Human Resource Development for Sustainable Agriculture and Rural Development under Present Climate Change

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ABSTRACT

Climate change is a natural process and the Earth was subjected to many changes since its formation. Just as the weather changes from day to day, the climate changes over decades, centuries and millennia. However, sustainable agriculture and rural development and climate are mutually dependent. There is a need to understand the effect of climate change on sustainable agriculture and rural development sector at Global level from the view point of providing food to growing population. The increase in temperature has significantly led to a change in the sustainable agricultural zones and shift in the growing seasons. On the other hand the change in the rainfall pattern is the serious threat to the sustainable agriculture and rural development, which in turn affects the economy and food security. The several research and evaluation studies conducted revealed that utilization of human resource is far from satisfactory in different parts of the world. Five scientific revolutions have emerged under changing global climate in the world during this millennium. Human Resource Development (HRD) is essential for adoption of emerging scientific revolutions in changing climate for Sustainable Agriculture and Rural Development. Climate change, energy and Human Resource play a pivotal role in areas of productivity and quality. Further, lack of attention to the nonliving factors may result in reduction of profitability to some extent but ignoring the human resource can prove to be disastrous. However, Narayana’s Innovation Attributes Lotus Model explains four attributes with seven sub components under each for appropriateness of technologies to adopt like Relative advantage, Compatibility, Practibility and Complexity in the emerging global climate change for Sustainable Agriculture and Rural Development. Further, Narayana’s Wheel Model explains management services for Technical advice, Production inputs, Credit support, Marketing service, specialized service, Crop insurance and Programme subsidy are very essential for different sustainable agricultural programmes at local level to increase agricultural production and rural development.

Climate change is a natural process and the Earth was subjected to many changes since its formation. Just as the weather changes from day to day, the climate changes over decades, centuries and millennia. But recently, the changes have become more apparent. Historical evidences suggest that the world has warmed more rapidly in the past 100 years than ever before. Climate change is one of the biggest challenges facing the world today. The problem of human induced climate change first came into force and drew the attention of the scientists and policy makers when Inter governmental Panel on Climate Change was established. The effects of global climate change are many folds and there is need to create awareness about its impact on various sectors of economy. There is an urgent need to take all necessary steps by both developed and developing countries to reduce greenhouse gases that are being let out into atmosphere. However, sustainable agriculture and rural development and climate are mutually dependent. There is a need to understand the effect of climate change on sustainable agricultural and rural development sector both at Global and as well as at regional level especially from the point of view of providing food to vulnerable section of the population. Changing climatic conditions can have the big effect on our life and our environment. The change
in weather conditions can be best observed through the extreme rise in temperature, melting of glaciers and sudden rise in sea level. These changes are causing serious problems to humans and other forms of life. Sustainable agriculture and rural development in India and entire world is mostly dependent on the persisting weather conditions. The alteration in Global warming has dramatically affected sustainable agriculture and its productivity. The increase in temperature has significantly led to a change in the sustainable agricultural zones and shift in the growing seasons. On the other hand the change in the rainfall pattern is the serious threat to the country’s economy and food security. The several studies conducted in different parts of the country indicated that the overall loss in the crop production in the country in the last few years due to the anticipated rise in the temperature. It is expected that in the near future India is going to face the challenges that includes unwanted pressure from the growing population, and changing scenario of world trade in sustainable agriculture. The poor are likely to be hit hardest by climate change, and that capacity to respond to climate change is lowest in developing countries and among the poorest people in those countries. It seems clear that vulnerability to climate change is closely related to poverty, as the poor are least able to respond to climatic stimuli. Furthermore, certain regions of the world are more severely affected by the effects of climate change than others. Generally speaking, vulnerability and adaptation to climate change are urgent issues among many developing countries. For this reason, there exist provisions in the United Nations Framework Convention on Climate Change (UNFCCC) to assist those countries that are thought to be most vulnerable and least able to adapt. Within the context of the Climate Change Knowledge Network (CCKN), a project on the impacts of economic changes and climate change on India’s sustainable agricultural and rural development sector is being pursued jointly by the International Institute for Sustainable Development (IISD), the Centre for International Climate and Environmental Research (CICERO) and the Tata Energy Research Institute (TERI).

Strengths and current issues of Agriculture and rural development:

The Strengths of Indian agriculture are like -

(1) Strong strides made in increasing the production in the past 50 years, mainly due to adoption of HYVs and other technological developments
(2) Subsistence agriculture with small land holdings and skewed distribution of land
(3) Wide variation in regional productivities
(4) Majority still depend on rainfed agriculture
(5) Frequently affected by extreme weather events such as droughts and cyclones
(6) Significant proportion of population still under poverty, mal-nutrition and chronic hunger.

The Current Issues in Agriculture are

(1) Overproduction in short-term, yet food insecurity for a large population
(2) Stagnation/decline in yields
(3) Diversification
(4) Quality and quantity of water resources
(5) Increasing production cost and decrease in the price of commodity.

Further, recent research studies suggested that there is a possibility that this gradual global warming could lead to a relatively abrupt slowing of the ocean’s thermo line conveyor, which could lead to harsher winter weather conditions, sharply reduced soil moisture and more intense winds in certain regions that currently provide a significant fraction of the world’s food production. With inadequate preparation, the result could be a significant drop in the human carrying capacity of the earth’s environment. According to the National Academy of Sciences, the earth’s surface temperature has risen by about 1 degree Fahrenheit in the past century, with accelerated warming during the past two decades. There is new and stronger evidence that most of the warming over the last 50 years is attributed to human activities that have altered the chemical composition of the atmosphere. The annual and monsoon rainfall has lot of variability and also the food production is mainly affected by the rainfall. This indicates that the production has been decreased during the low rainfall years. The rainfall during the season is most important and has lot of influence on the production instead of rainfall trend.

Interventions to overcome climate impact on sustainable Agriculture:

The predominant interventions to overcome climate related impacts in rainfed areas include

(1) Soil and water conservation practices
(2) Agronomic interventions
Nutrient management practices
Livestock based interventions
Development of alternate land use plans.

These interventions have a role to play in all agro-eco systems except that their order of priority changes, which basically depends on rainfall, status of natural resources like soil, water etc. Crop based interventions need to be planned based on amount and distribution of rainfall, availability and further augmentation of water resources with watershed programme. Various soil and water conservation measures for rainfed agriculture include

1. In-situ measures for rainwater management in rainfall areas.
2. Off season land treatment:
3. Conservation furrows
4. Ridges and furrows system in cotton
5. Cover cropping
6. Micro catchments for tree systems Medium term measures rain water management
7. Stone and vegetative field bunds for soil and water conservation
8. Graded line bund helps in efficient drainage.

Long term measures for rain water management like
1. Water harvesting
2. Contour trenching for runoff collection
3. On-farm reservoirs
4. Ground water recharges structure (percolation tanks).
5. Recharge through defunct wells. These rainwater management strategies have good scope for adoption.

The increasing probability of floods and droughts and other uncertainties in climate may seriously increase the vulnerability of resource-poor farmers to global climate change. In view of these climatic changes and the uncertainties in future sustainable agricultural technologies and trade scenarios, it will be very useful to have an early warning system of environmental changes and their spatial and temporal magnitude. Such a system could help in determining programmes to the potential food insecure areas and communities. Modern tools of information technology could greatly facilitate this through HRD.

Human Resource to use modern tools for rural development:

The development of human resource is becoming a matter of prime concern for increasing sustainable agricultural production. It is the professional who create circumstances that can help in making things happen. Human Resource Development (HRD) is the process of enabling people to make things happen. India is liberalizing and globalizing the economy in changing climate. This has created unprecedented upsurge in the demand for accurate information. The several research and evaluation studies conducted in India revealed that utilization of human resource is far from satisfactory in different parts of the country. Five Scientific Revolutions have emerged under changing global climate in the world during this millennium like (1) Genetic Engineering and ability to use this understanding to develop new process and products. (2)Eco-technology and blending of best traditional knowledge with frontier technologies (3) Information technology and its rapid growth in the systematic assimilation and timely dissemination to the concerned. (4) Motivation techniques for efficient utilization of available technologies by ultimate users. (5) Appropriate policies to technology development, technology dissemination and technology utilization. Hence, HRD is essential for adoption of emerging scientific revolutions in changing climate. The professional competencies include knowledge, skill, attitude and values. The professional competency is required for application of modern sustainable Agricultural Production system under current agrarian issues. The competencies could enable professional to act and improve for more alternatives and increase choices. Of all the factors of sustainable agricultural production man has the highest priority and is the most significant factor of production and plays a pivotal role in areas of productivity and quality. Further, lack of attention to the nonliving factors may result in reduction of profitability to some extent but ignoring the human resource can prove to be disastrous. Hence, there is need for HRD to increase sustainable agricultural production under changing global climate. The how aspect is explained as follows

(1) Need for Appropriate Technology Development to increase sustainable agricultural production and rural development:

The several research and evaluation studies conducted in India revealed that utilization of modern sustainable agricultural technologies is far from satisfactory in different parts of the country under current agrarian issues. However, Narayana’s
Innovation Attributes Lotus Model (Fig.1) explains four attributes with seven sub components under each for appropriateness of technologies to adopt like Relative advantage, Compatibility, Practibility and Complexity in the emerging global order.

(A) Relative Advantage:

Is the degree to which an innovation is superior to the idea it supersedes. It can be explained with seven sub items like.

(1) **Market feasibility:** as the extent of market demand for the product derived out of innovation and also the extent of scope for marketing product.

(2) **Market stability:** as the consistency of market price and demand of product derived out of Innovation.

(3) **Cost:** is of two types, initial cost and continuing cost. Initial cost represents the capital investment required for adoption of innovation. Further, the cash or inputs required for subsequent years use of innovation is termed as continuing cost.
(4) **Net Profit:** as the quantum of monetary benefit obtained by an individual through adoption of innovation. **(5) Profit consistency:** denotes the regularity of net returns obtained by an individual or group of individuals over a period of time by adoption of an innovation. **(6) Utility potential:** as the degree to which the multiple use potential of an innovation to an individual or group of individuals through adoption of innovations. **(7) Time saving:** Indicates the best efficiency of an innovation in terms of saving time in different aspects.

(B) **Compatibility:**
An innovation is consistent with past experiences, existing values, and future plans of the adopters of technologies. Compatibility is divided into seven subgroups like

1. **Cultural compatibility:** an innovation is consistent with the values and norms of the society.
2. **Social compatibility:** denotes prestige gain or esteem by individual in the society through adoption of an innovation.
3. **Physical compatibility:** an innovation is consistent and should fit into the needs and interests of the adopters.
4. **Psychological compatibility:** Is innovation usefulness as perceived by the members of social system.
5. **Situational compatibility:** Denotes consistency and harmony of the innovation with previous practices followed by adopters.
6. **Relational compatibility:** an innovation can be adopted independently by the adopters just like other practices.
7. **Anticipated compatibility:** An innovation should be consistent with the future ideas of the adopter over a period of time.

(C) **Practibility:**
An innovation can be easily communicated, tested, demonstrated and practiced.

1. **Point of origin:** Indicates the credibility of the source from where the innovation originated.
2. **Access to advice:** For implementation of innovation, its extent of availability of original and detailed information for guidance and clearing doubts that arise while implementing it.
3. **Visibility:** the results of an innovation are visible.
4. **Trialability:** Is the degree to which new idea can be tried on a small scale.
5. **Mastery:** Is the practice of an innovation could be learned or mastered in a short period of time.
6. **Demonstrability:** an innovation can be demonstrated to members of social system easily.
7. **Communicability:** Is the information about the new idea can be diffused to members of the social system easily and speedily.

(D) **Complexity:**
An innovation is relatively difficult to understand and use.

1. **Failure probability:** an innovation chances of failure and uncertainty of results after its adoption.
2. **Discomfort saving:** Represents avoidance of physical discomfort may be derived by adoption of an innovation.
3. **Resource complexity:** difficult in getting the necessary inputs and other resources for the application of an innovation.
4. **Reversibility:** degree of ease with which the innovation can be replaced in case of its failure.
5. **Work efficiency:** the adoption of new idea saves labour or increase the available labour efficiency.
6. **Cognitive complexity:** an extent of relative difficult in understanding an innovation.
7. **Application complexity:** relative difficulty of an innovations use and application on the farm. The appropriate technology developed should make use of sustainable Agricultural information system for proper dissemination. This demand for HRD.

2. **Management Services for eco-friendly management practices**:
Management services to small poor farmers are an emerging concept cited in recent literature. However, the Narayana’s Wheel Model (Fig. 4) of management services to small farmers explains that small farmers obtain assistance in getting operational activities required like Technical advice, Production inputs, Credit support, Marketing services, Crop/livestock insurance, specialized services and Programme subsidy (TICMSIS) for different eco friendly management practices programmes at local level.

(1) **Technical Advice:** Many times several small farmers fail to adopt recommended eco friendly management practices due to lack of technical assistance at local level. If assistance is provided small farmers adopt all recommended eco friendly management practices. Hence, they should get assistance to see demonstrations established in the locality to understand the importance of technology promoted and technical information through village meetings/training programme/distribution of literature etc. Promoters need to motivate them in respect of superiority of modern eco friendly management practices by exposing them to the economic aspects. Further, they should be helped to know the techniques at various stages of eco friendly management practices.

(2) **Production Inputs:** Extension Workers should help small farmers in finding out the requirements of inputs and help to obtain these inputs at local level sale point, if not available at local level sale point, they should arrange to get from the nearest sale point for eco friendly management practices.

(3) **Marketing Services:** Market for the produce is an important factor as many small farmers fail in marketing because of lack of knowledge. Hence, extension workers need to provide marketing assistance needed for small farmers in different aspects like grading, processing, storing, transport to market, pledge finance, market price information etc to avoid distress selling and middle man in marketing for eco friendly management practices.

(4) **Credit Support:** Credit is the most important input required for technology adoption. Many a times small farmers were not able to adopt the recommended eco friendly management practices because of financial constraints. If timely finance is provided small farmers will adopt the recommended technologies and increase the production. Extension workers should help farmers in finding out the requirements of credit and in getting local application, filling, processing and sanction without any difficulty for eco friendly management practices.

(5) **Specialized Services:** Many times small farmers feel difficult to carryout operations due to lack of equipments and they stop the particular operation or carry out in their own way with the available equipment. So extension workers need to help rural people in getting specialized services needed like getting machinery and equipment for the use of small farmers at local level for eco friendly management practices.

(6) **Crop/livestock Insurance:** Small farmers need insurance for technology adoption to escape from risk. The extension workers should assist small farmers in getting insurance cover for technologies adoption. There is need to cover all types of crops/animals under insurance programme for eco friendly management practices.

(7) **Programme Subsidy:** This assistance is required to motivate small farmers for technology adoption. Extension workers need to assist farmers in getting subsidy provided to different eco-friendly management practices. Further, help in getting application, filling, processing and sanction without any difficulty for eco friendly management practices.

### Microfinance to eco-friendly management practices:

The majority of small farmers in rainfed areas around the world lack access to financial services. In India alone, over 200 million people (36% of the rainfed agriculture population) do not have access to banks. Although India has more microfinance organizations than any other country, these organizations only reach a small percentage of needy households. The rest have no alternative than going to the local moneylenders whose exorbitant interest rates reinforce the indebtedness that contributes to lifetime poverty. Microfinance as the financial service for the small borrowers in rainfed areas and resource poor regions for their economic independence and emancipation. Microfinance as the entire range of financial services rendered to the poor including skill upgradation entrepreneurial development that would enable them to overcome poverty. Hence, microfinance has the
provision of financial service to low income clients including self employed for their livelihood security in rainfed India. Microfinance is being looked upon, by all the concerned as an instrument of poverty alleviation. In India major rural development projects are being funded by the leading agencies like the World Bank, International Fund for Agricultural Development, Asian Development Bank and African Development Bank are stressing upon the need for innovative reforms in credit delivery. However, microfinance is different from micro credit. The micro credit emphasis on loans but micro finance includes support services where we open channels for thrift, market assistance, technical assistance, capacity building, insurance, social and cultural programmes. The major institutional initiatives include the bank linkage programme under the overall guidelines and supervision of the NABARD. The RBI has come out with directives on various aspects of microfinance provision for eco friendly management practices. Hence, there is need to understand the concept and importance of microfinance for eco friendly management practices of small farmers. According to Asian Development Bank, one of the biggest donors for micro-finance, provision of financial services, such as deposits, loans, payment services, money transfers and insurance to poor and their micro-enterprises are broadly called ‘micro-financing’. The term microfinance came into greater currency since the early 1990s and has largely supplemented the term ‘micro-credit’. Further, micro finance play important role eco friendly management practices of small farmers in rural areas. Microfinance is providing financial services, savings and credit to small farmers who do not have access to formal financial institutions and considered world over as an important tool in poverty alleviation. The results of the study reported that micro finance programmes are unique, in that they foster the participation of the poor in the process of economic growth by creating employment opportunities. It helps in increasing the access of the small farmers to income generating assets and raising the productivity of these assets both physical and human. It enables the small farmers to manage risk better. In periods of change, it helps to mitigate the transitional costs of the adjustment process for most vulnerable groups. Its subsidized interest rates. It administered loan allocating and targeted credit programmes were designed to displace informal sources of financial services for eco friendly management practices.

4. Capacity building Among Professionals for Adoption of Modern technologies to increase sustainable agricultural production

Under the current agrarian issues capacity building among professionals is too complex phenomenon to be explained by a single factor. However, Narayana’s Wheel Model (Fig.2) explains combination of seven components for capacity building among professionals viz. Innovativeness, Decision making ability,

![Narayana's Wheel Model for Capacity Building](image-url)

Fig2 Seven Orchestrated, Concerted, Comprehensible shown on the Wheel
Achievement motivation, Information seeking ability, Risk taking ability, Coordinating ability and Leadership ability. The combined contribution of the above seven factors to an individual behavior is being expressed in terms of capacity building among professionals, so far attention given is limited.

(1) **Innovativeness:** Considered as socio-psychological orientation closely associated with change, adopting new ideas and practices. An individual adopts new ideas relatively earlier than others in his organization. However, innovativeness in professionals is very essential to motivate others for adoption of modern technologies.

(2) **Decision making ability:** Considered as the nature of decision making either individually or consulting with others while performing activities. It is the degree to which an individual justifies his selection of most efficient means from among the available alternatives on the basis of scientific criteria for achieving maximum profits. Hence, decision making ability is very important among professionals to motivate for adoption of modern technologies.

(3) **Achievement motivation:** Every man has a desire to achieve certain things in their life. Achievement motivation is considered as the extent to which an individual is oriented towards maximizing profits. Achievement motivation as a social value that emphasizes a desire for excellence in order for an individual to attain a sense of personal accomplishment. So achievement motivation increases efficiency of professionals in use of modern technologies.

(4) **Information seeking ability:** It refers to the frequency of contact by professional with various information sources. This is the pattern by which an individual gets information either on his/her own seeking or as a consequence of his being a part of the network. This component is important for use of modern technologies by professionals.

(5) **Risk taking ability:** Some take more risk, some others take moderate risk and many hesitate to take risk. Risk taking ability considered an individual orientation towards risk and uncertainty in adopting new ideas and courage to face the problems. Use of modern technologies demands ability to take risk by professionals.

(6) **Coordinating ability:** In order to complete the required work in stipulated period, one has to harmonize and synchronize the various activities for better profit. It is an individual co-ordinates action in a time dimension. This ability helps to increase the efficiency of professional in motivating farmers for adoption of modern technologies.

(7) **Leadership ability:** To get things done properly, a professional has to initiate the action, motivate the followers and decision should be taken. It is an individual initiates or motivates the action of the other fellows. Hence, leadership ability is an important component in professional to motivate others for adoption of modern technologies.
(3) **Skill Development among Professionals for Application of information System to increase sustainable agricultural production**

Under the current agrarian issues to meet the requirement of emerging problems of sustainable agriculture development the professional concerned should be trained properly in specific skills required for conducting an effective training of farmers. The skill as ability to do things, to effectively apply knowledge and personal aptitudes and attitudes in work situation. However, the concept of skill concerns the ability to use ones knowledge effectively and rapidly in execution of performance. More generally it is an acquired power of doing some thing competently. Skills, notably professional skills are becoming increasingly important. Further, sustainable Agricultural Information System to day calls for professional skills in its application. Further, seven skills are identified for effectiveness among professional. However, *Narayana’s Wheel Model (Fig.3)* describes seven orchestrated, concerted comprehensible skills required among professional for efficiency like -

(1) **Technical skill** is the ability of the professional to use any technique or method or equipment or product or process as a tool in the context.

(2) **Human Skill** is the ability of professional in motivating other people involved in with thorough understanding while working with them as a team.

(3) **Conceptual Skill** is the ability of professional coordinating and integrating of all the activities with visionary outlook.

(4) **Managerial Skill** is the ability of professional in planning, organizing, directing, leading, reporting and budgeting and reviewing the work of other people involved.

(5) **Design Skill** is the ability of professional in finding out a workable solution to problems. It requires deliberate efforts to develop solution.

(6) **Creative Skill** is the ability of professional in generating new ideas or in doing things already done in a new way.

(7) **Communicative Skill** is the ability of the professional to disseminate and make others to adopt technologies at different levels using series of methods over a period of time.
Training of Professionals for Efficient Use of Information System to increase sustainable agricultural production:

Training is a planned and systematic effort to increase professional competency. Further, to enable the professional to increase knowledge, to improve skills, to inculcate appropriate attitude and develop appropriate attributes to serve better. Several training models are used by the organizations to influence the professional to make desirable changes in their behaviour to achieve the objectives of the organization. Further, observed that training is a building process, to reflect this, a good course is organized in ascending order of complexity. However, understanding of modern technology and deliver it to users in a usable form along with monitoring of activities needed to implement and evaluate its usefulness are urgently needed. The information has to be integrated with available communication methods to suit the resource positions of institutions and time following the integration. Further, good linkage have to be established with inter and intra system of professional organizations. Further, experience gained in training so far indicates that mere development of conceptual understanding and an operational plan based on it may not be adequate. Training has to be made to work. This can happen only when all the three parties involved in training like organization, trainer and trainee – join in their effort and make it to work. An important issue facing us is commitment to training. This is required and it is seldom well realized. Hence, there is a need for knowledge of training models to train professionals. However, the Narayana’s Model of training process (Fig.4) for training professional explains that training process may be a temporary system but the trainer and trainee both learn through various opportunities available for checking their effectiveness. This training as an interdependent and interrelated process. Here lot of opportunity is given for independent and intervening variables to become dependent variables. Hence, this model helps to increase the efficiency of professionals and to develop competency among them. The process of training must start by questioning the basic assumption which have governed our training approach. So an analysis of SWOT i.e., Strength Weakness and Other Things called for to enable as to have new conceptualization. The training of professional during the millennium must take
in to account the needs of broad based sustainable agriculture information system to introduce greater professional competence to increase sustainable agricultural production.

(5) Human Resource Development to use information System efficiently to increase sustainable agricultural production

During the last five decades of development, growth of developing countries is directly related to their human resource bases. The countries which have given good performance are the countries which have made significant investments in Human Resource Development (HRD). There is an over whelming evidence that human capital is one of the key factors for adoption of modern technologies in Developed countries. Further, HRD is widely regarded as the single most important resource for faster adoption being attempted in the developing countries. Hence, there is need for training to develop human resource at various levels in organizations for efficient use of modern technologies. Human resources are assuming increasing significance under the current agrarian issues. However, experience in the past has indicated that HRD among professional is lacking in our country as revealed by large number of research and evaluation studies. How, it should be done is explained in Narayana’s Algebraic Model of HRD (Fig.5) among professionals.

HRD = HRS + HRT + HRU
i.e., HRD = HR (S+T+U)

i.e., Selection of Human Resource, Training of Human Resource and using of Human Resource profitably are urgently needed for adoption of emerging technologies to increase sustainable agricultural production. This is a challenge that needs to be tackled immediately.

(6) Strategy for Better Performance to increase sustainable agricultural production

Narayana’s Algebraic Formula explains how to get better performance from the professional.

Which indicates that

\[ P = A + W \]

i.e.,

\[ P = \text{performance}, \]
\[ A = \text{ability}, \]
\[ W = \text{willingness}, \]

Ability is further given as

\[ A = K + S \]

i.e.,

\[ K = \text{knowledge}, \]
\[ S = \text{skill}, \text{ and further} \]
\[ W = V + A \text{ i.e.} \]
\[ V = \text{values}, \]
\[ A = \text{attitudes}. \]

For better performance all the above i.e. knowledge, skill, values, attitudes are equally important. However, wisdom should be developed for application of knowledge and skill in sustainable Agriculture Information System appropriately for better performance and to increase sustainable agricultural production.