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Empowering change for sustainable agriculture: the need for participation

K. Kusnandar[a,b], F.M. Brazier[a] and O. van Kooten [c,d]

[a]Faculty of Technology, Policy and Management, Delft University of Technology, Delft, Netherlands; [b]Research Center for Development of Science and Technology, Indonesian Institute of Sciences; [c]Horticulture and Product Physiology, Department of Plant Science, Wageningen University; [d]Inholland University of Applied Science, Delft, Netherlands

ABSTRACT

Sustainable agricultural development (SAD) requires empowerment and engagement of all actors in the agricultural production and supply chain to enable change. This paper proposes a novel framework for Participatory Sustainable Agricultural Development (PSAD) that distinguishes four main classes of factors that influence participation in SAD: environmental, economic, social and governance-related. The factors in each of these classes are analysed in relation to their effect over time, on the basis of 49 SAD programmes reported in the literature. Findings show that the social factors of engagement and empowerment, not often addressed in existing SAD programmes, are of significant influence to effect over time, as are the environmental factors of food safety, and the economic factors of production and capacity development. As such this paper shows that in in addition to the well-acknowledged need for knowledge and skills related to food safety, production and capacity development, SAD programmes also need to address the social factors of engagement and empowerment to enable sustainable change over time for SAD through participation.

KEYWORDS

Sustainable agricultural development; participatory; empowerment; engagement; developing countries

Introduction

The United Nations' Sustainable Development Agenda, explicitly names 3 Sustainable Development Goals (SDGs) for Sustainable Agricultural Development (SAD): SDG 2.3, SDG 2.4 and SDG 12.3.[1] These SDGs address not only on-farm activities but also off-farm activities such as those related to the supply chain, services, and markets.

Policy development for SAD mandates an understanding of factors that influence the potential to achieve SAD within existing production and supply chains in developing countries. Previous studies on factors (Dillon et al., 2016; FAO, 2014; Grenz, Thalmann, Stampfli, Studer, & Hani, 2009; Komnitsas & Doula, 2017; Speelman, López-Ridaura, Colomer, Astier, & Masera, 2007; Van Cauwenbergh et al., 2007; Zahm, Viaux, Vilain, Girardin, & Mouchet, 2008) focus primarily on measuring SAD achievement for an individual (farmer or enterprise) or, in some cases, at the level of region. This paper, in contrast, focuses on understanding the factors, conditions and means that influence the feasibility of SAD within production and supply chains, in terms of the conditions and means needed for the transition.

Sustainable development involves multiple actors with different goals and interests (Munier, 2005; National Research Council, 1991; van Zeijl Rozema, Corvers, Kemp, & Martens, 2008), for which common understanding is not always acquired (van Zeijl Rozema et al., 2008). Top-down governance is commonly used for sustainable development. This approach, characterized by centralized decision-making with vertical relations between actors, is challenged by the need for collective action by,

CONTACT K. Kusnandar k.kusnandar@tudelft.nl Faculty of Technology, Policy and Management, Delft University of Technology, Jaffalaan 5, Delft 2628 BX, Netherlands

and equity of benefits for all actors in a chain for sustainable development (Munier, 2005; van Zeijl Rozema et al., 2008).

One of most extensive top-down programmes for SAD that has evolved during that past 30 years is the Farmer Field School (FFS) programme initiated by the Food and Agricultural Organization (FAO) (FAO, 2017; Rocha, 2017; Settle, Soumare, Sarr, Garba, & Poisot, 2014). The FFS programme focuses explicitly on increasing farmers' knowledge of environmentally friendly farming to increase agricultural productivity and farmers' income (Chhay et al., 2017; Doocy et al., 2017; Hussain, Rehman, Bibi, Khalid, & Khalid, 2017; Rocha, 2017; Settle et al., 2014). Recent studies (Doocy et al., 2017; Rocha, 2017; Scheba, 2017), however, show that this programme has not always been as successful as envisioned (in some cases with no effect at all on the farming techniques deployed or on productivity). Lack of awareness of the need for change for SAD, and lack of coordination between actors, are the two main causes named, in addition to lack of market, financial and other supporting infrastructures (Doocy et al., 2017; Scheba, 2017).

This paper explores the potential of programmes that explicitly address (the need for) coordination between actors whom are connected horizontally (in, e.g. communities) and vertically in agricultural production and supply chains. Such coordination focuses not only on exchange of technical knowledge (e.g. chemical use, productivity, income), but also on the social aspects of (self-) organization through participation needed to pursue common goals.

In such self-organization through participation (Folke, Hahn, Olsson, & Norberg, 2005; Gereffi, Humphrey, & Sturgeon, 2005), actors are connected based on mutual interdependency, they interact to build common understanding, participate in decision-making processes to create (emergent) institutions to govern their networks, and work together to achieve common goals (Andrews & Shah, 2003; Folke et al., 2005; Rhodes, 1996; van Zeijl Rozema et al., 2008). Participation of all relevant actors is vital to the success of self-organization (Andrews & Shah, 2003), in particular for SAD for which active participation of actors has been identified as one of the key conditions for change (Munier, 2005).

Participation is defined as 'to be part of a specific larger whole, to be in a reciprocal relationship with a specific larger whole, for actors to have the ability to act and to take responsibility' (Brazier & Nevejan, 2014). Actors need to be aware that they are part of a network and have the ability to contribute and take responsibility for their actions within the context of the common mission of a system – equity of benefits for all actors (Brown & Corbera, 2003; Gebara, 2013; Munanura, Backman, Hallo, & Powell, 2016) in SAD.

Based on the above explanation, the question addressed in this paper is 'Which factors influence participation in change for SAD?'. To this purpose this paper introduces a novel framework for SAD that extends existing frameworks to include potential for self-organization to achieve equity of benefits: Participatory Sustainable Agricultural Development (PSAD). This framework is used to position literature on SAD programmes to identify strengths and weaknesses of these programmes with respect to the classes of factors distinguished in the framework for PSAD, and their effect over time.

The agricultural supply network considered in this paper consists of actors whom are connected vertically and horizontally within an agricultural chain (farmers; wholesalers; food industries; exporters; retailers), and supporting actors whom are connected horizontally to the chains (government, academic, financial institutions, extension services, production inputs suppliers, etc.).

The first section below proposes the novel framework of Participatory Sustainable Agricultural Development (PSAD). The next section explains the methodology deployed for the literature study to identify relevant SAD programmes in developing countries, followed by a section that focuses on the analysis of these programmes using the proposed PSAD framework. The last two sections discuss the results of this paper and the conclusions.

Framework of participatory sustainable agricultural development (PSAD).

Sustainable development is defined in this paper as a development that not only concerns current needs, but also a sustainable future for people and planet[2] (Brundtland, 1987). Often three classes of factors are associated with sustainable development: environmental, economic and social (Carter & Rogers, 2008; Demartini, Gaviglio, & Bertoni, 2015; Harris, 2000; Lozano & Huisingh, 2011; Munier, 2005), also known as planet, profit and people (Elkington, 2004).

These classes of factors are also identified in the agricultural sector (de Olde, Carsjens, & Eilers, 2017; Dillon et al., 2016; FAO, 2014; Grenz et al., 2009;

Komnitsas & Doula, 2017; Reidsma et al., 2011; Speelman et al., 2007; Van Cauwenbergh et al., 2007; Zahm et al., 2008). Environmental factors relate to the quality of production inputs and farming practices; Economic factors relate to productivity, profitability, stability and viability, while Social factors relate to local context, actor participation, and distribution of benefits (Demartini et al., 2015; Dillon et al., 2016; FAO, 2014; Grenz et al., 2009; Harris, 2000; Komnitsas & Doula, 2017; Lehman, Clark, & Weise, 1993; Munanura et al., 2016; Reidsma et al., 2011; Speelman et al., 2007; Van Cauwenbergh et al., 2007; Zahm et al., 2008). In addition to these classes of factors, some literature also distinguishes governance-related factors that address decision-making structures, institutions and regulations between multiple actors involved in SAD (FAO, 2014; Reidsma et al., 2011; van Zeijl Rozema et al., 2008).

Equity of benefits, the main mission of PSAD (Assembe-Mvondo, Brockhaus, & Lescuyer, 2013; Brown & Corbera, 2003; Gebara, 2013; McClanahan & Abunge, 2016; Munanura et al., 2016) refers to factors such as equity of access to natural resources for present and future generations (environmental factor), equal access to resources, e.g. natural resources, finance, market resources (economic), inclusion of all actors in a chain (social) and decentralized decision making structures and processes that enable participation and institution development (governance-related) (Assembe-Mvondo et al., 2013; Brown & Corbera, 2003; Gebara, 2013; McClanahan & Abunge, 2016; Munanura et al., 2016).

PSAD extends existing frameworks to include factors that have the potential to empower all actors in agricultural production and supply chains to participate and cooperate in SAD[3] with the mission to achieve equity of benefits. The four classes of factors discussed below are: environmental, economic, social and governance-related. The framework of PSAD is illustrated in Figure 1.

Environmental

Three classes of environmental factors are distinguished: (1) water, land, and air (Demartini et al., 2015; Dillon et al., 2016; Grenz et al., 2009; Harris, 2000), (2) biodiversity (FAO, 2014; Grenz et al., 2009; Harris, 2000; López-Ridaura, Masera, & Astier, 2002; Van Cauwenbergh et al., 2007), and (3) food safety (FAO, 2014; Van Cauwenbergh et al., 2007).

1.1. *Water, land, and air*: factors related to protection of water, land, and air from any activities that can (directly or indirectly) cause damage[4] (Demartini et al., 2015; Dillon et al., 2016; FAO, 2014; Grenz et al., 2009; Komnitsas & Doula, 2017; Van Cauwenbergh et al., 2007).

1.2. *Biodiversity*: factors related to protection of the extinction of important organisms (plant and animals) for ecosystems (FAO, 2014; Grenz et al., 2009; López-Ridaura et al., 2002; Van Cauwenbergh et al., 2007), such as, for example, non-enemy essential anthropods (Pisa et al., 2015).

1.3. *Food safety*: factors related to ensurance that all activities in the food chains, from farm to consumers, avoid the risk of food-borne disease that can harm consumers[5] (Alli, 2016; FAO, 2014; Jouzi et al., 2017).

Economic

This class of factors relates to the economic functions within agricultural chains: production, market, logistics, finance (Van der Vorst, Da Silva, & Trienekens, 2007), and capacity development (Browning & Moayyad, 2017; Jouzi et al., 2017; Valdez-Vazquez, del Rosario Sanchez Gastelum, & Escalante, 2017).

2.1. *Production*: factors related to transforming or improving raw materials into desired products that encompass planning, implementation, control and coordination between chain actors to make it effective and efficient[6] (Simchi-Levi, Chen, & Bramel, 2005; Waters, 2003).

2.2. *Market*: factors related to a network of interdependent actors who co-create value through resource exchange, e.g. material, finance, and information (Diaz Ruiz, 2012; Storbacka & Nenonen, 2011).

2.3. *Logistics, transportation and communication infrastructures*: factors related to the flow of material and information within an agricultural chain, within and between chain actors, such as efficiency and effectiveness (Farahani, Asgari, & Davarzani, 2009; Simchi-Levi et al., 2005; Waters, 2003).

2.4. *Financial infrastructures*: factors related to credit and cash flow to support material flow in the chain[7] (Hofmann, 2005; Wuttke, Blome, & Henke, 2013).

2.5. *Capacity development*: factors related to performance of people, organizations, communities, including access to resources and opportunities,

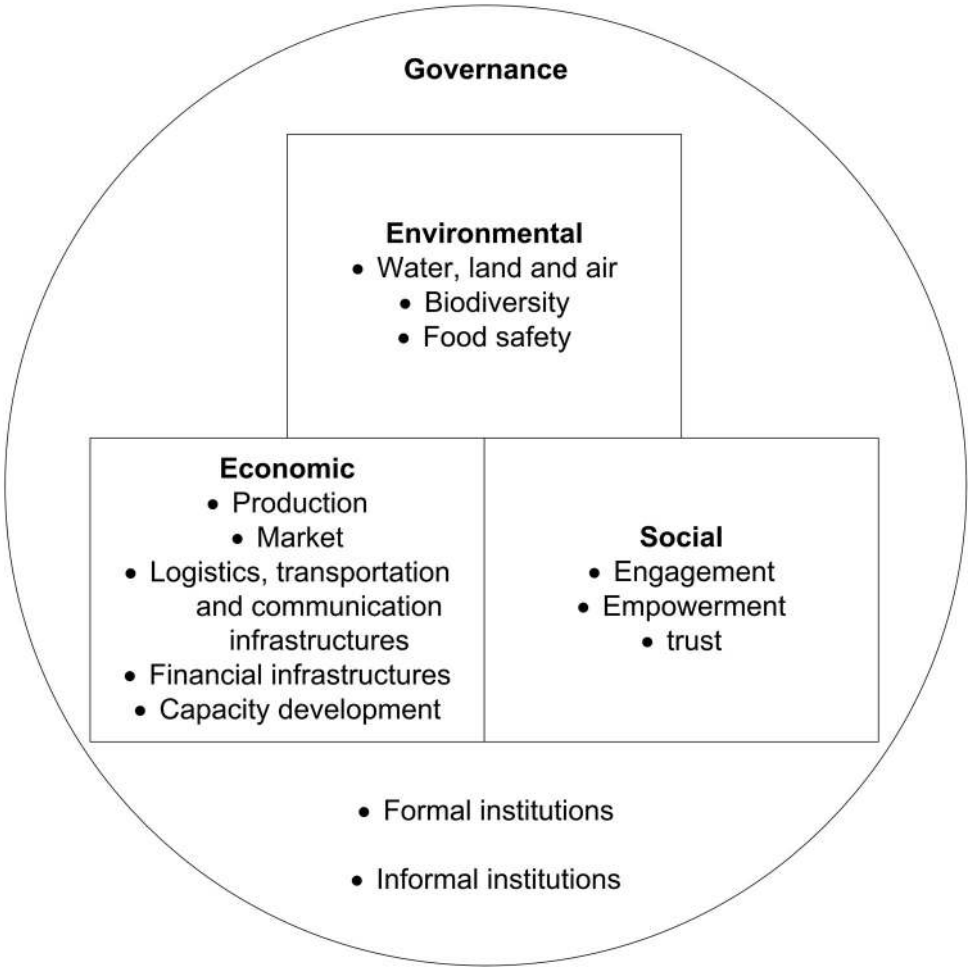

Figure 1. Framework of sustainable agricultural development based on self-organization approach.

skills to improve social economic position (Bolger, 2000; Brinkerhoff & Morgan, 2010; Lusthaus, Adrien, & Perstinger, 1999; UNDP, 1998).

Social

Three values of participatory systems, that are essential to sustainable development (Brundtland, 1987; FAO, 2014; López-Ridaura et al., 2002; Munier, 2005), are empowerment, engagement and trust (Brazier & Nevejan, 2014). These values correspond to the concept of the social aspects of sustainability proposed by Missimer, Robert, and Broman (2017): trust, common understanding, learning, and self-organization.

3.1. *Empowerment*: factors related to awareness of capability, decision making, ability to act and take responsibility, and ability to self-organize (Brazier & Nevejan, 2014; Missimer et al., 2017; Rowlands, 1995).

3.2. *Engagement*: factors related to connectedness and interaction among actors to communicate, awareness of each others' positions, a common understanding, joint-decision making, working together and collective learning (Brazier & Nevejan, 2014; Missimer et al., 2017).

3.3. *Trust*: factors related to quality of connection among actors in the system, in particular with respect to reliability (Missimer et al., 2017). Trust develops over time (either in the positive or negative ways) as a result of actors' interactions (Bauer

& Freitag, 2018; Rutter, 2001), either face to face or facilitated by ICT (Rutter, 2001; Sousa & Lamas, 2013). As trust cannot be assessed short-term, and is difficult to measure in the context of specific programmes. Therefore, this paper focuses on empowerment and engagement.

Governance

Governance, positioned as an umbrella for the three classes of factors, is defined as a collection of rules and structures on which institutions are based, formal and informal, that govern SAD (Reidsma et al., 2011; van Zeijl Rozema et al., 2008), involving actors for PSAD (Ostrom, 2010).

4.1. *Formal Institutions*: factors related to formal rules that determine the legal positions of the actors and the mechanisms for interaction (Groenewegen & Van der Steen, 2006; Koppenjan & Groenewegen, 2005). These include international regulations and standards, national laws and regulations (Diaz-Sarachaga, Jato-Espino, & Castro-Fresno, 2017; Harris, 2000; Missimer et al., 2017; Munier, 2005).

4.2. *Informal institutions:* factors related to informal rules that determine positions of actors and mechanisms for interaction, e.g. verbal agreements between actors, local culture, values, based on tacit and pronounced norms. (Groenewegen & Van der Steen, 2006; Koppenjan & Groenewegen, 2005).

Research method

The PSAD framework proposed in the previous section has been used as the basis for a review of the focus and effects of SAD programmes reported in the literature.

The method entails (1) to determine the type of literature, database, time horizon and the context of these programmes, (2) to determine a list of keywords to search the literature, (3) to perform the literature search and to select appropriate literature on the basis of pre-defined criteria and (4) to analyse the selected literature using the proposed framework of SAD based on participation.

Type of literature, database, time horizon and context

Only journal articles are to be considered, and Scopus is chosen as the database to be considered. As agricultural systems and their environment change continually, and the focus of this study is on the effects of programmes within their context, the time horizon of publication considered is limited to articles published in the last ten years, that is between 2008–2017. Developing countries are the context of the programmes chosen – a context for which empowerment is considered of great importance (Angeles & Gurstein, 2000; Farina & Reardon, 2000).

Keywords

The list of keywords is determined based on the desired topic, that is 'efforts to pursue sustainable agriculture in developing countries'. Four main concepts/keywords are considered: effort; sustainable development; agriculture; and developing countries. Synonyms or other terms or phrases that have the same meaning as one of the main keywords and/or are commonly used in scientific papers are determined by the authors. The keywords used to search the literature in this study are listed below.

Effort

- effort* OR intervention* OR program* OR initiative* OR scheme* OR action OR project* OR measure*.

These keywords are commonly used to state efforts conducted by governments or organizations for efforts in the agriculture sector. The symbol * is used to accommodate plural and singular words, or US/UK spelling differences.

Sustainable

- sustainable OR sustainability.
- ((environment OR environmental) AND (conservation OR preservation OR protection)) OR 'environmentally friendly'.

Both sustainability and sustainable are both used to indicate the essence of sustainable, as is the concept of environmental conservation to pursue sustainability.

Agriculture

- agriculture OR agricultural OR farming OR horticulture OR 'grain crop*' OR 'animal husbandry' OR livestock OR poultry OR dairy OR aquaculture OR fisher*.

These keywords define the scope of agriculture to include crops, animals and aquaculture.

Developing countries

- 'developing countr*' OR 'less developed countr*' OR 'underdeveloped countr*' OR 'low income countr*' OR 'low-income countr*' OR 'lower middle income countr*' OR 'lower-middle-income countr*'

These terms relate to the concept of a developing country. Some of them relate to level of income.[8]

The search term based on the series of keywords defined above used to search the Scopus database for appropriate journal articles is:

(effort* OR intervention* OR program* OR initiative* OR scheme* OR action OR project* OR measure*) AND (sustainable OR sustainability OR ((environment OR environmental) AND (conservation OR preservation OR protection)) OR "environmentally friendly") AND (agriculture OR agricultural OR farming OR horticulture OR "grain crop*" OR "animal husbandry" OR livestock OR poultry OR dairy OR aquaculture OR fisher*) AND ("developing countr*" OR "less developed countr*" OR "underdeveloped countr*" OR "low income countr*" OR "low-income countr*" OR "lower middle income countr*" OR "lower-middle-income countr*").

Selection

The criteria on the basis of which journal articles are selected in the analysis are: (1) contains a description of at least one programme on sustainable agriculture development in developing country(ies); and (2) describes the approach used in the programme(s).

Selection of papers followed a two-step procedure: First, the abstract of the papers are assessed with the given criteria. Second, the papers for which the abstract is judged to meet these criteria are analysed in depth to determine if, in fact, they meet the criteria.

Procedure for analysis

Each of the selected papers are analysed using the PSAD framework. The analysis of the SAD programme to which they refer is based on the factors in the proposed framework. An ordinal value is assigned to each factor for each paper/programme: a value of '2' if the factor is named and considered, a value of '1' if the factor is considered to a limited (implied) extent; and a value of '0' if the factor is not considered.

The effect of programmes is determined on the basis of information provided in the papers considered. An ordinal value is assigned to each programme: a value of '2' if long-term effects are reported, a value of '1' if short-term effects are named, a value of '0' if little or limited effect is indicated, and a value of 'NA' if no information on effects is mentioned. Programmes that have lasted for 4 years or more, with a positive effect are classified as having a long-term effect. Continuity of actor participation in SAD is the determining criterium. Short-term effect is assigned to programmes with a reported positive effect that have run for about 1–3 years, with no further information about the sustainability of participation of involved actors. Limited effect is assigned to programmes that have stated to have had little effect or limited effect. Programmes without any information about their effect are classified as unknown.

The Spearman test[9] is used to determine possible correlations between the factors in the proposed framework and the effect of programme.

Results

The selection process using the set of keyword combinations and Scopus as a database resulted in 491 papers. 76 papers were selected on the basis of their abstracts and the criteria of naming at least one programme and describing the approach taken. Based on deeper analysis of the papers themselves, 45 papers were found to meet the criteria. From the selected papers, 1 paper refers to 3 programmes, and 2 papers each report on 2 programmes: 49 programmes were identified in total. For one programme, additional information was acquired from another paper (to which the paper referred).

The programmes were analysed using the factors distinguished within the PSAD framework. The

Table 1. Number of cases of programmes considering the indicators of the framework of sustainable development.

Element	Indicator	Number of cases considering the indicator	% of total cases
Environmental	Soil, water, air	36	73%
	Biodiversity	18	37%
	Food safety	5	10%
Economic	Production	25	51%
	Market	6	12%
	LTCI*	2	4%
	Financial inf.	11	22%
	Capacity dev.	31	63%
Social	Engagement	10	20%
	Empowerment	13	27%
Governance	Formal inst.	27	55%
	Informal inst.	9	18%

*Logistics, transportation and communication infrastructures

matrix of programmes and the factors in the PSAD framework is depicted in Appendix A1. Table 1 shows the number of programmes that consider each of the factors in the PSAD framework.

Table 1 shows that most programmes focus on environmental, economic and governance-related factors. More specifically on protecting soil, water and air (environmental), capacity development and production (economic), and formal institutions (governance-related). Most programmes focussed on capacity development, formal institutions and production with relatively high number of cases to encourage farmers to participate in environmental protection. Class training and field technical assistance were methods often used for capacity development to disseminate knowledge, and to develop knowledge and skills of farmers for sustainable farming practice. These capacity development programmes were often integrated with production inputs provisions (production-related). Meanwhile, for formal institutions, mandatory and voluntary regulation with and without incentives were applied in many programmes. Most formal institutions were designed by the government and international organizations, and some were based on agreements/contracts between farmers and companies using various schemes.

With respect to the effect of programmes, most programmes (21 programmes) have limited effect, 12 programmes have short-term effect, and 8 programmes have long-term effect. The effect of 8 programmes is unknown.

For programmes with limited effect, four causes were named explicitly. *First,* conflict of interest between involved actors was named for cases 6, 15, 22, 30, 31 and 43. Some of these programmes, for example, focus on protecting areas from environmental damage caused by farmers' activities or to develop new products that can contribute to environmental protection. However, the programmes have a negative impact on local farmers' livelihoods leading to conflicts between local farmers and programme implementers. Limited effect was the result. *Second,* a mismatch between technology offered in the programmes and the local situations, farmers' characteristics and farming behaviour, and local market chains structure and governance (cases 1, 2, 3, 4, 11, 19, 28, 37, 35), was explicitly named as a cause for limited effect. *Third,* the absence of support to translate theoretical information into actionable information/practice for local farmers (cases 12, 13, 19) was named as a cause for limited effect. In these cases, short training was provided to disseminate specific knowledge on (farming and waste management) technology. *Fourth,* lack of transparency of the structure and rules of new institutions was named as a cause for limited effect (cases 25, 26). In these programmes, the new institutions were designed by only a few actors or by the government. Other actors were not involved and were not provided with enough information to understand (the implications of) the new institutions.

Correlation between factors in proposed framework and the effect of programme

Table 2 depicts the results of the Spearman test indicating correlations between each factor in the PSAD framework and the effect of each of the programmes. The strength of correlation is interpreted in line with (Corder & Foreman, 2009) as: 0 for trivial; 0.1 for weak; 0.3 for significant; 0.5 for strong; and 1.0 for perfect. In this analysis, the programmes with unknown effect have been excluded.

Table 2 shows that food safety is the only factor within the environmental class of factors that has a significant correlation with the effect of programme.

Production and capacity development are factors within the economic class of factors that have a significant correlation with the effect of programme.

Both factors analysed within the class of social factors: empowerment and engagement, show a significant correlation with the effect of programmes. In fact, the coefficient of these two factors are the two highest (0.38 and 0.45 respectively).

Table 2. Correlation between factors in the proposed framework and the effect of programmes using Spearman test.

Element	Factors	Spearman coef.	Prob
Environment	Water, land and air	−0.12	0.474
	Biodiversity	−0.15	0.359
	Food safety	0.36	0.021*
Economic	Production	0.36	0.021*
	Market	0.26	0.099
	Logistics, transportation and comm. Inf.	−0.03	0.870
	Finance infrastructure	0.03	0.831
	Capacity development	0.31	0.049*
Social	Empowerment	0.38	0.015*
	Engagement	0.45	0.003*
Governance	Formal institutions	−0.15	0.351
	Informal institutions	0.21	0.184

*Significant at $\alpha = 5\%$.

Discussion of results

The significant correlations for the environmental (food safety), economic (production and capacity building) and social aspects (empowerment and engagement) named above with the effect of programmes are discussed below.

The environmental factor of food safety, included in food safety standards, such as Good Agricultural Practices and Integrated Pests Management, implemented in programmes as a tool for farmers to acquire access to global markets (Cases 26 and 41) have shown to be successful in targeting long term effects. Access to global markets that offer a better price, encourage farmers in developing countries to follow food safety standard in their farming activities (Unnevehr, 2015).

Economic factors related to production: production inputs, production facilities (e.g. tools, machine), and knowledge of technical aspects of production, are explicitly addressed in programmes designed to improve production over time (e.g. cases 17, 26, 29, 39, 40), and have shown to be successful in their effect. Capacity development, the second economic factor with a significant correlation with effect, has shown to be effective for instructor-led training, field assistance (by project implementers) and peer to peer assistances methods aimed to improve knowledge and skills of farmers to pursue SAD (e.g. cases 16, 17, 26, 29, 39, 41). As most farmers in developing countries still have lack of knowledge and skills to improve their farming (Gereffi & Fernandez-Stark, 2016) activities to enhance their capacity, especially in technical aspects of production, are clearly still important.

The social factors of engagement and empowerment have shown to be effective over time: first, in programmes that focus on increasing awareness of local farmers through discussion to analyse their situation, and to find solutions most often facilitated by project implementers (cases 16 and 49); and second, in programmes that provide local farmers opportunities to act and take responsibility for their own actions (cases 16 and 41).

Three types of engagement for which a positive correlation with long-term effect was identified are: (1) engagement facilitated by project officers or other parties, in which local farmers were directly involved in programme activities, for example in discussions on their own situations and on assessments of their own resources (cases 16, and 40); (2) engagement of local farmers, who were trained first, involved in information and knowledge dissemination to other farmers (cases 29 and 41); and (3) engagement of local farmers who were organized into groups or institutions to work together to foster sustainable practice, with/ without a facilitator (cases 17 and 29).

Independent of the type of engagement, continued facilitation in a follow-up programme, has shown to correlate with a long-term effect (cases 16, 17, 29, 40, 41). The follow-up implemented in one of the programmes (case 29), enabled a gradual shift of roles from project implementer to local farmers, over time. This result is in line with the claim that continued facilitation is needed to foster self-organization (Folke et al., 2005) to maintain the momentum of change for local farmers.

General discussion

Most programmes on SAD follow a top-down approach in governance focusing on economic factors to encourage farmers to participate. Meanwhile, little attention is given to the social dimension. This result corresponds to previous findings on sustainable development (Dempsey, Bramley, Power, & Brown, 2011; Missimer et al., 2017), whilst its importance has been recognized, in particular as centralized governance is often not feasible (Folke et al., 2005).

This paper shows that most top-down programmes have little or limited effect on SAD. The challenges identified in this study with respect to effect over time are in line with previous studies: conflicts of interests between involved actors (Wang & Chen, 2014), incompatibility of technology with local situations (Buch-Hansen, 2012; Espinoza-Tenorio, Espejel, & Wolff, 2015; Unnevehr, 2015), the need for support to translate theoretical knowledge into practice (Reidsma et al., 2011), and the lack of transparency of new institutions (Douxchamps et al., 2015).

The social complexity of multiple actors in different roles in the agricultural production and supply chain (van Zeijl Rozema et al., 2008) mandates a different approach for SAD. In the programmes that targeted engagement participants were provided opportunities to interact and communicate with each other to improve understanding of each other's situation and needs (Brazier & Nevejan, 2014; Missimer et al., 2017), increasing awareness and ability to create

new forms of collaboration, in which actors can act and to take responsibility within their group or communities, and within the chain (Missimer et al., 2017; Rezaee, Oey, Nevejan, & Brazier, 2015; Rowlands, 1995).

Conclusion

This paper proposes a novel framework of PSAD based on four classes of factors that influence actor participation in SAD: environmental, economic, social and governance-related. The proposed framework has been developed to analyse SAD programmes in developing countries, to understand factors that influence participation of actors.

Five factors in the PSAD framework have shown to have long-term effect on SAD: food safety (environmental), production, capacity development (both economic), empowerment and engagement (both social). In addition to the well-recognized need for knowledge and skills related to food safety, production and capacity development, SAD programmes also need to address the social factors of engagement and empowerment to enable sustainable change over time for SAD. Follow-up programmes have shown to be instrumental to this purpose.

Notes

1. SDG 2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

   SDG 2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

   SDG 12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses

   http://www.un.org/sustainabledevelopment/development-agenda/
2. http://www.un.org/sustainabledevelopment/development-agenda/
3. Experience gained from previous programme, for example, reported by the Peace Corps (Peace Corps, 2005) is also taken into account.
4. e.g. water and land management, waste management, and reducing air pollutant and greenhouse gas emission to deal with climate change.
5. e.g. GAP, IPM, organic farming, GMP, sanitary and phytosanitary measures, and HACCP.
6. In agriculture natural resources are utilized in farming practice, harvest and post-harvest activities, and food processing.
7. Financial infrastructures include the financing network between chain actors (e.g. cooperation between wholesalers and farmers, cooperative) and financing system supported by external actors (e.g. Government, NGOs).
8. https://blogs.worldbank.org/opendata/new-country-classifications-income-level-2017-2018
9. Spearman test is one of techniques that is used to test correlation for non-parametric data (Corder & Foreman, 2009).

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Notes on contributors

K. Kusnandar is a PhD candidate at Systems Engineering Section, Department of Multi Actors Systems, Faculty of Technology Policy and Management, TU-Delft, the Netherlands. His research focuses on empowering agricultural chain actors through participatory approach. In his home country, Indonesia, he is affiliated to the Research Centre for Science and Technology Development, Indonesian Institute of Sciences (LIPI).

F.M. Brazier is a full professor within the Systems Engineering Section, Department of Multi-Actor Systems, Faculty of Technology Policy and Management, TU-Delft, the Netherlands. Her current research focuses on the design of participatory systems (www.participatorysystems.org), supporting self-organisation and emergence based on the values trust, empowerment and engagement.

O. van Kooten is a full professor at Horticulture and Product Physiology, Department of Plant Science, Wageningen University, the Netherlands. He is also affiliated to Inholland University of Applied Science. His current research focuses on new market strategies and chain partnerships in agricultural sector.

ORCID

O. van Kooten http://orcid.org/0000-0001-9444-0389

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Appendix A1. Matrix of cases of programme and the variables of sustainable agricultural development framework.

		Environmental			Economic					Social			Governance		Effect
No	Case	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	4.1	4.2	
1	Marine Steward Council (MSC) Label for fish in South Africa. (Ponte, 2008)	0	2	0	0	0	0	0	0	0	0	0	2	0	0
2	Private incentive mechanism to improve tuna sustainability in Philippines: Fishery Improvement project FIF. (Tolentino-Zondervan et al., 2016)	0	2	0	2	0	0	0	2	0	0	0	2	0	0
3	Private incentive mechanism to improve tuna sustainability in Philippines: Marine Steward Council (MSC). (Tolentino-Zondervan et al., 2016)	0	2	0	0	2	2	0	2	0	0	0	2	0	0
4	Private incentive mechanism to improve tuna sustainability in Philippines: International Seafood Sustainability Foundation (ISSF). (Tolentino-Zondervan et al., 2016)	0	2	0	0	0	0	2	2	0	0	0	2	0	0
5	Conservation agriculture (CA) promotion at Cabo Delgado, Mozambique. (Lalani, Dorward, Holloway, & Wauters, 2016)	2	0	0	0	0	0	0	2	0	0	0	0	0	NA
6	Marine protected areas (MPA) in India. (Ramesh & Rai, 2017)	2	2	0	0	0	0	0	0	0	0	0	2	0	0
7	Farmers field school (FFS) in China. (Guo, Jia, Huang, Kumar, & Burger, 2015)	2	0	0	0	0	0	0	2	0	1	2	0	2	0
8	Participatory land use planning in Laos. (Bourgoin, Castella, Pullar, Lestrelin, & Bouahom, 2012)	2	0	0	0	0	0	0	0	0	1	2	0	2	NA
9	Auction for payment for ecosystem services in Indonesia. (Leimona & Carrasco, 2017)	2	0	0	0	0	0	2	0	0	0	0	2	0	1
10	Testing resilience thinking in the context of poverty in Nigeria. (Bene et al., 2011)	2	0	0	2	0	0	2	0	0	1	2	0	2	NA
11	Developing fisheries co-management in the Tam Giang Lagoon system in Vietnam. (Ho, Ross, & Coutts, 2016)	2	2	0	2	0	0	2	2	0	0	0	2	0	0
12	Sloping land conversion programmes in China. (Kelly & Huo, 2013)	2	0	0	0	0	0	0	2	0	0	0	2	0	0
13	Sustainable highland agriculture in Kelang Village, Yunan Province, China. (M. Subedi et al., 2009b)	2	0	0	2	0	0	0	2	0	0	0	0	0	0
14	The equitable payment for watershed services in Morogoro, Tanzania. (Branca, Lipper, Neves, Lopa, & Mwanyoka, 2011; Kwayu, Sallu, & Paavola, 2014)	2	0	0	2	0	0	2	2	0	0	0	2	0	1
15	International payment for marine ecosystem in Mauritania. (Binet, Failler, Chavance, & Mayif, 2013)	0	0	0	0	0	0	2	0	0	0	0	2	0	0
16	Managing fish Pirarucu quota at Mamiraua, Brazil. (Castello, Viana, Watkins, Pinedo-Vasquez, & Luzadis, 2009)	0	2	0	0	0	0	0	2	0	1	2	2	0	2
17	Fishers alliance in Philippines. (Anabieza, Pajaro, Reyes, Tiburcio, & Watts, 2010)	0	2	0	2	0	0	0	2	0	0	2	2	0	2
18	Volunteer farmer trainers for dairy farmers in Kenya. (Kiptot & Franzel, 2014)	2	0	0	2	0	0	0	2	0	1	2	0	2	1
19	Biogas technology dissemination in sub-Saharan Africa. (Parawira, 2009)	2	0	0	2	0	0	0	0	0	0	0	0	0	0
20	Improving dairy production in Cameroon. (Bayemi & Webb, 2009)	2	0	0	2	0	0	0	2	0	0	0	0	0	1
21	Forest conservation by private sector in Malawi. (Chinangwa, Gasparatos, & Saito, 2017)	2	0	0	2	0	0	0	2	0	0	0	2	0	NA
22	Conservation policies in Rajiv Gandhi National Park, India. (Nautiyal & Nidamanuri, 2012)	2	2	0	0	0	0	0	0	0	0	0	2	0	0

(*Continued*)

Continued.

		Environmental			Economic					Social			Governance		Effect
No	Case	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	4.1	4.2	
23	Biogas installment and organic fertilizer production at craft village in Mekong-Delta, Vietnam. (Le et al., 2016)	2	0	0	2	0	0	0	0	0	0	0	0	0	NA
24	Volunteers farmer trainers to promote safety and health at work for farmers in Vietnam. (Kawakami, Van, Van Theu, Khai, & Kogi, 2008)	2	0	0	2	0	0	0	2	0	0	0	0	2	1
25	Agricultural water fee collection in China. (Wang & Chen, 2014)	2	0	0	0	0	0	0	0	0	0	0	2	0	0
26	Contract farming between an exporter and paprika farmers in Malawi. (Repar, Onakuse, Bogue, & Afonso, 2017)	0	0	2	2	2	0	0	2	0	0	0	2	0	2
27	Participatory business incubation of poultry in South Africa. (Alderson & Jordaan, 2007)	0	0	0	2	0	0	2	2	0	1	2	2	0	1
28	Conservation agriculture in Chongwe District, Zambia. (Mfune, 2013)	2	0	0	0	0	0	0	2	0	0	0	0	0	0
29	Empowering women farmers through farmers research group in Ethiopia. (Oumer, Tiruneh, & Tizale, 2014)	0	0	0	2	0	0	0	2	0	2	2	0	2	2
30	Bioethanol development in Brazil. (Franco et al., 2010)	2	0	0	2	0	0	0	0	0	0	0	2	0	0
31	Bioethanol development in Mozambique. (Franco et al., 2010)	2	0	0	2	0	0	0	0	0	0	0	2	0	0
32	Organic product development for Chepang tribal people at Chitwan district, Nepal. (Haas, Meixner, & Petz, 2016)	0	0	2	2	2	2	0	2	0	0	0	0	0	1
33	Improving safety and quality of produce for supermarket in Honduras. (Bloom, 2015)	0	0	2	2	2	0	0	2	0	0	0	0	0	NA
34	Ecological based rodent pest management. (Palis et al., 2011)	2	2	0	2	0	0	0	2	0	0	0	0	0	1
35	Forest product certification in Indonesia. (McCarthy, 2012)	2	2	0	0	0	0	0	0	0	0	0	2	0	0
36	Roundtable sustainable on palm oil (RSPO) certification in Indonesia. (McCarthy, 2012)	2	2	0	0	0	0	0	2	0	0	0	2	0	0
37	Payment for environmental services in Protected Areas in Cambodia. (Clements & Milner Gulland, 2015)	2	2	0	0	0	0	2	0	0	0	0	2	0	0
38	Policy of Government of Peru to protect Lake Titica. (Vera Cartas, Pucheu, & Torres Beristain, 2013)	2	2	0	0	0	0	0	2	0	0	0	2	0	NA
39	Organic cotton cultivation at Meatu district in Tanzania. (Altenbuchner, Larcher, & Vogel, 2016)	2	0	0	2	2	0	2	2	0	0	0	2	0	2
40	Collaborative resources management at Kibale National Park, Uganda. (Solomon, Jacobson, & Liu, 2012)	2	2	0	2	0	0	0	0	0	0	2	2	0	2
41	Farmers-to-farmers training on Integrated Pest Management (IPM) in La Paz county, Bolivia. (Jors et al., 2016)	2	0	2	0	0	0	0	2	0	1	2	0	2	2
42	Agricultural extension reformation in Bangladesh. (Islam, Gray, Reid, Kelly, & Kemp, 2011)	0	0	0	0	0	0	2	2	0	0	2	0	2	0
43	The impact of Marine National Parks on food security of local people in Kenya. (Darling, 2014)	2	2	0	0	0	0	0	0	0	0	0	2	0	0
44	Management of highland wetlands in Kenya. (Macharia, Thenya, & Ndiritu, 2010)	2	2	0	0	0	0	0	0	0	1	2	0	0	NA
45	Payment for ecosystem services in Northern Tanzania. (Nelson et al., 2010)	2	2	0	0	0	0	2	0	0	0	0	2	0	2
46	Grassland management program in northern China. (Kemp et al., 2013)	2	0	0	2	2	0	0	2	0	0	0	0	0	1
47		2	0	0	2	0	0	0	2	0	0	0	0	0	0

(*Continued*)

Continued.

No	Case	Environmental			Economic					Social			Governance		Effect
		1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	4.1	4.2	
	Fodder shrub innovation adoption in East Africa. (Wambugu, Place, & Franzel, 2011)														
48	Sustainable highland agriculture in Yunnan Province China. (Subedi, Hocking, Fullen, McCrea, & Milne, 2009a)	2	0	0	2	0	0	0	2	0	0	0	0	0	1
49	Farmer field school to promote Integrated production and pest management (IPPM) in West Africa. (Settle & Garba, 2011)	2	0	2	0	0	0	0	2	0	1	2	0	2	1

(1.1) Water, land, and air; (1.2) Biodiversity; (1.3) Food safety; (2.1) Production; (2.2) Market; (2.3) Logistics, transportation and communication infrastructures; (2.4) Financial infrastructures; (2.5) Capacity development; (3.1) Trust; (3.2) Empowerment; (3.3) Engagement; (4.1) Formal institutions; (4.2) Informal institutions; (4.3) Deliberative institutions;

(2) factors exist; (1) factor exist but limited; (0) factor does not exist;

(2) long-term effect; (1) short-term effect; (1) little/limited effect; (NA) unknown.