



REVIEW ARTICLE

TOOLS, POLICIES AND PRACTICES IN FARM TECHNOLOGY DELIVERY SYSTEM: A REVIEW

¹Kokate, K. D., ²*Dubey, S. K., ³Uma Sah and ⁴Sudipto Paul

¹MPKV, Rahuri, Maharashtra, India

²ICAR-ATARI, Kanpur-280002

³ICAR-IIPR, Kanpur-280014 India

⁴ICAR-IARI, New Delhi, India

ARTICLE INFO

Article History:

Received 07th February, 2016

Received in revised form

16th March, 2016

Accepted 24th April, 2016

Published online 31st May, 2016

Key words:

Extension tools,
Extension policies and reforms,
Developing countries,
KVKs,
ATMA.

ABSTRACT

Farm extension and advisory service delivery mechanism has witnessed challenges in diverse forms in the post Green Revolution era. The extension approaches, tools, policies and practices have undergone necessary shifts according to the need of the situation. The 'top-down' approach of extension, primarily being adapted in form of the globally recognized 'Training and Visit' system during the 1980s was gradually withdrawn and replaced with participatory 'bottom up' approaches. Farming system research and extension and participatory technology development became the thrust. The participatory appraisal tools like Rapid Rural Appraisal, Participatory Rural Appraisal, Participatory Learning and Action, Rapid Appraisal of Agricultural Knowledge System etc. became increasingly popular and are extensively used throughout the world. Immense policy appraisal, reforms and thereby revolution in technology dissemination could be observed during the 1990s. Merger of all the first line extension projects with the Krishi Vigyan Kendra (KVK) model of India has been visualized as the landmark step towards horizon expansion of research-extension linkage at the grass root. The farm outreach programmes exhaled a greater decentralization of decision making in all when Agricultural Technology Management Agency (ATMA) was initiated and currently spread across 630 districts of the country. With the motto of supplementing the efforts of public agricultural extension system by necessarily providing extension and other services to the farmers on payment basis or free of cost through agricultural experts, Agri-Clinic and Agri-Business Centre (ACABC) initiated in country since early 2000. Of late, the technology dissemination process recognized the farmer led innovation and extension models. For further profitability and sustainability of farm business, the scattered and largely unorganized farm businesses throughout the country are to be thoroughly organized. Linking farmers to the markets, fee based extension service delivery and judicious use of ICT tools will serve as the future perspective in this regard.

Copyright©2016 Kokate et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Citation: Kokate, K. D., Dubey, S. K., Uma Sah and Sudipto Paul, 2016. "Tools, policies and practices in farm technology delivery system: A review", International Journal of Current Research, 8, (05), 31438-31445.

INTRODUCTION

The general concern over a number of issues pertaining to sustainability of agricultural production, equity and environmental protection, has emerged recently questioning thereby the effectiveness of agricultural extension and advisory services. Farmers of the developing nations, predominantly being small to marginal exhale greater need for farm outreach programmes. The success of extension and advisory services largely depends upon a number of factors viz., adequate funding and manpower, use of appropriate tools, techniques and practices, policy and political support, stakeholder involvement and overall suitability of the technology in the micro eco situation (Anon., 2004).

*Corresponding author: Dubey, S. K.,
ICAR-ATARI, Kanpur-280002.

In the post-Green Revolution era, agricultural research and extension face numerous challenges in terms of relevance, accountability and sustainability. The changing economic scenario in India highlights the crucial need for appropriate agricultural technologies and farm management practices to respond to food and nutritional security, poverty alleviation, diversifying market demands, export opportunities, environmental concerns and productivity (Singh et al. 2014). Over a long period of time agricultural extension and advisory services were mainly concentrated upon top-down information and service flow (Dubey et al. 2014). The farming community used to be thought of mere 'receptors' of information and services and their actual needs were hardly taken into consideration in the research and development agenda (Gerolf and Daniele, 2004). With the gradual realization of the importance of understanding the varying social perspectives of

technology adoption and diffusion, extension and advisory service delivery mechanism started adapting a participatory and more pluralistic approach. The paper reviews the gradual shift of agricultural extension approaches over the last few decades, the gradual evolution of participatory extension tools and the policy framework as well as practices in the backdrop of ever changing roles of agricultural extension in global and national perspective.

Paradigm shift in agricultural extension approaches

Extension has a long root that dates back to 1800 B.C although the modern extension services started with the infamous 'potato famine' in 1845 in Ireland (Swanson *et al.*, 1997). In developing countries, although commodity related technical advices used to be provided during the colonial times to farmers, the National agricultural advisory services were not formally established until 1950s and 60s. Extension was included in the university mandate with the inception of 'university extension' in USA during 1860s. The scope of extension expanded during the nineteen fifties when the subcontinents of Asia and Africa started laying primary importance on agriculture for increasing food production and educating the farming community with improved farming practices (Antholt, 1994). The approaches followed in extension service delivery were not static, rather highly varied with the changing clientele group, commodity, purpose, context and location. Axinn (1988) observed different extension approaches followed throughout the world. The general agricultural extension approach which is a typical example of top-down extension planning and service delivery extensively used both in developed and developing countries over decades. In this approach, all the functions for enhancing production - input supply, research, extension, marketing and prices are grouped under a single administration.

An innovative approach, namely Training and Visit (T&V) system emerged during the last half of twentieth century. Compared to the prevailing extension approaches, T&V had a marked difference in the sense that it involved trained field staff to directly connect to the contact clientele groups. Although T&V was top-down in approach, feedback from the clientele groups was taken into consideration in this system of extension which was absent in the previous systems (Birkhaeuser, 1991). Anderson *et al.* (2009) however argued that this model involved huge expenses from the part of the donor agency and was not suitable once the donor agency stopped further financing or National food security is being achieved. The farming systems approach to research and extension involves holistic planning and seeks partnership of research and extension personnel using a systems approach (Maurya). This approach effectively addresses the problem of non adoption as Dunn *et al.* (1996) rightly pointed out that in developing nations, researchers recognized the specific need to apply new thinking to the 'problem' of slow or non-adoption. Pertinent to this approach, Rhoades and Booth (1982) coined the term 'farmer-back-to farmer' and Farrington and Martin (1988) derived 'Farmer Participatory Research' models. Robert Chambers developed the concept of 'Farmer First' in 1987 which had insights of three broad categories of farming systems viz., industrial, green revolution and the CDR

(Complex, Diverse and Risk-prone) agriculture. Since the Green Revolution of 1970s and 1980s and the felt unsustainability of Training and Visit (T&V) program (Anderson, 2006), agricultural extension is moving more towards decentralized, participatory, and demand-driven approaches in which accountability toward the users has gained prominence (Kokate *et al.* 2009). With more than 81 percent of Indian farmers cultivating an area of 2 hectares or less, it has been emphasized for increasing need for stronger intermediaries that can facilitate information access for diverse smallholder farmers (Directorate of Economics and Statistics, 2009). Moreover, farming being highly dynamic in Indian context, farmers need to take many complex decisions related to farm operations and technology use (Sulaiman and van den Ban, 2010).

Evolution of participatory extension tools

During 1980s, *agro-ecosystem analysis* emerged as a powerful tool for evaluating the social perspectives of technologies. In the latter half of twentieth century, *Rapid Rural Appraisal* (RRA) surfaced as an alternative of questionnaire surveys which is a systematic semi-structured survey by multidisciplinary teams designed to quickly acquire information on rural life (Conway, 1998). The methods and concerns of RRA include semi-structured interviewing and management of team interaction (Carruthers and Chambers, 1981) with situational variation (Mukherjee, 1997). A derivation of RRA is *Participatory Rural Appraisal* (PRA) which has evolved from *Farming Systems Research* (FSR) and RRA (Chambers, 1993). PRA tools attempt to investigate, analyse and evaluate the constraints and opportunities for facilitating timely decision and making the development project. Whereas, RRA is extractive with outsiders appropriating and processing the information, PRA is completely participatory in nature and the ownership of analysis mostly lies with the participating community members. Participatory Assessment and Planning is a tool for community based planning, management and development (Burkey, 1993). PAP was pioneered in Asia in the Farmer Centered Resource Management (FARM) program and was introduced in Africa in late 1990s. It is a process of bringing together the primary stakeholders- the farm households to the centre of decision making and planning in an interactive way (FAO, 1998). The *Rapid Appraisal of Agricultural Knowledge Systems* (RAAKS) facilitates innovation and development among multiple stakeholders with different goals and varying perceptions. The method was pioneered by the researchers at the Wageningen Agricultural University, Netherland. Agricultural Knowledge Information System (AKIS) focusing on information and knowledge as the common denominator among various actors in agricultural development is supposed to be the conceptual basis of RAAKS (Roling, 1983; Engel and Salomon, 1997). Agricultural Knowledge and Communication Systems (AKCS) was later developed in FAO deriving the ideas of RAAKS. *Participatory Rural Communication Appraisal* (PRCA), originally developed at FAO during 1994-95 focuses on local information and communication systems. Its basic use is diagnosis of information and communication constraints at the farm, household and community level and thereby identification of interventions to improve information

and knowledge sharing among local stakeholders (Anyaeibunam *et al.* 2004). Some of the other important tools for potential use in agricultural extension are briefly mentioned below:

- Information and Communication Technologies (ICTs) have emerged as one of the potent tool for facilitating the agricultural extension. Akca *et al.* (2007) have foreseen that knowledge is going to manage the world in years to come. Specifically, ICTs are one of the key areas of future technology to make its presence strongly felt (Michailidis and Papadaki, 2010). The ICTs' emergence started with the so-called "information revolution" (Jankowski and Van Selm, 2001) or "technological revolution" (Sheth, 1994), the evolution from industrialism to "post industrialism" (Lyon, 1995), or from an industrial society towards an "information society" (Servaes and Heinderyckx, 2002). Findings of the studies conducted by Attaluri and Maru (2011) revealed the perception among extension managers that the application of ICT in agricultural research, extension, marketing, education, library services and organizational management has considerably improved over a decade. However, they further observed that poor and less developed countries are lagging behind in using more advanced ICTs such as for database management, modeling, GIS and remote sensing, knowledge based systems and for agricultural research management.
- The applied dimension of ICT is Cyber extension which is the extension of agricultural technologies with the help of Information and Communication Technology tools utilizing cyber space. This kind of strong information sharing network is made possible through power of networks, computer communications and interactive multimedia. The major tools of cyber extension include Email, Expert systems providing information on pests and diseases, Internet browsing for extension information, Video conferencing, Call centres and Satellite, communication networks and News and Discussion groups
- The farm-household optimization model developed by Bernet *et al.* (2010) found its successful application in prioritizing extension and research activities in different ecological zones qualifying it as a potentially valuable decision-support tool for future efforts in agricultural extension and policy-making.
- Use of statistical models like multinomial logit model for determining the choices of decision making options especially in case of farmer to farmer extension (Attaluri and Maru, 2011), assessment the risk and vulnerability due to climatic crisis (Bernet, *et al.* 2010), Choices of Coping Strategies for Climate Extremes (Sah *et al.* 2014), etc have emerged as sound methodological tool in extension education sciences.
- Stakeholder analysis for prioritization of demand driven agricultural research for development (Mruthyunjaya, 2010; Sah *et al.* 2014).
- The lack of adequate comprehension of how different farmers accord priority to a given technology differently often prevents real execution of targeted support mechanisms either by the public sector or private organizations. In an analysis by Travis *et al.* (2013), it was argued that experimental auctions were a useful tool for

informing the design and evaluation of alternative market-segmentation and subsidy strategies. The mix of public benefits and heterogeneous private benefits associated with the given technology makes these strategies particularly potent as a means of improving social welfare.

Policy framework and practices of agricultural extension

Global overview of extension policy adaptation by different countries

Case of CHINA: Major policy level intervention in China's extension system was through reestablishment of its public agricultural extension system (PAES) at the end of the 1970s. By the end of the 1980s, the policy supported to employ the extension staff to the tune of more than one million 9 Zang, 1989) with more than 70 percent of them graduating from technical high schools or colleges (Lu, 1999). Further, more than 90 percent of them were deputed to work at PAES stations at the county and township levels, with most agents at the township level. By the mid-1980s, with consistent policy support, China established stations in every rural county and township, even in remote regions (Hu *et al.* 2009), and this large and inclusive system provided high-quality agricultural extension services (AES). Comparing to the 1.01 million of agricultural extension agents, there are only 0.74 million of agricultural administrative villages. And thus, at that time one extension agent usually tasked to provide technologies services to farmers in 3-5 villages. The proliferation of specialized stations made the PAES become overstaffed. Therefore, in the early 1990s, the Chinese government formalized and initiated series of further reforms to make PAES economically viable and sustainable. The first reform was the commercial reforms which classified the stations according to their source of funding i.e. fully funded stations, partially funded stations, and self-funded stations. Counties had flexibility in how to implement the reforms, and in some counties that were less able to finance agricultural extension all the PAES stations have become self-funded stations or partially funded stations. Cuts in funding for PAES affected the day-to-day operations of the system. Several studies have found that services have been greatly reduced since the early 1990's (Hu *et al.* 2012).

Case of USA: The Cooperative Extension Service at each of the Nation's Land-grant universities and colleges is a powerful presence in USA. As the country's population has changed over the years, historic links to colleges of agricultural and human sciences and the U.S. Department of Agriculture have expanded to include partnerships across the educational enterprise of the university and to several other federal agencies. The deep connections to citizens at the grassroots level are fostered by close relationships to local and county governments. The local-state-federal partnerships now include new relationships that take educational efforts into all communities and neighborhood across the U.S. Extension's potential is bounded only by its imagination and creativity (APLU, 2010). As a result, Cooperative Extension Services (CES) has identified and focused on strategic opportunity areas. These include - sustained profitable plant and animal production systems, prepare youth, families and individuals for success in the global workforce and all aspects of life, create

pathways to energy independence, ensure an abundant and safe food supply for all, assist in effective decision-making regarding environmental stewardship, assist communities in becoming sustainable and resilient to the uncertainties of economics, weather, health, and security and helping families, youth and individuals to become physically, mentally, and emotionally healthy.

An overview of extension policy adaptation in India

Adaptation in Indian agricultural extension already initiated on wider scale since XI five year plan which focuses on the major areas of policy reforms, institutional restructuring, management reforms, strengthening research–extension linkages, capacity building and skill upgradation, empowerment of farmers, mainstreaming of women in agriculture, use of media & information technology, financial sustainability and changing role of government (Anon.. 2007).

In order to meet the holistic rural needs in a sustainable manner, the following policy reforms in the extension system of the country had been adapted for envisaging a more broad-based and holistic extension service delivery that protrudes beyond agricultural technology transfer.

Institutional restructuring: Given the vast diversity of the country in terms of agro-ecology, landholding, and farm infrastructure, this is well understood that attaining uniformity in extension system throughout the region is rarely possible. Moreover, the same extension service delivery approach and technique will not bring uniformity in outputs in all the regions. Therefore, restructuring the Public Extension System on a continuous basis hitherto remains central to the process of technology dissemination.

Decentralization of decision making: The ATMA model

The Agricultural Technology Management Agency (ATMA) was introduced as a pilot project in 28 districts in seven states of India from 1998-2003 as part of the World Bank funded Innovations in Technology Dissemination (ITD) component of the National Agriculture Technology Project (NATP). In 2005 the Government of India expanded the ATMA model to 252 districts under State Extension Programmes for Extension Reforms (SSEPER), and then in 2007 to all the districts of the country (Working Group on Agricultural Extension, 2012). As stated by Swanson *et al.* (2008), ATMA is a semi-autonomous, decentralized, participatory and market-driven extension model. It basically links the research and extension activities of a district along with coordinating the government, NGO and some private organization operated extension programmes. Strategic Research and Extension Plan (SREP) is the characteristic uniqueness of ATMA. Under ATMA, grass root level extension is mainly channelized through the involvement of BTTs (Block level Technology Teams) and FACs (farmer advisory committees), farmer groups/ farmer interest groups and self help groups. Swanson (2008) observed that for the first time since the extension system in India was established, field extension staff at the block level actually had access to funds that could be used to implement extension programmes based on the needs of the different farmers' groups and for the

first time they could see the direct impact of their work on the lives of farmers, farm women and rural youth within their block and district.

National Mission of Agricultural Extension

The Extension Working Group, therefore, recommended that National Mission on Agricultural Extension be launched during the 12th Plan to deepen, widen and carry forward the extension reforms agenda of 11th Plan to meet the challenges brought out in the 12th Plan Approach Paper for achieving the plan objectives of faster, sustainable and more inclusive growth (Planning Commission, 2013). The Mission envisages Agricultural Extension to support the state governments, local bodies & institutions for enhancing their capacity and institutionalizing structures & mechanisms for a knowledge-driven, accountable, decentralized, broad-based & participatory programme planning & implementation to facilitate farmers, farmwomen & youth to achieve economic, food, nutritional & environmental security and thus achieve Plan objective of faster, sustainable and more inclusive agricultural growth". Mission contemplates to develop the capacity of ATMA and other local institutions in formulating competitive projects based on local needs and constraints, selection of best projects and their implementation. Mission shall challenge the states, SAUs, SAMETIs, ATMA, KVKs, and other institutions to realize their full potential and support and incentivize them for the same. ATMA, KVK & BTT shall be the fulcrum of activities.

Research-extension linkage at the grass root

Agricultural Science Centre (Krishi Vigyan Kendra) network: With a view to integrate the research output in the existing farming situations, the Indian Council of Agricultural Research (ICAR), came up with the noble idea of establishing Krishi Vigyan Kendras (KVKs) in the rural districts of the country in a phased manner for reducing the gap between technology generation and application in the field. As long as the need for close interaction between farmers, extensionists and researchers in participatory diagnosis of problems and location specific recommendations, emphasizing joint action and education rather than prescription has been increasingly felt, the Krishi Vigyan Kendra (KVK) network started spreading enormously. The first KVK of the country was established in 1974 at erstwhile Pondicherry and the mandate of KVKs in the initial years of establishment was confined only in training. Krishi Vigyan Kendras (1974) actually originated as one of the four first line extension services of ICAR that included National Demonstration (1966), Operational Research Projects (1974-75), and Lab to Land Programme (1979). The onus of effective implementation of these extension initiatives lied with the ICAR institutions and State Agriculture Universities (SAUs) in their contiguous operational areas with the active participation of research scientists. The immense policy reforms in the KVK mandates and its activities was brought about only after a thorough realization of the importance of micro eco situation perspectives of technology suitability and its adoption. All the first line extension services were merged with the KVKs during 1990s with new structural and organizational arrangements. With a decision of establishing

KVKs in all the rural districts of the country in Xth five year plan, the revised mandate of KVK became technology assessment, refinement and demonstration of technology/products. At present there is a network of 643 KVKs in the country. The activities of KVK include mainly on-farm testing for technology adaptation, frontline demonstrations of the proven technologies, capacity building of farmers, farm women, rural youth and extension personnel and acting as the resource and knowledge centre at the district level.

Transformation of human capital

With a view to supplement efforts of the public agricultural extension system by necessarily providing extension and other services to the farmers on payment basis or free of cost through agricultural experts, a centrally sponsored scheme, namely Agri-Clinic and Agri-Business Centre (ACABC) is under operation in the country since 2002. Agri-business centres are commercial units of agri-ventures, established by trained agricultural professionals. The scheme covers full financial support for training and handholding, provision of loan and credit linked back ended composite subsidy to agri-graduates, agri-diploma holders and degree or diploma holders of allied disciplines. As designated by the ministry, National Institute of Agricultural Extension Management (MANAGE) is responsible for arranging a two-months training to the aspiring agri-graduates. Till November, 2013, a total of 34,883 graduates have been trained leading to the establishment of 13603 agri-ventures in various parts of the country (ACABC, 2013). Although farmers have been largely benefited through this scheme, it has been reported that the trained agripreneurs face several constraints in availing bank finance to set up ACABCs (Karjagi, *et al.*, 2009).

Gender mainstreaming

There has been growing recognition about gender related issues and its inclusion in research-extension processes by the Government and ICAR. The National Research Centre for Women in Agriculture (NRCWA) was established in 1996 at Bhubaneswar, upgraded as the Directorate of Research on Women in Agriculture (DRWA) from the year 2008. CIWA is carrying out basic, strategic and applied research on various gender related issues in agriculture and allied sectors with thematic approach in creating a repository of gender disaggregated data; drudgery; gender sensitive extension; capacity building; efficient resource management; and gender mainstreaming (Anon., 2013). The first Global Conference on Women in Agriculture held at New Delhi, India during 2012 brings forth many policy and approach related intervention points for gender mainstreaming viz., gender specific data management on farm women; improving effectiveness of Government investment, building capacity of women group and enhanced role of scientific institutions in production of nutrition rich foods; build and strengthen coalition by providing enabling environment for innovative network; harnessing full potential of SHGs through channelizing agricultural support services for farm women; addressing social issues in context to marriage laws, property inheritance, control over assets, etc; access of women to market; developing gender sensitive course curriculum; sensitization

over climate change and initiating a global partnership programme called Gender in Agriculture Partnership (GAP) (Kokate *et al.*, 2012).

Public-Private-Partnership (PPP) approach

PPP involves a contract between public and private sector entities wherein the private entity provides a public service or project and assumes substantial financial, technical and operational risk in the project with specified roles and responsibilities (Ponnusamy, 2013). In India, PPP has entered both in research and extension. Production and marketing of basmati rice and medicinal plants in Bihar, maize in Andhra Pradesh and mango in Maharashtra through a partnership mode between Agricultural Technology Management Agency (ATMA) facilitated commodity groups and private agencies have been inspiring cases of PPP (Ponnusamy and Srinath, 2013). Experiences have shown that PPP fostered significant positive impacts in productivity enhancement (Ramasundaram, 2011), reduction of risks and uncertainties (Reddy and Rao, 2011), knowledge management and social mobilization, development of high end technologies (Khush, 2005) and women empowerment (Thangamani *et al.*, 2012).

Multi-stakeholder convergence: The range of extension service delivery agencies has been enlarged through policy reforms and institutional reconstruction. The public extension system although continues to be the leading extension delivery mechanism, NGOs, farmers organizations, state departments of agriculture and animal husbandry and panchayati raj institutions have been playing significant roles in extension service delivery. India has a large number of NGOs with varying capacity and strength, which implement a wide range of programmes. Around 15,000-20,000 successfully functioning NGOs are actively engaged in rural development. The ICAR has supported several NGOs for establishing KVKs. The Ministry of Panchayati Raj, Government of India in 250 backward districts, implemented the Backward Regions Grant Fund (BRGF). Ministry of Rural Development through the District Rural Development Agencies (DRDAs) implemented the Swarnajayanti Gram Swarozgar Yojana (SGSY). Forming farmer interest groups and federating them at the block and district levels is an important strategy of the ATMA extension approach implemented by the Government of India. The idea is to encourage farmer groups to organize different types of services for themselves, including input supply, credit, technical services and marketing that would increase their incomes, while decreasing their dependence on the government.

Implications

The public agricultural extension system has faced numerous challenges in different forms over the last two decades. It has become increasingly evident that the public extension system alone can no longer respond to the multifarious demands of diversified farming systems. There is a need to strengthen the public extension service delivery machinery so as to enable it to effectively address the newly emerging challenges. In one hand, there is a need to extensively adapt the market led models, and on the other hand farmer led innovations are to be

further promoted. Good extension practices from different parts of the country and world in general and developing countries in particular are to be documented for use in the national context. The technology dissemination process has to concentrate upon improving productivity, agricultural diversification, processing and value addition and sustainable management of natural resources. Public funding has to be adequately increased not only for sustaining the vast extension infrastructure but to promote research on diverse social issues and social perspectives of technology application. The diverse approaches of extension have to be appropriately streamlined with judicious use of information communication technologies and in accordance with the existing policies. Wherever possible the pluralistic mode of extension service delivery has to be properly channelized through community based techniques for holistic and sustainable rural development.

REFERENCES

- ACABC, 2013. www.agriclinics.net/ebulletin/e-bull-nov-13.
- Akca, H., M. Sayili and K. Esengun, 2007. Challenge of rural people to reduce digital divide in the globalized world: Theory and practice. *Government Information Quarterly*, 24, 404–413.
- Anderson, J. R., Feder, G. and Ganguly, S. 2006. The rise and fall of Training and Visit extension: an Asian mini-drama with an African epilogue. World Bank Policy Research Working Paper 3928. Washington, DC, The World Bank., 30 pp.
- Anon, 2004. The Role of Industrial Development in the Achievement of the Millennium Development Goals. In: Proceedings of the Industrial Development Forum and Associated Round Tables, Vienna, 1-3 December 2003, UNIDO, Vienna International Centre, Vienna, Austria, P:438
- Anon, 2007. Major Agricultural Extension Initiatives. Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India.
- Anon, 2013. www.drwa.org.in.
- Antholt, C. H. 1994. Getting ready for the twenty-first century: Technical change and institutional modernization in agriculture. World Bank Technical Paper 217. World Bank, Washington, DC, USA.
- Anyaegbunam, C, Mefalopulos, P and Moetsabi, T. 2004. Participatory Rural Communication Appraisal Starting With the People. 2nd edition, FAO, Rome, Italy.
- APLU, 2010. Strategic Opportunities for Cooperative Extension. Association of public and land-grant universities (APLU), 1307 New York Avenue, N.W., Suite 400, Washington, D.C. 20005-4722.
- Attaluri, S. and Maru Ajit, 2011. Information and Communication Technologies/Management in Agricultural Research for Development in the Asia-Pacific Region: A Status Report. Food and Agriculture Organization of the United Nations Viale Delle Terme di Caracalla, Rome 00153, Italy, October, PP: 126.
- Axinn, George, H. 1988. Guide on alternative extension approaches. Rome: FAO, P: 75.
- Bernet, T. O., Ortiz, R. D. Estrada, R. Quiroz and S. M. Swinton, 2010. Tailoring agricultural extension to farmer needs: A user friendly farm-household model to improve decision making in participatory research. Proceedings – The Third International Symposium on Systems Approaches for Agricultural Development, p:1-12.
- Birkhaeuser, D., Evenson, R.E and Feder, G. 1991. The economic impact of agricultural extension: A review. *Economic Development and Cultural Change*, 39(3): 607–650.
- Burkey, S. 1993. People first: A guide to self-reliant participatory rural development. Zed, London, UK.
- Carruthers, I. and Chambers, R. 1981. Rapid appraisal for rural development. *Agricultural Administration*, 8(6):407–422.
- Chambers, R. 1993, Challenging the profession—Frontiers for rural development. *Intermediate Technology Publications*, London, UK.
- Conway, G. 1998. The Doubly Green Revolution: Food for all in the 21st century. Penguin Books, New York, USA.
- Deressa Temesgen Tadesse, Claudia Ringler and Rashid, M. Hassan, 2010. Factors Affecting the Choices of Coping Strategies for Climate Extremes: The Case of Farmers in the Nile Basin of Ethiopia. IFPRI Discussion Paper 01032, Environment and Production Technology Division, IFPRI, P:36.
- Directorate of Economics and Statistics. Agricultural statistics at a glance 2009. Department of Agriculture and Cooperation. <http://dacnet.nic.in/eands/latest_2006.htm>. Accessed June 15, 2010.
- Dubey, S K., R. R. Burman, J. P. Sharma, K. Vijayaragavan, V. Sangeetha, Ishwari Singh and H. S. Gupta, 2014. Can post offices of rural India be the driver for agricultural technology dissemination? *Experiences of action research. Current Science*, Vol. 107, 2(25): 195-202.
- Dunn, T., Humphreys, L., Muirhead, W., Plunkett, M., Croker, N. and Nickl, M. 1996. Changing paradigms for farmer–researcher–extensionist relationships: Exploring methods and theories of farmer participation in research. *European Journal of Agricultural Education and Extension*, 3(3):167–181.
- Engel, P. and Salomon, M. 1997. Facilitating innovation for development. A RAAKS resource box.
- FAO, 1998. www.fao.org/docrep/w9500e/w9500e00.htm.
- Farrington, J. and Martin, A. 1988. Farmer participatory research: A review of concepts and practices. Agricultural Administration Unit, Occasional Paper 9, London: Overseas Development Institute.
- Gerolf Weigel and Daniele Waldburger, 2004. ICT4D – Connecting People For A Better World: Lessons, Innovations and Perspectives of Information and Communication Technologies in Development. Edited by Swiss Agency for Development and Cooperation (SDC) Global Knowledge Partnership (GKP), P: 290.
- Hu, R, Yang, Z, Kelly, P, and Huang, J. 2009. Agricultural Extension System Reform and Agent Time Allocation in China. *China Economic Review*, 20, 303–315.
- Hu, Ruifa, Jikun Huang and Kevin Z. Chen, 2012. The Public agricultural extension system in china: development and reform. Background Paper prepared for the Roundtable Consultation on Agricultural Extension, Beijing, March 15-17.
- Jankowski, N. and M. Van Selm, 2001. ICT en samenleving. Vier terreinen voor empirisch onderzoek. In: Bouwman, H.

- (Ed.), *Communicatie in de informatiesamenleving*. Lemma, Utrecht, pp. 217–249.
- Karjagi, R. H., Khan, S. S., Vijaykumar, H. S. and Kunnal, L. B. 2009. Problems of trained agripreneurs under the scheme of agriclincs and agribusiness centers in starting and running their agriventures: A study in south India. *Karnataka Journal of Agricultural Science*, 22(1): 233–234.36.
- Khush, G. S. 2005. Public-Private Partnership in Agricultural Biotechnology. Second Foundation Day Lecture Trust for *Advancement of Agricultural Sciences*, New Delhi, pp 1–20.
- Kokate, K. D. *et al.* 2012. Proceedings of first Global Conference on Women in Agriculture (GCWA) held during 13-15 March, New Delhi, India, P:82.
- Kokate, K. D., Karde, P. B., Patil, S. S. and Deshmukh, B. A. 2009. Farmers'- led Extension: Experiences and road ahead. *Indian Research Journal of Extension Education*, 9 (2), May 2009.
- Lautze, S., Y. Aklilu, A. Raven-Roberts, H. Young, G. Kebede, and J. Learning, 2003. Risk and vulnerability in Ethiopia: Learning from the past, responding to the present, preparing for the future. Report for the U.S. Agency for International Development. Addis Ababa, Ethiopia.
- Lu, Ming (editor), 1999. Fifty Years of Agricultural Science and Technology in China. China 20, Agriculture Press (in Chinese).
- Lyon, D. 1995. The Roots of the Information Society Idea. In: Heap, N., Thomas, R., Einon, G., Mason, R., Mackay, H. (Eds.). *Information Technology and Society*. Sage Publications, London, pp. 54–73.
- Maurya, D M. 1992. Farmer Participatory on-farm research methodologies: A sustainable model. In: Axinn G. H. and J.S. Caldwell (ed.) *Towards an new paradigm of farming system research/extension*. 12th annual farming system symposium. East lansling USA, Michigan State University, P: 87-110.
- Michailidis, A. and A. Papadaki-Klavdianou, 2010. Diffusion of ICTs in Agriculture: Comparative Analysis between the regions of Greece. Presented at the Agrotica's 3rd National Conference for Alternative Agriculture and Renewable Energy Sources, Thessaloniki, Feb. 5 Greece.
- Mruthyunjaya, 2010. Prioritization of Demand-driven Agricultural Research for Development in South-Asia. International Food Policy Research Institute (IFPRI), *Asia-Pacific Association of Agricultural Research Institutions (APAARI)*, P:68.
- Mukherjee, N. 1997. Participatory appraisal of natural resources. Studies in rural participation, number 3. Concept Publishing Company, New Delhi, India.
- Planning Commission, 2013. planningcommission.gov.in/plans/planrel/12thplan/.
- Ponnusamy, K. 2013. Impact of public private partnership in agriculture: A review. *Indian Journal of Agricultural Sciences*, 83 (8): 803–8.
- Ponnusamy, K. and Krishna Srinath, 2013. The mechanism of rural migration and technological interventions to reduce it. *Indian farming*, 62 (10): 11-14 and 29.
- Ramasundaram, P., Suresh, A. and Chand, R. 2011. Manipulating technology for surplus extraction: The case of Bt cotton in India. *Economic and Political Weekly*, 43 (46): 23-26.
- Rasheed Sulaiman, V. and A. W. Van den Ban, 2010. Agricultural extension in india - the next step. National Centre for Agricultural Economics & Policy Research, New Delhi.
- Reddy, G. P. and Rao, K. H. 2011. Public Private Partnership in Agriculture Challenges and Opportunities. Summary proceedings and recommendations of National Workshop. National Academy of Agricultural Research Management, Hyderabad.
- Rhoades, R. E. and Booth, R. H. 1982. Farmer-back-to-farmer: A model for generating acceptable agricultural technology. Social Science Department, International Potato Center, Lima, Peru.
- Roling Mc, N. G. 1983. Agricultural knowledge: Its development, transformation, promotion and utilization; Issues for information consolidation. Paper for third expert working group on information, analysis and consolidation. UNESCO/UNISIST, Kuala Lumpur, Malaysia, 12–16 September.
- Sah, Uma, Hem Saxena, Narendra Kumar, S. K. Singh and Shripad Bhat, 2014. Tobit analysis of farmer to farmer diffusion of improved pulse seeds in Bundelkhand region of India. *Indian Journal of Agricultural Sciences*, 84 (10): 1254–1261.
- Sah, Uma, S. K. Dubey and S. K. Singh, 2014. Validation of stakeholder analysis as a potential tool for mainstreaming the actors of pulses development. *Journal of Food Legumes*, 27(3): 238-245.
- Servaes, J. and F. Heinderyckx, 2002. The new ICTs environment in Europe: closing of widening the gaps? *Telematics and Informatics*, 19, 91-115.
- Sheth, J. N. 1994. Strategic importance of information technology. In: Sheth, J.N., Frazier, G.L., Dholakia, R.R. (Eds.), *Advances in Telecommunications Management. Strategic Perspective on the Marketing of Information Technologies*, Jai Press Inc, Greenwich, London, 4, 3-16.
- Singh, K. M., M. S. Meena, B. E. Swanson, M. N. Reddy and R. Bahal, 2014. In-Depth Study of the Pluralistic Agricultural Extension System in India (Ed.), P:165.
- Swanson, B. 2008. Global review of good agricultural extension and advisory service practices. FAO. Rome, Italy.
- Swanson, B. E., Bentz, R. P. and Sofranko, A. J. (eds). 1997. *Improving agricultural extension: A reference manual*. 3rd ed. FAO (Food and Agriculture Organization of the United Nations), Rome, Italy.
- Swanson, B., K. M. Singh, and M. N. Reddy, 2008. A decentralized, participatory, market-driven extension system: The ATMA model in India. Paper presented at *Advancing Agriculture in Developing Countries through Knowledge and Innovation*, Addis Ababa, Ethiopia.
- Thangamani, K, Leelavathy, K. C. and Meenakshi, S. 2012. Mainstreaming of farmwomen: An experience of PPP approach in vegetable marketing. Abstracts of *Global Conference on Women in Agriculture*, 13-15 March, 2012. New Delhi. pp. 159-160.
- Travis, J. Lybbert, Nicholas Magnan, David, J. Spielman, Anil Bhargava and Kajal Gulati, 2013. Targeting Technology to Reduce Poverty and Conserve Resources Experimental

- Delivery of Laser Land Leveling to Farmers in Uttar Pradesh, India. IFPRI Discussion Paper 01274, July PP: 44.
- Working Group on Agricultural Extension, 2012. Recommendations of working group on agricultural extension for formulation of eleventh five-year plan (2007–12). New Delhi: Planning Commission.
- Zang, Chengyao (editor), 1989. Activities of Agricultural Science and Technology in China 1949- 1989, *China Science and Technology Press*, Beijing (in Chinese).
