The game meat quality is influenced by the gender of the animals. In the case of males, the first step after slaughtering is representing by the remove of the testicles because these can imprint a strange taste to the meat. In the case of the males, the percent of muscular tissue is higher than in female's cases, and this tissue represent 60.51 $\pm$ 0.43 from the total carcass weight. In the case of the females,

the percent of the muscular tissue is 56.64 ± 0.97 , the difference between females and males carcasses is 3.87. In the males case the osseous tissue percent is 18.37 ± 0.81 from the total carcass weight. In the females case this percent is 15.98 ± 0.84 , and the difference is 2.39. There are also significant differences between the fat percent of males, comparative to female's carcasses. Also, the difference between the percent of conjunctive tissue of the two genders is 2.07, in the favor of females.

2. Another factor which affects the game meat quality is the age of the animal. The younger have a soft meat, comparative to the meat of the adult animals. The meat of the younger has a higher water percent comparative to the adult game meat. Also, the adult game meat has a higher protein, minerals and fat percent, comparative to the younger game meat. It is necessary to aging the both types game meat for being softly.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Bud I., Gh. Jiboteanu, V. Moldovan, I. Man (2002) - Vânatul, vânătoria și turismul cinegetic, Ed. AcademicPres, Cluj-Napoca.
2. Bud I., Anca Boaru, V. Vlădău (2003)-Iepuri, animale de blană și vânat, Ed. Academic Pres, Cluj-Napoca.
3. Reka Ștefan, I., Bud, (2005)-Analysis of game's physico-chemical features compared to domesticated animals, *Buletin USAMV - C.N.*, Vol. 61, ISSN 1454 - 2382, pag.284-289.
4. Reka Ștefan, I., Bud (2007) – Comparative reasearch into the microstructure of beef and deer meat muscles, 42nd Croatian & 2nd International Symposium on Agriculture, ISBN 978 - 953 - 6135 - 57 - 8, pag. 570-572.



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Physical and Chemical Characteristics of Forest Soil in Southern Guinea Savanna of Nigeria

By Unanaonwi, Okpo Esio, & Chinevu, Christian Nnaemeka

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Abstract - Most studies on soil characteristics have been centered on suitability for agricultural production and once a soil does not support crop production it is referred to as poor, unproductive, and finally abandoned. Such soil can be very useful for forest crop plantation. This study was designed to investigate characteristics and describe the forest soil in Ombi, southern Guinea savanna of Nigeria. Soil samples were collected randomly from three locations around the engineering department of Nasarawa State Polytechnic Lafia, at depth of 0-30cm. Samples (1kg each) were taken in plastics bags to the laboratory for studies. Physical and chemical properties were analyzed according to standard procedures. Results show that sand had the highest % in soil of the area (74.96). Bulk densities were within the same range (1.68; 1.77 and 1.78g/cm³) for sand, silt and clay respectively. Sand had the highest porosity (37.7%) while clay had the least (31.6%). Aggregate stability was least for sand (9.74%) and highest for clay (56.82%). Soil reaction was neutral (7.05); nitrogen and CEC were 1.6 and 12.3 Cmol kg⁻¹ among others, while organic carbon was 4.82g/kg⁻¹. The soil is described as light and falls under sandy loam. Forest plantation establishment will be worthwhile.

Keywords : forest soil; southern guinea savanna; sandy loam; forest plantation.

GJSFR-D Classification : FOR Code: 961403



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Keywords : forest soil; southern guinea savanna; sandy loam; forest plantation.

1. INTRODUCTION

Soil characteristics are made up of two properties namely physical and chemical and will usually behave according to the proportion and organization of these properties. Moreso, the proportion and percentage of the chemical and physical properties of a soil determines the use a soil is put into. Soils are made up of four basic components: minerals, air, water, and organic matter. In most soils, minerals represent around 45% of the total volume, water and air about 25% each, and from 2% to 5% organic matter (REZAEI et al. 2009). The mineral portion consists of three distinct particle sizes classified as sand, silt, or clay (BUOL, 1990; RETALLACK, 2008). Sand is the largest particle that can be considered soil. Sand is largely quartz, though other minerals are also present. Quartz contains no plant nutrients, and sand cannot hold nutrients as it is easily leached by rainfall or irrigation. Silt particles are much smaller than sand, but like sand, silt is primarily quartz (MILFORD et al. 2001).

The smallest of all soil particles is clay. Clays are quite different from sand or silt, and most types of clay contain appreciable amounts of plant nutrients. Clay has a large surface area resulting from the plate-like shape of the individual particles. Sandy soils are less productive than silts, while soils containing clay are the most productive and use fertilizers most effectively (RETALLACK, 2008).

Although farmers, ranchers, foresters, microbiologists, etc think of soil differently for different purposes, understanding soils and managing them well are essential to human welfare (UNANAONWI, 2009^c).

a) Soil Texture

Soil texture refers to the relative proportions of sand, silt, and clay (MICHAEL, 2009) and a loam soil contain these three types of soil particles in roughly equal proportions. A sandy loam is a mixture containing a larger amount of sand and a smaller amount of clay, while a clay loam contains a larger amount of clay and a smaller amount of sand (JAMES, 2008).

b) Soil Structure

Another soil characteristic is soil structure. Structure refers to the clumping together or aggregation of sand, silt, and clay particles into larger secondary clusters (JANET, 2008; VORONEY, 2006). Soil structure is developed through the action of soil biota such as microbes and earthworms. This biota creates openings for water and air penetration and secretes glues and sugars which bind silt and clay particles together to form aggregates (MICHEAL, 2009). Microorganisms help open up compacted soils so roots can more easily penetrate the soil. Good soil structure is apparent when the soil crumbles easily. This is an indication that the sand, silt, and clay particles are aggregated into granules or crumbs. Both texture and structure determine pore space for air and water circulation, erosion resistance, looseness, ease of tillage, and root penetration (ASA, 2005). Soil texture is related to minerals in the soil and changes little with agricultural activities. Soil structure on the other hand can be improved or destroyed readily by choice and timing of farming practices. (BROWN, 2003). Soil structure affects aeration, water movement, conduction of heat, resistance to erosion and plant root growth. Water has the strongest effect on soil structure due to its solution and precipitation of minerals and its effect on plant growth.

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Soil structure often gives clues to its texture, organic matter content, biological activity, past soil evolution, human use, and the chemical and mineralogical conditions under which the soil formed (JAMES, 2008; BAKER and ELDERSHAW, 1993).

c) *Soil Organic Matter*

Soil organic matter is the component of soil derived from all biological sources-whether living or nonliving. Soil organic matter is a vital indicator of soil health because of its impact on a variety of soil functions and properties. It provides the energy source for micro-organisms in the soil, is a reservoir of nutrients (especially N, P & S) and improves the structural stability, water holding capacity and pH buffering capacity of the soil (LINE-KELLY, 1994).

d) *Soil Chemical Properties*

The chemistry of soil determines the availability of nutrients, the health of microbial populations, and its physical properties. In addition, soil chemistry also determines its corrosivity, stability, and ability to absorb pollutants and to filter water. It is the surface chemistry of clays and humus colloids that determines soil's chemical properties. The very high specific surface area of colloids gives soil its great ability to hold and release cations in what is referred to as cation exchange. Cation-exchange capacity (CEC) is the amount of exchangeable cations per unit weight of dry soil and is expressed in terms of milliequivalents of hydrogen ion per 100 grams of soil.

A colloid is a small, insoluble, non-diffusible particle larger than a molecule but small enough to remain suspended in a fluid medium without settling. Most soils contain organic colloidal particles as well as the inorganic colloidal particles of clays (SOILS, 1957). There are over 72 minerals elements present in the soil which are referred to as plant nutrients and are classed as major and minor. They are very essential for plants growth and development. Some of the major elements include carbon, nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, manganese, iron, zinc, copper, boron, and molybdenum (IUSS, 2007)

e) *Soil Physical Properties*

The physical properties of soils, in order of decreasing importance, are texture, structure, density, porosity, consistency, temperature, color, and resistivity. These determine the aeration of the soil and the ability of water to infiltrate and to be held in the soil. Soil texture is determined by the relative proportion of the three kinds of soil particles, called soil "separates": sand, silt, and clay. Soil density, particularly bulk density, is a measure of soil compaction. Soil porosity consists of the part of the soil volume occupied by air and water. Consistency is the ability of soil to stick together. Soil temperature and colour are self-defining. Resistivity refers to the resistance to conduction of electric currents and affects the rate of corrosion of metal and concrete structures.

The properties of the identifiable layers in a particular soil profile may differ (SOILS, 1977).

Soil components larger than 2.0 mm are classed as rock and gravel and are removed before determining the percentages of the remaining components and the texture class of the soil. For example, a sandy loam soil with 20% gravel would be called gravely sandy loam. When the organic component of a soil is substantial, the soil is called organic soil rather than mineral soil. A soil is called organic if:

- Mineral fraction is 0% clay and organic matter is 20% or more
- Mineral fraction is 0% to 50% clay and organic matter is between 20% to 30%
- Mineral fraction is 50% or more clay and organic matter 30% or more (SOILS, 1977).

Studies on soil characteristics are many a time centered on suitability for agricultural production and once a soil does not support crop production it is referred to as poor, unproductive and degraded. Such soil is usually abandoned. There are other uses that soils could be put into if they are found to be unsuitable for a particular use, thus soil would not be left to lay waste. It is by studying the soil characteristics that would enable right decisions on what types of crop a particular soil can support. This study aims at determining the chemical and physical properties, and as well describes the soil of Ombi 1, Lafia, in the southern Guinea savanna of Nigeria.

II. MATERIALS AND METHODS

a) *Study Area*

The study area is Ombi 1 in Lafia North Development Area of Nasarawa State, Nigeria (08.33'N, 08.32'E and 175m high). Mean annual rainfall in the area is 1132mm, minimum and maximum temperature range between 24.8° C and 33°C respectively. The major occupation in the area is farming and the soil is an Oxisol (ferralsol).

b) *Soil Sampling*

Soil samples were collected from three locations around the engineering department of Nasarawa State Polytechnic at depth of 0-15cm (top soil). Samples (1kg each) were taken in plastics bags to the laboratory and air dried for studies.

c) *Laboratory Analysis*

The Soil properties that were analyzed are: Acidity (pH); EC (Electrical conductivity); Nitrogen(N); Phosphorus(P); Potassium(K); Sodium(Na); Calcium (Ca); Magnesium(Mg); Hydrogen(H); Aluminum(Al); Cation Exchange Capacity(CEC); Organic Carbon(OC); Sand; Silt and Clay.

d) Physical Properties

Particle size distribution was determined by the hydrometer method as described by ASA (2005). Size distribution of aggregates was measured by wet sieving through a series of sieve (2.0, 1.0, 0.5, 0.25mm). Bulk density was determined by core method and total porosity was calculated assuming a particle density of 2.65g/cm³.

e) Chemical Properties

Soil pH was measured in water (1:1-ratio) using pH meter. Organic carbon content in the sample was determined by WALKLEY and BLACK (1934) wet-oxidation method. Total nitrogen was determined by the Micro-Kjeldhal digestion-distillation method (BREMNER, 1965). Cation exchange capacity (CEC) was determined by saturating 10g of soil with normal natural ammonium acetate solution, washing out the excess ammonium

with methanol and subsequently distillation the absorbed ammonium into boric solution. The distillate was titrated against standard hydrochloric acid. The exchangeable cations were extracted with 1M ammonium acetate solution. The extract was then analyzed for calcium (Ca) and magnesium (Mg) by EDTA titration method, and for potassium K and sodium Na, by flame photometer. Available phosphorus was determined using the Bray No.1 method (BRAY and KURTZ, 1945). Total Aluminum was determined by the method of LIU (2001). Total potassium was determined by flame photometry.

f) Laboratory and Statistical Analyses

Laboratory analysis was carried out at the Department of Soil Science, Federal University of Agriculture Markudi, Nigeria. Descriptive statistics was used to describe the Laboratory results.

III. RESULTS

Table 1 : Laboratory result of physical properties of soil (0-15cm) in Ombi Area

Particle	%/g of soil	Bulk density(g/cm ³)	%porosity	%Aggregate stability
Sand	74.96	1.68	37.7	9.74
Silt	8.0	1.77	33.2	27.51
Clay	17.04	1.78	31.6	56.82

Result shows that sand has the highest particle size distribution in 1g of soil (74.96%) while clay particle occupied 17.04%/g of soil and the least being silt whose content is 8%/g of soil. Bulk densities of the three

particles were within the same range but silt was higher than sand by 0.9 and clay higher than silt by 0.10. Aggregate stability was highest for clay and least for sand.

Table 2 : Laboratory result of chemical properties of soil (0-15cm) in Ombi Area

Chemical property	Unit	Amount
Acidity (pH)	(1:1) H ₂ O	7.05
Electrical conductivity (EC)	Ms m ⁻¹	812.0
Nitrogen (N)	Cmol kg ⁻¹	1.60
Phosphorus (P)	Cmol kg ⁻¹	2.60
Potassium (K)	Cmol kg ⁻¹	0.95
Sodium (Na)	Cmol kg ⁻¹	1.64
Calcium (Ca)	Cmol kg ⁻¹	12
Magnesium (Mg)	Cmol kg ⁻¹	3.81
Hydrogen (H)	Cmol kg ⁻¹	3.60
Aluminum (Al)	Cmol kg ⁻¹	0.70
Cation Exchange Capacity (CEC)	Cmol kg ⁻¹	12.3
Organic Carbon (OC)	g kg ⁻¹	4.82

IV. DISCUSSION

a) Physical Properties

The structure and texture of the soil represents the physical properties. Physical property of a soil plays an important role in soil fertility because the amount and sizes of soil particles determine the porosity and bulk density which account for nutrients retention or leaching of nutrients. Result of the study (Table 1) indicated that

sand has the highest percentage (74.96%) composition in a 1g of soil taken from the study area followed by clay particle with 17.04%. The size distribution directly influences the porosity which is highest for sand as is expected because sand is the most porous of the soil particles. Sand has no ability to retain water and good water retention capacity of the soil is an important factor in soil fertility. Clay has the least % porosity meaning that it has the highest capacity to retain water. This also is

one of the reasons why clay particle is referred to as the nutrient storehouse. The high water holding capacity of clay makes it more stable (56.82%) than other particles. It is that high stability that enables it to hold nutrient cations for nutrient exchange in the soil for plant uptake. It implies that the higher the clay content of a soil, the higher the cation exchange capacity and the higher the fertility of the soil.

b) Soil Description

Heavy and light are commonly used to describe soils. They refer to the ease of tillage, and not to soil weight. Heavy soils are commonly finer soils, which require more horse power because the higher clay content makes them stickier. Light soils have a higher percentage of sand (coarse texture), stick together less, and require less muscle to till. Result of the study (Table 1) has shown that soil of Ombi area of Lafia is light.

c) Soil Chemical Properties

Chemical properties of soil are made up of elements which are referred to as nutrients in plant nutrition. These elements affect yield of forest trees in one way or the other. These elements are divided into macro and micro nutrients. The macro-nutrients are required in large amount by plants for optimum growth and yield while the micro-nutrients are required in small quantity by crop.

d) Acidity

In relation to yield, soil acidity is the power house for plant nutrients (ASA, 1971). Soil acidity results to complex change in the soil, such as increase in toxic levels of aluminum, inhibition of microbial processes, reduction of the cation exchange capacity and reduced availability of soil phosphorus. The inability of crops to utilize water effectively and take up sufficient quantities of nutrients is often the most visible problem with soil acidity. Acids soils are deficient of key macro nutrients such as calcium, magnesium and potassium. High soil acidity therefore will result into decrease in root growth and will therefore not favour tuber crops. Laboratory results (Table 2) shows that Ombi soil has acidity level of 7.05 indicating that the soil is not acidic but neutral. The result shows an increase acidity level of 0.85 from that of the Northern Guinea savanna of Nigeria (UNANAONWI, 2011). The fact that the major crops cultivated in the area are tubers, as in other parts of Nasarawa State, further supports this result.

e) Nitrogen

Soil nitrogen for the study area is 1.60 Cmol kg⁻¹. UNANAONWI (2011) reported 1.45 Cmol kg⁻¹ for the Northern Guinea savanna of Nigeria. Nitrogen accounts for up to 3% of all plant compounds. It is the most abused and misused production input in growing crops. The key to reducing nitrogen growing costs is to reduce nitrogen losses. The present nitrogen recommendations in most growing situations are based

upon experience and are usually in excess of specific plant requirements. Nitrogen losses come about by reduced aeration and higher compaction in soil. Nitrates can be lost by being converted to gaseous nitrogen by anaerobic soil microorganisms in soils. The losses from gasification will be more on heavy soils than on light-textured soils. Leaching losses of nitrogen will be higher on light soils.

Excess amounts of nitrogen can destroy soil humus and tilth. When excessive nitrogen is present in the soil, microorganisms will multiply by attacking the carbonaceous humus that is more accessible than randomly distributed crop residue. By breaking down humus for their carbon needs, soil microbes can deplete the humus reserve in soil. This depletion reduces the stable humus aggregates that are vital to tilth and aeration of a healthy soil and will subsequently affect crop yield. Crop requires nitrogen for formation of tuber, seed and healthy crop stand.

f) Phosphorus

Laboratory result shows that 1 kilogram of soil in the study area has 2.60 Cmol of Phosphorus. When phosphorus intake is deficient, plants will produce red and purple leaf colors and exhibit stunted root and top growth. Most synthetic phosphate fertilizers, when added to the soil, undergo a degree of phosphate fixation with other soil elements. The degree of fixation depends upon the chemical nature of the soil. High sodium levels reduce phosphorus availability. Bio-organic phosphates are chelated in organic complexes and designed to favour microbiological activity that converts phosphorus to a more available form for crop use, thereby, preventing losses by fixation.

g) Potassium

Plants contain an average of about 3% potassium as a part of plant tissue. Potassium is essential in the translocation of vital sugars in plant structures, strengthening plant stalks. Conventional fertilizers such as muriate of potash or potassium chloride are salts and contain chloride just as table salt (sodium chloride) does. Plants use potassium as the element K⁺ ion and its availability depends upon its position within the soil and relationship to clay, humus and soil water. A clay particle is a strong magnet in comparison to sand, silt and humus. Clay soils hold potassium very tightly and resist leaching. This characteristic makes it more difficult to recover potassium from clay soils. Soil aeration and healthy, balanced aerobic microbial activity are essential for making potassium available to plant. Soil of the area in this study has 0.95 Cmol kg⁻¹ potassium.

h) Calcium

Soil calcium level in the study area is 12 Cmol kg⁻¹. Calcium is often called the prince of nutrients because the soil colloid has to have a great saturation of calcium for plant uptake. It accounts for about 2% of

plant tissue. Calcium is used to make calcium pectate, a sturdy building material component of cell walls. Calcium deficiency causes stunted roots and stress symptoms in new leaves and discoloration and distortion of plant growth. It may be the single most important soil and plant element. However, UNANAONWI (2011) reported a significant negative correlation between calcium and gum yield in soil of the northern guinea savanna of Nigeria.

i) Magnesium

Chlorophyll molecule is built around a single atom of magnesium, which accounts for about 1% of plant tissue. Magnesium deficiency causes poor photosynthesis that restricts plant growth and vitality. Soil of Ombi has magnesium value of 3.81 Cmol kg⁻¹.

j) Cation Exchange Capacity

Table 2. Shows that CEC in soil of the study area was 12.3 Cmol kg⁻¹. The cation exchange capacity is a value given in soil analysis report to indicate its capacity to hold cation nutrients. It is determined by amounts of clay and humus that are present in a soil. These two colloidal substances are essentially the cation warehouse or reservoir of the soil and are very important because they improve the nutrient and water holding capacity of the soil. Sandy soils with little organic matter have a low CEC, but clay soils with high levels of organic matter, would have a much greater capacity to hold cations. A soil with low CEC has little or no clay or humus content. It cannot hold much water or cation nutrients and therefore, forest crop would not grow well in them.

k) Organic Carbon

Result indicated that the organic carbon content of soil in Ombi is 4.82 g kg⁻¹. Soil organic carbon is directly related to soil fertility in that it is the organic carbon present in soil that is eventually converted to nitrate for plant uptake (UNANAONWI, 2009^b). This implies that the more the organic carbon contents of a soil, the more the nitrogen content of the soil, and the more fertile the soil will be.

V. CONCLUSION

The aim of this study was to determine the chemical and physical properties and to describe the soil of Ombi area. The investigation has shown from laboratory analysis that some of the trace elements such as Boron, Zinc, Copper and Ion were not present in the soil of the area. Sand has the highest percentage in the soil of the area while silt was the lowest. Soil of the area can be described as light with its higher % of sand. Soil of the area is good for the cultivation of tuber crops as is presently the case in the area, because of its low or neutral soil reaction. Forest trees would therefore thrive well. Plantation establishment of tree crops is recommended.

REFERENCES RÉFÉRENCES REFERENCIAS

1. ASA., 2005. American Society of Agronomy. www.agronomy.org Retrieved 28th October, 2012.
2. ASA., 1971. American Society of Agronomy. www.agronomy.org Retrieved 28th October, 2012.
3. BAKER, D.E.; ELDERSHAW, V.J., 1993. *Interpreting soil analyses-for agricultural land use in Queensland*. Dept. of Primary Industries, Project Report Series QO93014, Australia.
4. BRAY, R.H.; KURTZ, L.T., 1945. Determination of total organic and available forms of phosphorus in soils. *Soil Sc.* 59:39-45.
5. BREMNER, M.A., 1965. Total nitrogen. In *Methods of soil analysis part 1*. (Ed) BLACK, C.A. American Society of Agronomy. Monograph No.9. pp371.
6. BROWN, R.B., 2003. "Soil Texture". *Fact Sheet SL-29*. University of Florida, Institute of Food and Agricultural Sciences.
7. BUOL, S.W., 1990. Soil genesis and classification, Ames, Iowa: Iowa State University Press, pp. 36, doi:10.1081/E-ESS
8. IUSS Working Group WRB., 2007. "World Reference Base for soil resources-A framework for international classification, correlation and communication". FAO
9. JAMES A., 2008. The Terrestrial Influence: Geology and Soils. Columbia University. pp46.
10. JANET, R., 2008. Dirt Is Not Soil. *ScienceNews*, July 17th, 2008
11. LINES-KELLY, R., 1994. *Soil Sense Soil Management for NSW North Coast Farmers*. NSW Agriculture, Wollongbar, NSW, Australia.
12. LIU, F., 2001. Handbook on Environment Monitoring for Agriculture. China Standard Press, Beijing. Pp 699.
13. MICHEAL. R., 2009. Factors Affecting Soil Development, Soil Systems, *The Physical Environment: an Introduction to Physical Geography*, University of Wisconsin, Stevens Point, October 1, 2009, retrieved January 3, 2012.
14. MILFORD, H.B.; MCGAW, E.J.A.; NIXON, K.J., 2001. Soil Data Entry Handbook for the NSW Soil and Land Information System (SALIS), 3rd ed., New South Wales Department of Land and Water Conservation Resource Information Systems Group, Parramatta, 2001, pdf pp. 30–32.
15. RETALLACK, G.J., 2008. Soils of the Past: An Introduction to Paleopedology (2 ed.). John Wiley and Sons. pp. 207. UK.
16. SOILS., 1957. Yearbook of agriculture (1957). Alfred Sefferud. ed. The United States Department of Agriculture. pp. 17.
17. SOILS., 1977. An Introduction to Soils and Plant Growth. Prentice Hall Inc. pp. 101-102.
18. UNANAONWI, O.E., 2011. Effects of nitrogen, calcium and cation exchange capacity on gum yield in *Acacia senegal* under plantation and

savanna woodland conditions in northern Guinea savanna, Nigeria. iForest 4:190-194 {online 2011-08 11}URL:<http://www.sisef.it/iforest/show.php?id=587>

19. UNANAONWI, O.E., 2009^p. Acidity, Organic carbon and Nitrogen status of soils under *Acacia senegal*/L. (Willd.) Plantation and Natural forest in Gummi forest reserve, Zamfara State, Nigeria. Nigerian Journal of Forestry, Vol.38 (2): 91-99
20. UNANAONWI O. E., 2009^c. Relationship between gum yield and soil chemical properties under natural stands of *Acacia senegal* L. *Journal of Research in Agriculture*. Vol.6 (4): 79-83.
21. VORONEY, R. P., 2006. The Soil Habitat. Soil Microbiology, Ecology and Biochemistry, Eldor A. Paul (ed). 12-546807-5
22. WALKER, A.; BLACK, I.A., 1934. Soil Science. 37: 29-38.
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Overtime Growth in Crop and Livestock Productivity in Pakistan's Provincial Context

By Mahboob Ellahi & Humaira Mahboob

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Keywords : crop and livestock production, pakistan, productivity, provinces, TFP.

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Mahboob Ellahi ^α & Humaira Mahboob ^σ

Abstract - Combined data on crops and livestock were used to examine productivity growth rates for the period 1980-81 to 2009-10 for four provinces, namely Punjab, Sindh, Khyber Pakhtunkhwa (KP) and Balochistan of Pakistan. The analysis revealed that economic infrastructure and the development of human capital had important implications for the growth of combined Total Factor Productivity (TFP). However, the benefits of growth are not evenly distributed across various provinces. The irrigation infrastructure is the most effective in triggering the growth of combined TFP in Punjab as compared with the rest. Road development and nutrition benefited Punjab's producers in a disproportionate way than those in other provinces. The benefits of literacy and medical facilities are spatially well spread and motivate TFP growth across most of the provinces. Extension activities for crops and research for livestock reflected positive impact on combined TFP. The trend in crop research variable is, however, negative, which needs to be carefully interpreted as its implications for TFP growth are obtainable with time lag. The situation in other provinces contrasts with that in Punjab as it has long benefited from research and extension for crops, while it is yet to be accomplished in the others. The relationship of combined TFP and tractor is mixed as it is a substitute for livestock and a complement for crops. Finally, animal health care positively impacted upon the combined TFP.

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I. INTRODUCTION

The agricultural sector in Pakistan comprises both crop and livestock industries in its four provinces, namely Punjab, Sindh, Khyber Pakhtunkhwa (KP) and Balochistan. Growth in Total Factor Productivity (TFP) in both sets of sectors is a vital consideration for planners and policy makers (Govt. of Pakistan, 2009, 2010d and 2011). In the post-independence era, a pragmatic approach for development of Pakistan's crop sector initiated in 1960s with the in-coming of green revolution technologies. Later in 1980s, several dimensions added to the Pakistan's agrarian economy, such as mechanical cultivation replaced bullock farming, arable land per capita was reduced and the livestock industries emerged as a major source of livelihood. It is noteworthy that the contribution of livestock to agriculture's value added in GDP increased from 28% in 1980-81 to 53% in 2009-10 (Govt. of Pakistan, 1981 and 2010c).

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Ellahi, *et al.* (2010 and 2012) conducted two separate studies on TFP for crops (1980-81 to 2005-06) and livestock (1980-81 to 2008-09), from where it transpired that TFP for the former was much higher than the latter. Although both industries are subject to vagaries of nature, but growth in livestock industries is observed to be relatively more stable, impressive and sustainable as compared with crops (Govt. of Pakistan, 2010c). However, there are evidences (Ellahi, *et al.*, 2010 and 2012) that the varying resource endowments across the country lead to uneven distribution in growth of crop-livestock combined TFP across the four provinces. This requires that estimates of combined TFP be carried out to assist the planning machinery for undertaking an integrated development plan for the overall agricultural sector. Further, crop and livestock enterprises are complementary to each other as fodders and crop byproducts, such as straw from wheat, rice and gram and sugarcane tops are used as feed for livestock. Therefore, the participation of spatial entities in this growth process needs to be ascertained and tested in the light of empirical results and other factors operating in the overall economy.

Most spatio-temporal studies of TFP growth in Pakistan related to crops. Examples are Ellahi (2007), Ellahi, *et al.* (2009, 2009a and 2010), Ali (2000 and 2005), Murgai, *et al.* (2001), Khan (1994 and 1997), Ali and Velasco (1994), Rosegrant and Evenson (1993), Azam, *et al.* (1991) and Wizarat (1981). A similar study was carried out by Ellahi, *et al.* (2012) for the fast-growing livestock sector.

II. MATERIALS AND METHODS

a) Method of Analysis

Several methods have been used to measure TFP in Pakistan. They include non-parametric linear programming (Ellahi, 2007; Ellahi *et al.*, 2009a, 2009b; Wizarat, 1981), index number methods (Azam *et al.*, 1991, Ellahi, 2007, Ellahi *et al.*, 2009a, 2009b, 2010 and 2012, Rosegrant and Evenson, 1993; Khan, 1997; Ho and Arif, 2004; Ellahi, 2007), and stochastic frontier analysis (Ahmad, 2003). The consideration of crops and livestock and time periods covered in various studies are different, ranging from 1953-54 to 1978-79 for Pakistan agriculture as a whole (Azam *et al.*, 1991), the period 1956-85 for the crop sectors in Pakistan and India (Rosegrant and Evenson, 1993), the period from 1960 to 1996 (Khan, 1997), from 1980-81 to 2005-06

(Ellahi, 2007; Ellahi *et al.*, 2009a, 2009b and 2010) and 1980-81 to 2008-09 (Ellahi, 2012). Ali and Byerlee (2002) used data on 33 crops and eight livestock products in all irrigated districts of Punjab. Ellahi *et al.* (2010 and 2012) considered 17 crop and 11 livestock products, respectively.

The spatio-temporal combined TFP analysis of crop and livestock production in Pakistan is proposed to be carried out for 30 years from 1980-81 to 2009-10. A two-stage analysis of the combined TFP change at the provincial level is undertaken using aggregate data for the four provinces. In the first stage, changes in TFP indices are to be measured, which is accomplished by using annual data on quantities and prices of crop and livestock inputs and outputs. In the second stage, following Rosegrant and Evenson (1993), the combined TFP index is regressed on determinants using a pooled model for all four provinces. Intercept dummies and spatial interaction variables are proposed to be included for Sindh, KP and Balochistan, with Punjab treated as the base.

Obtaining data on the determinants of TFP change proved to be challenging and some of the variables are proxies. The quantity of water, in million acre feet (MAF), obtained from tubewell and canal sources may capture the effects of hydrological developments on crop and fodder production and growth of grasses in the grazing lands. Road density (road length per thousand of rural population) is used to capture the effects of transport infrastructure for marketing of crop and livestock products. Research and extension (R&E) inputs, separately for crop and livestock, are measured from data on provincial expenditure in these services, to capture the effects of increased crop output, improved feeds, disease control and better animal health. The number of tractors per cultivated hectare may depict the level of mechanical technology as a replacement for bullocks in each province. The literacy rate, nutritional status and medical facilities represent human capital. Finally, product of the proportion of cases disposed of in the High Court and Supreme Court represents confidence of farmers in protection of the legitimate rights.

b) Index Method

The chain-linked Törnqvist TFP index (Törnqvist, 1936 in Coelli *et al.*, 2005) was selected to measure TFP change in livestock industries. This method was used in most previous studies of TFP growth and requires the aggregation of inputs and outputs into single indices using weights based on cost and revenue shares, respectively. In order to define the Törnqvist index, the input-output quantities and their respective shares in the total cost and total revenue, respectively, need to be defined. The rationale for selection of the Törnqvist TFP index is provided by Ellahi *et al.* (2010).

Coelli *et al.* (2005) defined the Törnqvist output quantity index in multiplicative form as:

$$Q_{st}^T = \prod_{m=1}^M \left[\frac{q_{mt}}{q_{ms}} \right]^{\frac{\omega_{ms} + \omega_{mt}}{2}} \quad (1)$$

where q_{ms} is the m -th output quantity in the base period, s , q_{mt} is the m -th output quantity in the current period t , and ω_{ms} and ω_{mt} are the revenue shares of output m in periods s and t , respectively. Following a similar procedure, Coelli *et al.* (2005) defined the Törnqvist input quantity index in its multiplicative form as:

$$\prod_{n=1}^N \left[\frac{x_{nt}}{x_{ns}} \right]^{(\omega_{nt} + \omega_{ns})/2} \quad (2)$$

where x_{ns} is the n -th input quantity in the base period, s , x_{nt} is the n -th input quantity in the current period, t , and ω_{ns} and ω_{nt} are the cost shares of input n in periods s and t , respectively. The average annual change in the Törnqvist TFP index was measured using these output and input quantity indices and following the standard procedure as detailed, for example, by Murgai *et al.* (2001).

c) Data Compilation

As mentioned above, the requisite data for crops and fruits were collected by Ellahi (2007) and Ellahi *et al.* (2010) for 26 years (1980-81 to 2005-06). These data were extended for another 4 years, i.e. up to 2009-10 and some other crops, such as sorghum, millet, barley and green fodders were included, while on the input side bullock draught power was added to data on fertilizer, irrigation, plant protection and labour used in Ellahi *et al.* (2010). The data series on livestock (Ellahi *et al.*, 2012) were extended accordingly so that analysis of the combined TFP may be undertaken consistently for the study period considered in this study.

Aggregate data for crops and livestock were collected on prices and quantities of crops (wheat, rice (coarse and fine), sugarcane, cotton, maize, sorghum, millets, barley, fodders, potato, onions, gram, pulses, special oilseeds, sugar beet, tobacco, almonds, apricots, bananas, citrus, dates, guava and mango), milk, draught power, beef, mutton, poultry meat, eggs, hides, skins and wool, and on the inputs used in the production of crop and livestock outputs. Annual input-output data and those for market prices for both crop and livestock at the country level are available in the *Economic Survey* (Govt. of Pakistan, 2010c), the *Agriculture Statistics of Pakistan* (Govt. of Pakistan, 2010a), the *Pakistan Statistical Year Book* (Govt. of Pakistan, 2010h) and the *Monthly Statistical Bulletin* (Govt. of Pakistan, 2010g). The marketing of sugarcane, sugar beet and special oilseeds is institutionally carried out by the sugar industry and Ghee Corporation,

respectively. Therefore, market prices are not available and support/indicative prices announced by the government were used. The support prices for sugar beet and special oilseeds were discontinued in 1990-91 and 1999-2000, respectively. The former is exclusively grown in KP and extension in its prices was based on those for sugarcane and the same for the latter were extended on the basis of past trend.

The national data on livestock were apportioned into provinces using the ratios of different types of stock obtained from data provided in the *Livestock Censuses of 1976, 1986, 1996 and 2006* (Govt. of Pakistan, 1978, 1988, 1998 and 2008). Data on inputs include milk for off-springs, green fodders, crop byproducts, concentrates, manufactured feeds, grains and a variety of feeds for poultry, animal health care, medical treatment and human labour used for livestock activities. Several crop byproducts are used for feed in livestock industries, i.e. straw from wheat, rice and gram, stalks from maize, millets and sorghum and tops from sugarcane. Their annual values in current prices are provided in the *Agriculture Statistics of Pakistan* (Govt. of Pakistan, 2010a) for country as a whole. The provincial apportionment was undertaken in accordance with spatial share in total value of the main output.

The basic sources of data on the agricultural labour are the *Population Censuses of Pakistan 1981 and 1998* (Govt. of Pakistan, 1984 and 2002) and the annual series of the *Labour Force Surveys* (Govt. of Pakistan, 2010f). These data, published in the *Economic Survey* (Govt. of Pakistan, 2010c), are for the country as a whole and relate to crops and livestock. Annual farm wages for casual labour used in the agriculture sector and wages for unskilled labour in the metropolitan areas are available in the *Monthly Statistical Bulletin* (Govt. of Pakistan, 2010g) and in the *Economic Survey* (Govt. of Pakistan, 2010c), respectively. Various issues regarding farm labour and wages thereof, for the period 1980-81 to 2005-06, are discussed by Ellahi (2007), whose method was followed to obtain and extend labour used for crops and livestock and wages thereof up to 2009-10.

For the econometric analysis, data on road density are obtainable from the Provincial *Development Statistics* (Govts. of Punjab, Sindh, KP and Balochistan, 2010c). Data on population and literacy for the years 1981 and 1998 are available in the *Population Censuses of Pakistan 1981 and 1998* (Govt. of Pakistan, 1984, 2002), while those for the remaining study years are obtained from the *Labour Force Surveys* (Govt. of Pakistan, 2010f). Data on irrigation, obtained from the *Agriculture Statistics of Pakistan* (Govt. of Pakistan, 2010a), is comprised of water volume in MAF delivered by the canals and tubewells separately.

Expenditures on R&E for crops and livestock are comprised of development and recurring accounts incurred by the provincial and federal governments.

Each provincial government makes expenditure on R&E from the development account until an activity is completed and thereafter the recurring expenditure is sanctioned. At the federal level, the pattern and type of budget allocation is same and its main organizations are the former Food & Agriculture and Livestock Divisions and Pakistan Agricultural Research Council. The latter has components for both crops and livestock. The collection of all these data is a gigantic task. On the provincial side, these data are consistently available in Govt. of Punjab (2010a and 2010b), while these are partially so for Govt. of Sindh (2010a and 2010b), Govt. of KP (2010a, 2010b and 2010d) Govt. of Balochistan (2010a and 2010b) and Govt. of Pakistan (1992). Data for Sindh, KP and Balochistan were estimated in two steps, i.e. the ratio of their partially available information with those for Punjab was obtained first. Then, for the deficient years, a product of the said ratio and data for Punjab were used to estimate those for the remaining provinces.

Annual R & E data for crops and livestock are inconsistently published for the study period by Govt. of Pakistan (2010b). For instance, crop and livestock data (considered for the extension component) were available for the years up to 1997-98; thereafter, they were combined with the overall agricultural R&E data. Data for years after 1997-98 were obtained by using the proportionate share of crops and livestock, in value added, in total agricultural R&E in 1997-98. Data on research expenditure are available for the whole of agriculture. The crop and livestock portions were obtained using the method applied for the extension component. Ultimately, the federal data were apportioned among the four provinces in the light of their respective shares in the total R&E budgets and added to their respective accounts to construct the overall R&E variables for crops and livestock. Thereafter, the estimates were converted into real values by using the GDP deflator with 1980-81 as the base (Govt. of Pakistan, 2010c). Variables on treatment reflecting animal health were taken from the Govts. of Punjab, Sindh, KP and Balochistan (2010c).

A moving average of the crop and livestock output variables need to be used to reduce the exaggerated effects of drought, floods and good seasons on crop output and for ample fodders and free of epidemics. These factors do not operate at a regular interval. However, a period of two years was considered appropriate to smooth out fluctuations in the combined TFP.

III. RESULTS AND DISCUSSION

a) Estimates of TFP Change

The empirical results of average annual growth rates in combined TFP using Törnqvist indices are presented in Table I for the whole study period and for two sub-periods, namely 1980-81 to 1994-95 and 1995-

96 to 2009-10. Indices are also depicted graphically for Punjab, Sindh and KP in Fig. 1 and for Balochistan in Fig. 2. The trend in combined TFP for Balochistan is portrayed separately because its production pattern, especially that of crops (Ellahi *et al.* 2010), was substantially different from rest of provinces over the

study period. As seen from Table I, Balochistan's combined TFP change per annum, for the entire study period, is about four times higher than that for the rest all provinces exhibiting about 1% average annual change.

Table I : Province-wise annual rates of change in TFP

Province Period	Punjab % p.a.	Sindh % p.a.	KP % p.a.	Balochistan % p.a.
1980-81 to 2009-10	0.83	1.05	1.27	4.01
1980-81 to 1994-95	0.87	0.64	1.66	7.25
1995-96 to 2009-10	0.41	0.94	-0.25	-2.67

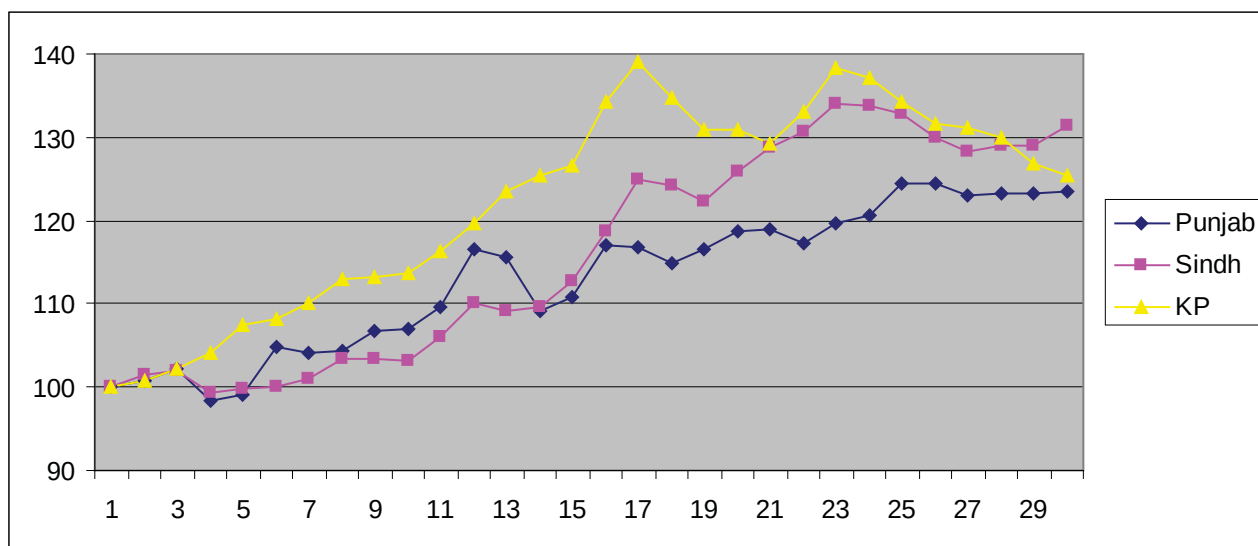


Figure 1 : Annual TFP Indices in Punjab, Sindh and KP, 1980-81 – 2009-10 (1980-81 = 100) for Crop-Livestock Industries Combined

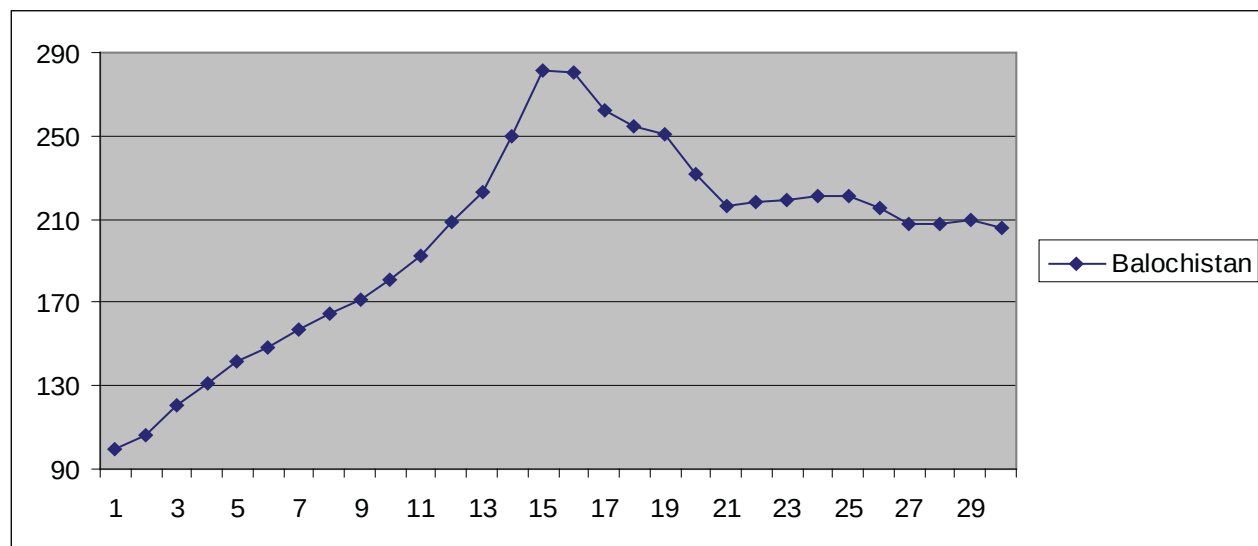


Figure 2 : Annual TFP Indices in Balochistan, 1980-81 – 2009-10 (1980-81 = 100) for Crop-Livestock Industries Combined

The results depicted in Figure I exhibit that the growth rate in the combined TFP for the entire study period and for Punjab, Sindh and KP was almost the same and stood at about 1% per annum. These estimates are lower than those for crop production (Ellahi *et al.*, 2010, Ali and Byerlee, 2004 and World Bank, 2007) and higher than those for livestock (Ellahi *et al.*, 2010). Further, KP scored the highest with an estimated 1.27% growth in the combined TFP per annum implying that crop and livestock activities, taken together, in KP is more efficient than that in Punjab and Sindh. The producers in Balochistan achieved the highest combined TFP growth rate of 4.01% per annum for the entire study period, but was well below producers in other provinces in the beginning of the study period. This phenomenon is attributed to additional canal water provided to Balochistan in the beginning of 1990s (Abbasi *et al.*, 2012), which gave a boost to crop output (Ellahi, 2007).

These average annual TFP growth rates for the whole study period hide some major inter-temporal variations. During the first sub-period from 1980-81 to 1994-95, the combined TFP growth rate was consistently high in all provinces, except Sindh (Fig. 1). It was especially high in Balochistan where farmers achieved high productivity gains of 7.25% per annum. But the rate took a downturn in that province in the second time period (1995-96 to 2009-10), i.e. it retarded

at an average annual rate -2.67% per annum (Fig. 2). A slight downturn of -0.25% per annum was recorded in KP as well. The combined TFP growth, in Punjab, dropped from 0.87% to 0.41% per annum compound, i.e. about one half, while the same in Sindh went up annually from 0.64% to 0.94% on an average. In the second time period, Sindh showed the highest TFP growth rate at 0.94%. The drop in the combined TFP growth rate in Punjab, KP and Balochistan in the second time period coincided with a reduction in beef and mutton production (Ellahi *et al.*, 2012).

b) *Changes in the Determinants of TFP*

The rates of change in the determinants of combined TFP, along with *t*-ratios, are provided in Table II. All provinces experienced significantly positive trends in their tubewell networks: the growth was somewhat weak in KP. Its growth was higher in Punjab and Balochistan than in Sindh and KP. It is noteworthy, in Sindh, that water is not mined from below the ground where it is brackish; rather, it is generally canal water that has to be lifted mechanically. Sindh and KP experienced a substantial decline in the canal network, while it showed increasing trend in Punjab and Balochistan. As said above, tubewells in Sindh draw water from canal and lead to reduction in surface water supply.

Table II : Rates of change in determinants of combined TFP in provinces

Variables	Punjab % p.a.	Sindh % p.a.	KP % p.a.	Balochistan % p.a.
Tubewell network	2.093 (19.2)***	1.636 (7.4) ***	0.153 (1.0)	2.171 (11.0)***
Canal network	1.455 (37.4)***	-0.136 (-1.4) ***	-0.962 (-11.3)***	2.326 (15.9)***
Road network	3.691 (22.6)***	-1.043 (-2.6) **	1.2 (17.9)***	-2.204 (8.7)***
Nutritional status	1.385 (14.2)***	0.964 (10.0) ***	5.201 (23.5)***	2.333 (13.2)***
Literacy rate	6.490 (16.5)***	3.977 (25.7) ***	5.269 (22.568)***	7.785 (17.3)***
Medical services	1.068 (10.6)***	-1.845 (-9.2) ***	0.239 (4.4)***	1.482 (8.8)***
Legal services	1.838 (4.1)***	0.246 (0.5)	0.639 (0.9)	2.478 (2.7)***
Extension services (Livestock)	-2.930 (-8.4)***	-3.201 (-7.3) ***	-8.632 (-21.7)***	-0.081 (-0.1)
Research services (Livestock)	2.153 (4.8)***	-1.789 (-2.2) **	3.959 (10.3)***	-0.758 (-1.8)*
Extension services (Crops)	-2.765 (-5.5)***	-4.319 (-4.8) ***	-0.148 (-0.2)	-2.662 (-6.9)
Research services (Crops)	1.627 (3.5)***	-1.161 (-3.3) ***	-1.563 (-3.2)***	-0.701 (-3.5)***

Mechanization	1.405 (4.9)***	-0.158 (-0.4)	0.101 (0.4)	1.589 (5.2)***
Animal health	0.837 (8.0)***	6.748 (11.9)***	3.475 (13.5)***	0.698 (1.4)

Notes: Figures in parenthesis are t-ratios. ***, ** and * denote statistically significant at the 1%, 5% and 10% levels, respectively, on the basis of a two-tail test.

Investment in human capital was boosted through the *Seventh and Eighth Five Year Plans (1988-1993 and 1993-1998)* (Govt. of Pakistan, 1987, 1994). Thus, all provinces exhibited generally positive trends in the literacy rate, nutritional status and medical services for human beings, and animal health services through treatment and vaccination. Growth in legal services was considerable in Punjab and Balochistan, while it was negligible in the rest. In respect of animal health (number of livestock treated), Balochistan excelled of all provinces, while the same in Punjab was negligible and statistically insignificant at the 10% level. Conversely, extension services for both livestock and crops declined in all provinces except Balochistan, where change is negligible. Research services for livestock increased in Punjab and KP but declined in Sindh and Balochistan. Research services for crops went up in Punjab and declined in the rest. Mechanization increased substantially and significantly in Punjab and Balochistan but did not change significantly in Sindh and KP. The

road network per unit of crop and livestock output deteriorated in Sindh and Balochistan, but improved significantly in the other two provinces.

c) *Estimates of Impacts of Determinants on TFP*

Following Rosegrant and Evenson (1993), the combined TFP index was regressed against the above referred determinants in a log-linear way. The data were found to be suffering from heteroskedasticity problem, which was remedied by using the appropriate model of the econometric software, namely, EVIEWS 6. The parameter estimates, representing elasticities, for the combined TFP for the four provinces are set out in Table III. The base elasticity (parameter) estimates are for Punjab and those for the other provinces were obtained by adding the interaction dummy estimates to the base and testing the difference from zero. Considerable differences for elasticity estimates and direction of change in the determinants are observed and explained below.

Table III : Model estimates for the determinants of TFP for Livestock

Variables	Coefficient	Standard error	z-statistic	p-value
Constant	-0.728	0.61	-1.19	0.23
Sindh dummy	-0.272	0.70	-0.39	0.70
KP dummy	1.59	0.65	2.43**	0.02
Balochistan dummy	4.063	2.09	1.96**	0.05
Tubewells (T)	0.008	0.08	0.11	0.92
Canals (C)	0.286	0.09	3.04***	0.00
Roads (RD)	0.037	0.03	1.19	0.23
Nutritional status (N)	0.357	0.10	3.41***	0.00
Literacy rate (L)	-0.048	0.02	-2.09**	0.04
Medical facilities (MF)	0.222	0.13	1.66*	0.10
Judicial services (J)	-0.051	0.01	-4.92***	0.00
Extension services for Livestock (E_L)	-0.219	0.03	-7.18***	0.00
Research services for Livestock (RS_L)	0.040	0.01	3.41***	0.00
Extension services for Crops (E_C)	0.247	0.04	5.90***	0.00
Research services for Crops (RS_C)	-0.098	0.03	-2.89***	0.00
Mechanization (ME)	0.009	0.04	0.25	0.80
Animal Health (AH)	0.006	0.02	0.24	0.81
Sindh*T	-0.061	0.09	-0.68	0.50
Sindh*C	-0.304	0.12	-2.59***	0.01
Sindh*RD	-0.118	0.03	-3.64***	0.00
Sindh*N	-0.311	0.12	-2.70***	0.01
Sindh*L	0.300	0.04	7.72***	0.00
Sindh*MF	-0.118	0.14	-0.87	0.38

Sindh*J	0.028	0.01	2.59***	0.01
Sindh*E _L	0.092	0.03	2.77***	0.01
Sindh*RS _L	-0.046	0.02	-2.45***	0.01
Sindh*E _C	-0.186	0.04	-4.36***	0.00
Sindh*RS _C	0.129	0.04	3.29***	0.00
Sindh*ME	-0.069	0.04	-1.63*	0.10
Sindh*AH	0.045	0.03	1.75*	0.08
KP*T	0.159	0.09	1.80*	0.07
KP*C	-0.170	0.13	-1.34	0.18
KP*RD	-0.077	0.05	-1.66*	0.01
KP*N	0.123	0.20	0.62	0.54
KP*L	-0.015	0.04	-0.38	0.70
KP*MF	-0.643	0.15	-4.17***	0.00
KP*J	0.051	0.01	4.83***	0.00
KP*E _L	0.258	0.04	7.15***	0.00
KP*RS _L	-0.016	0.02	-0.99	0.32
KP*E _C	-0.348	0.05	-7.56***	0.00
KP*RS _C	0.108	0.04	3.03***	0.00
KP*ME	0.054	0.04	1.27	0.20
KP*AH	0.039	0.05	0.80	0.42
KP*AV	-0.043	0.12	-0.36	0.72
Balochistan*T	0.077	0.19	0.41	0.68
Balochistan*C	-0.256	0.09	-2.98***	0.00
Balochistan*RD	-0.032	0.21	-0.15	0.88
Balochistan*N	0.204	0.07	2.83***	0.00
Balochistan*L	-0.760	0.20	-3.77***	0.00
Balochistan*MF	0.226	0.03	8.01***	0.00
Balochistan*J	0.376	0.06	6.26***	0.00
Balochistan*E _L	-0.085	0.07	-1.17	0.24
Balochistan*RS _L	-0.386	0.08	-4.91***	0.00
Balochistan*E _C	-0.108	0.23	-0.46	0.65
Balochistan*RS _C	0.316	0.18	1.74*	0.08
Balochistan*ME	-0.017	0.06	-0.30	0.77
Balochistan*AH	0.102	0.61	1.19	0.15

Note: *** significant at the 1 per cent level, ** significant at the 5 per cent level, * significant at the 10 per cent level on the basis of a two-tail test. $R^2 = 0.97$, Adjusted $R^2 = 0.95$ and DW statistic = 1.52.

The R^2 measuring overall goodness of fit is 0.97, showing that the model is well fitted to the data set used for the analytical purpose. The base coefficient estimate for intercept is less than zero and statistically insignificant (at the 10% level), which compares well with that reported by Ellahi *et al.* (2012). The same for Sindh is further low and those for KP and Balochistan are positive and statistically significant at the 5% level. It may be noted that in view of varying agro-climatic conditions, the pattern of livelihood in KP and Balochistan is different from that in Punjab and Sindh and the said results truly represent the inherent phenomenon in crop and livestock activities.

The base coefficient estimates for water resource development (T and C) bear positive signs as expected and that for tubewell is insignificant and close to zero, which may be attributed to spurious correlation

between the said irrigation variables. The estimates on interaction dummies for water-scarce KP and Balochistan are above the base showing the need for tubewell water to irrigate crops and fruit trees. The estimate on C is significant at the 1% level and the same with interaction dummies for the rest of provinces are below the base showing that canal system in Punjab is better developed and impacting positively on the combined TFP as reported by Ellahi *et al.* (2010).

The base elasticity estimates for road infrastructure (RD) and nutrition (N) are positive and the latter is statistically significant at the 1% level, while a converse of this is true for Sindh where the coefficient estimates for the interaction variables are statistically significant at 1% level. These results are in line with the temporal change in RD as seen from Table II. In KP and Balochistan road variable bears negative sign, while

nutrition coefficient estimate is above the base estimates. In Punjab, a 1% increase in roads leads to about 0.04% increase in the combined crop-livestock TFP, while the effect of N is many times higher than that created by RD. The general tendency noted with respect to both N and RD is in line with those reported by Ellahi *et al.* (2010) in respect of TFP for crop production in the four provinces.

Literacy and medical facilities (L and MF) contribute positively in Punjab, but the estimate on both are statistically insignificant at 10% level), which is true for Sindh and KP as well but for literacy only. Interaction dummies with L and MF for Balochistan, being negative is consistent with expectations that its population is well spread (Ellahi *et al.*, 2010) and has the lowest access to these facilities as compared with the rest. Further, crop-livestock activities do not require literacy whose annual growth is the highest in Balochistan (Table II) but is negatively associated with the combined TFP. The impact of judicial services (J) for the combined TFP, as seen from coefficients on the base is negative and significant at 1% level and converse of this is true for the rest of provinces as seen for the interaction dummies. These results are consistent with those reported by Ellahi *et al.* (2010). It is noteworthy that in KP and Balochistan, a traditional system called *Jerga* (a jury comprising tribal heads) is effectively used for the settlement of disputes among the parties concerned. Thus, crop-livestock producers are more confident about their legitimate rights in KP and Balochistan as compared with those in Punjab.

As seen from Table II, public expenses incurred on extension services on livestock and crops generally retarded in most of provinces. However, extension activities in Punjab for crop sector (E_c) are well developed than those for livestock (E_l), which is reflected in positive and strong impact of the former on combined TFP, while a converse holds for the latter, i.e. E_l . On the other hand, in view of strongly uprising livestock industry a great deal of research efforts (RS_l) are being made which is reflected in strongly positive impact on the base coefficient estimate. The trend in crop research (RS_c) variable is significantly negative, which is consistent with results reported by Ellahi *et al.* (2010) and in contrast with the inferences drawn by Rosegrant and Evenson (1993). This observation need to be carefully interpreted because implications of research expenses for combined TFP growth are obtainable with a considerable time lag (Ali, 2005). Also, the results presented by Kiani *et al.* (2008) highlight the lagged relationship between expenses on RS_c and combined TFP growth and lend support to results presented in this study. The situation with respect to expenses on RS_c for the remaining provinces of Sindh, KP and Balochistan contrasts with that in Punjab and accord with the conclusions drawn by Rosegrant and Evenson (1993). As seen from Table III, the coefficient

estimates for the rest all are above the base estimates for Punjab and generally significant at the 1% level. There seems a plausible explanation for this inference. Punjab has long benefited from RS_c and E_c in crop production (Heisey, 1990 and Byerlee, 1993), while it is yet to be accomplished in the other provinces and the said efforts are yielding good payoffs. Further, technological spillovers across provinces should have been achievable (Ellahi *et al.*, 2010) to boost agricultural output in Sindh, KP and Balochistan.

The base and other coefficient estimates for mechanical technology (ME) are generally insignificant at the 5% level. The base estimate and interaction dummy for KP bear positive and those for Sindh and Balochistan have negative signs. As per economic logic, it is expected that ME and TFP for livestock, comprising animal draught power, are substitutes as they replace each other, while ME and TFP for crops are complements. Therefore, the relationship of the combined TFP and ME is expected to be mixed as it is observed. The coefficient estimates for animal health (AH) for Punjab and others, though generally insignificant at the 5% level, have a positive impact on the combined TFP.

IV. CONCLUSION

The empirical analysis revealed that the development of irrigation and other economic infrastructure and policies for development of human capital had important implications for the growth of combined TFP. However, the benefits of growth are not evenly distributed across various provinces over the study period. The log-linear model used to decompose the combined TFP is well fitted to the data set used for analytical purposes.

The irrigation infrastructure is the most effective in triggering the growth of combined TFP in Punjab as compared with the rest of provinces. Road development and nutrition benefited producers in Punjab in a disproportionate way than those in other provinces. The relationship of the combined TFP and tractor technology is mixed as it is expected that tractor and livestock are substitutes, while tractor and crops are complements. The benefits of literacy and medical facilities are spatially well spread and motivate TFP growth across most of the provinces. However, judicial services tend to retard combined TFP in Punjab, while a converse is true for those having informal system of justice.

Well developed extension activities for crops in Punjab are reflected in positive and strong impact on combined TFP than the same for livestock. On the other hand, uprising livestock industry is attracting a great deal of research efforts which is reflected in strongly positive impact on the base coefficient estimate. The trend in crop research variable is negative, which is consistent with results reported by Ellahi *et al.* (2010)

and in contrast with the inferences drawn by Rosegrant and Evenson (1993). This needs to be carefully interpreted as implications of research expenses for TFP growth are obtainable with a time lag (Ali, 2005 and Kiani *et al.*, 2008). The situation in other provinces contrasts with that in Punjab and accord with Rosegrant and Evenson's (1993) results. There seems a plausible explanation for this inference. Punjab has long benefited from research and extension for crops, while it is yet to be accomplished in the other provinces. Finally, coefficient estimates for animal health have a positive impact on combined TFP.

REFERENCES RÉFÉRENCES REFERENCIAS

- Abbasi, A.N.G., S.M. Ahmed, K.A. Majid, Q. Sahto and S.Q.Z. Shah (2000), 'Kharif 2000 River Water Distribution and Management', mimeo.
- Ali, S. 2000. 'Productivity growth in Pakistan's agriculture, 1960-1996' PhD Dissert., Econ. Deptt., Simon Fraser Univ., Burnaby.
- Ali, S. 2005. 'Total factor productivity growth and agricultural research and extension: An analysis of Pakistan's agriculture, 1960-1996' Pakistan Dev. Rev. 44(4), Part 2, 729-746.
- Ali, M. and D. Byerlee 2004. 'Productivity growth and resource degradation in Pakistan's Punjab: A decomposition analysis' Policy Research Working Paper No. 2480, World Bank, Washington, D.C.
- Ali, M. and L.E. Velasco 1994. 'Intensification induced resource degradation: The crop production sector in Pakistan' Working Paper 94-14. International Rice Res. Inst., Manila.
- Azam Q.T., E.A. Bloom and R.E. Evenson 1991. 'Agricultural research productivity in Pakistan' Discussion Paper No. 644, Econ. Growth Centre, Yale Univ., New Haven.
- Byerlee, D. (1993) Technical change and returns to wheat breeding in Pakistan's Punjab in the post-green revolution period, Pakistan Dev. Rev. 32(1), 69-86.
- Coelli, T.J., D.S.P. Rao, C.J. O'Donnell and G.E. Battese 2005. 'An introduction to efficiency and productivity analysis' 2nd ed, Springer, New York.
- Ellahi, M., E. Fleming and R. Villano 2010. 'Explaining inter-provincial inequality in agricultural productivity growth in Pakistan' Spatial Econ. Analysis 4(5): 441-462.
- Ellahi, M., E. Fleming and R. Villano 2012. 'Spatio-temporal growth in livestock productivity in Pakistan' Sarhad J. Agric. 28(2): 309-317.
- Ellahi, M., E. Fleming and R. Villano 2009. 'Growth in Pakistan's agricultural productivity with reference to technical change and technical efficiency: An inter-provincial analysis' Seminar on Water Costing held on March 07, 2009 at Water and Power Dev. Authority (WAPDA), Planning & Design Div. (Water), WAPDA House, Lahore, Pakistan.
- Ellahi, M., E. Fleming and R. Villano 2009a. 'Varying agricultural productivity growth in Pakistan: An inter-provincial analysis' J. Agric. Training & Dev. 2(2): 1 – 22, Regional Agric. Econ. Dev. Centre, Vehari, Pakistan.
- Ellahi, M. 2007. 'Total factor productivity growth and technical efficiency in Pakistan's agriculture: An inter-provincial analysis' Res. Report for a Post-Doctoral Fellowship, School of Business, Econ. & Public Policy, Univ. of New England, Armidale.
- Govt. of Balochistan 2010a. 'Estimates of charged expenditure and demands for grants (Current Expenditure)' Vol. III (PartC), Finance Deptt. Quetta (various issues).
- Govt. of Balochistan 2010b. 'Public sector development programme 2010-11' Planning & Dev. Deptt. Quetta (various issues).
- Govt. of Balochistan 2010c. 'Balochistan development statistics' Bureau of Statistics, Quetta (various issues).
- Govt. of KP 2010a. 'Estimates of charged expenditure and demands for grants (Current Expenditure)' Vol. III (Part C), Finance Deptt. Peshawar (various issues).
- Govt. of KP 2010b. 'Medium term development framework 2010-13: Development programme 2010-11' Vol. I and II, Planning & Dev. Deptt. Peshawar (various issues).
- Govt. of KP 2010c. 'KP Development Statistics' Bureau of Statistics, Peshawar (various issues).
- Govt. of KP 2010d. 'White paper: 2010-11' Finance Department, Peshawar.
- Govt. of Pakistan 1984. '1981 Census report of Pakistan' Census Report No. 69, Population Census Organization, Statistics Div. Islamabad.
- Govt. of Pakistan 1992. 'Public sector development programme 1991-92: Summary tables' Finance Div. Islamabad (various issues).
- Govt. of Pakistan 2002. '1998 Census report of Pakistan' Population Census Organization, Statistics Div. Islamabad.
- Govt. of Pakistan 2003. 'Agricultural census 2000, All Pakistan report' Vol. 1 Agricultural Census Organization, Statistics Div. Islamabad.
- Govt. of Pakistan 1978. 'Livestock census 1976, All Pakistan report' Vol. 1 Agricultural Census Organization, Statistics Div. Islamabad.
- Govt. of Pakistan 1987. 'Seventh five year plan 1988-93 and perspective plan (1988-2003)' Vol. I, Planning Commission, Islamabad.
- Govt. of Pakistan 1988. 'Livestock census 1986, All Pakistan report' Vol. 1 Agricultural Census Organization, Statistics Div. Islamabad.
- Govt. of Pakistan 1994. 'Eighth five year plan 1993-98' Planning Commission, Islamabad.

29. Govt. of Pakistan 1998. 'Livestock census 1996, All Pakistan report' Vol. 1 Agricultural Census Organization, Statistics Div. Islamabad.
30. Govt. of Pakistan 2008. 'Livestock census 2006, All Pakistan report' Vol. 1 Agricultural Census Organization, Statistics Div. Islamabad.
31. Govt. of Pakistan 2009. 'Annual plan 2009-10' Planning Commission, Islamabad.
32. Govt. of Pakistan 2009. 'The New vision for Pakistan, investing for people, 10th Five year plan 2010-15: Approach paper' Planning Commission, Islamabad.
33. Govt. of Pakistan 2010a. 'Agriculture statistics of Pakistan 2008-09' Food and Agriculture Div. (Planning Unit), Islamabad (various issues).
34. Govt. of Pakistan 2010b. 'Demand for grants and appropriations (White Book)' Finance Div. Islamabad (various issues).
35. Govt. of Pakistan 2010c. 'Economic Survey' Economic Advisor's Wing, Economic Affairs and Finance Div. Islamabad (various issues).
36. Govt. of Pakistan 2010d. 'Federal government public sector development programme 2010-11' Planning Commission, Islamabad.
37. Govt. of Pakistan 2010e. 'Final report of the panel of economists: Medium-term development imperatives: A strategy for Pakistan' Planning Commission, Islamabad.
38. Govt. of Pakistan 2010f. 'Labour force survey' Federal Bureau of Statistics, Statistics Div. Islamabad.
39. Govt. of Pakistan 2010g. 'Monthly statistical bulletin' Federal Bureau of Statistics, Statistics Div. Islamabad.
40. Govt. of Pakistan 2010h. 'Pakistan Statistical Year Book' Federal Bureau of Statistics, Statistics Div. Islamabad.
41. Govt. of Pakistan 2011. 'Pakistan: Framework for economic growth' Planning Commission, Islamabad.
42. Govt. of Punjab 2010a. 'Estimates of charged expenditure and demands for grants (Current Expenditure)' Vol. II, Finance Deptt. Lahore (various issues).
43. Govt. of Punjab 2010b. 'Medium term development framework 2010-13: Development programme 2010-11' Vol. II, Planning and Development Deptt. Lahore (various issues).
44. Govt. of Punjab 2010c. 'Punjab Development Statistics' Bureau of Statistics, Lahore (various issues).
45. Govt. of Sindh 2010a. 'Annual development programme' Planning and Development Deptt. Karachi (various issues).
46. Govt. of Sindh 2010b. 'Estimates of charged expenditure and demands for grants (Current Expenditure)' Vol. III (Part B), Finance Deptt. Karachi (various issues).
47. Govt. of Sindh 2010c. 'Sindh development statistics' Bureau of Statistics, Karachi (various issues).
48. Heisey, P. (ed.) (1990) Transferring the gain from wheat breeding research and insuring against rust losses in Pakistan, Research Report No. 1, CIMMYT, Mexico, D.F.
49. Ho, C.S.F. and M. Ariff 2004. 'Foreign exchange market equilibrium in closely trading regions: A test of purchasing power parity' A Working Paper, Deptt. of Accounting and Finance, Monash Univ.
50. Khan, M.H. 1994. 'The structural adjustment process and agricultural change in Pakistan in the 1980s and 1990s, Simon Fraser Univ. Vancouver.
51. Khan M.H. 1997. 'Agricultural 'crisis' in Pakistan: Some explanations and policy options' Pakistan Dev. Rev. 36(4), 419-459.
52. Kiani, A.K., M. Iqbal and T. Javed 2008. 'Total factor productivity and agricultural research relationship: evidence from crops sub-sector of Pakistan's Punjab' European J. of Scientific Res. 23(1), 87-97.
53. Murgai, R., M. Ali and D. Byerlee 2001. 'Productivity growth and sustainability in post-green revolution agriculture: The case of the Indian and Pakistan Punjab' World Bank Research Observer 16(2), 199-218.
54. Rosegrant, M.W. and R.E. Evenson 1993. 'Agricultural productivity growth in Pakistan and India: A comparative analysis' Pakistan Dev. Rev. 32(4), Part I, 433-451.
55. Wizarat, S. 1981. 'Technical change in Pakistan's agriculture: 1953-54 to 1978-79' Pakistan Dev. Rev. 20(4), 427-445.
56. World Bank 2007. 'Pakistan: promoting rural growth and poverty reduction' Washington, D.C.
57. Tornqvist, L. 1936. 'The bank of Finland's consumption price index' Bank of Finland Monthly Bulletin, 10, 1-8.



Water Quality Evaluation of Hand-Dug Wells in Ibadan, Oyo State, Nigeria

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Abstract - In many countries around the world, including Nigeria, access to potable water has become a mirage. Exploitation of groundwater through the construction of hand-dug wells is a major source of drinking water for majority of the populace. The need to assess the quality of water from this source to ascertain the role of well construction methods has now become imperative because of the health impacts on individuals. Random surveys of three classifications of hand-dug wells were done between June and October 2010, in Ibadan, Nigeria. One hundred and one (101) hand-dug well were selected. A standard form was used for capturing data used for the classification of the wells into protected, semi protected and unprotected. Standard laboratory methods were employed for the analysis of electrical conductivity, pH, Temperature, Chlorides, Nitrate, E. coli and Total Coliform Count. Results show that Nitrate concentration, E. Coli and Total Coliform Count are more pronounced in wells that are installed close to domestic refuse waste, abattoir, Pit latrine, stagnant water and drainages. The pronounced concentrations decreased with increasing distance from the pollution sources irrespective of well classification. Protected wells gave better water quality relative to semi protected and unprotected wells. The paper recommends regular monitoring of groundwater quality, abolishment of unhealthy waste disposal practices and regulation of self supply well construction and design.

Keywords : hand dug well, groundwater, protected well, semi-protected well, un-protected well.

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WATER QUALITY EVALUATION OF HAND-DUG WELLS IN IBADAN, OYO STATE, NIGERIA

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Abstract - In many countries around the world, including Nigeria, access to potable water has become a mirage. Exploitation of groundwater through the construction of hand-dug wells is a major source of drinking water for majority of the populace. The need to assess the quality of water from this source to ascertain the role of well construction methods has now become imperative because of the health impacts on individuals. Random surveys of three classifications of hand-dug wells were done between June and October 2010, in Ibadan, Nigeria. One hundred and one (101) hand-dug well were selected. A standard form was used for capturing data used for the classification of the wells into protected, semi protected and unprotected. Standard laboratory methods were employed for the analysis of electrical conductivity, pH, Temperature, Chlorides, Nitrate, E. coli and Total Coliform Count. Results show that Nitrate concentration, E. Coli and Total Coliform Count are more pronounced in wells that are installed close to domestic refuse waste, abattoir, Pit latrine, stagnant water and drainages. The pronounced concentrations decreased with increasing distance from the pollution sources irrespective of well classification. Protected wells gave better water quality relative to semi protected and unprotected wells. The paper recommends regular monitoring of groundwater quality, abolishment of unhealthy waste disposal practices and regulation of self supply well construction and design.

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1. INTRODUCTION

Access to safe drinking water is a problem facing a large proportion of the inhabitant of the developing nations (UNICEF, 2005; Cosgrove and Rijsberman, 2000; Gomez and Nakat, 2002). In spite of the considerable investments of Nigerian government in water supply programme, over 52% of its population have no access to potable water (Oluwasanya, 2009). For instant in Ibadan, despite the effort of public water agency in providing potable water to the populace, the problem of acute water shortage is still dominant. Low access to safe water in Nigeria has been attributed to the enormous socio-economic development, growing industrial base, poor planning, insufficient funding and haphazard implementation, to mention a few (Oluwasanya, 2009). Consequently, the inhabitants have resulted into the use of hand-dug wells as an alternative

source of water supply. Hand-dug wells also provide cheap and low-technology solution to the challenges of rural and urban water supply. Well construction too affords an opportunity for community participation during all phases of the water supply process (Seamus, 2000). Hand-dug wells could either be protected, un-protected or semi-protected. A protected well is one equipped with a dedicated pump (manual or motorised), concrete lining and platform (or apron), head wall, cover and drainage channel (Murcott, 2007; Oluwasanya et al., 2011). Un-protected well is without any of the features stated above and a semi-protected well may have one or more of the features found in a protected well (Oluwasanya et al., 2011). Most hand-dug wells are shallow, although wells as deep as 120 metres have been reported (Watt and Wood, 1977). The wells are often more vulnerable to contamination than deeper boreholes. Whilst some shallow dug wells have a mechanised pumping, the majority (particularly those in developing countries) have water abstraction through some form of hand pump, windlass or rope and bucket system (Collins, 2000). Shimizu et al. (1980) have shown that bacteria contaminate well water depending on location. Thus, it is suspected that water from wells in unhygienic areas could be contaminated according to their proximity to sources of pollution. Contaminants such as bacteria, viruses, heavy metals, nitrates and salts have polluted water supplies as a result of inadequate treatment and disposal of waste from humans and livestock, industrial discharges, and over-utilisation of limited water resources (Adeyemi *et al.*, 2007). Contamination of well water, which has led to health risks, is known in the study area. Therefore, it becomes imperative to investigate the effect that construction pattern of hand-dug well has on water quality.

a) Study Area

Ibadan was derived from two words 'Eba Odan' meaning near savannah (Ayoade, 1979). The city is located in southwsetern Nigeria between latitudes 7° 00' and 7° 30' and between longitudes 3° 30' and 4° 00' (Figure 1). It is the capital of Oyo State. The city is located at about 128 km northeast of Lagos and 530 km southeast of Abuja. Its elevation ranges from 150 m above sea level (asl) in the valley to 275 m asl on the major North-South ridge (Lloyd et al., 1987). Ibadan is located within the undifferentiated basement complex and the rock types consist of quartzites of meta-

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(Table 1). Typical examples of the selected wells per classifications are shown in Figure 2. Other considerations include location in residential areas and accessibility.

One hundred and one (101) hand-dug wells were randomly selected from four Local Governments in the core area of Ibadan. The core area includes Ibadan North Local Government, Ibadan North East Local Government, Ibadan South East Local Government, and Ibadan South West Local Government (figure 1). The selection criteria for the wells were based primarily on construction pattern and mode of operation of the wells

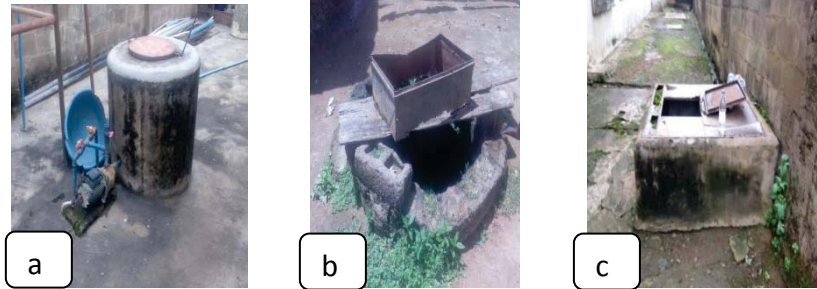
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Table 1 : Hand dug well classifications based on structure and mode of operation

Well Operation	Hand-Dug Well structures				
	LCAD	LAD	CAD	LC	NONE
Pump	P ⁺	S	S	P	U
Bucket/Rope	P ⁻	S	S	S	U

Note: L: Lining, C: Cover, A: Apron, D: Drainage, P: Protected Well, +: Best practice, -: Lower level than best practice, S: Semi-protected or missing one or more construction features, U: Unprotected or missing most of/no protective feature. Source: (Oluwasanya et al., 2011)

**Figure 2 :** Construction patterns of selected wells- a: protected well; b: unprotected well; c: semi-protected well

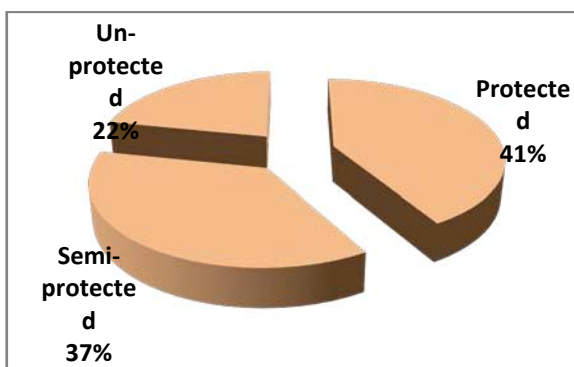
III. RESULTS AND DISCUSSIONS

The number of selected wells that fits into each well classification is presented in Table 2. Forty one

percent (42) of the hand-dug wells are protected, 37% (37) and 22% (22) of the wells are semi-protected respectively (Figure 3).

Table 2 : Number of wells within existing well classifications, type of operation, proximity to sanity facilities and number of users

Construction Pattern	Mode of Operation			Average Distance to Pollution Source		Average No of Users
	Pump	Pump/Bucket & Rope	Bucket & Rope	Toilet (m)	Burial Site (m)	
Protected Well	8	3	31	35.70	40.58	50
Semi-Protected Well	2	-	35	14.20	20.66	99
Unprotected Well	-	-	22	9.42	7.94	200
Total	10	3	88			

**Figure 3 :** Construction patterns of hand-dug wells

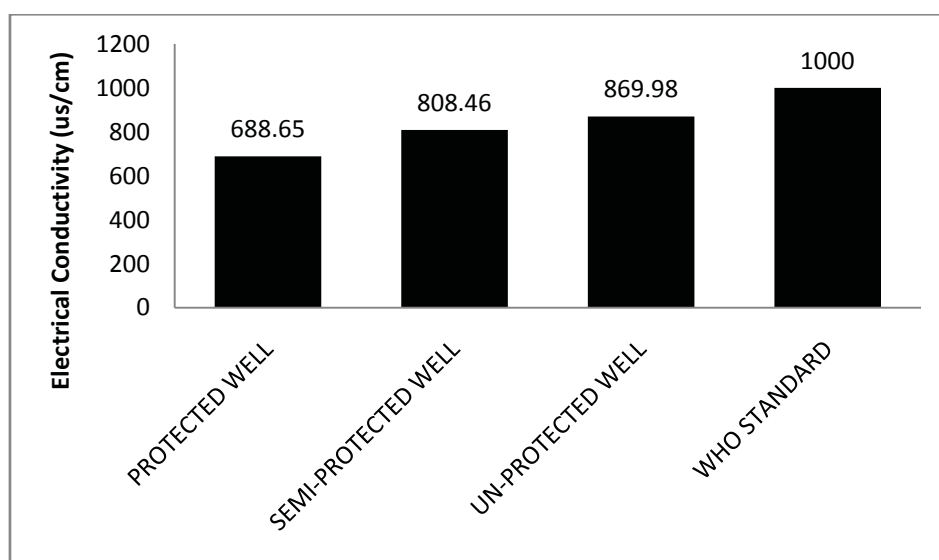
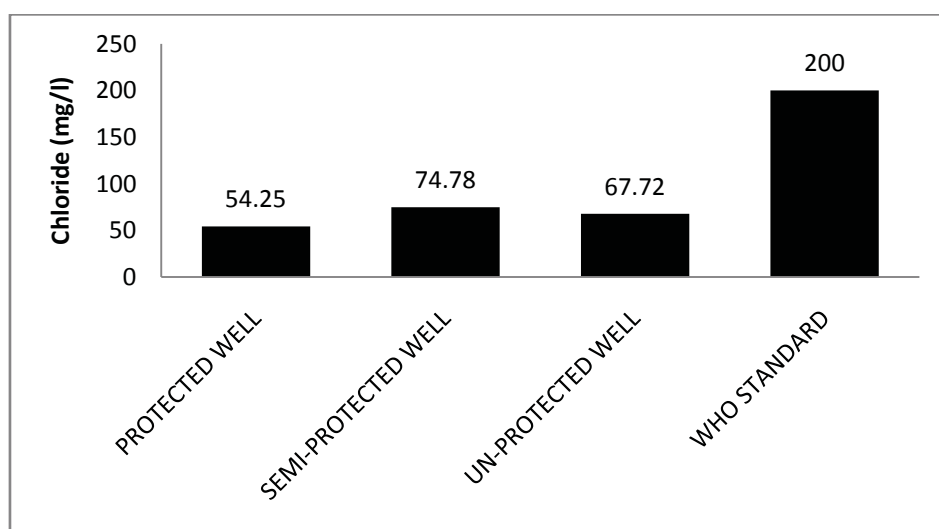
a) Hand-dug Well classification and Water Quality

The result of water analysis for different well classification is presented in Table 3. Table 3 shows that the highest average value of 869.98 us/cm was recorded for electrical conductivity in unprotected well relative to 688.65 us/cm and 808.46 us/cm that was recorded in protected and semi- protected respectively (Table 3 and Figure 4). The recorded high EC in unprotected wells may be due to direct ingress of water due to poor well construction. However, all of the recorded values are below the recommended value of 1000 us/cm (WHO, 2011; NDWQS, 2007).

Table 3 : Relationship between the average water quality status and hand dug well classifications

	EC (us/cm)	PH	TEMP (°C)	CHLORIDES (mg/l)	NITRATES (mg/l)	E.COLI (100ml/cfu)	TTC (100ml/cfu)
Protected Well	688.65	6.77	27.10	54.25	45.91	23.5	348.19
Semi-Protected Well	808.46	6.81	26.89	74.78	61.37	58.37	424.86
Un-Protected Well	869.98	6.94	26.21	67.72	56.61	74.09	685.00
WHO Standard	1000.00	6.50-8.50	27.00	200.00	50.00	0.00	10.00

The average chloride values ranges from 54.25mg/l for protected well, 74.8mg/l for semi-protected well and 67.73mg/l for un-protected well (Table 3 and Figure 5). All this values are below the recommended WHO (2011) value of 200mg/l for drinking water.

**Figure 4 :** Average level of electrical conductivity in hand-dug wells**Figure 4 :** Average values of Chlorides in hand-dug wells

Elevated nitrate were identified in the unprotected and semi-protected samples tested, with average values of 61.37 mg/l and 56.62 mg/l respectively compared to the protected well with an

average value of 43.19 mg/l (Table 3 and Figure 6). Most of the semi-protected and the un-protected wells have nitrate concentrations higher than the WHO (2011) recommended value of 50 mg/l for drinking water.

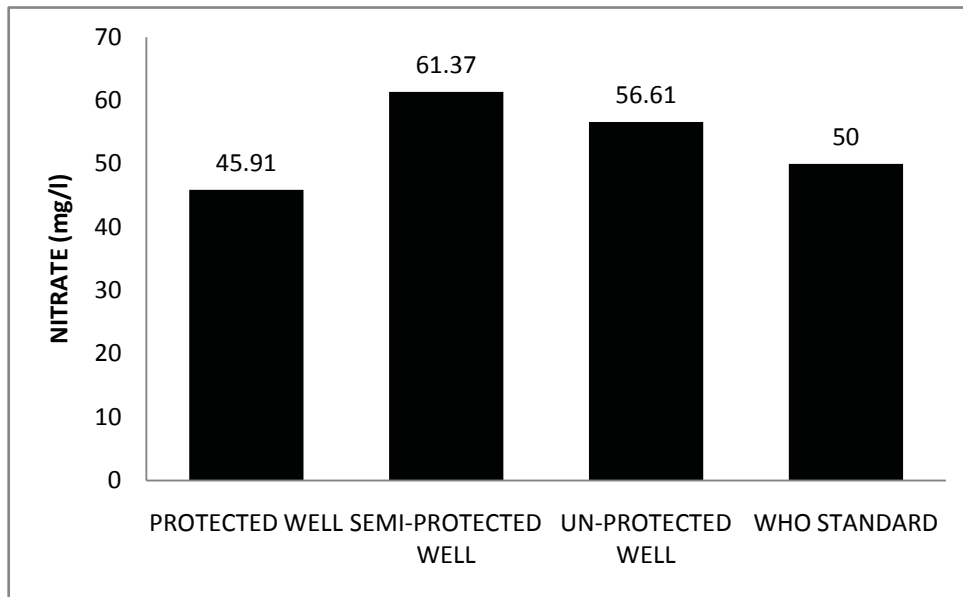


Figure 5 : Average values of Nitrate in hand-dug wells

Nitrate has known human health impacts, primarily in infants. Nitrate affects haemoglobin in the blood and reduces the babies' ability to transport oxygen; infants so affected are said to have 'blue baby syndrome'. There is also a 'suspected link between exposure to nitrate and cancer in human (WHO, 2004). The most common origins of nitrate in groundwater within the study area are agricultural activities and disposal of untreated human waste.

Furthermore, the results showed that all water samples contained E. coli that does not conform to the maximum contaminant level of 0cfu/100ml. The E. coli in protected well ranges between 0-90cfu/100 ml, while in semi-protected and unprotected well, it ranges from 0 - 120cfu/100ml and 0 - 270cfu/100ml respectively (Figure 7).

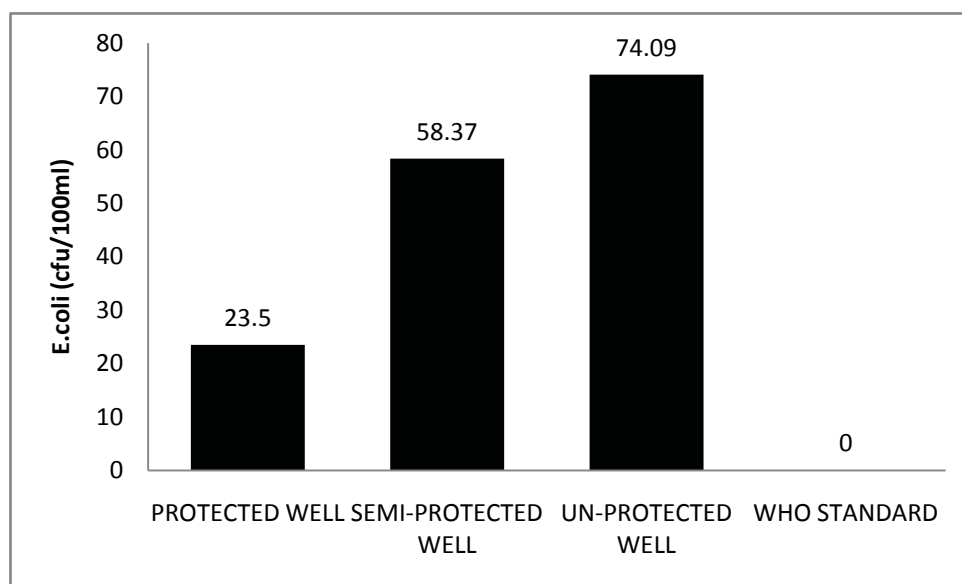


Figure 6 : Average values of E. coli in hand- dug wells

Effects of the presence of *E. coli* in water include: Urinary track infections, bacteraemia, meningitis, diarrhea, (one of the main cause of morbidity and mortality among children), acute renal failure and haemolytic anaemia (WHO 2006).

From the result of the analysis on TTC, it was observed that all the tested samples have detectable

amount of TTC, with concentration ranging from 0-1260 cfu/100 ml for protected, 120-840cfu/100ml for semi-protected and 210-1420cfu/100ml for unprotected wells (Table 3 and Figure 8), as against the WHO (2011) acceptable limit of 10 cfu/100ml for potable water. This is an indication of faecal contamination.

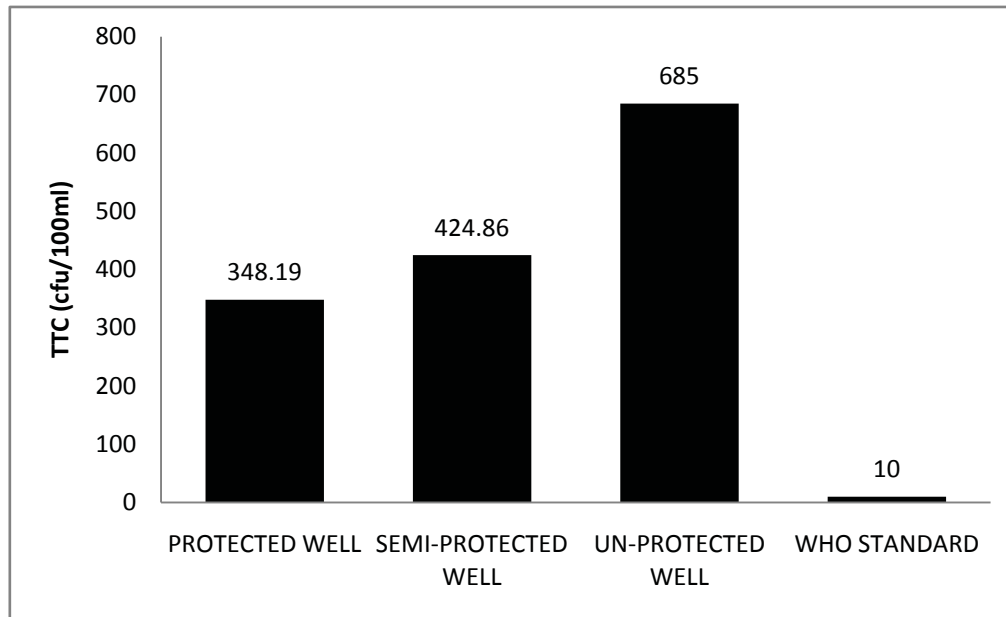


Figure 7 : Average values of Total Coliform Count in hand-dug wells

b) Hand-dug Well Classification and Mode of Abstraction

Observations during survey shows that possible contamination during abstraction because 3% of the hand-dug wells were operated with both pump and bucket & rope while 10% are operated through a motorized pump and 87% of the hand-dug wells were operated through bucket and rope gotten from different sources. This implies that high level of contamination during abstraction will be expected (Table 3 and Figure 8).

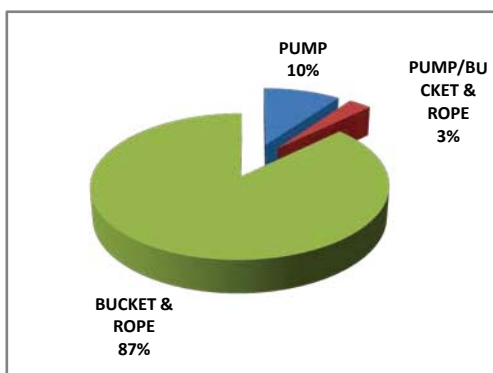


Figure 8 : Means of hand-dug wells Abstraction

Poor well design and construction can also contaminate groundwater by allowing polluted surface

water to reach the groundwater without filtering through soil. Wells constructed in pits, or built without being sealed or without a cap, may allow infiltration of contaminated surface water to carry bacteria, nitrates, pesticides, fertilizer, or oil into the drinking water supply. Proper well design and construction reduce this risk by sealing the well from contaminants that might enter from the surface.

c) Hand-dug Well Classification Versus Well Location

Proper location of hand-dug well is important to water quality. Locating a well in a safe place takes careful planning and consideration of surface drainage and possible contamination sources. A well downhill of pollution source has a greater risk of contamination than a well uphill of pollution sources. Similarly, as expected and as shown in this study, the greater the distance a well is from a potential contamination source, the less likely the well will be contaminated directly by that source. The Mississippi State Department of Health requires that a new well be installed at least 15.24 m from a septic tank and at least 30.5 m from the septic system drain field. These are *minimum separation distances*, and a well must be installed farther away from all pollution sources if possible.

Therefore, as presented in the result above (Table 3) an unprotected well with distance 9.42 m from pollution source has a greater risk of contamination

relative to the semi-protected and protected hand-dug wells with 14.20 m and 35.70 m respectively from pollution sources.

d) Well Age and Total Number of Users

The average age for Protected, Semi-protected and Un-protected hand-dug wells are 13 years, 32 years and 48 years respectively (Table 3). Age of well can be an important indicator of its ability to keep out contaminants. Hand-dug well of more than 70 years old is more likely to be shallower, located at the center of homestead, and surrounded by many potential contamination sources. Older well pumps are more likely to leak lubricating oils into the well. Older wells also are more likely to have thinner casing that may be corroded and allow in a contaminant. Even wells 30 to 40 years old may be subject to corrosion.

IV. CONCLUSION

The paper shows that the use of bucket and rope in the abstraction of water from hand-dug wells may contribute to increase in contamination of water in the wells irrespective of the well classification. Judging the importance of each of the well category in the study area, the use of protected wells design has been proven to be the best for proper hygiene and protection of wells. However, the combined effects of installing wells close to sanitary facilities, waste dumps, industrial effluent discharge area and burial ground, contributes significantly to high pollution of wells, resulting in the deterioration of the quality and its potential public health risk. Hence, there is therefore the need for a periodic water quality monitoring and incorporation of household water treatment practices with hand-dug well water. Upgrade of semi-protected and unprotected wells is recommended, and public enlightenment on water quality is necessary to forestall potential public health treats from such sources.

REFERENCES RÉFÉRENCES REFERENCIAS

1. Adeyemi, O., Oloyede, O.B., Oladiji, A.T., 2007. Physicochemical and microbial characteristics of leachate-contaminated groundwater. *Asian J. Biochem.* 2 (5), 343–348.
2. Ayoade, (1979), Land use changer and water quality in impounded water supply dams. Public perception of flood hazards in Niger Delta.
3. Collins s (2000), Hand dug shallow wells. SKAT publications, St. Gallen, Switzerland.
4. Cosgrove, W.J. and F.R. Rijsberman, 2000. *World Water Vision: Making Water Everybody's Business*. Earth scan Publication Ltd., UK, ISBN:185383730X, pp: 108.
5. Gomez, J.D. and A.C. Nakat, 2002. Community participation in water and sanitation. *Water Int.*, 27: 343-353. DOI: 10.1080/02508060208687014.

6. Lloyd, D. S., J. P. Koenings, and J. D. LaPerriere. 1987. Effects of turbidity in fresh waters of Alaska. *North American Journal of Fisheries Management* 7:18–33.
7. Murcott, S. (2007), *Water sources (improved and un-improved) and water supply*, MIT 11.4 79 J/1.851J, March 5, 2007, WATSAN planning, <http://ocw.mit.edu/NR>.
8. National Bureau of Statistics (2006), Nigeria provisional results for 2006 population census.
9. Oluwasanya (2009), *Better Safe than Sorry: Towards Appropriate Water Safety Plans for Urban Self Supply Systems in developing countries*, Phd. Thesis, Cranfield University. 459 pp.
10. Oluwasanya, G., Smith, J., and Carter, R (2011): Self Supply Systems: Urban dug wells in Abeokuta, Nigeria, *Journal of Water Science and Technology: Water supply*, Vol. II (2), IWA, UK, pg. 172 - 178.
11. Seamus C. (2000), Hand dug shallow wells, principles of Hand dug wells. Series manuals on drinking water supply. Vol. 5, pp 29-33.
12. Shimizu T., Agatomo H., Kigotake T. (1980), Bacteria contamination of drinking water from wells in Miyazaki, Miyazaki University, Japan, Pp 21-28.
13. UNICEF., 2005. National Rural water supply and Sanitation investment program. Final draft, 1 pp.
14. Watt S., Wood W. (1977) hand dug wells and their construction (London IT publication).
15. WHO (2004), Guidelines for drinking-water Quality, Health Criteria and other supporting Information, 2nd Edition, Vol. 2, World Health Organization, Geneva.
16. WHO (2006), Guidelines for drinking-water quality: Recommendations, 3rd Edition, WHO, Geneva Switzerland.
17. WHO (2011): Guidelines for drinking-water quality, World Health Organization, Geneva.

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1. General,
2. Ethical Guidelines,
3. Submission of Manuscripts,
4. Manuscript's Category,
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- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.



- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently. You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.



Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.



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Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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