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The Relevance of Customized Agricultural Extension Services for Social Inclusion and Food Security: A Showcase from Ethiopia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

For the last six decades, Ethiopia has been implementing different agricultural extension approaches. These approaches range from area focused comprehensive package programme which selectively targeted high potential areas to modified Training and Visit extension and the recent nationwide participatory extension System. One thing in common in all these approaches is standardized advisory system characterised by 'one size fits for all' approaches which pushes selected package of technologies and extension messages to all classes of smallholder farmers. The study followed a comparative analysis of baseline and post interventions assessment using 'one-timad extension package' customised advisory service. One -timad extension package is exclusively designed for land constrained poor farmers on a quarter of a hectare land size with farmers preferred crop varieties, recommended fertilizer rate, practical training and Integrated Pest management. The pilots were implemented in four regional states of Ethiopia to get an insight for further engagement. The finding shows the need for advisory service to be inclusive; technology

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supply and services tailored to the multiple capacities and demands of different classes of small farmers. Hence, further piloting to new clients and areas is recommended for institutionalization of the approach.

Keywords: Heterogeneous clients; customised extension service; Ethiopia.

1. INTRODUCTION

For the last six decades, Ethiopia has been implementing different agricultural extension approaches. These approaches have been pushed in one way or another for increased use of agricultural technologies for improved agricultural production and productivity. In mid-1990s a new agricultural extension package program called Participatory Demonstration and Training Extension System (PADETES) was introduced as the country's main agricultural extension strategy. Its features include: (1) package orientation; (2) increased use of agricultural inputs and (3) increased deployment of extension personnel. Since 2010 PADETES was modified into Participatory Extension System (PES) following the commencement of first Growth and Transformation Plan (GTP) of the country. The major difference of PES compared to PADETS was the establishment of development groups (one in five farmers groups, development units), Farmer Training Centre (FTC), categorization into watershed management and full-package extension service provision [1].

According to MoA, [2], Ethiopia established the largest public agricultural extension service delivery structure in Sub Saharan Africa (SSA) and the densest agricultural extension systems in the world with approximately 21 development agents (DAs) per 10,000 farmers. To-date over 83,000 DAs have been trained and graduated, of whom about 56,000 specialized in crops, livestock and natural resources deployed to 12,500 FTCs and Kebeles[1]. Despite its huge grassroots presence and commitments to deploy a large development army, the extension system suffers noticeable weakness in two interrelated fronts. The first weakness is the fact that the technology packages are generally designed considering factors like agroecology, rainfall, elevation and what is called commodity and zonal agricultural approach [3]. Secondly, the extension messages and packages are designed considering all smallholder farmers as homogeneous i.e. it failed to make its message tailor made [4]. The problem is that the extension system refers to "access" in terms of physical proximity of services, failing to recognize affordability, sociocultural appropriateness and context-specific relevance for different categories of smallholder farmers [5,6]. These two interrelated weaknesses resonate with what is popularly known as the "one size fits all" approach, which is known for its failure to provide tailor-made services.

The extension system failed to recognize that the vast majority of the potential target population and smallholder farmers diversity which represent a heterogeneous group. This is surprising given the clear evidence of diversity in the country both agroecologically and ethnically [7]. Hazell and Rahman, [8] identified a growing divergence between subsistence and business oriented small farms exist in terms of assets (materials), preference crops to grow, expertise, labour and technology use, and access to markets and services. The way in which agricultural extension service is able to respond to diverse farmers' situations and needs is still poorly understood by both policy makers and practitioners in developing countries including Ethiopia [9,10]. Studies conducted in Ethiopia reveals early models focusing on transfer of technology using a 'top-down' linear approach were criticized due to the passive role allocated to farmers, as well as the failure to factor in the diversity of the socio-economic and institutional environments facing farmers and ultimately in generating behavior change [11,12]. The common gaps in most developing countries extension approaches include promotion of self-selection and targeting of farmers for standardize package where clients have no ability to individualize or influence the composition and size of the package to their specific conditions. They are suffered from the syndrome of 'take it or leave it' type of top-down service delivery. Studies conducted in Ghana show that in terms of reaching farmers, extension officers demonstrate a technology to farmers but with much concentration on early adopters who are rich and socially influential [13]. A similar observation was reported by USAID [14] in its

[1] *A kebele is the smallest administrative unit of Ethiopia, similar to a ward, a neighbourhood or a localized and delimited group of people under woreda or districts*.

assessment on Extension and Advisory Services in 10 Developing Countries that agricultural extension strategies in developing countries have been built on traditional, top-down approaches that rely on "transfer of technology" models, inflexible packages of recommended inputs and practices and learning methods that lack understanding of how farmers learn and innovate.

This paper argue that agricultural extension has a lot to learn from contemporary marketing customizing of products and services to diverse potential consumers [15] and User Center Design (UCD) of Information Technology [16]. For example, UCD which advocate a redesign of marketing from the customers' perspective found to be highly effective in improving uptake and demand for products and services. According to Iivari J and Iivari N [17] User Centeredness is a multidimensional concept range from user focus; work-centeredness; user participation; to system personalization. Marketing firms are doing more than catering to new markets or delivering custom-made products at lower prices; they are transforming the practice of marketing from being seller-centric to being buyer-centric. Hart [18] defines mass customization as "a flexible processes and organizational structures to produce varied and often individually or a particularly defined segment customized products and services at the price of standardized mass-produced alternatives." According to Wind and Rangaswamy [19] customization of services at marketing end can be implemented with little prior information about customers, and the product itself can be manufactured after customers tell the company what they want to buy or with full profile registry of customers and product development to fit their specific demand. Both mass customization and customerization are attempts to provide products and services that better match the needs of customers—they are two sides of the same coin. Both mass customization and customerization are often accompanied with technological innovations including the internet technology (IT) although it is not a necessary condition. Customization is a process of making product and service tailored to end can customer needs and demands [20]. This is particularly relevant for the smallholder farming context. Farmers are highly diverse, differing in resources, gender, market access, crops and livestock systems, and therefore require different types of information and services to achieve sustainable productivity growth and better livelihoods [21].

REALISE (Realising Agricultural Livelihood Security in Ethiopia) programme has been piloting different approaches of customized agricultural extension services to different classes or categories of smallholder farmers. It unpacks the extension package components and design to suit the smallholder's categories such as PSNP beneficiaries who are chronically food insecure and non-beneficiaries who are food secure. This paper therefore presents the experiences of REALISE programme in promoting customized agricultural extension services for the different class of smallholder farmers and tries to verify the following research questions.

- What preconditions and effort do need to use extension customization?
- What effect does extension service customization has on the service utilization of productive safety net programme beneficiaries?
- What impacts do extension customization has on productivity, food security and resource use optimization?

2. LESSON FROM CUSTOMIZED MARKETING APPROACHES FOR THE NEXT GENERATION EXTENSION SERVICES

The concept of customization – is related to the degree to which the firms are offering a tailored made goods and services to meet heterogeneous customers' needs has gained increasing popularity over the last two decades. [22,23,24]. Customization aims at satisfying as many needs as possible for potential customers, in contrast to conventional techniques, which try to reach as many customers as possible while satisfying a rather limited number of customer needs [25,26]. Kotler [27] and Pine [23], among others, regard customization as an answer to the shifting nature of customer demand for greater variety, more features, and higher quality in products as well as services. While customization of marketing product and services is well placed [28] the conventionalized extension service is still continued little differentiated. Recently, Hara et al, [29] pinpoint that while service and product customization has received wide attention, product-service system (PSS) customization has been underexplored. PSS customization, which consider functions of both products and services and exploit the inter-relations among them, could be effective to inform service providing institutions such as

agricultural extension which combine product and service delivery.

Recognition of client diversity and the need for differentiation of services has called for customization of interventions based on a more nuanced categorization of farmers and understanding of their needs [5,30]. Contrary to the current conventional extension service which focused largely on model farmers (see Kaleb, 2016) and selected crop commodities in the different agro-ecological conditions [31]; REALISE paid attention to customized extension service which considers the different socio-economic situation and subsequent needs for support and advisory services [8], (Spoor, 2015).

The differences between the conventional agricultural extension and customized extension service delivery lies on orientation, customization, client targeting, promotion, focus, impact and preconditions (see Table 1). While the former is designed, built and delivered to a range of customers 'as standard', customized extension services can be tweaked and tailored depending on the needs or wants of customers. The summary is prepared form literature review and REALISE programme experience in piloting the customized extension service [25], (BENEFIT; 2019); [32,33].

3. OVERVIEW OF THE REALISE PROGRAMME

REALISE is one of the Dutch governments funded programmes in Ethiopia designed for three years (2018-2020) and implemented in alignment with Productive Safety Net programme (PSNP) of Ethiopian Government. Leveraging the experience of other sister programmes, REALISE focuses on validating, adapting and scaling of best fit agricultural practices (BFPs), fine tuning appropriate seed supply mechanism, bridge the capacity gap of partners in 60 Productive Safety Net Programme (PSNP) woredas. Its focus is addressing chronic food security (closing the food gap months), malnutrition (improve dietary diversity), ensuring access and capacity to use improved agricultural practices, creating access to quality seed and overcoming systemic bottlenecks through piloting of innovative interventions.

The programme nature demands working mainly with PSNP beneficiaries who are characterised by chronic food insecurity, malnourishment, poor resource endowment (small landholding, small asset holding, limited access to financial services etc.), marginalized to services and amenities. Selectively the programme target non PSNP

Table 1. Comparing customized and conventional agricultural extension services provision principles

Features	customized extension service	Conventional extension service
Orientation	Tailored made message and technology supply	Commodity and package-based services
Customization	Services vary from one group to the others; they can be customized.	Products or technologies standardized to clients.
Targeting of customers/ clients	Segmentation (identify bases, PSNP/NPSNP, wealth, production orientation)	Assume farmers are more or less homogenous
	Targeting (refine selection criteria, select target)	Develop homogenous product/package
	Positioning (positioning each segment, develop mix (4P): product, price, place, people)	Take it or leave it – "one size fits all" approaches
Promotion	Result oriented sell through advertisement, exhibition, sponsorship, discount	Validation, demonstration, scaling
Focus	Clients	Technology/packages value
Impact	High profit, client satisfaction	Inequality, poor adoption
Precondition	Well define client profile (market research, product development)	Undifferentiated due to homogenous client assumption

Approaches of REALISE customized extension services
Source: Own analysis through desk review

households to stimulate local level economic dynamics in selected interventions which has cash generation potential and trickledown effect in the form of job creation and food supply. The diversified nature of the target beneficiaries influences the programme to customize its products, extension message and implementation strategies.

3.1 Methods of Client Segmentation for Product and Service Customization in REALISE

For proper customization of product and services client segmentation is critically important. It means dividing a potential target into distinct groups of clients who have different, needs, characteristics or behavior and who might require separate product and services. Following the principle of market segment approach REALISE has identified a group of beneficiaries who respond in a similar way to a given set of programme interventions in four regional states of Ethiopia: Amhara, Oromia, SNNP and Tigray. To select the segments for the pilot, REALISE has used PSNP programme client registry and Kebele administration roster to identify other target groups such as Non-PSNP households and youths. The different household lists further refined in gender and other targeting criteria as needed.

The targeting has served to facilitate a discussion with stakeholders about farmer heterogeneity and the need to move away from overly simplistic generalization of "smallholders" that ignore the different needs and priorities of this huge group in terms of advisory services. It needs to be considered, however, that this categorization is (a) context-specific and may need to be adapted to different regions in the country, and (b) dynamic in that the categories and their composition change over time, just as the sectoral composition of an economy changes. REALISE programme interventions have customized for the three categories of smallholder farmers: youth, non-PSNP and PSNP to demonstrate the approach and the most distinct and easy to distinguish nature of the groups (Fig. 1).

Category 1: Surplus producing Non PSNP farmers include those who own relatively sufficient assets in addition to land, have sufficient access to inputs and services, and are already successfully linked to local markets and value chains. These farmers require entrepreneurial training and advice to allow them to move up the value chain, for example, by specializing in production or value addition to their produce [34]. Much of this assistance is geared towards high-value production, and service costs are incurred directly by the farmers [8]. Example of interventions with group farmers include standardized 0.5 ha of land package, testing and demonstration of new technologies. The package comprises improved seed, fertilizers and pesticides where inputs are purchased or credit service is linked with full repayment whereas extension advice is offered for free.

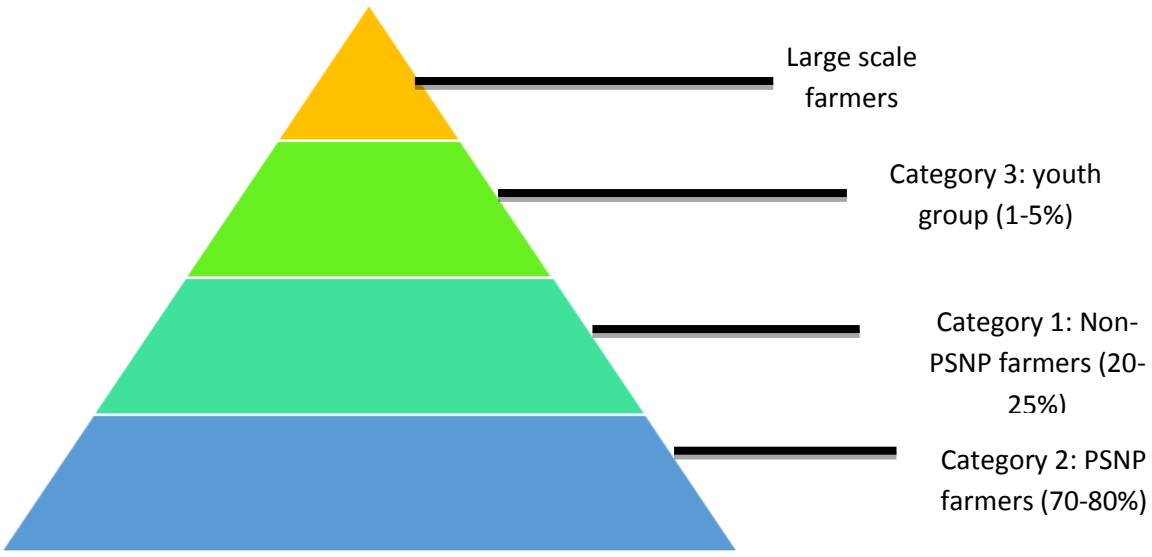

Fig. 1. REALISE programme service customization for different categories of clients

Category 2: Chronically food insecure PSNP farmers with fragile livelihoods who produce mainly for subsistence using traditional technologies but self-sufficient only for nine months even supported by the PSNP interventions. A growing number of these subsistence farmers depend on other income sources in addition to agriculture, such as low-waged casual labour, including seasonal migration, remittances and off-farm activities. They require support to go beyond subsistence (e.g. through skills development and employment generation) and – importantly – to address the various factors leading to their marginalization, including nutrition, risk containing support and the fact that they live in areas with limited agricultural potential and poor infrastructure [8]. The interventions designed for this target group include one timed package, backyard vegetable production and standardized package with credit or revolving fund arrangement.

Category 3: Comprise unemployed youth with poor access to and control over land, but relatively having better education, knowledge and skill endowment. They are engaged in knowledge intensive agricultural activities such as semi-commercial poultry production, small ruminant fattening, eucalyptus oil extraction, nursery development for seedlings supply etc. This category is emerging in rural Ethiopia and requires attention from advisory service.

3.2 Innovation Pathways: Identification Potential Interventions for the Different Targets

REALISE innovation pathways focus on addressing smallholder farmers challenges identified in the PRA and baseline studies. PRA is rooted in a neo-populist model of development which postulates that community members should be the primary agents of change in development and it uses a highly participatory methodology that actively integrated local values and knowledge for decentralized planning and democratic decision making [35,36,37]. REALISE has used PRA for rapid, cost-effective, participatory and local actors' empowerment means of collecting information for planning priority interventions to address major problems. The programme conducted PRA studies in all the target woredas. Besides PRA, REALISE programme also conducted a baseline survey to establish a baseline value for the key indicators of the programme such as crops productivity, food gap months, diet diversity score and resilience.

The combined analysis of PRA and baseline studies resulted in the formulation of innovation pathway. It has pragmatic key entry points. The first one is making seed of validated varieties of crops (proved suitable for local context) available and accessible to farmers in the right quality, quantity and diversity through seed cooperatives and seed producer farmer groups. The second is testing and validation of agricultural practices using participatory action research [2] . The REALISE innovation pathways involved key partners and stakeholder including research, extension and policy level actors at different phases. The pathway is designed in such a way that a technology which fit into the system move form validation to demonstration and pre-scaling while technology which failed to fit out immediately. Hence, move up or out principle is perused.

4. REALISE APPROACHES TO CUSTOMISED SERVICES

REALISE has designed a customised intervention to PSNP, NPSNP and youth potential target groups tailed to their needs, capacity and potential benefit. Accordingly, validation and demonstration were promoted to both PSNP and NPSNP farmers to get response before pushing them to scale. Hence, screening of innovation is made to all the potential target groups (PSNP, NPSNP and youth) based on their unique characteristics. The brief description and detailed list of the different customised interventions have presented hereunder.

4.1 Screening Innovation for Potential Targets

REALISE programme introduced the concept of up or out approaches in technology introduction. Validation is an entry point for technologies

[2] *Depending on the level of evidences the action research takes different procedures for screening potential technologies. Validation applied for testing technologies with little evidence using 10m by 10m land size per treatment; demonstration of improved technologies with some evidences meant to create wider awareness among farmers with two or three treatment design and total land size of 1250 m^2 (local, improved and research recommended practice); and pre-scaling of proven improved practices with 2500 and 5000 m^2 land size with different package options for heterogeneous groups of beneficiaries (learning promoter and inhibitors of a given technology from endowment and institutional setting perspectives).*

which is entirely new to a particular areas and targets whereas demonstration is promoted if a prior validation and limited awareness of the technology exist. Hence validation is deigned in small plots for the target to test technology feasibility and get involved in their own farm, context and capacity while demonstration is implemented in large parcel side by side with local practice. Pre-scaling is a method of promoting a proven technology to a particular biophysical context but the diver and inhibiters factors remained to be assessed. The focus of pre-scaling is to make sure the institutional capacity to deliver the technology, market is functioning and the intended targets are continued interested to use the technologies.

4.2 Deploying a Basket of Crops and Variety Portfolios for Potential Targets

Crop genetic resources are the building block of food production and sustainable agricultural development as these can be used to develop crop varieties adaptable to heterogeneous environmental and socioeconomic conditions. Studies has shown that the motivating factors for crop and variety diversification are the heterogeneous production environments, risk consideration and farmers' participation in the markets [38,39].

Crop and variety diversification can result in disease management, stabilize crop productivity on a sustainable basis and it broadens smallholder farmers' coping strategies against risk due to the smaller probability of all crops and varieties being affected by climatic or input and output market shocks in a similar manner [40]. Recent studies conducted in Ethiopia by [41,42] indicate that crop diversification, which improves productivity, enhances its important role in reducing the probability of household food insecurity and poverty. In the light of the forgoing discussions REALISE programme introduced 13 crops and 48 varieties which fit into the diverse environments and risk contained preference of farmers against climatic variability, market demand, food self-sufficiency, diet diversity and food security point of views.

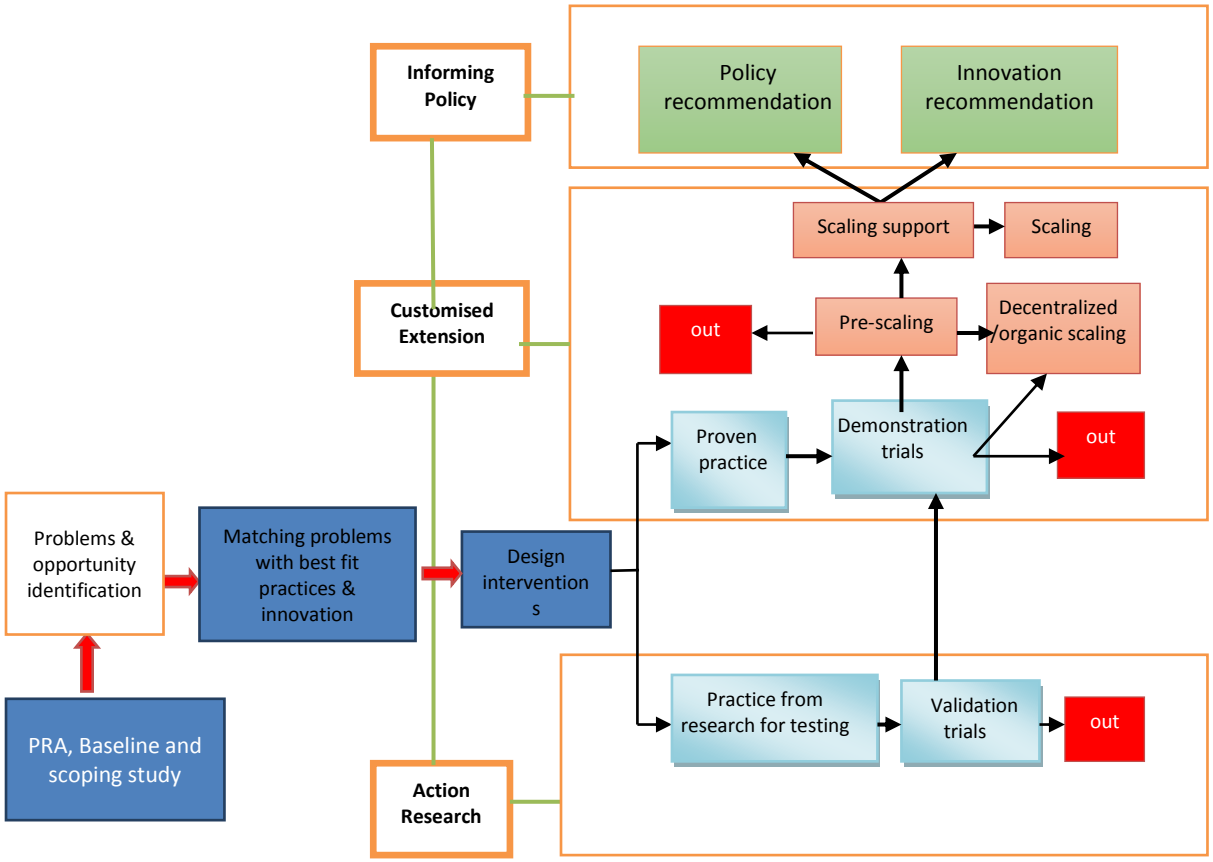

Fig. 2. Innovation pathways of REALISE programme
Source: REALISE programme leaflet, [43]

Table 2. REALISE designed one *Timad* package composition and costs

	Wheat	Maize	Teff	Early Maturing Sorghum	Late Maturing Sorghum	Finger millet	Food Barley	Common Beans	Faba Bean	Ground nut	Mung Bean	Sweet potato	Potato
Package													
Seed rate in kg/ha	120	30	25	12	12	15	125	80	200	100	25		2000
Seed required in kg/*timad*	32	5	12	6	4	5	36	36	60	37	14	0	355
Cost of seed per kg in ETB per ha	15	18	30	18	12	12	15	18	25	50	40		18
Seasons seed used (seed replacement rate in year)	3	1	4	4	4	4	3	4	3	3	3	3	3
Cost of seed for required land in ETB	158	86	92	27	11	15	182	160	503	623	192	140	2130
Fertilizer used in combination with compost at 4 ton/ha rate (1:1 ratio)													
Kg NPS required per ha	68	75	50	63	63	63	75	75	75	75	75	100	100
Kg Urea required per ha	75	75	75	25	25	25	75					75	75
Total cost of fertilizer in ETB	581	372	945	688	433	471	676	535	362	448	692	390	484
Total cost of fertilizer without compost in ETB	1,161	745	1,890	1,377	865	941	1,352	1,069	724	897	1,384	779	967
Cost of one *timad* input package together with compost in ETB	**739**	**459**	**1,037**	**715**	**444**	**486**	**858**	**695**	**865**	**1,071**	**884**	**530**	**2,613**
Cost of input package together without compost in ETB	**1,319**	**831**	**1,982**	**1,404**	**877**	**957**	**1,534**	**1,229**	**1,228**	**1,520**	**1,577**	**919**	**3,097**

Source: Own computation, REALISE, 2019 field data

5. ONE TIMAD PACKAGE FOR PSNP TARGET GROUP

REALISE designed a customized one *timad* package[3] for thirteen crops which have food self-sufficiency, nutrition and cash generation potentials in a least cost-effective way. The programme has introduced 48 varieties on 13 major crops with different strategies such as validation, demonstration and pre-scaling. The package comprises improved seed, inorganic fertilizer (options to apply half farm compost with half recommended inorganic fertilizers included), improved agronomic practices (row planting, tillage, weeding), practical in-situ training. The least cost package designed in less than a thousand Birr investment for most crops (exception is ground nut and potato) while the full inorganic fertilizers application without farm compost on average cost about 1500 Ethiopian Birr (teff and potato package cost more). For the one *timad* package design and return on investment see Table 3.

6. RESULTS AND DISCUSSION

Four key achievements of the pilot are presented to demonstrate the importance of customized extension service: Closing the yield gaps through testing, demonstration and pre-scaling; calories food self-sufficiency of the bottom pyramid food insecure households; optimization of land use and revenue though intensification and deployment of the right crops and varieties; and piloting and demonstration of scalable job creations for youth. The bassline scenario is included to justify the changes are associated with the customized extension piloted.

6.1 Potential for closing the yield gaps

The results indicate that yield gap existed between the baseline and the varieties potential is narrowed down by using quality seed of improved variety, increasing fertilizers use and enhancing agronomic skills of producers through training, home and field visits. Crop yields are at least doubled and if not tripled against the baseline although still below the potential yields (i.e., yon station yield). On average the yield increment on major crops was over 300% compared to the baseline (Table 4). The yield increment was found more than average for root crops and cereals while moderate for pulses.

6.2 Calories Self-Sufficiency of PSNP and Non-PSNP Households

The FAO [44] defines it in broad terms: "The concept of food self-sufficiency is generally taken to mean the extent to which a country can satisfy its food needs from its own domestic production." The definition can easily be contextualized to household self-sufficiency level which means the extent to which a household satisfy its food needs from its own production. The results show that given the food energy content of the introduced crops, average landholding size and 2100 kcal needed per day per Adult Equivalent Unit (AEU) both PSNP and NPSNP households ensure self-sufficiency (Agidew and Singh, 2018). The finding also reveals crops such as Irish potato, sweet potato, hybrid maize, wheat and late maturing sorghum are important for attaining household Calorie self-sufficiency. Whereas the Non PSNP households are in better position for achieving food self-sufficiency compared to PSNP because of the large average landholding they had.

6.3 Land and Revenue Optimization

The land use optimization is a key strategy for ensuring food self-sufficiency (energy calorie). Ogbu [45] notes insufficient farmland, low yields on farms and high storage losses of staples were the principal causes of food shortage. Many empirical studies also reported shortage of farm land is associated with food insecurity [46,47,48]. Hence, land use and income optimization are essential. When the target farmers are sorted for land use optimization according to PSNP and NPSNP the relative allocation of land to crops showed some differences while crop types except teff is the same for the two groups. On the basis of the yield level attained and the prevailing average landholding crops such as Hybrid maize, Irish potato, Onion, Faba bean, Wheat and Teff are best situated for Calorie self-sufficiency. For chronically food insecure households with small landholding growing maize, wheat, Faba bean and potato in order of importance is recommended. Intercropping other crops such as common bean with maize is also possible. For NPSNP households with relatively large landholding growing wheat, maize, teff, faba bean, potato and onion ensure land use optimization from the point of self-sufficiency acquisition. Mixed cropping in the form of intercropping and rely cropping is advisable for land use optimization.

[3] *Timad is a local land measurement used in Ethiopia and it is equivalent to a quarter of a hectare or 2500 m^2.*

Table 3. Closing food gaps by introducing high yielding crop varieties to PSNP and NPSNP households

Crop	Baseline yield (kg/ha)	On-farm Productivity (kg/ha)	Yield gained against baseline (%)
OPV maize	-	3000	-
Maize Hybrid	1509	7000	364
Early maturing sorghum	960	2200	129
Late maturing sorghum	322	3500	987
Wheat	1465	4000	173
Food barley	811	3500	332
Malt barley	1162	2800	141
Teff	352	2000	468
Haricot bean	590	2400	307
Faba bean	702	3500	399
Mung bean	400	1823	356
Groundnut	1700	1700	0
Irish Potato	6284	35000	457
Sweet potato	6024	29300	386
Onion	9279	30000	223

Source: Own computation, REALISE 2019 field data

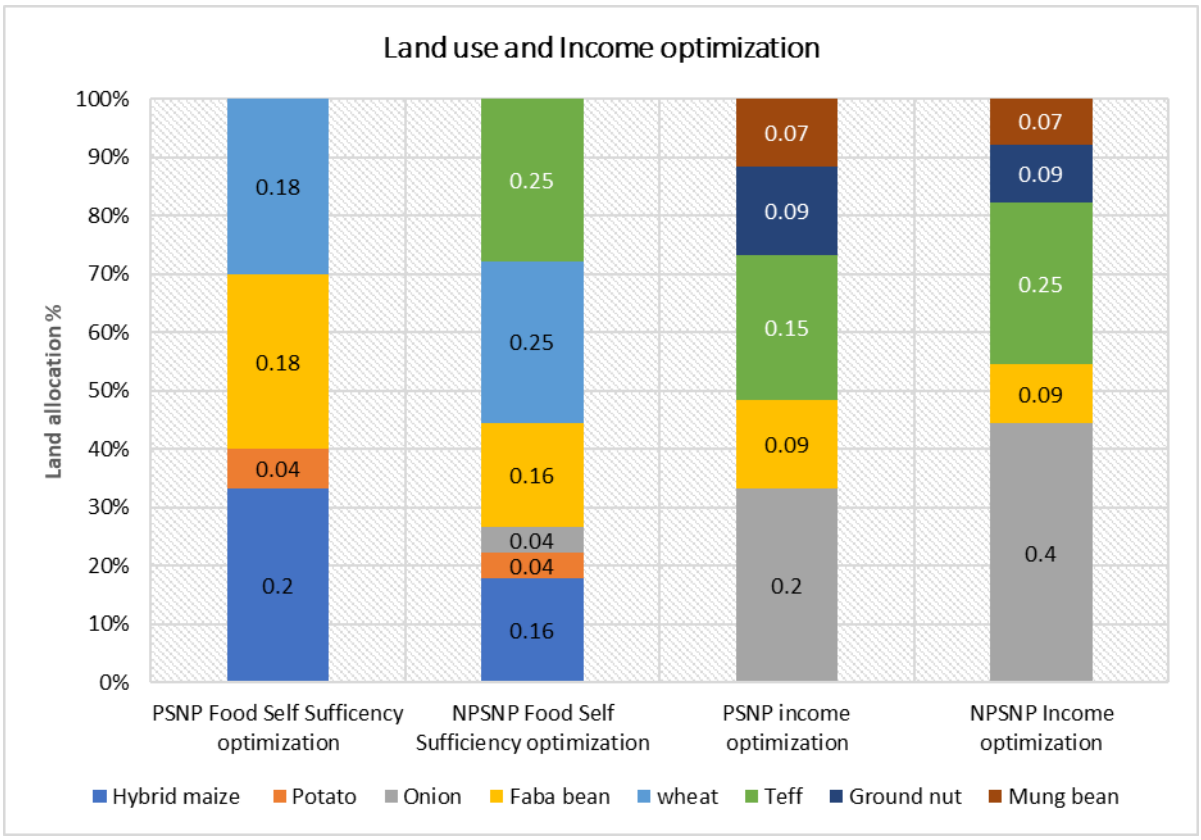

Fig. 3. Optimization of land use and revenue
Source: own computation, REALISE 2019 field data

Table 4. Closing food gaps by introducing high yielding crop varieties to PSNP and NPSNP households

Crop	Productivity (kg/ha)	Kcal in 1 kg	Total Kcal available from Production		Kcal required for family		Food self-sufficiency ratio	
			PSNP	NPSNP	PSNP	NPSNP	PSNP	NPSNP
OPV maize	3000	3640	6552000	9828000	3939810	4008795	1.66	2.45
Maize Hybrid	5700	3640	12448800	18673200	3939810	4008795	3.16	4.66
Early maturing sorghum	2200	3390	4474800	6712200	3939810	4008795	1.14	1.67
Late maturing sorghum	3500	3390	7119000	10678500	3939810	4008795	1.81	2.66
Wheat	4000	3340	8016000	12024000	3939810	4008795	2.03	3.00
Food barley	3500	3450	7245000	10867500	3939810	4008795	1.84	2.71
Malt barley	2800	3610	6064800	9097200	3939810	4008795	1.54	2.27
Teff	2000	3670	4404000	6606000	3939810	4008795	1.12	1.65
Haricot bean	2400	3370	4852800	7279200	3939810	4008795	1.23	1.82
Faba bean	3500	3410	7161000	10741500	3939810	4008795	1.82	2.68
Mung bean	1823	3470	3795486	5693229	3939810	4008795	0.96	1.42
Groundnut	1700	5670	5783400	8675100	3939810	4008795	1.47	2.16
Irish Potato	35000	580	12180000	18270000	3939810	4008795	3.09	4.56
Sweet potato	29300	860	15118800	22678200	3939810	4008795	3.84	5.66
Onion	30000	400	7200000	10800000	3939810	4008795	1.83	2.69

Source: our own computation, REALISE 2019 field data.

Note: we used the following figures to compute food self sufficiency

- *Mean grain productivity (kg/ha)*
- *Average landholding PSNP households 0.6 ha*
- *Average landholding Non-PSNP households 0.9 ha*
- *Average AEU of PSNP households 5.14*
- *Average AEU of Non-PSNP households 5.23*
- *Daily Kcal per person i.e. 2100 (see Agidew and Singh, 2018)*

Table 5. Priority crops for Calorie self-sufficiency and revenue optimization

Crop	Productivity (kg/ha)	Price per kg (Birr)	Birr value in ha	Land required for food self-sufficiency (ha)	Optimization
Sweet potato	29300	5	146500	0.15	Land and revenue
Maize Hybrid	5700	7	49000	0.17	Land
Irish Potato	35000	7	245000	0.19	Land and revenue
Wheat	4000	12	48000	0.28	Land and revenue
Food barley	3500	12	42000	0.30	Land
Onion	30000	12	360000	0.31	Revenue
Faba bean	3500	20	70000	0.32	Revenue
Late maturing sorghum	3500	6	21000	0.33	
OPV maize	3000	7	21000	0.39	
Groundnut	1700	43	73000	0.39	Revenue
Haricot bean	2400	15	36000	0.47	
Early maturing sorghum	2200	6	13200	0.52	
Teff	2000	30	60000	0.51	Revenue
Mung bean	1823	22	39600	0.60	

Source: own computation, REALISE 2019 field data

- *Average landholding PSNP households 0.6 ha*
- *Average landholding Non-PSNP households 0.9 ha*

Revenue from sale of crops can be optimized as function of price and yield obtained per unit of land. The cash crops such as groundnut, mung bean, beans and staple cereals fetch high and the use of package of practices for improved yield lead to income optimization. Better income is a proxy indicator of food security. Our analysis show that crop produces which fetch high prices is generally less productive and it requires optimizing combination of price and yield. Accordingly, onion is by far the best crop in terms of optimizing revenue and it assures food security in maize equivalent 792% in 0.25 ha of land. Following, groundnut, Faba bean and teff ensure more that 100% food security in maize equivalent in a quarter of a hectare land. On the contrary mung bean, malt barley, common bean and wheat needs more allocation of land to ensure food security in maize equivalent.

7. CONCLUSION AND IMPLICATION OF THE STUDY

Extension is essentially the means by which new knowledge and ideas are introduced into rural areas in order to bring about change and improve the lives of farmers and their families. Extension, therefore, is of critical importance. Without its presence farmers would lack access to the support and services required to improve their agriculture and other productive activities. However, despite this promises the conventional extension services failed to be inclusive. It left the poor, women farmers and resource constrained youth groups. There is a need for advisory service to be inclusive of resource-poor and vulnerable farmers; tailored to the multiple capacities, needs and demands of farmers. To do so a continuous dialogue and learning between farmers and service providers; and based on complementary services by different actors including NGOs, projects and farmers organization is a call of the day.

The promise of customised extension service on the other hand lies in the potential to overcome the constraints and failures of previous approaches to agricultural advisory services – ranging from progressive farmers biased services to standardized a linear transfer of technologies orientation characterized by 'take it' or 'leave it' nature. The way in which customised extension service are able to respond to diverse farmers' demands is still poorly understood. This paper therefore provides an overview of the current state of knowledge on "customised extension service systems" from REALISE programme pilot interventions, examining the need for demand-driven service provision, and the policy considerations and functional institutional arrangements. REALISE has designed ad promoted customised intervention to heterogeneity of farmers which highlighted the importance of differentiated services. The experiences warranting further attention, not only from a provider perspective (who can offer services for whom?) but from the perspective of socio-economic transformation of smallholders operating at different capacity. Empowering women and promoting gender equality, creating a future for youth in agriculture, ensuring production and productivity for food security and improving rural livelihoods – all of these are issues that affect and are affected by the set-up of inclusive advisory services. In light of the foregoing discussion the following policy implication are drawn following REALISE experiences:

- Smallholder farmers are heterogeneous and they need differentiated advisory services based on their needs, capacities and means available at their exposure
- Policy framework and investment is required in technology generation, supply and advisory services restructuring to address the heterogeneous client's challenges such as food security, better income and livelihood improvement
- A step wise implementation of customised extension services starting from pilot to full-fledged ones could foster learning, informed decision and action.
- Conditions for scaling up of customized extension services such as full information of the different segments of the potential targets, appropriate supply of technology, conducive institutional arrangement and capacity is necessary

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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