

CHAPTER I

Introduction

The word extension is derived from the Latin roots “*ex*” meaning “out” and “*tension*” meaning “stretching”. Extension education is stretching out to the people who are beyond the limits of educational institutions. The National Commission on Livestock (1976) refers to extension as an out of school education and services for the members of the farm family and others directly or indirectly engaged in farm production to enable them to adopt improved practices in production, management, conservation and marketing. Extension involves the conscious use of communication of information to help people to form sound opinions and make good decisions (**Van and Hawkins, 1996**). The main objective of all extension work is to teach people living especially in rural areas how to raise their standard of living by their own efforts using their own resources of manpower and materials with the minimum assistance from Government (**Leagans, 1960**).

Information Communication Technologies (ICTs) refer to hardware, software, networks and media for collection, storage, processing, transmission and presentation of information in the format of voice, data, text and images (**World Bank, 2002**). The potential of ICTs to contribute to livestock and rural development has been well recognized (**Singh, 2006**). Information and knowledge are indispensable tools for empowering livestock producers so that they will be able to make informed decisions. Globally, the development of ICT has proven its potentials for enhancing development efforts, but also virtually reduced the distance and turned the world into a global village (**O’Farrell, 2003**). Worldwide, ICTs are playing a vital cross-cutting enabler role to address many problems. It should be noted that several types of ICT (Radio, TV, internet, wired/wireless network, mobile phones, GPS, computer, fax, multimedia CDs, video/tele conferencing, instant messaging, magazine, newspaper etc.) have contributed positively to the development of this country as a source of information in commerce, industries, livestock, education, health, sports, culture and tourism and even religion. There are different ICTs including computers, internet, geographical information systems, mobile phones and traditional media (radio, television) which are used in delivering livestock information to the farmers (**Stienen et al., 2007**). In different parts of the world ICTs are seen to have positively contributed towards rural development. **Fu and Akter (2010)** indicated that extension workers use ICTs to gather, retrieve, adapt, localize and disseminate a broad range of information needed by rural families. Also **Singh (2006)** indicated radio and TV programs to have helped the farmers to receive support for improved crop production, quality control methods, processing, packaging and marketing. This shows that ICTs have helped to fill the gap that exists in extension service provision. Therefore, effective use of ICTs in livestock extension system can lead to the improved livestock productivity and perhaps realization of the first Millennium Development Goals (MDG).

In the era of globalization, Information and Communication Technology (ICTs) is the most powerful resource for the widespread transfer and sharing of information (**Lewis, 2009**). It is the convergence of media (print, audio, video, multimedia etc.) made possible by a common

digital platform (**Roy, 2009**) and it is perceived to have the potential to boost economic, social and political development, contributing toward the progress of humankind as a whole (**Rue, 2011**). It can send fast, consistent and exact information in a user-friendly manner for practical application by the end user (**Venkatesh et. al., 2012**). ICTs can be used to enable, strengthen or replace existing information systems and networks. Its utilization in livestock can promote and distribute new and existing farming information for bringing social and economic changes (**Swanson et. al., 2010**). ICT could be the best solution for effective spread of livestock related information and technologies. Hence, Government of Bangladesh has recognized ICT as the mainstream development tool to lift the economic and social status of the citizens of Bangladesh under the vision 2021 (**Menon et. al., 2014**).

The livestock is a thrust as a sub-sector for economic development of Bangladesh. Livestock is an integral component of the complex farming system in Bangladesh not only a source of meat protein but also a major source of farm power services as well as employment. The livestock sub-sector provides full time employment for 20% of the total population and part-time employment for another 50%. The poultry meat alone contributes a substantial 37% of the total meat production in Bangladesh (**Begum et al., 2011**). Moreover, livestock products, namely, leather and leather products, hides and skins are important exportable items contributing about 13% to total foreign exchange earnings during the 1970s and 1980s (**Rahman and Bhuiyan, 1991**). Therefore, given versatile nature of the potential contribution offered by the livestock sector are livelihood development tools for poor and pro poor, employment and income generation and poverty reduction, nutrition, food security and safety, and social safeguards, export earnings, rising demand and scope of increased productivity, renewable energy and soil health, value addition and supply chain development. Poultry and dairy farming has some comparative advantages over crop, fishery and forestry as they require less land, small capital and is least influenced by seasonal changes.

According to the estimate of the Department of Livestock Services (DLS), the population of livestock and poultry were 535.90 lakh and 3,041.72 lakh respectively in FY 2013- 14. The production of animal protein like milk, meat (beef, mutton, chicken) and eggs have been increasing over the past several years. As a result, per capita availability of animal protein is rising. Bangladesh is an livestock oriented country because the majority of her population is based in the rural areas and these people heavily depend on livestock as a source of animal protein and their livelihood.

There is no study on uses of ICT in livestock extension services in Bangladesh. Few activities are conducted in public sector through DLS. So, keeping this in view the proposed study was aimed at the following objectives:

- To identify the ICT tools for livestock extension services.
- To identify the livestock development issues/sectors for intervention of ICT tools.

CHAPTER II

Methodology

Data on livestock resources, livestock population and were taken from Bangladesh Economic Review (2015). Policy information was taken from National Livestock Extension Policy (Mia, 2013) prepared by DLS. Agro-based TV program and time schedule were collected from different electronic and print media. Website of different magazine and important public organization related to livestock were collected from print media and internet. Other relevant information from internet, journals, articles, and published paper by researcher has been used in preparing this article. All of the secondary data were documented, characterized, visualized, assessed and summarized to explore the potentialities of ICT tools for livestock extension services in Bangladesh. Intervention of ICT tools for better implementation of livestock extension policy is presented in Table 1. Popular Agro-based TV program in Bangladeshis is shown in Table 2. Important website related to livestock in Bangladesh is given in Table 3.

Table 1: Intervention of ICT tools for better implementation of livestock extension policy

Livestock development Issue	Intervention of ICT tools	Responsible organization	
		public	private
Institutionalization of livestock extension policy	Computer, fax, phone, internet, website, e-mail	MOFL, DLS	
Preparation of guidelines for coordination and supervision	Computer, fax, phone, internet, website, e-mail	MOFL, DLS	NGOs and private entrepreneur
Enabling environment for both public and private sectors	Computer, fax, phone, internet, website, e-mail	MOFL, DLS	
Farmers' organization Producers' organization	Computer, fax, phone, internet, website, e-mail	MOFL, DLS	NGOs and private entrepreneurs

Research – extension –farmers’ linkage	Computer, fax, internet, website, e-mail, GPS, video conference, multimedia CDs	MOFL, DLS, BLRI, Agril. Universities	NGOs, Donor agencies, Producers organizations
Cross cutting issues in livestock extension services	Radio, TV, internet, website,e-mail, GPS, video conference, multimedia CDs, Print media	Public sectors	NGOs, Investors, Entrepreneurs
Training & skill developmen	Computer, internet, website, e-mail, multimedia CDs	DLS, Universities, DYD	NGOs, private sector, poultry worker, livestock volunteers
Advisory services on farm management and husbandry practices	Mobile phone, Radio, TV Computer, internet, website, e-mail, multimedia CDs,	DLS, BLRI, BRDB, DYD, Universities	NGOs, private entrepreneur
Advisory services on primary healthcare	Mobile phone, Radio, TV, Computer, internet, website, e-mail, multimedia CDs	DLS, BLRI, DYD, BRDB, Universities	Pharmaceutical companies, vaccinator, paravets, NGOs
Commercial inputs and machineries supply	Computer, internet, website, e-mail, multimedia CDs, Mobile phone, fax	MOFL, DLS,BLRI	Pharmaceutical companies, NGOs, Input suppliers.
Credit delivery	Computer, internet, website, e-mail, Mobile phone, fax, instant messaging	DLS, BLRI, DYD, Social Welfar	NGOs and private sector
Breeding material	Computer, internet, website, e-mail, multimedia CDs	DLS, BLRI.	NGOs, Private sector
Quality control of vaccines and feeds	Computer, internet, website, fax, e-mail, multimedia CDs, phones	MOFL, DLS, BLR	

Marketing of livestock products	Mobile phone, Radio, TV, Computer, internet, website, e-mail, multimedia CDs	MOFL, DLS, BLRI, etc.	NGOs, Private sector
Hides and skin, Slaughter house by products	Radio, TV, Computer, internet, website, multimedia CDs, phone	MOFL, DLS, MOI.	Private Investors.
International trade management	Computer, fax, phone, internet, website, e-mail	MOFL, DLS, DAM, (LG)	Milk Vita NGOs and Private sector
Public Private Partnership (PPP)	Computer, fax, phone, internet, website, e-mail	MOFL, DLS, BLRI	NGOs, Private investor

*MOFL- Ministry of Fisheries and Livestock, DLS- Department of Livestock Services, BLRI- Bangladesh Livestock Research Institute, DYD Department of Youth Development MOI- Ministry of industry, DAM- Department of Livestock Marketing

Table 2: Popular Agro-based TV program in Bangladesh

TV Channel	Program and time schedule
B TV:	1.Mati o Manush (Sunday, 7.00 pm) 2.KrishiDibanishi (Monday, 7.00 pm)
Channel I:	1.HridoyeMati o Manush (Saturday, 9.35 pm) (Thursday, 3.05 pm) 2.KrishiShangbad (Daily, 5.20 pm)
Bangla Vision	Shamol Bangla (Monday, 6.30 pm) (Thursday, 7.05 pm)
Boishakhi Television	Krishi o Jibon (Sunday, 8.20 pm)
G TV	Shobuj Bangla (Friday, 8.10 pm))
ATN Bangla	Matir Shubash (Monday, 4.20 pm)

Table 3: Important website related to livestock in Bangladesh

Organization/ Magazine	URL
Ministry of Fisheries and Livestock	http://www.mofl.gov.bd
Department of Livestock Services	http://www.dls.gov.bd
Bangladesh Livestock Research Institute	http://www.blri.gov.bd
Livestock Information Services	http://www.ais.gov.bd
Krishi Barta	http://www.krishibarta.org
Agro Bangla	http://www.agrobangla.com
Krishi Bangla	http://www.krishibangla.com
Krishi Market	http://www.krishimarket.com
e- Krishi	http://www.ekrishi.com

Table 4: Livestock population of Bangladesh (in lakh number)

Livestock species	2015-2016	2016-17	2017-18
cattle	237.85	239.35	240.86
buffalo	14.71	14.78	14.85
sheep	33.35	34.01	34.68
goat	257.66	259.31	261.00
Total Ruminant	543.57	547.45	551.39
Chicken	2683.93	2751.83	2821.45
duck	522.40	540.16	558.53
Total poultry	3206.33	3292.00	3379.98
Total livestock	3749.90	3839.45	3931.37

Table 5: Contribution of Livestock and Poultry in the National Economy of Bangladesh (2017-18)

Contribution of Livestock in Gross Domestic Product (GDP) (Constant Prices)	1.54%
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GDP growth rate of Livestock (Constant Prices)	3.40 %
GDP volume (Current prices) (Million Taka)	396246
Share of Livestock in Livestock GDP (Current prices)	13.62%
Employment (Directly)	20%
Employment (Partly)	45%

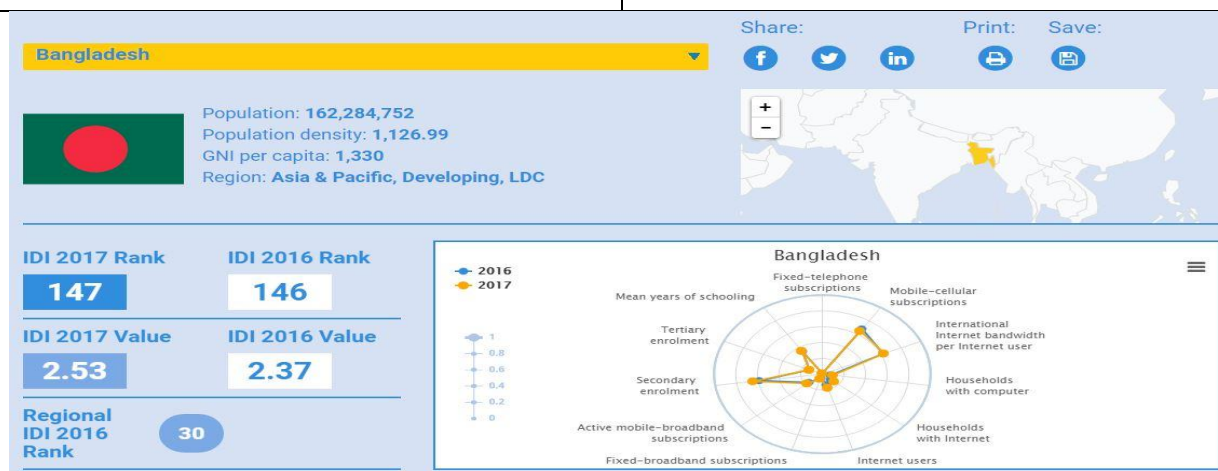
Table 6: Livestock contribution in GDP

	2015-2016	2016-2017	2017-2018
GDP (Base: 2005-06)*	1.66	1.60	1.54
Growth rate of GDP	3.21	3.32	3.40

*GDP calculated at constant price (Source: BBS); *P denotes Provisional; Livestock Economics Section, DLS.

Table 7: ICT Development Index of Bangladesh

Time (Year)	IDI (ICT Development Index)
2002	1.02
2007	1.34
2008	1.31
2010	1.61
2011	1.62
2012	1.90
2013	1.97
2015	2.27
2016	2.37
2017	2.53



CHAPTER III

Findings and Discussion

Present status of ICT uses in livestock of Bangladesh:

With a view to making DLS IT enable, a Management Information System (MIS) has been established in DLS and a total of 470 internet connection has been given to exchange information quickly between the head quarter and field offices. Local Area Network (LAN) has been established in DLS. All computers in DLS have been brought under this LAN. One high powered Mbps internet connection for 80 computers has been taken on lease from BTCL. Apart from this, extension of Web enables Geographical Information System (GIS) based MIS software development up to upazila level is in progress. SMS gateway system is continuing for diseases control for farmers and now a day its being efficiently used by them.

Scope of ICT in proposed National Livestock Extension Policy:

The development issues of National Livestock Extension Policy (NLEP) are many and some of them are directly linked to the implementation of the policy. But there are many cross cutting issues also within the broader spectrum of livestock development of the country. Few development issues considered to be important are discussed followings:

Food Security and Malnutrition:

Development of livestock could enrich the main protein source of milk, meat and egg for balancing and nutritious foods. Boosting up of livestock and poultry production, of course, enrich food basket and can be considered as an important frontier towards augmenting overall food production in the country. The motto of livestock extension services should be production oriented through the following initiatives:

- (i) Improvement of quality and productivity of livestock by strengthening research extension-farmer's linkages;
- (ii) Ensure development of animal health care services particularly for the control of parasitic and infectious diseases;
- (iii) Investment assistance for expansion of marketing network for production technologies, input supply, improved technology for preservation and marketing of livestock products;
- (iv) Support development and expansion of technologies for the resource poor people.

Food Safety Issues:

Presence of health hazardous components either microbiological or chemical residues in food products of animal origin is a major concern of present time. Informally marketed animal origin food items in Bangladesh are frequently tested not up to the standard of food safety management. At the level of pre and post production of meat, milk and egg as well as value added products; the focus should be on food safety. Food safety on the farm addresses the issue on chemical, microbiological and drug residues in food of animal origin.

Veterinary Public Health Issues:

Animal diseases can have a major impact on public health, national economy and international trade, food security and livelihood of households particularly of poor segments. There is a need for enhancement of veterinary infrastructure in public, private and NGO sector and their capacity for disease surveillance, diagnosis and epidemiological activities and public health awareness. Prevention and control of transboundary animal diseases requires regionally harmonized and effective early warning system to prevent the spread of diseases. The extension departments in collaboration with local government and other stakeholders should prepare guidelines and distribute it to the farmers regarding the effects and evils of public health and sanitation. In the training manual, there should be public awareness program on improvement of sanitation.

Zoonosis, Emerging and Re-emerging Issues:

Animal has the potential to transmit diseases to human known as zoonosis. Some of the zoonotic diseases such as Bird flu, Anthrax, Nipa, Rabies, and Tuberculosis etc. are caused through faulty husbandry practices, movement of infected animals, handling of animals and clinical equipment, management of animal wastes and dead animals, poor surveillance and unrestricted engrossment of borders of neighboring countries etc. Livestock diseases are not regularly reported and investigation into their epidemiology not fully introduced. DLS has preparedness and response guideline for the field officials and farmers to follow for control of the emerging and re-emerging diseases. Interministerial national coordination is needed to be formed to combat the spread of fatal infectious diseases. Proper pathways can be utilized for awareness creation among the general public regarding zoonotic diseases.

Bio-security:

Bio-security is those practices designed to prevent the introduction of harmful agent to livestock and poultry operation. Bio-security at the farm level is the management practices and enabling producers to prevent the movement of disease causing agents. Therefore, biosecurity involves many aspects of farm management such as disease control and prevention, feed management and visitor control. Other sources of contamination are closing goods, equipments and vehicles. The designing of planning process in view of the improved bio-security should include location, construction of houses, traffic off and on the farm, pest

management, designing of house cleaning and disinfection, personal hygiene, flock and herd health care and monitoring, husbandry practices and compliance with the regulations.

e-livestock:

ICT can play a key role in providing extension services with all information needed for the farmer's work including livestock production, inputs supply, disease control and improving market access, and availability of technology dissemination. It is vital to strengthen capacities of farmers, their organizations and rural communities. It is necessary to use ICT in the frontline offices of DLS in upazila and union parishad for linking livestock marketing and production through web and mobile based technology advisory services for farmers. Through these mobile and web based messages early warning of diseases and natural disasters as well as dissemination of information may be included in the extension procedure establishing gateway system.

Diseases Surveillance, Epidemiology and Reporting System:

Close intensified doorstep monitoring of animal production cycles, strong surveillance for diseases and their epidemiological scenario along with organized reporting for further immediate action should be a regular practice. A database of livestock and poultry production, animal health care services, disease incidence related statistics should be established and improved for forward work planning.

Specific Livestock Development Service Areas:

With the increase of commercialization of livestock, the traditional livestock is declining, but yet large number of dairy and poultry still exists and contributes to the national production. Commercial entrepreneurs are taking care of feeds and fodder, health services and marketing, but traditional dairy and poultry are left for public care. So, special attention to develop the traditional dairy and poultry and to improve their health care should be the thrust activities of DLS.

Organic Farming:

Organic farming is recently getting popularity among the consumers because of their system where material detrimental to human health and environment is not used. Organic farming strictly confines the use of growth regulator such as hormones, antibiotics, food additives and genetically modified organisms and Nano-materials. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic livestock farming combines tradition, innovation and science to benefit the shared environment and promote fair relationships and quality of life for all involved. The characteristics feature of organic products is costlier and environment friendly. Paramount importance should be given to disseminate bio-rational based management systems in the farms to ensure productivity and products' safety and quality standard maintaining collaboration with stakeholders and publicity through electronic and print media for mass awareness.

Value Chain Development:

Value chain is a high-level of businesses receives raw materials as input, add value to the raw materials through various processes, and sell finished products to customers. Value chain consist bundle of activities accomplished by firm to design, produce, market, deliver and support its products. These value chain activities are the discrete building blocks of the competitive advantages. Thus the analysis of value chain encompasses wider issues than supply chain which only shows physical flow of products or services through immediate stages of value addition. Constraints hindering value chain development should be identified by government machineries to provide enabling environment, opening opportunities, reducing risks and vulnerability for harnessing full potential of livestock sector.

Natural Disaster Management and Livestock Production:

Bangladesh is prone to natural disasters viz. heavy rainfall, floods, draught, cyclone, tidal surges and intrusion of saline water, etc. Livestock population is the first to be affected in that situation because of transportation of feed and fodder become more difficult to the affected areas including fresh drinking water. At that time, all efforts are made to safe human life. Due to unusual and difficult situation massive spread of epidemic diseases occurs during the post disaster period. In order to tackle this situation effectively, it is vital that disaster sustainable development and climate policy are integrated including livestock based interventions in terms of sustaining the livelihoods and resilience of the poor. Disaster Management Policy 2008 has a post and pre period disaster management and preparedness and response guideline can be followed in the affected area.

Technological Knowledge Gap on Hides, Skin, Horn and Bone:

Leather and leather goods are the third most important export earner items in Bangladesh. The value of hides and skin depends on its quality which in turn depends on techniques of flaying the skin and on the status of health & nutrition of animals. Little work is done on flaying technique. The main constraints are the poor flaying, improper method of curing, poor health and disease management, poor breed quality and age of the livestock species. On the contrary, valuable horns, hoofs and bones are mostly unused in spite of having usability and value addition. Mechanized slaughterhouse, storage facilities are also limited. DLS should introduce training program of the butcher on flaying and grading of meat cut, preservation of skins through curing. For quality control and certification of hides and skin, DLS may setup a wing and if necessary through promulgation of an act. DLS may also work on to prepare a comprehensive marketing policy for hides and skin.

Strengthening Infrastructure and Facilities for Livestock Services:

DLS being the public sector principal organization mandated for livestock extension should reach to the lowest tier of local government i.e. Union Parishad for better service delivery. There should be extension worker in the mainstreaming of DLS organizational setup like DAE. Provide adequate fund for effective delivery of livestock extension services. Ensure

satisfactory logistics support in terms of transport, extension kits for effective extension service delivery.

Animal Health Care Services:

Disease prevention through vaccination campaigns, reduction of mortality and morbidity losses, and meat hygiene have remained priorities considering public health concern. The working patterns of animal health worker and delivery of services tend not similar to regular mass extension rather mainly primary healthcare, vaccination, deworming, diagnosis and treatment. A case can be made for complementing animal health services with a parallel livestock extension service, possibly operating from the animal health clinics and hospitals, but staffed separately.

Cross Cutting Issues:

Livestock development is influenced by a number of issues that are either partially or entirely outside the mandate of MOFL and DLS. The issues include environment, gender, public health sanitation, diseases, population growth, and education.

a. Environment and Social Safeguard Issues:

Livestock production activities should be carried out in a sustainable manner keeping in mind the environment conservation issue. The department will promote livestock production especially ruminants (cattle, buffalo, goat and sheep) according to ecological standpoint of the areas. Department will document and distribute materials with best practices in a grazing management in order to conserve the environment. For instance, promoting exploration of methane fermenting cattle dung, poultry droppings and farm waste, utilizing urine as a tool of pest management.

b. Women in Livestock Extension:

Women and youths access to production resources and generating income from their work when compared to that of men is not negligible at all. Socio-cultural attitude that put youth in an inferior position in a society should be changed through social mobilization. In this respect especially in public sector in collaboration with other stakeholders with all livestock extension providers to ensure:

- (i) Mainstreaming gender issues into livestock farming communities;
- (ii) Promote gender sensitive labor saving technologies;
- (iii) Empower underprivileged groups to access livestock farming resources;
- (iv) Livestock keepers should have access to marketing information and marketing network and develop farmers group.

c. Knowledge Gap and Education:

The large number of population of Bangladesh suffers from illiteracy. Bangladesh in near future may suffer from insecurity of food and nutrition. While implementing livestock extension services, side by side, there should be a thrust for awareness on adult education. A course on zoonotic diseases may be included in school level.

d. Climate Change:

Impacts of climate stressors on animal livestock is reflective. The uncertainty of climate change and how change will influence on animal production on a global as well as regional scale is largely unspecified. In Bangladesh, by contrast, the bulk of livestock have no protective structures and they graze off the land. There is every reason to expect that livestock in Bangladesh will be sensitive to climate change. Early warning system and response measures in order to protect livestock and environment during natural calamities, technologies adoptable to climate tempted vulnerabilities and long term resilient strategy will be upheld.

e. Competition of Livestock and Crop Production on Land:

In accordance with massive population growth food grain requirement is increasing and with rapid urbanization cultivable land is shrinking every day, as a result, increased pressure on land for crop production for human consumption is traditionally getting priority over livestock production. State priority of crop production depriving the livestock population through squeezing the opportunity of grazing in pasture. No land especially is ear-marked for animal grazing and fodder production consequences a serious dearth of feeds and fodder.

Information technology in livestock farm management Breeding:

This contains information on the genetic stock of the animal and all aspects related to animal rearing related to pregnancies, vaccinations and diseases (if any) **Hayes et. al. (1998)**. Individual records: For recording photos and body measurements on various dates; includes support for electronic identification devices (**Stubbs et. al., 1985**).

Pedigree:

Shows sires and dams as a pedigree chart.

Herd:

Shows details about various categories of animals on the farm. i.e. male/female, milking/dry, adult/heifer/calf etc.

Selection/ culling:

An entry is automatically added every time an animal is purchased or sold to any other farm.

Feeding:

Feeding details of individual animals, concentrate feed compounding etc (**Nath *et. al.*, 2002**).

Milking:

Individual production records, milk disposal. In Africa, ITs have become important tools for recording livestock performance and production levels.

Health:

Complete record of individual/group health records with details of symptoms, drug used, dosage, route of administration etc. (**Stubbs *et. al.*, 1985**).

Task Reminder:

Notify you ahead of time of any planned tasks such as expected due date, veterinarian services, stall cleaning, etc (**Giovannini *et. al.*, 2003**).

Finance:

Income and expenses under various categories; can also generate balance sheets **Paterson *et. al.* (2000) and Murray and Sischo (2007)**.

Reports:

Can be Standard or user-defined.

Address Book:

Business related name and address is listed in one common place. Advantages of herd management software

- Ease of entering data in an organized livestock farm (**Henderson, 1998**).
- Human Error-checking
- Ease of handling the software
- Data security
- Generates information automatically
- Generates production efficiency
- Allows comparisons of two individuals, two groups of animal
- Re reminds about the scheduled activities.
- Generates reports: daily, monthly or annual report
- Data transmission for expert evaluation

Ease of analysis:

Data generated by herd management software can be easily converted to MS-Excel, MS-Access or any other database formation and subjected to statistical analysis for evaluating various factors influencing performance.

Integration with newer technologies:

Herd management software is an essential requirement in case the farm manager wishes to implement newer technologies like Radio Frequency Identification Devices (RFID), advanced machine milking etc. in order to improve farm efficiency.

Eco-friendly:

In times when livestock are being blamed by various organizations for causing more global warming than all the world's automobiles combined, computerized, paper-less farm records are eco-friendlier, and their contribution to saving the environment, by way of increasing efficiency and decreasing the number of livestock which need to be reared, would be substantial.

Precision livestock farming:

Precision Livestock Farming is the use of advanced technologies to optimize the contribution of each animal. Those results can be quantitative, qualitative and/or addressing sustainability. Precision livestock farming (PLF) is made possible by recognizing each individual animal. Using modern information technology, farmers now can record numerous attributes of each animal, such as pedigree, age, reproduction, growth, health, feed conversion, killing out percentage (carcass weight as percentage of its live weight) and meat quality. When this information is available, huge benefits can be derived (**Jain *et. al.*, 1995 and Ramkumar *et. al.*, 2003**).

Livestock disease control:

Ryan and Wilson (1991) reported that, the 'National Disease Control Information System' (NDCIS) of New Zealand, consists of a set of independent computers database on animal diseases such as tuberculosis and brucellosis, which is a good example of possible applications of IT in improving the animal health. **Jalvingh *et. al.* (1995)** and **Sanson *et. al.* (1999)** reported that, because of their economic importance, contagious animal disease outbreaks require rapid identification and elimination of all virus sources. For managing the vast amount of data and for help in setting the correct priorities, the use of computerized decision supports systems (DSS) seems to be promising.

Information technology in disease diagnosis:

Medical diagnostic technology has made rapid strides with the advent of the computer. Many of the advances in human diagnostic technologies are translated into veterinary medicine in developed countries. Newer branches like Imaging, Radiodiagnosis, Telemedicine, Telesonography and Teleradiology have emerged. Broadly, the

instrumentation/devices which have been created with modern technology in the present digital age are listed below. **Santos (2002)** reported that, the National FMD Task Force of Philippines uses an information system in managing data regarding disease situation, vaccination, and animal movement, which gives accurate information on the animal disease situation of an area at the quickest possible time (**Phand et. al., 2009**).

- **Image Intensifier TV system (IITV):**
Generally used in orthopaedic surgery. This facilitates fracture repair using a small incision thus achieving minimal invasive surgical manoeuvre.
- **Ultrasound:**
Ultrasound is routinely used as a diagnostic aid In small animal and equine practice. Ultrasonography seems to have a promising future in veterinary medicine, particularly for the assessment of intra/peri-abdominal disease.
- **Computerized tomography (CT):**
CT has been an extremely significant development which has a unique cross sectional imaging ability useful for the diagnosis of tumors, malformations, inflammation, degenerative and vascular diseases and trauma.
- **Magnetic resonance imaging (MRI):**
MRI is a highly sensitive and non-invasive technique providing accurate and detailed anatomic images with good contrast and spatial resolution. However, in veterinary medicine, MRI is still in its infancy and its use is infrequent. It is especially used to differentiate an inflammatory process from a neoplastic mass, tumors from peri-tumoral edema. It is more specific and sensitive in detecting, localizing and differentiating osteomyelitis, cellulites and abscess.
- **Nuclear scintigraphy:**
Nuclear scintigraphy is a highly sensitive advanced procedure in which radioisotopes are used to detect the functional abnormalities of the body system. It has been used to detect functional disorders of the kidney, liver, lungs, GI tract, thyroid gland and many other organs.
- **Aparoscopy:**
The most advantageous characteristic of laparoscopy is that it allows direct examination of abdominal cavity with only minimal and superficial surgical intervention.
- **Endoscopy:**
It is a minimal invasive diagnostic modality which aids in documenting mucosal inflammation, hyperemia, active bleeding, irregular mucosal surface etc. and facilitates biopsy in tubular organs like GI tract, respiratory and the urogenital systems.
- **Pulse Oximetry:**
It has the unique advantage of continuously monitoring the saturation of haemoglobin with oxygen easily and noninvasively, thus providing a measure of cardio-respiratory function.

Artificial intelligence in health management:

Artificial intelligence may be defined by comparing computer and human functions. If the computer performs a task that seems intelligent when it is done by humans it can be said to be exhibiting artificial intelligence. In medicine, most artificial intelligence research has been devoted to creating computer systems that contain detailed information about a specific medical subject. Expert systems are computer programs that typically contain large amounts of knowledge for making decisions about specific problem domains such as an area of medicine.

Information technology in instrumentation:

The modern molecular methods of diagnosis require sophisticated electronic equipments. Information Technology simplify handling these modern equipment viz. ELISA reader, HPLC, RIA, UV Spectrophotometer, Atomic Absorption Spectrophotometer-meter, Flow cytometer, freeze drier, ultra-low freezer, PCR machine etc., are now controlled by microcomputers and user-friendly software are provided to operate them. With this software, even a beginner can start handling this equipment with minimal training.

Information technology in data analysis:

The data collected from livestock farm, research, outbreaks over a period of time has to be analyzed statistically to develop models for better management and forecast future incidences of the disease. Many user-friendly and simple statistical packages are available that can do the same task efficiently.

Information technology in molecular biology:

Genomic analysis gains importance since it is the irrefutable form of diagnosis. To develop gene probes, the entire genome has to be mapped. After mapping, the unique areas have to be identified comparing it with the genome of other infectious agents. Many software are available that can compare the genome with existing genomes in a gene bank to identify unique areas.

Information technology in simulation studies:

Another area where IT can contribute significantly is the simulation of in vivo conditions. Certain advanced graphics based software offer best solutions for this. Trafficking of etiological agents, proteins etc. in between the cells can be studied using this software. Study on these trafficking patterns is essential to develop vaccines for cell associated viruses and intra cellular bacteria.

- **Program for Monitoring Emerging Diseases (ProMED):**

This is a program of the International Society for Infectious Diseases. The global electronic reporting system for outbreaks of emerging infectious diseases and toxins, open to all sources.

- **Marketing of livestock product:**
 In National Dairy Development Board, IT brings real benefits to more than 60,000 farmers daily who are involved in the milk collection project spread over 600 milk collection centers. Using relatively simple technology (PC, Weighing machine with PC interface) and online milk tester to measure milk fat and promptly make the payment to the farmers. It has resulted in the removal of incentives to those who adulterate milk, reduced the time for payments from 10 days to less than 5 minutes and instilled the confidence in farmers on cooperative set up. All these factors have helped the milk market to expand to greater dimension (**Sharma 2000**).
- **Disease Monitoring and Surveillance:**
 Animal disease monitoring describes the ongoing efforts directed at assessing the health and disease status of a given population. The disease can be a specific infectious disease/diseases or health in general, whereas the monitoring activities are the routine recording, analyses and distribution of information related to the disease (or health). The term disease surveillance is used to describe a more active system and implies that some form of directed action will be taken if the data indicates a disease level above a certain threshold. International Agencies involved in Disease Monitoring and Surveillance are WHO Statistical Information System (WHOSIS), World Organization for Animal Health (OIE) (**Kivaria and Kapaga 2005 and Saxena. 1994**).
- **Dissemination of livestock related information and ITKs:**
 Fast and efficient dissemination of suitable technological information from the Livestock Research System to the farmers in the field and reporting of farmers' feedback to the research system is one of the critical inputs in Transfer of Livestock Technology (**Sharma 2000**). To reach over 110 million farmers, spread over 500 districts and over 6000 blocks is an uphill task. The diversity of agro-ecological situations adds to this challenge further. Modern communication technologies can apply to conditions in rural areas, which will help improve communication, increase participation, and disseminate information and share knowledge and skills. It is being said that "Cyber Extension" would be the major form of technology dissemination in the near future. It is essential that information availability is demand driven rather than supply driven. Next to the radio and television the mobile phone users are increasing rapidly in India particularly in rural areas, creating platform for information dissemination through value added services like Short Message Service (SMS). The mobile phone looks like tomorrow's most likely access device for information dissemination. The livestock related information such as vaccination alert can be delivered through mobile service provider before monsoon.

ICT and its Challenge in Livestock:

It is very important that the application of ICT in livestock is increasing. E-Livestock helps in dissemination of gathered information to the farmers, mostly lived in rural areas, to use in their routine work. These services are provided and enhanced through the Internet and related technologies. This ensures the effective and efficient use of information and communication technologies for analyzing, designing and implementing existing and innovative applications to help the livestock sector. Those who are involved with livestock industry also need information and knowledge to manage their occupation efficiently. Any system applied for getting information and knowledge for making decisions in any industry should deliver accurate, complete, concise information in time or on time.

The information provided by the system must be in user-friendly form, easy to access, cost-effective and well protected from unauthorized accesses. An important role could be played by ICT in maintaining the above mentioned properties of information. An authentic livestock database based on animal and climate condition, animal disease history, farmers interest, demand of raw material, pest and disease management technologies, storage facilities, marketing system, etc. have to be developed with the help of ICT and GIS (Geographic Information System). Government has prioritized quick dissemination of livestock technologies to the farmer's level. Reduction of yield gap between research and farmers field has been identified as important parameter to increase livestock production. Number of action plans has been prepared to reduce the yield gap of the pulses, oilseed and spices. The gap between know how and do how of the knowledge based production system is being implemented through target oriented production plans.

Action plans are being implemented with improved seed supply, demonstration and imparting training, coordinated by MOFL and implemented by the DLS institutes, namely BLRI, LRI and UVH as well as MOFL. Developed countries some time failed to perform their responsibility to address the problem of unfair trade and rationalizing global financial system and transferring new technologies for productive youth employment in developing countries in order to achieve MDG 8: Develop a global partnership for development. Developed countries should come forward and assist the least developed countries in exploiting potentials of international trade and should fulfill their obligation as signatories to the MDGs. It would be a huge challenge to bring together the donors and recipient countries to form an effective partnership to attain MDGs in the stipulated period.

The Paris Declaration promotes partnerships that improve transparency and accountability on the use of development resources. This encourages donors and partners jointly assess mutual progress in Bangladesh in implementing agreed commitments on aid effectiveness by making the best use of local mechanisms. There needs to be infrastructural development and technology transfer throughout Bangladesh to diffuse knowledge as soon as possible to spread information and knowledge to the remote regions of the country. There are national strategies to promote ICT with the recent government vision of "Digital Bangladesh" by 2021.

Proposed Architecture of ICT for livestock:

The main component of the architecture is database server, which contains all the information that be provided. Now the way to access the information may be different based on the stakeholders. Farmers information system is a place connected with the central database and ready to provide information over mobile. A mobile server which is connected with the central database to provide information over mobile application. The application resides in the mobile server which eventually inherits information from the database server. A secured web-based system connected directly with the database server enables user to access the information over internet. An administrative end will be responsible for insert, delete, modify and update the information.

Future Outlook in ICT for Livestock:

For sustainable development of livestock and national economy to emphasis on ICT and its use in livestock very important. The following issues are very important for ICT management in sustainable livestock.

- animal zoning map
- animal suitability database
- livestock area, production forecasting system
- Availability of updated bio-physical database
- variety/livestock technology database
- Climate change scenarios
- nutrition and feed management information
- Pest and disease information
- Information on salinity, drought, flood, etc.
- Fisheries information systems
- Research management information
- Livestock information systems
- Socio-economic database
- Marketing information
- Farmer information system
- ICT personnel and ICT units

CHAPTER IV

Conclusion

ICT tools suggested to uses in the livestock extension services are computer, fax, internet, website, e-mail, GPS, video conference, multimedia, CDs, TV, Radio and mobile phone. In addition, these tools could be used for advisory services on livestock farm management and health care services. It can be concluded from the review that uses of ICT as management tools will increase the knowledge of livestock stakeholders in livestock extension services thus improve the production of milk, meat and egg for human consumption

Visible Impact can be seen after change the way of use ICT in livestock. That's may bring relief of farmers from different troubles as well as farmers economic, social and living standard will be increased. Product demand-supply flow can maintain by creating communication channel with the producer and seller. Disorganized market can also organize through ICT in livestock. Right to information and easy to access in livestock information can be ensured by strong establishment of ICT in livestock. Maintenance of information flow is not only possible all over the country but also possible all over the world by proper establishment of ICT in livestock.

We need a strong protective measure to overcome all the barriers. The government should take holistic initiatives to promote ICT by taking positive steps such as tax and import duty cuts on ICT equipment's, promoting ISP services, etc. in order to improve the situation. There needs to be infrastructural development and technology transfer throughout the country to diffuse ICT knowledge even to the remote regions of the country. Regular training expedition with operator and farmer, technologies adaptation capacity increase, service center establishment, regular technology monitoring, unauthorized access or hacker attack must be controlled to improve for the development ICT in livestock. Those who are involved with livestock industry also need information and knowledge to manage their occupation efficiently.

ICT in livestock statistically and actually is not advanced and developed tools in our country. We need to improve a lot for adapting these tools. We need also collaboration with GO, NGOs, international organizations and others, which can support to effective development of ICT in livestock. Besides, strong collaboration with public and private sector must have to have capacity of technology transfer through to actual end user.

CHAPTER V

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CHAPTER VII

Brief Biography of the student

Sabiha Zarin Tasnim Bristi is an intern student for the degree of Doctor of Veterinary Medicine (DVM), Faculty of Veterinary Medicine, CVASU. She passed the Secondary School Certificate Examination (SSC) in 2007 from Bangladesh Navy School and College Chittagong and got CGPA 5.00 and then Higher Secondary Certificate Examination (HSC) in 2009 from Bangladesh Navy School and College Chittagong and got CGPA 4.88 Then she admitted to the degree of Doctor of Veterinary Medicine (DVM), Faculty of Veterinary Medicine, CVASU in 2012-2013 session. She has great interest in animal welfare ,wildlife and small animal medicine.