Chapter 3
Empowerment of Stakeholders for Scaling-Up: Digital Technologies for Agricultural Extension

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Abstract In most of the developing countries in Asia and Africa large yield gaps are existing between the current farmers' yields and potential achievable yields. The necessity of meeting the farmers' requirement to scale up research results is paramount for adequate food production. This requires empowerment of farmers by answering queries of farmers appropriately through different extension channels including state and central machineries. These are the backbone of the agricultural technology development to empower farmers as the major stakeholders and hence requires attention. Lack of awareness among farmers about good agricultural management practices compel them to follow the traditional practices. All agricultural education and research, ultimately aims at increased productivity and economic well-being of farmers. This is possible only when there is a minimum gap between laboratories and land. This gap is bridged by agricultural extension. But human capacity, the content of the information, processes of delivery and technology determine effectiveness of extension services. Non-availability of sufficient extension personnel is a major constraint. To overcome these shortcomings, e-Extension (eE) is the alternative. It is important to rejuvenate the agricultural extension system (AES) with innovative information communication technology (ICT) models for knowledge generation and dissemination. Latest digital technologies are discussed in this chapter on ICT to empower farmers to scale up for reaching the required target of food production with special reference to Indian scenario.

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There is an urgent need to transform neglected knowledge delivery systems by strengthening the science of delivery which has been neglected by the researchers/development worker/policy makers alike. Availability of new technologies such as information technology (IT), internet of things (IoT), audio and video using cell phones, geographical information system (GIS), simulation modelling, remote sensing (RS) open up new vistas for effective knowledge delivery for achieving the impacts on ground. This will help to cross the *"Death Valley of Impacts"* for achieving the zero hunger goal by adopting innovative approaches/tools and partnerships.

Keywords Empowering stakeholders · Bridging yield-gaps · Science of delivery · ICT-enabled extension · Farmers' empowerment

3.1 Stakeholders, e-Extension (eE) and Empowerment

3.1.1 Stakeholders

A stakeholder is an individual or group with an interest in the success of an organization in fulfilling its mission—delivering intended results and maintaining the viability of its products, services and outcomes over time. The key constituencies in the realm of delivering outcomes suggest what members of each group have at stake. Some "stakes," of course, are held by more than one constituent group in the list of stakeholders (Table 3.1). Stakeholders are identified as any individuals or

Table 3.1 Key agricultural constituent groups and their stake in Project Success

Constituent Groups	Stake
Farmers	Good produce, good return, better social status, children education, social security, crop security, on-time supervision by the experts in case
Researchers	Replication of research results in field, Professional Excellency, Recognition
Extension Workers	Regular Research updating and back-up from researchers, Farmers' success, Help from Government machinery
NGOs	Regular research back up from research Institutions and state agricultural Universities, Constant link with the field workers and the farmers
Government Organisations	Supply of funds, Monitoring, Buying agricultural produce and/or easing quick purchase of produce, transport, basic infrastructural facilities for storage of produce.
Agricultural Universities	Research, Extension Education, Farmers' rallies, Publications in local vernaculars, Use of ICT, TV, other media for extension of research findings
Sponsors	Supply of funds, Monitoring
Business community	Keeping an watch over product, on-field pick up agricultural produce, quick and hassle-free payment to farmers
Taxpayers	Getting a good return on their tax investment
Citizens	Getting a good return on their tax investment, Good consumable products, reasonable at price

groups which can affect organization or project performance or which are affected by the achievement of the organization's or project's objectives as evidenced by a range of categories of stakeholders (Table 3.2). Identifying right stakeholders for scaling-up is a challenging task as several sectors are involved and are interlinked in delivering the desired impact. For example, for a large scaling-up mission program like *Bhoochetana* in Karnataka (Fig. 3.1) or *Rythu kosam* in Andhra Pradesh a consortium was formed amongst the knowledge- generating and -transforming institutions as well as private corporates for inputs supply and market linkages.

Table 3.2 Different types of stakeholders

Stakeholders	Sources
Government, political groups, shareholders, financial community, activist groups, consumers, consumer advocacy groups, unions, employees, trade associations, competitors and suppliers.	Freeman (1984)
Shareholders, customers, voters, general public, financial community, lawmakers, communities, the press, higher education, employees and their families, labour unions, company distributors and other companies including competitors.	Droge et al. (1990)
Customers, community, stockholders, government, employees.	Lerner and Fryxell (1994)
Buyers (intermediate customers: distributors and retailers; and ultimate customers), Suppliers (goods and service suppliers), Lateral stakeholders (competitors, government and non-profit organizations), Internal stakeholders: functional departments, employees and business units.	Morgan and Hunt (1994)
Client, project leader's organization, outsourced services, invisible team members	Briner et al. (1996)
Environmental stakeholders: customers, owners, community; Process stakeholders: employees, suppliers.	Atkinson et al. (1997)
Internal stakeholders (departments, divisions and functional units), External stakeholders (customers, shareholders, distributors, suppliers, employees, local community, the mass media, and the environment), Distal stakeholders (competitors, government agencies, labour unions, auditors, and industry leaders)	Sirgy (2002)
Owners, governments, customers or clients, employees, communities, society, suppliers.	Bao (2004)
Shareholders, customers, employees and other stakeholders including suppliers, and communities.	Fitzroy and Hulbert (2005)
upstream stakeholders (paying customers and end users; N downstream stakeholders—suppliers and subcontractors), external stakeholders (general community and independent concerned parties), invisible stakeholders (delivering project benefit with their vital support for project success), and project stakeholder group (project sponsors and delivery team).	Li (2007) and Walker and Nogeste (2008)
Citizens of India, Individual government employees, Various employee associations, NGOs, Sixth Central Pay Commission, NIC	(GoI 2020)

Revised from Rowlinson and Cheung (2008)

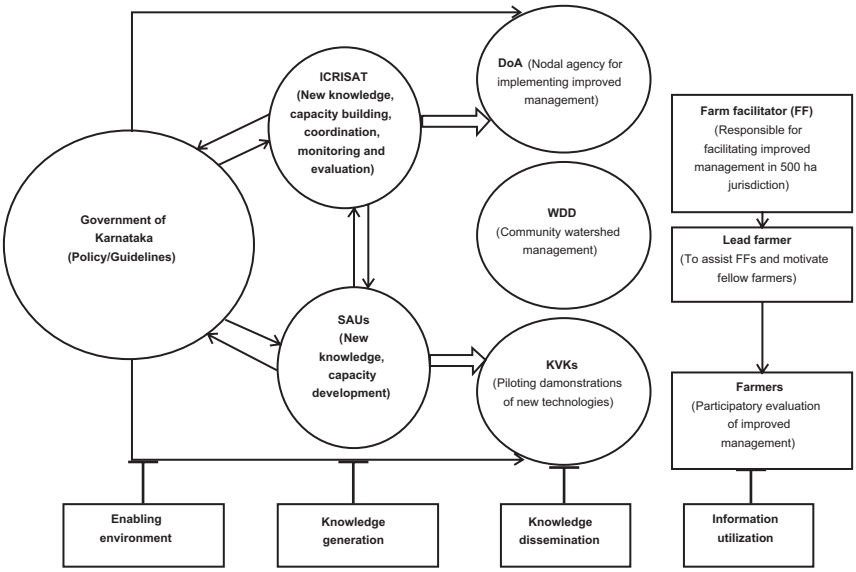

Fig. 3.1 Consortium of partners in the *Bhoochetana* programme in Karnataka. DoA, Department of Agriculture; FF, farm facilitators; KVKs, *Krishi Vigyan Kendras*; SAUs, state agricultural universities; WDD, Watershed Development Department. (Source: Anantha et al. 2016)

3.1.2 e-Extension (eE) and State Agricultural Universities in India

A discussion paper of the International Food Policy Research Institute (IFPRI) opened with a question: are farmers' information needs being met? (Glendenning et al. 2010). In fact, our agricultural extension system has several parallel channels of information to farmers. State Agricultural Universities (SAUs) are one of them. These are important because they are backbone of the agricultural technology development. They are also expected to perform an effective role in extension of these technologies. The question is how do they do it?

The SAUs ideally develop technologies and generate content. They provide extension education service through training of trainers. The scientific and technical staff of SAUs is mandated with extension. But it is just one of the mandates along with research and education which consume more of their time. The SAUs do provide limited extension through Agricultural Technology Information Centres which attract visitors. They also provide wider extension through Krishi Vigyan Kendras (KVKs) which depend on SAUs for technology and on ICAR for actual delivery through various channels (Adhiguru et al. 2009) (Fig. 3.2). All agricultural education and research, ultimately aims at increased productivity and economic well-being of farmers. This is possible only when there is a minimum gap between lab and land. This gap is bridged by agricultural extension. But human capacity, content of the information, processes of delivery and technology determine effectiveness of

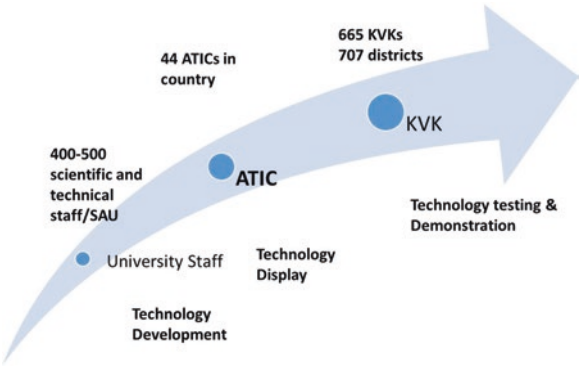

Fig. 3.2 Agricultural Extension in India: Role of SAUs (The dimension of the circle indicates relative contribution to agricultural extension). (Bhattacharyya et al. 2018a)

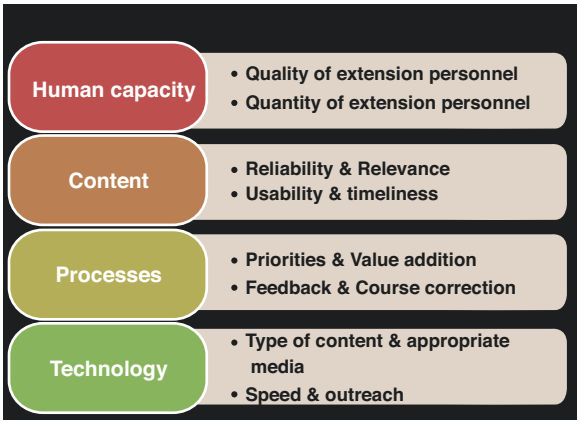

Fig. 3.3 Agricultural Extension in India: Effective extension. Lack of personnel and outdated technology are major constraints. (Bhattacharyya et al. 2018a)

extension services (Glendenning et al. 2010). Some of the parameters of these factors are keeping the effectiveness of agricultural extension perhaps at a low (Fig. 3.3).

Non-availability of sufficient extension personnel is a major constraint. The state agricultural universities (SAUs) do not have adequate extension personnel to reach out to the wider farming community. And as detailed earlier, they are burdened with other duties. On the other hand, the state agriculture department (a line department) catering to the same area as the jurisdiction of a SAU may have a relatively large number of extension personnel. For example, in Konkan region of Maharashtra, the extension workers in the agriculture department are nearly 100 times more than the university extension workers. Moreover, the state department has a wider presence than any SAU. Indeed, even the agriculture departments are under severe staff crunch in most Indian states (Sajesh and Suresh 2016). Another constraint is the limited reach of traditional extension approaches. Only about 40% of our farmers gain access to any kind of extension services either public or private. To overcome these shortcomings, e-Extension (eE) is the alternative as shown in Fig. 3.4 (Anonymous 2016; Ghimire et al. 2014; Anonymous 2009).

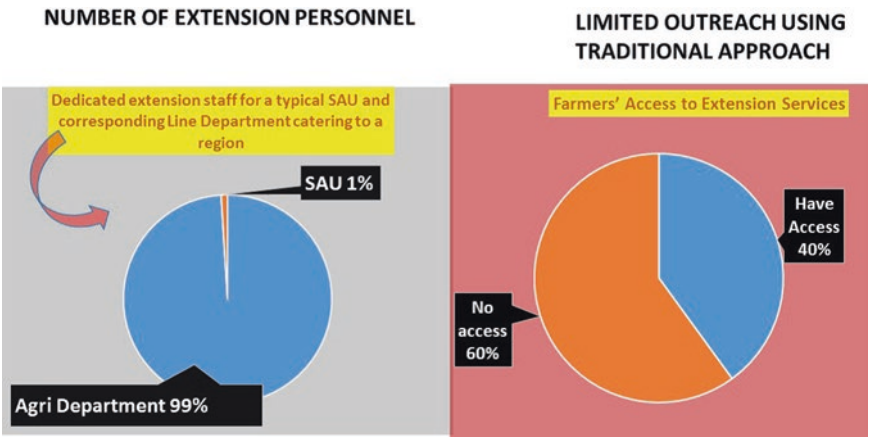

Fig. 3.4 Forces pushing for e- Extension in India. Lack of dedicated extension staff with SAUs and farmers' lack of access to extension services rendered through traditional means have made it imperative to go for e-Extension. The staff data is sourced for Konkan region from DBSKKV, Dapoli and Department of Agriculture, Government of Maharashtra. Data for access to extension services from Anon. 2016. (Bhattacharyya et al. 2018a)

3.1.3 Empowerment

Empowerment means authority or power given to someone to do something or is the process of becoming stronger and more confident, especially in controlling one's life and claiming one's rights. In this context farmers' empowerment means farmers are enabled to do improved farming with increased productivity and profitability in the current context. Empowerment comes through acquiring knowledge about new things but at the same time effective empowerment can be achieved only through convergence as without policy support farmers cannot achieve the goal of income enhancement even if they produce more as market pulls down the prices. Even productivity cannot be increased only through sharing the knowledge with the farmers as without needed availability of quality inputs at right time with right price productivity cannot be increased. Also farmers need to adopt *"fork to farm"* approach based on the market demand rather than *"farm to fork" where* farmers produce what they like and then find market. In brief, empowerment goes far beyond the context of traditional capacity building/development. In this chapter, we discuss the holistic empowerment of the farmers for achieving the goal of zero hunger through achieving food security and also wellbeing through increased family incomes.

In this regard the first step for empowering farmers is acquiring education by the farmers. Education is the process of facilitating learning, or the acquisition of knowledge, skills, values, beliefs or habits. Education methods include teaching, training, storytelling, discussion, directed research and demonstrations particularly participatory demonstrations. Education can take place in formal or informal

settings and in the context of extension for the farmers using new technologies also, the informal settings become important.

Thus, the concept of empowerment is addressed in this paper in order that the process of project management can be put into an appropriate, and contemporary context. Various authors have shown that a stakeholder management approach to governance entails long-term social exchange between parties, mutual trust, interpersonal attachment, commitment to specific partners, altruism and cooperative problem solving (Stoney and Winstanley 2001; Carter 2006). Now onwards, empowerment in this chapter is discussed as holistic empowerment of stakeholders for achieving the desired impact on ground.

3.2 Awareness Creation-Formal and Informal Methods for Skill Building, Knowledge, and Practices Through e-Extension (eE)

Overall reach of extension media has been reported to be 35-40 per cent farm household (Anon. 2016). Major farmers who adopted technology mediated by extension services reported the methodology and other details of innovations useful. The important extension media were progressive farmers, mass media, SAUs and KVKs. However, the pattern of access differed. The mass media was accessed routinely to provide general information. On the contrary, the SAUs and KVKs provide design, crop and even farm- specific advisory. With the use of internet and e-services, progressive farmers, SAUs, KVKs and extension workers can be empowered to reach the maximum number of farmers.

The eE is envisaged to operate mainly through web portals, social media and mobile apps and therefore has several benefits over the traditional extension approaches. The methodologies are portable, cost-effective and can reach to the larger section of people in real time. Most of these technologies are interactive with stakeholders connecting online or offline and permit quick feedback (Saravanan and Bhattacharjee 2015; Saravanan et al. 2015). The major benefit of e-Extension is that it has the capacity to integrate various farms and extension media such as texts, pictures, videos and animations. The eE provides opportunities for improving weak and vulnerable sections of society including women and unemployed youth. There is a scope to foster public-private and farmers-experts partnerships through eE. Resources including finance and insurance can also be mobilized greatly through this technique. The eE stands on four inter-connected bonds *viz* e-learning, e-extension, e-farming and e-trading (Fig. 3.5).

FAO suggested 15 points' strategy to modernize extension systems at lower levels (Table 3.3). Other than many, the point which flags performing extension services with less number of staff appears as the common scenario in most of the SAUs. Outsourcing is an important option. It also insists to make use of information technology tools and media, but with educated human back-stopping which is all

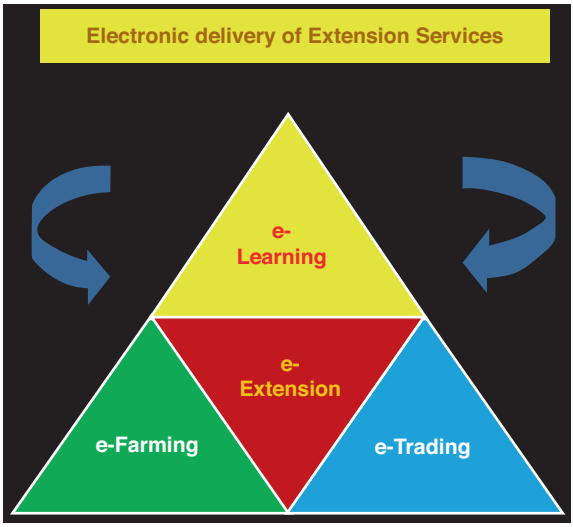

Fig. 3.5 The inter-connected bonds of e-Extension. (Source: Saravanan and Bhattacharjee 2015; Saravanan et al. 2015)

about e-extension. Treating extension finance and extension delivery would be two separate functions (FAO 2005).

The history of information and communication technology (ICT) for extension in agriculture dates back to the use of radio and much before that by just personal communication (Fig. 3.6), as an example in Sweden during 1800s. These channels help mostly in one-way dissemination of topical and general information. Farmers need farm and season-specific information. Attempts to make radio and television more interactive have proved successful. As per the national sample survey office (NSSO) report (Anonymous 2016), these media are routinely accessed by the farmers. But it is the IT revolution, which has really brought mobile and internet in the hands of the farmers (Rajkumar et al. 2016). The potential of IT found to be harnessed by government and different organizations for the best results (Kaegi 2015). Several initiatives have been taken up by the government departments for advancing e-E. The M-Kisan portal provides SMS based advisory as a value-added services. Service apps include *Kisan Suvidha*, *Gujarat Sarkar Khedut Mitra* (Gujarat), *Shetkari Masik* (Government of Maharashtra). Many of these can now be installed on smart phones and the relevant advisory information can be obtained by the farmers (Fig. 3.7). Even the Tata Chemicals supported *Kasturi* initiative which relies on in-person exposure of women agripreneurs travelling countrywide to various SAUs on a special train also relies on continuous digital learning (www.mykasturi.org).

The Indian Council of Agricultural Research (ICAR) has initiated several schemes for enhancing extension of agricultural technology. To increase electronic communication, the ICAR has facilitated development of network of *Krishi Vigyan Kendras* (KVKs) as stakeholders. To involve the farmers more proactively in dissemination of experiments and success stories, ICAR has also initiated farmers' blogs. It has launched mobile apps like Rice Expert which has a support system for

Table 3.3 Methods of e-Extension

Sl. No.	Particulars	Details
1.	Existing extension organization	Assessment
		Farmers' needs
		Strengthening and/or restructuring
2.	Decentralize extension	Capacity-building of the staff and
		Orientation of officials
3.	Technical mandate of extension	Broadening
		Development of rural human resources
4.	National policy	Formulation
		political and financial commitment
5.	Status of extension profession	long overdue
		Consider other agricultural disciplines
6.	Pre-service education in agricultural extension	Modernization
		Development of national extension system
7.	Pluralism	Involve public, private, and civil society institutions
8.	Privatization	Complete privatization
		Social and economic feasiblilty analysis
9.	Information technology (IT)	Development and application of IT tools
		IT Training extension workers
10.	Site-specific extension methodologies	Development of original, location-specific, participatory, gender-sensitive and inexpensive methodologies
		Apply modern techniques
11.	Orientation	Major food security
		Global developments
		Rural livelihoods
12.	Empowering farmers	Organizing legal associations
		Forming strong farmers' lobby
13.	Bottom-up approach	Encouraging grassroots extension
		Involvement of farmers for conservation of natural resources and environment protection
		Demand-driven extension
14.	Poor manpower	Outsourcing
		IT and media
		Merging overlapping staff positions
		Delivery responsibilities
		Contractual short-term staff
		Progressive farmers as facilitators
		Move bulk of extension staff from central level to sub-district level and village level
		Treating extension financing and extension delivery as two separate functions
		Avoiding individual farmer contact: Group extension approach
15.	Operational linkages	Effective organic relation between extension, research and other relevant institutions

Adapted from FAO (2005). Also see Bhattacharyya et al. (2018a)

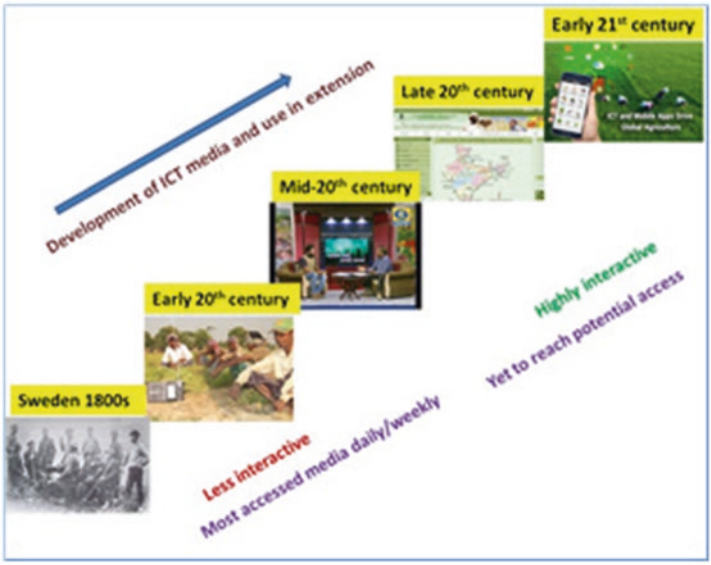

Fig. 3.6 Evolution of e-Extension. (Source: Anonymous 2016)

Fig. 3.7 Selected initiatives of agricultural e-Extension in India. (Source: Various web portals)

Fig. 3.8 Indian and ICAR initiatives of e-Extension. (Source: ICAR website and several brochures)

the farmers through electronic interface (Fig. 3.8). It is in this connection, the collaboration between Indian Farmers' Fertilizer Cooperative (IFFCO), Bharati Airtel and Star Global Resources Ltd. needs to be mentioned. It provides value-added services through the network of Airtel. They involved village co-operative societies as mediators. Information-driven apps are available on web portal and on smart phones. Real-time, predictive, weather and market information are also available. Many Non-Government Organizations (NGOs) have examples in Digital Green. It is a platform which acts as repository of locally produced videos. The NGOs use this information to disseminate knowledge to the farmers using extension channels, their integrated approach has been reported to be effective (Gandhi et al. 2009). Some SAUs have taken up e-Extension in a mission mode. Tamil Nadu Agricultural University is an example. Their content is streamlined and made available on a web portal. Group specific expert concept is also made available through mobile apps. This programme of digital media is one of the important tools to literate and provide information to the farmers about modern agricultural research and technology and to empower them in future days (Soni Kumari 2016). In addition to the government, private agricultural companies are also providing innovative solutions for agricultural extension (Fig. 3.9).

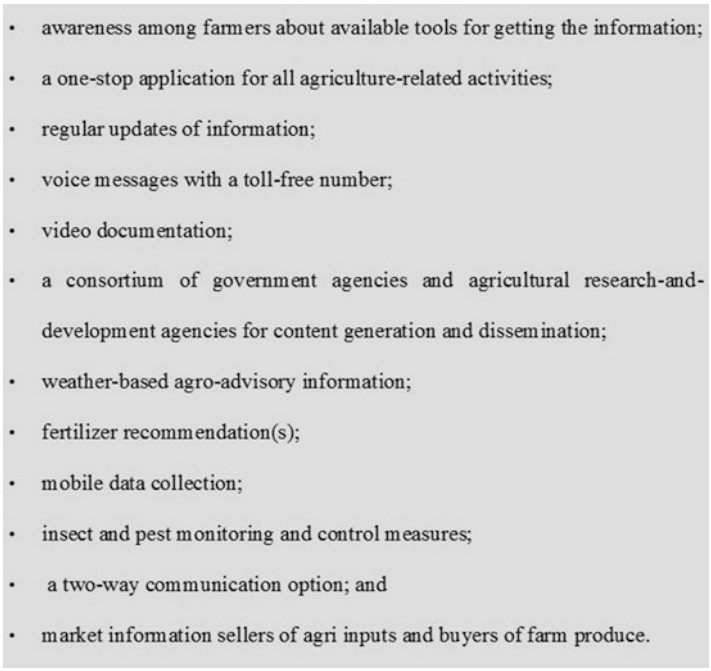

Fig. 3.9 Key constituents of an ICT assisted delivery system/AES. (Source: Patil et al. 2016)

3.3 Other e-Extension Approaches

An innovative agricultural extension system (AES) is necessary to ensure deep penetration of available agricultural technologies into the farming community. Introduction of farm facilitators (FFs) and lead farmers in the AES has provided the local point of information dissemination at the village level. FFs are not agricultural graduates and information acquired by them during training sessions is adequate to address basic issues, such as the use of soil-test-based nutrient management promotion of improved crop cultivars, generic pests and diseases, and other field operations. However, this information may not be sufficient to address real- time issues, such as crop planning based on weather, correcting the nutrient deficiency during the crop growing period and identifying pests and diseases. Thus, there is a need to create a convenient channel for information exchange between FFs and the developmental organizations and the research agencies.

Creative and effective ways of disseminating the information have been explored during the *Bhoochetana* programme to improve the adoption rate among the farming community. For example, information related to soil fertility status has been disseminated among the farmers through writing the information on the walls of schools or houses and through soil health cards. These ways are far more effective

than dissemination through group meetings. Use of media, posters, leaflets, and other written documents in the local vernacular are effective. This system is aimed at strengthening the local extension agent by providing a channel for information dissemination and to monitor the real-time agriculture status on the ground.

Digital technologies have been used in the AES such as television/radio programmes, call centres, satellite programmes and a short message service (SMS) - based advisory system. The cellular telecommunication has good penetration in urban as well as rural areas of India. Thus cellular technology has become a very useful tool for marketing through mobile marketing, the service providers can directly communicate with the consumers; the main objective is to develop close and stronger interactions with the consumer and provide customized services. AESs are already adapting mobile communication technology to change the livelihood of farmers through up scaling farming technologies (Patil et al. 2016).

3.3.1 Digital Technology

The other e-Extension techniques were piloted with Samsung Galaxy Tablet (Tab) 2. However, a tablet with a similar specification including a 17.8 cm (7 inch) touch screen. 3G and Wi-Fi connectivity, a voice-calling facility, a primary and secondary camera with a good resolution, global positioning system (GPS), Bluetooth, expandable memory and 1 GB RAM, is also suitable for a tablet-based extension system. The ruggedness of this tablet will be useful in farmers' fields.

Krishi Gyan Sagar (KGS), a tablet-based extension system, was developed by ICRISAT in collaboration with others (Patil et al. 2016). It is a generic framework for a digital extension system that can be deployed in any part of the world. The KGS is designed to help in sharing knowledge of front laboratory to farmers as well as information collection from farmers to laboratory. The web app is dovetailed in the KGS as the website for visualizing the data gathered by the farm facilitators (FF) using the KGS app (Fig. 3.10).

3.3.2 Adopting ICT Tools for e-Extension: Road to Precision Farming

The e-Extension has the potential to transform traditional farming into precision farming. Most developed countries rely on precision farming for increased productivity and profitability. Precision farming has economic, social and environmental benefits as is the case in Israel. Precision farming requires adoption of advanced technology. In most of the cases, technology is available, but its rate of adoption is slow. The e-Extension can play a crucial role to enhance the adoption rate of technology. In Israel, for example the number of extension personnel is just in 100s. But

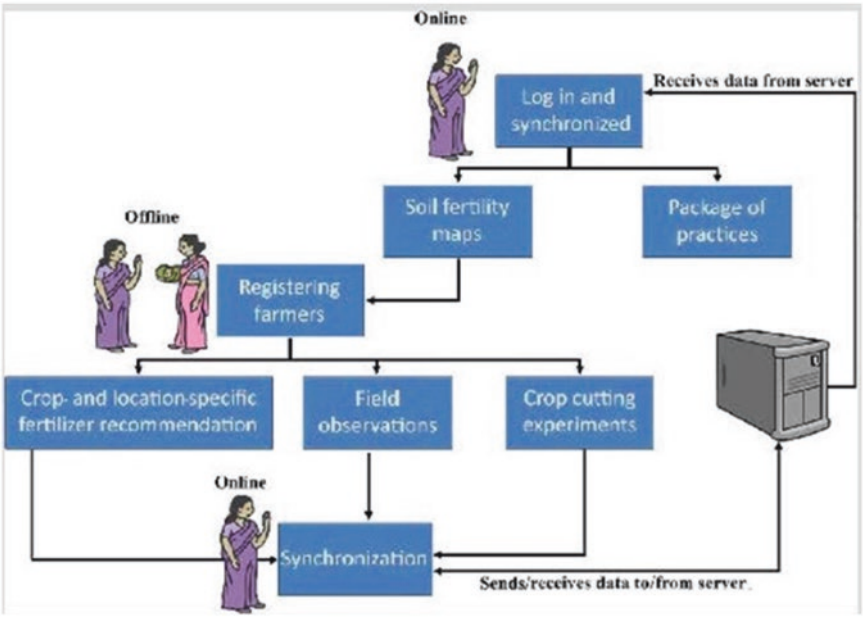

Fig. 3.10 Field Operation of the Krishi Gyan Sagar (KGS). (Patil et al. 2016)

they have ensured very high rate of technology adoption. The e-Devices and softwares ensure data logs from sensors and through feed-back. Management and analysis of these logs lead to improved technology which further enhance access to technology, inputs and advisory to improve the rate of adoption (Fig. 3.11) (Bhattacharyya et al. 2018a).

3.3.3 e-Extension: Opportunity for State Agricultural Universities

The SAUs are poised to take advantage of advanced technology for e-Extension. The limited and over-burdened manpower can be shifted to social media platform for productive interaction with farmers' groups. The newly-evolved Students-READY (Rural Entrepreneurship Awareness Development Yojana) Programme under the Vth Deans' Committee syllabus offers a unique opportunity to involve students as extension intermediaries (Bhattacharyya et al. 2018b). Information and communication technology is also an integral part of agricultural education. A wide range of mobile apps are available for recording data, monitoring crops and environment (Antle et al. 2017). Similarly, smartphone capabilities enable video making and better photography with Geo-tagged information. Social media is already being used to supplement the formal class-room, laboratory or field learning informally.

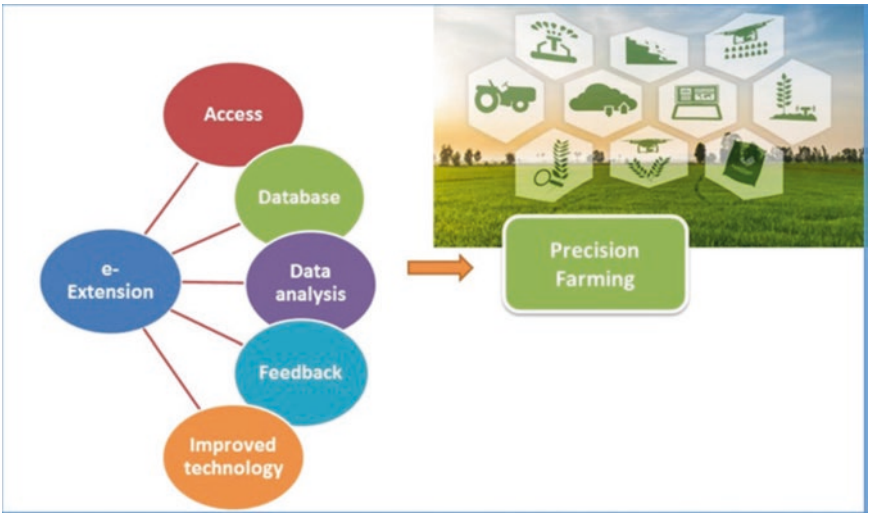

Fig. 3.11 e-Extension: Road to precision farming. (Bhattacharyya et al. 2018a)

SAUs can develop local diagnostic and responsive apps and reach an unprecedented number of farmers through their students. Therefore, SAUs should decide that they need not lag behind in providing extension services due to lack of manpower. Moderated social media can be successfully used for protective farming and at every stage of the value chain. The e-Extension further reduces the time lag between need and application of farming technology. It also helps in cost reduction and waste reduction. It empowers farmers by opting as a part of decision support system. The e-Extension can be harnessed to improve traceability of farm products which is a crucial parameter in the era of food certification. All these benefits together can contribute immensely to doubling farmers' income (DFI) (Bhattacharyya et al. 2018c).

3.3.4 Krishi Vani

ICRISAT in collaboration with IKSL and Bharti Airtel initiated the *Krishi Vani* platform which is a mobile phone/phablet-based application. This initiative has been piloted in 171 villages in Telangana and Karnataka benefiting 40,000 farmers (ICRISAT 2014). Through this application generic advisories are delivered to groups of farmers in a location through the mobile phone enabled by Green SIM. IKSL has pioneered the voice-message-based agro-advisory system. To subscribe to *Krishi Vani*, the user has to buy Green SIM card specially configured for receiving voice messages and other agro-advisory services. Every day, four free voice messages are delivered to the subscribers. The contents of voice messages are advised by subject matter specialists and cover diverse areas such as soil

management, crop management, dairy and animal husbandry management, horticulture and vegetable management, plant protection, market rates, weather forecast information, human and cattle health, employment opportunities and government schemes. The android KGS app is a field tool for information dissemination and data collection, whereas the web app is the website for visualizing the data gathered by the FF using the KGS app (Fig. 3.10). Both android app and web app have a common database server. The web address for this application is www.krishigyansagar.com; however, this application was not accessible to all users. The web app contained all the information available on the android app. The important features of this app were *user registration and report generation tools.*

3.4 Empowerment of Stakeholders

Stakeholder management involves the project team in a process of enabling stakeholders to identify, negotiate and achieve their objectives, such as social, environmental or economic, through active participation in the project process (Brammer and Millington 2004; Pajunen 2006). This involvement inevitably necessitates some degree of empowerment of the stakeholders to facilitate their engagement. Thus, the concept of empowerment is addressed in this paper in order that the process of project management can be put into an appropriate, and contemporary context. Various authors have shown that a stakeholder management approach to governance entails long-term social exchange between parties, mutual trust, interpersonal attachment, commitment to specific partners, altruism and cooperative problem solving (Stoney and Winstanley 2001; Carter 2006).

Relationship management influences empowerment and overall performance to accrue benefits as shown schematically in the model (Fig. 3.12) with special reference to India and Indian farmers. An input- conversion output paradigm is used in terms of several incentives to the Indian farmers by the Governments (Anonymous 2020) which determine the effectiveness of the empowerment through various stimuli for the ultimate benefits of the Society in particular and for the Nation, at large. This scheme might be a model understanding to empower Indian farmers and may be sharpened with new concepts and case studies in days to come.

Initiatives of the Government of India and Indian National Agricultural Research & Education System (INAERS) for empowering Indian farmers include Digital India Programme which is set to transform India into digital empowered society and knowledge economy (Fig. 3.13). This programme of digital media is one of the important tools to literate and provide information to the farmers about modern agricultural research and technology and to empower them in future days (Soni Kumari 2016).

As discussed in Chap. 1 of this book, large yield gaps between current farmers' yields and the achievable potential achievable yield exists for all the crops and across the countries in the developing world. In India, one of the main reasons identified for large yield gaps and low adoption of improved technologies/products is

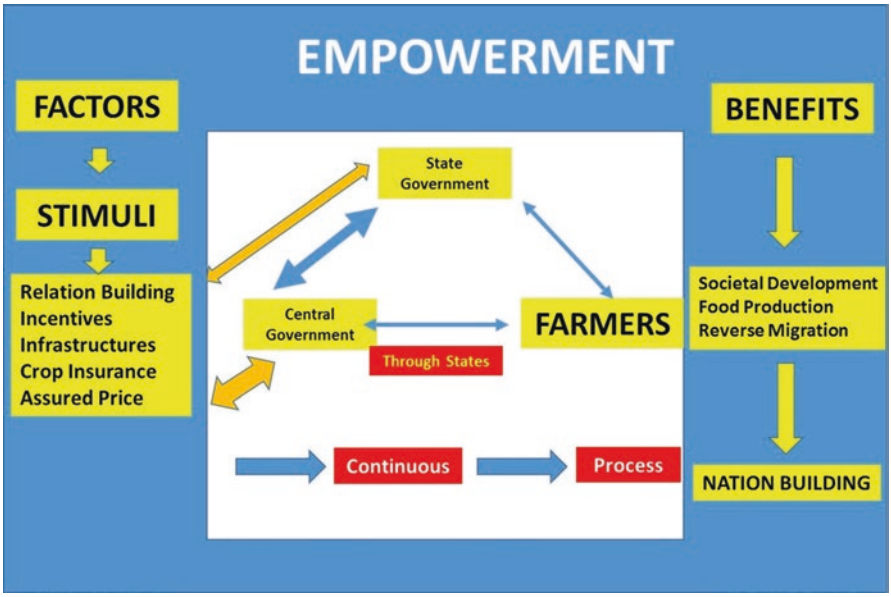

Fig. 3.12 Schematic Diagram showing Empowerment Model for Indian Farmers as a continuous Process. (Conceptualized from Goria et al. 2018)

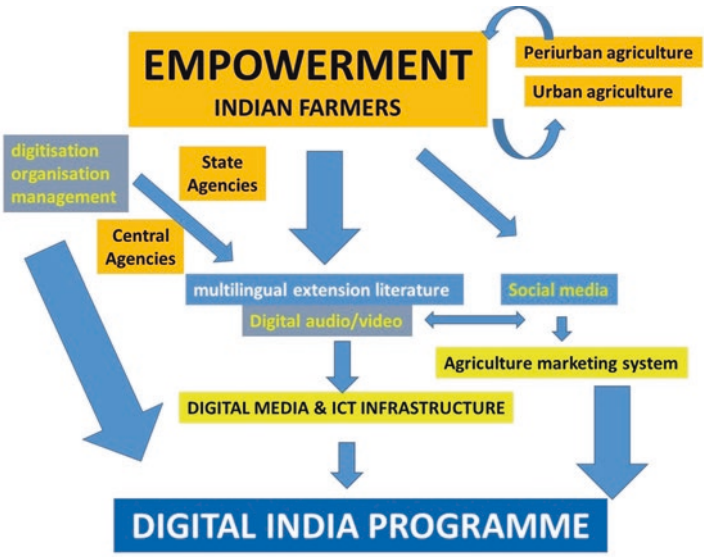

Fig. 3.13 Digital India Programme and Empowerment of Indian Farmers

poor extension support for the farmers. As per the national sample survey data, 51% farmers in India do not get any knowledge support (extension support) and only 11% farmers get support from the government machinery while remaining 30% farmers get support from peers, media and private agencies (NSSO 2013; GoI 2013). The situation cannot be different in other developing countries in Asia, Africa and Latin America. Recent meta-analysis undertaken by the Ceres 2030 team of scientists analysed 100,000 research papers published and recorded that ending hunger is not achieved largely due to wrong priorities of the researchers and not working with the farmers confirming findings of existing *Death Valley* of impacts (Wani 2020, 2021; Wani and Singh 2019; Wani et al. 2002, 2003; Nature Food 2020). The Ceres 2030 researchers found that major constraint for adoption of new approaches/technologies/products was lack of technical advice, input and ideas, collectively known as extension services for the small farm-holders. The small farm-holders are more likely to adopt new approaches specifically, planting climate-resilient crops when they are supported by technical advice, input and ideas (Nature Food 2020). Recent review of current status of trends and the way forward of extension system in India by (Gulati et al. 2018) observed that only 0.54% of gross domestic product from agriculture (GDPA) was spent on total research and extension education with a considerable variation amongst the states. They also noted that eastern states which are also poorest amongst few with high dependency on agriculture and low agricultural productivity are also the states with lowest spending on agricultural R & E indicating a strong linkage between extension and agricultural productivity. The declining rate of extension personnel in the agriculture sector in Karnataka contributed to low level adoption of science-led innovations thereby adversely affecting agricultural growth in the state (Government of Karnataka 2006). Low technology in the agriculture sector has hindered the production of high-value products that generates employment and income (Government of Karnataka 2011).

Based on earlier learning the consortium model was developed with salient constituents highlighting the need for strengthening the science of delivery using new science tools, building partnerships with different stakeholders by forming consortium, undertaking participatory demand driven research. Innovative capacity building approaches such as *"islanding approach"* within the watershed which served as site of learning within the village itself and also to build the confidence of farmers by undertaking research (Wani et al. 2003; Wani and Raju 2018, 2020). Linking successful on-station watersheds and on-farm watersheds for strategic research enabled the farmers as well as researchers to think differently to solve their problems. Other studies found that these farmers' incomes increase when they belong to cooperatives, self-help groups (SHGs) and other organizations that can connect them to markets, shared transport or shared spaces where produce can be stored (Bizikova et al. 2020) through learning from peer group members.

Using this framework focus of empowerment/capacity building varies with the goal of the development initiative. For example, in scaling-up initiative such as *Bhoochetana* the focus was on developing capacity at the bottom two levels of the framework (i) the organization, and (ii) the individual/farmer. Due consideration was, however, given to targeted initiatives (in a range of areas) at the other two levels (i.e. environmental and sectoral levels).

3.4.1 Model Case Studies

Empowerment is a concept linked to power. Information and Communication Technologies (ICT) have been found to bring many positive benefits and have helped farmers in many countries. Various model case studies are in place to empower the farmers viz. e-*Choupal* project in India that delivers farming information to farmers' mobile phones (Radhakrishna 2011), business project in Indonesian villages that brings farmers' mobiles in the social network (Vaswani 2012), and interactive community-based information network (Rural and Agricultural Development Communication Network; RADCON) in Egypt to link and support rural farmers (UNICEF 2011; Ginige and Richards 2012).

An Australian model involving mobile-based information system for empowering farmers was reported (Ginige and Richards 2012) (Fig. 3.14). The model details the goals, processes and activities of empowerment with its ultimate outcome for farmers. It helps to identify possible goals of the farmers and their families to have (i) a secure job, (ii) financial security, (iii) access to information for decision making, iv) perceive alternative solutions, (v) developed modern and sustainable agricultural skills, (vi) access education for themselves and their near and dear ones, (vii) feel safe as any other citizen of any Nation,, and (viii) create disaster recovery plan (Ginige and Richards 2012).

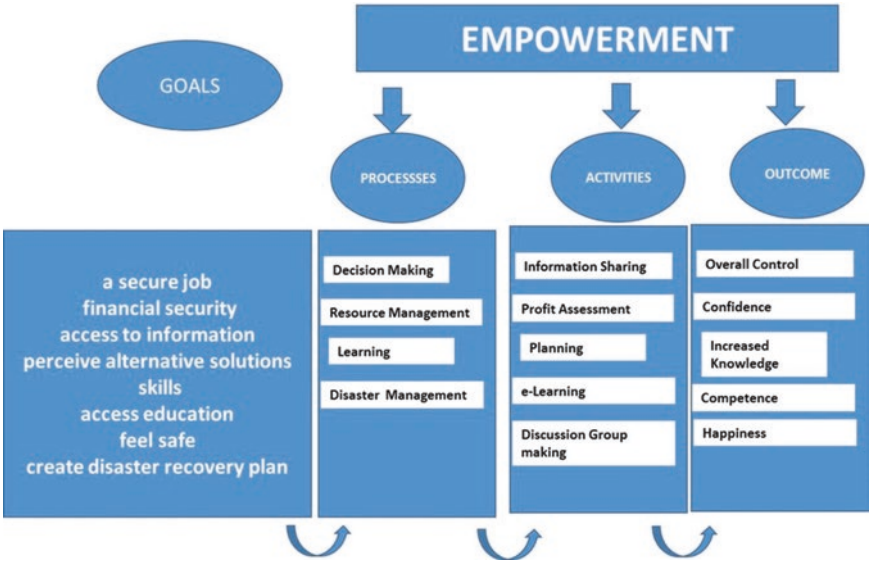

Fig. 3.14 An Australian model involving mobile based information system for empowering farmers. (Adapted from Ginige and Richards 2012)

3.4.1.1 *Bhoochetana* in Karnataka

This case study is based on the reports and publications based on the results recorded in *Bhoochetana* initiative during 2009-2016 (Wani et al. 2012, 2013; Patil et al. 2016; ICRISAT 2018). ICRISAT along with the Government of Karnataka implemented a unique scaling-up *Bhoochetana* mission program through institutional reforms for the *Bhoochetana* programme, which was operationalized through a structure composed of state- and grass-root-level institutions (Raju et al. 2013). At state level *Bhoochetana* cell for transparent monitoring and to facilitate input delivery and the educated practicing farmers as farm facilitators (FFs) (para-extension workers) from the farming community, formed the village-level institutional mechanism for scaling-up the *Bhoochetana* model. The innovativeness of *Bhoochetana* includes convergence of central and state-supported programmes/schemes to increase financial efficiency. The innovativeness of this project includes identification of soil nutrient deficiency status and taluk-wise (block level) (Wani 2008) nutrient recommendations based on nutrient status supported by making available the necessary inputs at 50% subsidy. For timely and readily available inputs, these were delivered in advance to each cluster of villages as well as to the *Raithu Samparka Kendras* (RSKs) at every *hobli*. These inputs (seeds, seed treatment chemicals, gypsum, micronutrients and biofertilizers) were supplied as a package.

Bhoochetana in Karnataka was unique scaling-up initiative technically supported by ICRISAT which was:

- Demand driven by the GoK as well as by the farmers and impact oriented.
- Science-based innovative strategy ensuring tangible economic benefits for small and marginal farm-holders (inclusivity).
- Convergence of state and central government schemes in the DoA and associated departments like Watershed Development Department (WDD) to benefit farmers.
- Integrated and holistic consortium approach to provide integrated solutions including ensuring availability of needed inputs at village level.
- Built partnerships between knowledge-generating institutions and knowledge delivery institutions in the state.
- Transformed AES using IT tools and honorary Farm Facilitators.
- Empowered stakeholders through suitable CB and training workshops.
- Soil health assessment (Wani 2008) was used as knowledge-based entry point activity (EPA) to build rapport with the farmers. Mapped soil nutrient deficiencies in all the 30 districts which was the starting point for scaling-up the soil analysis-based integrated nutrient management practices for sustainable growth in dryland areas of Karnataka.
- Farmers had to pay 50% cost for inputs upfront and register to participate in the program.
- Collective action through *Rythu samaparka kendras (*RSKs) and FFs.
- Participatory approach for DoA staff to fix targets for each season at district-*taluk* and *hobli* level and proper funding through convergence and budgetary provisions.

- Sound strategy development based on the constraints identified and needs assessment.
- Enabling policies and institutions by identifying and empowering policy makers.
- Result-based, open and transparent monitoring and evaluation system from the beginning.
- Creation of *Bhoochetana* cell at DoA headquarter to deal with implementation, planning, and monitoring the activities.
- Adopted improved best-bet management practices (BBMPs) on large scale and shared knowledge through trained FFs and lead farmers.
- Crop cutting experiments were conducted in partnership with staff of Department of Statistics & Economics, DoA staff, farmers, SAU staff to ensure that benefits observed are recorded transparently and results are integrated in annual economic survey for calculating gross domestic product (GDP) for the state.

3.4.1.2 Impact of *Bhoochetana* in Karnataka

An innovative holistic and integrated mission approach adopted in *Bhoochetana* in Karnataka benefitted the farmers through increased crop productivity and profits as well as the state government through increased GDP for the state through increased agricultural growth rate year on year since 2009 which was stagnant around 1% since 2001–2008. In addition to financial benefits for the farmers and the state government social and environmental benefits were also recorded due to *Bhoochetana* implementation in the state.

At the state level, the improved crop yield contributed to enhanced net income and additional value of the product. Net profits have been arrived at by subtracting the cost of micronutrients. At the state level, by the end of the seventh year since inception of the project in 2009, the net profit accrued from the programme was about Rs. 24497million Indian rupees equivalent to US $ 497 million from all the 30 districts (Table 3.4). The result of crop cutting experiments revealed that the state has potential in bridging the large yield gap by adopting holistic science-led crop management interventions with farmers' participation.

The project started with six districts in the state during first year covering 0.2 million ha and during second year additional 10 districts were included in the project. From third year onward, all 30 districts were covered. During seven years 7.4 million ha area was covered benefitting more than 4.75 million farmers with increased productivity by 20–66% over their traditional practice.

Table 3.4 Economic benefits accrued from *Bhoochetana* project during 2009–2015

Year	2009	2010	2011	2012	2013	2014	2015	Total
Net income (Rs. in Million)	114.9	2048.1	5994.5	4518	6951.5	487	1464.8	24,497
Net income (Million US$)[a]	2.52	45.72	112.48	82.44	110.35	77.3	22.53	453.34

[a]US $ conversions are done using the prevalent exchange rate during the time. Net income was calculated based on the minimum support price (MSP) provided by the government and cost of cultivation based on the inputs used in improved management

Benefits varied with crops and seasons as the rainfall differed from year to year as well as amongst the districts. In *Bhoochetana*, the overall benefit: cost (B:C) ratio (which was calculated by taking into account additional cost and additional income) of the cropping system in Karnataka was above 5:1. This suggests that the integrated approach, including soil-test-based fertilizer application, improved varieties of seed and integrated pest management measures, has the potential of producing a higher B:C ratio as compared with any single management approach (Anantha et al. 2016). Improved management practice in *Bhoochetana* enhanced the net income by ₹8000–10,000/ha under maize and nearly ₹3000–5000/ha under millet and sorghum production. Among pulses, pigeon pea was more remunerative as net income obtained from this crop varied from ₹20,000–25,000/ha at moderate rainfall of 800 mm. Improved management practice enhanced the net income further to ₹8000–10,000/ha. On the other hand, groundnut was very sensitive with application of micro and secondary nutrients. Net income for groundnut cultivation increased by ₹5000–15,000/ha with improved practices (IP) as compared with farmers' practices (FP) (Garg et al. 2016).

As planned annual growth rate in agriculture sector was >5 percent during the project period, every $ invested returned $ 3 to 14 to the farmers. Field observations and agronomic records also showed that crops were found to be more tolerant to various pests and diseases and yielded more compared with farmers' management practices. The beneficial impact of the *Bhoochetana* programme is observed in not only wet and normal years but also in dry years. The programme has proven that improved management systems were vital in building the resilience of the farming systems in spite of normal or below normal rainfall in the state. Increased crop yields and net income by about 30% has contributed to the household budget in rural areas as the benefit:cost (B:C) ratio ranges from 2 to 20 for different cropping systems and regions (Garg et al. 2016).

Bhoochetana became people's program rather than the government program in spite of changes of the government three times during the project. It happened due to public demand, ownership from the grass root level, and institutionalization of the program in the overall agricultural system of the state.

Apart from yield and economic benefits, social benefits of the programme were recorded as the yield and economic benefits have immensely contributed to improving the social status of the participating farmers. A stratified sampled household survey in eight districts representing four revenue divisions of the state revealed simple social benefit measures such as increased investment on assets formation, gender equity and enhanced knowledge (Anantha et al. 2016). About 40% of farm households reinvested the additional income obtained from *Bhoochetana* on agriculture and agriculture-related infrastructure. A proportion (13%) of households also invested in white goods (luxury goods). It is important to note that about 10% of the households have invested income obtained from Bhoochetana on loan repayment, house infrastructure and education.

Bhoochetana, a knowledge driven holistic process-based mission project, was intended to increase crop productivity and also enhanced stakeholders' knowledge regarding agricultural operations. The periodic training or capacity building programmes empowered the farmers as the knowledge dissemination process initiated by ICRISAT through master trainers from the University of Agricultural Sciences (UAS) and the Department of Agriculture (DoA), Karnataka had a most positive impact on farmers, as more than 50% of the households acknowledged improved knowledge on major aspects of agricultural development in the state. Secondly, the knowledge about soil health status, micronutrient application and seed varieties, which are critical components of agricultural development, improved significantly. More than 85% of rural households reported that their knowledge enhanced on these critical components. Besides, nearly 80% of households learnt new methods to control pests and diseases to enhance their crop yield in rain-fed agriculture (Anantha et al. 2016). More than 70% of farmers made collective decisions regarding harvesting, threshing, seed selection and storage.

3.5 Key Challenges (Limitations of Technology, Suitability, Adoption and Approvals from Agencies and Government)

The use of e-Extension technology in AES is changing as per the requirements. Changes in dissemination pathways were driven by innovation in technology and its adaptation. The major constraints faced during implementation of the digital extension system are as follows:

- information communication tools are themselves dependent on other technologies: for example, lack of appropriate infrastructural facilities, and internet speed,
- connectivity in remote villages restricts users' ability to update the android application,
- tablet and other AES tools may be relatively expensive and is not designed to be weather resistant.

3.6 Lessons Learnt and a Way Forward

Agriculture is the mainstay of Indian nation. Farming is a difficult profession and is becoming more so in the face of sever climate and socio-economic challenges. It is in this juncture farmers need to be motivated to till their lands for their own prosperity and the survival of all.

The state agricultural universities (SAUs) are mandated to impart agricultural education, to conduct research, to disseminate latest happenings in agriculture and allied field activities to the farming communities in the rural area and also to their children through education imparted by various schools, diploma colleges, and agricultural colleges at different levels (under-graduate, post-graduate, doctoral and post-doctoral). In other words, education in SAUs is closely interlinked with research and extension education. And logically these three components cannot be separated. Humanity plays a great role in raising the standard of agriculture. Individual motivation as a leader is above all funds and facilities. This motivation may come from a team of bright scientists, professors and extension experts and with the support of the farming community to do more (Bhattacharyya et al. 2018b).

Modern-day farming is heavily dependent on technologies which are born through research which are transferred to farmers through extension education and to the Gennext through agricultural education. The state agricultural universities (SAUs) should, therefore, be the hub of all such activities and should continuously be fed through other institutions related to agriculture (Fig. 3.15). Agriculture is an important ball game and should be handled with professionals only. The suggestive model might help the planners and administrators for way forward.

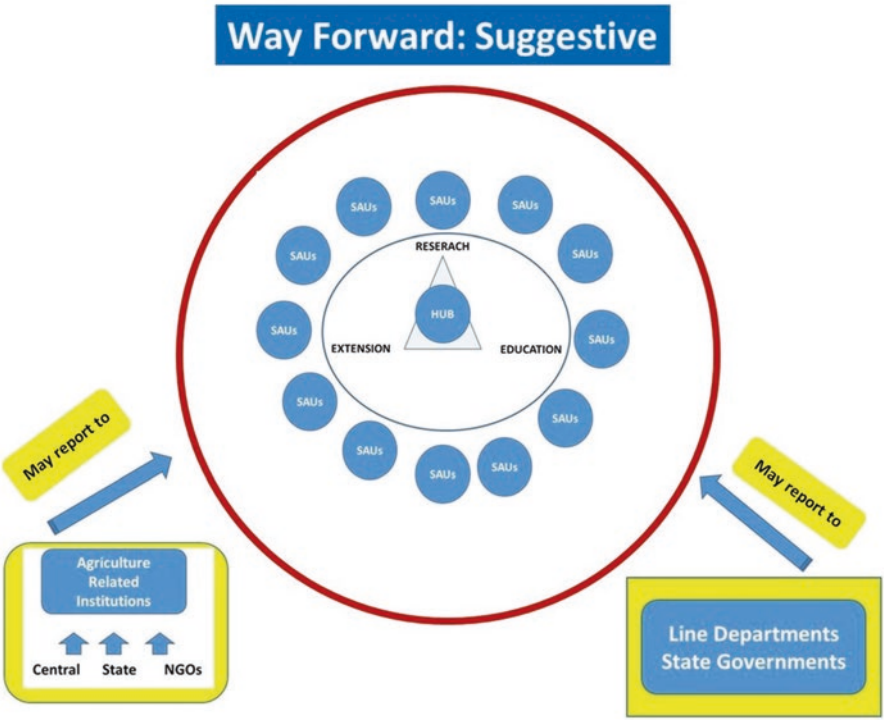

Fig. 3.15 Suggestive Plan to strengthen State Agricultural Universities (SAUS) for empowering farmers in India: Way Forward

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