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Kind Attention - Contributors

With a view to further enriching the contents of African-Asian Journal of Rural Development, articles are invited from the prospective Researchers/Government officials/NGO activists working in the field of agriculture and rural development. The article(s) should have bearing on the African-Asian countries in particular and developing countries in general. The article(s) could be written either in any of the official languages of AARDO-Arabic, English and French. The details regarding publication of the article are given on the reverse side of back cover card of the Journal under the heading 'Guidelines to the Authors'. The article(s) should be sent to the Editorial Office, African-Asian Journal of Rural Development, AARDO, No. 2, State Guest Houses Complex, Chanakyapuri, New Delhi 110 021, India. The Journal is a prestigious periodical of the Organization, being published regularly since 1967 and has wider circulation both in the developing and developed countries.

EDITORIAL

Over the past century, enormous progress has been achieved worldwide in improving human welfare. Many societies have been radically transformed on account of quantum leaps in technology and innovations in production systems. Globally, integrated production processes have equally brought certain benefits. However, they present some challenges in terms of their regulations and warrant steering towards more equitable and sustainable outcomes. It has been forecast that population dynamics will radically change demographics over the coming decades. Yet, one of the main global challenges is to ensure food and nutrition security for a growing population, whilst adjusting to an overall net increase of disasters, including those caused by climate change, and increased economic volatility, so as to eventually ensure long-term sustainable development, especially when billions of people are still facing pervasive poverty, gross inequalities, joblessness, environmental degradation, disease and deprivation.

Inclusive growth and sustainable sevelopment have to be driven by the progress in technologies. Proliferation of technologies has opened new vistas for its application in almost all walks of life. It has often been observed, and rightly so, that technologies have been helping –directly or indirectly– to improve efficiency and competitiveness. Food production enhancing technologies, indigenous knowledge and practices, low cost housing technologies, smokeless chullah or stove, clean water and sanitation technologies, information and communication technologies (ICTs), geographic information system (GIS), remote sensing, precision agriculture, biotechnology, nanotechnology, etc. are definitely contributing towards improving the productivity of farmers and enhancing their profitability leading to sustainable livelihood in rural areas.

In fact, it has been recorded that technologies, introduced during the Green Revolution in 1970s resulted into unprecedented increase in food production which alleviated rural poverty by increasing disposable income and purchasing power of many households in African-Asian countries.

Further improvement in production, productivity and efficiency will, no doubt, come through the optimum use of affordable and appropriate technologies capable of ensuring food and nutritional security. This strategy will obviously help in enhancing the incomes and productivity of small farmers. Thus, all initiatives have to be imperatively supported by appropriate policies capable of generating investments in agricultural based ventures and agritech to spur agricultural growth and eventually to boost up the economic growth in developing countries. It is encouraging that the agriculture sector in African and Asian countries is already undergoing significant transformation by adapting innovative approaches and environment friendly technologies for sustainable agriculture and rural development.

AARDO, since its inception in 1962, is focusing on sustainable development and emphasizing on use of innovative and environment friendly technologies for ensuring food security and sustainable rural livelihood in African-Asian countries. AARDO, through its human resource development (HRD) programmes and financing of development pilot projects had a number of such initiatives in collaboration with its centers of excellence in member countries. In the specific area of agricultural engineering and farm mechanization, AARDO has been collaborating with ICAR-Central Institute of Agricultural Engineering (CIAE), Bhopal, India since 2009. A total of nine courses have, so far, been successfully organized, wherein 69 senior officers/experts from AARDO member countries have been exposed to relevant agricultural and food processing technologies. All these programmes have been highly effective in imparting appropriate technical know-how to the participants. AARDO shall focus its activities and capacity building programmes on developing capacities for sharing of technical expertise and speeding up technology transfer amongst African-Asian countries.

This issue of the Journal covers pertinent themes related to agritech, farm mechanization, fisheries & aquaculture, empowerment of women and sustainable agricultural development and rural livelihood. The first article on "Agricultural Mechanization in Bangladesh: Higher Education and Research Institutions' Perspectives", by Md. Arif Hossain Jewel presents the findings of a research study conducted to understand qualitatively how the agricultural universities, agricultural research institutions and related organizations are contributing to the human resource development of agricultural mechanization in Bangladesh. The second paper on "Opportunities and Challenges for Mariculture in India", by Imelda Joseph highlights the opportunities and challenges for establishing mariculture in India by addressing advances in scientific and technical base to achieve cost-effective and eco-friendly operations. The third paper on "Production, Returns and Policy Initiatives for Nutri-Cereals (Pearlmillet) in India", by D. P. Malik attempts to study trend in area, production and productivity of pearlmillet in India, its economic viability in the higher productivity states and examines policy initiatives for its cultivation and productivity enhancement. The second last joint paper on "Growth of Agriculture Sector: A Key to Realization of SDG 2030", by Aprajita Srivastava and H. O. Srivastava shows that the SDGs could be achieved by increasing food production, not only to feed the existing but future population too that is estimated to reach 9 billion by 2030. It highlights as to why the 'knowledge agriculture', a massive programme of education and upgrading skills of farmers is needed to be embarked on. The last paper on "Dynamics and Process of Women Leadership in the Local Government of Bangladesh: Evidences from the Union Parishad", by Md. Mizanur Rahman discusses the reservation policy of government for empowering them and enhancing their participation in local political governance. The paper is based on a case study which is substantiated by contents analysis and observations method.

I hope pertinent issues addressed by the eminent scholars will give an insight to the readers of the journal and help in making action plan for sustainable agricultural development, use of appropriate technology for food security and sustainable rural livelihood.

African-Asian Journal of Rural Development, Volume 52, No. 2, 2019, pp. 7-27

AGRICULTURAL MECHANIZATION IN BANGLADESH: HIGHER EDUCATION AND RESEARCH INSTITUTIONS' PERSPECTIVES

Md. Arif Hossain Jewel*

Agricultural mechanization is one of the key development indicators of agricultural development in Bangladesh. Bangladesh has a long history of agricultural mechanization. Knowledge development organizations like higher agricultural education institutions, agricultural research institutions and other related institutions have significant contribution to bring agricultural mechanization status at present level in Bangladesh. This study is designed to understand qualitatively how the agricultural universities, agricultural research institutions and related organizations are contributing to the human resource development of agricultural mechanization in Bangladesh. The study is based on primary as well as secondary data. The study found that present education system at higher agricultural education institutions for human resource development of agricultural mechanization is very traditional, with very little group work and lack of critical reasoning. The present promotion criteria of faculty and scientist both in higher education institutions and research institutions can not endorse good teachers and scientists. The study also found some important general constraints and challenges of human resources development for agricultural mechanization in Bangladesh. Finally, this study concluded with a number of recommendations to strengthen human resources development for the agricultural mechanization in Bangladesh.

1 Introduction

The central concept of agricultural mechanization is to apply the principles of engineering and technology to do agricultural operations in a better way to increase crop production. Agriculture is one of the important sectors contributed 20.24 per cent to the GDP of Bangladesh with a growth rate of 4.12 per cent in 2010-11 (BBS, 2011). Agricultural sector contributed 43.6 per cent of total national employment whereas non-agriculture sector contributed 56.4 per cent of total employment in 2008-09 (BBS, 2009).

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Bangladesh is one of the populous countries in the world. It is a great challenge to produce of food for about 160 million people from 8.2 million hectares of cultivable land (Hossain, 2009). Almost 0.20 million people are being added to the total population every year whereas the estimated annual reduction of agricultural land is about 0.08 million hectares due to different non-agricultural activities such as housing, roads and other buildings, offices, mills, factories, etc. (BRRI, 2009). Appropriate farm mechanization has been emphasized as an important policy and development goal in Bangladesh (Mandal, 2014; Zhang et al., 2014). Apart from reduction of agricultural lands, introduction of high yielding varieties, improved irrigation facilities, use of higher doses of fertilizers and pesticides have increased the scope for greater agricultural mechanization. Practically agricultural mechanization helps for proper utilization of basic agricultural inputs like water, seed and fertilizer, optimum placement of the seed and fertilizer, ploughing, removal of weeds, leveling of uneven land and land reclamation.

1.1 Background of Agricultural Mechanization in Bangladesh

The development of agricultural mechanization in Bangladesh has an old history. A brief background of agricultural mechanization in Bangladesh is described as follows :

i) Before the birth of Bangladesh, the then Government of East Pakistan imported power tillers and power pumps in the late 1960s as a part of' 'Green Revolution' activities. After the birth of Bangladesh, the government also allowed continuous import of farm machinery for agricultural mechanization.

ii) A cyclone hit Bangladesh in 1988 within two and half years of a previous one, caused loss of large population of draught animal. The then president of Bangladesh abolished standardization requirements of imported machineries and made the market open for import of agricultural machines especially power tillers (two wheel tractors) and irrigation pumps at a nominal tariff.

iii) Since then agricultural mechanization in Bangladesh got popularity due to small number of draught animals, shortening of land preparation time, the introduction of high yielding variety (HYV) to feed growing population, shortage of labour at peak periods and increasing demand for irrigation in the dry season. Furthermore, it also created a window of demand for post-harvest operations.

iv) National Agriculture Policy (1999) of Bangladesh was formulated by emphasizing to meet the deficit of animal draught power through the import of machines and raw materials needed for local fabrication with tax relief, providing credit to both users and traders and encouraging the formation of user groups/cooperatives for owning or custom hiring of agricultural machinery to help mechanization.

v) These developments together with the more recent spread of tens of thousands of threshers powered by the Chinese diesel engines makes Bangladesh possibly the most mechanized and labour intensive agricultural sector in South Asia. It is also creating alternative livelihood opportunities for displaced labour and thus contributing to non-farm economy with substantial employment and other growth linkages to other rural and urban sectors.

1.2 Present Status of Agricultural Mechanization in Bangladesh

The present agricultural mechanization status can be described as farm power use capacity and number of units of used agricultural machineries. These two indicators help to draw a level for mechanization status in Bangladesh.

1.2.1 Power Use

The extent of energy input is one of the key indicators for measuring the state of mechanization level of a country. In Fig.1, available power in agriculture of Bangladesh is seen to increase gradually from 0.24 in 1960 to 0.32 kW/ha in 1985 after that it increases very sharply to 1.83 kW/ha in 2015. The increment rate is highest between 2000 and 2015. The farm power availability in major developed countries such as Japan, Italy, France, and UK are 8.75, 3.01, 2.65, and 2.50 kW/ha, respectively (Tandon, 2004).

1.2.2 Agricultural Machinery in Bangladesh

The agriculture mechanization started in 1960s with introduction of limited quantities of power tillers, tractors, shallow tube wells, deep tube wells, and low lift pumps. After independence in 1971, it gained pace especially, due to irrigation development. Though power tillers, tractors and other farm machineries like threshers and weeders increased with time, but irrigation equipment increased much faster than that of other machineries. The present status of agricultural machineries is shown in Table.1.

The agricultural mechanization in Bangladesh is continuing to achieve the sustainable goal in agricultural sector. Sustainability in mechanization is the key goal of all agricultural universities, research organizations, development organizations and other related organizations. These organizations are providing continuous support for knowledge and product development. They had also remarkable contribution to bring the agricultural mechanization in Bangladesh at this present level. Many studies have been accomplished to understand the mechanization trend, its problem prospects and challenges in Bangladesh. Unfortunately, very few studies found which discuss the contribution of higher education and research institution for human resource development in agricultural mechanization in Bangladesh. Hence, there appears a necessity to undertake a qualitative investigation in this regard. The purpose of the present study is to understand how the agricultural universities, agricultural research institutions and related organizations are contributing to the human resource development in agricultural mechanization in Bangladesh. First, the higher education and research institutions that offer agricultural engineering/mechanization programme, and their programme settings in Bangladesh are described. Then, their problems and prospects are described. Finally, the discussion is followed by the number of recommendations, and the conclusions are given.

2 Methodology

This manuscript has been prepared on the basis of primary as well as secondary information. Primary data was gathered through direct visit to institutions, face to face conversation and Key Informant Interviews (KIIs) with relevant persons. The pertinent secondary information was accumulated from relevant articles, different position papers and action plans of the government, and visiting websites of higher education and research institutions.

3. Findings and Disucssions

3.1 Higher education and research institutions offering agricultural engineering/mechanization programme, and their programme settings in Bangladesh

The higher education and research institutions contribute to the knowledge development of a country in various capacity. There are many higher education and research institutions in Bangladesh which contributing for the human resource development in agricultural mechanization. It is described in details in the following section.

3.1.1 Bangladesh Agricultural University (BAU), Mymensingh

BAU is the premier institution for higher agricultural education and research in Bangladesh. The Faculty of Agricultural Engineering & Technology is the first faculty in Bangladesh to shoulder the responsibilities of increasing the capacity of the students of Agricultural Engineering and Food Engineering programmes for nation building activities since 1964. This faculty is boosting up production to sustain the process of human development by adding research and teaching activities in the areas of agricultural machinery, irrigation and water management, farm structures, post-harvest technology, food processing and preservation, system analysis and computer science in agriculture. The faculty has started implementing the new curricula and the syllabuses since 2002. It offers two separate degree programmes, one for B.Sc. Agricultural Engineering and another for B. Sc. Food Engineering. The faculty of Agricultural Engineering & Technology has the following academic departments for offering B.Sc. Agril. Engg., B.Sc. Food Engg., M.S. and Ph.D. degrees.

- Department of Farm Structure & Environmental Engineering
- Department of Farm Power & Machinery
- Department of Irrigation & Water Management
- Department of Food Technology & Rural Industries
- Department of Computer Science & Mathematics

Farm Power and Machinery department of BAU has developed some machineries and equipments such as Neck harness, Improved animal-drawn plough, Manually operated seed drill, Orchard sprayer, BAU-ZIA seed fertilizer distributor, Self-propelled BAU reaper, Solar tunnel drier. A project named REFPI (Research and Extension in Farm Power Issues) worked for the dissemination of BAU developed machineries.

3.1.2 Hajee Mohammad Danesh Science & Technology University (HSTU), Dinajpur

HSTU is the first Science and Technology University in the northern region of Bangladesh. The faculty of engineering was established in 2014 which known as Faculty of Agro-industrial and Food-processing Engineering which offers

two different degrees (i) B. Sc. in Food and Process Engineering (ii) B. Sc. in Agricultural Engineering to graduate human resource development in the field of agricultural mechanization. The unique method of qualifying its students in various engineering fields serves to promote progress at the local and regional levels. This faculty, living up to its vision and mission statements, started Master's degree program and introduced some well-equipped research laboratory aided by HEQEP (Higher Education Quality Enhancement Project) CP-2245 Project ("Hstu," n.d.)

3.1.3 Sylhet Agricultural University (SAU), Sylhet

The Faculty of Agricultural Engineering and Technology FAET of Sylhet Agricultural University (SAU) was founded in 2011 to meet the increasing demand for skilled agricultural engineering graduates. Its goal is to position engineering graduates to be problem solvers, project leaders, communicators, and ethical citizens of a global community. Through innovative curricula, a teamwork approach, and leadership-building experiences, the students gain vital communication and critical-thinking skills. Presently, FAET is providing only four years' undergraduate degree in B.Sc.in Agricultural Engg. & Tech. in a combination of following four distinct departments.

- Department of Agricultural Construction & Environmental Engineering
- Department of Farm Power & Machinery
- Department of Irrigation & Water Management
- Department of Food Engineering & Technology
- Department of Computer Science & Engineering

3.1.4 Sher-e-Bangla Agricultural University (SAU), Dhaka

SAU is located in the heart of the gleeful Dhaka city. Agriculture graduates are taught Agricultural Engineering knowledge focusing on the systems, processes, and machines that are used to generate or utilize energy, food, and water by the department of agricultural engineering. This program provides students with background in mechanical design, hydraulics, instrumentation and control, finite element analysis, electronics and sensors to design, develop, analyze and operate machines and systems for

agricultural and biological products and processes, materials handling, construction and mining, forestry, lawn-and ground-care, and food and fiber production and processing ("Undergraduate Admissions - Purdue University,"n.d.).

3.1.5 Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur

The Department of Agricultural Engineering of BSMRAU started functioning in 2005 intending to disseminating the basic knowledge of agricultural engineering among the graduates of this university. It helps engender knowledge in the field of farm power machinery, irrigation and water management, farm structure and farm mechanization as a whole. The department accomplishes its intended activities and research using two highly equipped laboratories, e.g., farm power laboratory and irrigation laboratory along with an engineering workshop. The department of Agro-processing has recently been opened in this university with the vision to foster agro-processing education in view to globalized market of the agricultural products and the environment. Therefore, to take the advantages of expanding agribusiness and increasing employment opportunities in rural areas education in agro-processing would play an important role to impart adequate knowledge and training on the students for successful interventions technologies in order to boost up the economical development of the nation as a whole.

Together these two departments are providing MS degree in the field of agriculture and agro-processing engineering and irrigation and water management to foster human resource development for agriculture mechanization in Bangladesh.

3.1.6 Bangladesh Agricultural Research Institute (BARI), Gazipur, Dhaka

BARI is the largest multi-crop research institute ("Bangladesh Agricultural Research Institute," n.d.) researching a wide variety of crops, such as cereals, tubers, pulses, oilseeds, vegetables, fruits, spices, and flowers. Besides variety development, this institute researches such areas as soil and crop management, disease and insect management, water management and irrigation, development of farm machinery, improvement of cropping and farming system management, post-harvest handling and processing, and socio-economic studies related to production, processing, marketing, and consumption.

3.1.6.1 Farm Machinery and Postharvest Process Engineering (FMPE) Division

FMPE Division is one of the 16 research divisions of BARI. FMPE has developed 35 farm machinery and technology for different agricultural operations ("Farm Machinery and Postharvest Process Engineering Division,"n.d.). Besides the development of modern farm machinery, the Division also works on the postharvest processing techniques of different crops, vegetables, and fruits. This division develops low-cost postharvest handling, storage and packaging methods for the producers and processors to minimize the postharvest loss of agricultural products. Use of renewable energy as an alternative to fossil fuel in agriculture is one of the research areas of this division. The solar powered irrigation pump and non-edible jatropha oil as bio-diesel for the farm engines are the successful outcomes from this research area. The testing and evaluation of the field performance and suitability study of different imported and locally made agricultural machinery for Bangladeshi farmers is a regular task of FMPE division. Also, dissemination of matured technologies to the targeted users through training, field demonstration, seminar, workshop, mass media and participation of different fair is ongoing activities of this division. The technical training and technical assistance for the local manufacturers are provided to ensure the quality and durability of locally made agricultural machinery. BARI has so far developed 35 farm machinery and equipment. Out of these machineries and equipments, weeder, multi-crop power thresher, and maize sheller are widely used. Other pieces of machinery like power tiller operated seeder, reaper, mango harvester, potato grader, and hot water treatment plant need wide publicity to popularize them among the farmers and stakeholders.

3.1.7 Bangladesh Rice Research Institute (BRRI), Gazipur, Dhaka

BRRI is a major component of the National Agricultural Research System (NARS) of Bangladesh, dealing with research and development of rice production, the staple food for our people. The Institute has an outstanding contribution to the food security of Bangladesh. So far it has developed 67 high yielding rice varieties including four hybrid ones. Moreover, these varieties are cultivated in about 80 percent of the total rice areas and contribute almost 91 percent of the total rice production of the country ("Bangladesh Rice Research Institute,"n.d.).

3.1.7.1 Farm Machinery and Postharvest Technology Division

FMPHT Division is one of the 20 research divisions of BRRI. The scientists of this division apply knowledge of engineering and technology to transform

the traditional agriculture production system to mechanized production system for maximizing the farm production. FMPHT division has developed many farm machinery and agriculture technology till now. The main farm machinery are BRRI Diaphragm Pump, BRRI Animal Driven Pump, BRRI Open Drum Thresher, BRRI Close Drum Thresher, BRRI Power Tiller, BRRI Weeder, BRRI Seeder, BRRI Self Propelled Reaper, etc. Besides different types of projects and research activities for invention, development and promotion of farm machinery are implementing many parts of the country.

3.1.8 Rural Development Academy (RDA), Bogura

RDA was established as a specialized rural development institution for training, research, and action research. RDA is providing training of human resources development under different training courses to the technicians of related field, government officials, students and farmers. The major courses are farm machinery repairing and management; irrigation pump and engine management; plumbing and electrical; internship program for agricultural and food engineering students of different universities.

3.1.8.1 RDA-KMT workshop

RDA-KMT (Kamal Machine Tools) workshop is an action research project under public-private partnership (PPP) concept which started in 2012. This workshop is playing important role for human resource development in agricultural mechanization field by continuing training, research and developing different spare parts and agriculture machineries. The following spare parts/ agricultural machineries have been developed through this workshop. Liner C-16, 20, 25; Liner C-12; Liner C-6; Liner CD-4; Open Drum thresher; Close Drum thresher; Cow-dung crushing Machine; Chopper Machine; Grass cutting Machine, Bed former (Single); Bed former (Double); Power Winnower; Hand Weeder; Standard cow feed mixing machine, etc.

3.1.8.2 Agro Processing, Preservation and Marketing Unit (APM)

The APM unit of RDA is working to minimize the post-harvest losses of agricultural products. APM unit is comprised of different processing machines and equipments for reducing postharvest losses. It provides training for human resource development and continues research. This unit has the capacity to produce processed product like jam, jelly, chutney, souses, tomato ketchup, fruit candy, mustard oil, pasteurized milk, ghee, spices, etc.

3.1.8.3 Agro Tech International Exhibition

In Bangladesh, labourers are being migrated from agriculture day by day. Due to this labour shortage, the mechanization of agriculture in Bangladesh has been an issue of utmost importance. To cope up this situation, mechanization in agriculture is crucial. On the other hand, in house training organization for all people is not possible from revenue budget. From this thinking the introduction of different types of machinery and technologies scattered all over the country as well as the world, Agro Tech International Exhibition can play an essential role for human resource development for agricultural mechanization. Considering potentials of the exhibition, RDA, in collaboration with LIMRA has been organizing "Agro Tech International Exhibition" since 2011 under Public Private Partnership (PPP) concept.

3.1.9 Bangladesh Sugarcrop Research Institute (BSRI), Pabna

BSRI is one of the oldest research institutes of Bangladesh researching Sugarcane, palmyra pum, date pum and sugarbeet, the raw material sugar, gur and cane juice. Sugarcane is the only dependable cash crop in the low rainfall belt of the north-west and south-west parts of Bangladesh. Based on sugarcane, the sugar and gur (Jaggery) industries have developed in the country.

3.1.9.1 Agricultural Engineering Division

Agricultural Engineering division is one of the 11 research divisions of BSRI. The main responsibility of this division is to develop suitable farm machinery and technology for different sugar crop operations including postharvest process activities for achieving agricultural mechanization in Bangladesh. BSRI has developed several farm machinery for cultivation and processing of sugarcane and intercropping. These are mini hot water treatment plant, pedal operated bud chip cutter, hand operated bud chip cutter, power operated seed cutter, trencher, power weeder, harvester, etc.

3.2 Challenges and Constraints

The knowledge gap which is developed within students due to challenges and constraints of higher education institutions can be found among them when they are employed in the research institutions. It is one kind of chain and perpetual problem. Most of the challenges and constraints faced by both higher education and research institutions are the same. The challenges

and constraints faced by higher education institutions are identified as potential or prime problems. These are gradually and very strongly transferred to the research institutions. For the sake of easiness and intuitiveness, the challenges and constraints of higher education institutions are given importance in this article and described elaborately. It also shows a clear view of the challenges and constraints for the research institutions for the development of agricultural mechanization in Bangladesh. There are many challenges faced by higher education and research institutions in Bangladesh (Ahmmed, 2013). Corruption is one of the barriers of both higher education and research institutions. Besides, nepotism, recruitment of less meritorious teacher and personnel by political identities create an obstacle for the progressive development of higher education and research institutions.

There are many barriers found in the pathway to quality higher education such as financial problem, lack of sufficient residential halls, lack of adequate laboratory as well as the involvement of teachers with other activities. The traditional teaching method where sharing knowledge and students participation is very minimal. The brainstorming discussions and presentations by the students enable them for better grooming up. However, this type of education system is almost absent in our university. Moreover, the speech type teaching, the gap between teachers and students act as barriers in the appealing environment of free learning in the universities of Bangladesh.

On the other hand, modern teaching methods and facilities like internet, multimedia and sound system are not sufficient both in universities and research institutions. There is a lacking of quality teachers who fail to satisfy the students' needs. The consideration of political background during recruitment of teachers is an essential reason for lacking scientific and update knowledge (Ahmmed, 2013) that assists them to change their teaching methods. Due to lack of adequate library and a shortage of modern equipment in the laboratory, the university education is hampered. On the other hand, new text and reference books, peer review journals access are hardly available in the library. The articles published by the teachers are not international standard indexed (SCI, SCOPUS, ISI) journals. The allocated budget for the university and research institutions from the government is mostly spent on the salary and other allowances of the faculty and researchers. So, the less amount of money is allotted for research purposes. Most of the people of Bangladesh admit that the research budget is not enough in the higher education institutions. However, from the observation and author’s viewpoint, teachers are not motivated by themselves to take

research on the challenging topics. They always plead that due to lack of budget in research, they can not undertake cross cutting research. However, there are many types of research such as simulation, modeling and computation can comfortably be done with a simple computer only. In that case, they need to study deeply and more advanced topic. Lack of advanced knowledge is one of the significant drawbacks of the teachers and the researchers. Involvement in politics of both teachers and students have created a significant problem in the higher education sectors. Both teaching and learning are substantially interrupted by the teacher and student's politics.

3.3 General Constraints and Challenges of Human Resource Development for Agricultural Mechanization in Bangladesh

The agricultural machinery sector in Bangladesh faces some problems. One of them is that the private sector is dominating the agricultural mechanization and sometimes the quality of machinery produced is not acceptable. Because of low research and development (R&D) funds for innovation of machinery, promotion, extension and dissemination efforts by the government of Bangladesh are limited. The agricultural machinery sector is mostly import dependent. Local manufacturers have to compete with low tariff imported machineries. A lack of adequate trained workforce and inadequate technical know-how of manufacturers are barriers to the successful fabrication of quality machineries and to develope market demand. There are limited funds available for R&D and an absence of linkages among researchers, manufacturers and extension personnel. The high price of raw materials and imported parts and inefficient marketing and sale/services negatively impact the development of this sector. Non-availability of soft and hard infrastructure like credit facilities and material testing facilities are other significant constraints faced by this sub-sector. As an emerging sub-sector, agricultural mechanization faces many constraints. However, few significant constraints that have enormous implications on the growth of the agriculture machinery sub-sector are described in this section.

3.3.1 Lack of Modern Capital Machinery at the Producers' Level

It results in low productivity and poor quality of products. Agri-machinery sub-sector is comprised of small and medium-sized entrepreneurs. The entrepreneurs have mostly emerged from repair and maintenance service sector and lacking in experience and technical knowledge related to the manufacturing of sophisticated agricultural machines and equipment. Also, the lacking of information about appropriate machines and types of equipment

suitable for the production of quality machines and spares; lacking of appropriate design, drawing and manufacturing processes; and lacking of knowledge about the sources of this technical information. All the foundries and machining workshops are lacking in modern capital machinery. Mostly they depend on age-old outdated machinery for manufacturing agri-machineries and spare parts. As a result, producing quality compromised products and facing fierce competition with the imported machines and spare parts especially products from China.

3.3.2 Lack of Supply of Quality Raw Materials to the Foundries and Manufacturing Workshops

It hampers production and increases production cost. The imported raw material such as pig iron, ship breaking scraps, and local scrap iron, steel, brass influence the production of foundries, pump, and spare parts manufacturers. The production of the manufacturers also depends on the supply of hard coke and furnace oil. The ship breaking industries are lacking of the supply of old ships due to international market competition, especially with China and India.

On the other hand, a group of few importers from Chittagong and Dhaka controls the imports of these raw materials which manipulates the supplies of ship breaking scraps and hard coke, and responsible for the price hike. This crisis intensifies manifold when VAT is imposed. As a result, it increases the use of local iron scraps which reduces the quality of the product. Furnace oil supply in border districts such as Jessore, Dinajpur is restricted by 'quota' system (Alam et al., 2017). As a result, small foundries are hard hit at peak demand, as their working capital is not sufficient enough to allow them to stockpile the furnace oil over time. The higher price and unavailability of raw materials pose a significant threat to the domestic agri-machinery and spare parts production regarding production cost and quality compared with the imported machines and spare parts especially imported from China. The raw material supply situation is not at all congenial for the growth and development of this sub-sector.

3.3.3 Lack of Skill Related to Fabrication and Machining

The agricultural machinery manufacturing sector has lacking of skilled and experience workforce in all levels of production. As a result, the productivity gets low in this sector. The different operations such as iron, alloy steel and brass casting, and heat treatment; repair and maintenance of agricultural

machinery; and management and accounting keeping at the producer level results in low productivity. Qualified engineers or diploma holders are scarce in this sector. Therefore, the design, drawing, manufacturing process and quality control are not done properly which results in production of quality compromised products. Finally, these products face hard competition in market.

3.3.4 Lack of Steady Supply and Rationing of Electricity

It restricts the production and business at producer and as well as farmers level. Frequent power cut in daily is a great problem for the manufacturing of the agricultural machinery. Most of the respondents complain that frequent power cut hampers their production. On the other hand, the cost of per unit electricty is higher for small scal industries. During the irrigation season the power supply is stopped in the industrial areas after 8:00 pm to ensure continuous irrigation water for crop production. Together these problems makes the situation adverse for the potential growth of this sector.

3.3.5 Lack of Testing and Standardization Facilities

Now a daysfarmers are conscious about quality of the agricultural machinery and other spare parts. Currently there are few institutions for testing and certifying the manufactured agricultural machinery and spare parts. Sometimes the users have less trust on the certifying institutions because the products do not work as much as said or written. This impedes production of quality agricultural machinery and spares parts in Bangladesh.

3.3.6 Lack of Working Capital

The demand of agricultural machinery varies seasonally. So the manufacturers need sufficient capital in off-season to produce machinery and spare parts as they can supply during demand. Unfortunately this sector is small in size and lacking sufficient working capital. As for example, only in centrifugal pump production sub-sector in Bogra has Taka 475 million unmet market size because of limited supply in peak demand (Alam et al., 2017). Consequently, it hinders production of agricultural machinery and spare parts industries and workshops in Bangladesh.

3.3.7 Lack of Infrastructural Facilities

Lack of space and infrastructural facilities hinder the growth of agricultural machinery sector in Bangladesh. The northern districts such as Bogura,

Jessore are the main hub for the production and marketing of agricultural machinery and spare parts. Almost all of the agricultural machinery and spare parts are produced from these two districts. However, the agricultural machinery industries in these districts have grown scatteredly in small area. Due to small area it is difficult to accommodate the number of agricultural machniery and spare parts. The workshops are very congested and unhealthy which hamper production and workers' efficiency.

4 Recommendations

The development and growth of the agricultural machinery sector is comparatively new and mostly comprises of small to medium enterprises. Despite many problems this sector is expanding at high rate. It means that this sector has significant prospects in Bangladesh. Many steps may be taken to overcome the obstacles for the development of this sector. Therefore, a number of recommendations are proposed based on the findings and discussions of the study.

4.1 The modification of the syllabus of the higher educational institutions is necessary. It should be modern, time-bound, need-based and international standard which will develop high-level skills and innovative quality among students . The new innovative courses and ideas in the learning process should be introduced so that the students can face the challenging task.

4.2 Research and need based education should be ensured in each and every university. There must have the correlation between research and development. The higher education institutions and research organizations can act as the research hub for continuous development of knowledge and understanding of subject matters.

4.3 The recruitment should be planned and transparent both in universities and research institutions. Qualified and competent personnel should be recruited. Political intervention should not be considered during recruitment and promotion of the staffs.

4.4 The faculty evaluation system in universities should be updated and international standard. It must need to be improved in research organizations also. Present evaluation system does not improve the consciousness, motivation and responsibilities of the respective personnel. Universities also

need to value teaching excellence, such as the quality and pervasiveness of faculty training in education.

4.5 It is recommended to establish the agricultural machineries production zone by selecting the potential area throughout the country. It is also necessary to improve facilities for uninterrupted supply of life lines such as electricity, gas, water etc. at agricultural machinery and spare parts production units.

4.6 Establishment of agricultural machinery taining centre to increase the skill and efficiency of the workforce in agricultural machinery production sector.

4.7 Establishment of a 'Central Institute of Agricultural Engineering (CIAE)' for continuation of innovation through research and development. It is also needed to establish of sufficient testing and standardization facilities to increase the quality of the produced machineries.

4.8 Formulation and implementation of a modern and need based National Agricultural Mechanization Policy.

4.9 Formulation of guidelines of quality checking for finished products is necessary. A authority may be formed to check the quality of the products of agricultural machinery and spare parts. It is also recommended to establish a agricultural mechanization cell under the Ministry of Agriculture for monitoring the overall mechanization activities throughout the country.

5 Conclusion

A qualitative analysis was conducted to understand the prospects and problems of higher education and research institution for the development of agricultural mechanization in Bangladesh. The agricultural mechanization is inevitable to increase crop production in Bangladesh due to low cultivable land, rural labour force and cropping intensity. The present education system of higher agricultural education institutions of Bangladesh is in vulnerable position because of lack of combination of modern knowledge and state-of-art research, lack of capacity and poor quality of graduates. On the other hand, the leading research organizations in the field of agricultural mechanization have lacking of quality researchers, good governance and research fund. Together these are creating a vulnerable condition of agricultural mechanization situation in Bangladesh. Human resource

development through agricultural mechanization can meet the needs of the economy and food security in Bangladesh. It is the comprehensive development of social, economic and technological paradigm which are highly correlated factor for the overall development of the country. The development of higher education system, training and research can produce adequately trained manpower in agricultural mechanization sector of Bangladesh. The appropriate mechanization scale can only solve the farm power use pattern in Bangladesh. The improvement of research environment both in the higher education and research institutions is crucial for the sustainable development of agricultural mechanization.

Finally, a unique mechanization model comprising of higher agriculture education institutions and agriculture research organizations can boost up the status of agricultural mechanization in Bangladesh.

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Table.1 : Present Status of Agricultural Machineries Used for Crop Production

Sl. No.	Agricultural Machinery	Number of units
1	Power tiller	About 7,00,000
2	Tractor	> 60,000
3	High speed rotary tiller	> 4,000
4	Weeder	> 2,50,000
5	Seeder	5000
6	Transplanter	300
7	Sprayer	13,00,000
8	Combine harvester	80
9	Reaper	500
10	Open drum thresher	> 1,50,000
11	Closed drum thresher	> 2,20,000
12	Winnower	> 2,000
13	USG Applicator	> 18,000
14	Hand maize sheller	12,000
15	Power maize sheller	30,000
16	Engine	25,00,000
17	Irrigation pump	DTW- 36,034, STW- 15,63,791 and LLPs-1,71,041

Note : USG : Urea Supergranule, DTW: Deep Tube Well, STW: Shallow Tube Well, LLPs: Low Lift Pumps; (Source: Ahmmed, 2014)

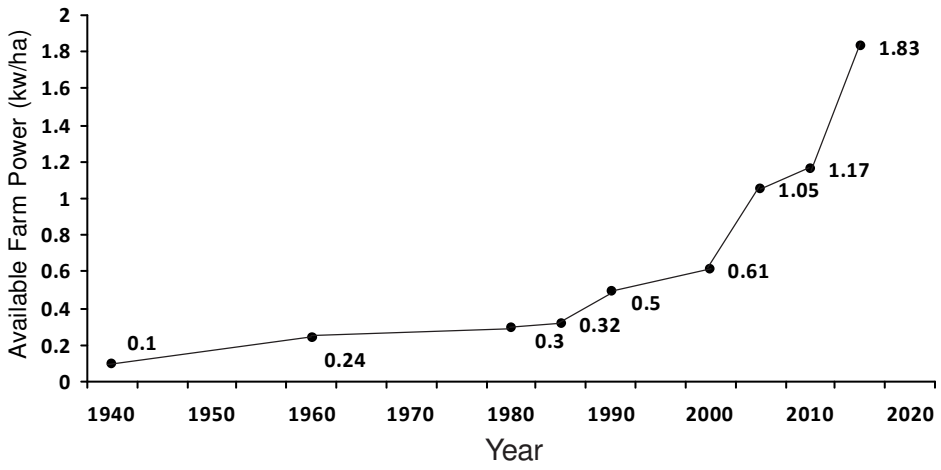

Fig.1: Farm Power Availability over the Year in Bangladesh

Source : Ahmmed, 2014

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OPPORTUNITIES AND CHALLENGES FOR MARICULTURE IN INDIA

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The contribution of fisheries sector to world fishery and trade is substantial. The items traded have gained reputation over the years which will help to keep the momentum of growth in the future. Total fish production in India was 12.59 million tonnes and the country exported 1.38 mt fish and fish products with a value of over Rs. 45,000 crore in 2017-18. Forecasts on seafood supply and demand indicate that the expansion of the world's trade of fish and fisheries products will continue in the coming decade, although at a slower pace (from 3.1% for 2010–2012 to 1.8% in 2022). Aquaculture will be mainly responsible for this expansion, as its production is expected to grow by 35% in volume until 2022. It is estimated that by 2022 developing countries will contribute 68% (in volume) of the world seafood exports destined to human consumption and 53% will be attributable to Asia. With its vast coastline, wider species diversity available for farming and the huge human resources and improved infrastructure, India can emerge as a strong seafood producer and supplier in the global market. Over the years, Indian aquaculture industry has also undergone a structural change which equipped the sector to maintain its consistency and competency in the global fishery trade.The present paper has highlights the opportunities and challenges for establishing mariculture in India by addressing advances in scientific and technical base to achieve cost-effective and eco-friendly operations.

1 Introduction

Mariculture involves farming of marine organisms for food as well as products such as pharmaceuticals, nutraceuticals, food additives, cosmetics and jewellery, either in the sea, or sea-based enclosures, such as cages, pens, ponds, raceways or recirculating systems. Seaweeds, molluscs, shrimps, finfishes, and a wide range of other minor species are presently farmed around the world's coastlines. Mariculture is the world's fastest growing food production activity and with the current trends in population growth and consumption it is suggested that aquaculture will need to provide 83 million

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of aquatic food by 2030, suggesting future production globally of over 42 million t. Mariculture offers possibilities for sustainable food production and economic development of local communities as well. However, on a large scale, mariculture may pose several threats to marine and coastal environments, such as degradation of natural habitats, overloading of nutrients and uncontrolled waste discharge, escape of farmed organisms, transmission of diseases to natural stocks and displacement of local and fishing communities. Mariculture thus presents both opportunities and challenges for the environment and society. Whether farming in the ocean can mitigate food security concerns and be sustainable in terms of production and environment safety depends in large part on the governance infrastructure of the sector. Besides from being host to fishing livelihoods and ecosystem functions, coastal areas are always multi-use resources.

Handbook on Fisheries Statistics (2018)of Government of India recorded that the inland fisheries accounted for 8.9 mt and the marine fisheries 3.69 mt of production in 2017. India is currently the second largest producer of fisheries after China. The total fish production in 2017-18 was 10.14 per cent more than 11.43 mt produced in 2016-17. Inland fisheries, which grew at 14.05 per cent accounted for much of the growth. Marine fisheries production, on the other hand, went up by only 1.73 per cent in 2017-18. The fisheries and aquaculture production contributes around 1% to India's Gross Domestic Product (GDP) and over 5% to the agricultural GDP. According to Food and Agriculture Organization (FAO) report "The State of World Fisheries and Aquaculture 2018" apparent per capita fish consumption in India [average (2013-15)] lies between 5 and 10 Kg (Govt. of India, 2019). Fish and fish product exports emerged as the largest group in agricultural exports and in value terms accounted for Rs.47,620 crore in 2018-19 and are contributing over 17% to the national agricultural export (Economic Times, 2019).

2 Opportunities for Mariculture in India

2.1 Physical Components

India has a coastline of 8129 km, a continental shelf of about 50 million hectares and a brackishwater area of about 1.7 million hectares. The east and west coasts of India are productive and suitable for undertaking mariculture, while the edges of the seas offer scope for large scale culture of organisms such as oysters, mussels and seaweeds. Fish production in India is almost entirely from the capture of fisheries, despite the country having huge potential for sea farming. With nearly 3.5 per cent growth per

annum, India should be producing at least 10.5 million tonnes of marine fish by 2050. India has numerous unexploited opportunities for mariculture, with good potential to pursue it, particularly to potentially alleviate food and nutritional security concerns. Countries like China, which are already leading in mariculture do not have the most biologically suitable waters, and are less sustainable or optimal. At least 0.5 to 1.0% of the vast coastline of the country can be effectively utilized for mariculture activities involving fishers and coastal populations.

2.2 Biological Components

2.2.1 Diverse Species for Farming

a) Crustaceans

The spiny lobster Panulirushomarus and P. polyphagus available along the Indian coast cannot yet be grown through its many larval stages. However, lobster juveniles or post-larval stages (pueruli) can be collected readily as they metamorphose from the planktonic to benthic habit, sometimes in very large numbers, and these may be grown out to marketable size in 6 to 12 months in sea cages. The spiny lobsters are not cannibalistic in nature and would, therefore, are preferable for mariculture. Collection of pueruli from the wild is unacceptable in the long run because of concerns about potential impacts on natural populations and fisheries. Thus, commercial level spiny lobster culture most probably must await perfection of the technology for rearing the animal throughout its entire life cycle.

The mud crab Scylla serrata and S. tranquebarica are farmed in two methods. Grow- out culture involves growing young crabs for a period of 5 to 6 months till they attain marketable size. Mud crab grow-out systems are generally coastal ponds of 0.5-2 ha, with proper bunds and water exchange. Wild collected juvenile crabs of 10-100 g size are used for stocking. The duration of the culture varies between 3-6 months. The stocking rates are commonly between 1-3 crabs/m2, with supplementary feeding. Feeding is usually with trash fish (wet weight feeding rate-5% per day of the biomass), along with other locally available items. On fattening of crabs, soft shelled crabs are reared for a period of a few weeks till their exoskeleton gets hardened. These 'hard' crabs are locally known as "mud" (meat) and fetch three to four times better price than the soft crabs. The marine blue swimmer crab Portunuspelagicus is also a suitable species for mariculture in India

Farmed species of shrimp are Indian white shrimp Fenneropenaeusindicus, black tiger shrimp Penaeusmonodon, American white leg shrimp Litopenaeusvannamei and the grass shrimp Penaeussemisulcatus. The export of shrimp has exceeded 0.5 million metric tonnes in India and it is the major foreign currency earner in the country. Farming is mostly done in coastal ponds with seawater pumping systems and aeration.

b) Molluscs

The prospects and potential molluscan mariculture in India was realised as early as in 1970s and concerted efforts were made to develop suitable technologies for scientific farming which could be easily adopted by the coastal fishermen. This has resulted in development of seed production and farming of mussels, pearl oyster, edible oyster, clams and marine pearl production. For pearl culture, out of the six species of pearl oysters available In IndiaPinctadafucata is the common species used. Two species of marine mussels, the green mussel Pernaviridis and the brown mussel P. indica are suitable for coastal aquaculture in India. Among the four species of edible oysters from Indian coasts Crassostrea madrasensis is farmed widely along the east and west coasts of India. Viable technology for the production of seed and rearing are available for blood clam Anadaragranosa, M. meretrix, M.casta, Paphiamalabarica and Villoritacyprinoidesin the country.

c) Finfishes

Comprehensive technology for seed production and farming of Asian *seabass Lates calcarifer* is available in the country with commercial hatchery operation for the species in the government and private funded hatcheries. *Cobia Rachycentroncanadum* which is popular globally with its fast growth rate, adaptability for captive breeding, low cost of production, good meat quality and high market demand is a candidate species for mariculture in India. Hatchery produced seeds are available for smll scale farming in the country. Silver pompano Trachinotusblochiiand Indian pompano T. mookalee are the other two prospective candidate species for mariculture in India. Both species are fast growing with good meat quality and high market demand. Orange spotted grouper Epinepheluscoioides a species suitable for coastal mariculture in ponds as well as cages has very good export potential also. The seed production technology for all the above species have been standardized in India.

d) Ornamental fishes

Marine ornamentals suitable for mariculture include clown fishes and damsels. Amphiprionpercula, A.ocellaris, A. perideraion, A. ephippium, Dascyllusaruanus, PomacentruscaeruleusandChrysipteracyanea a few of them for which seed production technology has been developed.

e) Seaweeds

Around 60 species of commercially important seaweeds with a standing crop of one lakh tonne occur along the Indian coast. Gelidiellaacerosa, Gracilariaedulis and Hypneavalentiae are some of the species suitable for mariculture. Culture of the carageenan yielding seaweed Kappaphycusalvarezii is also prevalent and prospective along the Indian coast. Edible seaweeds are not farmed in India and all farmed seaweeds are used either for production of agar, align or carageenan. For production of bioactive compounds and nutraceuticals seaweeds can be used. Raft, net tube and rope culture methods are followed for farming of seaweeds in India.

f) Microalgae (Phytoplankton)

Several species of unicellular algae are grown routinely in India as food organisms for larval finfishes, molluscs and crustaceans. Culture systems range from tanks and cylinders in hatcheries to outdoor ponds. The major species are Chlorella marina, Nanocloropsis oculata, Chatoceros calcitrans, Pavlovalutheri, Isochrysis galbana, and Tetraselmis.

3 Technological Opportunities

3.1 Sea Cage Farming

Cage culture has made possible the large-scale production of commercial finfish in many parts of the world and can be considered as the most efficient and economical way of rising fish. India has initiated cage farming in 2005 and it has reached some level in the country now in terms of indigenous design of cost-effective cages and farming of a variety of finfishes and crustaceans in the cages. The technology has very good impetus in the country because of (i) availability of suitable sites for cage culture within the territorial waters of the country, (ii) well established breeding techniques for a variety of high value marine species, (iii) availability of supporting industries such and feed, net manufactures, marketing networks etc., (iv) strong

research and development initiatives from institutions, state and central governments and universities (v) the private sector showing interest in scaling up of seed production, establishment of mariculture systems, thereby developing the industry further in a rapid pace and (vi) developmental institutions funding mariculture at different levels for different activities from hatchery set up to cage farm establishment with subsidies.

3.2 Recirculating Aquaculture System (RAS)

Closed-system aquaculture presents a novel and expanding commercial opportunity for mariculture in India. Recirculating aquaculture systems (RAS) are tank-based systems in which fish can be grown at high density under controlled environmental conditions with minimum water exchange. In RAS, water flows from the rearing tank through treatment systems and then return to the tank, making the system recirculating. RAS use land based units to pump water in a closed loop through fish rearing tanks and consist of a series of sub-systems for water treatment which include equipment for solid waste removal, biological filtration, heating or cooling, dissolved gas control, water sterilization and photo-thermal control. Even though capital intensive, RAS is a better option for intensive and biosecure farming of marine organisms.

3.3 Integrated Multi-Trophic Aquaculture (IMTA)

In IMTA, the fed species like finfishes and shrimps are integrated, in the right proportions, with species which are suspension feeders, deposit feeders or herbivorous fish and species which are extractive(e.g. seaweeds). The wastes generated from one species are recycled to become inputs for another as fertilizers, feed and energy in IMTA. It aims for an ecosystem management that considers site specifications, operational limitations, food safety guidelines and regulations. The goals include environmental sustainability through biomitigation, social acceptability through economic stability and product diversification, reduction of risks, and better management practices. In India, the scope of IMTA is very high because of the diversity available in species that can be farmed, the tropical climate prevalent which is conducive for farming both fed and non-fed species and the increasing demand for a variety of farmed species for domestic consumption as well as export. In any variety of the IMTA systems, the co-cultured species should be more than just biofilters and should be of commercial value (including in terms of biodiversity). In the existing fed aquaculture of finfishes and finfishes, non-fed bivalve species like green mussel Pernaviridisand edible oyster

Crassostrea madrasensis are also farmed to a greater extent in the country. Extractive species farmed are some red and brown sea weeds like *Gracilariaedulis* and *Kappaphycusalvarezii* which are having good market demand for non-edible purposes.

3.4 Culture Based Fisheries Enhancement

Marine fisheries/stock enhancement involves release or stocking of hatchery reared finfishes, molluscs, crustaceans, or other organisms into a natural marine environment where they will replenish the depleting stock, thereby expanding the opportunities for enhanced capture fisheries production of a particular species or area. These activities take two forms: (1) mitigation for the purpose of replacing natural regeneration that has been destroyed by human interventions and (2) for the purpose of augmenting natural stock that are overfished or declining naturally.

4 Major Inputs in Mariculture Systems

4.1 Feed

The primary operating cost for mariculture operations is feed ranging from 30 to 40%. The price of feed is linked with fish meal prices, which correlate closely with other plant meal prices and are highly variable. It is apparent that a number of opportunities exist to reduce the costs of feed production and marketing through advanced technology, thereby improving the competitiveness of mariculture industry. Entrepreneurship can be developed at different levels based on scales of production and capital investment. The feeding habits and the morphology and composition of feed vary greatly by species. Consequently, different artificial diets and feeding systems need to be developed in each kind of culture operations. With focus on nutritional requirements, effective feeding systems, improved efficiency of feed utilization and alternative protein sources, and specific requirements during different periods of the life cycle cost-effective and quality feeds can be produced for mariculture operations.

The larval and juvenile stages of many marine species are relatively small (2-3 mm) at the time of first feeding and at this stage, size of food offered, the acceptability of prepared food versus live food and the delivery system are very crucial. Microencapsulated diets can replace live feeds for larval

and juvenile stages to a certain extent only and are not yet entirely. Incorporation of feed attractants to promote feeding leading to lower feed conversion ratios scan be aimed at. Protein is the single most expensive and essential component of fish feeds and the substitution of less expensive sources of protein for fish and other animal meals in feed could substantially reduce production costs. Since, feeds can release large amounts of nitrogen and phosphorus to the ambient water causing localized eutrophication, improved feeds could mitigate concerns about it. All these areas open an opportunity in mariculture.

4.2 Seed

Seed is the major input for any successful aquaculture operation. Availability of seed would remain as a constraint if the issue is not addressed in time. In India, for all the maricultured species, hatchery technology is not being available. Those species, for which seed production technology is standardized,it may not be commercialized except for one or two. The lacuna lies mainly in scaling up of seed production. A well proven strategy is establishment of satellite hatcheries all along the coast using newly hatched larvae supplied from a main production centre. Skilled operators can run such centres and supply seeds to the farmers for mariculture. Establishment of nursery rearing/post-hatchery rearing facilities also would add to feasible mariculture operations.

4.3 Human Resource Availability

India has nine coastal states which are well populated and depending on the marine resources in one way or the other and the residents pursue a variety of other economic activities too. The state of the marine resources surrounding these communities is associated with the nature of activities, and in particular, in the manner at which fishing and aquaculture activities are being conducted in these areas. There are about 3.9 million marine fishers in the country. For traditional fishers, fishing is already the livelihood and the lack of access to production inputs and other skills other than fishing explains their dependence on low-input resource like artisanal fishing. In coastal regions where traditional fishery jobs are in decline, mariculture provides employment opportunities that maintain links to traditional life-styles. At least a percentage of more than a million fishers in the country can be utilized effectively for mariculture activities. The graduates and post-graduates in fisheries and related subjects can be employed in every related sector and many can be made as entrepreneurs in the evolving mariculture industry in the country.

5 Enhancing Economic Feasibility of Mariculture in India

Factors like creation of new capabilities, design of more higher-yielding operations and reduction of expenditures through more effective and efficient operations and the substitution of cost-effective capital investment for labour can result economically feasible mariculture operations. Specific opportunities for improving mariculture in these areas include: culture systems that make possible the production of marine species in environmentally sound ways; improved technology for culture operations to utilize inputs more efficiently, increase productivity, and reduce costs of production and waste disposal (e.g., water use and reuse, feeding technology, product inventory, product handling, waste disposal); technology that improves the cost-effectiveness of operations through intensification of culture systems, reduced operating costs, and increased productivity; and technology that reduces production uncertainty (e.g., through disease detection and treatment, inventory monitoring systems, and design of more seaworthy facilities), thereby reducing risk and the associated costs of capital, insurance, and other non-operational factors. Marketing and Product Information Technology can enhance the quality and value of products in addition to increasing productivity and reducing costs. E.g.; harvest, transportation, processing, and packaging technologies that will allow aquaculture to deliver high-quality products in good condition to appropriate markets; technologies that can maintain high-quality standards and ensure wholesome and safe products; and valuechainsfor new and traditional aquaculture species.

5.1 Seafood Processing Industry

Opportunities exist in areas including production, manufacture, and processing of non-food products from mariculture, such as pharmaceuticals and ornamental fish. The advantages of mariculture over traditional fisheries for local economies include year round industries and the development of a technically skilled work force. For the nation, mariculture has the potential to contribute significantly to the enhancement of fisheries stocks that are in decline or in danger of extinction. This role could be instrumental in augmenting species for recreational purposes, for commercial fisheries, or for wild species preservation. As a complex scientific and engineering field, mariculture systems and technology can contribute to the development of marine biotechnology, which in turn has the potential to contribute to a number of medical and scientific advances.

5.2 Organizational Support in Mariculture

For mariculture, central and state government institutional support is available in India through R& D as well as financial support schemes. National Fisheries Development Board (NFDB), a developmental agency in India is doing major funding for mariculture in India through the blue revolution scheme. NFDB is involved in the promotion of commercial aquaculture including technology up-gradation and support services (i.e., AQUAONE Centres). Further it has a leadership role in promotion of mariculture by introducing guidelines in farming systems and policy drafting; support of mariculture related R&D programs, skill development programmes in mariculture and dissemination and popularisation of existing farming and related technologies for end users. of production and marketing statistics and related information.

The banks like National Bank for Agriculture and Rural Development (NABARD) and few nationalized banks and state cooperative banks are also actively involved in financing schemes in mariculture and related activities in India.

6 Blue Dimensions of Mariculture in India

- The development of mariculture and blue economy of it has a potential to increased sea food production

- Increasing mariculture has greater demand for good quality sea water

- Mariculture is concerned with a wide range of environmental issues

- Blue carbon emissions occur from increased manufacture and usage of artificial feeds, structures like cages, nets etc.

- There is blue growth potential for increasing seafood production through expansion of coastal and open sea mariculture, which is essential for sustainable development of the blue economy

7 Trade Opportunities in Mariculture

Even as growth in agriculture sector remains a challenge for the government, due to fluctuating growth in sectors like crop, livestock and forestry from 2014-15 to 2017-18, fisheries sector has grown rapidly from 4.9 per cent in 2012-13 to 11.9 per cent in 2017-18. Fish and fish product exports emerged

as the largest group in agricultural exports and in value terms accounted for Rs. 47,620 crore in 2018-19. Fisheries is a fast-growing sector in India, provides nutrition and food security to a large population, besides providing income and employment to more than 14.5 million people. India is the second largest fish producer in the world with a total production of 13.7 million metric tonnes in 2018-19 of which 35 per cent was from marine sector. The fisheries sector has been showing a steady growth in the total gross value added and accounts for 5.23 per cent share of agricultural GDP. Foreseeing the vast resource potential and possibilities in the fisheries sector, a separate Ministry of Fisheries was created in July 2019 (Economic Survey, 2019). The Government has merged all the schemes of fisheries sector into an umbrella scheme of 'Blue Revolution: Integrated Development and Management of Fisheries' focusing on increasing fish production and productivity from aquaculture and fisheries resources, both inland and marine. The drivers explaining the expansion and transformation of trade patterns in last decades include: the improvement in freezing and storage technologies, the growth of aquaculture production, the establishment of Exclusive Economic Zones, the over exploitation of fish stocks, the increase in per capita fish consumption and changes in consumption habits, the increased relevance of processing and trade liberalization (FAO, 2009, 2018; Anderson, 2003; Asche and Smith, 2010).

8 Challenges in Mariculture

8.1 Vulnerability to Economic Uncertainties and Climate Challenges

While mariculture shows potentials for coastal population through a diverse range of employment in commercial farms, sustaining the incomes and employment from it remain a challenge. Every aspect of mariculture operations and all types of engagement, either as cage owner/operator or as employed worker, are vulnerable to economic uncertainties and climate challenges. Risk and vulnerability are similarly high in cases where fishers operate as smallholder mariculture investors.

8.2 Environmental Issues

Mariculture should address environmental issues relating to compliance to carrying capacity, maintenance of healthy aquatic ecology, ecosystems risk arising from escapees from mariculture systems and mitigating the impacts of climate change. A fundamental and tested approach to address these

challenges that are either already being experienced or yet unforeseen is by sustaining support for scientific biological and socioeconomic research and development studies to provide sound basis for improved design of mariculture technologies, and the consequent formulation and implementation of science-based mariculture regulations.

8.3 Social Challenges

Social challenges that require investigation include livelihood security and seasonality of mariculture systems, including the potential impacts of climate variability and change; management of investments and risk; establishment of functional government support systems especially for small-scale operations; insurance schemes; maintenance of sustainable culture protocols (e.g. feeding and pollution management). In terms of addressing social challenges of securing availability and access to food among the poor, policy studies should evaluate mechanisms for balancing the role of mariculture in providing local food as against improving national incomes from exports. Understanding the gendered nature of mariculture and related activities (i.e. that men fit well with strenuous tasks in cage construction and harvesting while women are adept in net mending, marketing and fish processing) can be instrumental in addressing some of the social challenges.

8.4 Marketing Challenges

The establishment of an organized marketing to manage production and distribution of produce would sustain mariculture as an industry. The assurance that there are markets and good prices for the produce throughout the year would translate to mariculture being an effective and sustainable livelihood diversification strategy in rural coastal communities in India. Marketing strategies include seasonality analyses and management; and improved species availability and distribution channels to meet market demand for viable species. For high-end and niche mariculture species, initiating branding and image building of products from will potentially get rid of the disadvantages and losses from the generally ‘‘generic’’ nature of marketing of high-value aquatic species produced through mariculture.

9 Mariculture Policy

Forecasts on seafood supply and demand indicate that the expansion of the world’s trade of fish and fisheries products will continue in the coming decade,

although at a slower pace (from 3.1% for 2010–2012 to 1.8% in 2022). Aquaculture will be mainly responsible for this expansion, as its production is expected to grow by 35% in volume until 2022. It is estimated that by 2022 developing countries will contribute 68% (in volume) of the world seafood exports destined to human consumption and 53% will be attributable to Asia. As on date India lacks a mariculture policy in the country. However, NFDB has initiated its attempt on drafting a policy taking into consideration of the entire stakeholders in the sector. The major features of the proposed policy are (i) mariculture area development by demarcating zones and parks by identifying sites using satellite data (ii) development of climate resilient species, systems and practices (iii) additional livelihood options for coastal communities (iv)R&D in offshore mariculture, designs of cages and automation, and (iv) selective breeding of species to improve growth, disease resistance etc.

10 Recommendations

- Mariculture could be promoted as a provider of healthy food in India, due to the increased number of vegetarian population in the country.

- India can support mariculture through strong R& D programmes and establishment of facilities for new and improved systems and more species for commercial feasibility.

- Union Government can formulate a plan for the explicit inclusion of mariculture interests and impacts on coastal and offshore planning activities in policies of different maritime states.

- Mariculture should focus on environmentally safe technology, methods and systems

- The technologies followed in mariculture should be synergistic with other uses in the sea

- Socio-economic dynamics of mariculture industry to be focused (e.g. Employment patterns)

- Marketing of mariculture products can be focused on countries in Afro-Asian region, where India do not have a presence at present. Currently, export is mainly to Europe and U.S.

11 Conclusion

A number of benefits would accrue to the nation from a healthy mariculture industry, including wholesome high value seafood to replace harvests of wild fish from stocks that are declining or at maximum sustainable yield, products for export to improve the nation's balance of trade, enhancement of commercial and recreational fisheries and of fisheries that are utilized fully, economic opportunities for rural communities, and new jobs for skilled workers. Advancement of the science and technology base in mariculture also provides potential benefits to other industries, such as biotechnology and pharmaceuticals. With strong policy back up and financial support through national schemes, the mariculture industry will emerge in the country as a leading enterprise, providing livelihood and nutritional security to the people.

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PRODUCTION, RETURNS AND POLICY INITIATIVES FOR NUTRI-CEREALS (PEARLMILLET) IN INDIA

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Pearlmillet is the most commonly used of all millets around the world. It performs well under hot and dry climatic conditions with rainfall of between 200-600 mm annually. The paper is attempted with objective to study trend in area, production and productivity of pearlmillet in India, its economic viability in higher productivity state and to examine policy initiatives for its cultivation and productivity enhancement. The results obtained based on the data Collated from various published sources indicate that acreage under pearlmillet showed declining trend in western India comprising of Haryana, Gujarat and Maharashtra. The four states including Rajasthan together shared 63.90 per cent of total pearl millet production in the country. The growth rate of area exhibited negative sign (-1.01%) while production revealed inclining trend (1.45%) during period 1970-2019.The productivity of pearl millet increased upto 12.36 qtls ha^{-1} with annual increase of 2.51 per cent(1970-2019) due to genetically improvement, crop management, effective extension oriented activities and growing markets. The recent hike in MSP of pearlmillet and procurement arrangement is favourable policy decisions to support pearlmillet cultivation. The decadal analysis reflected that decline in area was not covered by sharp increase in productivity level and caused decline in production of pearlmillet during 1970-80, 1990-2000 and 2010-19. The expenses incurred in production of pearlmillet in higher productivity state i.e. Haryana unveiled increase over period due to increase in prices of purchased inputs, wages of labour, hiring charges of machines, etc. The rental value of land alone contributed more than one-third of total cost involved in cultivation of pearlmillet. The harvesting plus threshing constituted the highest share of total cost i.e. varied from 17.33 to 25.43 per cent as harvesting of pearlmillet is still done manually.The value of R-C ratio figured by taking into consideration gross returns and total cost was in the range of 0.86 to 1.01 indicates economic viability of promising pearlmillet hybrids.

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The cultivation of viable hybrids and adoption of improved agronomic practices are being incentivised by extending the programs like Initiative for Nutritional Security through Intensive Millet Promotion (INSIMP), Rainfed Area Development Programme (RADP) Nutri-Farms,Sub-Mission on Nutri-Cereals under NFSM to farmers in pearlmillet growing states. Besides, marketing and value addition interventions are also received attention to increase its consumption. Recently, nutri-rich cultivars of pearlmillet as evolved are being cultivated to address micro-nutrients deficiency. State governments have included millets including pearl millet in the Public Distribution System (PDS) to address the problem of malnutrition and created assured market for sustainable cultivation of millets in rainfed and marginal lands. The pearlmillet exported mainly gulf countries and needs to explore other destinations for export in the world.

1 Introduction

Pearlmillet (Pennisetumglaucum) is the staple nutri-cereal of the hottest, driest areas of the tropics and subtropics regions of world. Being short in duration, it is the most drought-tolerant cereal grown in the arid and semi-arid regions of the world (Bhagavatula et al., 2013). It is the sixth most important food cereal in the world. Globally, the area under millets displayed a declining trend after 1973, reaching 31.24 ha by 2017 compared to 43 million ha in 1961-62. Pearlmillet production is concentrated in the developing countries which account for over 95% of the production and acreage.But the production showed an increasing trend and touched 35 million tonnes in 2003 but over the last 54 years it has again fallen back to the starting level of 28.46 million tonnes in 2017. Productivity increased from 600 kg ha^{-1} in 1961 up to 965 kg ha^{-1} in 2008, but declined to about 911 kg ha^{-1} in 2017 (FAOSTAT,2017). At least, productivity growth has ensured that the production did not fall despite a regular decrease in the area under millets.Pearlmillet grain is the staple diet for farm households in the world's poorest countries and among the poorest people. Pearlmillet is annually cultivated on nearly 29 million hectares across the arid and semi-arid tropical and sub-tropical regions of Asia, Africa and Latin America (Kannan et al., 2014).Pearlmillet is one crop which has been growing historically for dry-fodder production and cattle grazing in the USA (Guliaet al., 2007). It is a staple food for more than 90 million people who live in the drier areas of Africa and Asia (FAO, 2010).India is also considered the secondary centre of origin for pearlmillet with many distinct cultivars being grown throughout the country. More than 60 per cent of pearlmillet cultivated area in India is in arid and semi-arid regions, characterised by long dry seasons, inadequate and unpredictable rainfall,

infertile and fragile soils conditions. These regions provide around 40 per cent of the food produced (Gulati and Kelley, 2000).In arid and semi-arid conditions, the cropping choice is restricted due to moisture stress, low soil fertility, poor and saline soils and lack of assured sources of irrigation. Dryland cereal such as pearlmillet is hardy crop that thrive in adverse agro-ecological situations, making them less risky for producers.

Pearlmilletis cultivated in India as dual purpose crops cultivated on 7.48million ha ranking fourth among cereals.Pearlmillet is a crop with the potential to cope with harsh agro-climatic conditions and is cultivated largely by poor and marginal farmers on nearly 9.0 million ha of inferior lands and soils with poor water holding capacity. Pearlmillet area marginally declined from 9.02 million ha in 1950-51 to about 7.48 million ha by 2017-18 in India. But its production increased from 2.60 million tonnes in 1950-51 to 9.21million tonnes in 2017-18. This rapid increase was possible because of trebling of productivity from 288 kg ha^{-1} in 1950-51 to 1231 kg ha-1in 2017-18. Pearlmillet accounted for about 5.87 per cent of the total foodgrains area in 2017-18.The pearlmillet growing state in India are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh, Haryana, Karnataka and Madhya Pradesh which together account for 94.79 and 93.68 per cent of total area and production of pearlmillet in the country (2017-18).

Pearlmillet is an important coarse cereal crop of Western India (Haryana, Gujarat, Maharashtra and Rajasthan states), which occupies about 17.34 percent of the total foodgrains cropped area in the region. About 5.89 million ha is under pearlmillet in Western India sharing 78.91 per cent of total pearlmillet area in the country. In India, more than 70 per cent of the pearlmillet area is accounted by three (3) states viz., Rajasthan, Maharashtra and Gujarat. In terms of production share, Rajasthan, UP and Gujarat accounts for 77.0 per cent of the total production (Nagaraj, 2012).

Besides grain, it is an important feed for livestock, especially in the dry months when other feed resources are in short supply. Pearlmillet, on the other hand, apart from being used as a staple food, is also used as poultry and animal feed, and for the production of alcohol and health foods.

The advantages of growing pearlmillet are that it needs lesser external inputs, drought tolerant, sturdy, climatic resilient, suitable for extreme weather conditions, short to medium duration, low labour utilising, resistant to pests and diseases and meet food, nutrition, and fodder requirements. Pearlmilletis the richest sources of nutrition, especially iron, calcium and zinc among

cereals and can provide all the nutrients at the least cost to the poor as compared to wheat and rice (Parthasarathyet al, 2006). Further, crop residue forms an important component of feed for livestock (Parthasarathy and Hall, 2003). Despite these advantages, a lack of economic incentives in the face of declining food consumption of this crop has relegated them to the status of inferior crop.

Furthermore, the nutritional value of pearlmillet offers scope for increased demand due to blending with high-value health foods preferred by the health conscious high-income consumer segments (Yadavet al., 2011). Pearlmillet has a high nutritional value in terms of levels of energy, dietary fibre, proteins with a balanced amino acid profile, many essential minerals, some vitamins and antioxidants. These factors play a significant role in the prevention of important human ailments, such as diabetes, cancer, cardia vascular and neurodegenerative diseases (Jukantiet al., 2016). Apart from this, non-alcoholic beverages (mahewu), flakes, drinks and pops are the value-added products of pearlmillet (Chandiposhaet al., 2013). The technologies required for various procedures of pearlmillet, like milling, malting, blenching, acid treatment, dry heating and fermentation, which reduce nutritional values and increase the digestibility of eclectic food products like unleaved flat bread (roti/chapati), porridges, and bakery products were highlighted by Raiet al., 2008. Non-food uses include cattle and poultry feed and as raw material for starch in breweries industries (Reddyet al.,2018)

Virtually, all the world pearlmillet production is done by the subsistence farmers and is rarely commercially traded (FAOSTAT, 2017). Export and import of pearlmillet grain are negligible suggesting low demand, and/or unreliable availability of marketable surplus for this commodity in world markets. Keeping in view, present scenario of pearlmillet cultivation, it is imperative i) to analyse trend in area, production and productivity of pearlmillet in India, ii) to evaluate its economic viability in higher productivity state and iii) to examine policy initiatives forcultivation and productivity enhancement of pearlmillet.

Nutritional Importance : Malnutrition arising from dietary deficiency of mineral micronutrients such as iron (Fe) and zinc (Zn) has widely been recognized as a serious public health problem worldwide, affecting more than 2 billion people (WHO, 2002). Fe deficiency ranks 9th and Zn deficiency ranks 11th among the 26 major risk factors for the global burden of disease estimates (Ezzatiet al., 2002).This problem is particularly serious in developing countries, especially in high risk groups such as pregnant women, infants and adolescent children. For instance, in India, about 80 per cent of pregnant

women, 52 per cent of non-pregnant women and 74 per cent of children in the age group of 6–35 months suffer from Fe deficiency-induced anaemia (Chakravarty and Ghose, 2004). After almost 72 years of Independence, malnutrition continues to plague India as vast segments of resource-poor people suffer from under-nutrition, particularly micro-nutrient deficiencies (hidden hunger).Numerous health problems arising from Zn deficiency could be as serious as those arising from Fe deficiency; however, there are no well-documented studies to establish this fact.

Micronutrient malnutrition or 'Hidden hunger' is caused due to inadequate accessibility of minerals and vitamins in diet. Zinc is also an important micro-nutrient which is required for proper growth, the deficiency of which may lead to stunting, increased susceptibility to many infectious diseases, morbidity and low mental ability (Deshpandeet al, 2013). Among all the possible ways to combat this micro-nutrient deficiency, crop bio-fortification is better and viable approach (Bouiset al., 2011; Stein,2010). Crop bio-fortification is increasingly being recognized as a cost-effective and sustainable approach to address the widespread micronutrient malnutrition arising from Fe and Zn deficiencies. Pearlmillet as a cereal crop species has higher Fe density than all other major cereals.It is found to be the economical source for rural residents to get micro-nutrients compared to other cereals such as rice and wheat (Parthasarathyet al., 2006). A recent study has shown that pearlmillet accounts for 19 to 63 per cent of the total Fe intake and 16 to 56 per cent of total Zn intake from all food sources in some of the major pearlmillet-growing states of India such as Maharashtra, Gujarat and Rajasthan (Parthasarathyet al., 2006). Under the bio-fortification program, ICRISAT and Mahatma Phule Krishi Vidyapeeth, Maharashtra jointly developed a high-iron variety of pearl millet, called Dhanashakti which was released in 2012 in Maharashtra and later in 2013 across India, making it the first mineral bio-fortified product of any crop cultivar released in India.

2 Methods and Materials

The paper attempted to analyze the status of area coverage and production in four states of western India i.e. Gujarat, Haryana, Maharashtra and Rajasthan contributing 90 per cent of the production and consumption of pearlmillet in India. Information related to area, production and productivity of pearlmillet was gathered from different published sources like Agricultural Statistics at a Glance, FAO Statistics, Statistical Abstract of Haryana, etc. Haryana having place in highest productivity of pearlmillet was selected to analyse costs and returns of its cultivation. The relevant information pertaining

to various resources used in production process of pearlmillet and output attained over years was collated by Farm Management Specialists working at Krishi Vigyan Kendras (KVKs) placed at various district headquarters of the state. Three years average of area, production and productivity of pearlmillet is considered to even out any sharp fluctuations. Further, decadal averages were also computed to ascertain changes in area, production and productivity of pearl millet over different decades as well as to reduce influence of drought periods. The descriptive analysis was done using average, percentage, and budgeting technique and also computed compound growth rates to underline outcome as per targetedobjectives of the study. The return to cost (R-C) ratio for cultivation of pearl millet in Haryana over years was obtained by taking ratio of total returns to total costs to evaluate its economic viability.

Besides, considering the vital role of pearlmillet in the food basket and livestock economy in the country, necessary information for various programs/ schemes implemented to support pearlmillet cultivation in India was obtained from various research organisations and concerned offices of Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi.

3 Results and Discussion

3.1 Pearl Millet Status at Global Level

More than 90 million desperately poor people depend on pearl- millet for food and income. They generally live in the drier parts of Africa and Asia, places where most other crops just would not grow, and local farm households literally have nowhere else to turn for food security. Fortunately, pearl millet is not just a resilient and dependable source of energy, but also a good source for other dietary needs, especially micronutrients. Pearl millet accounts for about 50% of the total global production of millets. India is the largest single producer of the crop, both in terms of area (7.48 million ha.) and production (9.21 million tonnes). The West and Central Africa (WCA) region has large areas under millets (15.7 million ha), of which more than 90% is pearl millet. The crop is cultivated on more than 2 million ha in the Eastern and Southern Africa region.The six major pearl millet producing countries in WCA are Niger, Nigeria, Mali, Chad, Burkina Faso and Senegal.Global pearl millet production has increased over the past 15 years, primarily due to higher yields in India and expanding production area in West Africa.

3.2 Performance of Pearlmillet

The cultivation of pearlmillet is dispersed mainly during kharif season across the country. It is also grown to a lesser extent during rabi season in Andhra Pradesh, Karnataka, Tamil Nadu and Pondicherry. It is well adapted to production system characterized by low rainfall, low soil fertility, high saline soil and high temperature. Pearlmillet is mainly consumed in winter season as staple food and rich source of protein, fat and linoenic acid. Pearlmillet hybrids aremainly cultivated in India and cover more than 50 per cent of the total national pearlmillet area of 9.88 million ha.(Thakur et al.,2003).

3.2.1 Pearlmillet at the All-India Level

In triennium ending 1969-71, the area under pearlmillet was 12.39 million ha and it started steadily declining over the nearly five decades to reach 7.18 million ha in 2017-19 (Table 1). Area trend of pearlmillet in India is constantly declining. Between 1972–73 and 2004–05, nearly 3 million ha area diverted from pearlmillet cultivation to other crops, such as wheat, rapeseed mustard, cotton, chickpea and groundnut. The area under pearlmillet in India has decreased by 9.78 per cent even during the recent period between 2011-13 and 2017-19. But, over the fourand-a-half decades, the production of pearlmillet has enumerated a small increase of 2.63 million tonnes. In fact, it decreased by 1.27 million tonnes in the decade between 1969-71 and 1978-80. The highest production of 9.42 million tonnes was attained during 2011-13. The productivity level was found highest level i.e. 1234kg ha^{-1} in 2017-19.

The decadal analysis of acreage reveals that area under pearlmillet was maximum i.e.11.72 million ha during 1970-79 and after that due to continuous decline; it reached to level of 7.75 million ha.in 2011-19 (Table 2). The decline in area over decades registered to the tune of 33.87 per cent over nearly five decades. The production level was 5.39 million tonnes during 1970-79 inclined to 9.26 million tonnes in recent decade recording an increase of 71.79 per cent. Popular public hybrids such as HHB 67 (released by Haryana Agricultural University in1989) delivered increased production levels from the early 1990s onwards. Similarly, productivity exhibited increase of more than double in same period.

The growth rate analysis indicates that acreage under pearlmillet showed negative sign (-1.01%) while production and productivity increased at rate of 1.45 and 2.51 per cent per annum during period 1970-2019 (Table 3). The

production exhibited negative sign for three decades i.e.1970-80, 1990-2000 and 2010-19 due to sharp decline in acreage. The decline in acreage was not offsetted even by increase in productivity. However, the productivity showed positive values of growth rate for all decades except 1970-80 due to adoption of hybrids having high level of tolerance to biotic stresses and adoption of production technologies suitable for different cultivation conditions. During 1970s, one of the reason for decline in productivity as crop was succumbed to downy mildew and huge loss in yield was recorded.

The area under pearlmillet is likely to decelerate though the productivity may improve with the availability of improved technology. Almost 50 per cent of area under millets has been diverted largely to soybean, maize, cotton, sugarcane and sunflower. A combination of factors like low income as compared to other food crops, lack of input subsidies and price incentives, supply of fine cereals through Public Distribution System (PDS) atsubsidised rateand change in consumer preference (difficulty in processing, low shelflife of flour and low social status attached to millets) have led to shift from production of millets to other competing and remunerative crops.

3.2.2 Performance of Pearlmillet in Major States

In terms of area under pearlmillet, Rajasthan ranked at first position with a share of about 58.40 per cent in the country's area during 2017-19 (triennium average). After Uttar Pradesh, Maharashtra, Gujarat and Haryana occupied the next three places with shares of 8.89, 5.46 and 6.08 per cent, respectively. These four states of western India together had a share of 78.83 per cent in the total area. However, Rajasthan aloneaccounted for two-fifth (42.42%) of the pearlmillet production in the countrywith productivity level of only 896 kg ha^{-1} (Table 1). Maharashtra registered a 5.54 per cent share in production by recording average yield of 736 kg ha^{-1}.

Gujarat reported the average yield of 2197 kg $ha^{-1}$and contributed to 9.74 per cent of pearlmillet production in the country. Haryana accounted share of 6.20 per cent of production with productivity of 1835 kg ha^{-1}. These four states together accounted for a 63.90 per cent share in total country's production. The area under pearlmillet has increased marginally (0.08%) in the case of Rajasthan and Maharashtra up to 1990-92 after that it declined to 4.19 million ha.in 2017-19 (Table 1). Except for Rajasthan, all other three states showed sharp declining trends in acreage of pearlmillet. The decline rate in area was observed in Maharashtra (62.73%), Gujarat (77.95%) and Haryana (61.29%) during 1969-71 to 2017-19. As concerned with productivity, Rajasthan state has registered the highest growth (176%) followed by Gujarat

(172%), Haryana (150%) and Maharashtra (131%) during 1969-71 to 2017-19.The decadal analysis of western states reveals that area under pearlmillet unveiled declining trend in all states except Rajasthan and Maharashtra for two decades (1970-79 and 1980-89). Maharashtra lost a significant area under pearlmillet since 1990-92 onwards due to shift in area towards cotton and pulses (Table 2).

The growth rate of area under pearlmillet indicated decrease in all states and highest decline was recorded in Gujarat (2.60%) followed by Maharashtra (1.69%), Haryana (1.57%) and Rajasthan (0.09%) (Table 3). The decline in area in all states was also observed in different decades except in Maharashtra during 1980-90 and Rajasthan during 2000-10. The production growth rate figures reveal positive sign for all states. The per annum increase in production over period 1970-2019 was attained highest in Rajasthan (3.42%), followed by Haryana (1.72%), Maharashtra (0.69%) and Gujarat (0.52%). The similar trend was observed in case of productivity level of all four states.

The data as depicted in Figures 1 to 3 also clearly indicate behaviour of area, production and productivity of pearlmillet for these states and the country as whole. However, there is a growing scope for alternative uses of pearlmillet grain in the coming years, and most of the growth will come from cattle and poultry feed industry, breweries and starch industry which trigger demand of pearlmillet in future.

4 Economics of Pearlmillet Cultivation in Haryana

Pearlmillet is cultivated on 4.24 lakh ha area mainly in southern part of state. Its cultivation is confined to rainfed or limited irrigation condition, poor/marginal fertility land and sandy soil. The average productivity level of pearlmillet was20.68 quintals ha-1in 2018-19 which is highest in the country due to cultivation of promising hybrids embodied with improved agronomic practices and close contact of field functionaries with cultivators. The most prevalent pearlmillet hybrids likeHHB-67(improved), HHB-197, 86M86, 86M88, 86M64, Proagro-9444, Nandi-72, Nandi-67are grown in the state with recommended quantity of inputs and adoption of improved production technologies. Recently, two bio-fortified hybrids i.e.HHB-229 and ABH-1200 were released for cultivation in the state. The planting time of pearlmillet starts with onset of monsoon rains normally in the month of June-July and it is harvested in the month of September with crop duration of 60-70 days. It is short duration, less quantity of seed requirement and resource exhaustive crop grown as

sole crop in kharif season.It competes with cluster bean, kharif pulses (green gram, black gram) and cotton for area coverage in the state. Its grain is mainly used for human & livestock consumption and stoveris used as livestock feed.

Therefore, it is necessary to analyse various resources used in production process of pearlmillet and income gained by cultivators. The various expenses in cultivation and output attained in pearlmillet in Haryana was analysedover the period to evaluate its economic sustainability. The total cost and variable cost of pearlmillet at different intervals of period i.e. 2003-04, 2007-08, 2010-11, 2013-14 and 2018-19 worked out were Rs. 13505, Rs.16394,Rs. 23970, Rs.38170, Rs.44500 and Rs.5978, Rs.7330, Rs.10790, Rs.19645 and Rs.23715, respectively (Table 4). The share of variable expenses varied from 44.26 to 53.29 per cent of total cost over the period. The total cost and variable cost exhibited increase over period due to increase in prices of purchased inputs, wages of labour etc. as well as increase in machine hiring charges due to escalation of fuel price and cost of farm machinery& implements. The rental value of land alone contributed more than one-third of total cost involved in cultivation of pearlmillet. The operation-wise cost of cultivation of pearlmillet indicates that harvesting plus threshing operation dominated the total cost of cultivation which constituted 17.33 to 25.43 per cent, followed by field preparation (10.88 to 12.09 %), fertilizers cost (4.21 to 6.42%)and plant protection chemicals (3.82 to 4.76%) during period 2003-2019 (Table 3). The cost of seed is very meagre as recommended seed rate of 2.5-4.0 kg ha^{-1}. The irrigation charges were almost less than 2.0 per cent of total cost as it is largely cultivated as rainfed crop and sometimes one life saving irrigation is used to reduce moisture stress at critical crop stage. The similar pattern of share of various operations in total cost of pearlmillet cultivation in Rajasthan was reported (Nagarajet al., 2012).The harvesting of pearlmillet is still done manually which ensued to higher expenses and dependent on farm labour. However, threshing operation is mainly carried out with latest threshing machine developed. The use of plant protection chemicals is limited to large extent as hybrids under cultivation are having tolerance against biotic stresses.

The productivity level of pearlmillet was 16.63 quintals ha^{-1} in 2003-04 touched to varied 21.70 quintals ha^{-1}in 2014-15 indicating about 23.37 per cent increase within one decade.The productivity came down to 21.00 quintals ha^{-1} in 2018-19 due to delayed planting and early withdrawal of monsoonal rains. The gross returns capturedfrom pearlmillet revealed increasing trend

over period and it was Rs.12053 in 2003-04 increased to Rs.23715 in 2018-19 (Table 5). The returns over variable expenses computed out alsoindicated increasing trend and it touched to Rs.21195 in 2018-19.The increased grain and fodder yield due to proprietary hybrids and supplemental irrigation ultimately improved the net returns realized by cultivators.The returns to cost (R-C) ratio is used as indicator to measure the economic viability and sustainability of cultivation of farm enterprise. The value of R-C ratio figured by taking into consideration gross returns and total cost was in the range of 0.86 to 1.01 indicates economic viability of promising pearlmillet hybrids.

The pearlmillet cultivation is profitable crop enterprise particularly in rainfed areas over the years due to evolution of drought tolerant hybrids, adoption of improved agronomic practices, procurement by government agencies, increased demand of livestock and poultry feed and use in alcoholic industries. Recently, the state Government has commenced procurement at MSP and introduced pearlmillet in Targeted Public Distribution System (TPDS) to address nutritional deficiency in privileged section of population.

5 Pearlmillet Trade Opportunities in India

World trade in pearlmillet is less than one per cent of the production. India ranked top in terms of production of pearlmillet,followed by African countries. However, there is no export of pearlmillet in these countries.The pearlmillet export countries are India (15.4%) followed by Ukraine (14.%), Russia (11%), France (7.2%), China (5.3%) and Austria (4.6%) in 2017 (Commodity Outlook and Situation Analysis Report, NACEAR).India exports pearl millet to about 60 countries of the world. India exports pearl millet mainly to UAE (24 %), followed by Saudi Arabia (16%), Yemen(14%), Tunisia (5.0%) and United Kingdom (4.0%). There is high demand for pearlmillet in Gulf countries like UAE (24%), Saudi Arabia (16%) and Yemen (14%) together account for more than 50 % of export from India. The export of pearlmillet witnessed an increasing trend during the period 2013 to 2015 and started declining during recent years.In 2013, pearlmillet export was US$ 9.2 million, it increased at US$ 18.4 million in 2015 but further went down drastically to US$ 11.4 million in 2018. India can leverage comparative advances for expanding its export by increasing production particularly nutri-rich cultivars of pearlmillet, creation of demand for consumption of high content nutrients (iron and zinc) products, development of variety of products and exploring new destinations in the world.

6 Policy Initiatives for Cultivation and Market Support of Pearlmillet

Rainfed lands, on which coarse cereals like pearlmillet are grown, never received the benefits of any compensating public investments and remained low productive areas (Rao,2006). Once irrigation facilities were developed, cropping patterns changed from coarse cereals like pearlmillet to fine cereals (rice), cotton and so on. Further, TPDS has distorted the price ratios in the market and the consumption of coarse grains was substituted by that of fine cereals(wheat, rice) at subsidized price.The PDS system in India is based on the wheat and rice model, which is less relevant in many areas and especially in the dryland farming areas, where millets, sorghum, and pulses are traditionally the staple grains for household consumption (Dayakaret al.,2007). Further, heavy subsidies provided by the government to rice and wheat in the Public Distribution System have led to the substitution of coarse cereals by the fine cereals in the consumption patterns of both the rich and the poor as well as urban and rural people.The demand for coarse grains as a food source is shrinking, as with increasing income and larger availability of wheat and rice through the TPDS, consumers are shifting from coarse grains to finer grains. Although the government has included coarse grains in the National Food Security Act to be distributed through the PDS at a subsidised rate of Rs. 1 per kg, no substantial distribution is likely unless the government starts procuring coarse grains.

At present, pearlmillet accounted for 7.70 per cent of the area and 3.54 per cent of the cereal production in 2017-18 and is a stabilizing force in maintaining the buffer stocks of India. Pearlmillet is practically devoid of stored grain pests, having long storage life and keeping quality, minimizing storage costs. Propelling pearlmillet into the food economy during low production years as substitute to fine cereals (wheat, rice) provides nutritious food at affordable price and reduces burden of import of foodgrains to large extent.

The Government of India has introduced centrally sponsored program i.e. Integrated Cereals Development Program in Coarse (ICDP-CC) under Macro Management of Agriculture (MMA) in 2000 with objective to increase production and productivity of coarse cereals through work plan prepared by the state governments. The outlay for the program was shared between the central and the state governments in the ratio of 90:10 except north-eastern states (entire expenditure was borne by Central Government). The program focussed on rainfed agriculture by providing quality seed, adequate use of nutrients, field demonstrations, promotion of area specific technology, water

management and capacity building of farmers to create awareness for available farm technologies. Afterthat new program i.e.Initiative for Nutritional Security through Intensive Millets Promotion (INSIMP) under RKYV for promotion of millets as Nutri-cereals was propelled in 2011-12 with objective to demonstrate the improved production and post-harvest technologies in an integrated manner to enhance the production of millets in 16 states of the country. Under this program, incentives for cultivation of coarse cereals including pearlmillet were given to farmers for demonstration of improved production and protection technologies, agro-chemicals, micro-nutrients, bio-fertilizers as well as funds given to research institutes for refinement of post-harvest technologies and value addition. Later on INSIMP program was subsumed under Coarse Cereals component of National Food Security Mission (NFSM) from 2014-15 onwards.

Another program i.e. Nutri-Farms was initiated as special program to address malnutrition and hidden hunger in 100 high burden malnutrition districts of nine states like Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh and Uttarakhand to promote the cultivation of bio-fortified cultivars of crops including pearlmillet with the view thatfood uses of bio-fortified pearl millet varieties will go a long way to reduce iron and zinc deficiencies. Farmers were incentivised by providing demonstration of improved production technologies, market support, value chain and capacity building.Later on Nutri-Farms was also coupledwith NFSM from 2015-16 onwards. The coarse cereals including pearlmillet is being promoted under NFSM from 2014-15in 265 districts of 28 states by providing financial support for demonstrations of newer varieties, seed production and distribution, awareness for consumption, etc.

Another program i.e. Sub-Mission on Nutri-Cereals under NFSM was initiated in 2018 to promote the cultivation ofpearlmillet, sorghum and small millets in 202 districts of 14 states in the country with the target of area expansion, productivity enhancement, strengthening seed supply system, enhancing post-harvest and value addition at farm gate for better price realization to farmers, development of market linkages, formation of Farmer-Producer Organisations (FPOs) and establishment of processing centres. Under this mission, pearlmillet cultivation and their value addition is supported in 88 districts of nine states like Andhra Pradesh (01), Gujarat (14), Haryana (09), Karnataka (07), Madhya Pradesh (04), Maharashtra (11), Rajasthan (21), Tamilnadu (02), Uttar Pradesh (19). Special allocation is earmarked for national and state seed corporations, International (ICRISAT) and national (IIMR) research institutes; extension functionaries (KVKs) for multiplication

of seed through establishing seed hubs and distribution of seed minikits of newly released cultivars.

All these efforts resulted with record coarse cereals production of 46.97 million tonnes in 2017-18 with pearlmillet production of 9.21 million tonnes. In promoting millets among farmers and consumers, private extension services may be used extensively (Federet al., 2011).

ICRISAT in collaboration with IFPRI, Harvest-Plus and national research institute released bio-fortified high iron pearlmillet cultivators like Dhanashakti in 2012 and ICMH-1201 (Shakti-1201) in 2015 which are well accepted by farmers. Recently, pearlmillet hybrids (ICMH 1202, ICMH 1203 and ICMH 1301) with a high grain yield and high levels of iron (70–75 mg kg-1) and zinc (35–40 mg kg-1) densities have been developed and released in India. Further , two bio-fortified hybrids HHB-229 having Zinc (41.0 ppm)and Iron content (73.0 ppm) as developed by CCS Haryana Agricultural University and ABH-1200 having iron content (73.0 ppm) as developed by KrishiVidyapeeth, Parbhani, Maharashtra were notified in 2017 for cultivation in states of Haryana, Rajasthan, Gujarat, Punjab, Delhi, Maharashtra and Tamil Nadu.Currently, more than 70,000 ha of bio-fortified pearlmillet under cultivation in India and furthermore more pipeline cultivars are under various stages of testing at the national (India) and international (West Africa) trials for a possible release (Govindarajet al.,2019). Till today, no special markets existed to promote bio-fortified varieties and hybrids as no incentive price to products existed to address food and nutritional insecuritysimultaneously.In recent years, many states have included millets in TPDS to make available at affordable price to address malnutrition and also to support the cultivation of millets by providing assured market. Millets also need to be integrated with Supplementary Nutrition Program (SNP) of Integrated Child Development Services (ICDS), Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA) and Mid-Day Meal (MDM) programs in regions wherever these crops are predominantly grown. There was remarkable increase (29.82%) in MSP of pearlmillet from Rs.1425 to Rs.1950 per quintal in 2017-18 to benefit the farmers in rainfed and resource poor areas

7 Conclusions and Policy Implications

Pearlmillet is predominately grown in arid and semi-arid regions of India under rainfed conditions and continues to play a prominent role in the dryland regions. The acreage under pearlmillet has declining trend over years. However, production after 1980s showed positive sign due to adoption of

improved cultivars of pearl millet even in rainfed conditions. The Adoption of Good Agriculture Practices (GAP) by the cultivators has led to significant impact on improving productivity of pearlmillet in different agro-ecologies of India. The productivity of pearl millet increased notice ably from 6.22 qtls ha^{-1} to 12.36 qtls ha^{-1} with annual increase of 2.51 per cent during1970-2019 due to genetically improvement, crop management, effective extension oriented activities and growing markets. The high productivity of pearlmillet provides space to cultivation of other crops and maintains production level in the country to meet demand for livestock feed, starch and alcoholic industries. The costs and returns analysis in higher productivity state like Haryana reveals profitability of pearlmillet cultivation particularly in moisture stress areas due to its tolerance to biotic and abiotic stresses. The cost of cultivation can be reduced to certain extent with development of cost effective farm machinery for harvesting operation. The stimulation of pearlmillet cultivation is being taken through initiation of production oriented programs to incentivise the farmers in the country. Research efforts are going on for refinement of production technology, evolution of hybrids with high tolerance and suitable for different climatic conditions in the country, Besides, special focus is given to evolve bio-fortified cultivars with high iron and zinc content to address micronutrient deficiency.

Some state governments have included millets including pearlmillet in the TPDS to address the problem of malnutrition and created assured market for sustainable cultivation of millets in rainfed and marginal lands. The recent hike in MSP of pearlmillet and procurement arrangement is a favourable policy decision to support its cultivation.There is pre-requisite of uninterruptedly price support for pearl millet coupled with assured procurement for acceleration pace of production in the country. However, there is need for inclusion of millets in public distribution system, SNP, MNREGA, MDM and create awareness among consumers for addition in daily diet for health benefits. The food industry should be incentivised to use pearl millet for development of new recipes and processed food products for increase in consumption.The breeding programme should be strengthened to develop nutri-rich and higher yielding, short duration, drought tolerant hybrids with good quality of grain and fodder.The market demand of pearlmillet can be increased in future by investing more funds in crop breeding and the integration into the public distribution system, nutritional intervention schemes, private seed and food companies with strong mainstreaming nutritional policies. The pearlmillet production must be supported by offering remunerative prices to cultivars by exploring new international markets for growing export of pearlmillet.

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Notes

Rainfed Area Development Programme (RADP) as part of Rashtriya Krishi Vikas Yojana (RKVY) in 2011-12 was launched with aims at improving quality of life of farmers' especially, small and marginal farmers by offering a complete package of activities to maximize farm returns for enhancing food and livelihood security. RADP focussed on Integrated Farming System (IFS) including millet based for enhancing crop productivity in rainfed areas/ partially non-irrigated by adoption of a cluster approach in a village or an area of not less than 25 ha for injecting investments to utilize the potential of available/created common resources and also to mitigate risks associated with climatic variabilities (drought ,flood etc.) in ten states and later on it extended to the 424 districts (having less 60 per cent of cultivated area under irrigation) of all 29 states of Indian Union. From 2014onwards, this program is implemented as component of National Mission for Sustainable Agriculture (NMSA).

RashtriyaKrishiiVikasYojana (RKVY) is big umbrella known as National Agriculture Development Plan was introduced in 2007 with recommendation of National Development Council (NDC) of India to achieve growth rate of 4 per cent in agriculture sector during 11th Plan This programme is being implemented through formulation of comprehensive agriculture plan for each state of Indian Union taking into account agro-climatic conditions, natural resources and technology for ensuring more inclusive and integrated development of agriculture and allied sectors and eventually maximize the returns of farmers. The funds allocated fromGovt of India for each state based on specific criteria for under various heads-production growth (35 per cent), infrastructure and assets (35 per cent), special projects (20 per cent) and flexi funds(10 per cent).

National Food Security Mission (NFSM) is a Centrally Sponsored Scheme launched in 2007 based on the recommendations of National Development Council (NDC) with the objectives to increase farm net income by enhancing the production of targeted crops through area expansion, productivity enhancement, restoration of soil fertility and productivity on sustainable basis. The target for NFSM was to increase the production of food grains (rice, wheat, pulses)by 20 million tonnes in 11th Plan and later on the target for 12 Plan was 25 million tonnes with inclusion of coarse cereals. At present, the program is being implemented in 638 districts of all 29 states of the country. The key interventions with incentive/subsidies are being implemented like demonstrations with improved package of practices (PoP) at farmer's field,

production and distribution of quality seed, IPM and INM practices, for farm machinery, need based area specific activities (augmentation of water resources, post -harvest, storage solutions, primary processing) and capacity building of cultivators .

Krishi Vigyan Kendras (KVKs), is an integral part of the National Agricultural Research System (NARS) established at district level that aims at assessment of location specific technology modules in agriculture and allied enterprises, through technology assessment, refinement and demonstrations. KVKs are functioning as Knowledge and Resource Centre of agricultural technology supporting initiatives of public, private and voluntary sector for improving the agricultural economy of the district . The KVKs are 100 per cent financed by Government of India and at present 706 KVKs being operated by Agricultural Universities, ICAR institutes, Government Agriculture Departments and NGOs across the country.

Supplementary Nutrition Program (SNP) is one of the six services provided under the Integrated Child Development Services (ICDS) Scheme launched in 1975 in India oo bridge the gap between the Recommended Dietary Allowance (FDA) and the Average Daily Intake (ADI). Supplementary Nutrition is given to the children (6 months – 6 years) and pregnant and lactating mothers.

Mid Day Meal (MDM) Program-Government of India initiated the National Programme of Nutritional Support to Primary Education (NP-NSPE) in 1995 with objective to improve the effectiveness of primary education by improving the nutritional status of primary school children. Later on the program was extended upto 8th class and renamed as Mid Day Meal Program in 2001. Under this program, free lunch is provided.

MGNREGA came into existence in 2005 in India with aims to enhance the livelihood security of people in rural areas by guaranteeing 100 days of wage-employment in a financial year to a rural household to address chronic poverty . The program is being implemented in every village of the country.

Targeted Public Distribution System (TPDS)-The central and state governments share the responsibility of regulating the TPDS to ensure food security. While the Central government is responsible for procurement, storage, transportation, and bulk allocation of food grains and state governments hold the responsibility for distributing the same to the consumers through established network of fair price shops (FPSs) to households below poverty line at highly subsidized rates.

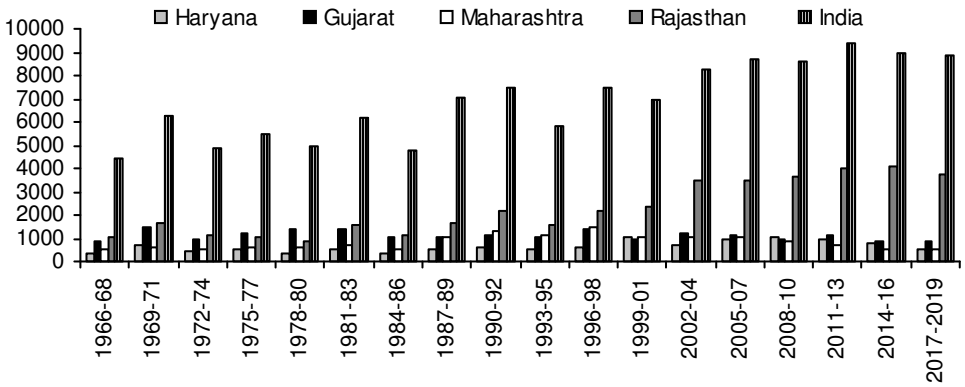

Fig. 1 : Area under Pearlmillet in States of Western India

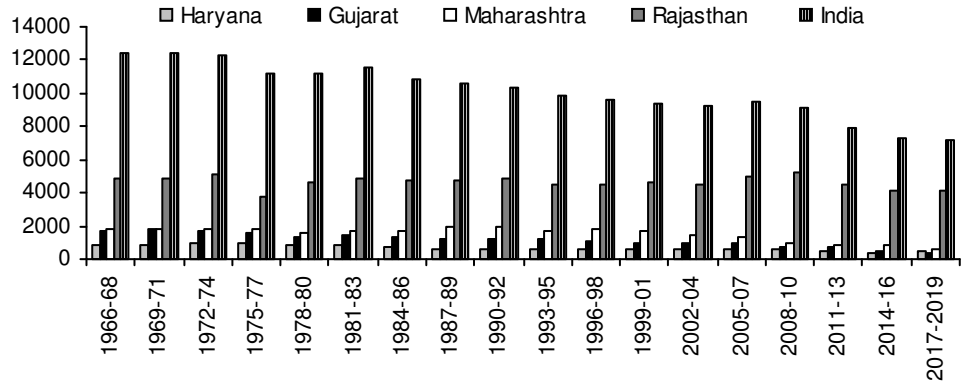

Fig. 2 : Production of Pearlmillet in States of Western India

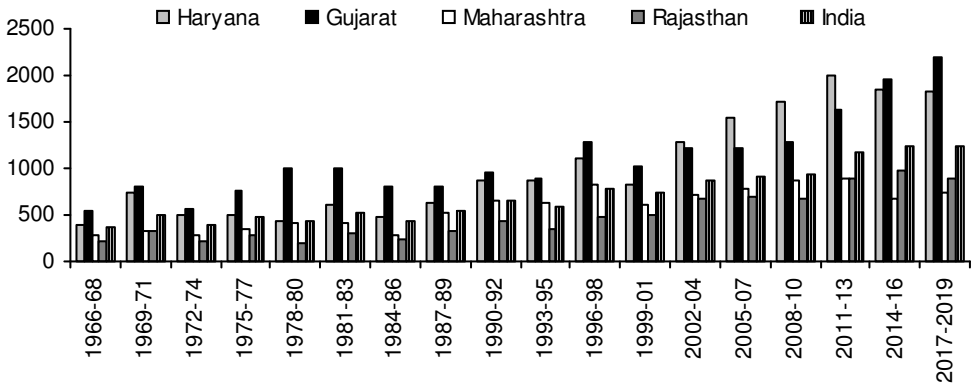

Fig. 3 : Productivity of Pearlmillet in States of Western India

Table 1 : Triennium Average Area, Production and Yield of Pearlmillet in India

Year	Haryana	Gujarat	Maharashtra	Rajasthan	India
			Area		
1969-71	897.47	1780.67	1773.33	4857.67	12393.00
1978-80	852.30	1366.00	1570.67	4610.33	11209.67
1990-92	600.53	1191.73	1915.37	4818.20	10373.33
1999-01	593.50	951.73	1645.20	4570.67	9418.33
2011-13	463.50	720.00	796.00	4481.12	7961.67
2017-19	437.35	392.48	646.00	4195.30	7182.97
			Production		
1969-71	654.67	1441.33	596.67	1615.00	6225.00
1978-80	378.67	1369.33	635.33	887.67	4953.00
1990-92	598.33	1165.40	1263.87	2152.50	7474.67
1999-01	1027.67	978.63	1017.37	2389.10	6941.67
2011-13	931.67	1161.31	704.33	4032.46	9422.67
2017-19	549.59	863.33	491.50	3758.58	8860.52
			Productivity		
1969-71	733.00	809.67	319.00	324.67	500.00
1978-80	441.67	1003.00	404.00	189.33	440.00
1990-92	865.00	966.67	660.33	441.33	653.00
1999-01	826.33	1031.00	617.00	505.33	735.67
2011-13	2007.33	1634.67	884.33	901.33	1184.33
2017-19	1835.00	2197.00	736.00	896.00	1233.50

Table 2 : Decadal Average Area, Production and Yield of Pearlmillet in India

Year	Haryana	Gujarat	Maharashtra	Rajasthan	India
			Area		
1970-79	906.69	1630.40	1686.70	4561.30	11712.00
1980-89	741.03	1321.40	1754.50	4839.70	11039.00
1990-99	580.88	1121.07	1808.14	4560.84	9841.00
2000-09	597.27	901.66	1366.84	4866.56	9334.70
2011-19	462.94	566.88	802.01	4399.39	7752.10
			Production		
1970-79	492.50	1267.90	573.10	1229.80	5390.30
1980-89	467.80	1183.60	735.90	1411.10	5905.00
1990-99	577.60	1153.03	1265.73	1915.67	6818.50
2000-09	961.10	1086.38	973.21	3296.55	8132.00
2011-19	818.02	976.89	654.42	4035.50	9260.00
			Productivity		
1970-79	537.90	782.50	330.50	264.60	456.50
1980-89	574.60	871.90	413.90	285.30	499.80
1990-99	950.80	1030.10	697.90	413.70	671.50
2000-09	1327.60	1207.90	718.40	651.40	864.30
2011-19	1890.22	1821.00	800.33	921.56	1199.00

Table 3 : CGR of Area and Production and Productivity of Pearlmillet in India

Year	Haryana	Gujarat	Maharashtra	Rajasthan	India
			Area		
1970-80	-0.49	-3.65	0.27	-3.13	-1.85
1980-90	-3.72	-1.99	1.84	-0.26	-1.05
1990-00	0.17	-2.34	-1.20	-1.66	-1.53
2000-10	0.63	-3.58	-5.36	1.75	-0.47
2010-19	-3.74	-10.74	-4.71	-2.69	-3.05
1970-19	-1.57	-2.60	-1.69	-0.09	-1.01
			Production		
1970-80	-8.88	-0.19	5.24	-11.22	-3.18
1980-90	-3.19	-4.47	3.98	2.35	2.27
1990-00	1.86	1.45	1.52	-0.82	-0.52
2000-10	0.85	-0.84	-2.64	4.67	1.66
2010-19	-9.32	-4.60	-8.99	-2.09	-1.72
1970-19	1.72	0.52	0.69	3.42	1.45
			Productivity		
1970-80	-8.47	3.59	4.94	-8.36	-1.36
1980-90	-1.77	-2.53	2.09	2.59	1.07
1990-00	3.94	3.87	2.75	0.87	2.52
2000-10	10.73	2.84	2.87	2.88	2.13
2010-19	-0.36	6.88	-4.49	0.62	1.38
1970-19	3.50	2.13	2.41	3.51	2.51

Table 4 : Cost of Cultivation of Pearlmillet in Haryana

(Rs.ha^{-1})

Sl. No.	Particulars	Years				
		2003-04	2007-08	2010-11	2014-15	2018-19
1	Field Preparation	1632.5	2210	2827.5	4153.5	4870
		(12.09)	(13.48)	(11.8)	(10.88)	(10.94)
2	Seed cost	142.5	142.5	460	922.5	835
		(1.06)	(0.87)	(1.92	(2.42)	(1.88)
3	Fertilizer investment	782.5	690	1225	2450	2452.5
		(5.79)	(4.21)	(5.11)	(6.42)	(5.51)
4	Irrigation	0	425	457.5	895	912.5
		0	(2.59)	(1.91)	(2.34)	(2.05)
5	Plant Protection	622.5	650	915	1795	2120
		(4.61)	(3.96)	(3.82)	(4.7)	(4.76)
6	Harvesting and Threshing	2340	2667.5	4270	8335	11317.5
		(17.33)	(16.27)	(17.81)	(21.84)	(25.43)
7	Miscellaneous	457.5	545	635	1092.5	1202.5
		(3.39)	(3.32	(2.65)	(2.86)	(2.7)
8	Total Variable cost (A)	5977.5	7330	10790)	19645	23715
		(44.26)	(44.7	(45.01)	(51.47)	(53.29)
9	Management and risk charges	1270	1580	2160	3930	4995
		(9.4)	(9.64)	(9.01)	(10.3)	(11.22)
10	Rental value of land	5895	6927.5	10202.5	13722.5	15257.5
		(43.65)	(42.25)	(42.56)	(35.95)	(34.29)
11	Transportation charges	362.5	560	817.5	875	782.5
		(2.68)	(3.42)	(3.41)	(2.29)	(1.76)
12	Total cost	13505	16397.5	23970	38170	44500
		(100)	(100)	(100)	(100)	(100)

Note : Figures in parenthesis indicate the percentage to total cost

Table 5 : Returns from Pearlmillet Cultivation in Haryana

(Rs.ha^{-1})

Items	Years				
	2003-04	2007-08	2010-11	2014-15	2018-19
Total variable cost	5977.5	7330	10790	19645	23715
Total cost	13505	16398	23970	38170	44500
Gross returns	12052.5	15540	20510	36252.5	44910
(a) Grain Production	8400	10755	14885	27067.5	37717.5
	(16.63)	(18.00)	(18.23)	(21.7)	(21.0)
(b) By-product	3652.5	4785	5625	9185	7190
Returns over variable cost	6075	8210	9720	16607.5	21195
Returns-cost (R:C) ratio	0.89	0.95	0.86	0.95	1.01

Note : Figures in parenthesis indicate quantity of grain production in terms of quintals ha^{-1}

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GROWTH OF AGRICULTURE SECTOR : A KEY TO REALIZATION OF SDG 2030

Aprajita Srivastava* and H. O. Srivastava**

The agenda for Sustainable Development Goals (SDGs)-2030 is aimed to end poverty and deprivation, preserving the planet's ocean and land and tackling climate change though agenda was adopted in 2015 three billion people in the developing countries, who produce majority of food for global consumption, are most vulnerable to climate changes, drought and floods, lack of inputs such as seeds and fertilizers and prone to market shocks. Still 821 million people on the planet go hungry each year and their number has sharply increated by 40 million reaching to 821 million from 2015 to 2017. About 690 million population globally is severely food insecure, with 48 percent in Africa; 45 percent in Asia; 5 percent in Latin America and 2 percent across Europe and North America. This research study shows that the SDGs could be achieved only by increasing food production not only to feed the existing population but the future population too which is estimated to reach 9 billion by 2030. The present article highlights as to why the Knowledge Agriculture™, a massive program of education and upgrading skills of farmers is need to be embarked on.

1 Introduction

Farming, traditionally, involves managing the crops, livestock and finances of the farm with little or no specialized education. Most of the farmers still follow the traditional ways of farming yet, these small farmers, herders, and fishermen in rural areas produce about 70 percent of the global food supply. Nevertheless, they suffer from poverty and hunger and continue to remain vulnerable to food insecurity. They are mostly less or uneducated, have no access to modern tools, technology and markets and hence, are exploited by a long chain of middle men who steal their profits. Out of a billion farmers in the world, about 95 million live in Asia and Africa as per 2011 data [1], which are also home to 805 million hungry people (Asia-520 million, Africa-243 million and Latin America -42 million). The world has over 821 million hungry

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people and 78% of the poor live in rural areas where they largely depend on farming to make a living. Several studies have concluded that the productivity of farmers has a direct correlation with their level of education, which is essential to enable them to cope with the changing environment and adopt innovative ideas[2]. Therefore, to meet the increasing demand for food production and bridge demand /supply gap sustaining the planet's resources, a new type of agriculture is required, which has been termed as "Knowledge AgricultureTM" [3].

The Knowledge Agriculture encompasses the use of emerging technologies such as sensors and instruments mounted in the fields on devices like UAV to capture several parameters required for the healthy growth of plant, cloud technology or satellites to remotely monitor the health of the target plants and delivery of optimum resources like water and fertilizer. It also manages through devices to control the effect of climate on specific plants. Thus, it not only helps increasing the yield but also makes use of resources with precision.

2 Technology Description

A few examples of high-end technology for knowledge agriculture being used in various advanced countries are mentioned below:

2.1 Fujitsu Greenhouse Technology, Finland

Fujitsu Greenhouse Technology, Finland has established a plant factory equipped with FUJITSU Intelligent Society Solution, Akisai Food and Agriculture Cloud [4] with fully artificial light using LEDs, multi-tier growing trays, and full automation software with remote monitoring. It helps in growing baby greens and leaf lettuce in the harsh weather of Finland during winters to overcome the scarcity of fresh vegetables.

2.2 Artificial Intelligence (AI) to Increase Tomato Yield

Nature Sweet, USA[5] is using AI technology, developed by Israeli digital company Prospera[6], in its tomato farms in Arizona to control the pests and diseases in greenhouse, thus, increasing the yield by 20%. Prospera is working on tracking more crops such as peppers and potatoes.

2.3 Smart Vineyard Using UAV to Reduce Production Cost by 20 to 30%

Devastating diseases and pests such as oidium, mildew, botrytis, esca etc cause enormous losses to grape owners due to severely affecting the wine grape production. In France, 13% of wine production was lost in 2015 [7][8] resulting in a loss of EUR 1 billion. California has also lost 14% of wine grapes due to these pests. The experiments have shown that the use of onsite sensors can forecast data enabling calculation of local grape diseases intensity enabling grape owners to take preventive actions to minimise losses. This is achieved by capturing data on pest's infection and then using UAV (Unmanned Aerial Vehicle) to selectively use pesticide. Another novel use of a hi-tech UAV has been made in Australia to reduce crop losses. The UAV capable of emitting fake bird distress calls have been deployed to scare avian away from ripening grapes.

2.4 Crop Monitoring and Analysis Using Drones

Drone companies like PrecisionHawk [9] offer farmers combined packages which include robotic hardware and analysis software. Ground based robots, like BoniRob [10], provide even more detailed monitoring as they are able to get closer to the crops. Some can also be used for other tasks like weeding and fertilizing. The use of drones or unmanned aerial vehicles (UAV) provide several benefits for conservation of environment as shown in Fig. 1.

2.5 Robot-Assisted Precision Irrigation

Traditionally, lot of water is used for irrigating and fertilizing crops. The growing scarcity of water over the globe needs efficient use of water in agriculture. Ground Robots are used to autonomously navigate between rows of crop and pour water directly at the base of each plant. Ground based robots are also used for detailed monitoring of the crops, weeding and fertilizing. Some weeding robots do not use chemicals but use lasers to kill the weeds or use computer vision to detect plants as it is pushed by a tractor. It then automatically hoes the spaces between plants to uproot the weeds. LettuceBot[11] is one such robot that uses computer vision for weed removal and has been declared as "outstanding product innovation in agriculture. The "IDTechEx Agricultural Robots"- report [12] found that more than 300 thousand tractors with autonomous functionality were sold in 2016 and the number would rise to 500 thousand by 2023. There is also a rising trend where tractors autonomously follow human-driven combine harvesters to

collect the grain. The EU-funded "Clever Robots for Crops", project developed for site-specific spraying and selective harvesting of fruit and vegetables, is making progress on a few harvesting applications such as apple harvesting, grape picking and sweet pepper picking [13].

2.6 Shepherding and Herding

Robotic milking parlour technology has matured with transponder sending signal to the milker unit on the proper teat placement for the cow, attachment of robotic arm to the udder, washing the cow's teats, massaging them and stripping out the first streams of milk. A robotic feed scraper pushes feed up to the curb where the cows eat. As on 2017, there were 35000 Robotic Milking Systems (RMS) operational in the world. Agricultural Engineering Precision Innovation Centre (Agri-EPI Centre) in Shepton Mallet, in southwest England is testing 5G smart collars and health-monitoring ear tags to recognise the cows' readiness to milk and precisely latch on to its teats for milking, while the cow munches on a food reward.

Automated activity monitoring (AAM) systems are used to collect data related to cow reproductive and health status. 24-7 monitoring of activity index, allows inseminate at the correct time optimizing the reproduction, calving interval and semen costs [14].

3 Technology for Knowledge Engineering

A pictorial representation of a few technologies in use for knowledge agriculture for higher yield and sustaining the resources of the planet is given in Fig. 2. The Fig. 2 shows shows the technology being used in the developed countries to increase the food production and, at the same time, conserving the resources such as water, soil, fertilizer, manpower etc. The automation of agriculture has improved precision, efficacy, reliability, operational consistency and minimization of soil compaction and drudgery. The use of these technologies is slowly spreading to developing countries. For example, Agribot is an agricultural robot based on image processing that was designed by student s of BIT Hyderabad, India [15]. Being an agrarian country, India's 60% population depends on agriculture that contributes about 16% of the total GDP and 10% of total exports. In Africa, 530 million people are dependent on agriculture and the number is estimated to reach to exceed 580 million by 2020. The 48% of the total African population rely on agriculture; in East Africa, agriculture employs 80% of the population, mostly women and there is great potential for precision agriculture. African Union, High Level Panel on Emerging Technologies (APET) and NEPAD have realised the need of

Knowledge Agriculture and have released a report on “Drones on the horizon: Transforming Africa’s Agriculture” [16], that recommends different technologies for agriculture highlighting the utility of drones. “The Executive Council of the African Union (AU), requests the AU and Member States to harness drones for agriculture as one of three emerging technologies of relevance for African development”- Decision EX. CL/Dec. 986-1007 (XXXII).

4 Farming as a Service' (FAAS)

Farming in India and elsewhere is getting ready to become “Farming as a Service (FAAS)”where complete end to end solution namely seeding, weeding, harvesting and Agri-advisory using mechanisation and technology will be provided by specialist service providers [17]. Government of India is supporting entrepreneurs with funding and companies like EM3, VST,Triingo (a Mahindra company), Zamindara, and a few others have started operations. However, it is yet to be seen whether FAAS will provide a viable service to small farm holders. Further, even the large farm holders will need to understand the processes and tools used by these companies and shall need entrepreneurship skills to use the FAAS services.

5 Education of Farmers

Most of the farmers in Asia and Africa do not have latest information on how to grow food efficiently and economically. Improving their knowledge of new techniques and technologies, in addition to providing them with physical resources is necessary for implementation of SDGs. The farmer’s education and training have great bearing on the agricultural yield, storage and marketing at a price that is profitable to him. The agriculture has now become a knowledge based profession that revolves around the disciplines like agronomy, horticulture, environment, entrepreneurship, financial planning, marketing, science, technology and so on. A new breed of farmers is now needed to achieve the SDGs -2030. The studies have found that even the level of a zmother’s education is a strong determinant in her child’s nutrition. Rates of stunting are highest in families where mother has received no formal education relative to those with higher education; this variability can exceed 50 percent between these two extremes [18]. SDG involves a massive task of educating the farmers and at the same type motivating them to love their profession. This needs Governments to build dynamic, sustainable, innovative and farmer-centered economies, promoting youth and women's economic empowerment. It needs well-educated workforce with scientific, technological and innovative skills and capacities for the use of technology

and follow best practices for enhanced farm yield. A comprehensive assessment of worldwide agricultural education programmes needs to be conducted on the lines of Future Farmers of America (FFA), which was constituted as early as in 1928 and adopted by many countries. It is interesting to quote here “Creed of the Future Farmers of Canada” (Fig.3).

Some pioneering work has been done in Albania, Greece, Egypt, India, Korea, Thailand, Taiwan, Japan, Philippines, South Viet Nam, Honduras, Canada, South Australia, Peru, Columbia, Brazil, and Mexico [19]. However, what we need now is to design new courses in the field of agriculture and allied sciences and make available to farming population. Of the 7 billion population of the world, 37% depend on agriculture and allied sectors. Africa and Asia account for about 95% of the world’s agricultural population [20]. Therefore, it is estimated that 530 million people in Africa and 1930 million in Asia (555 million in India) desperately need education and training in Knowledge Agriculture. In USA, only 2% people depend upon agriculture.

6 ICT and Mass Media for Education

Educational need for massive farming population is a real challenge. The work of “Knowledge Agriculture” in India and Ethiopia proves that ICT and Mass Media technologies can be deployed to impart knowledge, skills making attitudinal changes in a large population of farmers who are mostly illiterate or semi-literate. Some of the technologies can be used for their advantages.

6.1 Mass Media

Radio is the most powerful tool of education for the communities suffering from digital divide. It is economical in crossing geographical barriers and allowing communication with populace in their own language and dialect. The radio receiver costs just about one dollar and runs on battery. The radio receivers with crank shaft or solar cells can be used for a long period without replacing battery. Radio transcends the literacy barrier and is known as ‘women’s medium’ since they can perform their tasks even as they listen to the radio. It has the potential to reach vulnerable and resource-poor communities, while establishing a feedback and monitoring system through the use of other technologies.

Community Radio and Public Broadcasting : The term ‘community radio’ was first coined by Powell in1965 [21]. The Community Radio (CR) for farmers, also known as “Farm radio” provides an avenue for free flow of beneficial

information regarding sowing, harvesting, storage and marketing. Variety of programmes on entrepreneurship, farming, health & hygiene, woman empowerment, entertainment can be launched in local languages. The communities themselves can be trained to record the programmes and events and broadcast them. Different countries in the world have their own regulations for licensing the Community Radio. 'Knowledge Agriclture' has established Community Radios in India and Ethiopia (Fig.4) [22].

Radio-Public broadcasting : Public broadcasting of Radio Programme is undertaken by several Governments as well as independent authorities as a part of national service of education, information and entertainment and, broadcasting is mostly done via free to air channels. The major public broadcasters are Australian Broadcasting Corporation, British Broadcasting Corporation, Canadian Broadcasting Corporation, Prasar Bharati (India) etc. All India Radio, the radio broadcasting wing of Prasar Bharati, started a "Krishi Channel (Farm Channel)" devoted to agriculture education using radio broadcasting in 2001. Ghana Broadcasting Corporation (GBC) devoted considerable air time to agricultural topics [23]. Radio-based extension activities, particularly interactive programmes, provide information on government initiatives for availability of seeds, fertilizers, pest control, sowing and reaping seasons, climate, proper use, finances, storage, marketing and also warning for natural disasters, food security, climate-related issues. Although radio is only a verbal medium with limited interactivity, its use has proved to having positive impacts. Purdue University of USA showed that the use of radio increased the level of interest in and adoption of triple bagging of cowpeas by farmers in Nigeria. Over 50% of Ethiopian farmers increased their knowledge of teff cultivation by radio listening. Farm Radio International's participatory radio campaign has led to an increase in farmers testing new innovations.

Video : McQuivey's Forrester study reveals that "Video is worth 1.8 million words". A study by Insivia found that "viewers retain 95% of a message when they watch it in a video, versus 10% via text" [24]. RSA-style animated videos can pack in a lot of information in a short time [25]. Videos are an indispensable part of the agricultural extension tool kit. Video based training assisted with facilitator is found very effective in motivating farmers to adopt new agricultural practices for about one-tenth of the cost of traditional extension systems. Video on complete information (climatology, variety, agronomy, plant disease management, post-harvest management etc.) and recommended package of practices for the mandate crops can be developed and provided to farming community using a variety of delivery systems. The delivery system may consist of Television broadcasting, narrow videocasting using low power

video transmitters, Internet channels like YouTube, or virtual private networks (MPLS VPN) using “Any to Any” topology.We undertook a pilot scheme in India (State of Bihar) and Farmer’s feedback shows that viewing a practice on a video while being told about it by a facilitator improves the effectiveness of video in inspiring changes in rural behaviour [26]. In a study undertaken in Uganda, it was concluded that “videos may provide visual and auditory stimuli that lead to cognitive processes of schema abstraction and cued recall, which, in contrast with classic studying, has the potential to create new and longer-lasting connections between concepts” [27].

7 Video Cloud as Medium for Delivery

Cloud is a metaphor for network and Video cloud is a term where the resources in terms of hardware, software, applications are placed at a remote location. These resources are managed and maintained by service provider on a rent. Thus, a user is absolved from maintaining a complex computer network and needs only to learn to use the application remotely through notebook, IPAD or mobile. The use of cloud technology for education to farmer has many advantages as it allows sharing of resources. The audio /video/ data and other information may remain on cloud and may be accessed by farmer using any digital device.

The benefits of cloud-based agricultural extension system are given in Table 1. A couple of global networks tailored to address regional and site-specific needs may fulfil the basic needs of agriculture education of farmers of entire Asia and Africa. There are added tools to monitor the statistics such as tracking the activity of visitors before and after visiting website, heat maps, search engine comparison, tracking HTTPS websites, sharing access with team members, checking JavaScript stats etc. The success of video cloud technology in diverse areas all over the world is a proof of people’s adaptability to the technology. WhatsApp (one billion users) [28], Facebook (2.06 billion users) [29], YouTube (one billion user) [30], Bank of America, Merrill Corp., American Airlines are few of the successful users of the platform. The advantage of the platform is that it leaves the function of maintaining a huge data processing center to the video cloud service provider and allows agriculture scientists to focus on their expertise.

8 Conclusion

Agricultural systems are remarkably diverse, with livestock, crops, climates, tools, soils, and technology varying from country to country and even farm to farm. The use of technology is an essential requirement to put a check on

unmindful waste of resources in present agricultural practices. There is also a trend of growing migration of farmers to cities to take alternate professions due to poor income and lack of support. The dole like ensuring Minimum Support Price (MPS) or waiver of farm loans is no prescription to the solution. A massive integrated training and education program with support from governments in terms of access to market and direct sale channels cutting the middlemen may be a right path. Organizations like African-Asian Rural Development Organization, Food and Agriculture Organization of the United Nations, United Nations Educational, Scientific and Cultural Organization and technology partners need to play a very proactive sustained role to make SDG2030, a reality.

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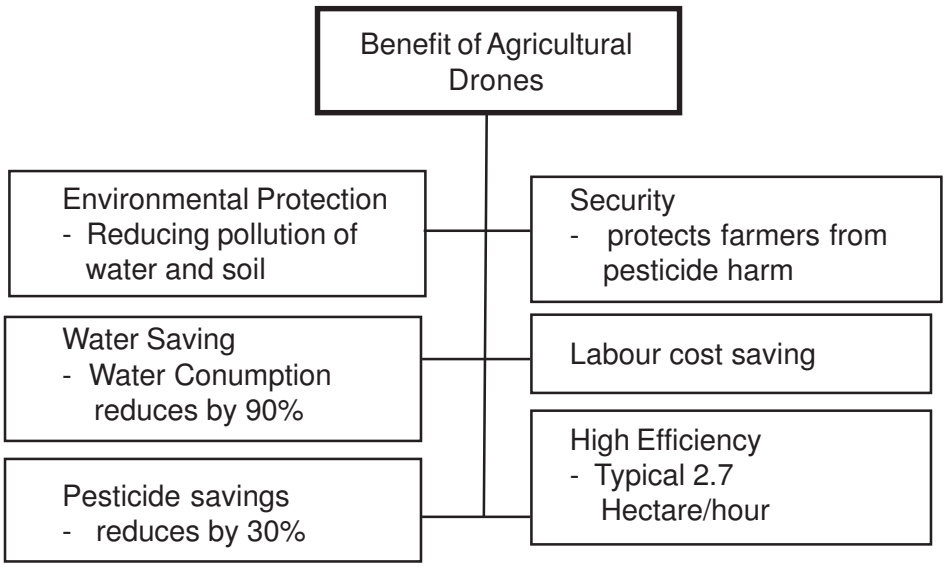

Fig.1 : Benefits of Agricultural Robots

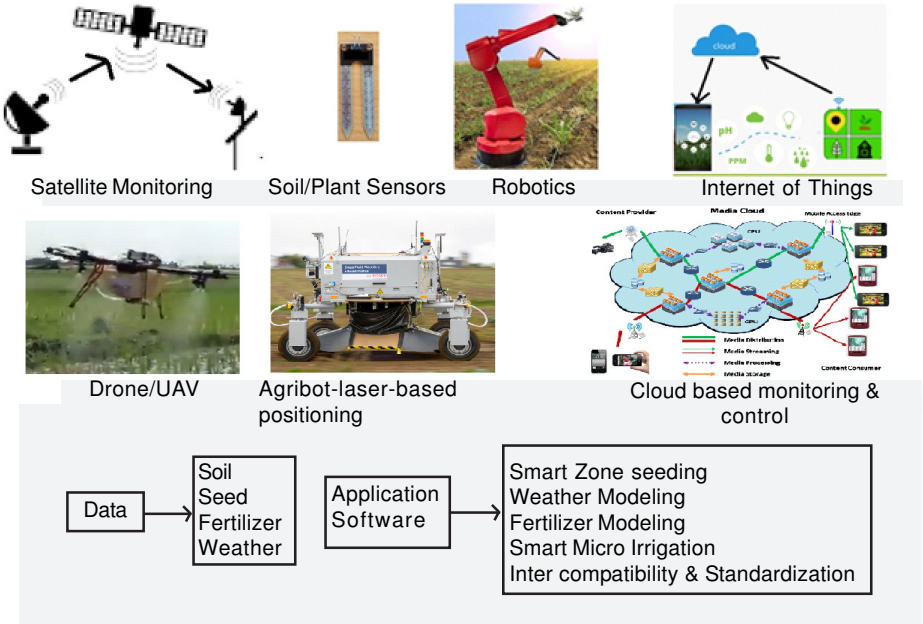

Fig.2 : Technologies in use for Knowledge Agriculture

- I believe in the future of farming and that life on a farm is both honorable and satisfying.
- I believe that success in farming comes through a scientific attitude, efficiency, hard work and determination.
- I believe in being a good citizen... honest and fair in all my dealings.
- I believe in accepting responsibilities and doing my part in my home, school and community.
- I believe that serving my country, helping others, and doing my best in my vocation will lead to a happier, fuller life.

Fig. 3 : Creed of the Future Farmers of Canada

Source : https://files.eric.ed.gov/fulltext/EJ1122267.pdf

Fig. 4 : Community Radio at Dilo Borana, Ethiopia

Source : World Development Foundation

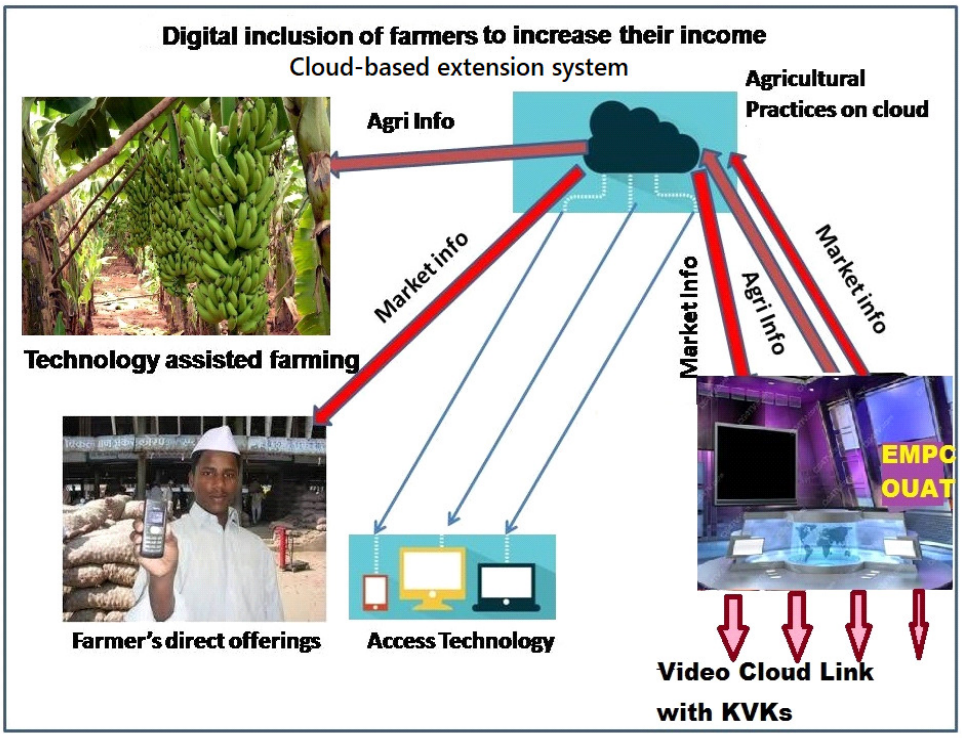

Fig. 5. : Cloud Based Agriculture Education and Extension System

Table 1 : Benefits of Cloud-based Agriculture Extension System

Geographical coverage	Multi-nation Archive with free ON DEMAND unlimited access to all content
Access	Any location, any digital device, any time
Type of content	Educational, market information, meteorological information
Added Facility	Online trading through portals
Reliability and scalability	Very high
Level of interaction and flexibility	High
Automatic metadata and multiple l anguage subtitles	Yes
Advertising models	Automatic ads insertion server side
Player support	Single URL, using HTML5
Streaming	Adaptive Streaming permits to deliver video for broad range of devices – mobile, tablet or OTT and varying network bandwidths
Advanced technologies	AI-infused and cognitive technologies

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DYNAMICS AND PROCESS OF WOMEN LEADERSHIP IN THE LOCAL GOVERNMENT OF BANGLADESH: EVIDENCES FROM THE UNION PARISHAD

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Union Parishad (UP) as a unit of rural local government was established in 1870 by the British colonial regime in the undivided Indian subcontinent, which now constituted 3 different states i.e. India, Pakistan and Bangladesh. Since its beginning to date, the structural continuity is going on without having any substantive change in its composition and forms. Since colonial era there was hardly any scope for woman's representation but recently the Government of Bangladesh introduced a one-third reservation policy for women's representation in the structure of UP in 1997. Following such a reservation policy, huge woman members entered into the trajectory of local political governance of UP although these woman members are yet to ensure their enshrined rights within these two decades time span. In a traditional society like Bangladesh, apart from huge women members, only 23 women were directly elected as UP Chairpersons. But there was hardly any work with these Women Chairpersons (WCs). Against such backdrop, this paper aimed to unravel the research questions:i) To analyze the socio-economic characteristics of these WCs, ii) What factors helped them become leaders at the UP? iii) Were there common factors for their leadership process? The paper was based on case study method which was substantiated by content analysis and observation method. The findings revealed that most WCs had better socio-economic base, were married and moderately educated. They became leaders using their family legacy, while some of them emerged as leaders using social capital gained through NGO involvement and political network.

1 Introduction

Since colonial era there was hardly any provision of women representation in the UP. Women's representation in the UP was ensured in 1997 which provided one-thirds reservation of women. Following a one-thirds reservation

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system, along with a huge number of elected women members, 23 women leaders were elected Chairpersons in the UP. During the study period, the number of Man and Woman Chairpersons in the UP were 4474 and 23 respectively, who were directly elected as the Chairpersons in the lowest unit of rural local government for the time frame of 2011 to 2016. Although the number of UP Women Chairpersons (WCs) was small but in a traditional society like Bangladesh where women were excluded in all sphere of socio-political life, which triggered question to unravel that who were these WCs, and what factors have helped them becoming leaders in the UP. Against such a backdrop, this paper aimed at uncovering the research questions: i) to analyze the socio-economic characteristics of these Women Chairpersons (WCs), ii) What factors have helped them become leaders at the community level? iii) Were there common patters or factors for their leadership process in the UP of Bangladesh?

2 Methodology

This paper is prepared from a broader research design[1] i.e. from a Ph.D. dissertation. To prepare this paper, the researcher followed a mixed method approach which incorporated both qualitative and quantitative research method putting special focus on qualitative approach. To deal with the qualitative approach, data were collected employing several qualitative methods such as phenomenology, case studies, content analysis and observation methods.

This paper is primarily based on primary data. As part of the qualitative approach, sincere efforts were made to collect data through ten in-depth case studies covering five women members, and five women chairpersons of the Union Parishad.Out of total 23 directly elected Women Chairpersons(WC), concentrating on 5 in-depth case studies on the Women Chairpersons, this paper tried to delve into socio-economic profiles, the process of their leadership and thus to identify a few common factors for the leadership process of these WCs in the UP following a short checklist. Based on the principles of the qualitative method[2] to the selected cases were chosen from different socio-cultural zones[3] of Bangladesh based on purposeful selection and easy access. To achieve the purpose of this paper, all these cases were abridged substantively deducting some data to make the cases focused and sharpen in line with the research questions. Observational knowledge gained through prolonged field work (about 200 hours) is also incorporated in to the writing of this article. To support primary data and to analyze the textual descriptions obtained from the participants, a method of

content analysis was used, and relevant secondary datawas consulted through a heuristic search with library materials and online both.These data were collected during 2013-2016.

Qualitative research basically attempts to analyze any phenomena with small number of samples a rigorous, in-depth insights and subjective judgments of the researcher. The contextual realities of the field settings, inductive knowledge of direct interaction with the research participants (respondents), analytical interpretation of the respondents' textual description and narratives and the researcher's subjective judgment and understanding of the social construction are exigently important. The strength of the qualitative research lies with the basic fact that in this approach of research method the researcher himself is the basic tool of data gathering, exploring facts, extracting data with thematic arrangements and unraveling field data by adding meaning to those data with theoretical/conceptual framework.

In connection with this paper, since no data is available regarding socio-economic profile of Women Chairpersons, hence data relating to the socio-economic, political profiles and leadership process obtained from the case studies of the women chairperson of the Union Parishad have been analyzed with the quantitative data gathered from the Women Members of the UP and thus data gained from multiple sources including case studies helped achieved triangulation and validation in this paper. In fact the main limitation of the qualitative approach represents the fact that from the findings of the qualitative research it is very tough to obtain generalization and to reach to a valid conclusion. However, to confirm and validate the findings of this qualitative approach (case studies) some quantitative data were also collected from 73 Women Members of the Union Parishad taking sample from different socio-cultural zones of Bangladesh as reflected in the Fig.1.

3 Women's Representation in Local Government in Bangladesh

The British colonial rule introduced local governments (LG) in this subcontinent with the Village Chowkidary Act in 1870, which was the cornerstone of today's Union Parishad. With the end of British rule in India in 1947, India and Pakistan emerged as two different states. Afterwards, Bangladesh achieved its independence in 1971 from the "internal coloniasm"[4] of Pakistan and inherited the LG system from Pakistan with some modifications in its structure. Since from 1870, the functionaries of local governments were always in the hands of males (Chowdhury et al., 1994: 6) and rights to vote in the local bodies were dependent on the educational qualification, possession of property and tax payment etc. (Smock, 1977:

117; Women for Women, 1992). Although women's representation in the political community was allowed by the Government of India Act in 1935 (Forbes, 2002) but women for the first time took part in the election of the rural local bodies in 1956 (Rashiduzzaman, 1968; Inter Parliamentary Union, 1987). Following this provision during Pakistan regime only one female candidate was elected in the UP election of 1956 and 1969.

After independence of Bangladesh, in the first UP election of 1973, out of 4352 UPs, only one woman from Rangpur district was elected as UP Chairperson (Alam and Begum, 1974: 38-51). Afterwards, women's representation to local government was enshrined by two presidential ordinances namely the Local Government Ordinance of 1976 and the Muncipal Ordinance of 1976, which provided a provision of nomination of 2 women members in the UP. Regarding women's representation in the UP, important development took place during Ershad regime[6] through the passage of the Local Government (UpazilaParishad and Upazila Administration Reorganization) Ordinance of 1982 and the Local Government (Union Parishad) Ordinance of 1983. According to the Local Government (Union Parishad) Act of 1983, provision of nomination of three women members was introduced (Haque, 2003; Khan, 2011; Khan and Ara, 2006). A major breakthrough in the representation style of women members in the UP was made in 1997, which provided reservation of one-third seats for women members. At the same time, some women were also contested and thus elected as Women Chairpersons in the UP and this paper mainly focused on those women chairpersons.

4 Structure and Functions of Union Parishad in Bangladesh

Union Parishad serves as the lowest unit or tire of rural local government in Bangladesh that covers an area of 10-12 sq. km. A UP shall consist of a body comprising a Chairman and 12 members, who were elected in every five years on a non-party[7] basis. Each UPrepresents villagers ranging from 10,000 to 30,000. Among 12 members only 3 positions are reserved for the women members in the UP. A Union is divided into 9 Wards[8], among which 3 Wards are reserved for a woman member. In each Union nine male members are elected from 9 Wards[8] and 3 women members are elected from their respective reserved Wards (Fig.-2). There are a few salaried employees i.e. Secretary, Dafader and Chowkidar in the UP. Jurisdictionally UP covers a wide range of community services such as, promotion of cottage industries and family planning; protection and maintenance of public property; maintenance of law and order, birth and death registers, UP records, hats and bazaars; lighting of public ways, public streets and public places;

plantation and preservation of trees; maintenance and regulation of cattle pounds; issue of various kinds of certificates and license; settlement of pretty disputes; and excavation of derelict ponds for pisciculture; building and development of physical infrastructure; regulating community behavior; and improving environment, forestry and disaster mitigations etc.

5 Socio-economic Profiles and Leadership Process of Women Chairpersons : A Few Evidence Based Cases from the Grassroots

Giving emphasis on deep attentiveness to the life experiences of the participants, these cases were prepared in order to achieve an in-depth analysis of the leadership process of women chairpersons covering their personal, demographic, family, economic, social, political backgrounds, family network, their experiences etc. in the Union Parishad. These cases revealed many crucial factors relating to women's leadership in the UP.

5.1 The Case of Mst. Razia Begum (Mina), Chairperson, Bethkapa UP

Mosammat Razia Begum (Mina), a widow of age 48, after contesting election 3 times was elected Chairperson of Bethkapa Union, Palashbari Upazila in the Gaibandha District in Bangladesh. She runs her small but single family[9] with a monthly income of about 40,000 taka[10] (471 US$). Her family is composed of 2 sons and the eldest one has recently passed the MBBS (Bachelor of Medicine, Bachelor of Surgery) from Dhaka Medical College, and the youngest one is a BBA (Bachelor of Business Administration) student at Dhaka University. Mina hails from KhamarNorail village and obtained a BA (Bachelor of Arts) degree, and owns some landed property from her husband and parents. Most of her income comes from agricultural land of about 2.5 acres and it is supported by the monthly pension of her husband. Razia comes of a good family. Her father, a matriculate served in a public office has recently passed away. Her mother, having education up to the SSC level, is a widow and worked in a private organization; she is now passing her retired life. In the family of Rezia Begum, nobody acted as leaders in the any of the political positions i.e. Union Parishad, Upazila or ZillaParishad, or the National Parliament, but a few of her ancestors played roles in the Sardary/ Matbori[11] system in village. Before coming to the UP, she was involved with the Grameen Bank[12] . She was elected to this office for the first time in her life. She maintained a good communication with the MP (Member of

Parliament) of her concerned constituency, a person that was a teacher of her late husband. She and her husband hailed from the same Union. She studied in a high school and government college in PalashbariUpazila. During her college life she and her husband were both involved in the same students' political organization that ultimately led them to get married. Her husband had a cherished desire to become an MP as a candidate from Bangladesh AwamiLeague (BAL), a major political party in Bangladesh. Her husband thought that before that, if his wife was elected on the UP, it could help him win in the MP election. Being inspired from her husband, Rezia Begum quit her permanent position at the Grameen Bank where she had worked for the previous 13 years. While she decided to contest in the UP election she was promoted to Manager in the Grameen Bank. She told that her coming to UP was fully backed and supported by her husband. At the age of 21, she was married to her husband. As a government official Mina's husband was a very honest officer and he maintained a good linkage and network with the socio-political elites at the district and sub-district (Upazila) level as well with a view to becoming future MP from that constituency. As soon as she entered in to the public political sphere, her husband suddenly passed away from the world in December 2012.

Mina has a good grasp of the legal aspects, rules and regulation and acts of the Union Parishad. After taking the helm of UP leadership, she got an opportunity to visit the Gram Panchayats system in Bangalore and the Kerala States of India in 2012. During her tenure in the office as Chairperson she received some training programs relating to the functions of the UP. On attending such training program, she realized the importance of training and she opined that women members should be given more training in order to enable them doing their roles and responsibilities smoothly. As the chief executive of the Union Parishad, she is engaged in various functions in UP governance. She hoped that if people wished, she would love to contest again for the UP next time.

5.1.1 Summary and Analysis on Mina's Case

Socio-political involvement helps developing leadership : Through delving into the description of Mina's case study, it was learnt that she had been involved in student politics since her school and college life, which might have helped her take her present political leadership position in the UP. She had been working in Grameen Bank for a long time where she had obtained the qualities of a managerial role, techniques of interpersonal communication, socio-political consciousness, and social mobility using her positions and in

the ultimate analysis all such qualities prompted her to hold leadership positions in the UP.

Family support is helpful for leadership : Although Mina did not have any political network in her family that could help her become a leader in the public domain, she received tremendous support from her husband, who gave her mental courage and enthusiasms to become the UP Chairperson.

Factional knowledge and training helped playing better leadership : Her knowledge of rules, regulations obtained through training on UP management also helped her playing leadership role in the UP. She might have used her knowledge and insights received from the orientation and exposure visit program in Kerala and the Bangalore local government in India.

A strong socio-economic background helps with the leadership role: In the case of a developing country, rather than education, politician hold position using their socio-economic and political prerogatives, which have become the usual practice in Bangladesh. The same might be the case in the grassroots-based local government in the UP. Mina's husband worked in the public sector. Mina has a good economic base having a better income and some landed property. She possesses good social status with a good family background and structures. For this reason, the strong socio-economic background of Mina's might have helped her playing desired role and performance in the UP.

5.2 The Case of Samsunnahar Begum, Chairperson, Chandpur UP

Samsunnahar, aged 45, hailed from Dhopadanga village, and was elected Chairperson of Chnadpur UP, Boalmari Upazila, Faridpur District in 2011. Samsunnahar came from a rich family and was married to a rich businessman. She maintained her monthly income with an income of 1 lack Tk.[13] (1,179 US$). Most of her income came from business and land. She owned landed property of 10 acres. She lives in a beautiful flat endowed with all the modern amenities and furniture. They possess 2 cars in their family. She and her husband obtained an education up to the HSC (Higher Secondary Certificate Examination) and BA (Bachelor of Arts) respectively.

Her father read up to the SSC and was a businessman. Her family is composed of 9 members. She has 2 sons. She lives in a joint family[14] with some close relatives. Her husband is the family head. She obtained this leadership position through his wide political network. Through an in-depth

interview with her, it was learnt that many of her predecessors used to serve in the UP. Interestingly her husband served as Chairman in the UP for 5 consecutive terms and her father-in-law acted as Chairman in the UP for 2 terms. Moreover, one of her 4 uncles acted as Chairman in the UP in the past. Most of the senior members/fore-fathers of her family members also acted as sarder/matbar in the informal judicial structure of the village-based community. Before coming to the UP she was also involved with an NGO related to human rights, Manabodhiker. Samsunnahar was involved in a student political party (Chatra League) during her school life. Now her husband is also involved with the Bangladesh Awami League (BAL). She has a good linkage with the local MP. Samsunahar was elected Chairperson of the UP for the first time. In her 2-year tenure as a Chairperson she attended some training on human rights, child marriage, and divorce and child abuse; program on role, responsibilities and the functions of the UP at the Upazila and District level. She was additionally trained in the areas of project planning, construction, maintenance and repair or renovation of road under the auspices of the LGSP[15] and LGED[16] .As the executive head, Samsunnaher was engaged in a wide range of activities relating to the UP i.e, coordination, resource management; preparation, formulation, implementation, and monitoring of various projects, negotiation with NGOs, monitoring the performance of the distribution of the VGD[17], VGF[18] card, old age pension cards, ensuring birth and death registration, organizing village courses and playing a role in local dispute resolution, chairing of monthly and special meetings, various meetings organized at the Upazila and District level and has been involved in various types of decision making. Apart from that she is also involved in promoting some activities related to sports and cultural programs in educational institutes, clubs, and cultural organizations. She is found involved in some of the Standing Committees as the Chairperson such as the Social Welfare and Disaster Management Committee and she is also involved in the Education, Health and Family Planning Committee as a member. Despite that, Samsunnaher has also acted as Chairperson of some Primary and High Schools in her UP constituency. She is also involved with two NGOs, named the human rights organization and women's welfare samittee (cooperative organization) as their chief executive. She thinks that to enhance the performance of the women members in the UP they need more training from different organizations.

Sharing background of becoming Chairperson of the UP, she noted that 6 months before the UP election her husband became paralyzed all of a sudden. After that her father, a freedom fighter and the BAL leader, requested her to

run for the Chairman position mentioning that it was their family tradition to rule through the UP. For example, her father stated the following:

> *"Your parental grandfather, father in law and your own husband and many others in this dynasty served the Chairman position for many many years, so now it is your responsibility to take the helm of it as you do not have anyone to serve in such a position. Immediately after that, the local BAL leader, local MP, Upazila Chairman, local political leaders and inhabitants of my neighboring areas came to me and convinced me to contest for the position of Chairman of that UP and thereafter I have been able to become UP Chairperson with a landslide victory.*"

Pointing out her experience in the UP she opined that at the initial stage they lacked experience in project implantation but gradually the women members could learn techniques of project implementation quickly. After implementation of one projects and getting a little training on some aspects of the UP, the women members started formulating project proposal. When they were assigned project responsibility these women members purchased and procured required inputs, employed necessary labor force, and implemented project without facing problem. Mrs. Begum, as the Chairperson of the UP took some social initiatives for the local people of the Union, that included taking attempts against child marriage, dowry; proving special grant for education; helping curbing violence against women by providing employment to that woman; helping poor people to get loan from the NGOs and Bank; providing assistance to the poor people in getting treatment; giving financial assistance to the poor women during their marriage; motivating people for using sanitary toilets, attending lots of functions such as marriage ceremony, annual sports of the school or clubs and attending religious programs, festivals and occasions.

5.2.1 Summary and Analysis on Samsunnahar's Case

Socio-political Involvement helps Leadership : Since her childhood Samsunnahar Begum has been involved in students' politics and she was personally involved with a human-rights related NGO, Manabodiker, for a considerable time, before she was elected Chairperson in the UP. Both involvements in student politics and in the NGO might have helped her to become a public leader.

Family Legacy: Her father-in-law, uncle and husband were involved in the UP for a long period and this gave her a foundation to become a public

leader. Using her family political network, she became a public leader. Another factor is no less formidable: in contemporary politics, most of the women leaders in South Asia have occupied their leadership role in public life using their family network. Through using the family and political legacy of their ancestors, some women leaders come to the political sphere as is the case here for Samsunnahar.

*Training Helps Better Performance :*Samsunnahar's case reveals that as a woman Chairperson she achieved sufficient command over UP affairs within a short tenure there. Attending many training courses might have helped her to be capable of handling those activities. It was learnt that through providing sufficient training, women's capacity to work in the UP can be ensured.

5.3 The Case of Nargis Akhter Khandaker, Chairperson, Machchar UP

Nargis Akhter Khandaker was elected UP Chairperson of the Machchar UP, FaridpurSadarUpazila of Faridpur District in 2011. She hails from Gaandia village of that Union. She is 45 years old and is married to a businessman and has obtained an education up to class five only. On the other hand, her husband only passed the ninth class. Nargis runs her family with a monthly income of 60,000 Taka (707 US$). Most of her income comes from her husband's rice mill. Her husband is also owner of an earthen industry and a few fisheries. Her husband has some landed property, which is about 5 acres. Her father passed eighth class in the school. After marriage they have been living in a single family and until now they do not have any children. Her husband is the head[19] of this single unit family. She comes of a middle class family. She was never involved in any political organization in her student life or even afterwards. However, it was observed that some of her predecessors were involved in the local judicial process as sardar or matbar. She has a linkage with the local MP. She has 2 bothers-in-law that were BNP[20] supporters and are doing business. She came to the UP due to her husband's wish.Nargis' grandfather acted as a UP Chairman for 25 years. Her cousin also served in the UP. Her brother-in-law contested for a UP Chairmanship but failed and in later days he became a UP member for 2 terms (10 years). She said that her sister-in-law served as a member for one term in the UP. In her family background, Nargis had a political history in her past family life. She got married to a businessman that is actively involved in local politics. Her husband holds a president position in the Bangladesh Nationalist Party (BNP) at the Upazila level. Nargis told that as and when party supporters visited her house, she always used to entertain them. As

and when her husband invited party supporters in their residence she cooked food for them and thus she started connecting with local influential socio-political elites. She preferred attending many social occasions in her vicinity territory and every time where she went, people requested her to become a UP Chairman. Being the granddaughter of a grandfather that had served as a UP Chairman for 25 years she found that no one from the paternal side of her family had occupied public office until now. Based on such a basic premise, many of her paternal relatives also wished that someone would come forward to hold a public position. Her husband was involved in local politics, which helped him to achieve a wide political linkages and networks with local and national-level political leaders. Another factor might have influenced her thinking process. Having no baby in her married life she thought that if she could win in the election she would be able to serve the interests of the poor people and thus get some mental satisfaction. Getting blessings from all those aforesaid and drawing inferences from those multiple hidden factors, she was ultimately convinced to contest for the UP election as Chairperson in 2003 for the first time and she earned a massive victory in the UP election, winning 7 out of 9 centers in that UP. After coming to the UP, she started doing some good projects related to road construction.

5.3.1 Summary and Analysis on Nargis' Case

Gateway to Politics : Coming into contact with the party supporters of her husband by inviting them in their family and attending many social occasions such as birthday parties, wedding ceremonies, circumcision ceremonies for male children, inaugural or opening ceremonies, etc. in her area, she made her first gateway to entry into political life.

Family Legacy helps Leadership : Analyzing the case of Nargis, it can be noted that she became a public representative in the UP using her family linkage and legacy. All of her relatives wanted to see her as a public representative because they want to continue their dynastic tradition through her. Her economic background also could contribute to her becoming a woman leader in the UP. The political affiliation in her paternal family might have helped her becoming leader in the UP.

Socio-political Involvement helps Leadership : Nargis' involvement in an NGO helped her to become a UP Chairperson. Such socio-economic involvements have helped her achieve social mobility, remove inertia and develop her attitude to have a position in the public domain.

Education has little role in leadership performance: It was quite evident from her case study that education has little significance in playing the role of a good leader. With only primary level education (five class) she was doing excellent in her assigned roles in the UP.

5.4 The Case of Begum Parul Akhtari, Chairperson, Manikdaha UP

After the death of her husband, Begum Parul Akhtari was elected Chairperson of the Manikdaha UP, VangaUpazila, Faridpur District in 2011. In fact she served in this UP for 2 terms. After the death of her husband she contested in the UP election in 2006 and was elected by the adult franchise of the population of that Union. Parul, 38, an SSC and a widow, is now mother of 2 sons and one daughter and is living in a joint family with 7 family members. She needed to spend 40,000 Taka (471 UD$) on a monthly basis to defray family expenses. She inherited some landed property from her husband, about 20 acres. Most of her monthly income is managed by earning that comes from the landed property and she has some small businesses also. Her father was an SSC while her husband, an IA degree holder, was involved in business; he had passed away long ago. In fact, her husband was killed by opposition people. Concerning political linkages, Parul disclosed that many of her close relatives were involved in the UP. Her family had a long tradition of serving in the political position. Her father was a 2-time Chairman while her husband served 20 years in the UP. Her father-in-law was Chairman of the UP for 37 years while her parental Grandfather also served as Chairman of the UP for 2 terms. Her brother-in-law also served as Chairman in the UP for 5 years. In the course of time, her father also became Upazila Chairman. By tradition most of her elderly family members served as sardar and matbar for many years in their respective villages. However, Parul had no political linkage during her school age and even after coming to the elected position she had no direct involvement with any political party. Nobody in her family was found to be involved in active party politics. Immediately after the killing of my husband she was elected Chairperson in the Union Parishad. She said that her father-in-law had been UP Chairman for 37 years and her husband served as UP Chairman for 20 years. The fact was that their family had been very close to the general public for a long time. She added that after her husband's sudden death, the public did not allow her to stay aloof from the UP and due to their frequent request she made up her mind to contest the UP election. She added that at first there was no contestant and she was elected Chairperson in the UP election. She was again elected Chairperson in 2006 for the following term. After nine years, again she became Chairperson in 2011, contesting with 12 contestants in the UP election. She

disclosed that to win the election some candidates spent more than crores[21] of Taka (128,568 US$) but they could not win the election. She finally said that in fact due to the public demand she was involved with such representative politics but she never thought of coming to the UP. She said that as a public representative she had been working with sincerity and if the public wanted her she had no objection to contest in the next UP election again.

5.4.1 Summary and Analysis on Parul's Case

Family Legacy and political network helps with leadership:Although Parul had no direct political linkage in her student life, but her husband, father, father-in-law, parental grandfather, and her brother-in-law were directly involved with the UP for a long time thus Parul bears a long tradition of a family legacy serving in public office, as many of her direct blood-connected relatives had worked in the UP for quite a long time. The paternalistic linkage is one of the formidable features in the women's leadership in South Asian countries, which was also corroborated in her case.

5.5 The Case of Urmilla Rani Baroi, Chairperson, Jolla UP

After her husband's death by unidentified gunmen, Urmilla Rani Baroi, 47, started serving in the Jolla UP, WazirpurUpazila, Barisal District for the last 2 consecutive terms since 2006. As a widow she looked after her one son and four daughters with a monthly income of 20,000 (236 US$) that come from landed property of about 4 acres and a few fisheries. She read up to eighth class. Her father passed only sixth class while her husband was an IA[22] . She is heading a joint family which is composed of 9 members. Her husband served as Chairman of the same Jolla UP for 2 terms. Nobody in her family was involved with any representative or political position. Before coming to serve in the UP, Urmilla used to work in an NGO named "Aloshikha." Urmilla, in fact, was elected Chairperson in the by-election of the UP, while her husband served as a sitting Chairman and was shot and killed by unidentified hooligans suddenly in 2008. While asked about the context of election in the UP, she pinpointed that she needed to contest with 12 contestants among whom 4 were Muslims and 8 were Hindus, to whom she was one of them. She informed that all candidates spent huge amount of money but she had no money but public support. She won the election by using such public support.

5.5.1 Summary and Analysis on Rani's Case

*Socio-cultural involvement with an NGO helps with leadership :*Urmi Rani was involved in an NGO which helped her become elected to the UP.

6 Analysis of the Findings of Women Chairpersons of the UP

In this part, some of the findings obtained from the 5 case studies were analyzed in the light of available literature from other studies. The issues included in the empirical analysis were socio-economic background comprising age, income, education, marital status, land ownership etc., and their leadership process includes family legacy, NGO involvement, political involvement, linkages with the MP, family support and training received by the women representatives, etc.

6.1 Socio-economic Profiles of the Women Chairpersons

A strong socio-economic background played a significant role in terms of the efficaciousness of the women leadership. Among 5 case studies, 4 Chairpersons except for Baroi, had a strong socio-economic base, which might have helped them to play an effective role at the community level. The major socio-economic profile is given below.

6.1.1 Age Group

It was found that out of 5 WCs, 4 belonged to 45 plus age whereas only Parul's age was 38 years, having an average of 44.6 years. On the other hand, in case of women members, it was found that most of them belonged to relatively young age group. World Food Program (WFP: 1998) found that 42.78% and 25.56% of the women members belonged to the age group of 30-39 years and 20-29 years respectively. Quddus et al. (2001: 8) found almost similar findings, where 46.27% and 38.70% of the women members belonged to the 25-34 and 35-44 age groups respectively. Rahman and Sultana (2005) found 46.15 % and 21.80% of the women members in the age group of 26-30 years and 31-35 years respectively. Most of the studies found a lower number of women members that belonged to below the age group under 25 years and the age group above 50 years. Rahman (2015)[23] found that 73% of the women members belonged to the 30-39 age group, and 19% of the women were from the 40-49 age group and only 8% belonged to the 50-plus age group (Table 1).

6.1.2 Income

Here it was found that average monthly income of 5 WCs was Tk.52,000.00 (613 US$), which was quite good in the context of Bangladesh society. A WFP (1998) study revealed that 74.44% women members did not earn any money, while 15% of them had an annual income ranging from Tk. 6,000.00 (71 US$) to Tk. 20,000.00 (236 US$). Only 9% of the women members had an annual income of Tk. 21,000.00 (248 US$) and above. Quddus et al. (2001) exhibited that 16.82% of the women members had an annual income of Tk. 25,000.00 (295 US$) whereas 17.77% and 15.14% of the women members belonged to the earning income group of Tk. 45,000-55,000 (530 -648 US$) and Tk. 85,000 (1,002 US$) per annum respectively. Rahman(2015) found that the majority women members (37%) belonged to the monthly income group of Tk. 10,001-20,000 (annual income=2122 US$[24]) and followed by 21% with monthly income group of Tk. 20,001-30,000(annual income=3536US$) having an annual average income of Tk. 2,57,268 (3,032 US$).

6.1.3 Education

From the 5 cases it was found that none of the Women Chairpersons (WCs) had an education above graduate level and a few of them had an education of primary level, which means that education had an insignificant role in terms of the WCs being successful. In case the women members' education the WFP (1998) study revealed that 56.11% of the women had a secondary level of education. It also showed that 15.00% and 6.94% of the women members had an SSC and HSC level of education. Only 5.28% of the women members had a bachelor level of education. Quddus et al. (2001) pointed out that 44.00% of the women had read up to the secondary level, whereas 15.10% and 3.90% of the women had achieved SSC and HSC level of education respectively and only 2.90% obtained bachelor and master level of education. Rahman and Sultana (2005) found that 41.03% of the women members had an education up to the secondary level and 24.36%, 8.97%, and 3.85% of the women leaders had an SSC, HSC, and bachelor level of education respectively. Rahman (2015) found that 38% of the women members had an education below the SSC level whereas only 19% of them had an HSC, and 8% of the women members had a bachelor level of education (Table-3). The findings revealed that the women members in the UP were moderately educated. From the 5 cases of WCs it was found that education has an insignificant role in women becoming a successful leader. This was

quite evident from the case of Nargis, who had only primary level of (read up to class five) education, but she was very successful in managing the UP affairs very successfully. Her success was also credited to extending many social services and benefits to the poor people. Nargis case also testifies the fact that education has little relation with performance. This finding was corroborated by Siddiqee (2008), who found that compared to the women UP members with relatively higher levels of education, women having relatively lower level education were significantly more likely to have knowledge about their roles and responsibilities in the UP, and also those women were found more to be involved in the social welfare affairs in their communities.

6.1.4 Marital Status

Concerning marital status of the WCs, it was found that 3 WCs were widow and the rest 2 were married. In different studies it was revealed that most of the women members in the UPs were married. The WFP (1998), Qudduset al. (2001), and Rahman and Roy (2005) found that 84.72%, 85.8%, and 83.33% of the women leaders were married respectively. Rahman (2015) found that 95% of the women members in the UP were married (Table-4). It is deemed that married women having their age in the forties do not necessarily face muchchallenges in performing leadership role at the grassroots.

6.1.5 Land Ownership by Women Leaders

The average land owned by the women chairpersons is 8.3 acres, which means that the families of the women chairpersons are relatively rich in the standard of Bangladesh society. In case of women members, a WFP (1998) study found that 53% of the elected women's families owned more than five acres of land and none of the elected woman was totally landless. This was supported by the study findings of Rahman and Sultana (2005), where no women member belonged to the landless category. However, in a study conducted by Quddus et al. (2001) it was found that 2.73% women belonged to the landless group, and 60.88% and 28.50% of the women members belonged to the small and medium farmer's group having land size of 0.05-2.45 and 2.50-7.49 acres respectively, whereas only 7.89% women had 7.50 acres or more land. This differed however from the findings of the Rahman and Roy (2005), which revealed that 61.74% of the women members had more than 7.50 acres of land and 51.51% women had .05 - 4.99 acres of

land. Rahman (2015) found that 38% women members belonged to landless group(0-.05 acres land), whereas 41% and 7% women leaders belonged to small farmer group(.05-2.50 acres land) and large farmer group(7.50 acres and above land) respectively(Table-5). In the present study, it was found from the case studies that the women Chairpersons belonged to the relatively upper landed class because most of them had more than 5 acres of land.

6.2 Leadership Process of Women Chairperson

6.2.1 Family Legacy

To become a leader, family legacy plays a supportive role. In the present paper it was found that out of the 5 cases, 4 Chairpersons directly come to politics using their family legacy. By observing their close relatives' role in the public domain, some women Chairpersons obtained the proper attitude and stature to serve in the public domain. Thus using their family political network they became UP Chairpersons. In a traditional society, where women are socially, culturally, economically, and politically entrapped and enchained with lots of bottlenecks, in such a context, breaking the bondage of all of those hurdles women may find themselves helpless to become leaders in the public domain, so family legacy may be helpful for those women leaders to participate in the political sphere. This corroborates the findings of other studies. Quddus, Begum, Zahid& Biswas (2001) found that 61% of the women members' nearest relatives and kin were actively involved in political activities, among which, around 50% of the husbands of the women members were actively involved with different political parties. Rahman and Sultana (2005) found that 17.95% of the women member's relatives were previously involved in the UP, followed by 54.84% in 2006(Rahman, 2006) and 63% in 2015, which implies that over the years the number of women members coming to the UP leadership position using their family network and family political legacy was increasing gradually (Table 6). In a traditional society like Bangladesh where women's role is highly confined to the household and reproductive activities and they are subjugated and differentiated everywhere due to myriad socio-cultural, economic, and political problems, this may happen so.

From the South Asian perspective, evidence shows that many national-level women leaders entered into political office using their legacy or political dynasty and as surrogates of their husbands or fathers. Evidence shows that "South Asia has a strong legacy of family politics where the phenomenon of daughters and wives standing as surrogates for their fathers or husbands

is particularly apparent in regions of the world where women in leadership positions would be least expected" (Jalalzai, 2004). It was observed that the first women Prime Minister of the world, Sirimavo Bandaranaike (1960-1965, 1970-1977, 1994-2000), and her daughter Chandrika Kumaratunga (1993, 1994) from Sri Lanka; Indira Gandhi (1966-1977, 1980-1984), Sonia Ghandhi (wife of Rajiv Gandhi and daughter-in-law of Indira Gandhi) and Rabri Devi (1997) from India; Benazir Bhutto (1988-1990, 1993-1996) from Pakistan; Corazon Aquino (1986) from the Philippines; Yingluck Shinawatra (2011 to date); Khaleda Zia (1991-1996, 2001-2006) and Sheikh Hasina (1996-2001, 2009-2014, 2014 to date) from Bangladesh—all belong to that political group of individuals that became leaders using their family legacy or political dynasty (Paxton & Hughes, 2007; Anderson, 1993:52; Boudreaux, 1991; quoted in Saint-Germain, 1993; Moraes, 1980: 127, quoted in Everett, 1993; Wikipedia, 2014). Scholars opine that the surrogate route to power may be most common where the attitude towards women is especially traditional (D' Amico, 1995: 18; Burn, 2005: 234). It was evident that in most of the cases surrogate women leaders refer to their father's or husband's achievement during their public address. The fact might be that after assassination or being hanged or spending a great deal of time in prison, they try to make their husbands or fathers as martyr or heroes in the eyes of the public, and people vote for those surrogate wives or daughters as symbols of the continuing struggle that their fathers or husbands were engaged in. Analyzing the surrogate path to power, it was found that the "female widows of politically-powerful husbands often have little political experience before standing in as a surrogate for their husband. In contrast, it was found that "daughters of political figures have substantial political experience before taking power" (Genovese, 1993: 212-3). Another important phenomenon is interesting here—that in most cases the sons, daughters or relatives of those surrogate women leaders also followed their footsteps to come to the political sphere. India and Bangladesh are special cases in point.

6.2.2 NGO Background

Most of the women Chairpersons in the UP were found to have been previously involved with NGOs. It was evident that out of 5 UP Chairpersons, 4 were directly involved in different NGOs before they were elected to the UP. Rahman (2006) found that 64.52% of the women members had a linkage with various NGOs and socio-economic development organizations, 39% and 77% in 2007 and 2015 respectively (Rahman, 2007) and (Rahman, 2015)(Table-7). Gani and Sattar (2004) found that 50% of the women members were involved in NGOs. Having been involved in NGOs these women leaders might have received a lot of training and opportunities to

interact with many people and situations. The aftermath of all those factors might have helped contribute to better role as leadersin the community.

6.2.3 Linkage with Political Parties

Leadership does not grow automatically in human life. Some sorts of previous linkages with political institutions can be helpful for playing leadership roles. It was found that out of five, 2 Chairpersons hadpolitical affiliation from their student life, which might have helped them achieve a leadership position. In case of 2 other Chairpersons, it was found that their husband wascurrently directly involved in political parties. The fourth one i.e. Parul had a strong family legacy.In Bangladesh the political identity of women leadership remains clandestine because elections are not held on a party basis. Quddus et al. (2001) revealed that 39% of the women members were actively involved in politics but a few of them held positions in the political party. Gani and Satter (2004) found that 16.80% of the women members had a political linkage in the UP. Rahman & Roy (2005, 2006) found that 80% of women members were involved in political parties, and this was followed by 53% in 2015 (Table 6).

6.2.4 Family Support

In case of women member, it was observed that 84% of them received family support while coming to the UP (Table 6). Family support helped thewomen chairpersons to emerge as public leaders. In thecase of Mina and Nargis, this was quite evident. The 3 othershad a strong family legacy, which indicated that they also became women leaders by using their family support.

6.2.5 Linkage with MP

It was found that among the 5 UP Chairpersons, all had a linkage with the MP. Undoubtedly for playing an important role in a political institution, a linkage with an MP is extremely essential, as the MP has a direct role in local development, so it is quite natural to maintain a good relationship with the MPs. Rahman (2015) found that 81% of the women members in the UP had a linkage with the MP(Table 6).

6.2.6 Training Received

It was found that almost all of the women Chairpersons attended various training programs during their tenure, which might have contributed to their

better job performance in the UP. Qudduset al. (2001) found that 89.78% of the women members received training for at least 3 days. Rahman (2006) found that 76.56% had received training in the UP. Again, Rahman (2015) found that 97% of the women members in the UP attended various training program in different GOs and NGOs (Table-8). The name of the training programme was describedin Table- 9.

6.2.7 Reelected Issue

Reelected issue is an important indicator for women leaders. Except for Mina, 4 Chairpersons were elected for more than one term. Among the 5 Chairpersons, Mina contested the UP election 3 times, including her current leadership position, one was elected 3 times to a leadership position, and all 5 women were elected for 2 terms in the UP. Evidence shows that only 14.52% (Rahman, 2006), 55.80% (Gani and Satter, 2004) and 19% (Rahman, 2015) women members were reelected in the UP(Table-6). Due to women members' huge popularity they achieved this, which means that they were really performing excellently in their assigned role by their competent leadership. In the context of Bangladesh, coming to the UP, these women leaders were able to grasp all of the necessary rules, regulations, and practices quickly, and they were also able to adjust tothe prevailing established socio-cultural and political milieu of the rural society, which in turn might have helped them achievesuccess in bringing change and transformation tothe rural society. Therefore people recognized their performance through electing them for multiple terms.

6.3 Common Factors Contributing to the Leadership Process of the Women Chairpersons in the UP

Based on the research questions and a rigorous analysis combining the findings of the salient features and significant factors of all 5 cases of women UP Chairpersons the following common factors that contributed to their leadership process have been identified. It was observed that in most of the cases, the women chairpersons entered into political space by using their family network and dynastic political legacy, being surrogates for their husbands or fathers. Women's prolonged association and work experiences with NGOs helped them flourish their leadership potential; achieve social mobility, conscientization, enough practical knowledge, courage and mental strength, etc., which in turn might have helped them to form their attitude, behavior, beliefs to develop their personality and achieve some managerial capacity. The combining effects of all those above factors helped them

achieving a huge social capital- might have resulted and also contributed to their assuming a leadership role in the community.

7 Conclusion

Analyzing the socio-economic characteristics of these Women Chairpersons (WCs), it was found that most of the women had better socio-economic base. All of these WCs were married having their age in the early fifties. Most of the WCs were moderately educated but education had little role in their performance.In fact, WCs at the UP were the product of the family legacy, while some of them emerged as leaders using their social capital gained through NGO involvement. In most cases, the women leaders entered into political space by using their family network and dynastic political legacy, being surrogates for their husbands or fathers. The common contributing factors behind playing their leadership role were their better socio-economic base, family support,previous political network and linkage with political parties and the local MP which, in fact, provided them a supportive base for their leadership process in the UP of Bangladesh.

Endnotes

1 In the dissertation, in line with the research questions, 10 in-depth case studies, covering 5 women chairpersons and 5 women members, were done in the major socio-cultural zones in Bangladesh. In this study quantitative data were collected from 73 Women Members of 27 UPs from 5 divisions of Bangladesh using a short questionnaire comprising demographic, socio-economic background, socio-political network, and leadership process of the Women Leaders in the Union Parishad. Apart from that to verify some data obtained from case studies and phenomenology, three focus-group discussions (FGDs) and three participatory rapid appraisals (PRAs) were conducted in three UPs, respectively comprising different sections of villagers.

2 In qualitative research, the size of the sample is of secondary importance to the quality of data, as “qualitative research is concerned with smaller numbers of cases with more intensive analysis” (Davidson &Layder, 1994: 173). Moreover, in qualitative research, the selection of the sample does not matter much; rather collecting data from the real world is much more important and even the term sampling is not used.

3 There are 4498 UPs in 7 divisions and 64 districts in Bangladesh. The sampled UPs were selected from covering 5 divisions and 7 districts of Bangladesh i.e. Chittagong, Comilla, Faridpur, Sylhet, Barisal, Bogra and Gaibandha districts. From these districts, data were collected from 73 Women Members and 6 Chairpersons of the 27 Union Parishad (see Annexure-1).

4 The term internal colonialism was used by Rawnak Jahan (1972) in her book Pakistan: Failure in National Integration, USA: Columbia University.

5 Here in this paper local government connotes rural local government, more specifically Union Parishad, the oldest rural local government body in Bangladesh. Till 1983, the only local government in Bangladesh was Union Parishad. In the last 149 years that spanned from 1870 till 2019, UP never loses it representative character and election was continued every 5 years alternate in UP unlike many ups and downs in Bangladesh society.

6 Hussain Muhammad Ershad was one of the military rulers in Bangladesh. While he was the Chief of Army Staff of the Bangladesh Army, he declared Martial Law following a bloodless coup and became Chief Martial Law Administrator in 1982. Afterwards he occupied the office of the President of Bangladesh from 1983 to 1990. During Ershad regime, following the suggestions of National Executive Committee for Administrative Reform and Reorganization (NICARR), he undertook substantive reform measures in the sphere of civil administration and local government system in Bangladesh.

7 During my study period (2011-2016) the representatives of the Union Parishad were elected on a non-party basis but after that in the election for the term of 2016-2021 government introduced a political party-based election in the Union Parishad of Bangladesh for the first time in the history of about one hundred and forty nine years(1870-2019) of this institution.

8 Ward is the lowest planning unit of Union Parishad, which is composed of one or more than one villages. Nine Wards make a Union.

9 Single family refers to a single unit family of husband, wife and their children. In general husband acts as the family head in the single family concept. With the gradual development of the society the tradition of extended or joint family is changing whereas single unit family is getting preference in the rural society like the urban society.

10 1 US$=84.84 taka as of 23November 2019. The figure is calculated more or less in full digit deducting the fraction amount.

11 Sardar and Matbor refer to the local leader that performs a leadership role in local dispute resolutions in the community through an informal and unstructured mechanism. The act of providing service from the sardar or matbor may be regarded as sardari or matbori. Both terms are interchangeably used in Bangla and English.

12 Grameen Bank is a specialized financial institution in Bangladesh. The Grameen Bank is a Nobel Peace Prize-winning microfinance organization and community development bank founded in Bangladesh. It has developed a group-based micro credit approach which is applied to use peer-pressure within a group to ensure the borrowers follow through and conduct their financial affairs with discipline, ensuring repayment and allowing the borrowers to develop good credit standing. More than 99% of its borrowers are women and through micro-credit program Grameen Bank helps empowering the poor women in rural Bangladesh.

13 This is locally practiced in Bangladesh. One lack= 1,00,000 Tk.

14 Joint family refers to an extended family that is composed of the members of a single family plus other relatives of husband or wife living in that family. A joint family is headed by an elderly person that may be the father, mother, brother, sister, father in law, mother in law, grandfather, grandmother of either husband or wife or any other close relatives of the husband or wife. During earlier days in the typical rural society, most of the family belongs to such extended family but nowadays the concept of joint family is undergoing change in the rural society.

15 LGSP is an acronym for Local Governance Support Project (LGSP). It is a World Bank-supported project to strengthen the Union Parishads (UP) of Bangladesh. Under this project performance-based financial support (grants) is directly given to the UP. Like government system, in the LGSP, there is a provision that thirty percent of the total projects will have to be given to women members. Moreover, according to LGSP rule, women members of the respective ward will have to play the role of the Chairperson of the Project Implementation Committee (PIC) in the LGSP-supported projects.

16 LGED=Local Government Engineering Department. The main responsibility of the LGED, the biggest civil engineering department in Bangladesh, is to construct, maintain and develop rural road infrastructure of the country.

17 Vulnerable Group Development (VGD) is a food based Social Safety Net Program in Bangladesh, sponsored by the World Food Program. The target group of the program is mainly destitute women covering landless and asset-less women that are widowed, divorced, abandoned, having under-nourished children, lactating mothers and women with handicapped husband etc. In recent times, the program has moved from its role of relief provider to larger development role like providing training on life skills and income generating skills to women beneficiaries. To achieve the objective of the VGD program, currently about 3.75 million beneficiaries from ultra-poor households are provided with the provision of monthly food ration of 30 kg of wheat or 25 kg of fortified wheat flour (Atta, in Bangla) for a period of 24 months, and a package of development services for human capital development.

18 VGF is the acronym of Vulnerable Group Feeding. VGF program is one of the food based social safety net programs in Bangladesh. It originated in 1970s by World Food Program (WFP) for emergency aid caused by disaster. Now government provides food subsidy for the poorest under this program. Criteria targeted by the program are i) Daily laborer whose income is low or irregular; ii) Landless or those who have less than 0.15 acres of land; iii) Persons with disabilities or their wives, iv) Poor women/men affected by natural disaster.

19 In a traditional Bangladeshi society, family head refers to the position that makes decisions in the family.

20 BNP stands for Bangladesh Nationalist Party. It is one of the major political parties in Bangladesh. The founder of this party was Major General Saur Rahman, the first military ruler in Bangladesh. It is a pro-Islamic political party in Bangladesh. According to the number of seats in the parliament it is the second largest political party in Bangladesh.

21 This is locally practiced in Bangladesh. One crore = 10 million.

22 IA= Intermediate in Arts, which is equivalent to Higher Secondary Certificate Examination in Bangladesh.

23 These data were collected by the researcher during his field trip using a short checklist in 2013-2016.

24 Here from the range of monthly income, annual income has been calculated. Over a long period time amount of the income increased naturally as per growth of the national economy of Bangladesh.

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Division Women	District	Upazila Parishad	Union Members	Number of Women	Number of Chairperson
Chittagong	Chittagong	Mirsarai	Wahedpur	3	
		ComillaSadar	BijoypurModham	2	
			North Durgapur	3	
			South Durgapur	3	
			Amratali	3	
			Kalir Bazar	1	
		Chouddagram	Alkora	2	
	Comilla		Suvapur	3	
			Chiowra	3	
			Gunabati	3	
			JannathDighi	1	
Dhaka		FaridpurSadar	Machaar	3	1
	Faridpur	Vanga	Manikdaha	3	1
		Boalmari	Chandpur	3	1
Sylhet		SylhetSadar	Jalalabad	3	
	Sylhet		Tuker Bazar	3	
			Khadimpara	3	
			Khadimnagar	3	
Khulna		Agoljara	Bakal	3	
	Barisal		Ratnapur	3	
			Rajihar	3	
			Goila	3	
		Wazirpur	Jalla	1	1
Rajshahi	Bogra	Sherpur	Mirjapur	3	
			Garidaha	3	
	Gaibandha	Palashbari	Betkapa UP	3	1
			Pabnapur	3	1
5 Divisions	7 Districts	11 Upazilas	27 UPs	73 Members	6 Chairpersons

Fig. 1 : Selection of Research Participants (Respondents)

Source : Field Survey, 2015

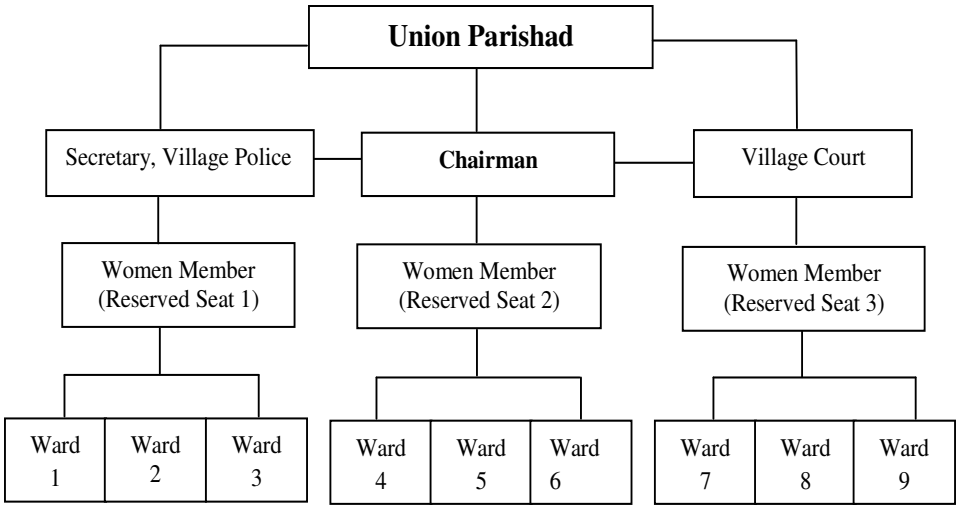

Fig. 2 : Structure of Union Parishad of Bangladesh

Source : Prepared by the Author, 2015

Table 1: Age of the Women Members in Different Age Group in the Union Parishad

Age Group of the Women Members	Number of Female Members	Percentage
20-29 years	-	-
30-39 years	53	73%
40-49 years	14	19.18%
50-59 years	6	8%
Above 60 years	-	
Total	73	100%

Source : Field Survey, 2015

Table 2 : Distribution of Monthly Income of the Women Members of UP

Income Range (in Tk.)	Number of Respondents	Percentage
20-29 years	-	-
Up to 10000	12	17.4
10001-20000	27	37
20001-30000	15	20.55
30001-40000	11	15.07
40,001-50000	7	9.59
Above 50000	1	1.37
Total	73	100
Average Monthly Income	21439.00 Tk	

Source : Field Survey, 2015

Table 3 : Educational Status of the Women Members of UP

Educational Status	Female Member (Nos.)	Percentage
Illiterate (cannot read and write)	-	-
Literate (can write only)	2	2.74
Upto class V	9	12.33
VI-X	13	17.81
S.S.C	28	38.36)
H.S.C	14	19.18
Graduate	6	8.22
Masters and Above	1	1.37
Total	73	100

Source: Field Survey, 2015

Table 4 : Marital Status of the Women Members of UP

Marital Status	Female Member (Nos.)	Percentage
Unmarried	3	(4.11)
Married	69	(94.52)
Separated	-	
Widow	1	(1.37)
Divorced	-	-
Total	73	100

Source: Field Survey, 2015

Table 5 : Land owned by Women Members of UP

Sl. No.	Categories of Respondents	Number of Responses	Percentage
1	Landless Farmers (0-.05acres)	27	(37.99)
2	Small Farmers (0.05-2.50 acres)	30	(41.10)
3	Medium Farmers (2.51-7.49) acres	11	(15.07)
4	Large Farmers (7.50 acres & Above)	5	(6.85)
	Total:	73	100

Source: Field Survey, 2015

Table 6 : Linkages/network of Women Members in UP

Types of Involvement	Yes	No
Did you involve with any political party before coming to the UP?	39 (53%)	34 (47%)
Did you get family support while representing to the UPs?	61 (84%)	12 (16%)
Was anyone in your relatives involved in UP activities before?	46 (63%)	27 (37%)
Do you have linkage with local MP	59 (81%)	14 (19%)
Were you elected before in the UP?	14 (19%)	59 (81%)

Source: Field Survey, 2015

Table 7 : Linkage of UP Women Members with Various NGOs and Socio-Cultural Organisations

Sl. No.	Categories of Respondents	Number of Responses	Percentage
1	Non-Governmental Organizations (NGOs	56	76.71
2	Member of Various Socio-cultural Organizations	9	12.33
3	Insurance Company	8	10.96
	Total	73	100.00

Source: Field Survey, 2015

Notes :

i) In this study Member of various socio-political institutions include Ansar-Village Defense Party, Educational Institute, BRAC Kinder Garden School, Comprehensive Village Development Programme(CVDP); Women's Education, Income, Nutrition Improvement Project(WEINIP)

ii) Insurance companies include Alico Life Insurance, Islami life Insurance, Meghna Life Insurance, National Life Insurance

iii) NGOs include World Vision, Bangladesh Rural Advancement Committee(BRAC), Women Samity, Women's Affairs Samity, Bureau Bangladesh, Swedish Development Corporation, Association of Social Advancement(ASA), Podokhep, Satota Samity, Prime, Protigga Parishad, Proshikha, Grameen Bank, NariKollayan, Legal Aid, Friends in Village Development Project (FIVDP), Nari Uddogh.

Table 8 : Response Regarding Training Received by Women Members in UP

Response Regarding Training Received by the Women Member in the UP	Yes	No
Did you receive any training programme in your term?	71(97%)	2(3%)

Source: Field Survey, 2015

Table 9 : Name of Training Received by Women Members of UP during the Year: 2011-2016

Sl. No	Name of Training	Responses	Institution
1.	Orientation on Management of UP	53	Local Government Engineering Dept.(LGED), Bangladesh Academy for Rural Development(BARD)
2.	Empowerment of women and gender Issue	35	Khan Foundation
3.	Road Maintenance Projects	26	Cooperation for American Relief Everywhere(CARE) and LGED
4.	Birth Registration	24	Upazila Head Quarter
5.	Development and Good Governance	21	Coast Trust, BARD
6.	Fisheries Development	19	Fisheries Department
7.	Maintenance of Road, Ghats	18	CARE and LGED
8.	Sanitation	14	Upazila Head Quarter
9.	Water Resource Management	12	LGED
10.	Poverty alleviation	11	Bangladesh Rural Development Board(BRDB)
11.	Family Planning	8	Directorate of Youth Development
12.	Canal Digging	8	Upazila Head Quarter
13.	Climate Change, Environment and Social Forestry	4	-Do-
14	Project management	8	National Institute of Local Government(NILG)
15	Law and order	15	NILG
16	Human rights	12	CARE
17	Village court	5	CARE
18	Financial management of UP	17	NILG
19	Training on capacity development	15	Upazila Headquarter
20	Anser- Village Defence Party	4	Upazila Headquarter
21	Leadership training	13	CARE

Source : Field Survey, 2015

Note : Each respondent received more than one training programme.

LIST OF AARDO PUBLICATIONS

General

1 AARDO At A Glance (Arabic, English and French versions)

2 AARDO Constitution (Arabic English and French Versions)

3 Financing of Development Projects folder (Arabic English and French Versions)

4 AARDO Factsheet (Arabic, English and French versions)

5 AARDO's Initiatives on Rural Development (1962-2005)

6 Fifty Years of Cooperation for Rural Transformation, 1962-2012 (English & Arabic)

7 Report of Fiftieth Anniversary Celebration of AARDO

8 Report of Research Study on "Jordan Accession to WTO: Impact on Agricultural Sector", 2007

9 Report of Research Study on "Economic and Social Viability of Agro-processing Industries in India", 2012

10 "New Delhi Declaration" of the Inter-Ministerial Summit on Rural Development : Afro-Asian Perspective, 2007

11 "AARDO Declaration on Rural Development" after the Fiftieth Anniversary Celebration of AARDO, 2012 (Arabic, English and French versions)

12 Report of the Expert on "Management of Small Scale Animal Production and Entrepreneurship Development in Oman", 2007

13 Report of the Retreat on "Rural Development : Afro-Asian Perspective", Part I and Part II, 2007

14 Training and Study Visit on Desertification - A Report, Cairo, Egypt, 2007

15 Report of the International Workshop-cum-Training Programme on "Water Resource Management for Sustainable Development", Hyderabad, India, 2009

16 Technical Work Programme 2018-2020

17 Report of AARDO - JA Zenchu (CUAC) Study Mission on Agricultural Cooperatives in: (i) Philippines; (ii) Mauritius; (iii) Ghana; (iv) Malaysia; (v) Egypt; (vi) Jordan; (vii) Sudan; (viii) Syria; (ix) Oman; (x) Kenya; (xi) Bangladesh; (xii) Morocco; and (xiii) Zambia

18 Report of the Roundtable Meeting on *Agriculture Insurance - A Climate Change Adaptation Tool in the African, Asian and Pacific Regions*, 2017

Compendiums

1 A Compendium of Pilot Development Projects, 1991-1999

2 A Compendium of Human Resource Development, 1991-1998

3 A Compendium of Human Resource Development for 1999

4 Compendium of Technical Work Programmes for 2000

5 Compendium of Technical Work Programmes for 2001

6 Compendium of Technical Work Programmes for 2002

7 Compendium of Technical Work Programme for 2003-2005

8 Compendium of Technical Work Programme for 2006-2008

Annual Reports

1 Annual Reports from 1985 to 2000 and 2003 to 2018

RECA (Research and Education Centre of AARDO) Seminars

1 The Role of Agricultural Cooperatives in Developing Rural Communities with Special Reference to Japanese Experience : Report of First and Second seminars, 1968/1969

2 Agricultural Cooperatives : Organisation and Functions with Special Reference to Japanese Experience : Report of Third and Fourth seminars, 1970/1971

3 Rural Cooperation and the Role of Youth : Report of Fifth seminar, 1972

4 Integrated Approach to Rural Development through Agricultural Cooperatives with Special Reference to Japanese Experience : Report of Sixth seminar, 1974

5 Integrated Rural (Agricultural) Development with Special Reference to Japanese Experience : Report of Seventh seminar, 1975

6 Integrated Rural (Agricultural) Development with Special Reference to Japanese Experience : Report of Eighth seminar, 1976

7 Integrated Rural (Cooperative) Development with Special Reference to Japanese Experience : Report of Ninth seminar, 1978

8 Integrated Rural (Cooperative) Development with Special Reference to Japanese Experience : Report of Tenth seminar, 1979

9 Integrated Rural Cooperative Development : Report of Eleventh seminar, 1982

10 Brief Information on Japanese Agriculture : Study Prepared for Eleventh seminar, 1983

11 Basic Information for the Case Study of Eleventh seminar in Aomori Prefecture, Japan, 1983

12 Long Term Planning for Cooperative Rural Development : Report of Twelfth seminar, 1984

13 Minami-Hata Agricultural Cooperative Society : Case Study of Thirty Years of Experience with Long-term Plans for Agricultural Development : Presented at the Twelfth seminar, 1985

14 Rural Agricultural Development and the Role of Agricultural Cooperatives in Japan: Report of Fourteenth seminar, 1987

15 Provision of Input Supply, Credit and Other Service Facilities by Cooperatives with Special Reference to Japanese Experience : Report of the Fifteenth seminar, 1988

16 Role of Agricultural Cooperatives in Agricultural Development in Japan with Particular Reference to Supply of Inputs and Marketing of Agricultural Produce : Report of the Sixteenth seminar, 1990

17 Role of Agricultural Cooperatives in Agricultural Development in Japan with Particular Reference to Supply of Inputs and Marketing of Agricultural Produce : Report of Seventeenth seminar, 1992

18 Role of Agricultural Cooperatives in Agricultural Development in Japan with Particular Reference to Supply of Inputs and Marketing of Agricultural Produce : Report of Eighteenth seminar, 1994

19 African/Asian Women Farmer Leaders Conference (Part A) and Women in Rural Development (Part B) : Report of Nineteenth seminar, 1996

20 Second African/Asian Women Farmer Leaders Conference (Part A) and Women in Rural Development (Part B) : Report of Twentieth seminar, 1998

21 Fourth International Conference on Women in Agricultural Cooperatives in Asia and Africa (Part A) and Agricultural Cooperatives in Japan with Special Reference to Women (Part B) : Report of Twenty-first seminar, 1999

22 Fifth Asian-African Women Farmer Leaders Conference (Part A) and Agricultural Cooperatives in Japan with Special Reference to Women (Part B) : Report of Twenty-second seminar, 2000

23 WTO and its Impact on Agriculture : Report of Twenty-third Seminar, 2001

24 WTO and Agriculture : Report of Twenty-fourth Seminar, 2002

25 Empowerment of Women through Agricultural Cooperatives : Report of Twenty-fifty Seminar, 2003

26 Sustainable Family Farming and Role of Agricultural Cooperatives : Report of Twenty-sixth Seminar, 2004

27 Food Safety on the International Negotiation and the Interantional Agricultural Trade : Report of the Twenty-seventh Seminar, 2005

28 Multifunctionality of Agriculture in the Context of WTO Negotiations on International Agricultural Trade : Report of the Twenty-eighth Seminar, 2006

29 Empowerment of Rural Women in Afro-Asian Region - Opportunities and Challenges : Report of the Twenty-ninth Seminar, 2007

30 Public-Private Community-Based Insti-tutions Partnership: An Approach towards Sustainable Agricultural and Rural Development : Report of the Thirtieth Seminar, 2008

31 Geographic Information System (GIS) Application for Agricultural and Rural Development: Report of the Thirty-first Seminar, 2009

32 Food Security - Global Trends and Perspective: Report of the Thirty Second Seminar, 2010

Other Seminars

1 *Planning for Rural Development* : First Arab Seminar Report, 1971

2 *Integrated Approach to Community Development* : Second Arab Seminar Report,1973

3 *People's Participation in Community Development* : Third Arab Seminar Report, 1975

4 International Seminar on *Rural Development : R O China's Experience*, 1977

5 *The Role of Saemaul Undong in Integrated Rural Development*, 1978

6 International Seminar on *Strategies in Developing a Modern and Efficient Food Crops Sector,* published in collaboration with the Department of Agriculture, Government of Malaysia, 2001

7 International Seminar on *Challenges to Agriculture in the New Millennium,* 2001

8 International Seminar on *Sustainable Farming - Ensuring Food Safety and Environmental Quality,* 2003

9 International Seminar on *Management of Natural Resources* published in collaboration with the International Center for Land Policy Studies and Training, Taoyuan, R O China, 2004

10 International Seminar on *Rural Development : Retrospect and Prospects*, 2012

Report of International Workshops

1 Afro-Asian Workshop on *Developing Information Base*, 1982

2 International Workshop on *Energy, Appropriate Technology and Rural Reconstruction*, Part I & II, 1986

3 International Workshop on *Planning and Management of Minor Irrigation Schemes*, Part I & II, 1986

4 International Workshop on *Rural Unemployment*, Part I & II, 1987

5 International Workshop on *Natural Disaster Management*, 1988

6 International Workshop on *Management of Rural Development Programmes*, Part I and II, 1989

7 International Workshop on *Planning and Management of Small Scale, Rural and Cottage Industries*, 1989

8 International Workshop on *Dryland Farming and Wasteland Development*, Part I and II, 1989

9 International Workshop on *Rural Health & Family Planning*, Part I and II, 1990

10 International Workshop on *Social & Medical Care to Children in Rural Areas*, Part I, 1991

11 International Workshop on *Rural Poverty and Ways & Means to Alleviate it*, Part I, 1992

12 International Workshop on *Management of Agricultural Cooperatives*, 1992

13 International Workshop on *Rural Industrialization*, 1993

14 International Workshop on *Strategies for Sustained Advancement of Women in Rural Areas*, 1993

15 International Workshop on *Social Development in Rural Areas*, 1994

16 International Workshop on *Assessment of Impact and Status of Implementation of the Recommendations of Study Missions on Agricultural Cooperatives in Member Countries*, 1994

17 International Workshop on *Integrated Rural Development*, 1995

18 International Workshop on *Role of Local Self-Government in Rural Development*, 1995

19 International Workshop on *MIS in Agricultural Cooperatives in Asia*, 1996

20 International Workshop on *Environmental Degradation and its Implications on Rural Development*, 1996

21 International Workshop on *Approaches to Watershed Management*, 1997

22 International Workshop on *Micro-Entrepreneurship Development for Rural Women*, 1998

23 International Workshop on *People's Participation in Rural Development*, 1998

24 International Workshop on *Integrating Gender Issues in Rural Development Projects*, 1999

25 International Workshop on *Establishment of Marketing Extension of Farm Produce,* 2000

26 International Workshop on *Promotion of Agro-business to Enhance the Income of Farm Households,* 2000

27 International Workshop on *Income Generating Activities for Rural Families : Identification, Planning and Implementation,* 2001

28 International Workshop on *Agricultural Technology Transfer and its Consequences*, published in collaboration with the Agricultural Research Institute, Taichung, R O China, 2003

29 International Workshop on *Land Reclamation and Rural Development : Policies, Strategies and Practices*, 2005

30 International Workshop on *Role of Modern Irrigation Techniques in Improving Food Security,* 2005

31 International Workshop on *Empowerment of Women through Rural Enterprises,* 2006

32 International Workshop on *The Role of Land Tenure in Rural Development*, 2006

33 International Workshop on *Effective Agricultural Insurance Schemes for Sustainable Family Farming in the Developing Countries*, 2007

34 International Workshop on *Promotion of Aquaculture in Family Farming*, 2007

35 International Workshop on *Innovative Micro-credit Delivery Systems for Rural Poverty Alleviation*, 2008

36 International Workshop on *Best Practices in Rural Poverty Alleviation : Afro-Asian Experiences,* 2008

37 International Workshop on *Climate Change and Food Security*, 2009

38 International Workshop on *Universal Access to HIV and AIDS Services-Breaking the Vulnerability Cycle through Rural Development*, 2010

39 International Workshop on *Water Harvesting Techniques and Practices and their Roles in Enhancing Rural Livelihoods*, 2010

40 International Workshop on *The Role of Women Leaders in Empowering Rural Women Leaders in the Context of Rights and Development Issues in Afro-Asian Region*, 2011.

41 International Workshop on *Impact of Globalization on Rural Development in Afro-Asian Countries*, 2012.

42 International Workshop on *Climate Change and Agriculture : Adaptation and Mitigation*, 2015

43 International Workshop-Cum-Exposure Visit *on Potential of Sericulture and Silk Industry for Employment and Income Generation In AARDO Member Countries*, 2016

Report of Regional Workshops

1 Regional Workshop on *Agriculture As A Business in Africa : A New Paradigm*, 2006

2 Regional Workshop on *Women Entrepreneurship in Rural Africa: Trends and Perspectives*, 2007

3 Regional Workshop on *Role and Importance of Extension Services in Quality Improvement of Agro-Products*, 2007 (Arabic language)

4 Regional Workshop on *Micro Credit Delivery System and Good Governance in Rural Development*, 2010

5 Regional Workshop on *Integrated Pest Management*, 2010 (Arabic language)

Cooperatives

1 Amalgamation of Primary Cooperatives : The Japanese Experience, 1973

2 The Role of Cooperatives in Agricultural Development, 1969

3 Reports and Papers of the Asian Top Level Cooperative Leaders Conference, Japan, 1973

4 Enhancing Cooperative Capability : Reports and Papers of the Top Level Cooperative Leaders Conference, Japan, 1983

African-Asian Journal of Rural Development

(formerly, Afro-Asian Journal of Rural Reconstruction)
Bi-annual research periodical from Vol. 1, August 1967 to Vol. LII, No.1, January-June, 2019

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ABOUT
African-Asian Rural Development Organization

African-Asian Rural Development Organization (AARDO) (formerly, Afro-Asian Rural Development Organization), formed in 1962, is an inter-governmental autonomous organisation currently comprising thirty-one full members and two associate members from Africa and Asia. AARDO is devoted to develop understanding among members for better appreciation of each other's problems and to explore, collectively, opportunities for coordination of efforts, for welfare and eradication of thirst, hunger, illiteracy, disease and poverty amongst rural people. AARDO implements its activities mainly through Human Resource Development (HRD) Programmes and Development Pilot Projects. Under HRD, it organises international/regional level workshops, seminars and training programmes, deputation of expert/consultant, study visits, research studies, etc., whereas under Development Pilot Projects, AARDO provides financial assistance to implement development project in its member countries. Besides, the Organization disseminates information about its activities by way of publications, internet and library services. It also collaborates and network with other organizations engaged in agriculture and rural development.

The organizational structure of AARDO includes : AARDO Conference, Executive Committee, Liaison Committee and AARDO Secretariat, Technical Programme Committee. Besides, AARDO has six regional offices, namely, Regional Office for the Far East at Seoul, R O Korea; for Middle East at Amman, Jordan; for South and Central Asia at Islamabad, Pakistan; for Western Africa at Accra, Ghana; for North and Eastern Africa at Cairo, Egypt; and for Southern Africa at Lusaka, Zambia. These regional offices serve as liaison office for the AARDO headquarters located at New Delhi, India.