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ORIGINAL ARTICLE

Bringing ISFM to scale through an integrated farm planning approach: a case study from Burundi

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Abstract Integrated soil fertility management (ISFM) is generally accepted as the most relevant paradigm for soil fertility improvement in the tropics. Successes however are mainly reported at plot level, while real impact at farm level and beyond remains scattered. As a consequence, many Sub-Saharan African countries continue experiencing soil nutrient mining and insecure and insufficient agricultural production. Since technology-driven projects at the plot level failed to bring ISFM to scale, a different approach is needed. This paper describes a bottom-up approach developed in Burundi, the "PIP approach". It starts at farmer family level with the creation of an integrated farm plan (Plan Intégré de Paysan in French—PIP) and aims at wide-scale spreading of farmers' intrinsic motivation to invest in activities that make the household more resilient and profitable, while moving towards sustainable agricultural intensification based on concepts of ISFM. As such, and once firmly embedded in and supported by village or district plans, agriculture becomes a business rather than a default activity inherited by parents, and ISFM an intrinsic aspect of farm management. In this paper the PIP approach as currently being implemented in Burundi is explained and discussed, with special reference to soil fertility management and some preliminary promising results.

Keywords ISFM · Integrated farm planning · Participatory approaches · Scaling-up · Burundi

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Introduction

In many African countries, integrated soil fertility management (ISFM) is promoted as an important pathway towards increasing agricultural production and rural income (Bationo et al. 2012; The Montpellier Panel 2014; Vanlauwe et al. 2014). Nevertheless, years of investment in subsidized input provision and farmer capacity development have not led to the required increase in per capita production, yield and revenues, nor to a reduction of levels of poverty in Africa (Sumberg 2005). UNCTAD (2013) identified several key reasons for that: (1) limited attention for continued soil degradation, (2) the low efficiency of smallholder production systems, and (3) the absence of markets. Furthermore, availability of labour at farm

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level is often a constraining factor for increased agricultural production, as well as for the low economic returns on investment in technologies (Demeke et al. 2013). Nevertheless, some success stories do exist, being often quick and eye-catching at the plot level, where quite simple and locally-known improved soil fertility management practices and rates of nutrient applications enormously boost yields (The Montpellier Panel 2014). However, the spin-offs of these improvements on the farm level, notwithstanding at the village and beyond, are often disappointing. A recent study by the CASCAPE project in Ethiopia among 77 farmers shows that a 68 % increase in crop production on the plot level only leads to a 18 % increase in the economic return at the farm level (Fig. 1).

The challenge how to bridge this "plot-farm" gap aligns well with recent literature on sustainable intensification that acknowledges that intensified agricultural production requires combined productivity, Natural Resource Management (NRM) and institutional innovations (Vanlauwe et al. 2014; Tittonell 2014). Sustainable intensification requires an integrated approach, making smart use of available agro-ecological, human and financial resources across different systems levels (Robinson et al. 2015). Two aspects are key in such an approach. Firstly, resilience at the farm level, with resilient agricultural production

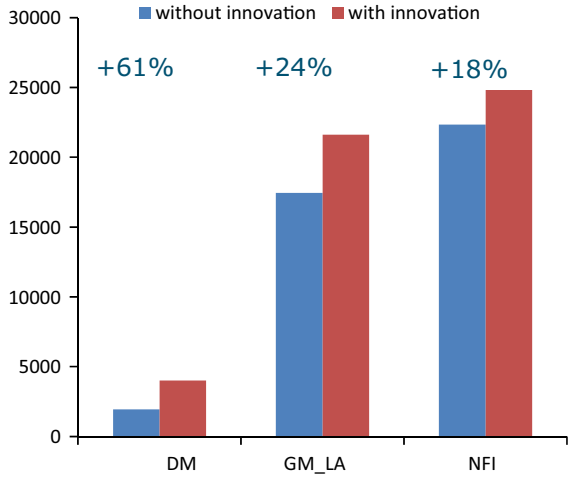

Fig. 1 An example of reducing effectiveness of innovations from field to farm level: wheat yield (DM in kg grain/ha), gross margins at field level (GM_LA in Ethiopian Birr) and net farm income (NFI in Ethiopian Birr) with and without innovations. *Source*: CASCAPE project, unpublished results

systems (e.g. adapted to climate change) and a reinforced social system in which male and female farmers are able to cope with shocks and changing conditions (e.g. weather, prices, diseases). However, and secondly, resilience at the farm level will not have enough impact if not implemented at a wider scale (more farmers) and embedded in an adequate enabling environment. Such an enabling environment can foster the development of coherent (village or regional) development plans, improve access to micro-credits, micro-insurances and market schemes that may reduce risks and foster smallholders' investments in agriculture. Some of the key constraints for intensification, such as poor soil fertility management and low availability of seeds and nutrients from organic and inorganic sources then become part of an integrated approach, in which fostering synergies between technological and institutional innovations across farm, community and district level becomes central.

This paper presents such an integrated approach. It is based on ISFM principles and the crucial issue of closing nutrient cycles at the plot level (Van Beek et al. 2014). However, central to this approach is vision building, integrated farm planning, and the scaling-up of farmers' intrinsic motivation and capacity to invest in their farms. ISFM will become more effective when being part of integrated farm planning, and when these plans align with and enrich plans at higher administrative units. It is our conviction that these integrated and multi-scale aspects have often been overlooked by past projects, which often focused on a limited number of practices at plot level (e.g. anti-erosion measures) without taking into account the other activities that are inherently crucial to the farm and its resilience. Furthermore, we hypothesize that the scaling-up potential of an approach that emphasizes transfer of vision and intrinsic motivation rather than transfer of knowledge and technologies is much higher, and can create a more solid foundation for sustainable development in rural African realities struck by the continuous decline in soil health.

Given that joint vision development and formulating an integrated farm plan (Plan Intégré du Paysan in French—PIP) with the entire farmer family lies at the basis of this approach, it is called the PIP approach. The PIP approach is currently being tested and implemented in Burundi; a country facing two key constraint for sustainable intensification in the Central Africa highlands (IITA 2014): high pressure on land

with the majority of the population living in the rural area, and unsustainable farming practices on a hilly landscape leading to erosion and soil degradation. The PIP approach is not a completely new approach, quite the opposite, it is rooted in sustainable rural development approaches that promote farmer participation, engagement and investment for individual and collective farmer action, and particularly also in transdisciplinary approaches that focus on integrated soil fertility management.

In this paper we first explain the PIP approach and some theoretical and conceptual underpinnings, as well as details of the approach itself as applied in Burundi. Subsequently we elaborate on the implementation of the PIP approach in four collines (villages) in Gitega, a province in the Central Highlands of Burundi. Finally, we present some preliminary results, conclusions, and the way forward.

Explaining the PIP approach and related concepts

The PIP approach can be positioned within a paradigm shift from the technology-centred to the more integrated systems approaches to agricultural innovation. This shift was set in after increased awareness concerning the limitations of the Transfer of Technology approach, with its 'top-down' transfer of technology to farmers (Rogers 1962). The farming systems approach, although still rather 'top-down', reflected increased attention for the socioeconomic and agro-ecological context of the farm and its household (Biggs 1995). More bottom-up approaches actively sought farmers' participation (Chambers et al. 1989), also in research through joint learning by means of e.g. Farmer Field Schools (e.g. Kenmore 1991) or Participatory Learning and Action Research (e.g. Wopereis and Defoer 2007). More recent is the attention to scaling issues, and the importance to take the enabling institutional context into account in the process of agricultural innovation (Hounkonnou et al. 2012).

The PIP approach is different from the above mentioned approaches in the sense that (1) it is a multi-scale approach and (2) it aims at the farmer-to-farmer transfer and realisation of a vision, of intrinsic motivation. Burkey (1993) described the latter as the capacity of people to influence their own future, since development involves changes in awareness, motivation and behaviour. Ramisch et al. (2006) in their approach of strengthening folk ecology (SFE) also emphasize the crucial importance of institutionalizing new power and confidence by means of scaling-up through farmer-to-farmer training, where the latter no longer focuses on presenting solutions, but on building farmers' confidence to experiment and combine existing and new knowledge, preferably in a community-based learning setting (Defoer 2000). Experimentation is also crucial to ISFM, which is, as mentioned, an important aspect in the PIP approach. ISFM can be defined as "A set of soil fertility management practices that necessarily include the use of fertilizer, organic inputs and improved germplasm combined with the knowledge on how to adapt these practices to local conditions, aiming at optimizing agronomic use efficiency of the applied nutrients and improving crop productivity. All inputs need to be managed following sound agronomic and economic principles" (Bationo et al. 2012). In ISFM, mineral fertilizers are the main entry point to increase yields, and organic fertilizers are used to improve the efficiency of the mineral fertilizers. Since the 2000s ISFM is generally accepted as the most relevant paradigm for soil fertility management in the tropics. However, notwithstanding its scientific consensus, the true application of ISFM is often hindered by limited availability of (high quality, i.e. degradable) organic matter. Therefore, crucial to effective ISFM is that farmers learn to experiment (e.g. using improved compost pits) and exchange with other farmers, because only then ISFM can contribute to solving farmers' priority problems such as food security and low income (Ramisch 2004).

The PIP approach as applied in Burundi and discussed in this paper finds its origin in Bolivia, where integrated farm planning was part of a strategy that changed mostly passive Bolivian Andes farmers into active participators in natural resources conservation (Kessler 2007). In that strategy, based on a solid foundation of villagers with a progress-driven attitude, Integrated Farm Plans were created and executed within a framework of rural development activities. Within this strategy the PIP and its process of creation serve three important purposes:

1. The PIP is crucial for planning: it contains realistic and tangible activities according to the needs of the household, which are to be achieved

within a certain period of time. Given that the PIP brings insight in the basic needs of the family (food security, housing, facilities, etc.) and that all activities are planned with active involvement of all household members, ownership is assured. As such, the PIP captures the household's future vision and provides an action plan that motivates them to act.

2. The PIP fosters learning: it triggers discussion and reflection on current problems within the farm household, how these are related and the different perspectives and opportunities of the household members to improve and develop. Furthermore, because it is dynamic and simple, the PIP can be adjusted anytime according to new insights; hence, learning continues, with the PIP having a key function.
3. The PIP fosters integration: implementing activities together achieves more than their sum! The PIP does not focus on agriculture alone, it motivates farmers to also include non-farm activities, with the future dream of each member of the family being the starting-point. As such, the PIP aims at sustainability of the farm (with a coherent set of activities) and eventually of the whole village.

For the process side of the PIP approach, the underlying belief is that triggering farmers' intrinsic motivation to plan and invest in their future is the foundation for sustainable bottom-up rural development. Depending on how fast scaling-up takes place, the PIP approach will lead to genuine participation at village level. During this process, stakeholders (i.e. farmers and their family) pass through the following three stages of increased "awareness":

1. *Conscientisation* This is the process of people becoming aware about their ability to transform their reality by conscious collective action (Freire 1972). Essential is awareness that problems can be solved, that the future can be better, and that doing this together has added value. Dialogue is the means of achieving conscientisation, and the role of extension agents in this process is that of communication, because comprehension and communication are inseparable and occur simultaneously (Nyirenda 1996). Conscientisation within the PIP approach thus achieves that farmers recognize that they are capable of participating in the transformation of their world. And although a PIP is basically a plan for the farm, including collective activities is therefore a must in each plan.
2. *Intrinsic motivation* Intrinsic motivation, the personal willingness that drives people to improve and undertake action, is essential for development. Hence, where conscientisation focuses on becoming aware that change is possible, intrinsic motivation leads to action, without being directly compensated, often simply because it is inherently interesting or enjoyable (Deci and Ryan 1985). This is particularly crucial for environmental behaviour (Osbaldiston and Sheldon 2003) but also for ISFM (e.g. compost making) and other sustainable land management activities where initial costs often outweigh direct benefits. Intrinsic motivation makes the use of incentives or rewards needless.
3. *Genuine participation* Genuine participation is driven by intrinsic motivation, and cannot be imposed on farmers or forced from the outside (Kessler 2008). The PIP approach aims at participation where local people, and particularly the farmer trainers, are as much in control as possible. Achieving wide-scale genuine participation requires a diversity of people (Eversole 2003), which in the PIP approach is particular important in the group of farmer trainers, in which male and female farmers, old and young, as well farmers from different socioeconomic strata are represented. The farmer trainers are the first to become self-reliant and empowered, and are able to foster the PIP implementation and scaling-up themselves.

In practical terms, the PIP approach builds on various elements of the Farmer Field School (FFS) approach, especially the learning-by-doing elements, in which developing the skills of farmers to experiment is crucial. This has enormous benefits as compared to conventional extension approaches, which often caused loss of trust between farmers and the extension worker due to incorrect recommendations provided to farmers and lack of capable extension staff to deal with the complexity of agricultural problems. Davis et al. (2010) in Kenya and Tanzania showed that participation in FFS increased agricultural production and income in nearly all cases, and up

to 80–100 %. FFS are very accessible for women and low-income farmers, and particularly suited for changing farmers' perspectives and boosting their self-confidence and pride, which are essential aspects for sustainable development based on farmers' capacities. Similar findings are reported by Duveskog (2013) in Kenya, where FFS had significant impact on building the capacity of people to make choices and decisions related to agricultural innovations and collective action, but also fostered changes in everyday life and the household economic development. Furthermore, FFS hold the potential for quick scaling-up of innovations, by means of FFS facilitators that carry on their knowledge as participant in FFS to other interested farmers in a community or to new FFS groups.

However, a recent review of the impact of FFS in several African countries (Waddington et al. 2014), reveals that particularly the scaling-up of technologies learned by the FFS remains problematic. In this case no evidence was found that knowledge on Integrated Pest Management spreads from FFS farmers to their neighbours, who subsequently do not experience improvements in agriculture outcomes. Furthermore, Waddington et al. (2014) found no evidence of long-term positive effects on agricultural outcomes among participating FFS farmers.

According to Braun et al. (2005) the reason for lack of diffusion related to FFS does not so much reside in the technologies themselves (which are generally simple and based on local knowledge), but rather in the lack of transferring an attitude change that should go hand-in-hand with the implementation of these technologies. Hence, when neighbouring farmers hear about a certain innovative technology they do adopt it, but they lack the problem solving and innovation skills that are required for sustainable impact. Furthermore, according to Davis et al. (2010) the experiential nature of the FFS training, and the need for the benefits of the technology to be observed, are barriers to spontaneous diffusion. FFS therefore is not an agricultural extension approach as such (Duveskog 2013), although according to William Settle (2015, personal communication) elements of scaling-up are currently being more and more implemented in FFS, particularly through linkages with value chains.

The PIP approach as being applied in Burundi aims to overcome such limitations by paying particular attention to (1) scaling-up (i.e. achieving wider coverage and long-term sustainable impact), (2) integrated planning (i.e. having techniques implemented by farmers and their family on their farm with an integrated vision), and (3) transfer of vision (see also Table 1). These aspects combined, so integrated planning at the farm level by intrinsically motivated farmers willing to transfer their vision, together with achieving scale impact, is what assures sustainability. As mentioned before, crucial in the PIP approach is the role of farmer trainers. Their attitude and role are completely different than in the FFS approach. Most important is that they do not only transfer knowledge (e.g. on specific soil fertility management practices), but also passion, motivation, and a vision. By means of farmer-to-Farmer training they facilitate the process of "conscientisation–intrinsic motivation–genuine participation", and other farmers learn by doing how to create their PIP. Furthermore, by doing this in the form of farmer competitions, large groups of farmers can be reached in a short time, and in a much more sustainable and motivating way than the more top-down conventional extension approaches. These farmer contests worked in the Bolivian Andes (Kessler and de Graaff 2007) because of their appeal to conscientisation and eagerness of farmers to learn and develop.

Although sustainable agricultural activities are at the heart of the PIP, also all kind of other activities can be included, such as activities related to health, training, microcredits, etc. Furthermore, when farmers start collaborating in groups at neighbourhood or watershed level, the individual PIPs serve as the input for planning and formulating common activities at this Cooperation level (Fig. 2). Going one step further, such common activities can then become the basis for plans at Village level (or commune or district level), and as such might become instrumental for governmental institutions to implement their development plans. PIPs therefore can be scaled-up horizontally (from farmer to farmer) but also vertically, from individual, to cooperative and to village level by involving stakeholders at these higher administrative levels in the PIP approach.

Preliminary results of the PIP approach in Burundi

Burundi is part of the highlands of Central Africa, a region where yield gaps are currently among the

Table 1 Overview of added value of PIP as compared to farmers field school (FFS)

Topic	FFS	PIP
Vision development (inducing intrinsic motivation in farmers)	±	X
Development of an integrated farm plan (with time horizon of 3–4 years)	0	X
Involvement of entire family in action planning (based on SWOT analysis)	0	X
Following an integrated approach (with a wide diversity of subjects/activities)	±	X
Scaling-up phase based on farmer-to-farmer training included and seen as crucial	±	X

X = included; 0 = not included; ± = not always/less frequently included in the approach

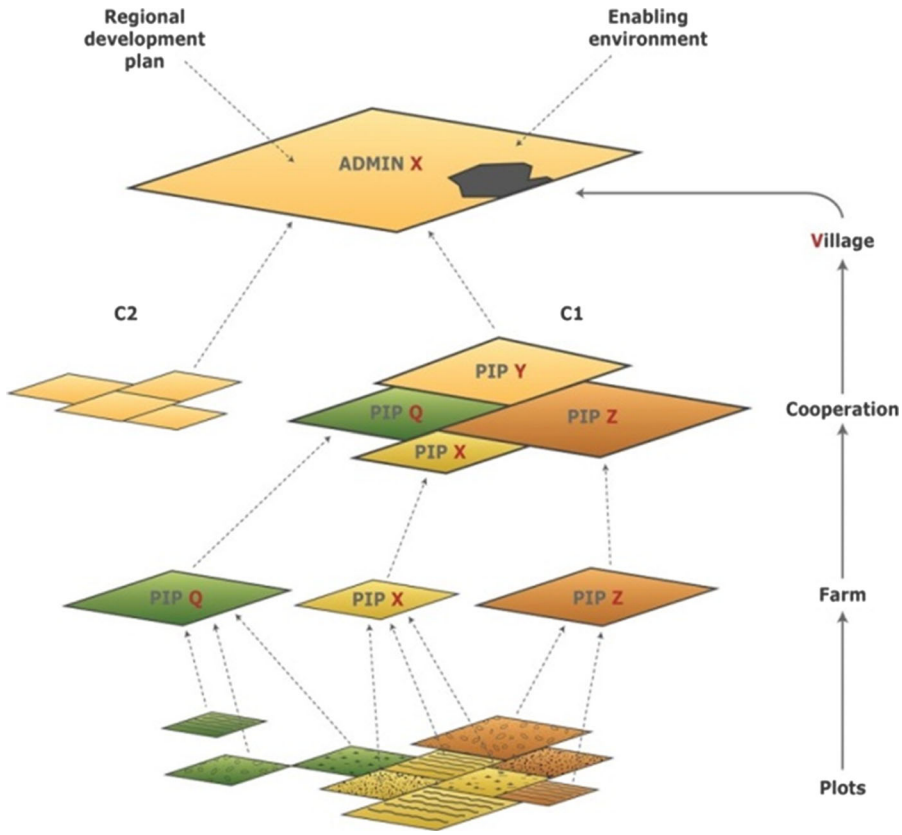

Fig. 2 Scaling-up of the PIP approach: from plot, to farm, to cooperation, village level and beyond

largest in the world (Tittonell and Giller 2013). The PIP approach is currently being implemented and further improved in the framework of the project Fanning the Spark in three provinces in Burundi, with the longest experience running since September 2013 (now more than one-and-a-half year) in four villages in two communes of Gitega: Bukerizasi and Makebuko (Fig. 3). The agricultural systems in Gitega are characterized by high population density (482 people/km^2, small farm size of on average 0.4 ha/family, and with only 53 % of farmers using external inputs (Jarvis et al. 2008; Linard et al. 2012) and only 13 % of farmers apply ISFM compared to 40 and 33 % in DRC and Rwanda, respectively (Lyambabaje et al. 2012).

The PIP approach counts four phases which together cover about 3 years. These phases and their time-length are based on our experiences in Gitega (where phase 4 will start soon) and currently validated in the other two provinces. Some phases overlap slightly, and the first two phases are most important

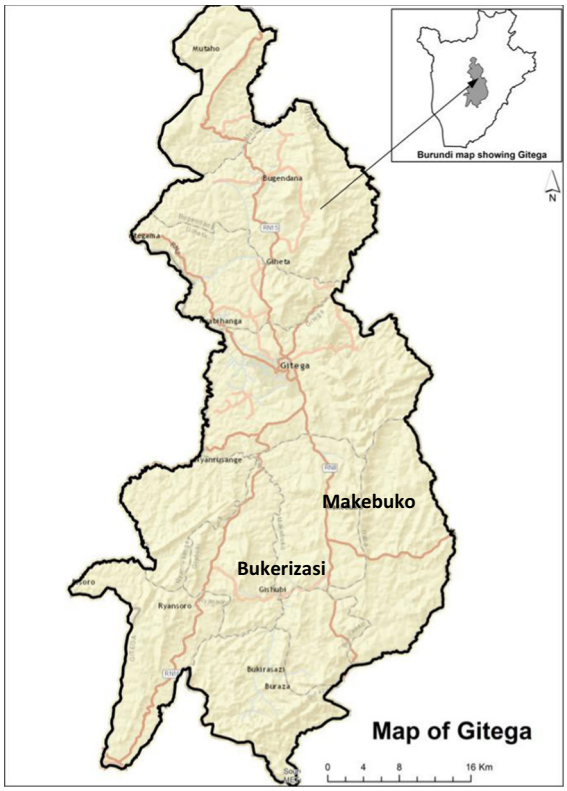

Fig. 3 Gitega Province and the location of the two communes of the project Fanning the Spark

(1 year) because there the foundation for scaling-up is being laid:

Phase 1: Awareness raising at village level—3 months
Phase 2: Creating and implementing PIPs with PIs—9 months
Phase 3: Scaling-up with farmer competitions—1 year
Phase 4: Scaling-up beyond village level—1 year

Phase 1: Awareness raising at village level

The bricks of a solid foundation for sustainable development are the people; self-reliant people with a progress-driven attitude, based on equality. Only when this is accomplished, genuine participation in village development can be expected. Therefore, during the first phase of the PIP approach, the focus is on generating such a progress-driven attitude among the villagers, by means of activities aiming at the above described steps of conscientization, intrinsic motivation and genuine participation. At village level a series of awareness-raising activities are carried out (e.g. theatre contests among farmer groups), which not only aim at informing the people about the project's activities, but also at advancing towards the fulfilment of conditions required for a solid foundation for sustainable development.

Simultaneously, farmer trainers (or PIs from the French *Paysan Innovateur*) are chosen by the villagers themselves. The PIs should be forerunner farmers (female/male) that are trusted by the local community, have a long-term vision and are willing and able (they have the skills and some financial buffer) to experiment on their farm. To identify the PI within a group of farmers three main criteria are taken into account: (1) social status in the village; (2) having a forward driven attitude; (3) farm performance and willingness to innovate.

Phase 2: Creating and implementing PIPs with PIs

The second Phase of the PIP approach aims at creating and starting to implement the PIPs with the PI group, the Farmer Trainer group. It takes about nine months and includes four crucial steps: (1) Creating awareness about current problems, (2) Explaining the PIP approach, (3) Drawing the PIP, and (4) Creating the PIP. After this, gradual implementation of the PIPs starts.

Step 1: Creating awareness about current problems and available resources Creating awareness among the PIs concerning the underlying causes of current problems and the resources (labour, tools, financial means) is indispensable. One can only go from A to B once A is known. This can take one to several workshops depending on the level of awareness and progress made. During these workshops open discussions are crucial, and project staff facilitates that all PIs can talk and express their perception of current problems at different scales, as well as suggest possible or already known solutions. Crucial is that the PIs motivate each other with their local knowledge and innovations, that they tell what they already do and know, and that all of them become intrinsically motivated to undertake action and start creating their PIP.

Step 2: Explaining the PIP approach The three basic aspects of a PIP (planning, learning, integration) must

be explained and discussed, until these are well understood. Most important to explain is the third aspect about the integration of activities, because this is what should finally be expressed in the PIP of each PI. Furthermore should it be stressed that a PIP covers all agricultural plots of a household, as well as other aspects inherent to the household (e.g. non-farm activities, but also training activities), and how these are mutually reinforcing (effect of integration, leading to increased production, more sustainable farming systems and resilient households). Six categories of activities are considered to be taken into account in a PIP:

1. Crop production (producing more and better quality crops, including soil fertility management);
2. Land management (how to protect the land and maintain its productive capacity)
3. Livestock rearing (practices to achieve optimal number and mix of healthy animals)
4. Income generation (new and existing skills or activities, including collective activities);
5. Farm household (fulfilling basic needs and a healthy environment);
6. Training activities (learning specific skills for all activities, as well as new skills, e.g. record keeping of inputs and outputs crucial for optimizing resource use efficiencies).

Step 3: Drawing the PIP In this step each PI starts to concentrate on his/her own PIP with all family members. This step has three important activities: (1) drawing the actual situation of the farm and household (a kind of baseline), (2) making an inventory of the family members' aspirations and capacities (called in French a *Fiche de la Famille*), *and* (3) drawing the future vision based on integrated farm management (the "PIP dream"). The actual and future vision shown together (Fig. 4) clearly shows the desired changes over a period of 3–5 years of time (for Burundi this is already a long period; in other countries a different period may be more feasible). The *Fiche de la Famille* is crucial because it energizes the family members by discussing about their aspirations and goals, and it stimulates them to think about and discuss opportunities to deal with existing limitations. As such it provides the basis for drawing their PIP.

Step 4: Creating the PIP Based on the drawing of the PIP, the PI can proceed with detailed planning of identified activities: the drawing now becomes a real action plan! During the creation of the PIP, often more and new activities are included, based on new insights (e.g. after having seen innovations elsewhere or after a training on a specific topic) and thereby always bearing in mind that the integration of activities is crucial. An important aspect is that the PIP is always visible for each household member. This will trigger an on-going discussion about the integration of activities, the collaboration within the family, and the implementation of the action plan. And that refers to the main aim of the PIP: fostering forward driven farmers who are motivated to invest in their future, based on sustainable agriculture.

Phase 3: Scaling-up with farmer competitions

The following phase of the PIP approach concerns the training of the PIs (converting them in farmer-to-farmer trainers) and the scaling-up towards village level by means of the farmer competitions: spreading the PIP approach from PIs to groups of farmers (the PIP groups) and further to village level. In the competitions between organized farmer groups, one PI (a Farmer Trainer) leads a group and transfers knowledge to the group members, being followed by the collective implementation of what is learned (a certain technique or practice) on selected fields of all members. Given that this is done within a village-wide competition, the "match-element" of only one can be the winner is brought in, through which each group is stimulated to show the best of themselves and give both maximum effort and implementation. This is "*learning by doing*" in an entertaining way, stimulating collective action, knowledge transfer and building strong (social) groups within a community that become more confident in taking new steps together.

Hence, the four main objectives of the PIP competition are:

1. To raise awareness about the importance of Integrated Farm Management;
2. To train farmers in how to make their PIP;
3. To stimulate collaboration and group work (social cohesion) as a basis for future collective action;

Fig. 4 The actual situation of the farm (*left*) and the dreamed PIP (*right*)

4. To build confidence (self-esteem) among farmers that with a plan (based on doable steps) they can steer their own success.

Particularly the third objective is important for integrated development at different levels. Not only working together within the family is important, with the PIP providing the basis for "Family Agriculture", but also within the competing groups. In these groups participating farmers can enrich the PIPs of their fellow farmers during the group process with collective activities, e.g. aiming at soil and water conservation as the basis of natural resource management, and often requiring collective action and wide-scale implementation in order to become effective (e.g. watershed management).

In order to scale-up towards village level, two competitions are needed: a first one only with PIs training the so-called 2nd generation PIP farmers, and a second competition where both PIs and 2nd generation PIP farmers can train all other farmers who become the so-called 3rd generation PIP farmers. In the ideal situation all families within a village are covered (have their PIP) after this second PIP competition. First results in Burundi show a coverage of the village on average of 30 % after the first competition, and 80 % after the second competition.

Phase 4: Scaling-up beyond village-level

This phase concerns massive scaling-up of PIPs, reaching a critical mass and the tipping-point required for igniting a "PIP epidemic" (or the spark) within a region. Vertical scaling-up, institutionalizing the PIP approach by intensive collaboration with (an effective) national extension service is indispensable. In Burundi this is a major challenge, but activities are already set in motion at provincial and national level. Furthermore, horizontal scaling-up requires setting-in the PIP-trainers, the ones who received the official certificate of being able to train other farmers concerning PIPs, as well as a way of compensating them for investments in training (e.g. paying him/her for time in cash or kind). Eventually, being a certified PIP-trainer can even become a real income-generating activity, a job for these farmers, especially when the PIP approach is spreading beyond the district boundaries or to other Provinces.

The process of scaling-up towards neighbouring villages already starts during the PIP competitions, for

instance when some farmers from adjacent villages are able to join the competition and be trained. The process is further triggered by organizing some concrete activities in the adjacent villages, such as:

- A PIP Day in each of the new villages;
- Exchange visits with farmer leaders (20–25) from these adjacent villages;
- Stimulating the formation of Innovative Farmer Groups in each of the new villages;
- Farmer-to-farmer training by PIP-trainers to these organized groups;
- PIP-competitions facilitated by the extension service.

Although too early for an impact evaluation, preliminary results of the above steps show enormous changes, particularly among the PIs (now certified farmer trainers) but also among the 2nd generation and 3rd generation PIP farmers during the two rounds of competitions. These changes inducted by the project can be divided into qualitative and quantitative ones. For instance, testimonies received from the PIs illustrate their view on the added value of the Integrated Farm Plans, just to mention a few:

- With the PIP, we are learning to look far like an eagle and not like a hen which sees just in front of its feet;
- The PIP is important because it avoids us wasting our resources and energy, and it helps us concentrate them in order to reach our fixed objectives;
- I was now able to buy 2 goats. Without the PIP I could not have done this;
- There is one thing I will never forget: before I was trained in PIP, I used to do whatever came in my mind without planning and consultation of my family members. But now, we have a plan which is enriched with my wife and children's inputs and I expect a good future when we will have implemented it.

New crops, especially vegetables, in combination with ISFM were introduced into the PIPs of many PIs as they understood their value in terms of income generation and nutritional value, and were trained in new cropping techniques and nutrient management. This increase in crop diversity and the focus on more nutritious crops has an enormous potential impact on food security and health in these villages.

A first quantitative assessment was carried out for the application of the improved bean variety. At planting, farmers were asked to give the amount of seeds for sowing and the harvest of the old bean variety obtained last year for that specific plot as well as the amount of seeds of the improved variety there were about to sow for that same plot. Plot size was measured by the project staff. The farmers expressed these amounts in local measuring units: i.e. a small saucepan equivalent to 1 kg of bean seeds. At harvest the amount in terms of the same local units was again provided by the farmers. Subsequently, all data were recalculated in SI-units (Table 2), showing the measured changes in bean cropping systems of 52 PIs. It evidences that the introduction of new bean varieties together with small amounts of KCl generates enormous impact. To start with, PIs used on average 55 % less seed input (new/old seed ratio is 0.45) which resulted in a yield increase of 74 % (new/old yield ration is 1.7). This eventually resulted in an increase of the bean output/input ratio from 3.0 to 11.1, being an improvement of 370 % on average. Hence, despite using less than half the number of bean seeds, yields almost doubled. In addition to this quantitative difference, farmers reported to our staff that they noticed to their amazement the big difference in crop performance already after seedling stage, with farmers cultivating the old variety having a less vigorous crop than the farmers with the new variety. Spontaneous application of the improved cropping technique occurred when farmers saw the difference.

Also the PIP approach itself received special interest from the administration representatives of the two communes, who were amazed by the response of the farmers as expressed in their ideas and the content of the PIPs. As they mentioned in their speeches: "The PIP components meet the real needs of the population and the PIPs are in harmony with the community development plans of the communes (PCDC) which is also for 5 years like most of the PIPs. Consequently, in being involved in the PIP elaboration and in diffusing it, the farmers are also contributing in the implementation of the communal plans".

Several other farmers (non PI farmers) have already started to put in practice the lessons they learnt from the PIs, illustrating that scaling-up is already taking place. Particularly worth mentioning concerning soil fertility management is the success of the use of

Table 2 Measured changes in bean cropping systems after the introduction of the new variety Nyawera (VCB 81013) and Bishaza (AND 10) together with small amount of KCl in the 4 collines in Gitega

Colline	S-old (kg/ha)	Y-old (kg/ha)	S-new (kg/ha)	Y-new (kg/ha)	Y-new/ Y-old	S-new/ S-old	Old Y/S	New Y/S	Number of PIs
Kibere	391	428	127	1123	2.6	0.32	1.1	8.8	11
Bukirasazi	515	1839	274	2888	1.6	0.53	3.6	10.5	8
Rwezamenyo	233	638	78	1031	1.6	0.33	2.7	13.2	19
Rwesero	114	507	73	884	1.7	0.64	4.4	12.1	14
Weighted average	313	853	138	1481	1.7	0.45	3.0	11.1	
Change in %					74	45	370		

S seeds, *Y* yield, *PI* innovative farmer

organic fertilizers and the construction of compost pits. Furthermore, many farmers have started to buy improved seeds and followed the example of the PIs in using improved techniques of cultivation: eight farmers improved seeds of beans, and five farmers improved seed potatoes inspired by the PIs.

However, most important is the observed change in the behaviour of PIs and many fellow farmers. Although monitoring of these changes is currently on-going, PIs seem to have developed a much higher self-esteem and motivation because of the PIP approach and the activities carried out over the last year. This is key for the next steps in their development, and testified by their intrinsic motivation to train farmer groups during the first PIP competition (where 100 % of the PIs, so all 80 male and female PIs have been involved in), as well as their efforts in the second PIP competition where scaling-up towards village level has taken place. This profound change in self-esteem and intrinsic motivation, as well as its reflection on the PIs attitude and their live in general, was also reported by Taylor et al. (2012) for participants in FFS in Kenya, and is similar to what in transformative learning is called perspective transformation (Mezirow 2000). As mentioned before, in the PIP approach such a transformation is considered the foundation for sustainable development of a farm and the household.

Discussion and conclusions

The PIP approach holds the potential to generate considerable impact in terms of scaling-up sustainable agricultural practices in general and ISFM in particular, because of these being integrated in family owned farm management plans. This integration and the emphasis of the PIP approach on longer term vision development and intrinsic motivation enhances sustainability and impact of the PIP approach beyond field scales. However, experiences are in a very early stage, and particularly the success of future scaling-up activities is still uncertain and highly dependent on the ability of the PIP approach to generate intrinsic motivation and genuine participation at the higher institutional levels in Burundi. In the current project-in-control setting we see that the approach works, that participating farmers really change (e.g. buy also more land based on savings and earnings from last year) and become very enthusiastic, and that spreading of the PIP creation (the making of the plans) and copying of improved cropping techniques occurs increasingly more in a spontaneous way, also outside the intervention villages and without any project involvement. We also see that the quality of the PIPs remains high even in the 3rd generation farmers (those trained by farmers that were trained themselves). This is very important, as it shows the farmers' vision and intrinsic motivation to plan for the future, to collaborate and to implement activities in an integrated way, indeed creating enthusiasm among the population. Furthermore, the competitions apparently appeal to a desire among the population to collaborate, to change their reality by collective action and invest in a future with better prospects. These observations are backed by some of the preliminary results from Burundi, which show a coverage of 80 % of the farm households in each village involved in Integrated Farm Planning and

having made their PIP. This was achieved with farmer-to-farmer trainers, local farmers who are intrinsically motivated to train their fellow farmers; without anything in return. This is in line with a conclusion by Franzel et al. (2014) who found that farmer trainers consider early access to technology and altruism more important than salaries and allowances. This is indeed a major achievement, because it lays the foundation for further scaling-up and attaining sustainable results. Collective action is crucial in the PIP approach, farmers learn to work together, and they prepare for the next step: access to markets with their products, eventually becoming farmer entrepreneurs.

Related to this, the PIP approach can also be seen as a response to the current popular value chain approach to development. Notwithstanding some impressive results of these approaches (e.g. Achterbosch et al. 2014) they are often targeted at the better-off farmers who are already involved in a value chain. For most smallholders, especially in Burundi, only a fraction of their production is sold and finally reaches an external market (and hence becomes part of a value chain). For these farmers a value-chain approach does not work. The PIP approach gives a more integrated prospect and empowers them to make a conscious decision on which strategies are most suitable for them, which may include—eventually—value chains as well.

In conclusion, recent experiences from Burundi presented in this paper show that the PIP approach holds the potential to fill a niche in approaches aiming at increasing food security for smallholder farmers based on ISFM, especially those in the most vulnerable conditions like in Burundi. Particularly worth mentioning is that this approach, with its focus on learning-from-each-other and doing-things-together, also contributes to solving e.g. land conflicts and other recent disputes resulting from the civil war in Burundi. People are eager to learn and collaborate, and the PIP approach offers them this opportunity, enabling all farmer households in a village to benefit from Integrated Farm Planning and the improved soil fertility and land conservation practices that come along with—and are an inherent part of—the PIP approach.

The way forward for the PIP approach is to expand the experiences in the other Provinces and learn lessons on how to improve the approach, with specific emphasis on vertical scaling-up elements; i.e. on how to embed the PIP approach in the current agricultural extension system. Many challenges are still ahead, and although the PIP-by-design is a promising approach for overcoming current constraints related to integrated soil fertility management, sustainable agriculture and scaling-up, the coming years will tell if the approach can actually live up to the expectations. So far the PIP approach seems a promising alternative for integrated farm management on smallholder farms, as well as for scaling-up ISFM without using heavy investments in terms of extension workers or external incentives.

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