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AGRICULTURAL EXTENSION SYSTEM: WHAT WORKS AND WHAT DOES NOT? IMPLICATIONS FOR TAMIL NADU

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In today's world extension must improve the capacity of farmers on entrepreneurship through the lens of the Agricultural Innovation System at the farm level. Extension advisory systems have changed worldwide. It has evolved from the introduction of the T&V system to the adoption of ICT and enterprise-led extension and will evolve continually. In developing countries, agriculture can serve as an engine for economic growth. However, the productivity of these countries is far lesser than that of developed countries (Aker, 2001). Therefore, to reverse this yield gap, adopting a range of improved technologies and practices is often critical (Kumar *et al*., 2020). The extension advisory services can help bridge these knowledge gaps of farmers and the adoption of new technologies (Ferroni and Zhou, 2012). Various extension approaches and advisory services are followed in developing countries. Especially, the importance of the extension advisory systems (including relations between different actors in the extension systems) in improving the productivity, production and income of the farmers was strongly felt as these are the indicators of rural development.

In Tunisia, Farmer training, demonstration, and farmer-to-farmer interactions were perceived as the most effective agricultural extension methods (Dhehibi *et al*., 2020). In Sub-Saharan African extension systems, field visits facilitate the learning process in technology adoption. However, the heterogeneity and diversified farm households with varying needs still pose a series of challenges to the adoption of improved technologies. Field evidence shows that wealthier farm households are more likely to adopt the latest technology than resource-poor farmers (Abay *et al*., 2016). The lack of communication between producers with one another and with others in the market chain results in poor returns (Rivera, 2011). Also, the absence of guaranteed markets for smallholder farmers in many emerging economies poses multiple marketing challenges. And, for the majority of these farmers, middlemen still determine the price of produce (Yankson *et al*., 2016). In developing countries, market-oriented advisory services largely depend on the formation and capacities of farmer groups. These farmers' collectives are resolving most of the farm and marketing challenges. Norton and Alwang (2020) argue that farmer groups and virtual networks play an important role in technology diffusion. Moreover, Information and communication technology (ICT) based extension programmes can facilitate the adoption of technologies (Aker, 2011). Hence, the extension systems can greatly benefit from the use of ICTs (Steinke *et a*l., 2020). It is also believed that ICT-based extension systems are the key to improving the agrarian situation and farmers' lives by increasing their access to information and sharing knowledge (Saravanan, 2012). There is an ever increasing need for an extension system to respond to the varying needs of the farmers from time to time. The delivery of information without providing farmers with an informed dialogue by a trained extension agent is often ineffective (USAID, 2015). Extension advisory systems require human resources that are competent both technically as well as in-process skills (Ghimire, 2016). As agriculture is increasingly moving away from mere production of crops to innovations and enterprise diversification both within and outside farms, extension systems require a new generation of highly competent extension personnel to help farmers become innovators in the agricultural sector, rather than recipients of the technology generated elsewhere.

In India, Line departments, State Agricultural Management and Extension Training Institutes (SAMETIs), Agricultural Technology Management Agency (ATMA), Krishi Vigyan Kendras (KVKs), State Agricultural Universities (SAUs), Farmers Training Centres (FTCs) etc., are the major public extension systems. Further, to strengthen the public extension system, the National Mission on Agriculture Extension and Technology (NMAET) was launched by the Department of Agriculture and Farmers' Welfare (DACF) in 2014-15 to make the system farmer-driven and accountable by restructuring and strengthening existing agriculture extension programmes. This will enable the delivery of technology and improve the current agronomic practices of farmers. Also, the ICT interventions such as Farmer portal (https://farmer.gov.in/), mKisan, Kisan Suvidha, Pusa Krishi, Agricultural Market, Bhuvan Hailstorm, Kisan Call Centre (KCC),

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Kisan TV Channel, Community Radio Station, etc., play a significant role in public extension system (Gulati *et al*., 2018).

Apart from the public extension, the agriculture extension services by the private sector are improving the farm sector A few examples are Hyderabad-based Nuziveedu Seeds through 'Subeej Krishi Vignan' provides extension services. Fertiliser companies, such as IFFCO (Indian Farmers Fertiliser Co-operative Limited) and KRIBHCO (Krishak Bharati Cooperative), etc., are conducting farmer meetings, organizing crop seminars, making arrangements for soil testing facilities, adopting villages etc. Tata Chemicals initiated Tata Kisan Kendras intending to empower and enable farmers in the adoption of improved agronomic practices to enhance crop yield. Syngenta organises training programmes on crop protection and the use of pesticides etc. Similarly, Nestle provides veterinary extension services on dairy and cattle health (Gulati *et al.*, 2018). Further, the advisory services of Agri-Clinic & Agri-Business Centres (AC&ABC) and Diploma in Agricultural Extension Services for Input Dealers (DAESI) are reshaping the private extension in India. The extension services of DAESI trained input dealers can be categorised into three major headings namely field extension, market-led extension and virtual extension (Babu *et al.*, 2012 and Vincent and Balasubramani., 2020).

NGOs, financial and non-financial sectors have gradually been adopting new extension methods, education tools, delivery models, innovative extension structures etc. to overcome the ever increasing challenges related to agriculture and to meet the changing needs of the farming community. NGOs, such as Professional Assistance for Development Action (PRADAN), BAIF Development Research Foundation and Action for Food Production (AFPRO) are actively involved in promoting extension activities in more than one state (Gulati *et al.*, 2018). Therefore, to understand the extension approaches of public, private and NGOs, a case study was undertaken in Tamil Nadu. The major objectives of the study were to understand the present extension advisory systems of Tamil Nadu in India; know the different extension approaches followed by the public, private and NGOs for meeting the information needs of farmers and to find out the challenges faced by extension service providers.

Tamil Nadu, one of the federal states in India was selected purposively to understand the extension systems and assess the extension approaches adopted by the extension stakeholders to meet the information needs of farmers. For this, seven districts were selected from the seven agro-climatic zones as representative districts, one from each agro-climatic zone.

The selected districts are as follows

(i) *Villupuram* from North Eastern Zone

(ii) *Salem* from North Western Zone

(iii) *Coimbatore* from Western Zone

(iv) *Thiruvarur* from Cauvery Delta Zone

(v) *Tirunelveli* from Southern Zone

(vi) *Kanyakumari* from High Rainfall Zone and

(vii) *Nilgiri* from Hilly Zone.

The districts were selected based on four criteria viz*.,* (i) Total gross cropped area (ii) Total net irrigated area (iii) Total food crop area and (iv) Cropping intensity) + or - one criterion. The district was selected when it fulfilled at least two or three of the four selected criteria for a given agro-climatic zone for the study.

The study has followed the ex post facto. The stakeholders selected for the study were the (i) Department of Agriculture, (ii) Department of Horticulture and Plantation Crops, (iii) Department of Animal Husbandry, (iv) Department of Sericulture, (v) Department of Agricultural Marketing and Agri-Business as well as supportive extension systems namely Agricultural Technology Management Agency (ATMA), Krishi Vigyan Kendra (KVK), Tamil Nadu Agricultural University (TNAU), Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), Non-Governmental Organisations (NGOs), Farmers Producer Organisations (FPOs) and progressive farmers.

The secondary data were collected by reviewing the existing studies, annual reports, policy notes, leaflets, folders and brochures of the line departments, KVKs, NGOs and FPOs. The primary data from the aforementioned extension stakeholders were collected majorly through in-person and informant interviews from each selected district. The respondents for the study were selected purposively. Around 80 respondents i.e. five scientists from Tamil Nadu Agricultural University (TNAU), four scientists from Tamil Nadu Veterinary and Animal Sciences University (TANUVAS), 14 extension personnel (seven Programme Coordinator and seven SMS (Extension) from seven KVKs, 42 extension professionals from line departments including ATMA i.e. seven Joint Directors of Agriculture, seven Joint Directors of Horticulture, 14 Agricultural Officers (AOs) and 14 Horticulture Officers (HOs), ten officials from Farmer Producers Organisations (FPOs) and five officials from NGOs were selected. An in-person interview and 27 stakeholder meetings were organised i.e. one stakeholder meeting with TNAU, one with TANUVAS, seven with seven KVKs, seven with the department of agriculture/ATMA, seven with the department of horticulture, one with FPO and three with three NGOs. Also, key informant interviews were

conducted among the select farmers to assess the effectiveness of extension services in meeting their information and knowledge needs.

Indicators/parameters used for assessing the agro extension advisory

The study has assessed the present programmes and schemes that existed for extension services along with emerging extension models for individual, group and cyber extension services in catering to the growing information needs of farmers. Further, the study analysed the specific extension approach followed by TNAU, TANUVAS, line departments, KVKs, FPOs and NGOs.

Knowledge-intensive technologies and adoption challenges

A number of technologies and practices are promoted by public and private extension service providers in the state of Tamil Nadu. The major technologies are System of Rice Intensification (SRI), Direct sowing and Machine planting (paddy), Intensifying crop diversification through millets, System of Pulses Intensification, Integrated Farming System (IFS), Integrated Nutrient Management (INM), Integrated Pest Management (IPM) practices, micro irrigation, etc., (GoTN, 2020).

The present study results reveal that the extension systems such as line departments and KVKs are facilitating the adoption of improved varieties. By and large, paddy receives major focus from extension service providers as it is cultivated in 18.04 lakh hectares (50% of the total gross area irrigated). ADT 36, ADT 43, ADT 47, ADT 49, ADT 50, CO 45, CO 51, ASD 16 etc., are a few improved paddy varieties. Of all paddy varieties, the area share of CO 51 was 26 % of the total paddy cultivated area in Kar season (May-June), followed by ASD 16 (17%) and ADT 43 (16%) and the remaining by other paddy varieties in Kar season. In Samba season (August to October), BPT 5204 cultivation shares 25% of the total paddy cultivated area. (GoTN, 2020). Following paddy, millets receive increasing attention from extension advisory service providers. During 2018-19, 9.24 lakh ha of area was under millet cultivation. Concerted efforts are taken by both public and private extension systems to increase the millet area and production keeping in view their importance in the changing diet of consumers. K 12 and CO 30 & 32 (Sorghum); Tenai ATL 1 was introduced recently by TNAU. Pulses are the third largest food crop promoted in the state as it is cultivated in about 8.46 lakh ha of the area. LRG 41 (Red gram); VBN 5, VBN 6, VBN 7, VBN 9 and VBN 10, VBN 11; MDU 1; (Black gram); VBN 4 (Green gram); VRI (GN)., 6 are a few pulses varieties promoted at scale. The promotion of oilseeds also finds a major place in the extension systems of Tamil Nadu. Around 4 lakh ha of the area is under oil seeds. Groundnut, gingelly, sunflower & castor dominate the oilseed crops. The state has the highest oil seed productivity in the country with 2,729 Kg/ha, while the national average pegs at 1284 Kg/ha (GoTN, 2020). Further, the crops such as coconut (4.40 lakh ha), sugarcane (2.14 lakh ha), cotton (1.60 lakh ha) etc., share a major area in the state.

However, the extension services were inadequate in influencing the adoption behaviour of farmers towards these new varieties because these varieties do not meet the needs of farmers. Even today, the seed replacement rate of most pulses and oil seeds is less. For example, the seed replacement rate of groundnut was only 6.07% and redgram was just 6% (TANU, n.d.). Further, the emerging technologies such as GPS, remote sensing and variable rate application schedules recommended by the TNAU have shown a differential adoption rate, not all farmers have the capacity, investment and knowledge to adopt the high-end technologies. Also, a few farmers have adopted them partially (Gopu and Ravikumar, 2016). In 2010, the Tamil Nadu state government with the funding support (US $500 million) of the World Bank implemented Tamil Nadu Irrigated Agriculture Modernization and Water-bodies Restoration and Management (TN–IAMWARM) Project. One of the focus areas of the project is to promote SRI methods and water-saving technologies such as drip fertigation. As a result, the System of Rice Intensification (SRI) is adopted in 10.78 lakh ha during 2019-20 in the state. However, there prevails an unfavourable attitude among farmers in adopting SRI as it is laborious, demands most care while transplanting, skilled labour, use of weeders and inadequate extension services (Krishnan, 2008 and Devi and Ponnarasi, 2009). This may lead to the discontinuance of the adoption of SRI.

Also, the lack of knowledge among traders about the new technologies leads to an unfavourable situation for the adoption of new technologies by farmers. Consumers also lack awareness of the relative advantage of new varieties. For example, consumers in Tamil Nadu still prefer the rice variety – BPT 5204 over other new rice varieties due to its cookability. The study shows that the adoption rate of the improved varieties is less in Tamil Nadu. Many studies also reveal that inadequate extension advisory services and manpower at the field level affect the adoption rate. Also, there is a lack of location specific technologies. NILERD (2015) shows that farmers' preference for CO 45 (slander type rice) and CR 1009 (long duration variety) were lower as they need thick type rice as opposed to CO 45 and short duration variety in place of CR 1009. The state extension systems were still following the top down

extension approaches with little importance given to the location specific technology. Most extension services were embedded in schemes and programmes, thereby, not taking into account the local innovation systems (Focus Group Discussion, 2018).

Market-oriented extension advisory services with collective approaches

The findings of the study are also identical to the previous research outcomes. There is sufficient evidence that the extension service providers (both public and private) are involved in promoting farmers' collective as small and marginal farmers account for 93% of the total farming community. To improve their livelihoods, the state government introduced "*Collective Farming*" scheme during 2017-18. Until 2021 30,000 Farmers Interest Groups (FIGs) and 6,000 Farmers Producer Groups (FPGs) formed benefitting 6 lakh small and marginal farmers (GoTN, 2020). The state has about 500 Farmers Producer Groups (FPOs) (10% of the total FPOs in the country), exclusively promoted by the public extension systems (GoTN, 2019). The NGOs and other private firms have also promoted farmers and commodity interest groups in their project zones. Apart from fostering collectivism among farmers for production and marketing to get an assured price for their produce, these groups were found to play a critical role in innovations.

Role of FPOs

The results indicate that farmers groups like the *Velliangiri Farmer Producer Company Ltd (VFPCL)* at Coimbatore play a vital role in improving the knowledge and skills of farmers through knowledge dissemination. This includes organising frequent training on improved crop production technologies (e.g. *Organic farming, Azolla cultivation, Zeba water-absorbent technique*), mobile-based market-related advice (e.g. *WhatsApp groups* for sharing the price of coconut, vegetables, etc.), development of model farmers on the latest technology by fostering the capacity of a selected farmer through continuous mentoring, technical hand holding and platform of cross-learning facilitation. VFPCL is highly successful in terms of providing continuous market access to the member farmers and influencing farmers' decision process in favour of modern agriculture through regular extension advisory services. Hence, for the FPO system to work for farmers sustainably, FPO needs to focus on agro advisories in addition to collective marketing.

Major focus areas of FPOs

From the findings, it can be ascertained that most of the FPOs focus on the collective marketing of farm produce. However, they are also involved in promoting value addition, food processing, supplying inputs at affordable prices, supply of quality planting materials, promoting organic inputs, organising training, capacity development programmes etc., on the latest agricultural technologies as well as developing model farmers, organising field visits to progressive farmers fields, etc (Fi-1). The FPO model suggests that farmer collectives are certainly a workable market-oriented advisory system. Yet, not all collective actions have succeeded, majorly because of a larger number of small-scale farmers in the state (around 93%) with lower incomes. The state average landholding of small-scale farmers is just 0.41 hectares (GoTN, 2019).

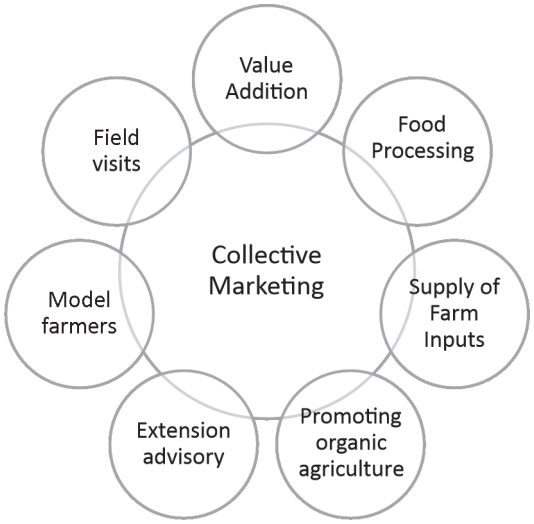

Fig. 1. Major focus areas of FPOs in Tamil Nadu

Cyber extension

The study results illustrate that the public extension system introduced several cyber extension models. e.g. Android mobile-based expert Apps, Agritech portal, Agriculture Management and Information System (AGRI-MIS), which helps the line departments to identify the knowledge/capacity gap of each farmer and to develop extension strategies such as training, capacity building programmes, agripreneurship, etc. Many private organisations have introduced cyber extension models. Indiagriline (EID Parry), mKRISHI (TCS), Onefarm (Ekgaon technologies), Farm Field (SAAL), Reuters Market Light (Thomson Reuters), mASK etc., are a few ICT interventions of private organisations.

Among all cyber extension initiatives, Uzhavan Mobile App introduced in 2018 plays a major role in the dissemination of agro advisory services. Farmers can access agricultural information at any time in their mother language (Tamil). This App contains information concerning the availability of stock of seeds, fertilisers, and farm machinery (both public and private). Farmers can also access the information related to the premium of crop insurance, notified crops and areas, and the place of visit of AAOs and AHOs in advance. As on 6th July

2022, more than one million people have downloaded the app including farmers, extension professionals, scientists etc. More than 5 lakh farmers registered with this app (Nandhini and Rohini, 2022). However, there is no evidence that who access what. Nandhini and Rohini, 2022 and Kumar *et al.*, 2020 stated that although the farmers in Dharmapuri and Coimbatore districts as well as the Thanjavur district of Tamil Nadu found that the information on the uzhavan app is valuable and user-friendly, yet, farmers informed that the lack of price details of some commodities, difficulty in the use of the app due to poor content visibility, lack of training on operating the app, lack of real time weather information, inadequate information on allied activities etc., are the major challenges encountered by them while using the App. The state has around 79.38 lakh operational landholders operating on 59.73 lakh hectares (GoTN, 2019). But, not all farmers own smartphones to download this App and access the benefits thereof. There is also no system put in place to monitor the farmers who have downloaded the Uzhavan Mobile App and their utility pattern.

Human resources in extension advisory system

In India, the strength of the extension personnel is inadequate at various levels (Gulati *et al.*, 2018). The DFI Committee recommended a need for adopting an optimal ratio between extension manpower to farming family viz., for Hilly areas-1:400; Irrigated areas1:750 and Rainfed areas 1:1000 for effective extension services. Findings also reveal that in Tamil Nadu, the ratio of extension personnel/field extension personnel to farmers was 1:1834. The ratio is less than the recommended level of the Doubling Farmers Income (DFI) committee. If this prevails, it will be challenging for the existing personnel to meet the specific information and advisory needs of each farmer.

For example, most posts in the Department of Agriculture of Coimbatore district are vacant. About 22% of Agricultural Officers (AOs), 62% of Assistant Seed Officers (ASOs), 17% of District Agricultural Officers (DAOs), 22% of Assistant Agricultural Officers (AAOs) etc., posts are vacant against the sanctioned posts (Joint Director of Agriculture, Coimbatore, 2018). Similarly, at the Department of Horticulture in Kanyakumari district Absence of 80% of Assistant Director of Horticulture (ADH), 8.4% of Horticultural Officers (HOs) and 87% of Assistant Horticultural Officers (AHOs) in Kanyakumari district is the major constraint on account of more than 50 per cent (54.66 %) of the area under horticultural crops (includes coconut) to the total net cultivated area. It affects the efficiency in identification of right farmers and conduct of training/demonstration of technologies such as bee hives/colonies. (FGD with Officers of Department of Horticulture, Kanyakumari, 2018). Also, most of them were involved in a mere supply of target-oriented inputs. Furthermore, increased paper works and fewer extension activities along with amplified financial accountability pertinent to each scheme were found to have affected the extension services. Also, attending more meetings such as meetings with District Collector about collective farming, micro irrigation, insurance, 20-point programme, bankers meeting, mass contact programme and ad hoc meetings are affecting the extension activities. Extension personnel indicated that they attend meetings at least four to five times a week.

Emerging role of private extension

Private organisations such as UPASI, Parry's corner, Dhan foundation, Hatsun Agro products, Sustainable Agro Alliance limited, progressive farmers, input dealers (both DAESI Trained and non trained), AC&ABC Candidates, and mass media are the major sources of information to farmers in India (Ferroni and Zhou, 2012).

Neo private extension

Agri Clinics & Agri Business Centre (AC&ABC)

AC&ABC has been taping the expertise of the graduates of agriculture since its inception (2002), and also inculcates them with technical competency through training in different aspects of agriculture and allied sectors. As of June 1, 2020, out of 72,136 trained candidates, around 7764 candidates (10.78 %) were from Tamil Nadu, while, only less than 50 % (3689/47.51%) of the trained candidates have established any ventures. Of the trained candidates, around 38 % of them ventured into agri-clinics/agri clinics and agribusiness centres. AC&ABC professionals can play a greater role in providing quality extension services for farmers if there is a facilitating policy environment to support them in establishing ventures and sustaining them.

Diploma in Agricultural Extension Services for Input Dealers (DAESI)

DAESI launched during 2002-2003 intending to train the input dealers on scientific agriculture and thereby transform them into para-extension professionals for the benefit of farmers. Tamil Nadu was one of the few states to implement DAESI when it was piloted by MANAGE in 2002-2003. Since then the state has actively been implementing the programme. The state has trained around 919 candidates (about in 24 DAESI batches) as of March 2020. However, it is only a fraction of (3.17%) the share, when compared to the total trained candidates (28,986) across the country. Another 160 input dealers are likely to complete the training in 2020-21. About 68.6% of the agricultural information is met from Input

Dealers and 51.2% of the information is met from the extension personnel of the pubic extension system (Babu *et al.*, 2012 and Rasheed, 2012). The farmers accessing private extension providers, particularly input dealers may further widen if the public extension personnel continue to prioritise their extension advisory services based on input supply. However, the over-dependence on the private input dealers for information may not be sustainable in the long run as most of the dealers are profit-oriented rather than predisposed to the welfare of farmers.

Major structural extension reforms

Agricultural Extension in the state was started with the introduction of the Community Development Programme (CDP) in the 1950s. Followed by the implementation of the Intensive Area Development Programme (IADP) and the introduction of the Green Revolution in the early 1960 and 70s were the major structural changes that helped the state to increase productivity and production. Later, with the changing needs of domestic and international markets, and to feed the burgeoning population, the extension intervention was further strengthened by adapting to the Training and Visit System funded by the World Bank, which played a timely role in the transfer of new technologies. However, it was during the 1990s, the state government through its Tamil Nadu Agricultural Development Project (TNADP) integrated agriculture with its allied sectors namely Horticulture, Animal Husbandry, Fisheries, Sericulture and Forestry under one umbrella of the Broad-Based Extension System, thus leading to holistic advisory services for an overall farm improvement. And, with the dawn of the 21st century, the state government has reshaped its extension system with ICT approaches to deliver fast-paced services to the farmers. As a result, it has introduced, the Agricultural Information and Services Network (AGRISNET), Farm Crop Management System (FCMS), and Uzhavan App to deliver end-to-end information to farmers. The veterinary and fisheries extension is gaining importance due to the active participation of the Department of Animal Husbandry and Fisheries in livestock extension. However, most veterinary services are associated with clinical services for animals. Therefore, veterinary doctors seldom pay attention to the livestock keepers/ farmers' activities like adding value to the milk, food processing, etc. In fisheries, lack of training of fisheries extension professionals, less contact between fisher folks and extension personnel, inadequate extension staff (1687 nos), untrained extension professionals along with the improper running of fisheries cooperative societies have been considered to be the major constraints in providing fisheries extension services in the state. Further, the inland fisheries suffer from a lack of seeds/fingerlings and pellet/mash seeds. Though some of the hatcheries/seed production and rearing centres are owned by private players (229 Nos of private players are in the state) the price of seeds/fingerlings is unaffordable by marginal and small farmers. Therefore, addressing the above issues will certainly help improve the allied extension services in the state.

Emerging third sector extension - Role of NGOs

Non-Governmental Organisations (NGOs) organise several training programmes, demonstrations and exposure visits with the view of uplifting the farming community. For this reason, NGOs began to be called the third sector in the field of agricultural extension. Three NGOs namely *TSSS-Tirunelveli Social Service Society, Tirunelveli; CREATE, Thiruvarur and VK-NARDEP, Kanyakumari* were selected from Tamil Nadu to understand their roles in agricultural extension. Table 1. explains in detail the major activities of these select NGOs.

The above table indicates that the role, responsibilities, mandates, extension approaches, technologies, use of publications, marketing etc., of the three NGOs have some similarities and also differences. Except for 'CREATE', most of the activities of NGOs namely TISS and VK-NARDEP focus on the promotion of organic agriculture. These three NGOs together cover more than 50 thousand farmers in the state of Tamil Nadu. Of them, 40 % are women farmers. Other than the NGOs selected for the study, NGOs such as the Dhan foundation based in Madurai, MSSRF based in Chennai, Centre for Indian Knowledge System (CIKS) are prominent in the state. Gulati et al, 2018 state that NGO-led extension models help to address the challenges far more effectively as their extension approaches are prioritized toward the sensitivity to local issues and conditions. However, the limited manpower, resources, funding support etc., are impacting the scale of their operations.

ATMA as a centre of extension reforms

In India, the Agricultural Technology Management Agency (ATMA) is conceived to be the major single best-fit institutional extension reform in extension advisory systems. Wherein, the convergence of human and financial resources available in the government, civil society, farm community and the private sector takes place and it is a coordinating extension system of all ongoing extension efforts in all 32 districts of Tamil Nadu.

The study results show that ATMA has benefited around 9.69 lakh farmers in training during 2017-2020 on various new technologies, practices and Integrated Nutrient Management (INM) among others Table 2. It

Table 1. Major activities of Non-Governmental Organisations

Component	TSSS	CREATE	VK-NARDEP
Headquarter	Tirunelveli	Thiruvarur	Kanyakumari
Place of operation	Tirunelveli and Tuticorin.	Throughout Tamil Nadu.	Throughout Tamil Nadu and parts of India.
Membership	19000 Females and 1000 Male.	37 000 farmers.	Mainly provides demonstration to all farmers.
Roles and responsibility	Production and procurement of organic produce.	Production, procurement and popularisation of traditional rice varieties of Tamil Nadu.	Popularisation of food/nutrition gardening and promotion of organic farming.
Techniques and technologies	Organic farming techniques like Ganajeevamirtham, Jeevamirtham mix, Nimastram, Agniastram, Fish amino making etc.,	Traditional rice varieties like Kattuyanam, Poongkar, Karunguruvai Kuzhiyadichan, Kudavaalai, Gauvuni, Mappillai Samba, Samba Mosanam, Arupatham Kuruvai; their production technologies.	Cow dung-based plant, Terrace gardening, production of NPK manure, community/traditional water harvesting, Organic farming, Azolla, Bio-gas Bio-Fertilisers production, natural pest repellent, Fish amino makings.
Major extension activities	Awareness campaign on major international days, training and demonstration on latest organic production technologies and community led watershed programme.	Awareness meetings on traditional rice varieties; training, exposure visits, demonstration, etc.,	Demonstration, training and Field visits related to Azolla cultivation, Bio-gas production, bio-fertilisers production, terrace gardening, organic farming etc.,
Publication	Velan Vithai is a monthly magazine published on organic farming practices and technologies.	Only folders, pamphlets, are circulated.	Folders, pamphlets, are circulated.
Virtual media	The website created by TSSS provides information about various topics of interest including organic farming (http://www.tsssindia.org/).	A website has been created to host a hub of activities and information related to traditional rice varieties of Tamil Nadu (https://neljayaraman.com).	The official website of VK-NARDEP provides online videos, information about developmental activities including organic farming (http://www.vknardep.org/).
Marketing	Sells the organic produce of its members in market outlets provided at TSSS daily.	Procures seeds of traditional rice varieties from its members and redistributes them to the farmers on a demand basis.	It sells Bio-fertilisers, Azolla, Bio-gas and natural pest repellent to the farmers at affordable prices.

was observed that not less than 250 extensions and agro advisory services are carried out every year in each district of Tamil Nadu by the Department of Agriculture through ATMA, which benefit about 25 000 farmers from each district, i.e. more than 75,00000 (75 lakh) farmers in the state. However, there is neither a substantial increase in the adoption rates nor an increase in farm productivity and income. The present study further revealed that often the same farmers were selected as beneficiaries for various training and demonstration due to limited time to reach out to the remotest farmers, coupled with political nepotism that favour well-off farmers. Also, the major extension of personnel of ATMA such as Block Technology Manager (BTM) and Agricultural Technology Manager was employed on a contractual basis and majorly engaged to complement the desk works of the Department of Agriculture and to meet the targets specified in various schemes implemented by the agriculture department, not evidently extension activities. Field study suggests that they often quit their jobs for want of better opportunities. This is also indicative of the fact that the lack of accountability and ineffective extension personnel lead to poor advisory services of ATMA. Further, ATMA was not able to carry out the extension activities due to a lack of evaluation or monitoring mechanism to review what worked for farmers and not worked in terms of adoption (new technology), infusing the innovations at the farm level, fostering partnership, farmers feedback, mobilisation of farmers at the cluster level, linkages of farmers with research as well as markets among others.

It is considered therefore that ATMA needs to evaluate the impacts of its extension approaches in terms of increased knowledge of farmers on new

Table 2. Achievements of ATMA

S.No.	Extension activity	2017-18	2018-19	2019-20
		Physical Progress	Physical Progress	Physical Progress
1.	Farmers covered Training	267198	570913	129867
2.	Demonstration	8946	4321	16665
3.	Exposure Visit	1681	1173	1747
4.	Farmers covered Exposure Visit	39803	4079	19211
5.	Farmer Friends	2586	68	30
6.	Farm Schools	1068	496	174

Source: https://extensionreforms.dacnet.nic.in/DashBoard_Statusatma.aspx

technology and a corresponding increase in the adoption rate, as well as how the different extension methods/ tools such as Farmer Friend (FF), farmers training, farm schools, demonstration etc., influence the farmers' decision making process in agriculture, preferably towards (micro) enterprise development. This will help the state to assess the impacts in real time benefits (econometric gains) and to attract donor agencies for increased funding. Norton and Alwang (2020) argue that the difficulty in attributing the economic gains to the extension effort might have been the factor for its low budget and political support. Further, the gaps found in the autonomy of ATMA and its failure to effectively engage with NGOs and private sectors led to the divergence of the performance (Ferroni and Zhou 2012; Gulati *et al*., 2018). Besides, the ATMA extension system has encountered numerous challenges that range from inadequate quality manpower, lack of quality delivery mechanism, and technical support to a clear route for fostering partnership (Kapoor, 2010). Ferroni and Zhou (2012) further argue that the quality of implementation varies from state to state, also inculcating a culture of accountability to the farmer (in a multi-tier organisation) as well as establishing an association between knowledge generation and the extension will remain major challenges for ATMA. In addition to ATMA, the State Agricultural Extension Management Institute (STAMIN) and Farmers Facilitation Centre (FFC) and Water Management Training Centre (WMTC) provide training to not less than 0.25 lakh extension functionaries/farmers/youth/entrepreneurs every year, 0.29 lakh benefited from the training organised by STMAIN and FFC during 2016-17. WMTC trained about 1100 field-level extension functionaries during 2016-17.

Role of universities

Tamil Nadu Agricultural University (TNAU) plays a major role in agricultural education, research and extension. TANU is conducting research in 14 colleges and 39 Research Stations across the State (GoTN, 2020). TNAU has released 819 new crop varieties 165 agricultural implements and 1,527 management technologies up until 2018. The major extension activity undertaken by TNAU is Front Line Extension, i.e. dissemination of proven technologies, management techniques, standardised crop production and protection practices/techniques to all the line departments. The monthly Zonal Work Shop is organised as the platform to discuss the upcoming extension works, field problems, existing farming situation, farming issues and solutions for the same. Similarly, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS) is catering to the knowledge needs of students, researchers, veterinary extension, scientists and other stakeholders related to animal husbandry, its welfare and management. The most important services of TANUVAS are clinical and laboratory-based. About 24 Veterinary University Training and Research Centres (VUTRC), three KVKs and three FTCs of TANUVAS provided around 2090 training, benefiting 70507 farmers across the state during 2016-17.

KVKs – Connecting farmers with science

Krishi Vigyan Kendras (KVK) are the field research units of the National Agricultural Research System (the Indian Council for Agricultural Research-ICAR). They are involved in testing new seed varieties, agronomic practices, machinery etc. in field conditions across different agro-climatic zones, before recommending them for a wider scale promotion (Gulati et al, 2018). The KVK scheme is 100% financed by the Govt. of India and the KVKs are sanctioned to Agricultural Universities, ICAR institutes, related Government Departments and Non-Government Organizations (NGOs) working in Agriculture. A total of 14 KVKs are linked to TNAU in the state and are considered to be a single window to the farmers.

To conclude, extension systems in Tamil Nadu have co-evolved with the advancement of the extension (innovation) system both in the country and world. The transition from a solely public extension to the pluralistic extension system has helped the state to become one of the few states to achieve a formidable foot in food grain production. Though T&V, ATMA, Market-led

Table 3. Achievement of KVKs during 2016-2019

S.No.	Name of Extension Activity	No of activities	Coverage of farmers/youth/women
1.	On Farm Trials (OFTs)	1593	-
2.	Demonstrations	5692	-
3.	Training	2377	64835
4.	Vocational training for youth/women	100	5070
5.	Sponsored training	680	30044
6.	Exhibitions/melas /field days	891	2,62,939
7.	Promotion of technologies and practices	251	-

Focus Group Discussion with Scientists of TNAU and KVKs, 2018.

extension, ICT approaches with pluralistic nature had been successful in terms of transfer of technology, diffusion of new knowledge and skills throughout the 20th century and at the beginning of the 21st century, the same extension approaches have not largely worked well. As the food system is increasingly transiting away from the production of crops to enterprise and innovation-based production systems, the knowledge and information needs are becoming more diverse and heterogeneous. Therefore, the state needs to reorient its extension policies concerning knowledge-intensive technology transfer with the infusion of technology by facilitating bottom-up innovations and enterprise (at the farm level), pluralism with effective convergence, highly competent extension personnel with sufficient ratio to farmers, sound market-oriented extension system at all levels, etc. This will ensure that the extension system in the state (developing countries as well) remains abreast in reducing the knowledge asymmetry and help meet the demand driven information by infusing local innovations. This will further contribute to reducing the yield gaps by instilling location and crop-specific recommendations by all stakeholders in the extension innovation system.

Authors' contribution

Conceptualization and designing of the research work (SR, AV): Execution of field experiments and data collection (AV): Analysis of data and interpretation (AV): Preparation of manuscript (AV, SR).

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