# Investigating Technology Transfer Gaps Through Farmers Field School

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## Abstract

*Technology transfer is one of the core elements in a rapidly changing agricultural sector. However, the booming of agricultural innovation is not followed by the generation of methodological tools able to diffuse innovation in farmers and other stakeholders. For the last decades, Farmers Field School (FFS) approach is offering technology transfer and co-generation, infused by agricultural extension. Traditional FFS form is a learning by doing method and farmers are learning from other experienced farmers. Even though FFS has various forms which are trying to cover gaps between science and practice, there are still different methodological challenges in each FFS form. In this research, we propose a Hybrid FFS strategy, assembled by the strengths of various FFS forms and trying to close these gaps. We review and implement a meta-analysis of FFS forms, investigating these gaps. Afterwards, a comprehensive, holistic and dynamic conceptual and methodological model, derived from meta-analysis is proposed to cover the technology transfer methodological gaps. Our Hybrid FFS strategy highlight strategic questions which offer the appropriate background for establishing a strong educational strategy and overcome possible challenges. "Learning by doing" is supported from farmers to farmers as well as from experts to experts. Various stakeholders from value chain are promoted to use and be familiarized with new technologies, practical tools and the internet, as well as develop their managerial skills in value chain products. Modules cover the gaps of recent FFS approaches, by incorporating issues of sustainability and certification of value chain products, with business and entrepreneurship. Flexibility of a hybrid (virtual and physical) environment resolve complex situations (i.e. COVID-19). This methodology can be useful to policy makers managers or agricultural extension researchers, in order to construct, implement and evaluate an FFS agricultural program. Hybrid FFS strategy describes how agricultural education approaches of the past can create educational environments of the future and lead learning accelerators in agricultural sector.*

**Keywords**: Agricultural extension; applied research; CIPP model; evaluation; Farmers Field School; technology transfer;

**JEL Classification:** I21; I25;

**DOI:** http://doi.org/10.24818/ejis.2022.29

## 1. Introduction

Technology transfer is the diffusion of agricultural innovations from centers of discovery to end users and is the basic element of agricultural extension (Pershin *et al.*, 2009).

Received: 5 July 2022; Revised: 26 September 2022; Accepted: 30 November 2022

Technology transfer attempts to train and influence farmers' practices via the introduction of new technologies (Cook *et al.*, 2021). Nowadays, agricultural extension research is booming and is using various technology transfer methodologies (Cook *et al.*, 2021). But when experts transfer technology to farmers, they often neglect social, ecological or other issues (Charatsari and Lioutas, 2020; Cook *et al*., 2021).

A widely used methodology for technology transfer is field schools (Osumba *et al.*, 2021). Since '80, Farmers Field School (FFS) approach represented a response to the limited ability of these traditional, linear practices of knowledge transfer, to supply farmers with systemic and experiential knowledge (Charatsari *et al.*, 2020). FFS is a bottom-up (from farmer to farmer) agricultural learning approach which targets "learning by doing". A top-down approach is technology transfer from experts to farmers, whereas bottom-up approach disseminates the information from farmers to farmers. Farmers are sharing experiences to other farmers though group working on the field. This can work as a bridge to close gaps between science and the field (Charatsari *et al.*, 2020). Nowadays, FFS approach is widely used on applied research (Osumba *et al*., 2021) and evolved versions of the "classic FFS" are keeping the core idea: learning by doing and closing gaps from science to practice (Osumba *et al.*, 2021; Tham-Agyekum *et al*., 2021a). Even though there are numerous of research using different FFS approaches for agricultural extension and learning (Bakker *et al.*, 2021; Charatsari *et al.*, 2020; Rejesus and Jones, 2020; van den Berg *et al*., 2020), there is lack of a conceptual framework, applicable in different training programs and covering technology transfer methodological challenges of modern agriculture.

Methodological challenges of technology transfer are creating gaps between science and practice. Conventional agricultural extension, based on top-down technology transfer approach, is efficient in information dissemination but is inadequate to transform modern forms of agribusiness (Osumba *et al*., 2021). Modern agriculture has multidimensional problems in terms of environment, society and economy, creating challenges of a curriculum covering all important aspects (Dalampira and Nastis, 2020a; Dalampira and Nastis, 2020b). After outbreak of diseases (i.e. ebola, COVID-19), it was clear that FFS participatory methods should able to work in hybrid (physical and virtual) environments (Osumba *et al.*, 2021; FAO, 2020). In modern agri-food value chain, beneficiaries are not only farmers. Societal challenges create the need for hearing the voices of farmers and rural people (Charatsari et al., 2018), but also gaps between experts' and other stakeholders' perceptions should be considered (Dalampira and Nastis, 2020a; Dalampira and Nastis, 2020b; Salehi *et al.*, 2021). Also, evaluation of agricultural extension learning (Liossi, 2019) plays a critical role: it highlights what needs to change for better quality of learning (Charatsari and Lioutas, 2020). Experts have the experience to give feedback for changes in FFS learning program but are often unaware of real challenges of farmers (van den Berg *et al.*, 2021). On the other hand, co-creating and evaluating extension systems with farmers can strengthen their effectiveness (Lioutas *et al*., 2019). Hence, there is a need for holistic evaluation tools able to close the gap of perspectives between experts and farmers (Salehi *et al*., 2021) or other stakeholders (Dalampira and Nastis, 2020a) and simplify the assessment (Dalampira and Nastis, 2020b). All in all, an innovative approach is needed to promote the harmonization of complementary attributes of different FFS forms (Osumba *et al*., 2021).

The aim of the present paper is to support research into agricultural extension about technology transfer methodological gaps. More specifically we analyze and critically present current FFS research and develop a new conceptual and methodological FFS strategy which attempts to build on strengths and surpass limitations. First, a literature

review about technology transfer by using different FFS forms is presented. Afterwards, a meta-analysis describes the limitations of these FFS forms and explores the possibility of a more comprehensive model. Then, the Hybrid FFS strategy is proposed, as a more dynamic and systematic approach of an agricultural extension learning program. This is an attempt to fuse different FFS forms in order to cover technology transfer methodological gaps in future agricultural extension learning programs.

## 2. Literature review: Technology transfer by FFS

Farmers Field School (FFS) is an agricultural approach developed in the late 80's by Food and Agricultural Organization of United Nations (FAO). Field School is a group-based extension concept based on the principles of adult learning (Osumba *et al.*, 2021). In all its forms, FFS methodology is usually based on technology transfer and co-generation, infused by agricultural extension.

In this section, different forms of FFS are presented. These forms are according to differentiation found in literature but also recognized by the FAO, the organization behind the creation of the FFS approach. In this way, we aim to reveal the main characteristics of each form, as well as strengths and weakness. Therefore, this section is structured according to this observation of different forms of FFS and their evaluation.

### 2.1 Integrated Pest Management FFS: the core of FFS approach

The first FFS application was on rice Farmers in Asia who investigated and learned by themselves, obtained required skills and inherit benefits from adopting Integrated Pest Management (IPM) practices in their fields (Pershin *et al.*, 2009). This first form of field school was afterwards evolved. Since then, the approach is used globally in many other cultivations (Hussain *et al.*, 2017) and livestock (Cai *et al*., 2021) and in various directions of agricultural extension (Osumba *et al*., 2021; Naval *et al*., 2021; Charatsari *et al*., 2020).

The main principles of IPM FFS is select a field, farmers cultivate and experiment on this field for a crop season. During this experimentation, they learn how to grow a healthy crop by reducing pests in an ecological way (SUSTAINET EA, 2010). The essential elements to build a program with FFS approach is a group of 10 to 30 participant farmers with common interests, needs, problems. These farmers experiment on a field, by using a curriculum generated in local conditions or problems (SPRING, 2017) and based on the natural cycle of a cultivation or livestock (Amanah *et al*., 2021). A facilitator (usually extension agent) is the person to lead participants to hand-on exercises, but not as teachers; once the farmers know what to do in the activity, he/she only offers guidance (Amanah *et al.*, 2021). Duration is one crop or livestock cycle (Amanah *et al.*, 2021).

FFS approach in IPM form is largely bottom-up and farmers are learning from farmers. It evolved from the concept that optimal learning is derived from experience in the field, from farmers to farmers (Pershin *et al.*, 2009). In this bottom-up methodology, they empower communities and build their decision-making, promote adaptation practices though social learning and capacity building (Charatsari *et al.*, 2020). Key educational strategy is observation which will lead to knowledge and create co-generation of the agriculture. Curriculum of learning programs is about an agricultural commodity (i.e. plant, animal). Regarding the content of modules, the major focus is on IPM experiments. This form of adult learning approach is included in outdoor learning, with focal facility a field site, because "*it is a school without walls composed by farmers*" (FAO, 2006).

### 2.2 Climate Field School: bringing solutions for climate resilient cultivations

Climate Field School (CFS) derived from IPM FFS. CFS objectives to select an area and increase the knowledge of farmers about climatological processes in order to grow a healthy crop in a sustainable way and anticipate in extreme weather events in their agricultural planning (FAO, 2019). The essential elements by using FFS approach is facilitating farmers information about climate and using it to build their own experiences and knowledge about management decisions. The farmers learn on a meteorological station or similar facility by a facilitator who guides to set up management strategies (FAO, 2019).

CFS is largely top-down because farmers learn from facilitators, who are experts about the climate (Osumba *et al.*, 2021). Key educational strategy is technology transfer and focusing how to disseminate science information. The major focus of the curriculum is climate and agrometeorological analysis, and learning is occurred by "good practice" demonstrations. The content of modules includes meteorological hazards (i.e. heat stress, flood). This form is indoor experimental adult learning (Osumba *et al.*, 2021).

### 2.3 Digital Farmers Field School: the new era of FFS

Digital Farmers Field School (DFFS) was firstly created, as a form of FFS able to cover the inability to "work on field"; focal facility of learning, is another medium of communication, instead of the field (Sasidhar *et al*., 2011). Also, DFFS can use the field in combination with other mediums such as internet, as an alternative solution for participants to access information (Lairing *et al.*, 2021). An example could be circumstances of diseases like ebola (Witteveen *et al*., 2017) and COVID-19 (Lairing *et al*., 2021; FAO, 2020) and other reasons like long distances between participants and inability to transportation (Sasidhar *et al*., 2011). DFFS is implementing the same techniques and methods and keeping the core principles of FFS (Osumba *et al.*, 2021). By using a medium of communication (i.e. video, radio, internet), distance learning programs can be conducted to have attitude change and gaining knowledge (Ongachi *et al.*, 2017; Osumba *et al.*, 2021; Sasidhar *et al*., 2011; Wyckhuys *et al.*, 2018).

This FFS form may lack of group activities (Sasidhar *et al*., 2011) or not (Witteveen *et al*., 2017). But main principles of FFS like learn how to grow a healthy crop in an ecological way, exchange knowledge and solving common problems and covering common needs are used in DFFS (Lairing *et al*., 2021). Also, in many cases there is the ability for group collaboration via the use of the medium of communication (Sasidhar *et al.*, 2011; Witteveen *et al*., 2017).

As a form of FFS, DFFS approach, can have application in both IPM and CFS curriculums, whereas can be ether bottom-up or top-down (Osumba *et al*., 2021). DFFS evolved from the combination of need of experiential learning and inability to work on the field (Lairing *et al*., 2021). Key educational strategy is technology transfer and responsible innovation of local stakeholders, based on the use of digital technology (Lairing *et al*., 2021). Curriculum of the learning included an agricultural commodity and use of digital technology. Modules can include IPM, certification, sustainability standard certification, market linkages in value chain (Lairing *et al*., 2021; Witteveen *et al.*, 2017). This form of adult learning can be indoor, outdoor or both (Lairing *et al*., 2021; Osumba *et al*., 2021; Witteveen *et al*., 2017). DFFS is offering a new perspective of Agricultural Extension and can be leveraged to develop learning models of farmers' group networks (Osumba *et al.*, 2021).

### 2.4 Farm Business School: incorporating management in FFS

Farmers Business School (FBS) is another form of FFS learning approach which supports farmer groups' participation in agricultural market and value chains (Huong and Huong,

2018). FBS build capacity among farmers to improve their business knowledge, decision - making skills and to change attitudes towards commercialization (Chilemba and Ragasa, 2020). FBS empower the FFS with entrepreneurial skills of farmers, improve knowledge and skills for viability and growth of farms as businesses (Naval *et al.*, 2021). The essential elements to build a program with FBS form is a group of 10 to 30 members with common market needs and problems (Chilemba and Ragasa, 2020). These farmers are implementing a curriculum which will help them learn, as a group, "*technical and business knowledge and interact with market chain actors and stakeholders such as input suppliers, traders, retailers, transporters, and others*" (Huong and Huong, 2018). Duration usually lasts one year starting before planting and continue through the full cropping season (Chilemba and Ragasa, 2020).

FBS approach is linked to the models of farmer-to-farmer extension or farmer-centered-extension, hence it is largely bottom-up (Chilemba and Ragasa, 2020). FBS activities are based on participatory, field based and joint learning (Chilemba and Ragasa, 2020; Prain *et al*., 2020). Key educational strategy is customer emphasis, intelligence dissemination and market responsiveness (Tham-Agyekum *et al*., 2021a). Curriculum of the learning program is based on business and entrepreneurship, in order to increase the capacity of farmers to manage their farms effectively and increase their profitability (Chilemba and Ragasa, 2020). Contents (modules) are covering management and business issues from seed selection to marketing of farm produce (Naval *et al*., 2021). The major focus is entrepreneurial skills and development of smallholders, market orientation and application of improved techniques. Focal facility of the learning is the field as well as the entire market and value chain., hence it is outdoor or indoor combined with experimental learning (Huong and Huong, 2018).

## 3. Meta-analysis: gaps of current FFS

Reviewing and analysing the above prominent technology transfer strategies which are occurred through FFS approach have revealed similarities and differences as well as methodological gaps between them. These key observations from planning and implementation to evaluation are presented below in ***Table 1***.

Firstly, the top-down approach of some FFS forms reveal the question of the validity of categorization as FFS. In other words, it is questionable whether a learning can be named as FFS, if the fundamental factor of FFS, the bottom-down approach itself, is missing. CFS and DFFS use the conventional extensionist-centred top-down approach, whereas IPM and FBS the group-centred bottom-up approach. But the fundamental feature of technology transfer "from farmer to farmer" in a top-down model, could in theory help other farmers from their knowledge of CFS (Osumba *et al*., 2021) and bring all stakeholders together and facilitate towards local innovation to overcome the challenges to DFFS (Lairing *et al.*, 2021). Therefore, a framework covering both extremes, from largely bottom-up to largely top-down, may contribute to a more systematic planning of FFS, rather than strictly follow one approach.

**Table 1. Key factors of conceptual and methodological differences between Farmer Field School forms**

| Strategic question | Factor | IPM | Climate Field School | Farmer Business Schools | Digital Farmer Field School |
|---|---|---|---|---|---|
| *Why?* | *Approach* | Largely bottom-up | Largely top-down | Largely bottom-up | Largely top-down |
| | *Key strategy* | Observation & knowledge/co-generation | Technology transfer & dissemination of information (how to use it) | Technology transfer & market responsiveness | Technology transfer & responsible innovation |
| *What?* | *Curriculum* | Agricultural commodity (i.e. plant, animal) | Meteorological hazard for cultivations/husbandries (i.e. heat stress, drought) | Agricultural commodity and business and entrepreneurship | Agricultural commodity and use of technology |
| | *Major focus/ content of modules* | Integrated Pest management experiments | Climate analysis, demonstration of good practice (instead of experimentation) | Business and entrepreneurial skills development of smallholder, improving market orientation, apply improved techniques | Integrated Pest Management, certification, sustainability standard certification, market linkages in value chain |
| *Where?* | *Focal facility* | Outdoor (i.e. field) | Indoor (i.e. agrometeorological station) | Outdoor & Indoor (i.e. field, classroom, entire market) | Medium of communication (i.e. field, internet, radio, learning platform) |
| *Whom?* | *Target groups* | Farmers | Farmers | Farmers & other stakeholders | Stakeholders in the value-chain |

Source: Adapted from by Osumba *et al.* (2021)

Second, it is noteworthy that all forms of FFS are derived from the evolved key strategy of IPM form. IPM built on the key strategy of observation and knowledge in order to succeed co-generation (Osumba *et al*., 2021). This strategy was transformed into targeting on how to use innovation and information and implement technology transfer to CFS, DFFS and FBS forms (Lairing *et al*., 2021; Naval *et al*., 2021; Tham-Agyekum *et al*., 2021b). It is ambiguous if co-generation tends to exclude the other side of technology transfer. Also, each one of the FFS forms had an extra factor in their strategy; dissemination of information (CFS), market responsiveness (FBS) and responsible innovation (DFFS). Promoting a more spherical key strategy with combined approaches (technology, sustainability, trade), completed each other can lead to a more inclusive methodology (Chilemba and Ragasa, 2020; Ongachi *et al*., 2017).

Third, contents as well as curriculum of FFS forms have wide variation, covering additional issues for the development of the smallholders. Even though, a specific agricultural commodity such as a plant or an animal is the basis of the curriculum, each form tries to induce an additional aspect and solving a revealed problem. Meteorological hazards and sustainability, using digital technology, marketing and entrepreneurship are interconnected issues which counterpart an agricultural commodity (Chilemba and Ragasa, 2020; Lairing

*et al*., 2021; Ongachi *et al*., 2017; Osumba *et al*., 2021). A multidimensional curriculum is lacking from substantial support to solve these problems.

Forth, more comprehensive major focus (contents and methodology) leads to an integrated outlook. Similarly to the curriculum, major focus of FFS should follow the multidimensionality of modern sustainability (Dalampira and Nastis, 2020b). Consequently, IPM FFS experiments regarding the pests to a cultivation but there is a need to observe them as agribusiness with both technical and marketing problems (Codron *et al*., 2014; Maman *et al*., 2017; Ortiz *et al*., 2019; Rejesus and Jones, 2020). CFS Climate analysis focus on good practices, which may also have an impact in pests but also marketing related issues (Naval *et al*., 2021). On the other hand, FBS and DFFS apply improved techniques and offer market linkages in value chain (Witteveen *et al*., 2017). What if there was a broader major focus, covering all the above? Modern needs require modern solutions incorporated in a connected way.

Returning to the first argument, even fundamental factors of FFS differentiate, we can still practice FFS. Hence, the "field" can be any focal facility used for FFS. Again, the forms of FFS are using a binary continuum of the place "where learning happens". More "traditional" forms like IPM uses outdoor learning and its diametrically opposed indoor learning is used by CFS and FBS forms. But the key issue of the "field" is to learn in an experimental way, rather than using an actual piece of land as a learning site. Experimental techniques and methods can work outdoors, as well as indoors. Also, the newly induced form DFFS, propose diverse environments as "fields" of learning (Ongachi *et al*., 2017), which provide us with solutions to problems. Depending on the content of each module but also on the practicality of each circumstance each one farmer or facilitator can teach one other farmer using land, classroom and/or internet as focal facility (Lairing *et al*., 2021; Naval *et al*., 2021; Ongachi *et al*., 2017; Osumba *et al*., 2021; Witteveen *et al*., 2017).

In the context of implementation, even though FFS was firstly inspired to be implemented in learning programs only by farmers, nowadays participants are various stakeholders (FAO, 2020). Target groups of FFS can be local, regional or national public authorities, sectorial agencies (such as research companies), education/training centers and schools, SMEs, business support organizations, higher education and research institutions, enterprises in the agri-food sector (i.e. growers associations), NGOs and other interested groups. The IPM and CFS form, as a more traditional way of implemented FFS (SUSTAINET EA, 2010), targets on farmers participate in learning process (Arnés *et al*., 2018; Charatsari *et al*., 2018; David, 2007). DFFS can train farmers, but also includes other stakeholders of the value chain in gathering the rural knowledge of the learning material, at the stage of planning (Witteveen *et al*., 2017). Also, there is research shown that participants in DFFS are not only "farmers" but "stakeholders" or "value-chain actors" (Lairing *et al*., 2021; Sasidhar *et al*., 2011; Wyckhuys *et al*., 2018). Also, in FBS form there are cases focusing on farmer implementation of FFS (Chilemba and Ragasa, 2020) or farmers interacting with other value-chain actors and stakeholders such as traders and service providers (Prain *et al*., 2020). The nature of FFS forms demands a multi-stakeholder approach (Osumba *et al*., 2021).

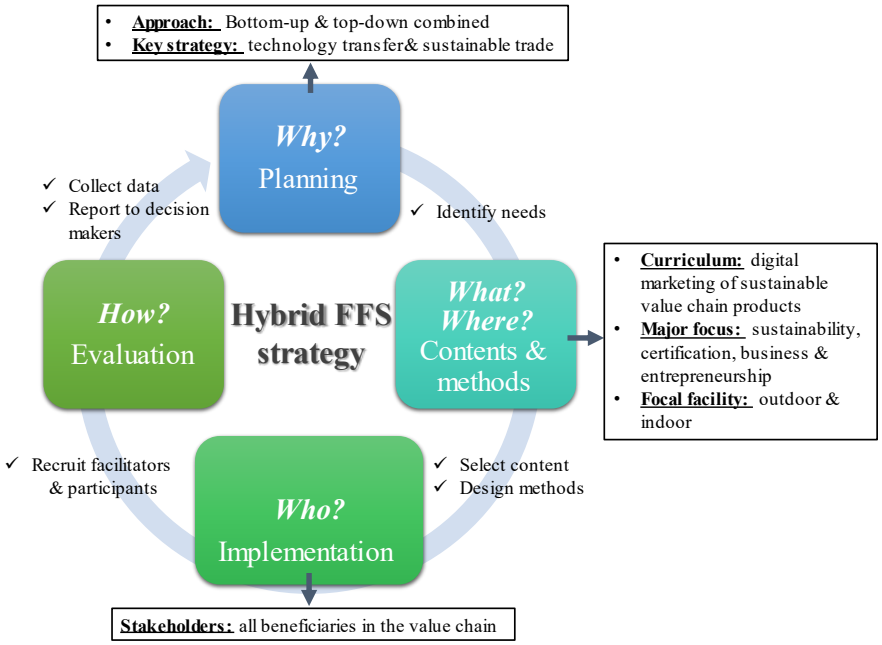
Finally, an integral part of FFS approach is evaluation and monitoring. FFS is based on experimental adult learning, hence one of its core principles is a targeted, fully organized evaluation (El Sawi, 1996). For FFS evaluation it is important to consider achieving practicality and usefulness of the evaluation methodology (Peshin *et al*., 2009). In this way, the next cycle or learning, will be revised and corrected for better results. Before establishing FFS content, an assessment should be performed to identify educational needs

(FAO, 2016). Formal surveys alone cannot provide an in-depth analysis to understand farmers' empowerment (David, 2007). Qualitative studies using diffusion and social network mapping, focus groups and participant observation are needed to complement formal surveys (Bogner *et al*., 2009). The key indicators (group profile, plants, good management, group experimentation etc.) of successful FFS will give the appropriate information on whether learning cycle is working between participant farmers and facilitator (FAO, 2016). Widely used evaluation methods and models, such as Bennett's Hierarchy and CIPP model can be applied in different FFS forms, depending on the aim and objectives of the learning program (Salehi *et al*., 2021; Sasidhar *et al*., 2011). CIPP has been proposed from key theorists as a basis to build a metamodel of evaluation (Owen, 2004). Bennett's hierarchy has been used for DFFS an revealed a major impact on developing awareness (Sasidhar *et al*., 2011). A wide range of evaluation concepts and models exists, but the framework of the original CIPP model (Owen, 2004), is still successfully used in FFS research (Salehi *et al*., 2021). According to FAO, combination of Bennett and CIPP evaluation models in FFS programs focusing on rural empowerment, innovation, and agricultural development (Amanah *et al*., 2021).

## 4. Towards a new framework: hybrid FFS

Based on the meta-analysis, we developed a new FFS strategy, incorporating the strengths and surpass limitations of different FFS forms. Our conceptual and methodological framework combined current FFS methodologies, in order to construct a Hybrid FFS strategy, which covers technology transfer methodological gaps (***Figure 1***).

**Figure 1. Conceptual and methodological framework of Hybrid FFS strategy**




Source: Adapted from Amanah *et al.* (2021, 2006); Salehi *et al.* (2021)

The Hybrid FFS strategy includes four steps inspired from fundamental strategy to effective evaluation: planning, contents and methods, implementation, and evaluation (Amanah *et al*., 2021). These steps, impose clear strategic questions which need to be answered, in an FFS learning program. Elements of previous research of IPM, CFS, DFFS and FBS incorporated, revealed the Hybrid FFS strategy.

*Why should participants feel motivated?* - Planning is the core of Hybrid FFS and is referred to key strategy and approach. It investigates the needs of the participants and conclude to the vision and incentives of the strategy. It motivates people to participate. Bottom-up and top-down approach combined, can offer the ability to learn from the experts the difficult scientific information and discuss with the farmers, practical local problems erased, in order to find solutions. Key strategy is technology transfer for a sustainable trade, hence, covering topics from farm to market in the context of sustainability.

*What will we achieve? Where will we achieve it?* – Creating contents and methods of Hybrid FFS strategy is the second step. It includes the curriculum, major focus, and contents of modules. The goals, objectives and outcomes are finalized in this stage. Curriculum target on the digital marketing of sustainable value chain products. Modules include thematic areas of sustainability and conservation standardization, business, marketing and entrepreneurial skills and certification following local legislation. The focal facility - outdoor, indoor or both - of Hybrid FFS strategy depends on the availability of participants, but also the thematic areas of modules.

*Who will be valued?* – Implementation of Hybrid FFS strategy is occurred by various stakeholders. In this step, the value network of this strategy is documented. Hybrid FFS strategy has a multidimensional curriculum; hence it offers the inclusivity needed for multi-stakeholder implementation. Participants are not only farmers, but also processors, manufacturers, traders, public or private organizations, research, or educational centers.

*How will we count the degree of the achievement?* – Evaluation is the final and closing step of the Hybrid FFS strategy cycle. Evaluation strategically analyses the resources that should be allocated to accomplish the mission, for the value network. Without evaluation, Hybrid FFS cannot be finished. We created a metamodel of evaluation, based on CIPP model (Owen, 2004) and combined two generic forms of evaluation with detailed information (***Table 2***).

**Table 2. Evaluation metamodel of Hybrid FFS strategy**

| CIPP stages | Owen's evaluation | Audience benefited | Type | Stage | Focus | Method | Time |
|---|---|---|---|---|---|---|---|
| *Context* | Program development/ proactive | Internal | Summative | Planning (program synthesis) | Goals/ objectives | Needs-based | Before implementation |
| *Input* | Impact assessment/ Learning accountability | External | Formative | Evaluation (settled/ finished program) | Outcomes /delivery | Goal-based/needs-based | After implementation |
| *Process* | | | | | | | |
| *Product* | | | | | | | |
| *Output* | | | | | | | |
| *Program reengineering* | | | | | | | |

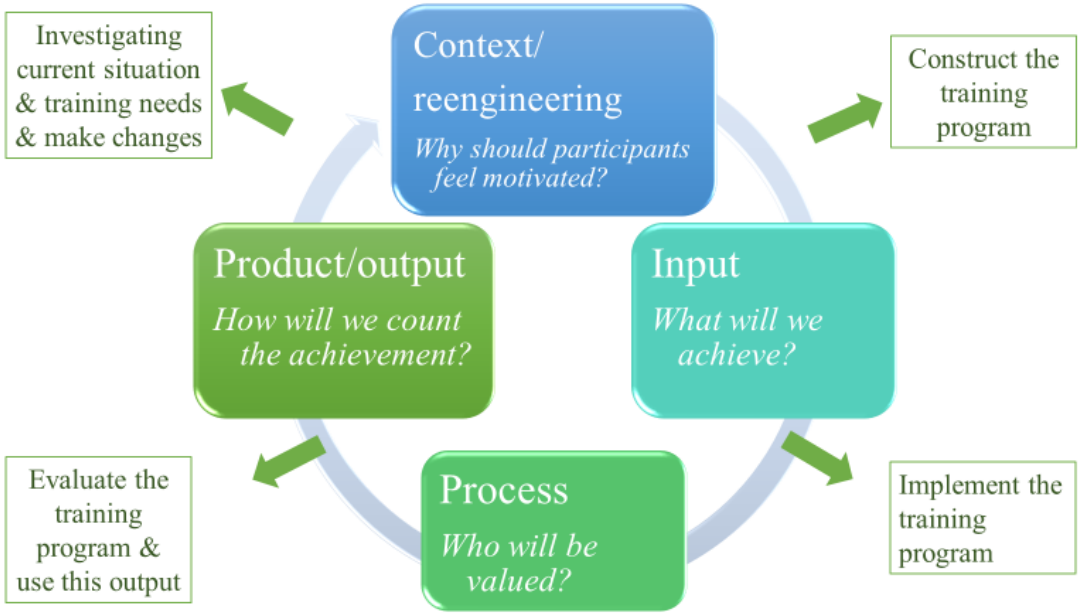
Source: Adapted from Owen (2004); Salehi *et al.* (2021)

The Hybrid FFS evaluation model is based is proposed in order to close the gap between experts and farmers perspectives (Charatsari *et al.*, 2018; Salehi *et al*., 2021). CIPP methodology is used to separate the stages of evaluation in a multiperspective form, including program development (context stage) and impact assessment (Input-Process-

Product-Output-Program reengineering stages). The use of the stages are to determine, before and after implementation, the worth of the learning program (Owen, 2004).

This mixed type (formative and summative) of evaluation creates a more spherical evaluation, offering knowledge about the outcomes, but also the impact to stakeholders and society ( Charatsari *et al*., 2020; Salehi *et al*., 2021). Summative part reports on the program as it is needs-based for participants (Charatsari and Lioutas, 2020). Formative part, impact assessment is goal-based and reports to the program for its improvement (Salehi *et al.*, 2021). Overall, the proposed Hybrid FFS evaluation model is depicted by ***Figure 2***.

**Figure 2. Hybrid FFS evaluation model**




Source: Adapted from Salehi *et al.* (2021)

## 5. Conclusion

In a rapidly changing rural environment, there is an urging need for modern technology transfer methodologies. Even though different forms of FFS (IPM, CFS, DFFS, FBS) are ideal approaches for co-generation and technology transfer, there are methodological and practical gaps. There is a demand for a methodological tool able to work in an international level, which will offer a holistic approach for closing gaps between science, technology and practice.

We propose an original conceptual and methodological Hybrid FFS strategy, generated from critically reviewing strengths and limitations of various FFS forms. Hybrid FFS strategy entails conceptual and methodological framework, from planning to evaluation of an agricultural extension program. Hybrid FFS strategy is showing a path to cope with challenges of modern agricultural extension with clear cut questions. Combination of bottom-up and top-down approaches are offering a common ground with training needs to be achieved. Key strategy is the technology transfer and sustainable trade. Overall, with a

Hybrid FFS strategy, stakeholders will be promoted to use and be familiarized with new technologies, practical tools and the Internet, as well as develop their managerial skills in value chain products. Modules will cover the gaps of recent FFS approaches, by incorporating issues of sustainability and certification of value chain products, with business and entrepreneurship. Ability to work in both physical and virtual environments offer the flexibility needed to complex circumstances (i.e., COVID-19). Stakeholders valued from this procedure are beneficiaries of the whole value chain. Finally, this strategy should count the degree of the achievement by a holistic evaluation.

Hybrid FFS strategy is a proposed methodological tool trying to surpass limitations and discovering weaknesses of different FFS forms. Using a different conceptual model or framework may result into a more comprehensive or effective tool. Also, there is a possibility of neglecting weaknesses of FFS forms. Although, it can be a useful methodological tool for agricultural extension training programs. Policy makers, managers or agricultural extension researchers, could use it to construct, implement and assess an agricultural extension training program. This newly induced framework could work as the first step of organizing technology transfer programs from the beginning or investigate if ongoing projects are right on track. This work may provide new perspective for future planning as well as evaluation of extension/education projects.

**Acknowledgement:** This was financially supported by the European Union, the Joint Technical Secretariat of the Managing Authority of the Black Sea Basin 2014-2020 Programme, under the project "Herbs for Growth"-HEGO (BSB987). The present study has been presented at the 14th International Conference "Economies of the Balkan and Eastern European Countries", EBEEC 2022, Florence, Italy (http://ebeec.ihu.gr/).

## References:

Arnés, E., Díaz-Ambrona, C.G., Marín-González, O. et al. (2018). Farmer field schools (FFSs): A tool empowering sustainability and food security in peasant farming systems in the Nicaraguan highlands. *Sustainability* (Switzerland) 10(9). DOI: 10.3390/su10093020.

Amanah, S., Seprehatin, S., Iskandar, E., Eugenia, L., & Chaidirsyah, R.M. (2021). Investing in farmers through public–private–producer partnerships – Rural Empowerment and Agricultural Development Scaling-up Initiative in Indonesia. FAO Investment Centre Country Highlights, No. 7. Rome, FAO and IFPRI. https://doi.org/10.4060/cb7126en

Bakker, T., Blundo Canto, G., Dugué, P. et al. (2021). To what extent is the diversity of Farmer Field Schools reflected in their assessment? A literature review. *Journal of Agricultural Education and Extension* 27(3): 381–401. DOI: 10.1080/1389224X.2020.1858890.

Bogner, A., Littig, B., & Menz, W. (2009). Introduction: Expert Interviews --- An Introduction to a New Methodological Debate. In: Bogner A, Littig B, and Menz W (eds) *Interviewing Experts*. London: Palgrave Macmillan UK, pp. 1–13. DOI: 10.1057/9780230244276_1.

Cai, J., Ding, F., Hong, Y., et al. (2021). An Impact Analysis of Farmer Field Schools on Hog Productivity: Evidence from China. *Agriculture* 11(10). DOI: 10.3390/agriculture11100972.

Charatsari, C., & Lioutas, E.D. (2020). Evaluating agricultural extension and education projects: the VELVET approach. *Development in Practice* 30(4): 548–557. DOI: 10.1080/09614524.2020.1727856.

Charatsari, C., Koutsouris, A., Lioutas, E.D. et al. (2018). Promoting Lifelong Learning and Satisfying Farmers' Social and Psychological Needs Through Farmer Field Schools: Views From Rural Greece. *Journal of Agricultural and Food Information* 19(1): 66–74. DOI: 10.1080/10496505.2017.1325742.

Charatsari, C., Lioutas, E.D., Koutsouris, A. (2020). Farmer field schools and the co-creation of knowledge and innovation: the mediating role of social capital. *Agriculture and Human Values* 37(4): 1139–1154. DOI: 10.1007/s10460-020-10115-8.

Chilemba, J., & Ragasa, C. (2020). The Impact on Farmer Incomes of a Nationwide Scaling Up of the Farmer Business School Program: Lessons and Insights from Central Malawi. *European Journal of Development Research* 32(4): 906–938. DOI: 10.1057/s41287-019-00246-y.

Codron, J.M, Adanacioğlu, H., Aubert, M. et al. (2014). The role of market forces and food safety institutions in the adoption of sustainable farming practices: The case of the fresh tomato export sector in Morocco and Turkey. *Food Policy* 49. Pergamon: 268–280. DOI: 10.1016/J.FOODPOL.2014.09.006.

Cook, B.R., Satizábal, P., Curnow, J. (2021). Humanising agricultural extension: A review. *World Development* 140. DOI: 10.1016/j.worlddev.2020.105337.

Dalampira, E.S., Nastis, S.A. (2020a). Back to the future: Simplifying Sustainable Development Goals based on three pillars of sustainability. *International Journal of Sustainable Agricultural Management and Informatics* 6(3): 226–240. DOI: 10.1504/IJSAMI.2020.112089.

Dalampira, E.S., Nastis, S.A. (2020b). Mapping Sustainable Development Goals: A network analysis framework. *Sustainable Development* 28(1). DOI: 10.1002/sd.1964.

David, S. (2007). Learning to Think for Ourselves: Knowledge Improvement and Social Benefits among Farmer Field School Participants in Cameroon. *Journal of International Agricultural and Extension Education* 14(2): 35-49.

El Sawi, G. (1996). Curriculum Development Guide: Population Education for Non-Formal Education Programs of Out-of-School Rural Youth, Extension, Education and Communication Service (SDRE)-Food and Agriculture Organization of The United Nations. Rome, Italy. Available at: https://www.fao.org/3/ah650e/AH650E00.htm#Contents

FAO (2006). *Farmer Field School (FFS) Manual - Special Framework of Assistance (SFA): Guidelines for the Implementation of a Farmer Field School (FFS)*. FAO and European Union. St. Lucia.

FAO (2016). *Farmer Field School Guidance Document. Planning for quality programmes*. FAO. Italy: Rome. ISBN 978-92-5-109126-5.

FAO (2019). *Farmer Field School Curriculum on Climate Smart Agriculture in coastal/delta zone*, Ayeyarwady Region, Myanmar. Yangon, 20 pp. Licence: CC BY-NC-SA 3.0 IGO. ISBN 978-92-5-131328-2.

FAO (2020). *Running farmer field schools in times of COVID-19: A resource handbook*. Rome. https://doi.org/10.4060/ca9064en.

Hussain, M., Rehman, F., Bibi, I. et al. (2017). Impact of farmer field school approach on the competency of the farmers. *Journal of Animal and Plant Sciences* 27(3): 991–995.

Lairing, N., Witteveen, L., Busa, Y. et al. (2021). Co-constructing principles for Digital Farmer Field School Enrekang Design in South Sulawesi - Indonesia. E3S Web Conf. 306: 3013. DOI: 10.1051/e3sconf/202130603013.

Liossi, F. (2019). Validation of non-formal and informal learning: From European policies to national implementation | Επικύρωση της μη-τυπικής και άτυπης μάθησης: Από τις ευρωπαϊκές πολιτικές στις εθνικές εφαρμογές. Academia (Greece) 2019(14): 93–118.

Lioutas, E.D., Charatsari, C., Černič Istenič, M. et al. (2019). The challenges of setting up the evaluation of extension systems by using a systems approach: the case of Greece, Italy and Slovenia. *The Journal of Agricultural Education and Extension*. Routledge: 1–22. DOI: 10.1080/1389224X.2019.1583818.

Maman, U., Inawati, I., Aminudin, I. et al. (2017). The need of tailor made agribusiness farmer field school to develop entrepreneurship: The experience from paddy seed growers in Indonesia context. *Journal of Engineering and Applied Sciences* 12(10): 2676–2681. DOI: 10.3923/jeasci.2017.2676.2681.

Naval, R.C., Carig, E.T., Dolojan, F.M. et al. (2021). Empowering the entrepreneurial skills of women vegetable growers through farmer business school. *International Journal of Agricultural Technology* 17(3): 991–1000.

Ongachi, W., Onwonga, R., Nyanganga, H., Okry, F. (2017). Comparative Analysis of Video Mediated Learning and Farmer Field School Approach on Adoption of Striga Control Technologies in Western Kenya. *International Journal of Agricultural Extension* 5: 1–10.

Ortiz, O., Nelson, R., Olanya, M. et al. (2019). Human and Technical Dimensions of Potato Integrated Pest Management Using Farmer Field Schools: International Potato Center and Partners' Experience with Potato Late Blight Management. *Journal of Integrated Pest Management* 10(1). DOI: 10.1093/jipm/pmz002.

Osumba, J.J.L., Recha, J.W., & Oroma, G.W. (2021). Transforming Agricultural Extension Service Delivery through Innovative Bottom–Up Climate-Resilient Agribusiness Farmer Field Schools. *Sustainability* 13(7). DOI: 10.3390/su13073938.

Owen, J. (2004). *Evaluation Roots*. Thousand Oaks, California: SAGE Publications, Inc. DOI: 10.4135/9781412984157.

Peshin, R., Vasanthakumar, J., Kalra, R. (2009). Diffusion of Innovation Theory and Integrated Pest Management. In: Peshin R. and Dhawan A. (Eds.) *Integrated Pest Management: Dissemination and Impact.* Vol.2, Springer Science+Business Media B.V. e-ISBN: 978-1-4020-8990-9.

Prain, G., Wheatley, C., Odsey, C. et al. (2020). Research-development partnerships for scaling complex innovation: Lessons from the Farmer Business School in IFAD-supported loan-grant collaborations in Asia. *Agricultural Systems* 182. DOI: 10.1016/j.agsy.2020.102834.

Rejesus, R.M., & Jones, M.S. (2020). Perspective: enhancing economic evaluations and impacts of integrated pest management Farmer Field Schools (IPM-FFS) in low-income countries. *Pest Management Science* 76(11): 3527–3536. DOI: 10.1002/ps.5912.

Salehi, M., Abbasi, E., Bijani, M. et al. (2021). Evaluation of agricultural extension model sites approach in Iran. *Journal of the Saudi Society of Agricultural Sciences* 20(8): 506–518. DOI: https://doi.org/10.1016/j.jssas.2021.06.002.

Sasidhar, P.V.K., Suvedi, M., Vijayaraghavan, K., et al. (2011). Evaluation of a Distance Education Radio Farm School Programme in India: Implications for Scaling up. *Outlook on Agriculture* 40(1): 89–96. DOI: 10.5367/oa.2011.0033.

Sawi G., 1996. Curriculum Development Guide: Population Education for Non-Formal Education Programs of Out-of-School Rural Youth. Extension, Education and Communication Service (SDRE)-Food and Agriculture Organization of The United Nations. Rome, Italy. Available at: https://www.fao.org/3/ah650e/AH650E00.htm#Contents

SPRING (2017). Farmer Field School Curriculum: Good Agronomic Practices for Groundnut Production. Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) project. Arlington, VA.

SUSTAINET EA (2010). Technical Manual for farmers and Field Extension Service Providers: Farmer Field School Approach. Sustainable Agriculture Information Initiative, Nairobi.

Tham-Agyekum, E.K., Kwarteng, J., Okorley, E.L. et al. (2021a). Market orientation and entrepreneurial proclivity as antecedents of innovative behaviour: Implications for cocoa farmers in Ghana. *Journal of Agriculture and Crops* 7(4): 132–139. DOI: 10.32861/jac.74.132.139.

Tham-Agyekum, E.K., Okorley, E.L., Kwarteng, J. et al. (2021b). Enhancing market orientation of cocoa farmers through farmer business schools: The Ghana cocobod experience. *Asian Journal of Agriculture and Rural Development* 11(1): 129–138. DOI: 10.18488/journal.ajard.2021.111.129.138.

van den Berg, H., Ketelaar, J.W., Dicke, M. et al. (2020). Is the farmer field school still relevant? Case studies from Malawi and Indonesia. NJAS - Wageningen Journal of Life Sciences 92. DOI: 10.1016/j.njas.2020.100329.

van den Berg, H., Phillips, S., Poisot, A.S. et al. (2021) Leading issues in implementation of farmer field schools: a global survey. *Journal of Agricultural Education and Extension* 27(3): 341–353. DOI: 10.1080/1389224X.2020.1858891.

Witteveen, L., Lie, R., Goris, M. et al. (2017). Design and development of a digital farmer field school. Experiences with a digital learning environment for cocoa production and certification in Sierra Leone. *Telematics and Informatics* 34(8): 1673–1684. DOI: https://doi.org/10.1016/j.tele.2017.07.013.

Wyckhuys, K.A.G., Bentley, J.W., Lie, R. et al. (2018) Maximizing farm-level uptake and diffusion of biological control innovations in today's digital era. *BioControl* 63(1): 133–148. DOI: 10.1007/s10526-017-9820-1.