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ABSTRACT

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Software development studies were conducted on the Metrological Parameter Conversions for Agribusiness and Agro-Engineering Matric system Development in Bangladesh with the major objectives to know the indigenous agrometrological units, to formulate the respective conversion Coefficients, and to prepare selective Agrometrological ready recorner. The studies were conducted involving primary data collection and analysis and finally developing one ready-use software by different sectors of clients including agriculturist and agribusiness professional. Formulae recommendations included: katha, decimal, acre ara, Butha, kani, pura, hectare kuchi, bigha, seer, Dhari, kg, maund, gha, gonda, pon,, kora, nal, hands, tirpi kani, dron, ari, pia, kuri ghati, hali, pakhi, bira, choli, and Bisha etc. The software developed was given detailed trials with users and found acceptable at the precision level. It is recommended that use of this software will increase the competency of beneficiaries significantly. It was strongly recommended that this software may be easily uploaded in computers for instant use by the technical Field Officers of Agriculture and Engineering service Departments.

Key words: agro-metrology, SI Units, unit conversion indices, agro-engineering units

INTRODUCTION

Metrology is defined by the International Bureau of Weights and Measures (BIPM) as "the science of measurement, embracing both experimental and theoretical determinations at any level of uncertainty in any field of science and technology. The ontology and international vocabulary of metrology (VIM) is maintained by the International Organization for Standardization. Industrial metrology concerns the application of measurement science to manufacturing and other processes and their use in society, ensuring the suitability of measurement instruments, their calibration and quality control of products. Unit of counts and measurement was a subject of invention from time immemorial. What may be said is that the unit of measurement is the mother of all sciences, which has been developed through continuous formulation and conversions using mathematical principles. But for international acceptability as per Standard International (SI), the conversion of local indigenous units has become very much important for quality standards and measurement (Leconte 1904). According to Thompson and Taylor (2008) reported that the conversion of mathematical formulae in the current world was a very important aspect of business modernization specially of agricultural commodities. Thousands of localized units were in use throughout the region in all cases of land area, volume and weight of products, length of materials and routes. Metrology is the science of measurement. Metrology includes all theoretical and practical aspects of measurement. The word comes from Greek μέτρον (metron), "measure + "λόγος" (logos), amongst others meaning "speech, oration, discourse, quote, study, calculation, reason. In Ancient Greek the term μετρολογία (metrologia) meant "theory of ratios". Amin (1998, 2004) in a publication suggested about metrology and use of metric units in Bangladesh, that the local diversified units need to be mathematically converted to uniform standards. For example there are about 5 types of Bigha, 4 types of Katha, 3 types of Tola and Seer, etc. are available which need to be converted to (SI; Anon. 2006; USDA 2009) about 45 units have been developed though body points of human which are in use in the rural areas of Bangladesh. Practically about 500 types of measurement units may be found in about different 500 Upazila/Thana in Bangladesh which need to be formulated mathematically developing for easy and correct formula for its acceptable conversion. The IT companies of the world are now developing professional calculator, the Google/Yahoo/MSN which have been developed and served software for instant conversion of units for different countries (Williamson 2008). A core concept in metrology is metrological traceability defined by the BIPM as the property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons, all having stated uncertainties. In the context the present piece of research was undertaken to achieve outputs on computer software development on the metrological conversions for indigenous agro-engineering and market business units as to make technical administration easy. The specific objectives of the studies were to know the parameter variations, parameter priority and preparing conversion matrix as a foundation process of making one farmer friendly ready recorner.

MATERIALS AND METHODS

The materials and methods of the studies mainly included collection of locally utilized units, developing the formulae invention and finalizing the compatible software parameter series units. The questionnaire formats were structured as per directives given by different workers (Alder 2002; NWML 2008; USA 2010; Majcen and Taylor, 2010 and Warwick 2007). The major study tools were survey through a technical questionnaire for

priority scores and Agrometrological calculations for coefficients. In all 55 sites covering local agricultural, mathematics and agribusiness units. The software course used in the study are given in the Table 1.

Table 1. Software code and formulae used for the conversion matrix (as example)

Code.	a. Bigha ha	b. Deci acre	c. Acre ha	d. Paki bigha	e. Kani	f. Deci katha	g. Khata acre	Formulae standards
01					0			1 kani=1 bigha= 30 decimal, 1 dhone=20 bigha.
02	0						0	1 katha=2.25 dec. 1 bigha=46 dec.
03		0		0				1 kani=30 dec.
06		0	0					1 pakhi=33 dec. 1 bigha=52 dec.
07	0		0					1 bigha=33.33 dec.
57		0	0					1 pakhi=30 dec.
58	0						0	1 katha=5 dec. 1 bigha=5 katha.
59	0					0		1 katha=2.5 dec. 1 bigha=33-decimal.

RESULTS AND DISCUSSION

The results obtained from the studies are sequentially mentioned here. The results and its outputs are presented here in both tabular and graphical forms.

Characteristics of the respondents

The profiles of some respondents selected at random are mentioned in the Table 2 and 3. The results show that about 88% of the respondents were minimum graduate. About 27% respondents were science graduate. The characteristics of the respondents indicate that the data and conversion elements thus collected were in the acceptable level.

Table 2. Characteristic features of the contributing respondents: 7 persons in each group

District	Upazila	Qualification	Profession
Brahman-baria	Akhaura	M. Sc. (TE)	Service
Jhenidah	Horinakundu	M. Com.	Service
Sunamganj	Doara Bazar	B. A.	Banker
Chandpur	Shahrasti	B. Sc. (TE)	Teaching
Comilla	Debidwar	B. Sc. (TE)	Teaching
Faridpur	Boalmari	B. Sc. (TE)	Teaching
Kishoreganj	Mitamain	S.S.C.	Service
Manikganj	Manikganj	B. Sc. Eng. (Civ)	Teaching

Agrometrology relating to agro-engineering units of measurements and weights of agricultural commodities, and inputs in mass, volume, land area, and number. It is interesting to note that Bangladesh has its own metrologies from time immemorial for local use by farmers and businessmen. Different districts have their own agrometrology systems greatly varying in nomenclature and measuring units. However, the Government of Bangladesh introduced the metric system of measures from 1982 through an Ordinance. Although there exist a great diversity of agrometrological units in different parts of the country, these however bear some relationship with Standard International. Illustrations of human physical tools instantly used in the rural areas are given in the Fig. 1. The previous results and outputs on unit conversion found similar of such work (Bhuiya *et al.* 2012).

Table 3. Traditional Measuring Units used in different areas of the country

Name	Local units	National and SI units
Length, distance	Inch, Hand, Modoom, Leg, Palm, Finger, Bigat, Foot, Yards, Gira, Furlong, Crosh, Mile	Centimeter, Meter, Kilometer
Area	Decimal, Bigha, Ganda, Khuchi, Kuni, Kiar, Katha, Pakhi, Kani, Ara, Pura, Butha, Acre	Are, Hectare
Volume	Katha, Pura, Pint, Gallon, Motka, Tin, Jug Glass, Cup, Spoon, Bottle	Cubic Meter, Liter
Mass (weight)	Tola, Kacha, Bhutha, Chatak, Poa, Seer, Maund, Dhara, Ari, Kati, Pairi, Palla, Muth, Lap.	Kilogram, Gram

Prioritized unit combinations:

Netrakona, Sunamganj
1 Katha = 10 Decimal, 1 Acre = 10 Katha
1 Ara = 16 Katha = 160 Decimal, 1 Butha = 5 Katha = 50 Decimal
1 Kani = 33.5 Decimal, 1 Pura = 16 Ara
1 Decimal = 0.1 Katha, 1 Hectare = 24.7 Katha
1 Katha = 4 Kuchi,

Manikganj, Mymensingh
1 Bigha = 33 Decimal = 5 Katha, 1 Katha = 6.75 Decimal
1 Khuchi (Paddy) = 1.75 Seer, 1 Pura = 33/30 Decimal

Feni, Lakshmipur
1 Korha = 1.5 Decimal = 6 Nal ×1 Nal (1 Nal =7 Hands)
1 Ganda = 4 Korha, 1 Kani = 4 Ganda, 1 Kani = 4 Kuni
1 Tirpi Kani = 20 Ganda = 1.2 Acre, 1 Dron = 16 Kani
1 Ari = 10 Seer/16 Seer, 1 Pia = 14 Pura, 1 Kuri (Banana) = 24 (numbers)

Rajbari, Faridpur
1 Bigha = 52 Decimal, 1 Acre = 100 Decimal, 1 Ghati = 1 Seer
1 Pon = 20 Hali, 1 Hali = 4 (numbers), 1 Ganda = 4 Hali

Munsiganj, Dhaka
1 Pakhi = 26 Decimal, 1 Bigha = 3 Pakhi, 1 Katha = 20 Pakhi
1 Bira (Betel Leaf) = 20 Ganda = 80 (numbers), 1 Choli = 5 Ganda = 20 (numbers)
1 Hundred (Mango) = 112 (numbers), 1 Bisha (Fish) = 32 (numbers)

Noaga, Bogra
1 Bigha = 20 Katha = 33 Decimal, 1 Dhara = 5 Seers
1 Kati (Rice) = 20 Seers

Narayanganj, Comilla
1 Kani = 1.80 Acre/30 Decimal = 120 Decimal, 1 Sai Kani = 20 Ganda = 4 Kuni
1 Ganda = 9 Decimal = 4 Korha, 1 Kuni = 5 Ganda, 1 Kuri (Fish) = 25 (numbers)
1 Kuri (Banana) = 25 (numbers), 1 Seer (Land) = 3 Decimal, 1 Chatak (Land) = 1/640 Kani

Natore, Pabna
1 Gha (Betel Nut) = 10 (numbers), 1 Pakhi = 29 Kani = 27 Decimal
1 Bigha = 33 Decimal, 1 Mone (Paddy) = 20 Katha, 1 Dhara = 5 Seers

Narsingdi, Gazipur
1 Pakhi = 35 Decimal, 1 Seer (Milk) = 105 Tola, 1 Khara = 5 Seers
1 Maund (Fuel Wood) = 10 Pahar, 1 Hali (Banana) = 5 (numbers)
1 Khata (Rice) = 5 Seers

Rajshahi
1 Bigha = 33 Decimals, 20 Katha = 1 Bigha, 1 Katha = 1½ Decimal
40 Seer = 1 Maund, 1 Dhari = 5 Kg, 1 Poa (Betel Leaf) = 32 Bira
1 Bira = 64 (numbers) = 16 Ganda, 20 Ganda (Mango) = 1 Pon
1 Pon = 80 (numbers)

Sirajganj, Tangail
1 Bigha/Pakhi = 30 Decimal, 1 Khada = 16 Bigha, 1 Korha = 4 Ganda
1 Dhara = 5 Seers, 1 Hali (Mango) = 5 (numbers), 1 Seer = 80 Tola
1 Seer (Milk) = 105 Tola, 1 Kuri (Fish) = 22 (numbers)

Madaripur, Barisal
1 Korha = 4 Ganda, 1 Korha = 2 Decimal, 1 Kati = 20 Decimal
1 Acre = 100 Decimal, 1 Kura = 160 Decimal, 1 Kathi = 22 Seers
1 Seer (Keroshine oil) = 60/100 Tola, 1 Kuri (Betel Nut) = 22 (numbers)

Meherpur, Kushtia
1 Bigha = 33 Decimal, 1 Acre = 100 Decimal, 1 Par = 80 (numbers)
1 Pakhi = 60 Decimal, 1 Dhari = 5 Seers

Bagerhat, Khulna
1 Dhari = 5 Seers, 1 Bigha = 66 Decimal
1 Chunia = 15 Seers, 1 Katha = 30 Seers

Coxs Bazar, Chittagong
1 Kani = 160 Decimal/40 Decimal, 1 Ganda = 4 Korha/2 Decimal
1 Ari (Paddy) = 18 Seers, 1 Maund = 4 Ari

Chandpur, Noakhali
1 Kani = 120 Decimal,1 Kani = 20 Ganda
1 Ganda = 4 Korha, 1 Korha = 1.5 Decimal
1 Bira (Betel Leaf) = 18 Ganda = 72 (numbers)
1 Maund = 40 Seers

Joypurhat, Gaibandha
1 Bigha = 33 Decimal, 1 Bigha = 20 Katha, 1 Acre = 100 Katha
1 Bira (Betel Leaf) = 16 Ganda, 1 Ganda = 4 (numbers), 40 Seers = 1 Maund

Kurigram, Rangpur
1 Bigha = 2.5 Doan = 60 Decimal, 1 Doan = 4 Poa, 1 Hali (Fish) = 7 (numbers)
1 Dhara = 5 Seers, 1 Mon = 8 Dhara = 40 Seers

Panchgar, Dinajpur
1 Bigha = 48 Decimal, 1 Bigha = 20 Katha, 1 Gha (Betel Nut) = 10 (numbers)
2 Ganda = 1 Pon, 1 Dhari = 5 Kg, 8 Dhari = 1 Maund
Hundred (Betel Leaf) = 16 Ganda = 64 (numbers)
1 Korha = 2 Decimal

I Hand = 16-17 inches female	I Hand = 17-19 inches male
1 Bighat 6.5-7.5 inches man and woman, 1 Gira 8-10 inches man and woman	1 Leg step = 15-18 inches female, male 17-20 inches
Cups volume variable	Spoons knifes variable

Fig. 1. Few examples of indigenous or traditional units/tools and its mean average measures studies

Software Outputs

The software developed from the research for various parameters including land area weight measure, volume weights, length and distance, time etc are given in the Fig. 2 and 5.
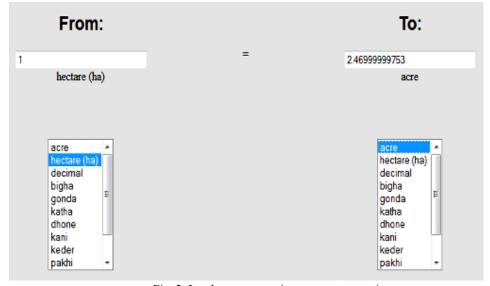

Fig. 2. Land area conversion parameter matrix

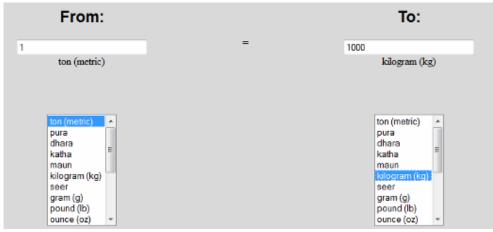Fig. 3. Land area conversion software language

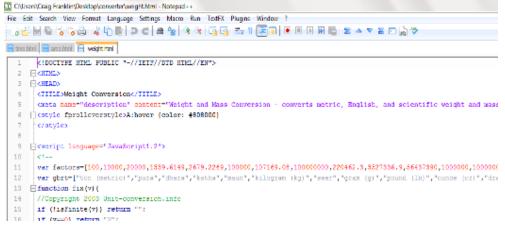Fig. 4. Metrology weight unit conversion format

Fig. 5. Metrology weight unit conversion software language

CONCLUSION

It is strongly concluded and recommended to prepare a ready reconer both in printed and electronic forms using the outputs of this research. Concluding formulae recommendations as software parameter typically include: Katha, decimal, Ara, Butha, Kani, Pura, Hectare, Kuchi, Bigha Khuchi Seer, Dhari, Dhari Maund, Gha (Betel nut) Gonda, Pon, Kora, Kani, Nal, Hands, Tirpi Kani, Acre, Dron, Ari, Pia Kuri Ghati, Hali, Pakhi Bira (Betel Leaf), Choli, Bisha (Fish), with respective conversion coefficients used in the process of softaware development and obtaining instant outputs. This may directly used by the respective Technical Field Officer uploading in own computers.

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